Liquiflo™
Chemical Processing Pumps

INSTALLATION, OPERATION & MAINTENANCE MANUAL

4-SERIES

MAGNETIC-DRIVE, CLOSE-COUPLED
GEAR PUMPS

Models 41, 43, 44 & 45

Document No.: 3.20.005

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Introduction

This manual provides instructions for the installation, operation and maintenance of the Liquiflo **4-Series** Gear Pumps, Models **41**, **43**, **44** & **45**. 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 4-Series Mag-Drive, Close-Coupled Gear Pumps – Models 41, 43, 44 & 45.

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.

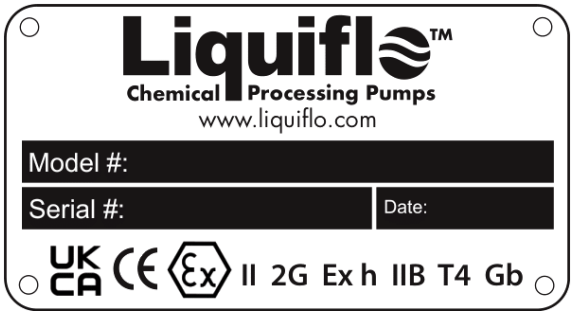
Upon receipt of your Liquiflo pump:

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

B) Verify that the *Liquiflo Stainless Steel Nameplate* Is attached to the pump's mounting bracket. The nameplate displays the pump *Model Number* and *Serial Number*, positioned as shown.

C) Verify that the Model Number on the nameplate matches the Model Number that was ordered.

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



Refer to **Appendix 7** for meaning of the Tag Certification Markings.

B) 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 2** for more information.)

1.2 Pump Specifications

Table 1: 4-Series Gear Pump Specifications

Pump Model		41		43		44	45	Units
Ports	Size	1/4	3/8	1/4	3/8	3/8	3/8	in
	Type (Threaded)	NPT	BSPT	NPT	BSPT	NPT or BSPT	NPT or BSPT	–
Pump Body & Containment Can		316 Stainless Steel, Alloy-C (C-276) or Titanium						–
Gears (Drive & Idler)		316 SS, Alloy-C (C-276), Titanium, PEEK (Bearing Grade), Ryton (PPS/25% Glass/15% PTFE) or Teflon (PTFE/25% Glass)						–
Wear Plates & Bearings		Carbon (Graphite Grade), Silicon Carbide (pure, self-sintered), PEEK (Bearing Grade) or Teflon (PTFE/25% Glass)						–
Shafts, Keys & Retaining Rings		316 SS, Alloy-C (C-276) or Titanium [7]						–
Shaft Coating		316 SS & Alloy-C: Uncoated, Chrome Oxide (Cr_2O_3) or Tungsten Carbide (WC); Titanium: Titanium Oxide (TiO_2)						–
O-Rings		Teflon (PTFE)						–
Mounting Bracket	Material	304 SS (New Pumps) or Cast Iron, Epoxy-Painted (Legacy Pumps)						–
	Motor Frames	NEMA 48C, IEC 71 (B14 Face) & NEMA 56C						–
Magnetic Coupling	Magnet Material	MCN (Neodymium Iron Boron) or MCR (Samarium Cobalt)						–
	Casing Material	Inner Magnet: 316 SS, Alloy-C (C-276) or Titanium [7] Outer Magnet: Carbon Steel/Epoxy						
	Size (Max Torque @ 72°F)	MCN (20) or MCR (30)						in-lb
Maximum Speed		1750		1750		1750	1750	RPM
Theoretical Displacement [1]		.000276		.000828		.001379	.001930	GPR
		.001045		.003134		.005220	.007306	LPR
Maximum Flow Rate		**0.48**		**1.45**		**2.41**	**3.38**	GPM
		1.83		**5.48**		**9.13**	**12.8**	LPM
Maximum Differential Pressure [2]		100		100		100	100	PSI
		6.9		6.9		6.9	6.9	bar
Maximum System Pressure		300		300		300	300	PSI (g)
		20.7		20.7		20.7	20.7	bar (g)
Maximum Operating Temperature [3]		500		500		500	500	°F
		260		260		260	260	°C
Minimum Operating Temperature		-40		-40		-40	-40	°F
		-40		-40		-40	-40	°C
Maximum Viscosity [4]		8,400		7,000		7,600	6,600	cP
		8,400		7,000		7,600	6,600	mPas
NPSHR [5]		4.5		3		3	2	ft (a)
		1.4		0.9		0.9	0.6	m (a)
Suction Lift (dry) [6]		0.5		1.5		2.0	4	ft
		0.15		0.45		0.6	1.2	m
Weight (less motor; approx.)		11		11		13	13	lb
		5		5		6	6	kg

1 Pump Displacement Rate is based on new pump operating at Maximum Speed and 0 PSI (bar) differential pressure.

2 Maximum Differential Pressure may be de-rated based on temperature and material selections.

3 Actual Maximum Operating Temperature depends on materials of construction. (See Notes below.)

4 Maximum Viscosity is specified with MCR Magnetic Coupling @ 77°F (25°C), 300 RPM, 50 PSI (3.4 bar) ΔP, with Double Metal Gears and Triple-Clearance Viscosity Trim.

5 NPSHR (Net Positive Suction Head Required) is specified at Maximum Speed and < 150 cP (mPas).

6 Dry Suction Lift is based on water @ room temperature and Maximum 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.

7 Material will match Pump Body Material.

NOTES:

1 Nonmetal gears and bearings may require a trim to compensate for thermal expansion at elevated temperatures. Reference the pump model code to determine if the pump is trimmed.

2 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.

3 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.

1.3 Model Coding

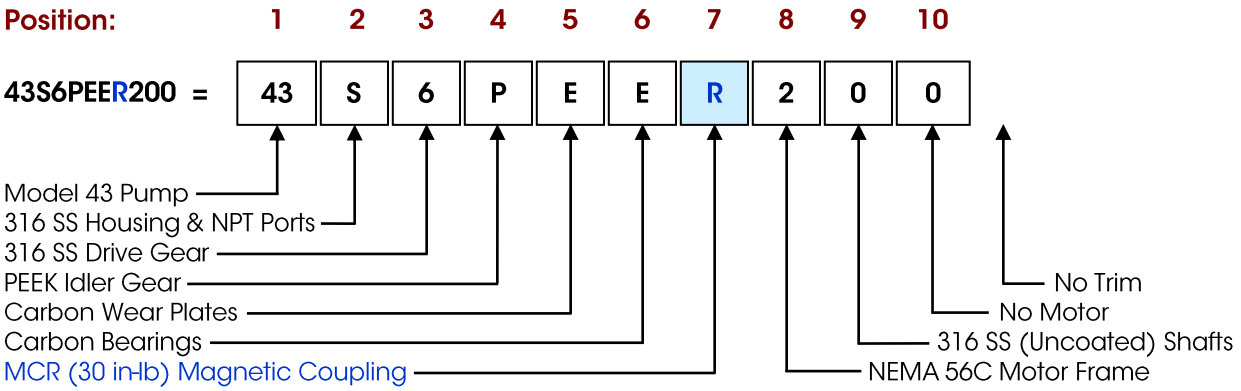
Table 2: Model Coding for 4-Series Gear Pumps

Position	Description	Code	Selection
1	**Pump Model** (Max Capacity)	**41**	Model 41 (0.48 GPM)
		43	Model 43 (1.45 GPM)
		44	Model 44 (2.41 GPM)
		45	Model 45 (3.38 GPM)
2	**Basic Material & Port Type**	**S**	316 SS Housing & NPT Ports
		X	316 SS Housing & BSPT Ports
		H	Alloy-C Housing & NPT Ports
		Y	Alloy-C Housing & BSPT Ports
		T	Titanium Housing & NPT Ports
		Z	Titanium Housing & BSPT Ports
3	**Drive Gear** (Spur Type)	**1**	Alloy-C
		3	Teflon
		4	Titanium
		6	316 SS
		8	Ryton
		P	PEEK
4	**Idler Gear** (Spur Type)	**1**	Alloy-C
		3	Teflon
		4	Titanium
		6	316 SS
		8	Ryton
		P	PEEK
5	**Wear Plates** (Relieved Type)	**E**	Carbon
		3	Teflon
		4	Ceramic (SiC)
		P	PEEK
6	**Bearings** (Sleeve Type)	**E**	Carbon
		3	Teflon
		B	Silicon Carbide
		P	PEEK
7	**Magnetic Coupling** (Nom. Torque Rating)	**N**	MCN (20 in-lb)
		R	MCR (30 in-lb)
8	**Outer Magnet Bore** (Motor Frame Size)	**0**	1/2 in. (NEMA 48C)
		1	14 mm (IEC 71 – B14 Face)
		2	5/8 in. (NEMA 56C)
9	**Shafts**	**0**	Material Same as Housing, Uncoated (**Position 2** = **S**, **X**, **H** or **Y**) or Titanium/TiO_2 Coated (**Position 2** = **T** or **Z**)
		1	Chrome Oxide Coated (**Position 2** = **S**, **X**, **H** or **Y**)
		2	Tungsten Carbide Coated (**Position 2** = **S**, **X**, **H** or **Y**)
10	**Motor**	**0**	No Motor
		A	0.25 Hp/1750 RPM – TEFC-115-230 VAC/1-phase/50-60 Hz [1]
		B	0.25 Hp/1150 RPM – TEFC-115-230 VAC/1-phase/50-60 Hz [1]
		C	0.25 Hp/1750 RPM – TENV-90 VDC with SCR Control [1]
Suffix	**Trim Option**		No Trim
		- 8(T) [2]	Temperature Trim
		- 9D [3]	Viscosity Trim, Double Clearance
		- 9T [4]	Viscosity Trim, Triple Clearance
		-9D-8(T) [5]	2X Viscosity Trim & Temperature Trim
		-9T-8(T) [6]	3X Viscosity Trim & Temperature Trim

1 Motor option was discontinued on 10/1/2022.
2 **T** = Application Temperature in °F (Example: **- 8(300)** = Temperature Trim at 300°F).
3 Suggested for viscosities of at least 150 cP and less than 300 cP.
4 Suggested for viscosities of 300 cP or greater.
5 Combination of Double-Clearance Viscosity Trim and Temperature Trim.
6 Combination of Triple-Clearance Viscosity Trim and Temperature Trim.

NOTE: See Model Coding Example on next page.

Model Coding Example:



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 6**.

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 3** for Wear Allowances). 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 2**). The repair kit for the 4-Series pump includes the following parts: gear-shaft assemblies, bearings, wear plates, housing O-rings, bearing lock pins and housing alignment pins. The parts not included in the repair kit are the housings (front, center and rear), magnets (inner and outer), containment can, mounting bracket 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 2 thru 5** 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: The 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.

NOTE: The 4-Series pumps are close-coupled and no alignment procedure between the pump and motor is required.

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.

4) Piping runs should be designed to minimize friction losses.

5) 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 during maintenance. Valves which open to the full pipe diameter, such as ball valves, should be used.

6) 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 37 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 the pump's lifetime.

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 48C & 56C, and IEC 71 (with B14 face) motor frames. (See pages 23-24 for more information.)

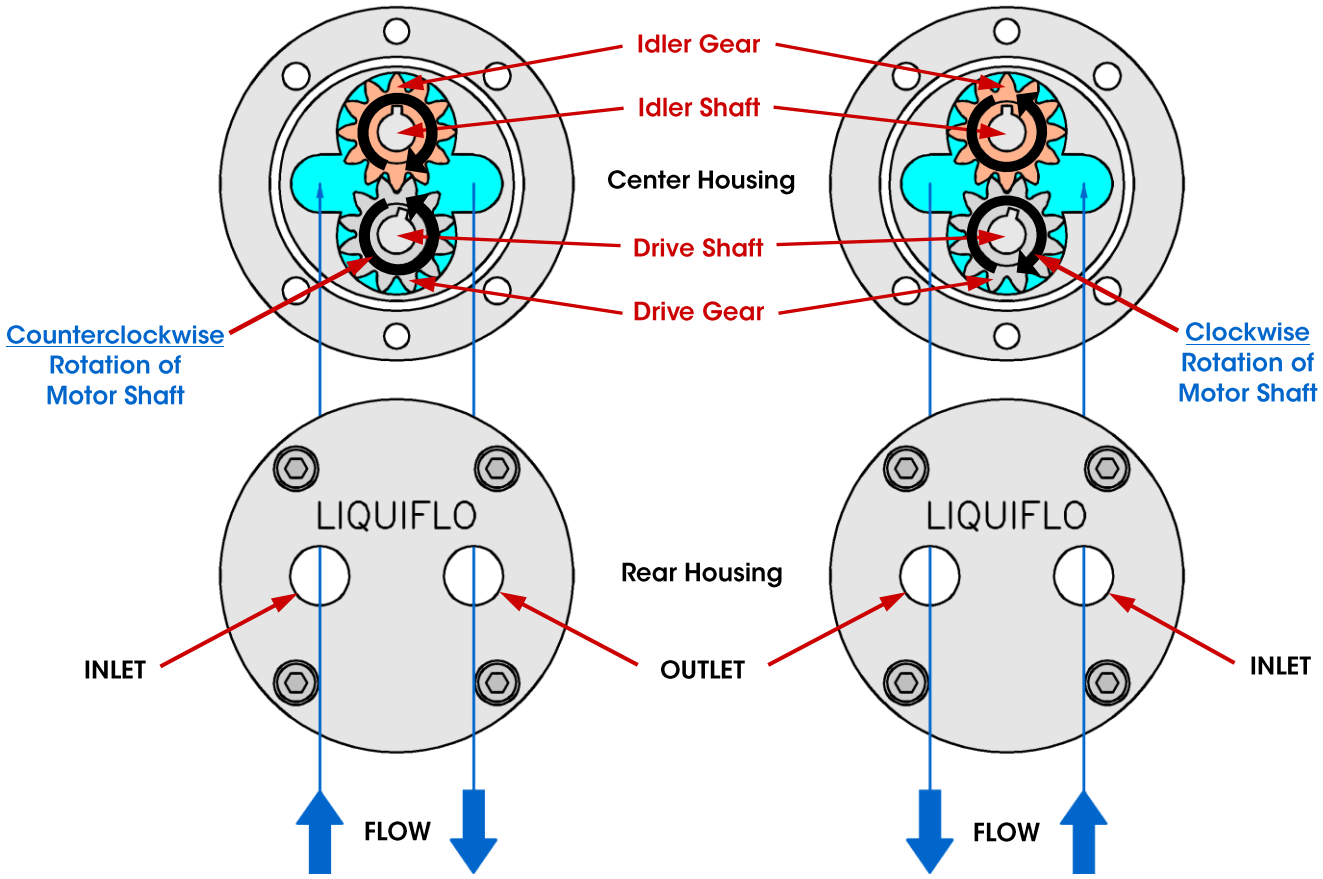
2) The motor speed and power rating are usually determined at the time the pump is ordered to meet the specified conditions of service. The power requirement of the application depends on the flow rate, differential pressure and fluid viscosity. Up to 100 cP, the pump performance charts can be used to 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 Shaft Direction

The motor shaft is magnetically coupled to the drive shaft of the pump. Both shafts will turn in the same direction. Because the gear pump is bi-directional, the pump 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 4-Series pumps, the flow direction will be as shown below:



Counterclockwise (CCW) Rotation of Motor Shaft:

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

Clockwise (CW) Rotation of Motor Shaft:

Fluid will enter the pump at the right port (inlet) and be discharged at the **left** port (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 11 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. If any problems occur, stop the pump and refer to **Appendix 6** for troubleshooting.

Section 5: Maintenance & Repair

The pump has internal bearings, wear plates, gears and shafts, which require replacement over time due to wear. Standard repair kits are available to facilitate repair of the pump. The repair kits for the 4-Series pumps include the gears, shafts, wear plates, bearings, keys, bearing lock pins, housing alignment pins, O-rings and retaining rings. The 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.

5.1 Work Safety

Before performing maintenance, review the Safety Precautions given in **Section 2** (see page 8).

Caution!
The Magnetic Couplings used in these pumps contain strong magnets. Observe the precautions given in Section 2.2.

5.2 Removal from System

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.

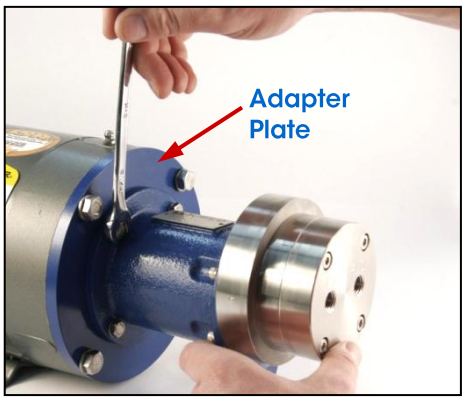
5.3 PUMP DISASSEMBLY

Follow the procedure below and refer to the drawings in **Appendix 5**. Drawing reference numbers are given in parentheses.

Removal of Pump from Motor:

1 **a.** Remove the four mounting bolts (17) which secure the mounting bracket (14) to the motor.

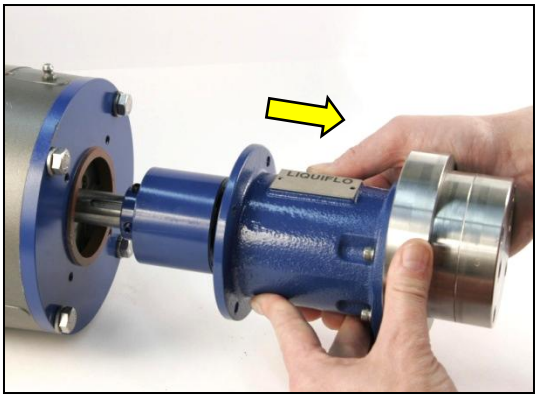
NOTE: A Legacy pump is shown with a blue bracket mounted to a NEMA 56C motor frame using a blue adapter plate. New 4-Series pumps have a 304 SS bracket which mounts directly to the motor and therefore no adapter is required.



b. Separate the pump and mounting bracket assembly from the motor by pulling it straight out, as shown.

Caution!
Do not place hands or fingers between the C-faces of the Motor and Pump Bracket.

NOTE: Force must be applied to overcome the magnetic attraction between the outer and inner magnets.

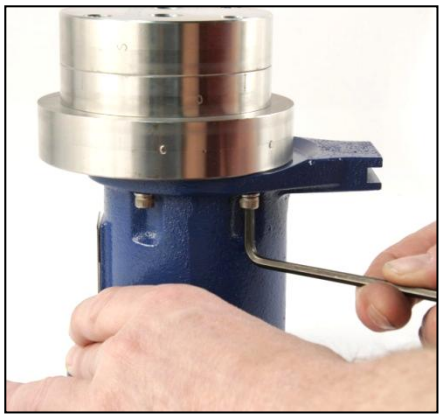


Caution!
The next step will separate the containment can from the pump, which will contain residual fluid that may be hazardous. Be careful not to contact or spill any residual fluid once the containment can is free.

Removal of Containment Can:

2 **a.** Remove four bolts (16) to detach the pump module from the mounting bracket (14).

NOTE: Orient the pump as shown. This will capture the residual fluid in the containment can. Once the bolts are removed, the containment can is no longer attached to the pump.



2 **b.** Separate the *pump module* from the bracket. Discard the containment can O-ring (13).

> ***Caution!***
> *The Containment Can is no longer secured to the pump. Be careful not to spill any residual liquid existing inside the can.*

c. Remove the containment can (11) from the bracket (14) and dispose of any residual fluid.

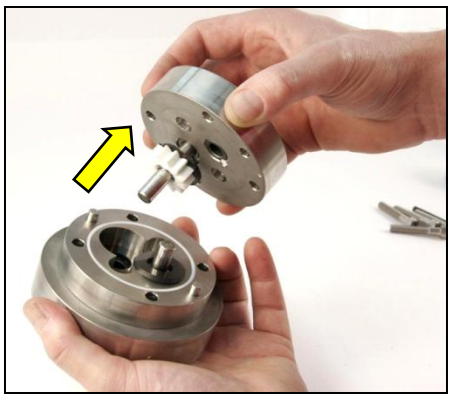
Removal of Inner Magnet:

3 Loosen the setscrew (27) and remove the inner magnet (10) from the drive shaft (20).

Removal of Internal Parts from Pump Module:

4 **a.** Remove the four housing bolts (4) that hold the front housing (8), center housing (2) and rear housing (12) together.

4 **b.** Separate all parts and dispose of the housing and containment can O-rings (5 & 13).



NOTE: If any parts are worn, they should be replaced (see **Appendix 3** for wear allowances). O-rings and retaining rings should always be replaced when repairing the pump. Liquiflo Repair Kits contain the gears and shafts preassembled, as shown in **Appendix 2**. If it is not necessary to separate the gears from the shafts, skip **Step 5** and proceed directly to **Step 6**.

Gear-Shaft Disassembly: (If required; see Note above.)

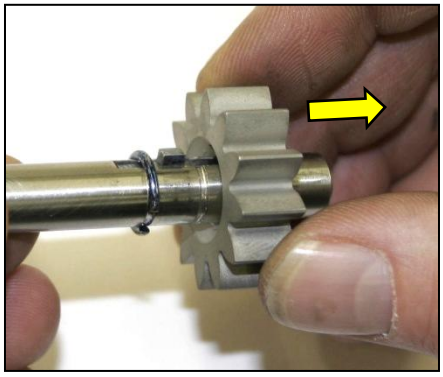
5

Caution!
Be careful not to damage the drive and idler shafts.

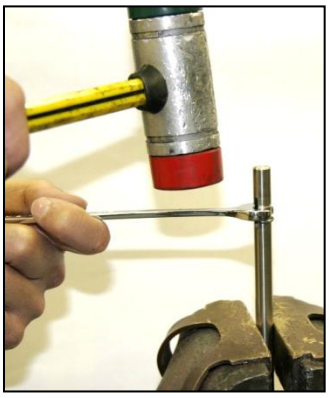
a. Remove one retaining ring (21) from the shaft (1 or 20).

NOTE: The retaining ring can be removed by inserting a pointed tool in the split and then prying it off, as shown. To hold the shaft in place, use special vice jaws made of aluminum, bronze, brass or other soft material so as not to dent or damage the shaft (see photo).

b. Separate the gear (6 or 15) and key (23 or 24) from the shaft.



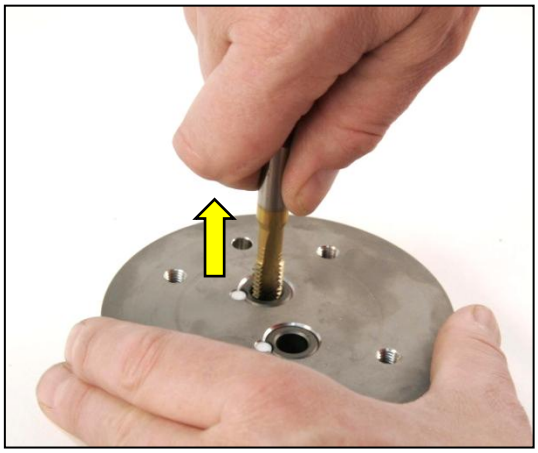
5 **c.** Remove the other retaining ring (21) from the shaft.



NOTE: One method for removing the retaining ring is shown at right. First bridge the shaft with a close fitting open-end wrench and then strike the wrench handle with a mallet to dislodge the retaining ring from the groove (see photo).

Removal of Bearings:

6 Extract the bearings (3) from the front housing (8) and rear housing (12).



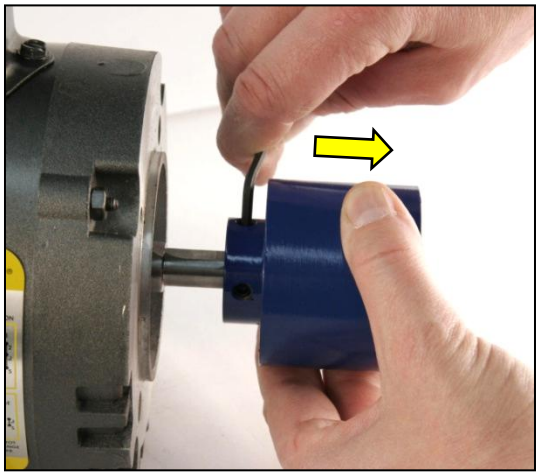
NOTE: The bearings can normally be removed by using a **hooked tool** (as shown below). Insert the hook underneath the bottom surface of the bearing and then pull it upward. For Carbon or plastic bearings that are difficult to remove, thread in a **tap** with a diameter that is slightly larger than the inner diameter of the bearing and then pull it upward (as shown to the right).

Removal of Outer Magnet:

7 If necessary, remove the outer magnet as follows:

a. Loosen the two setscrews (26) on the hub of the outer magnet (9).

b. Remove the outer magnet from the motor shaft.



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

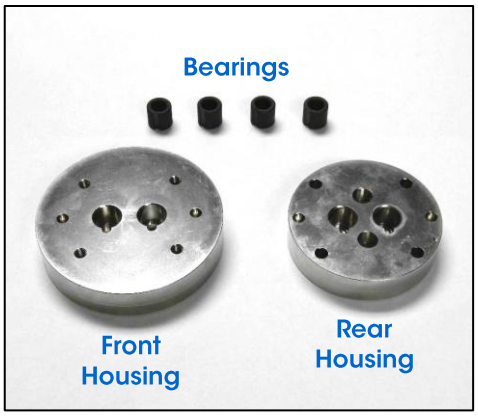
END OF DISASSEMBLY PROCEDURE

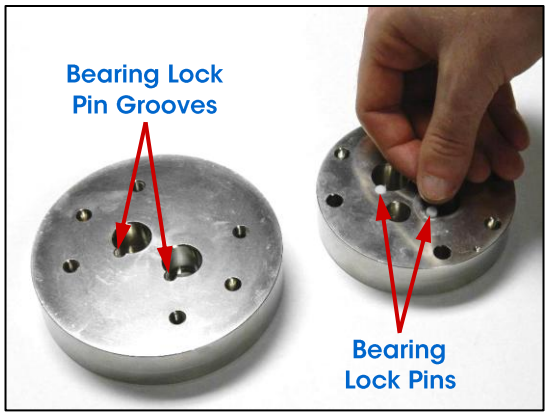
5.4 PUMP ASSEMBLY

Follow the procedure below and refer to the drawings in **Appendix 5**. Drawing reference numbers are given in parentheses.

Installation of Bearings into Front and Rear Housings:

1 Insert the bearing lock pins (28) into the front housing (8) and rear housing (12).

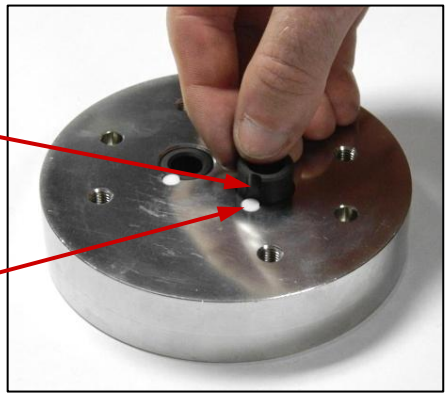




NOTE: The pins serve to prevent the bearings from rotating.

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

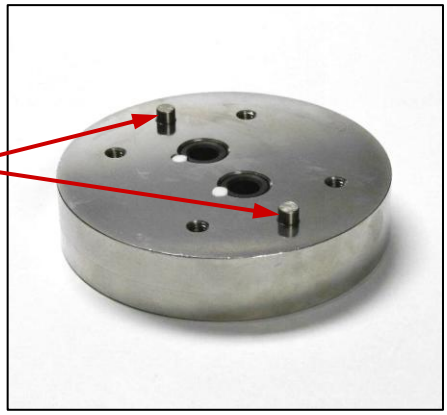
NOTE: Align the groove of the bearing with the bearing lock pin in the housing. The bearings should slip in but may require a light press fit.



3 Install two housing alignment pins (25) into the front housing (8).

NOTE: The housing pins serve to accurately align the front, center and rear housings.

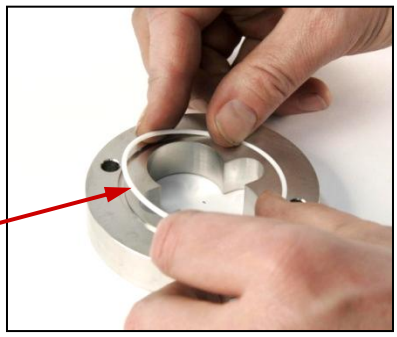
NOTE: An earlier design used two long pins, as shown to the right.



4 Install two O-rings (5) into the center housing (2).

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

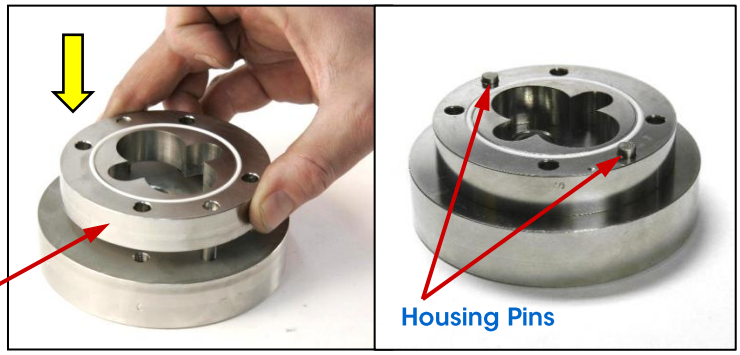
NOTE: The center housing has a circular O-ring groove on each side. Install one O-ring into each groove.



---

5 **a.** Place the center housing (2) over the housing alignment pins (25) and onto the front housing (8), as shown.

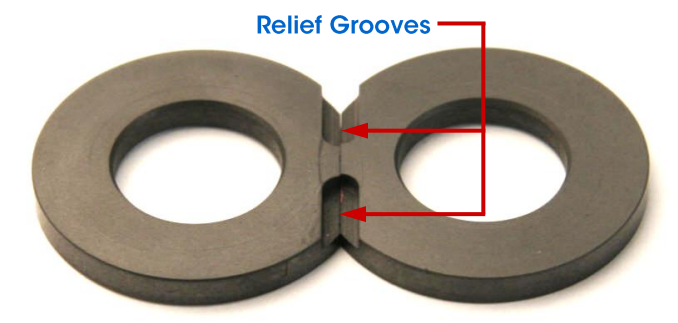
b. For new pumps supplied with four alignment pins, insert the other two pins into the center housing.



Installation of Wear Plates

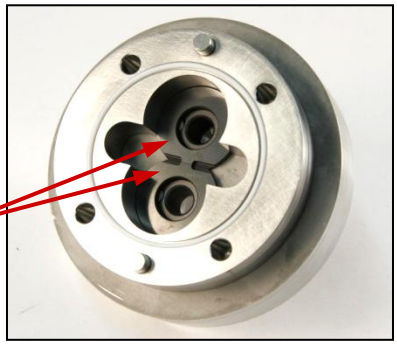
Standard Liquiflo wear plates are manufactured with cut-outs or grooves to provide liquid relief paths to reduce hydraulically-induced gear separation forces that exist during pump operation. These forces decrease pump life by placing significant loads on the shafts and bearings. To be effective, **the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

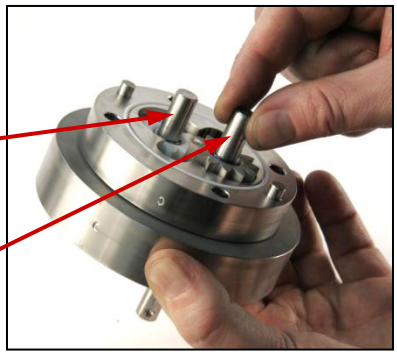
NOTE: For relieved wear plates, the cut-outs must face up (see photo). This will orient the relief grooves toward the gears.



Installation of Gear-Shafts:

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

NOTE: Liquiflo Repair Kits contain the gears and shafts preassembled, as shown in **Appendix 2**. If the replacement gears and shafts are not assembled, see **Appendix 4** for the assembly procedure.



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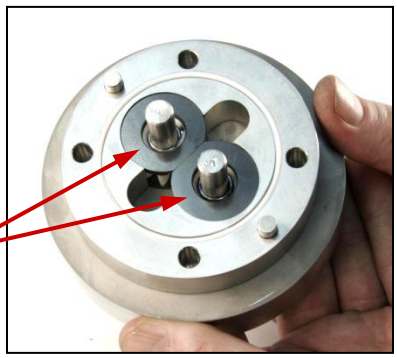
8 Place two wear plates (7) into position on top of the gears, as shown.

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



---

9 Install the rear housing (12) over the housing alignment pins (25) and onto the center housing (2), as shown.

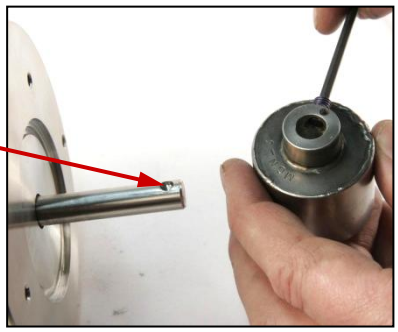
---

10 Install and tighten four housing bolts (4).

NOTE: Tighten the bolts in a crisscross pattern to ensure even compression on the surfaces of the housing O-rings. Teflon O-rings cold flow so the bolts may need to be retightened several times. See **Appendix 1** for the torque specifications of the fasteners.

Installation of Inner Magnet:

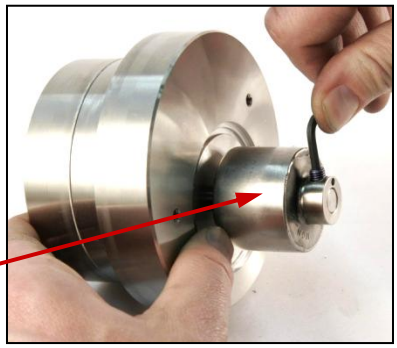
11 **a.** Adjust the dog-point setscrew (27) of the inner magnet (10) so that it will not touch the drive shaft during installation.



---

b. Slide the inner magnet (10) on the drive shaft (20) and align the setscrew over the positioning hole on the shaft; then tighten the dog-point setscrew into the positioning hole.

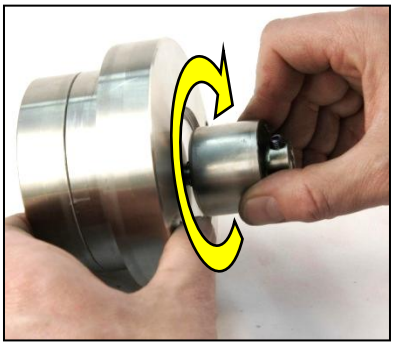
NOTE: The inner magnet must be installed with the orientation shown.



---

c. Turn the inner magnet by hand to ensure that the gears will rotate freely inside the housing.

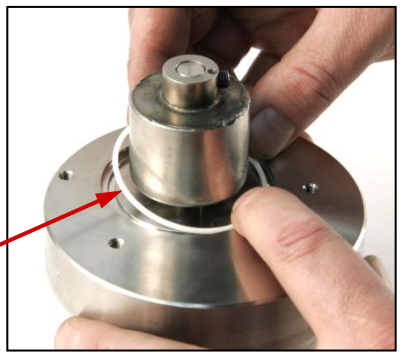
NOTE: The gears should rotate freely with no more than a slight amount of drag.



---

12 Install the containment can O-ring (13) into the circular groove on the front housing (8).

Caution!
Do not reuse O-rings.



Installation of Containment Can & Bracket:

13 **a.** Place the containment can (11) over the inner magnet (10) and onto the front housing (8).

NOTE: The containment can should seat naturally into the counter-bore on the front housing.

---

b. Place the mounting bracket (14) over the containment can and onto the front housing, with orientation as shown.

NOTE: The mounting bracket, once installed, will secure the containment can to the pump. The legacy **Cast Iron/Epoxy-Painted** blue bracket is shown. New pumps have a **304 Stainless Steel** bracket.

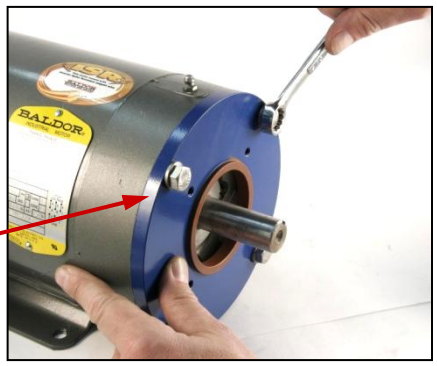
---

c. Install four sets of bolts (16) and lock-washers (29); then tighten the bolts.

NOTE: Tighten the bolts in a crisscross pattern to ensure even compression on the O-ring's surface. Teflon O-rings cold flow so the bolts may need to be retightened several times. See **Appendix 1** for the torque specifications of the fasteners.

NOTE: **Step 14 is required only for Legacy pump with Blue Epoxy-Painted Bracket that will be mounted to a NEMA 56C motor frame.**

14 Install the adapter plate (18) to the motor using four sets of adapter mounting bolts (19) and lock-washers (31).



NOTE: The *adapter plate* (Part No. 442203) shown is required to mount the pump bracket to a NEMA 56C motor frame only for legacy pumps. Refer to **Appendix 1** for the torque specifications of the *adapter mounting bolts* (Part No. S1000).

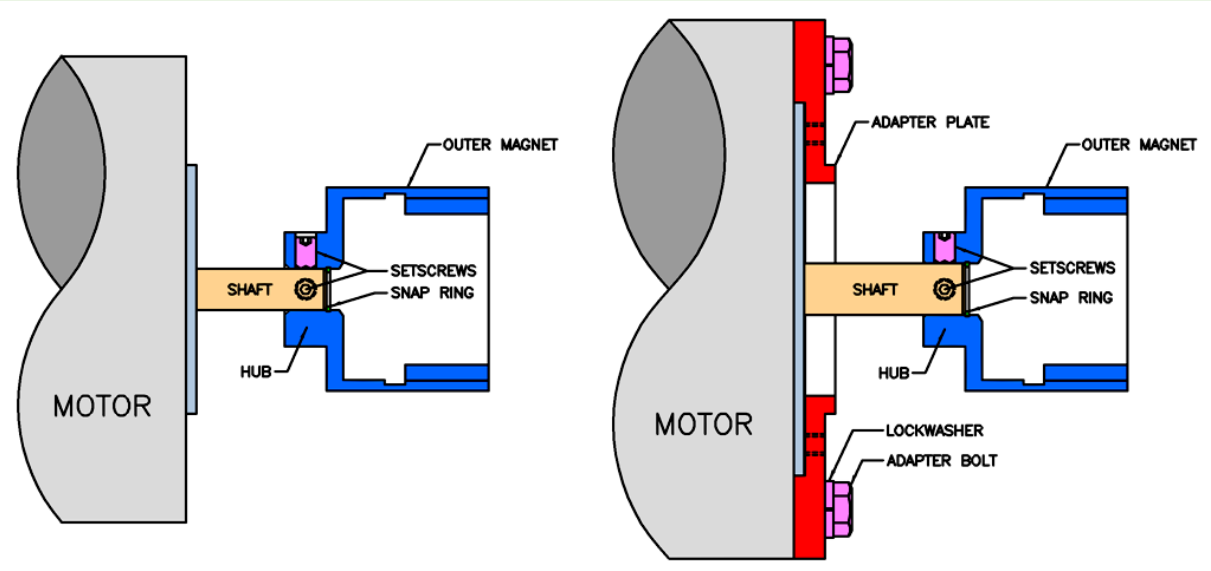
Installation of Outer Magnet

The outer magnets for the 4-Series pumps are available with three different bore sizes to allow installation on the shafts of standard motor frames (see table below). (Note: The pump is supported by the motor and therefore a Foot-Mount motor is required.)

Standard Motor Frame	Motor Shaft Diameter or Outer Magnet Bore Size
NEMA 48C	1/2 in.
IEC 71 (B14 Face)	14 mm
NEMA 56C	5/8 in.

Each outer magnet for the 4-Series Pumps has the same method of installation on the corresponding motor frame. As shown in the diagrams below, the outer magnet is positioned on the motor shaft by a snap ring installed in the hub of the outer magnet. **The outer magnet is in position once the snap ring contacts the end of the motor shaft**. Two cup-point setscrews are used to lock the outer magnet in position on the motor shaft.

NEMA 48C or IEC 71 (B14) Motor Frames: **NEMA 56C Motor Frames:**



NOTES:

1. New 4-Series Pumps utilize **Footless 304 SS Brackets** that mount directly to the motor frames shown above. For the NEMA 56C motor frame, no adapter plate is required.

2. Legacy 4-Series pumps use **Cast Iron/Epoxy-Painted Brackets** designed to mount directly to NEMA 48C and IEC 71 (B14 Face) motor frames. For the NEMA 56C motor frame, an **Adapter Plate** is used with the NEMA 48C bracket to mount the pump to the motor. (See diagrams above.)

3. Refer to **Appendix 2** for a list of all 4-Series pump parts and corresponding photos.

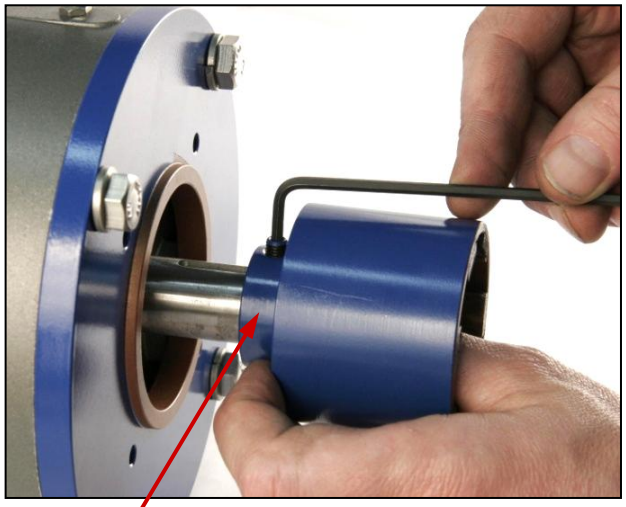
Installation of Outer Magnet:

15 **a.** Apply a small amount of anti-seize compound to the motor shaft.

b. Slide the outer magnet (9) onto the motor shaft and position the hub as shown on page 23.

c. Tighten both setscrews (26) on the hub of the outer magnet.

> **NOTE:** For NEMA 56C and IEC 71 (B14 Face) motors, the cup-point setscrews can be tightened on the round surface of the shaft. For NEMA 48C motors, one setscrew can be tightened on the flat surface of the shaft and the other on the round surface.



Outer Magnet & Bracket Part Numbers:

The specific outer magnet and mounting bracket supplied with the pump is dependent on the motor frame selected; the outer magnet also depends on the magnetic coupling size (see table below).

Position 8 of the pump model code designates the **Motor Frame** (Outer Magnet Bore Size to fit Motor Shaft Diameter); **Position 7** of the model code designates the **Magnetic Coupling Size** (Coupling Torque Rating). (See Table 2, page 5.)

Model Code Position 8	Standard Motor Frame	Motor Shaft Dia. or Outer Magnet Bore Size	Model Code Pos. 7 – Magnetic Coupling Size	Outer Magnet Part Number	Bracket Part Number (304 SS)
0	NEMA 48C	1/2 in.	N	SOMCN-4	442200
			R	SOMCR-4	
1	IEC 71 (B14 Face)	14 mm	N	SOMCN-71	442201
			R	SOMCR-71	
2	NEMA 56C	5/8 in.	N	SOMCN-5	442202
			R	SOMCR-5	

MCN = Neodymium Iron Boron (20 in-lb); **MCR** = Samarium Cobalt (30 in-lb).

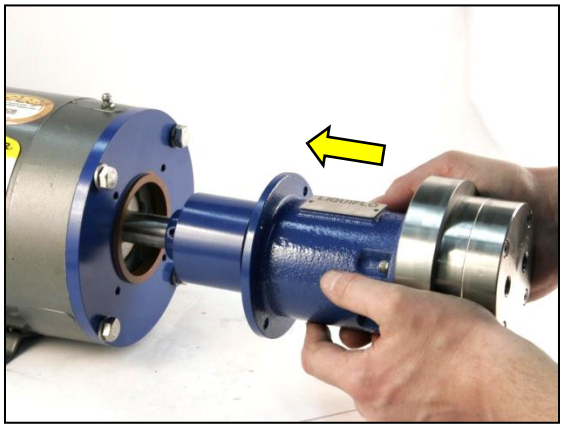
> **NOTE:** New 4-Series pumps use a **Footless 304 SS Bracket** which mounts directly to the motor. For **Legacy pumps** with NEMA 56C motor frame, an **Adapter Plate** is used with the former NEMA 48C **Cast Iron/Epoxy-Painted Bracket**. (See photos on page 25.)

Installation of Pump to Motor:

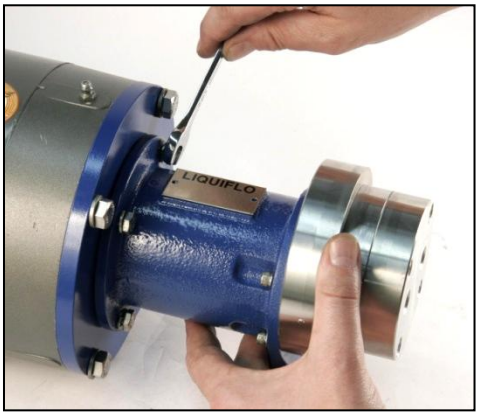
16

> ***Caution!***
> *Do not place hands or fingers Between Bracket and Motor C-faces. The Outer and Inner Magnets will suddenly pull together with significant force.*

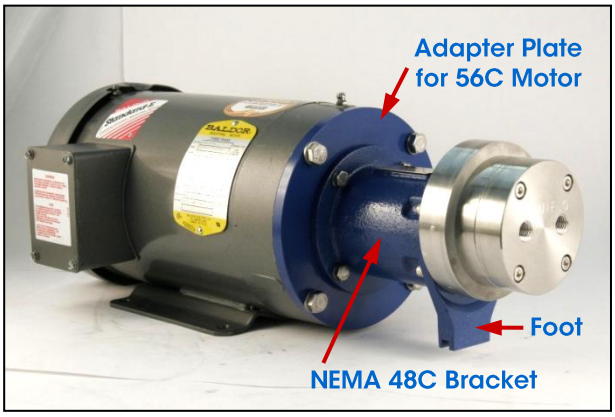
Carefully move pump bracket (14) over the outer magnet (9), as shown, and install onto motor using four mounting bolts (17) with lock-washers (30); then tighten the bolts.



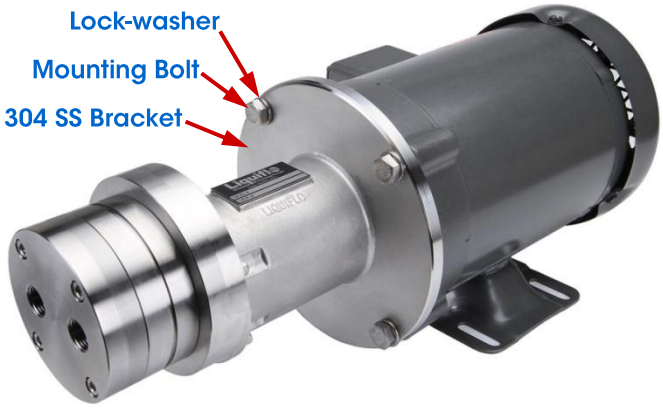
NOTE: The C-faces of the bracket and motor should mate freely and mount flush. New pumps have a **Footless 304 SS Bracket** that mounts directly to the motor. For **Legacy pumps** with NEMA 56C motor frame, an **Adapter Plate** is required and the foot of the blue bracket will not touch the ground. A shim or extra support underneath the foot is not required. (See photos below.)



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



4-Series **Legacy Pump** shown Close-Coupled to NEMA 56C Motor Frame



4-Series Pump shown Close-Coupled to NEMA 56C Motor Frame (New Design)

END OF ASSEMBLY PROCEDURE

Appendix 1: Fastener Torque Specifications

Maximum Torque Values for 18-8 Stainless Steel Bolts

Function	Pump Models	Model Code Position 8 – Motor Frame	Bolt Size	Bolt Type	Quantity (per Pump)	Max Torque Specifications	
						(in-lb)	(N-m)
Housing Assembly	41 & 43	0, 1, 2	1/4-28 UNF x 1 1/2	SHCS	4	94.0	10.6
	44 & 45		1/4-28 UNF x 2				
Pump-Bracket Assembly	41 – 45	0, 1, 2	#10-32 UNF x 5/8	SHCS	4	31.7	3.58
BOLTS for MOTOR-BRACKET ASSEMBLY:							
Motor(1)-Bracket Assembly	41 – 45	0	1/4-20 UNC x 5/8	HHCS	4	75.2	8.50
Motor(2)-Bracket Assembly	41 – 45	1	M6 x 16 mm	SHCS	4	67.2	7.6
Motor(3)-Bracket Assembly	41 – 45	2	3/8-16 UNC x 1 1/4	HHCS	4	236	26.7
Motor(4)-Adapter Assembly	41 – 45	2	3/8-16 UNC x 1 1/4	HHCS	4	236	26.7
Adapter(4)-Bracket Assembly			1/4-20 UNC x 5/8	HHCS	4	75.2	8.50

(1) NEMA 48C motor frame
(2) IEC 71 (B14 Face) motor frame
(3) NEMA 56C motor frame with Footless 304 SS Bracket
(4) NEMA 56C motor frame with Legacy Cast Iron/Epoxy Bracket

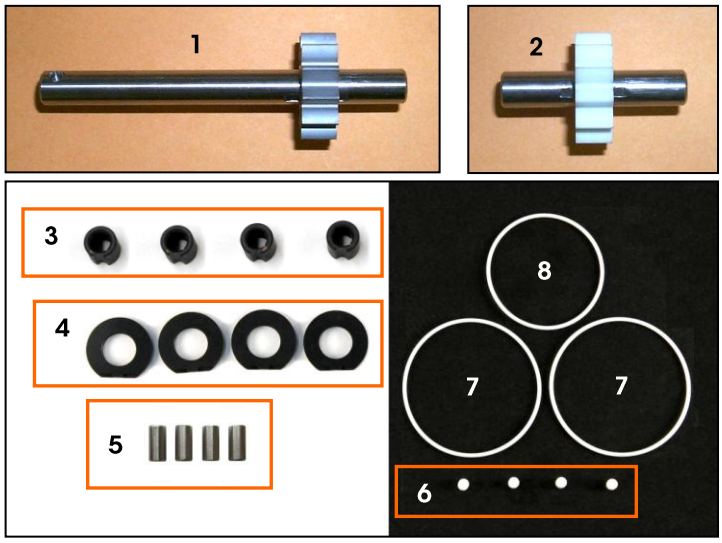
SHCS = Socket Head Cap Screw
HHCS = Hex Head Cap Screw

Appendix 2: Pump Parts List

Repair Kit parts (and quantities):

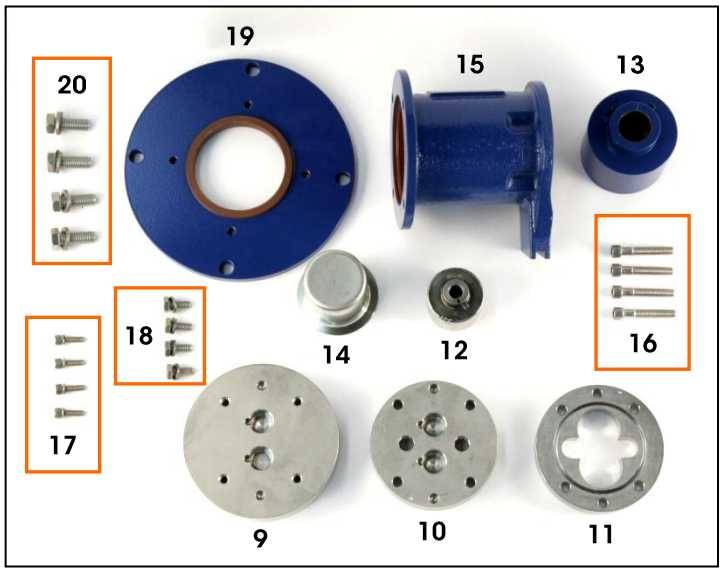
1 Drive gear-shaft assembly (1)
2 Idler gear-shaft assembly (1)
3 Bearings (4)
4 Wear plates (4)
5 Housing alignment pins (4)
6 Bearing lock pins (4)
7 O-rings for housing (2)
8 O-ring for containment can (1)

NOTE: The gears and shafts come pre-assembled in a standard repair kit, as shown above. These parts can also be purchased separately. To assemble the gears and shafts, see the procedure in **Appendix 4**.



Other assembly parts (and quantities):

9 Front housing (1)
10 Rear housing (1)
11 Center housing (1)
12 Inner magnet (1)
13 Outer magnet (1)
14 Containment can (1)
15 Bracket (1)
16 Bolts for pump housing assembly (4)
17 Bolts and lock-washers for pump-bracket assembly (4 sets)
18 Bolts and lock-washers for bracket-motor assembly (4 sets)
19 Adapter plate (1) *
20 Bolts and lock-washers for adapter-motor assembly (4 sets) *



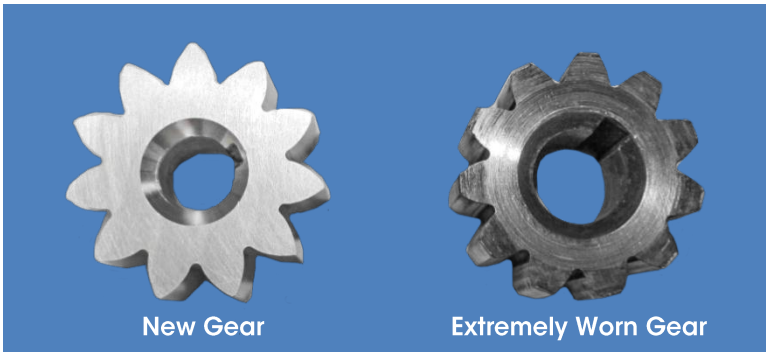
* Parts required only for Legacy pumps with NEMA 56C motors. New 4-Series pumps use Footless 304 SS Bracket and no adapter is required.

NOTE: For Liquiflo Part Numbers, refer to 4-Series Consolidated Bill of Materials (BOM).

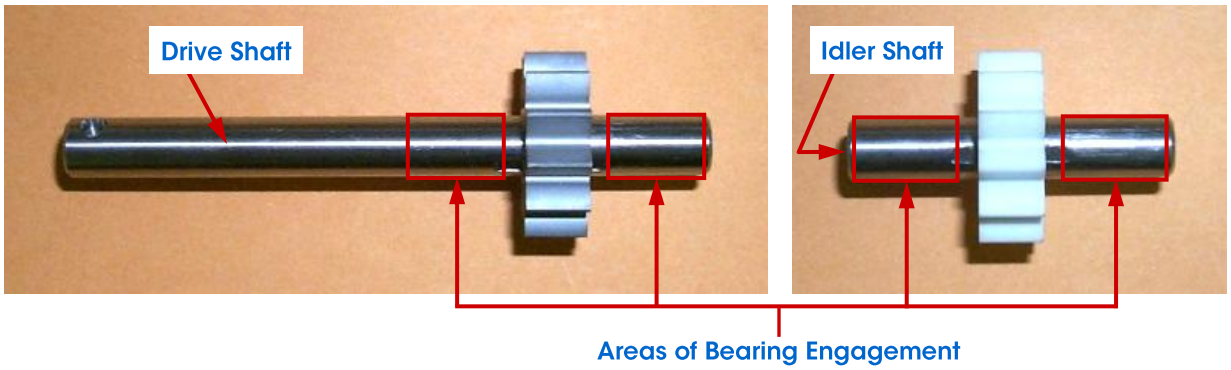
Appendix 3: Wear Allowances

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 and not included in repair kit) may also incur physical wear by contact with the gears caused by excessively worn bearings. 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 in the **Wear Allowances Chart** (see next page):

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 below).

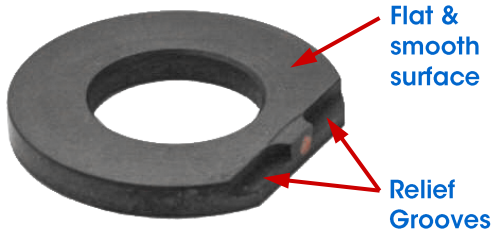


Shafts: The area of the shaft that is engaged in the bearings will wear over time depending on the service conditions and materials of construction (see photos below). Hard-coated shafts are available to minimize or eliminate wear of the shaft surfaces. Worn shafts may allow the gears to contact the 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.

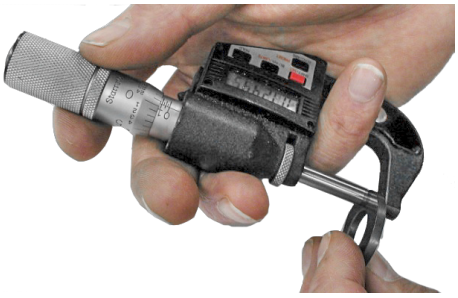


Wear Plates: This is a sacrificial part of the pump designed to protect the front and rear housings from wear by continual contact with the sides of the gears. Erosion of the wear plates increase clearances causing slip to increase. This results in a reduction in pump performance. Wear plates should 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 on opposite page.)

Appendix 3: Wear Allowances (Continued)

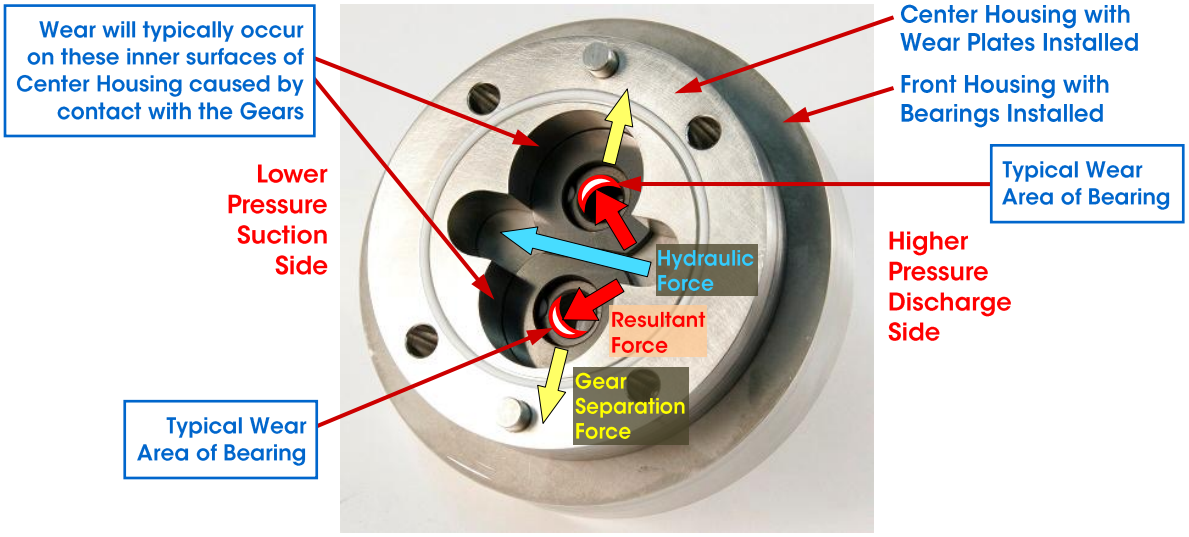


Wear Plate (Relieved Type)



Measuring Wear Plate Thickness

Bearings: The 4-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. (See photo below for the typical wear areas of the bearings.) 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.



Wear Mechanism of Bearings & Center Housing

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 above for wear surfaces.) 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)

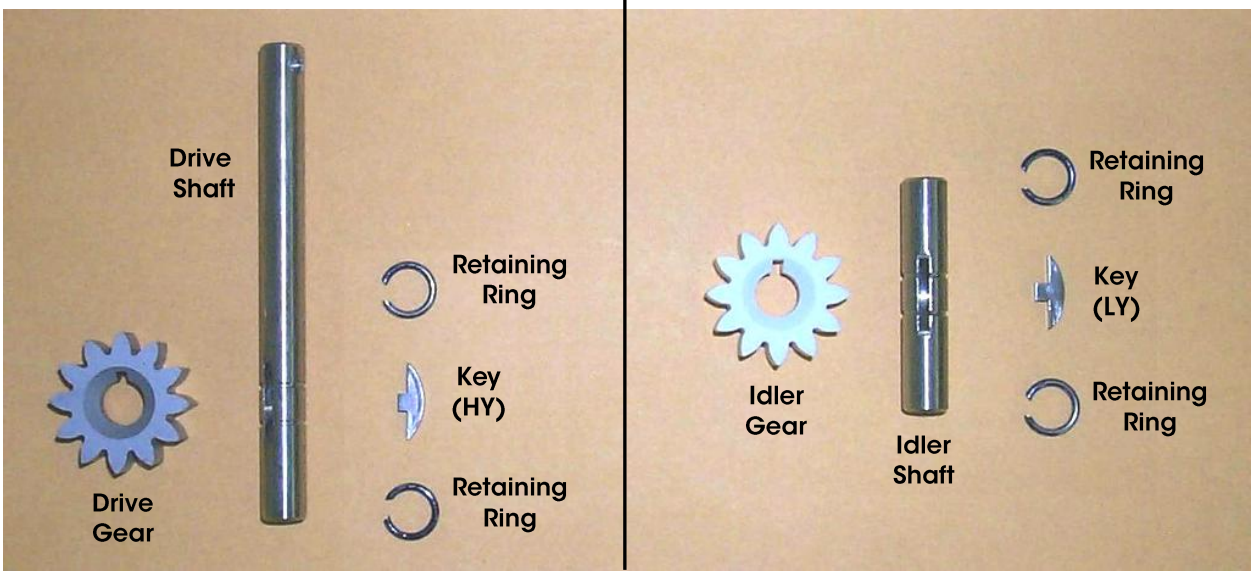
Pump Models	Gears		Shafts		Wear Plates		Bearings	
	Nom. O.D.	Min O.D.	Nom. O.D.	Min O.D.	Nom. Thick.	Min Thick.	Nom. I.D.	Max I.D.
41 & 44	1.163	1.158	0.375	0.373	0.250	0.247	0.375	0.378
43 & 45	1.163	1.158	0.375	0.373	0.125	0.122	0.375	0.378

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

Appendix 4: Gear-Shaft Assembly

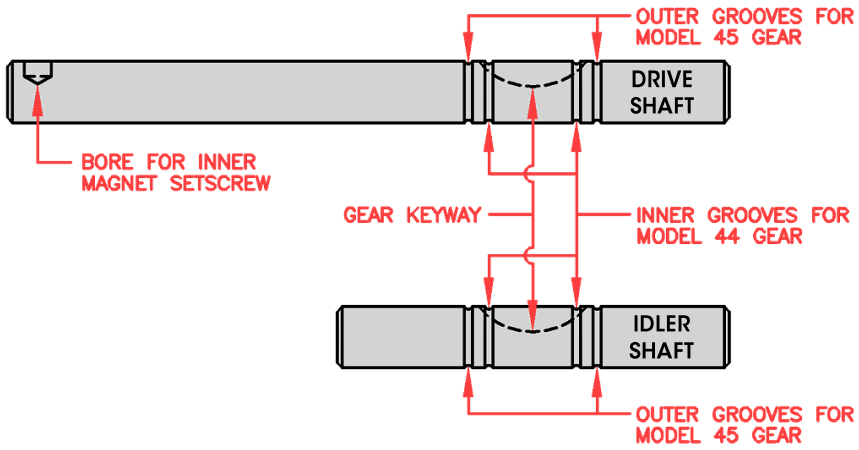
Parts List for Gear-Shaft Assemblies

Drive Gear-Shaft Parts		Idler Gear-Shaft Parts	
Part	**Quantity**	**Part**	**Quantity**
Drive Gear	1	Idler Gear	1
Drive Shaft	1	Idler Shaft	1
Key	1	Key	1
Retaining Ring	2	Retaining Ring	2



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 bore on one end for the inner magnet setscrew. The gears are positioned on the shafts using two retaining rings per gear. The shafts for Models 41/43 have one set of retaining ring grooves to position both the Model 41 gear and the Model 43 gear (see photo above). The shafts for Models 44/45 contain an inner set of grooves to position the Model 44 gear and an outer set of grooves to position the Model 45 gear (see diagram below). The chart at the top of the following page can be used to identify the shafts.



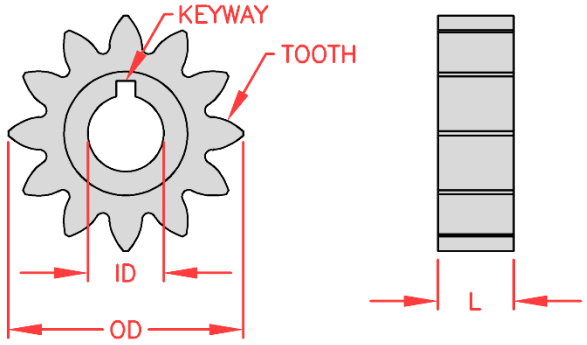
Appendix 4: Gear-Shaft Assembly (Continued)

Gear & Shaft Identification Chart (Units: inches)

Part	Part Dimension	Pump Model			
		41	43	44	45
Gear (Drive or Idler)	Outer Diameter (OD)	1.163	1.163	1.163	1.163
	Inner Diameter (ID)	3/8	3/8	3/8	3/8
	Length (L)	1/8 *	3/8	5/8	7/8
	# of Teeth	12	12	12	12
Drive Shaft	Diameter	3/8		3/8	
	Length	3.92		4.42	
	# of Retaining Ring Grooves	2		4	
Idler Shaft	Diameter	3/8		3/8	
	Length	1.91		2.40	
	# of Retaining Ring Grooves	2		4	

* Gear has 3/8" Hub

Gears: The 4-Series pumps use spur style gears, as shown below. The above chart can be used to identify the gears.



Keys: Two types of gear keys are used in the 4-Series pumps: High-yield (HY) and low-yield (LY). 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.

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 ring for the 4-Series pumps is shown at right in actual size.)

Appendix 4: Gear-Shaft Assembly (Continued)

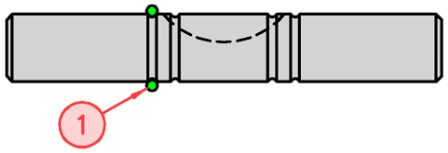
Gear-Shaft Assembly Procedure:

NOTE: Assembly of Model 45 Idler Gear-Shaft is shown as example.

Caution!
Be careful not to damage the shafts.

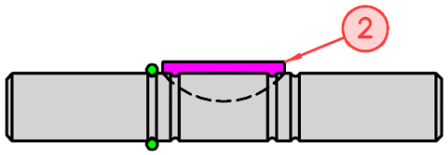
1 Install the first retaining ring (21) into either outer groove of the idler shaft (1).

NOTE: The inner groove would be used for a Model 44 gear. See the Shafts diagram on page 30.

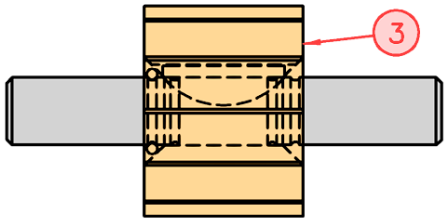


2 Install the appropriate key (23) into the keyway slot on the shaft, as shown.

NOTE: The proper key to use depends on the gear model and the gear material. See the Keys section on page 31.



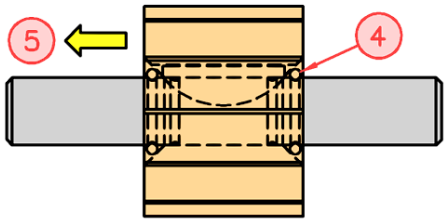
3 Install the gear (6) on the shaft so that it engages the key and contacts the retaining ring.



4 Install the second retaining ring (21) in the other outer groove.

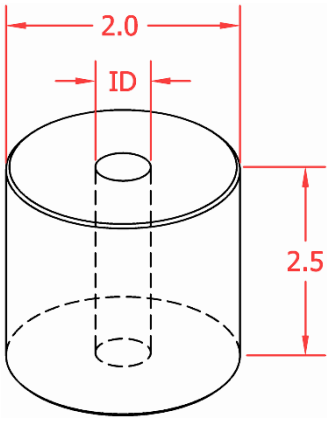
NOTE: The other inner groove would be used for a Model 44 gear.

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



Retaining Ring Installation:

The tool shown at right is recommended for installing the retaining rings on the shafts. It should be manufactured from a hard material, such as steel.



To install retaining ring on shaft:

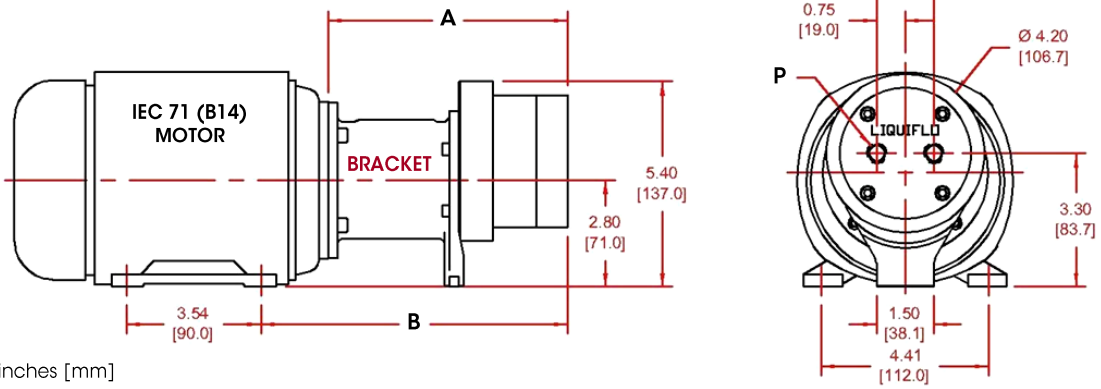
(1) Force one retaining ring on bottom end of shaft by striking top end with rubber mallet.
(2) Place retaining ring over bore of tool and then tap shaft thru bore to push retaining ring into outer groove.
(3) For Model 44 gear only, strike end of shaft with rubber mallet to force retaining ring out of outer groove and into inner groove.

Tool Dimensional Specifications:
ID: .378 ± .001 inches (**NOTE:** Do not chamfer inside edges.)

Appendix 5: Reference Drawings

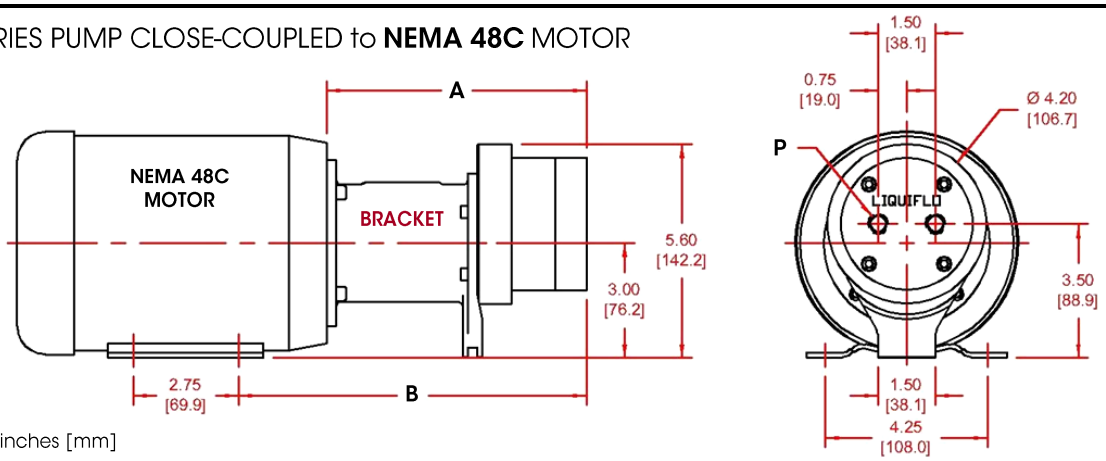
Dimensional Drawings – 4-Series Gear Pump (Mag-Drive)

4-SERIES PUMP CLOSE-COUPLED to **IEC 71 (B14)** MOTOR



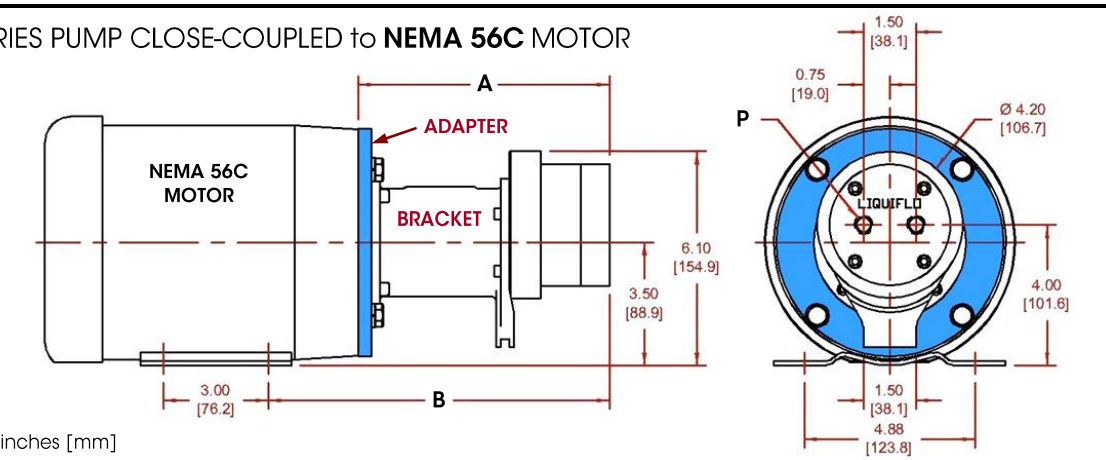
Units: inches [mm]

4-SERIES PUMP CLOSE-COUPLED to **NEMA 48C** MOTOR



Units: inches [mm]

4-SERIES PUMP CLOSE-COUPLED to **NEMA 56C** MOTOR



Units: inches [mm]

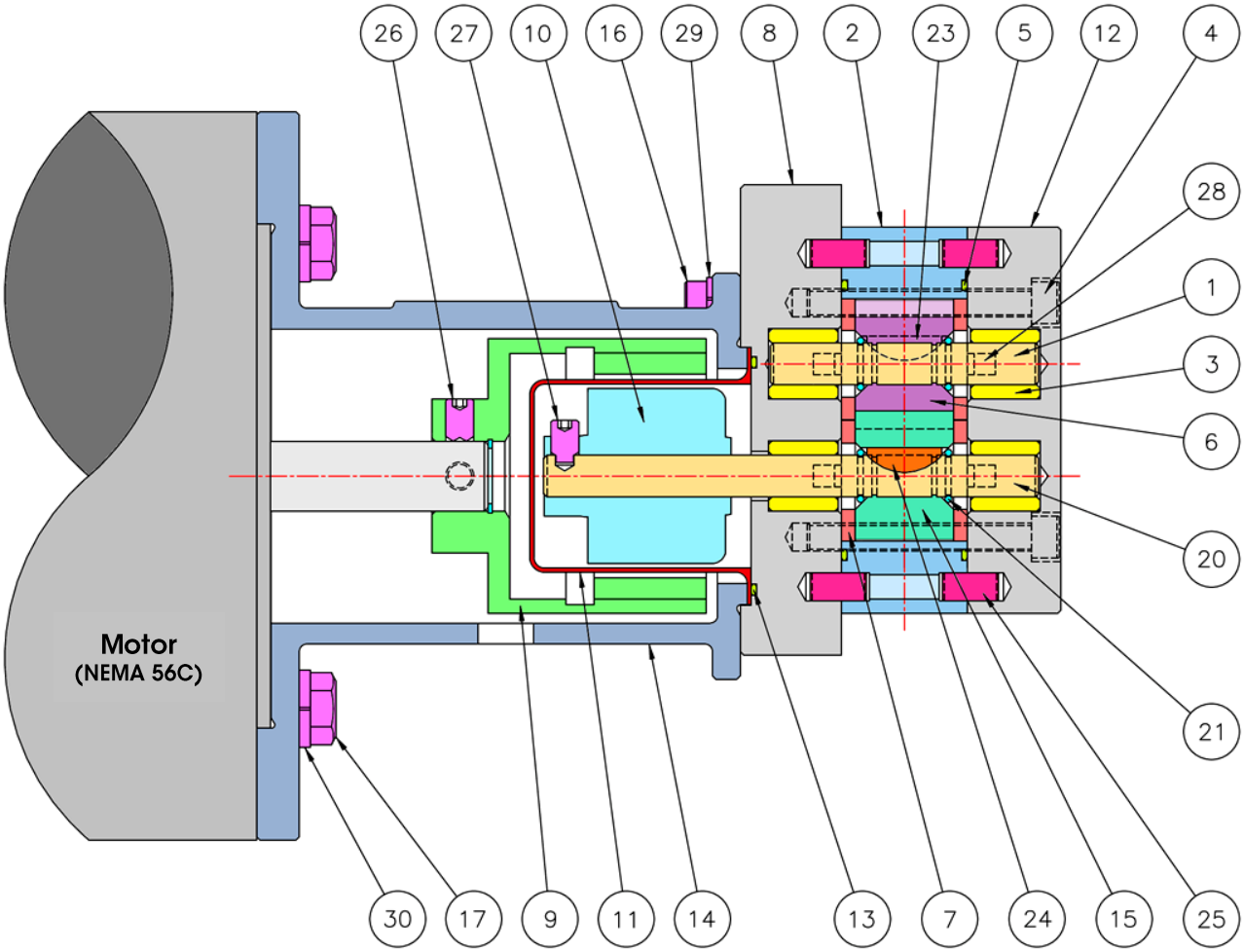
NOTE: New 4-Series pumps use **Footless 304 SS Bracket** and Adapter is not required for NEMA 56C motor frame.

Dimensional Data (inches [mm])

Pump Models	Port Size (P)		IEC 71 (B14)		NEMA 48C		NEMA 56C	
	NPT	BSPT	A	B	A	B	A	B
41 & 43	1/4	3/8	5.80 [147.3]	7.57 [192.3]	6.30 [160.0]	8.62 [218.9]	6.68 [169.7]	9.24 [234.7]
44 & 45	3/8	3/8	6.30 [160.0]	8.07 [205.0]	6.80 [172.8]	9.12 [231.6]	7.18 [182.4]	9.74 [247.4]

Appendix 5: Reference Drawings (Continued)

Sectional Drawing #1 – 4-Series Gear Pump (New Design)



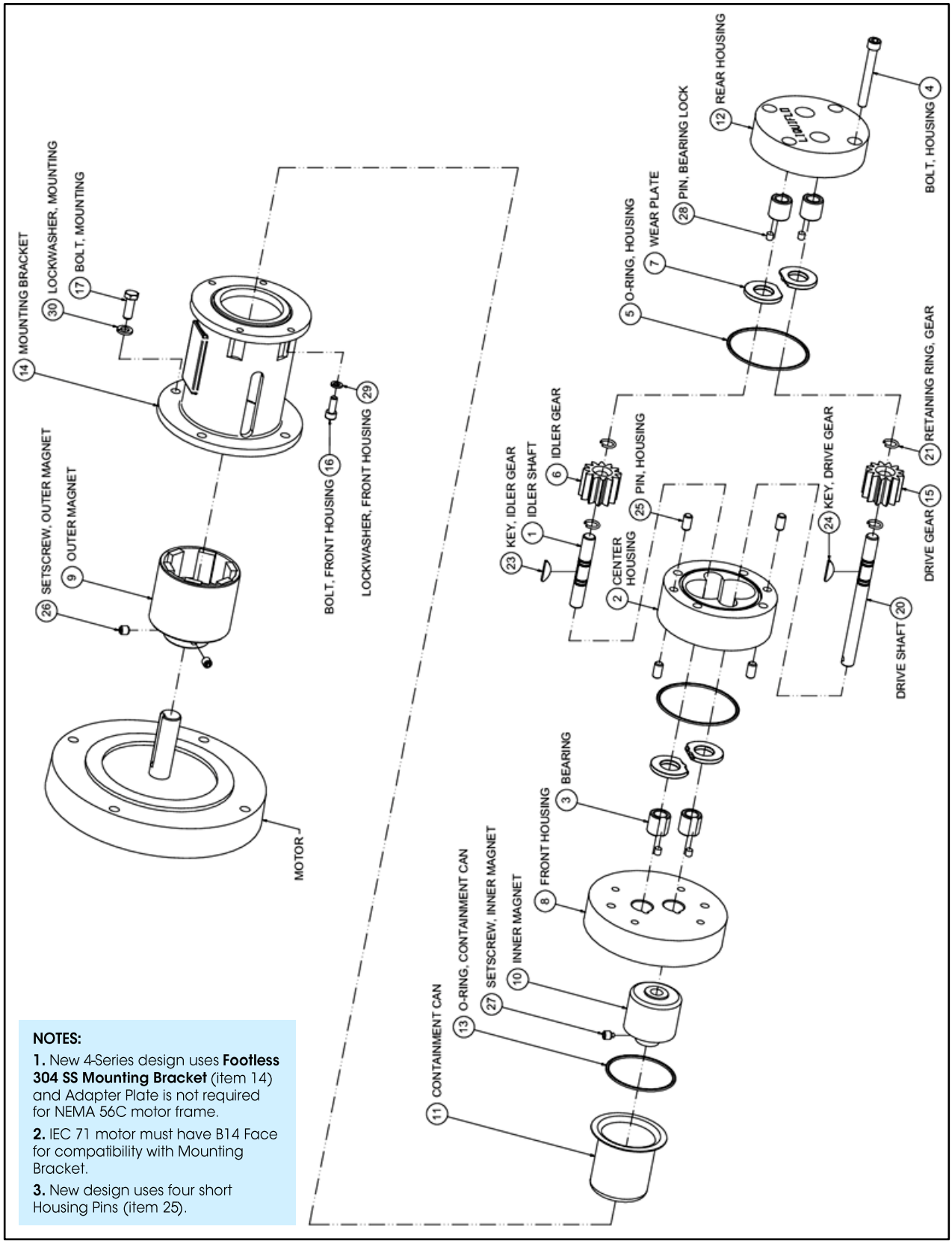
Ref. #	Description	Qty.	Ref. #	Description	Qty.
1	Idler Shaft	1	17	Bolt, Mounting (3/8-16 x 1-1/4 HHCS) [3]	4
2	Center Housing	1	18	N/A	–
3	Bearing	4	19	N/A	–
4	Bolt, Housing (1/4-28 x L SHCS) [1]	4	20	Drive Shaft	1
5	O-ring, Housing	2	21	Retaining Ring, Gear	4
6	Idler Gear	1	22	Bumper, Mounting Bracket	1
7	Wear Plate	4	23	Key, Idler Gear	1
8	Front Housing	1	24	Key, Drive Gear	1
9	Outer Magnet (Assembly)	1	25	Pin, Housing Alignment	4
10	Inner Magnet (Assembly)	1	26	Setscrew (1/4-28 x 3/8 SHSS-CP)	2
11	Containment Can	1	27	Setscrew (1/4-28 x 3/8 SHSS-HD)	1
12	Rear Housing	1	28	Pin, Bearing Lock	4
13	O-ring, Containment Can	1	29	Lock-washer, Front Housing (#10)	4
14	Mounting Bracket [2]	1	30	Lock-washer, Mounting (1/4) [3]	4
15	Drive Gear	1	31	N/A	–
16	Bolt, Front Housing (#10-32 x 5/8 SHCS)	4	–	–	–

1 See **Appendix 1** for bolt lengths (**L**).
2 New design (effective Sept. 2019) has **Footless 304 SS Bracket** that mounts directly to NEMA 56C motor, as shown above.
3 Size given for NEMA 56C motor; see **Appendix 1** for NEMA 48C and IEC 71 (B14) motors.

NOTE: For Liquiflo Part Numbers, refer to 4-Series Consolidated Bill of Materials (BOM).

Appendix 5: Reference Drawings (Continued)

Exploded View Drawing #1 – 4-Series Gear Pump (New Design)



NOTES:

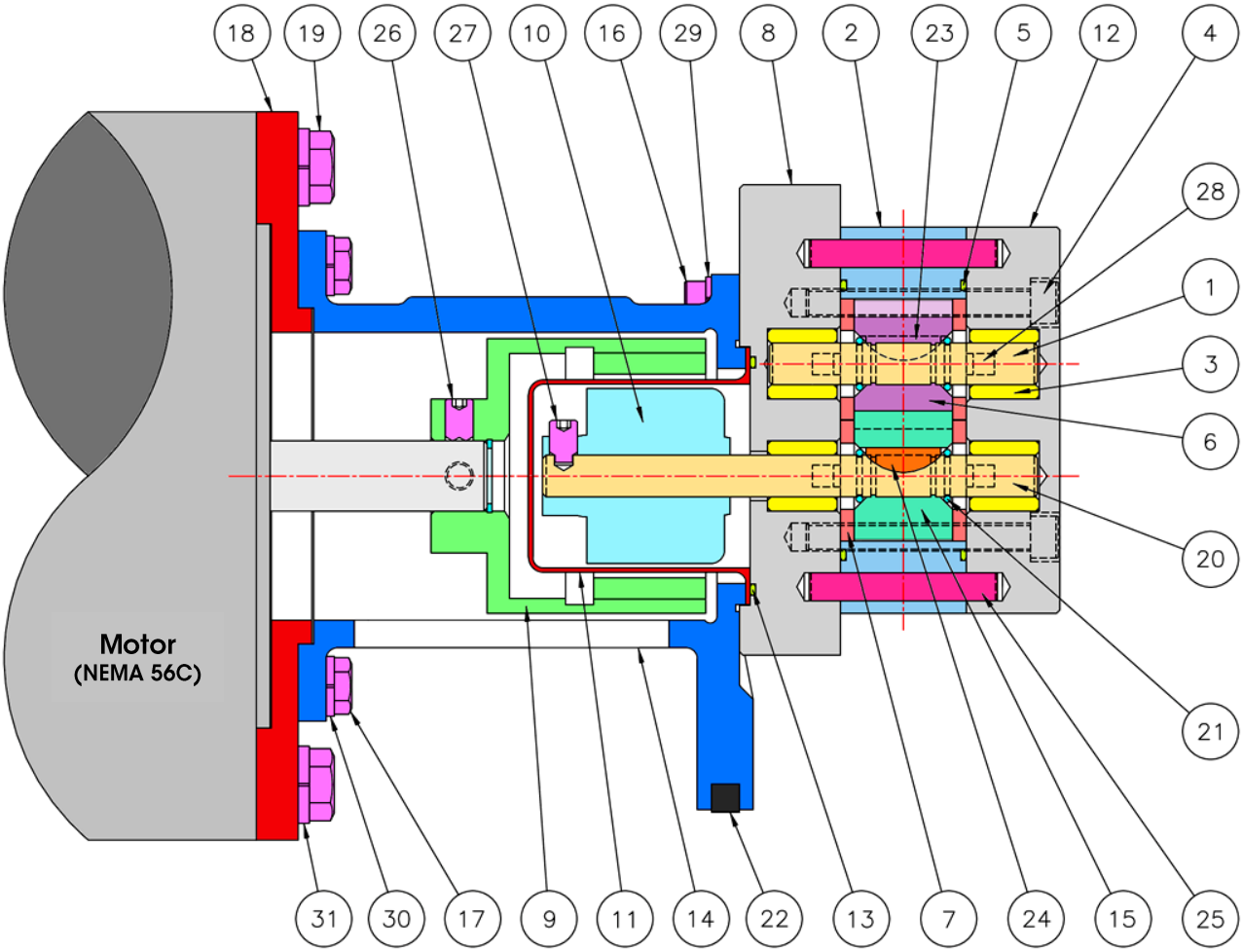
1. New 4-Series design uses **Footless 304 SS Mounting Bracket** (item 14) and Adapter Plate is not required for NEMA 56C motor frame.

2. IEC 71 motor must have B14 Face for compatibility with Mounting Bracket.

3. New design uses four short Housing Pins (item 25).

Appendix 5: Reference Drawings (Continued)

Sectional Drawing #2 – 4-Series Gear Pump (Legacy Design)



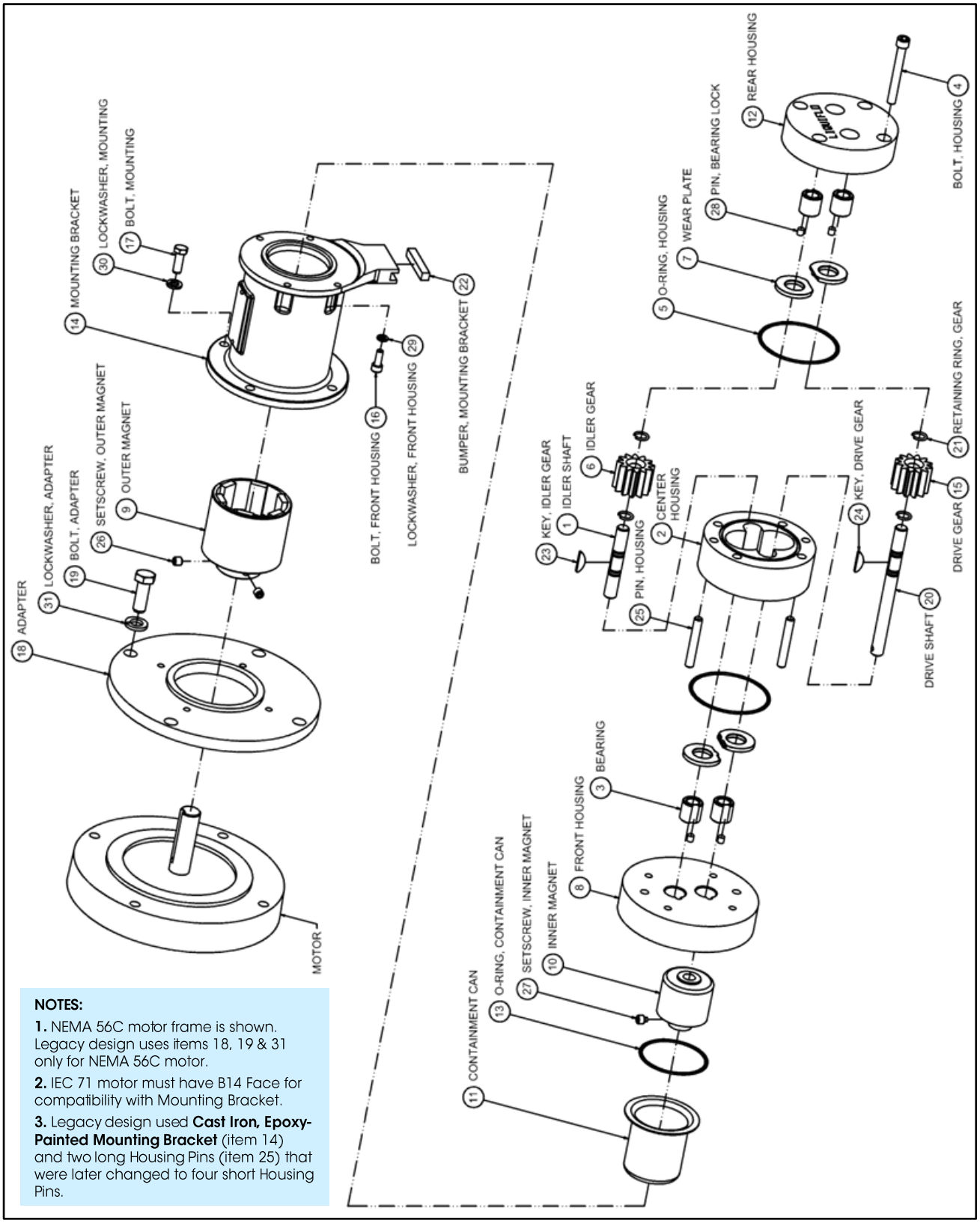
Ref. #	Description	Qty.	Ref. #	Description	Qty.
1	Idler Shaft	1	17	Bolt, Mounting (1/4-20 x 5/8 HHCS) [3]	4
2	Center Housing	1	18	Adapter Plate – NEMA 56C Motor [2]	1
3	Bearing	4	19	Bolt, Adapter (3/8-16 x 1-1/4 HHCS) [2]	4
4	Bolt, Housing (1/4-28 x L SHCS) [1]	4	20	Drive Shaft	1
5	O-ring, Housing	2	21	Retaining Ring, Gear	4
6	Idler Gear	1	22	Bumper, Mounting Bracket	1
7	Wear Plate	4	23	Key, Idler Gear	1
8	Front Housing	1	24	Key, Drive Gear	1
9	Outer Magnet (Assembly)	1	25	Pin, Housing Alignment [4]	2
10	Inner Magnet (Assembly)	1	26	Setscrew (1/4-28 x 3/8 SHSS-CP)	2
11	Containment Can	1	27	Setscrew (1/4-28 x 3/8 SHSS-HD)	1
12	Rear Housing	1	28	Pin, Bearing Lock	4
13	O-ring, Containment Can	1	29	Lock-washer, Front Housing (#10)	4
14	Mounting Bracket [2]	1	30	Lock-washer, Mounting (1/4) [3]	4
15	Drive Gear	1	31	Lock-washer, Adapter (3/8) [2]	4
16	Bolt, Front Housing (#10-32 x 5/8 SHCS)	4	–	–	–

1 See **Appendix 1** for bolt lengths (**L**).
2 Legacy pumps have **Cast Iron/Epoxy Bracket** (shown above) and items **18**, **19** & **31** are required only for NEMA 56C motor.
3 Size applicable for NEMA 56C & 48C motors; see **Appendix 1** for IEC 71 (B14) motor.
4 Original 2-Pin design (shown above) was changed to 4-Pin design in January 2012.

NOTE: For Liquiflo Part Numbers, refer to 4-Series Consolidated Bill of Materials (BOM).

Appendix 5: Reference Drawings (Continued)

Exploded View Drawing #2 – 4-Series Gear Pump (Legacy Design)



NOTES:

1. NEMA 56C motor frame is shown. Legacy design uses items 18, 19 & 31 only for NEMA 56C motor.

2. IEC 71 motor must have B14 Face for compatibility with Mounting Bracket.

3. Legacy design used **Cast Iron, Epoxy-Painted Mounting Bracket** (item 14) and two long Housing Pins (item 25) that were later changed to four short Housing Pins.

Appendix 6: Troubleshooting Guide

Troubleshooting Guide – Part 1

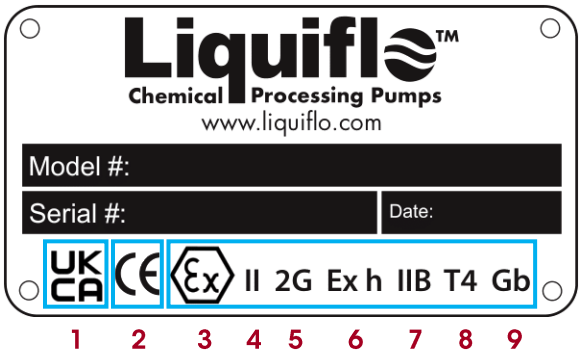
Problem	Possible Cause	Corrective Action
No discharge	Pump not primed	Verify suction pipe is submerged. Increase suction pressure. Open suction valve.
	Wrong direction of rotation	Reverse motor leads or reverse suction and discharge piping.
	Valves closed	Open all suction and discharge valves.
	Bypass 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.
	Magnetic coupling has decoupled	Stop driver and then check temperature and viscosity of fluid. Restart driver and then check flow.
	Pump parts worn or damaged	Rebuild pump.
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 parts worn or damaged	Rebuild pump.
Loss of suction after satisfactory operation	Pump not properly primed	Reprime pump.
	Air leak in suction line	Tighten connections. Apply sealant to all threads. 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 6: 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.
Excessive noise and vibration	Suction and/or discharge piping not anchored or properly supported	Anchor per Hydraulic Institute Standards.
	Motor and/or base not properly mounted or secured	Tighten motor mounting bolts to proper torque specification. Secure base to the ground.
	Worn pump bearings	Replace bearings.
	Worn motor bearings	Replace bearings or motor.
	Pump cavitation	Increase NPSH available.
Excessive product leakage	Static seal failure caused by chemical 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.
	Crevice corrosion of pump housing material	Only pump chemicals that are 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 7: 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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