Liquiflo™ Chemical Processing Pumps

INSTALLATION, OPERATION & MAINTENANCE MANUAL

CENTRY® SERIES

MAGNETIC-DRIVE, CLOSE-COUPLED CENTRIFUGAL PUMPS

Model 620-MC

Document No.: 3.20.024

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Introduction

This manual provides instructions for the installation, operation and maintenance of the Centry® Series Centrifugal Pump, Model 620-MC (Magnetically-Coupled). 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 pumps 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

This manual covers the Centry® Series Mag-Drive, Close-Coupled Centrifugal Pump, Model 620-MC. (Note: Model 620-MC was formerly called Model 62-MC.) Long-coupled mounting options using the Liquiflo Power Frame and S-Adapter are also covered in this manual.

1.1 Pump Description

Model 620-MC is an end-suction magnetic-drive centrifugal pump with the following features:

- Sealless design (no mechanical seal or packing to replace)
- Close-coupled or long-coupled mounting options
- Choice of threaded or flanged ports
- Back pullout design to simplify maintenance
- Standard reduced impeller sizes to simplify pump selection
- Sturdy Cast Iron mounting bracket that supports pump and driver

The pump *Model Number* and *Serial Number* are stamped on the *Stainless Steel Tag* that is attached to the pump's housing. The Serial Number is also permanently stamped on the pump's volute.

The Model Number completely describes the pump's construction and is required when ordering either a new pump or replacement parts for an existing pump. The Model Number for the mag-drive pump is based on a 10-position *Model Coding* system that is described in **Section 1.4** (see page 5).

1.2 General Instructions

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.

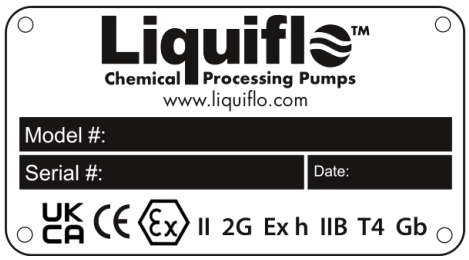
Upon receipt of your Liquiflo pump:

1) Inspect pump and verify that it was not damaged during transit.

2) Inspect tag and verify that the Model Number of the pump matches the Model Number of the pump that was ordered.

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

   Refer to **Appendix 6** for meaning of the Tag Certification Markings which are shown at the bottom of the tag.



4) Record the following information for future reference:

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

1.3 Pump Specifications

Table 1: Dimensional Specifications

Specification		Value	Unit
Ports	Type	Threaded (NPT) or Flanged (ANSI 150# RF)	–
	Suction Size	1.00	in
	Discharge Size	0.75	in
Impeller	Diameter	3.75	in
	Standard Trims	3.50, 3.25, 3.00, 2.75	in
	Type	Open	–
Mounting Bracket		Close-Coupled, Pedestal [1]	–
Motor Frames (C-Face)		NEMA 56C thru 145TC; IEC 71, 80 & 90 (B5 Flange) [1]	–

1 Power Frame & S-Adapter are available for long-coupling pump mounting bracket to other motor frames.

Table 2: Performance & Torque Specifications

Specification		Value	Unit
Maximum Speed		3600	RPM
Maximum Flow Rate		45	GPM
Maximum Differential Head		65	ft
Magnetic Coupling Maximum Torque @ 20°C	MCD	33	in-lb
	MCF	120	in-lb

Table 3: Absolute Temperature & Pressure Ratings

Specification	Value	Unit
Minimum Operating Temperature	-40	°F
Maximum Operating Temperature	500	°F
Maximum Operating Pressure	300 [2]	PSIG

2 For flanged pumps, max rating is 275 PSIG @ -20 to 100°F; above 100°F, derate by 0.3 PSIG/°F.

Table 4: Weight Data

Item	Weight	Unit
Pump with Threaded Ports [3]	30	lb
Pump with Flanged Ports [3]	34	lb
Power Frame	16	lb
S-Adapter	6.0	lb

3 Weight includes mounting bracket (pedestal) and excludes motor.

Table 5: Material Data

Components		Materials
Pump Body, Impeller & Shaft		316 Stainless Steel or Alloy-C
Shaft Coating		Chrome Oxide (Cr_2O_3) or Tungsten Carbide (WC)
Bearings		Carbon (Graphite), Silicon Carbide (α-SiC) or Teflon [4]
Thrust Washers		Carbon (Graphite), Silicon Carbide (α-SiC) or Teflon [4]
O-rings & Gaskets		Teflon (PTFE), Viton (Type A) or Graphoil
Magnetic Coupling	Magnets	MCD: Ceramic ; MCF: Samarium Cobalt (SmCo)
	Inner Magnet Casing	316 Stainless Steel or Alloy-C [5]
	Outer Magnet Casing	Carbon Steel/Epoxy
Mounting Bracket (Pedestal)		Cast Iron/Epoxy
Mounting Hardware		18-8 Stainless Steel
Power Frame		Frame: Cast Iron/Epoxy; Shaft: Carbon Steel
S-Adapter		Carbon Steel/Epoxy

4 PTFE, 25% Glass-filled. **5** Material will match Pump Body Material.

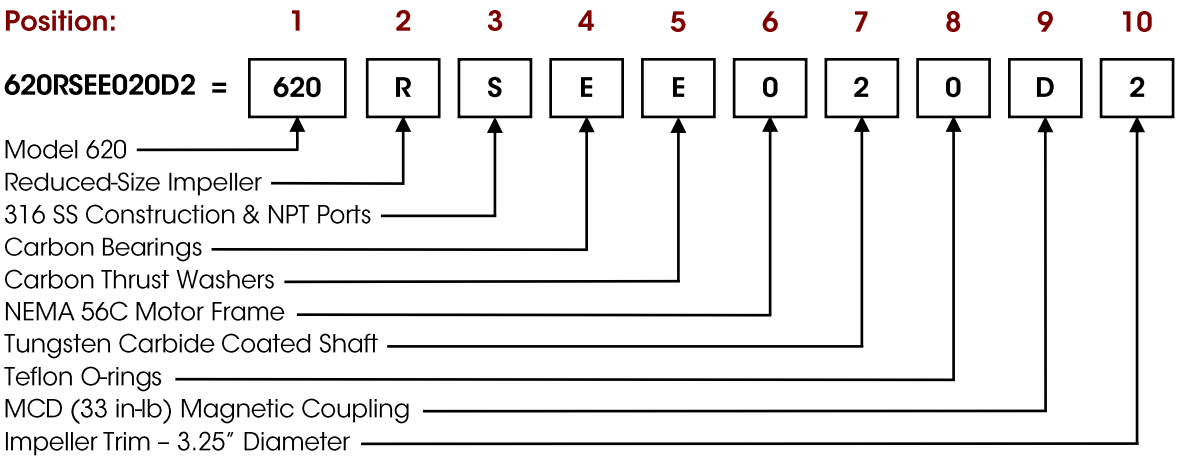
1.4 Model Coding

Table 6: Model Coding for Centry® Model 620-MC

Position	Description	Code	Selection	
1	Pump Model	620	Model 620	
2	Impeller Size	F	Full-Size – 3.75″ Diameter	**Pos. 10 = 0**
		R	Reduced-Size	**Pos. 10 = 1, 2, 3 or 4**
3	Basic Material of Construction & Port Type	S	316 SS Construction & NPT Ports	
		H	Alloy-C Construction & NPT Ports	
		L	316 SS Construction & Flanged Ports	
		C	Alloy-C Construction & Flanged Ports	
4	Bearings	E	Carbon	
		B	Silicon Carbide	
		3	Teflon	
5	Thrust Washers	E	Carbon	
		B	Silicon Carbide	
		3	Teflon	
6	Motor Frame (Outer Magnet Bore)	0	NEMA 56C (5/8 in.)	
		1	NEMA 143TC/145TC (7/8 in.)	
		2	IEC 71 – B5 Flange (14 mm)	
		3	IEC 80 – B5 Flange (19 mm)	
		4	IEC 90 – B5 Flange (24 mm)	
7	Shaft Coating	1	Chrome Oxide	
		2	Tungsten Carbide	
8	O-rings/Gaskets	0	Teflon O-rings	
		V	Viton O-rings	
		G	Graphoil Gaskets	
9	Magnetic Coupling	D	MCD (33 in-lb)	
		F	MCF (120 in-lb)	
10	Impeller Trim (Standard)	0	No Trim	**Pos. 2 = F**
		1	3.50″ Diameter	**Pos. 2 = R**
		2	3.25″ Diameter	
		3	3.00″ Diameter	
		4	2.75″ Diameter	
Suffix	Options	-8(HT)[1]	High Temperature (300 to 500 °F)	
		-8(LT)[2]	Low Temperature (-100 to 32 °F)	

1 **HT** = High Temperature in °F (Example: **- 8(400)** = High Temperature Application at 400°F).
2 **LT** = Low Temperature in °F (Example: **- 8(-40)** = Low Temperature Application at -40°F).

Model Coding Example:



1.5 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 centrifugal pump will deliver a steady and pulse-less flow with no leakage, be relatively quiet and have a predictable flow rate and power requirement based on the impeller size, operating speed, differential head and fluid specific gravity. Centry Model 620 performance curves can be obtained from the Liquiflo website: www.liquiflo.com. For viscous liquid applications, a performance correction is required (see **Section 3.8**).

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 5**.

1.6 Maintenance & Repair

The magnetically-coupled sealless pump has internal bearings, thrust washers and a shaft which require replacement over time due to erosion wear. Possibly, other pump parts, such as the impeller, volute and containment can, may require replacement due to abrasion wear, corrosion wear or cavitation wear. O-rings and gaskets should always be replaced when rebuilding the pump.

The main factors affecting the physical wear of the pump are operating speed, differential head, 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 head, (2) fluid leakage, (3) unusual noise or vibrations and (4) increased power consumption.

Before performing maintenance on the pump, review the safety precautions and follow the included instructions.

1.7 Replacement Parts

Replacement parts for the pumps can be purchased from your local Liquiflo distributor. Refer to **Appendices 3 & 4** for individual parts information.

1.8 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 a long-coupled pump without the coupling guard installed
- **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.** Centrifugal pumps cannot be used in a suction lift arrangement unless the pump is primed before starting. Many issues can be avoided with a flooded suction arrangement.

2) For Close-Coupled Centry pumps, no alignment procedure between the pump and motor is required.

3) For Long-Coupled Pumps utilizing the **Power Frame** or **S-Adapter**, manual alignment of the motor and power frame shafts or the motor and S-adapter shafts, respectively, is required. (See **Appendix 4** for diagrams of pump mounting options and **Sections 3.11** and **3.12** for more information about these ancillary options.)

   NOTE: If the pump was delivered as a complete long-coupled assembly, it was properly aligned at the factory. However, alignment should be checked after installation to ensure that the pump and motor are still aligned. Alignment can be checked by measurements at the coupling. Flexible couplings are not intended to compensate for severe misalignment. Therefore, both angularity and parallelism should be checked. If these are off by more than 0.015", the assembly should be realigned.

> ***Caution!***
> *After performing alignment procedure, ensure that the Coupling Guard is replaced before operating pump. Do not wear loose clothing around rotating objects.*

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.

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) 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.

4) **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.

5) **Suction piping should be designed to minimize friction losses.** The length of the suction line should be as short as possible with no sharp turns or bends. Any elbows used should be long radius. There should be a minimum of five pipe diameters of straight pipe between the elbow and the suction inlet. Reducers, if used, should be eccentric at the pump suction port.

6) The **suction pipe** must be submerged sufficiently below the liquid surface to prevent vortices and air entrapment at the supply.

7) **Suction Head (Flooded Suction) Arrangement:** Piping should be level or slope gradually downward from the supply source to eliminate air pockets.

8) **Suction Lift Arrangement:** The suction pipe must slope continuously upward towards pump suction to eliminate air pockets. All connections must be air tight. A means of priming the pump must be provided.

9) Gasket materials used with flanged connections must be compatible with the fluid and operating temperature.

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

3.3 Strainers & Solids Handling

1) Centry mag-drive pumps use internal sleeve bearings with very close bearing-shaft clearances and are designed to pump relatively clean fluids. If small abrasive particles are present, they can get in between the shaft and bearings, which will accelerate or increase wear over an extended period of time. Although some solids can be tolerated, **pumping abrasive particles is not suggested with these pumps.**

2) The maximum allowable particle size for Centry mag-drive pumps is 150 microns. **Regardless of particle size, these pumps are intended for relatively clean liquids** where the general concentration of solids is limited to 2% 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 lifetimes.

3) 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.** 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. When a suction strainer is used, it should have a net open area of at least three times the suction pipe area.

3.4 NPSH Requirement

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). The NPSH required by the pump is a function of pump speed and impeller diameter, and is included with the Performance Curves of the pump. NPSH values are typically given in units of **ft H_2O (a)** (feet of water, absolute) or **m H_2O (a)** (meters of water, absolute).

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.

3.5 Flow Requirements

The pump must be operated with a minimum flow rate to prevent overheating of the process fluid. A generally accepted industry practice for minimum flow rate is 15% of the flow rate at the Best Efficiency Point (BEP). Alternatively, the minimum flow rate can be calculated based on the service conditions, power dissipation and the allowable temperature rise of the fluid. Consult the Hydraulic Institute Handbook or Liquiflo Engineering.

Operating the pump at over 90% of the flow rate at runout should be avoided to prevent a system fluctuation from causing the pump to "run off the curve," which can increase the NPSH required by the pump, possibly going above the NPSH available in the system and causing cavitation.

3.6 Controlling the Flow

A centrifugal pump is a kinetic type pump, and **flow is typically controlled by throttling the discharge valve**. The operating point for a centrifugal pump is the intersection of its Head vs. Flow Performance Curve (for a specific impeller diameter) and the System Resistance Curve (which is a function of the flow rate). Increasing the flow area of the valve reduces the system resistance and causes the flow rate to increase (i.e., further opening of the valve moves the operating point to the right on the performance curve). Conversely, decreasing the flow area of the valve increases the system resistance and causes the flow rate to decrease (i.e., further closing of the valve moves the operating point to the left on the performance curve).

3.7 Affinity Laws

The performance of a centrifugal pump at **any operating speed and impeller diameter** can be closely approximated from the performance at a standard motor speed and impeller diameter by using the Affinity Laws:

Affinity Laws for Centrifugal Pumps

$$(1)\ \frac{Q_1}{Q_2} = \frac{n_1 D_1}{n_2 D_2} \qquad (2)\ \frac{H_1}{H_2} = \frac{{n_1}^2 {D_1}^2}{{n_2}^2 {D_2}^2} \qquad (3)\ \frac{P_1}{P_2} = \frac{{n_1}^3 {D_1}^3}{{n_2}^3 {D_2}^3}$$

Where, **Q** = Flow Rate, **H** = Head, **P** = Power, **n** = Speed and **D** = Impeller Diameter.

3.8 Viscous Fluids

Centry sub-ANSI pumps are generally applied at viscosities under 200 centipoise (cP). For fluid viscosities over 2 cP, a **Viscosity Correction per Standard ANSI/HI 9.6.7** is required to size the pump and motor. For sizing of viscous fluid applications or for more assistance in general selection, contact the local distributor or Liquiflo Engineering.

3.9 Motor Selection

1) For the **Close-Coupled** configuration, the motor frame size is part of the pump model coding and is selected at the time the pump is ordered. The motor frame must have a C-face for compatibility with the pump mounting bracket. Refer to **Position 6** of the pump model code (see Table 6 on page 5).

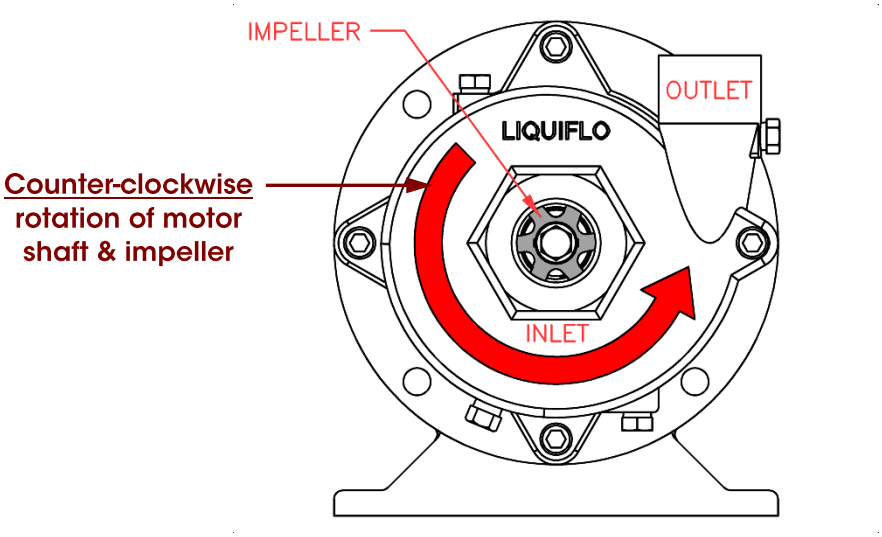
2) For the **Long-Coupled** configuration, the motor is mechanically-coupled to the **Power Frame** or **S-Adapter** ancillary devices. For these cases, any suitable motor frame can be used. However, a Foot-Mount motor is required for mounting to a base (see Long-Coupled diagrams on pages 13 and 14).

3) The motor must have an **enclosure** that is compatible with the application conditions. If an explosion-proof motor is required, the *temperature code* of the motor must be acceptable for the process fluid.

4) The motor speed and power rating are usually determined at the time the pump is ordered to meet the specified conditions of service. For **thin liquids**, the Head vs. Flow Performance Curves can be used directly to determine the speed and brake horsepower (BHP) requirements, as well as the required impeller diameter. For **liquids heavier than water**, the BHP obtained from the Performance Curves must be multiplied by the Specific Gravity of the liquid to determine the BHP required. For **viscous fluids**, a viscosity correction is required (see **Section 3.8**). Additional power is required to overcome the friction losses due to viscosity.

3.10 Motor Shaft Direction

The motor shaft must turn in the direction required by the centrifugal pump. Looking at the pump end, the motor shaft must rotate counter-clockwise (see diagram below).



3.11 Power Frame Option

The Liquiflo Power Frame is an ancillary option that allows the mag-drive pump to be long-coupled to a motor. The power frame has the following uses and advantages:

1) The power frame allows motor frames that are not compatible with the pump mounting bracket to be coupled to the pump. (For example, motor frames larger than NEMA 145TC or motor frames without a C-face can be used.)

2) The power frame enables the motor to be isolated from the pump simply by removing the flexible coupling. (This is convenient for removing or replacing the motor, or when performing maintenance.)

3) The power frame thermally isolates the pump from the motor. (The power frame has an integral cooling jacket that keeps its bearing system cool even when the pump is operating at maximum temperature.)

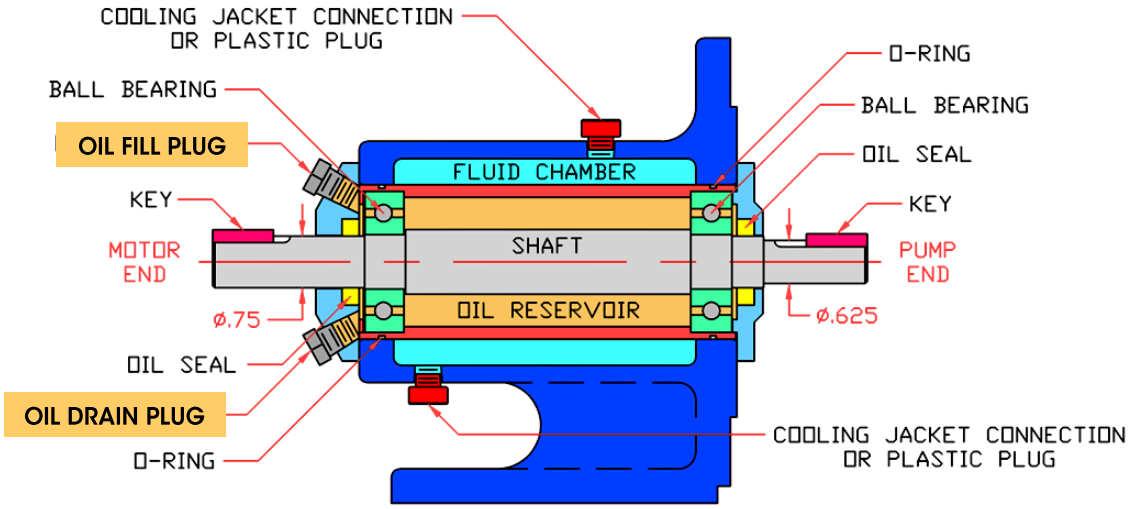
The power frame is shown in detail at the top of page 13. The key components of the power frame are described below:

Bearings: Ball bearings on opposite ends of the frame are used to support the shaft. The *oil reservoir* is used to lubricate the ball bearings. This reservoir is accessible by removing the two 1/8" NPT plugs on the end of the casing.

Cooling Jacket: The power frame's *integral cooling jacket* is used to keep the bearing system cool when the pump is operating at elevated temperatures. This is accomplished by circulating a *heat transfer fluid* thru the jacket. The cooling loop must be connected to the 1/8" NPT ports on the top and bottom of the casing. (Note: The ports come with red plastic plugs installed. These plugs should not be removed unless a cooling loop is used.)

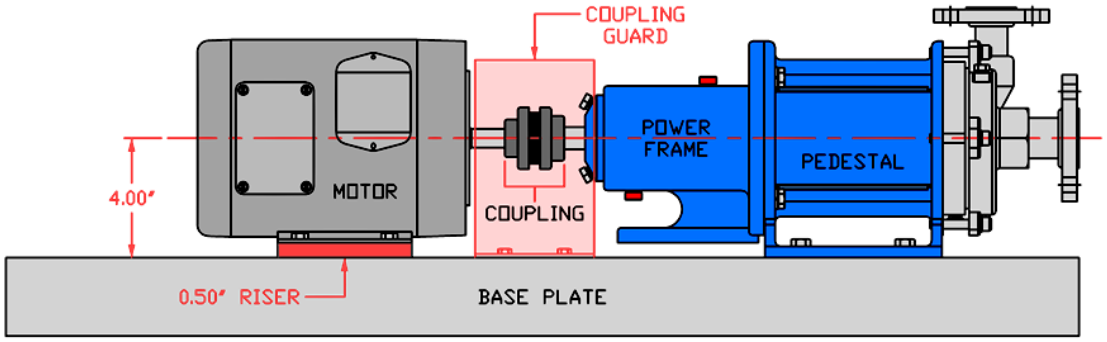
Shaft: The motor end (or driven end) of the shaft has a 3/4" diameter. The pump end (or driver end) has a 5/8" diameter. (Note: Additional dimensional data for the power frame is given in **Appendix 4**.)

Power Frame Cross-Sectional View:



A typical long-coupled mounting of the pump and motor, using the **power frame** option, is shown below:

Long-Coupled Mounting with NEMA 56 thru 145T or NEMA 56C thru 145TC Motor Frames



Power Frame Maintenance:

The power frame is delivered from the factory with its oil reservoir empty. Before operating the power frame, fill the reservoir with **4 fluid ounces of #20 wt., non-detergent type oil**.

The oil in the reservoir should be replaced periodically, with use. To replace the oil: (1) Remove the fill and drain plugs and collect the used oil in a container, (2) Replace the drain plug, (3) Fill the reservoir with **4 fluid ounces** of clean oil, and (4) Replace the fill plug. (For more information, see the Liquiflo website for the power frame service manual.)

Caution!
Do not operate the Power Frame without oil in the reservoir. Before performing maintenance, ensure that the power to the motor is turned OFF and locked out. Do not overfill the reservoir.

3.12 S-Adapter Option

The Liquiflo S-Adapter is another ancillary option used for long-coupling the mag-drive pump to a motor. The S-adapter is typically applied in the following situations:

1) When only a standard motor (without a C-Face) is available.

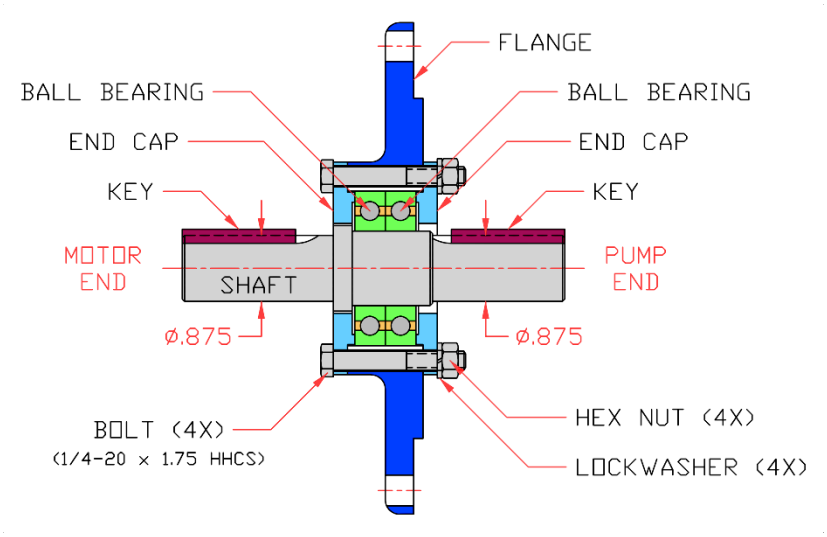
2) When a C-Face motor is available, but not compatible with the pump's mounting bracket.

3) When it is desirable to physically isolate the pump from the motor.

The maximum temperature rating of the S-adapter is 250°F. For higher temperatures, the power frame should be used (see **Section 3.4**).

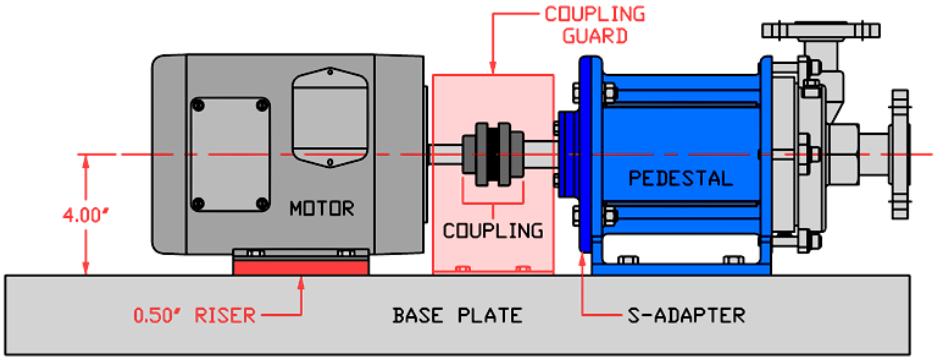
The S-adapter is shown in detail at right:

The S-adapter shaft has a 7/8" diameter on both sides and is supported by two ball bearings. (Note: Additional dimensional data for the S-adapter is given in **Appendix 4**.)



A typical long-coupled mounting of the pump and motor, using the **S-adapter**, is shown below:

Long-Coupled Mounting with NEMA 56 thru 145T or NEMA 56C thru 145TC Motor Frames



S-Adapter Maintenance:

The S-adapter bearings are sealed and greased-for-life and therefore do not require periodic lubrication. However, if the bearings are worn, they should be replaced. (See Liquiflo website for service manual.)

Caution!
Before performing maintenance, ensure that the power to the motor is turned OFF and locked out.

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) A **power sensor** should be installed to stop the motor in the event of a loss-of-load or overload condition.

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

NOTE: Suction valves must be open to supply the pump with fluid. Fully closing a discharge valve when the pump is operating will cause circulation of fluid inside the pump's volute. Operating the pump continuously in this state will cause significant heating of the fluid.

4) **Long-Coupled Pumps:** Pumps using the Power Frame or S-Adapter should be checked for proper alignment (see **Section 3.1**). Ensure that the Coupling Guard is installed to the base.

> ***Caution!***
> *Do not operate a long-coupled pump without the coupling guard properly installed to the base plate. Do not wear loose clothing around rotating objects.*

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

NOTE: For a flooded suction, allow the fluid time to enter the pump before starting. For a suction lift, a method of priming the pump must be available to prevent dry-running. Prolonged dry running will cause rapid wear and damage to the bearings and shaft 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**.

6) Jog the motor to check the direction of rotation. Motor shaft direction must be counter-clockwise as seen from the suction end of the pump. (See **Section 3.10** on page 12.)

> ***Caution!***
> *Always prime the pump before operating. Do not run the pump dry for more than 30 seconds or damage to internal components may result.*

4.2 Operation & Troubleshooting

A normally operating centrifugal pump will deliver a steady and pulse-less flow, be relatively quiet and have a predictable flow rate based on the impeller size, operating speed and differential head across the pump. Refer to the performance curves for Centry Model 621 or 622, which are available on the Liquiflo website. (Note: If the fluid viscosity is significantly higher than the viscosity of water, a performance correction is required as explained in **Section 3.8**.)

The differential pressure can be measured with calibrated pressure gauges close to the suction and discharge ports. (Note: The true differential pressure must take into account the difference in gauge elevations and the velocity head (dynamic pressure) differential resulting from the increase in fluid velocity thru the centrifugal pump. Pressure is related to Head by the following formula: Pressure [PSI] = (Head [feet] x SG)/2.31, where SG is the Specific Gravity of the fluid.) The flow rate can be measured with a calibrated flowmeter in the discharge line.

After priming and start-up, monitor the pump for several minutes to ensure proper operation. If excessive noise is heard, or product leakage is observed, or performance is not as expected, stop the pump and refer to **Appendix 5** for troubleshooting.

Section 5: Maintenance & Repair

The magnetically-coupled pump has internal bearings, thrust washers and a shaft that require replacement over time due to wear. O-rings and gaskets 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 8).

Caution!
The magnetic couplings used in these pumps contain strong magnets. Observe the safety precautions given in Section 2.2.

5.2 Removal from System

Before servicing, prepare the pump as follows:

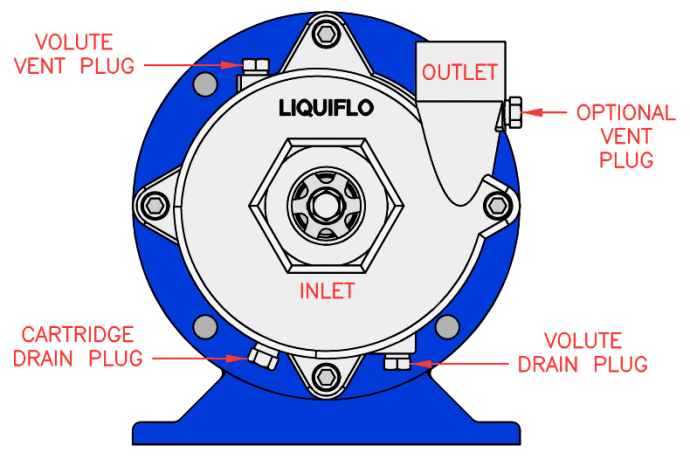
Caution!
If the pump was used on hazardous or toxic fluids, it must be flushed and decontaminated prior to removal from the system piping. Refer to the Material Safety Data Sheet (MSDS) for the liquid and follow all prescribed safety precautions and disposal procedures.

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.

NOTE: The pump has a back pullout design. This feature makes it unnecessary to disconnect the volute from the system piping. The pump can be drained of residual liquid by removing the plugs from the volute and cartridge (see diagram below).

Location of Vent & Drain Plugs:

The pump has three **1/8" NPT plugs** but may contain an additional plug on the outlet port (see diagram at right).



5.3 PUMP DISASSEMBLY

Follow the procedure below and refer to the Sectional and Exploded View drawings in **Appendix 4**. Drawing reference numbers are given in parentheses in the following procedure.

> ***Caution!***
> *Be certain that the power to the motor is turned OFF and locked out.*

1 Remove the four sets of volute mounting bolts (6) and lockwashers (7); then separate the volute (2) from the assembly.

NOTE: The pump has a back pullout design. This feature makes it unnecessary to disconnect the volute from the system piping.

2 Remove the thrust washer (18) and pin (19) from the volute (2).

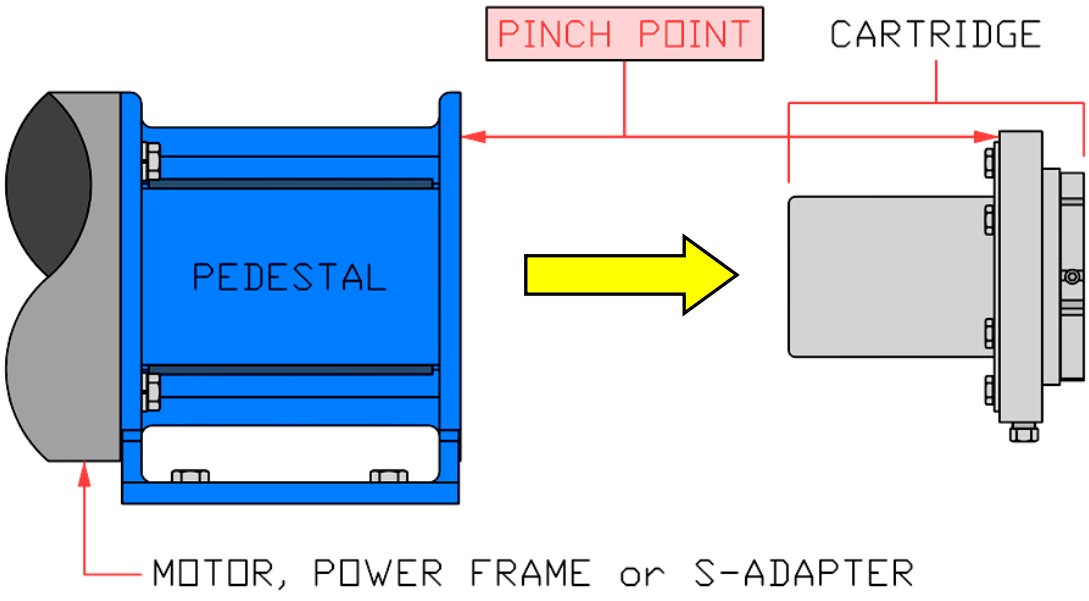
3 Remove the volute O-ring or gasket (5) and discard.

Cartridge Removal:

4 Remove the pump cartridge from the pedestal (16) by pulling the cartridge straight out.

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

> ***Caution!***
> *Do not place hands or fingers between the Pedestal and Cartridge.*



Cartridge Disassembly:

5

a. Remove the six containment can bolts (13); then separate the containment can (12) from the front bearing holder (3).

b. Remove the containment can O-ring or gasket (14) and discard.

c. Remove the impeller setscrew (8); then separate the impeller (1) from the shaft (4).

d. Remove the thrust washer (18) and pin (19) from the front bearing holder (3).

e. Remove the shaft & inner magnet assembly (4 & 20) from the front bearing holder (3).

f. Loosen the setscrew (9) and then remove the inner magnet (20) from the shaft (4).

NOTE: Place the inner magnet in a safe location away from tools and metal parts.

Removal of Bearings:

6 Carefully remove the bearings (17) from the front bearing holder (3) and containment can (12).

NOTE: Removal is generally accomplished by destroying the bearings. The bearings may be pulled out using a hooked tool on the inside bottom surface of the bearing. Teflon bearings can be extracted using a tap that is slightly larger than the inner diameter of the bearing.

Caution!
Be careful not to damage the bearing bores when removing the bearings.

Removal of Outer Magnet:

The outer magnet may be attached to the shaft of the motor, power frame or S-adapter. If necessary, remove the outer magnet as follows:

7

a. Remove the four bolts (10) from the pedestal (16) and then pull out the motor, power frame or S-adapter, which contains the outer magnet (21).

b. Loosen the two setscrews (22) on the hub of the outer magnet (21).

c. Remove the outer magnet (21) from the driver shaft.

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

END OF DISASSEMBLY PROCEDURE

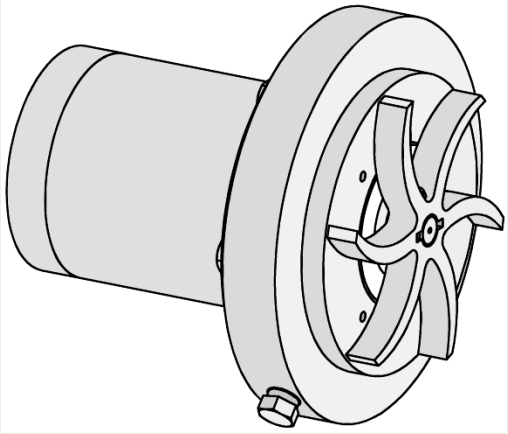
5.4 PUMP ASSEMBLY

Follow the procedure below and refer to the Sectional and Exploded View drawings in **Appendix 4**. Drawing item numbers are given in parentheses in the following procedure.

Part A: Cartridge Assembly:

The **Cartridge** for the 620-MC pump is a complete mag-drive pump less the volute, outer magnet and pedestal. A cartridge replacement is a convenient way to quickly replace a pump that requires maintenance. Pump cartridges are available from the factory and are designated by placing a **C** in front of the pump model number.

Example:
Pump Model Number: 620FSEE010D0
Cartridge Model Number: C620FSEE010D0



1 Remove any burrs on the shaft (4) and bearing bores, by polishing.

NOTE: This step is important to ensure the proper fits of parts. The bearing bores are located inside the front bearing holder (3) and inside the containment can (12).

Installation of Bearings:

2 **a.** Insert the front bearing (17) into the bearing bore of the front bearing holder (3).

b. Insert the rear bearing (17) into the bearing bore inside the containment can (12).

NOTE: A light press fit may be required to insert the bearings.

Inner Magnet Installation:

The inner magnet is positioned automatically by means of a setscrew bore on the pump shaft.

3 **a.** Place the inner magnet (20) on the shaft (4) with orientation as shown in the reference drawings on pages 28-29.

b. Align the setscrew (9) with the bore on the shaft (4).

c. Tighten the setscrew (9) to lock the inner magnet (20) on the shaft (4).

4 Insert the magnet end of the shaft (4) into the bearing (17) inside the containment can (12).

NOTE: Place the containment can in a vertical orientation with the flange facing up. The end of the shaft with the step and setscrew bore should be protruding out of the can.

5 Install the drain plug (15) into the front bearing holder (3).

NOTE: Apply Teflon tape or anti-seize compound to the plug threads to prevent leakage and galling.

---

6 Install the O-ring or gasket (14) inside the groove on the front bearing holder (3).

Caution!
Do not reuse O-rings or gaskets.

---

7 Place the front bearing holder (3) in position on the flange of the containment can (12).

---

8 Install the pin (19) and thrust washer (18) onto the front bearing holder (3).

Impeller Installation:

9 Place the impeller (1) in position on the end of the shaft (4); then tighten the impeller setscrew (8) into the bore on the shaft. Turn the impeller by hand to ensure free rotation.

---

10 Attach the containment can (12) to the front bearing holder (3) using six bolts (13). This completes the **cartridge** assembly.

NOTE: Apply anti-seize compound to the bolts. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the 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.

Part B: Outer Magnet-Driver Assembly:

The axial positioning of the outer magnet on the driver shaft is critical to pump performance. Refer to the diagrams on page 21 when positioning the outer magnet. (Note: The driver can be the motor, power frame or S-adapter.)

11

a. Insert key into the keyway on the driver shaft.

b. Apply a small amount of anti-seize compound to the driver shaft.

c. Align the keyway of the outer magnet's hub with the key on the driver shaft.

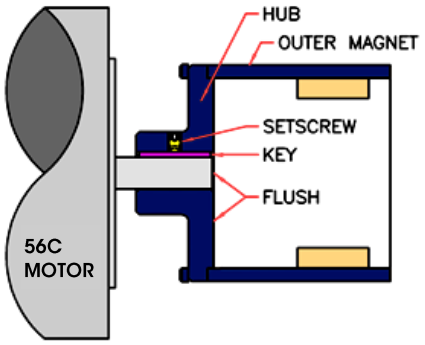
d. Slide the outer magnet (21) onto the driver shaft and position the hub as shown on page 21.

e. Tighten the two setscrews (22) on the hub.

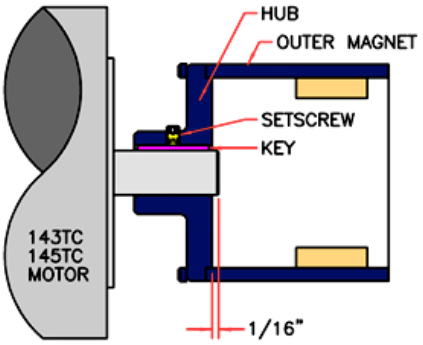
Outer Magnet Positioning Diagrams:

The positioning of the outer magnet on the driver shaft is dependent on the driver used with the pump. The standard cases are described below:

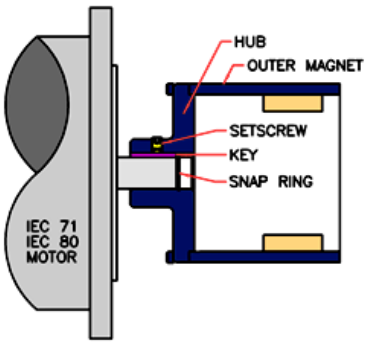
1. NEMA 56C Motor Frame:
The end of the motor shaft must be flush with the inner surface of the outer magnet's hub.



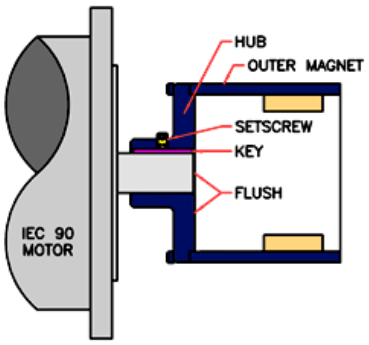
2. NEMA 143TC & 145TC Motor Frames:
The motor shaft must protrude past the inner surface of the outer magnet's hub by 1/16 in.



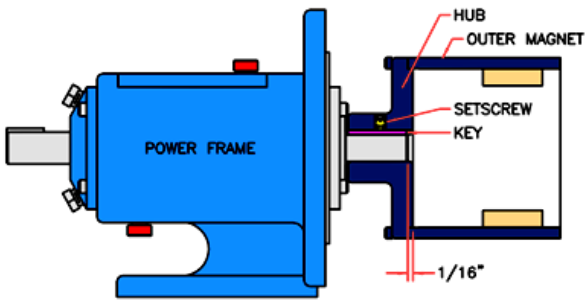
3. IEC 71 & 80 (B5 Flange) Motor Frames:
The end of the motor shaft must contact the snap ring installed in the outer magnet's hub.



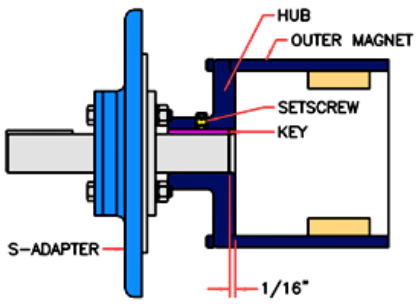
4. IEC 90 (B5 Flange) Motor Frame:
The end of the motor shaft must be flush with the inner surface of the outer magnet's hub.



5. Power Frame: The inner surface of the outer magnet's hub must extend past the end of the power frame's shaft by 1/16 in.



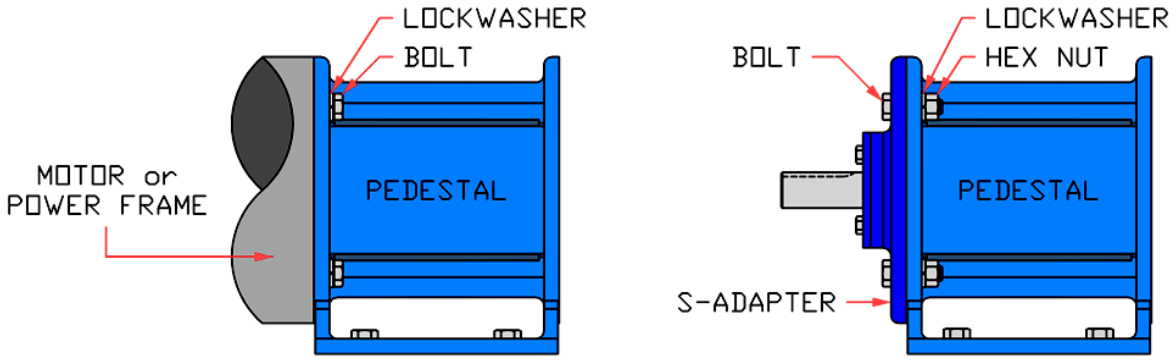
6. S-Adapter: The inner surface of the outer magnet's hub must extend past the end of the S-Adapter's shaft by 1/16 in.



Part C: Driver-Pedestal Assembly:

12 Install the driver (with outer magnet) to the pedestal (16) using four sets of bolts (10) and lockwashers (11).

NOTE: The S-adapter uses four slightly longer bolts with hex nuts and lock-washers (see diagram below). Refer to **Appendix 1** for the lengths and torque specifications of the bolts.



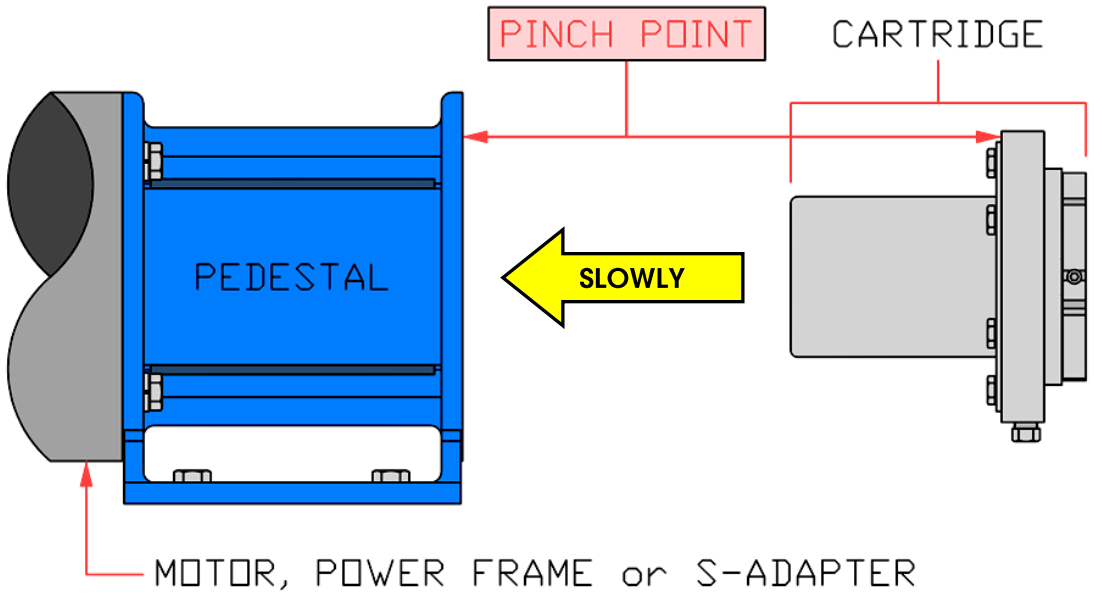
Part D: Cartridge Installation:

13

Caution!
Do not place hands or fingers between the Pedestal and Cartridge. The Outer and Inner Magnets will suddenly pull together with significant force.

Carefully install the cartridge into the pedestal (16), as shown below.

NOTE: Be certain that the cartridge is properly seated into the counter-bore of the pedestal. The face of the front bearing holder will mount flush with the face of the pedestal. When the cartridge is in position, turn the impeller by hand; the outer magnet should rotate synchronously with the impeller.



Part E: Volute-Pedestal Assembly:

14 Orient the cartridge drain plug (15) as shown in the photo below.

---

15 Install the O-ring or gasket (5) on the front bearing holder (3) of the cartridge.

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

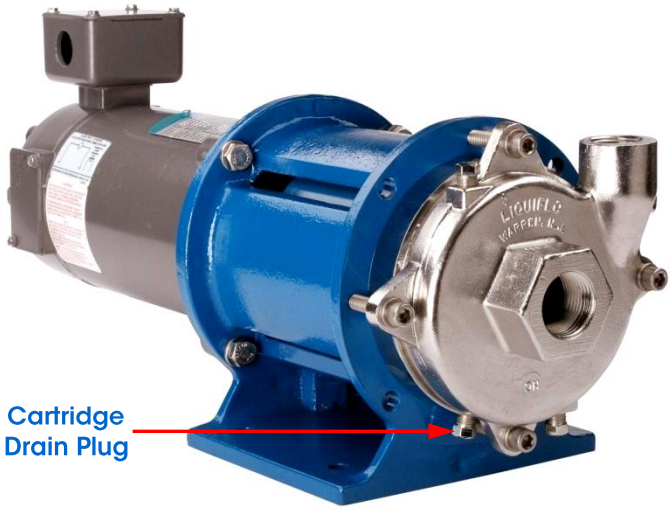
---

16 Install the pin (19) and thrust washer (18) on the inside of the volute (2).

---

17 Install the volute (2) to the cartridge and pedestal (16) using the four mounting bolts (6) with lock-washers (7).

NOTE: Apply anti-seize compound to the bolts. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the 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.



Model 620-MC Pump shown with NPT Ports & Close-Coupled to Motor

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END OF ASSEMBLY PROCEDURE

Appendix 1: Fastener Torque Specifications

Maximum Torque Values for 18-8 Stainless Steel Bolts

Function	Model Code Position 6	Bolt Size	Bolt Type	Quantity (per Pump)	Max Torque Specifications	
					(in-lb)	(N-m)
Volute - Pedestal Assembly	0 - 4	5/16-18 UNC x 1-3/4	SHCS	3	132	14.9
		5/16-18 UNC x 2-1/4	SHCS	1		
Containment Can - Bearing Holder Assembly	0 - 4	1/4-28 UNF x 1/2	HHCS	6	94.0	10.6
BOLTS for MOTOR-PEDESTAL ASSEMBLY:						
Motor(1) - Pedestal Assembly	0, 1	3/8-16 UNC x 1	HHCS	4	236	26.7
Motor(2) - Pedestal Assembly	2	3/8-16 UNC x 1-1/2	SHCS	4	236	26.7
Motor(3) - Pedestal Assembly	3, 4	M10 x 40 mm	SHCS	4	327	37.0
BOLTS for POWER FRAME or S-ADAPTER to PEDESTAL ASSEMBLY:						
Power Frame(4) - Pedestal Assembly	0	3/8-16 UNC x 1	HHCS	4	236	26.7
S-Adapter(5) - Pedestal Assembly	1	3/8-16 UNC x 1-1/4	HHCS	4	236	26.7

1 NEMA 56C, 143TC & 145TC motor frames
2 IEC 71 (B5) motor frame
3 IEC 80 & 90 (B5) motor frames
4 Pump with Power Frame option requires Pos. 6 Code = **0** so Outer Magnet bore of 5/8" will fit Power Frame shaft.
5 Pump with S-Adapter option requires Pos. 6 Code = **1** so Outer Magnet bore of 7/8" will fit S-Adapter shaft.

HHCS = Hex 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	**Allen Wrench, 1/4" Hex**	For volute mounting bolts.	
2	**Allen Wrench, 1/8" Hex**	For impeller setscrew, inner magnet setscrew and outer magnet setscrews.	
3	**Wrench, 7/16"**	For containment can bolts and 1/8" NPT plugs.	
4	**Wrench, 9/16"**	For NMEA 56C-145TC motor, power frame or S-adapter mounting bolts.	
5	**Allen Wrench, 5/16" Hex**	For IEC 71 motor mounting bolts.	
6	**Allen Wrench, 8 mm Hex**	For IEC 80 & 90 motor mounting bolts.	

Appendix 3: Pump Bill of Materials (BOM)

BOM for Model 620-MC – Part 1

Drwg. Ref. #	Part Description		316 SS Pump		Alloy-C Pump		Qty.
			Part #	Material	Part #	Material	
1	Impeller	3.75" Dia. (Full Size)	620301	316 SS	620302	Alloy-C	1
		3.50" Dia. (Reduced Size)	620305	316 SS	620309	Alloy-C	
		3.25" Dia. (Reduced Size)	620306	316 SS	620310	Alloy-C	
		3.00" Dia. (Reduced Size)	620307	316 SS	620311	Alloy-C	
		2.75" Dia. (Reduced Size)	620308	316 SS	620312	Alloy-C	
2	Volute	Threaded (NPT)	620003	316 SS	620002	Alloy-C	1
		Flanged (ANSI 150# RF)	620005	316 SS	620006	Alloy-C	
3	Front Bearing Holder		S620020	316 SS	S620021	Alloy-C	1
4	**Shaft ***	Chrome Oxide Coated	S620401-CO	316 SS/CO	S620402-CO	Alloy-C/CO	1
		Tungsten Carbide Coated	S620401-TC	316 SS/TC	S620402-TC	Alloy-C/TC	
5	**O-ring/Gasket, * Volute**	Gasket	620601	Teflon	620601	Teflon	1
		O-ring, (2-154)	620621	Viton	620621	Viton	
		Gasket	620603	Graphoil	620603	Graphoil	
6	Bolt, Volute	5/16-18 x 1-3/4 SHCS	621101	18-8 SS	621101	18-8 SS	3
		5/16-18 x 2-1/4 SHCS	621102	18-8 SS	621102	18-8 SS	1
7	Lock-washer, Volute (5/16)		3126341	18-8 SS	3126341	18-8 SS	4
8	Setscrew, Impeller (1/4-28 x 3/8 SHSS-HD)		S620000	316 SS/ Teflon	S620001	Alloy-C/ Teflon	1
9	Setscrew, Inner Magnet (1/4-28 x 3/8 SHSS-HD) [1]		S620000	316 SS/ Teflon	S620001	Alloy-C/ Teflon	1
10	Bolt, Motor/PF (3/8-16 x 1 HHCS) [2]		620825	18-8 SS	620825	18-8 SS	4
11	Lock-washer, Motor/PF (3/8) [2]		S1004	18-8 SS	S1004	18-8 SS	4
12	Containment Can		S620010	316 SS	S620011	Alloy-C	1
13	Bolt, Cont. Can (1/4-28 x 1/2 HHCS)		S620012	18-8 SS	S620012	18-8 SS	6
14	**O-ring/Gasket, * Containment Can**	O-ring (2-042)	S4000	Teflon	S4000	Teflon	1
		O-ring (2-042)	S4002	Viton	S4002	Viton	
		Gasket	S4005	Graphoil	S4005	Graphoil	
15	Plug, 1/8" NPT [3]		362304	316 SS	362301	Alloy-C	3
16	Pedestal	NEMA 56C thru 145TC	SP000	CI/Epoxy	SP000	CI/Epoxy	1
		IEC 71 - B5 Flange	SP001	CI/Epoxy	SP001	CI/Epoxy	
		IEC 80/90 - B5 Flange	SP002	CI/Epoxy	SP002	CI/Epoxy	
17	**Bearing ***		S620032	Carbon	S620032	Carbon	2
			S620025	Teflon	S620025	Teflon	
			S620029	SiC	S620029	SiC	
18	**Thrust Washer ***		S620723	Carbon	S620723	Carbon	2
			S620720	Teflon	S620720	Teflon	
19	Pin, Thrust Washer		360801	316 SS	360804	Alloy-C	2

* Primary repair components.

1 Setscrew included with magnet assembly. **2** For NEMA motor frames or Power Frame. See page 24 for IEC motor bolts.

3 The front bearing holder has one plug. The volute has at least two plugs but may contain an optional third plug on the outlet port (see pages 16 & 29).

Appendix 3: Pump Bill of Materials (BOM) (Continued)

BOM for Model 620-MC – Part 2

Drwg. Ref. #	Part Description		316 SS Pump		Alloy-C Pump		Qty.
			Part #	Material	Part #	Material	
20	Inner Magnet	MCD (33 in-lbs) – 1/2" Bore	SIMCD-04	316 SS/ Ceramic	SIMCD-14	Alloy-C/ Ceramic	1
		MCE (120 in-lbs) – 1/2" Bore	SIMCE-04	316 SS/ SmCo	SIMCE-14	Alloy-C/ SmCo	
21	Outer Magnet – MCD (33 in-lbs)	5/8" Bore (NEMA 56C)	SOMCD-5	CS/ Ceramic	SOMCD-5	CS/ Ceramic	1
		7/8" Bore (NEMA 143/145TC)	SOMCD-7	CS/ Ceramic	SOMCD-7	CS/ Ceramic	
		14 mm Bore (IEC 71)	SOMCD-71	CS/ Ceramic	SOMCD-71	CS/ Ceramic	
		19 mm Bore (IEC 80)	SOMCD-80	CS/ Ceramic	SOMCD-80	CS/ Ceramic	
		24 mm Bore (IEC 90)	SOMCD-90	CS/ Ceramic	SOMCD-90	CS/ Ceramic	
	Outer Magnet – MCF (120 in-lbs)	5/8" Bore (NEMA 56C)	SOMCF-5	CS/ SmCo	SOMCF-5	CS/ SmCo	
		7/8" Bore (NEMA 143/145TC)	SOMCF-7	CS/ SmCo	SOMCF-7	CS/ SmCo	
		14 mm Bore (IEC 71)	SOMCF-71	CS/ SmCo	SOMCF-71	CS/ SmCo	
		19 mm Bore (IEC 80)	SOMCF-80	CS/ SmCo	SOMCF-80	CS/ SmCo	
		24 mm Bore (IEC 90)	SOMCF-90	CS/ SmCo	SOMCF-90	CS/ SmCo	
22	Setscrew, Outer Magnet (1/4-28 x 3/8 SHSS-CP) [1]		421104	CS	421104	CS	2

NOTE: MCD Inner Magnet is used with MCD Outer Magnet; MCE Inner Magnet is used with MCF Outer Magnet. Reference numbers correspond to sectional and exploded view drawings in **Appendix 4**.

HIGH-TEMPERTURE PARTS (-8(HT) Suffix)				
17	**Bearing, Trimmed** *	300 to 499 °F	S620032A (Carbon)	2
			S620029A (SiC)	
		500 °F	S620032B (Carbon)	
			S620029B (SiC)	
–	Gasket, Insulating [4]	300 to 500 °F	371113 (Non-Asbestos 3160)	1

LOW-TEMPERTURE PARTS (-8(LT) Suffix)				
17	**Bearing, Split** *	-100 to 32 °F	S620032-SB (Carbon)	2
–	Gasket, Insulating [4]		371113 (Non-Asbestos 3160)	1
–	Shroud, Pedestal [5]		865080 (304 SS)	1

4 For isolation of Pump and Pedestal.
5 For frost protection of Outer Magnet and Containment Can.

Ancillary Options				
Option #	Part Description	Part #	Material	Qty.
1	**Power Frame**	A-620804	CI/CS/Epoxy	1
2	**S-Adapter**	SADAPT	CS/Epoxy	1
	Bolt, S-Adapter (3/8-16 x 1-1/4 HHCS)	S1000	18-8 SS	4
	Nut, S-Adapter (3/8-16 Hex)	S1003	18-8 SS	4
	Lock-washer, S-Adapter (3/8)	S1004	18-8 SS	4

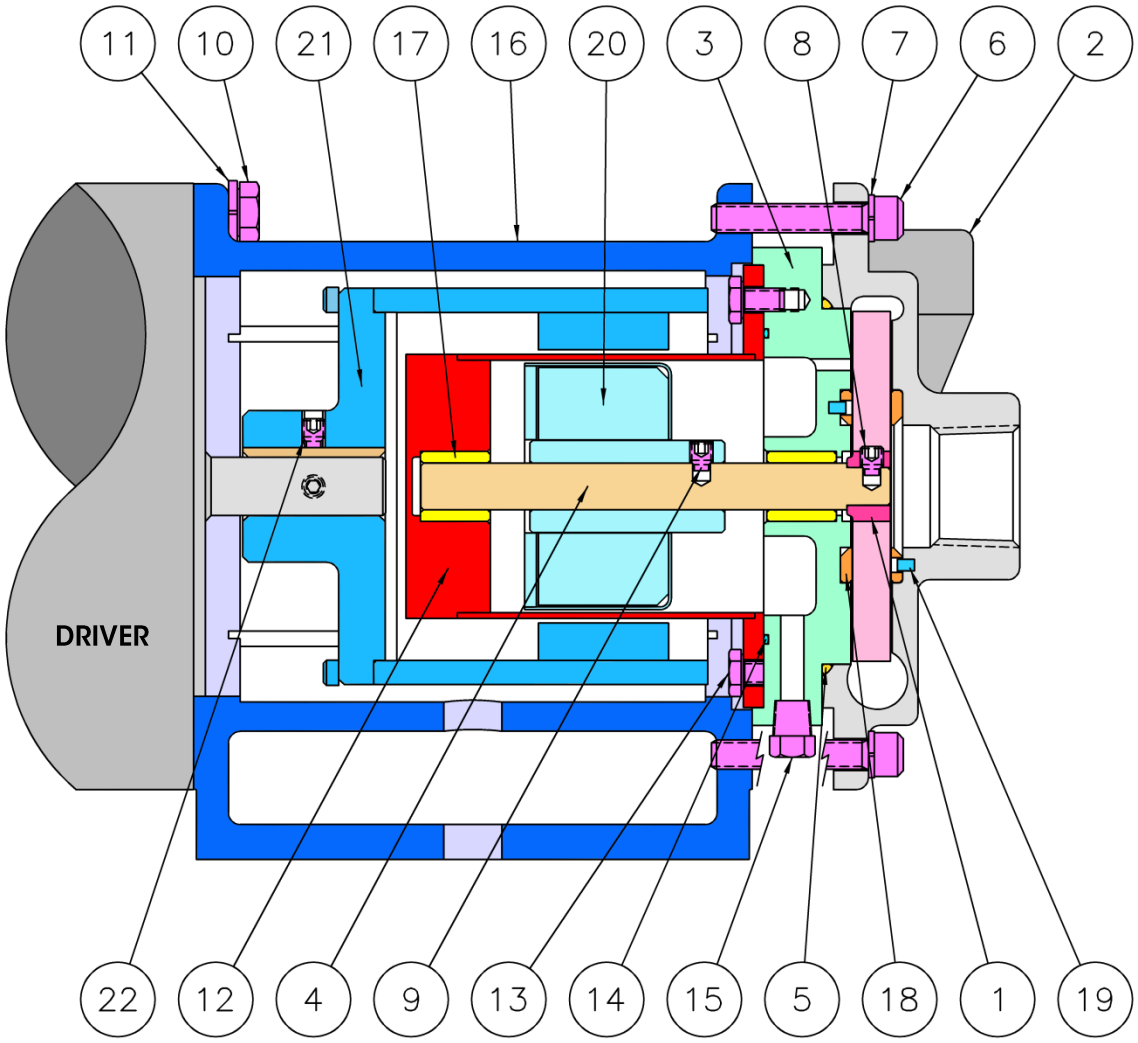
HHCS = Hex Head Cap Screw
SHCS = Socket Head Cap Screw
SHSS-CP = Socket Head Set Screw, Cup Point
SHSS-HD = Socket Head Set Screw, Half Dog

CI = Cast Iron
CS = Carbon Steel
SS = Stainless Steel

PF = Power Frame

Appendix 4: Reference Drawings

Sectional Drawing – Model 620-MC

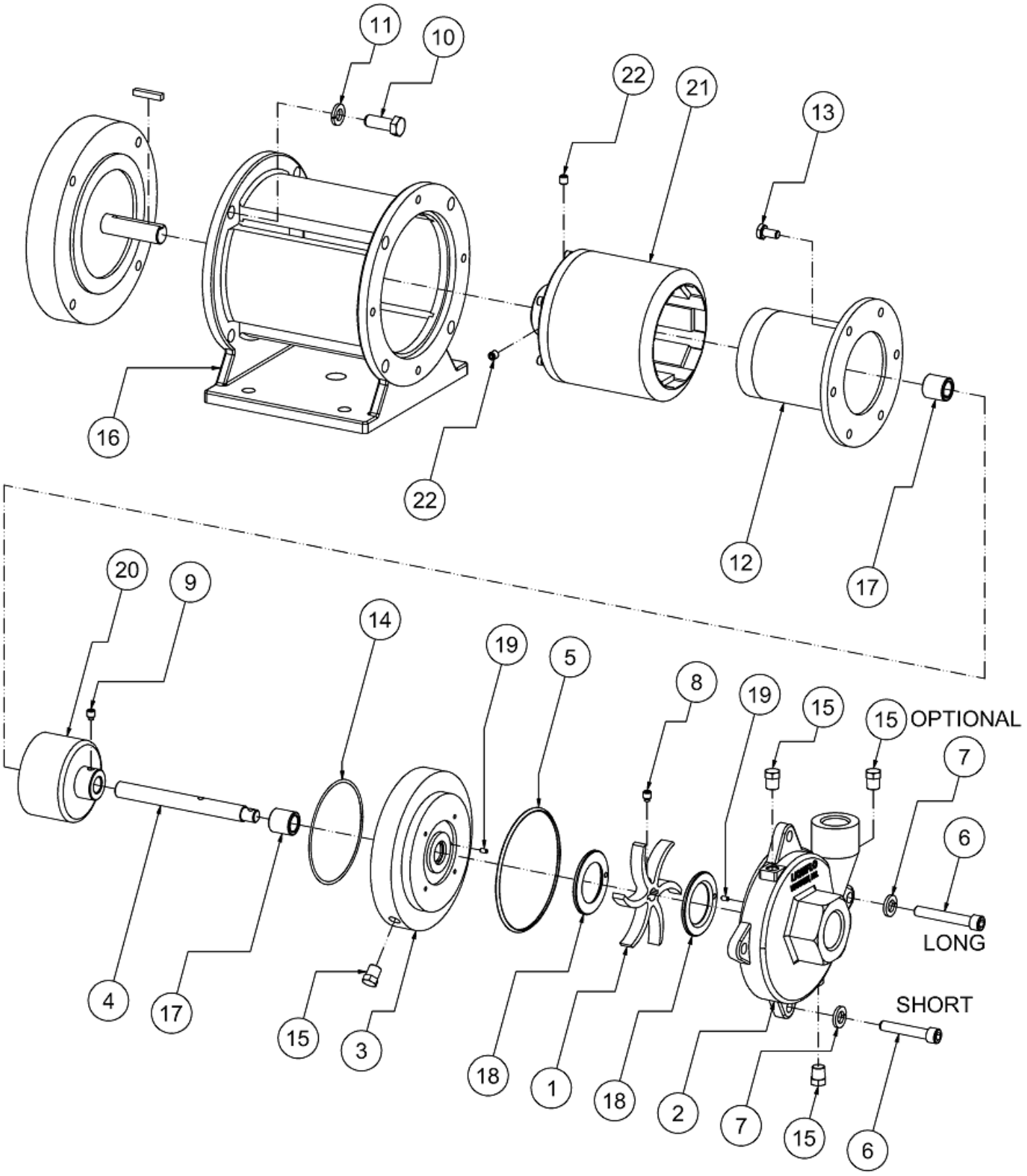


Ref. #	Description		Qty.	Ref. #	Description	Qty.
1	Impeller		1	12	Containment Can	1
2	Volute		1	13	Bolt, C. Can (1/4-28 x 1/2 HHCS)	6
3	Front Bearing Holder		1	14	O-ring/Gasket, Cont. Can	1
4	Shaft		1	15	Plug, 1/8 NPT [3]	3
5	O-ring/Gasket, Volute		1	16	Pedestal (Mounting Bracket)	1
6	Bolt, Volute	5/16-18 x 1-3/4 SHCS	3	17	Bearing	2
		5/16-18 x 2-1/4 SHCS	1	18	Thrust Washer	2
7	Lock-washer, Volute (5/16)		4	19	Pin, Thrust Washer	2
8	Setscrew, Impeller		1	20	Inner Magnet (Assembly)	1
9	Setscrew, Inner Magnet [1]		1	21	Outer Magnet (Assembly)	1
10	Bolt, Driver (3/8-16 x 1 HHCS) [2]		4	22	Setscrew, Outer Magnet [1]	2
11	Lock-washer, Driver (3/8) [2]		4			

1 Setscrews included with magnet assembly. **2** For NEMA motors or Power Frame; see page 27 for S-Adapter hardware.
3 Two volute plugs are not shown. Volute may have an optional third plug on the outlet port (see pages 16 & 29).

Appendix 4: Reference Drawings (Continued)

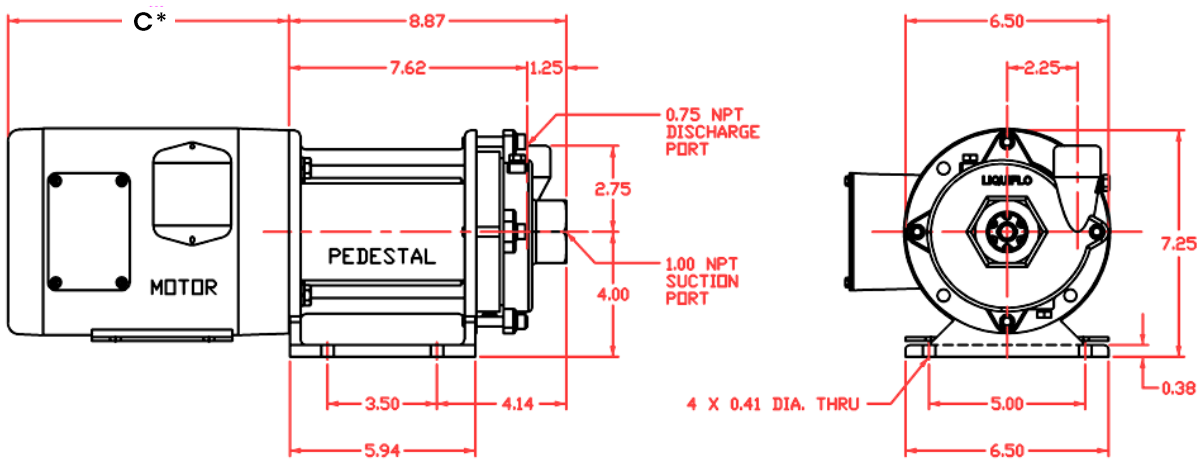
Exploded View Drawing – Model 620-MC



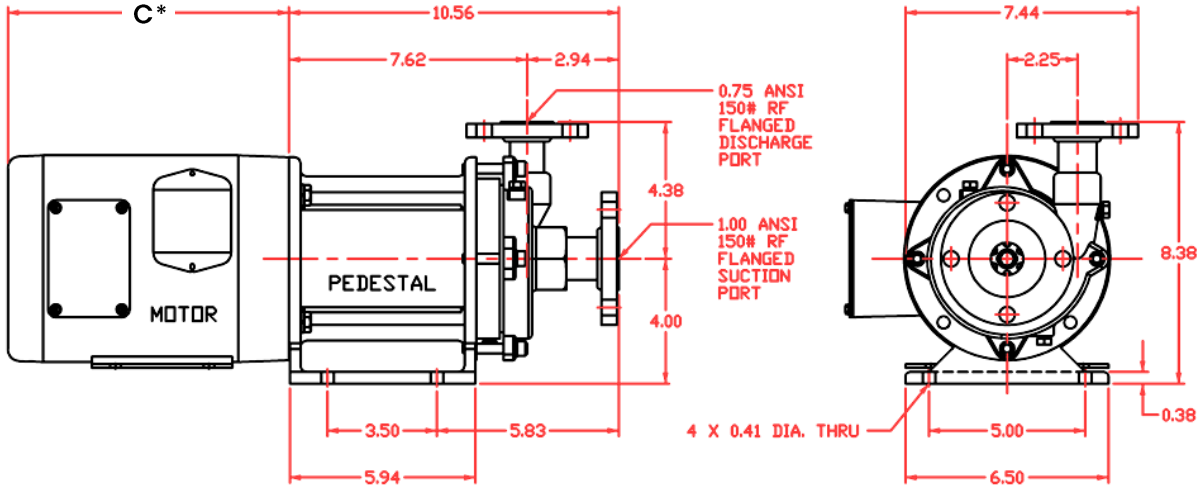
Appendix 4: Reference Drawings (Continued)

Dimensional Drawing #1 – Model 620-MC with Close-Coupled Mounting

MODEL 620-MC with NPT PORTS & CLOSE-COUPLED to MOTOR



MODEL 620-MC with FLANGED PORTS & CLOSE-COUPLED to MOTOR



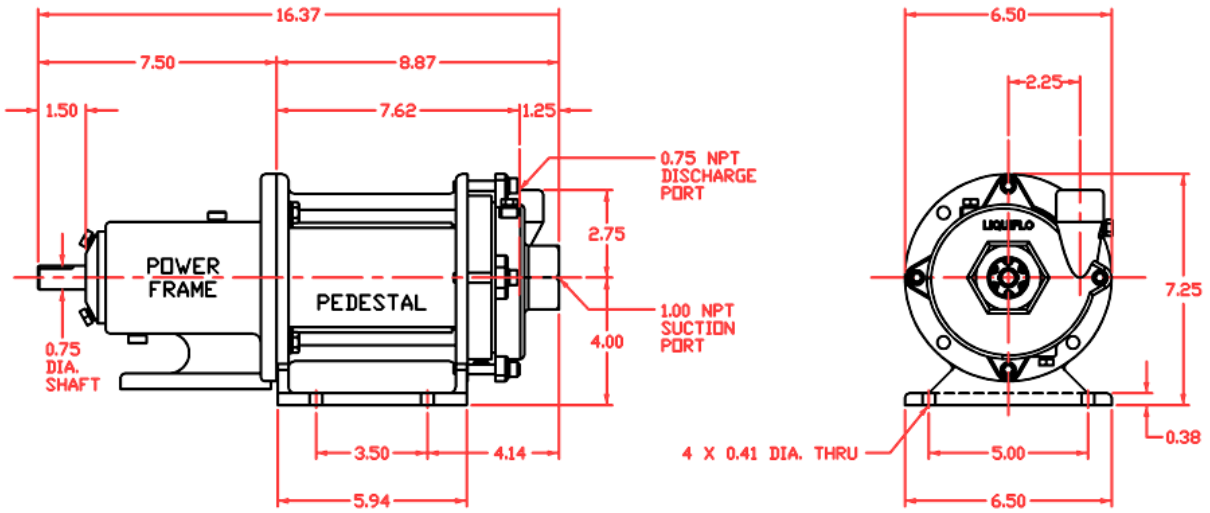
Units: inches

* See dimensional data from motor manufacturer for "**C**" dimension.

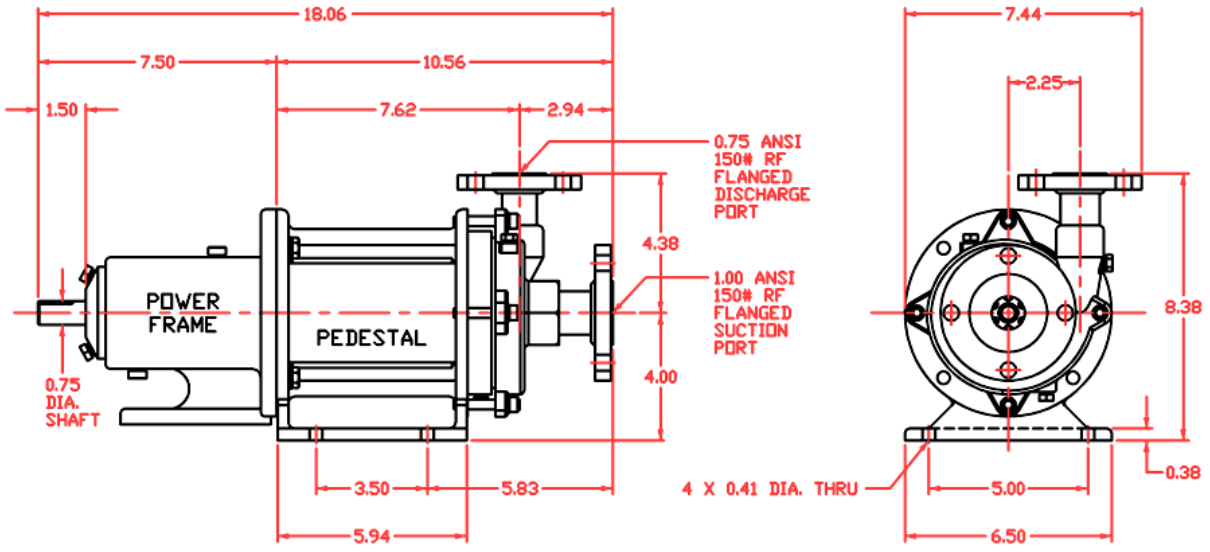
Appendix 4: Reference Drawings (Continued)

Dimensional Drawing #2 – Model 620-MC with Long-Coupled Mounting using Power Frame

MODEL 620-MC with NPT PORTS & POWER FRAME



MODEL 620-MC with FLANGED PORTS & POWER FRAME

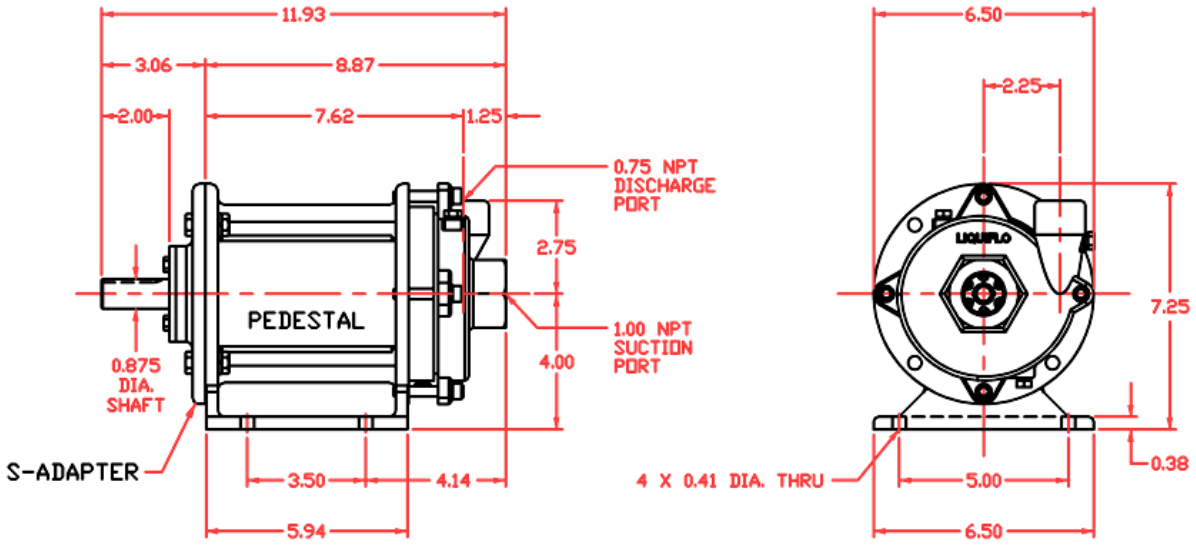


Units: inches

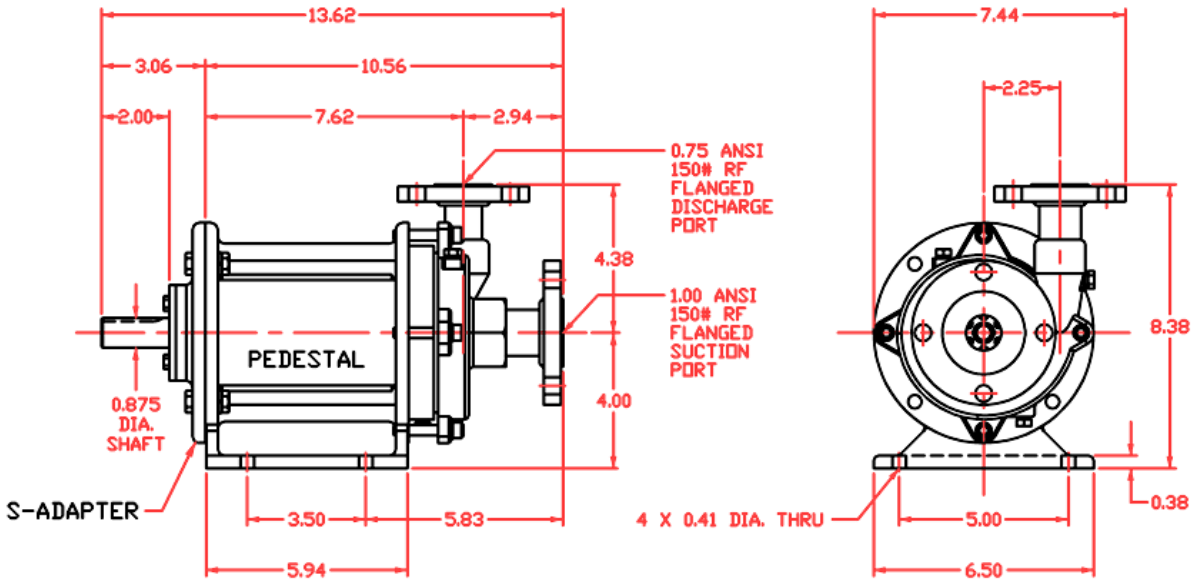
Appendix 4: Reference Drawings (Continued)

Dimensional Drawing #3 – Model 620-MC with Long-Coupled Mounting using S-Adapter

MODEL 620-MC with NPT PORTS & S-ADAPTER



MODEL 620-MC with FLANGED PORTS & S-ADAPTER

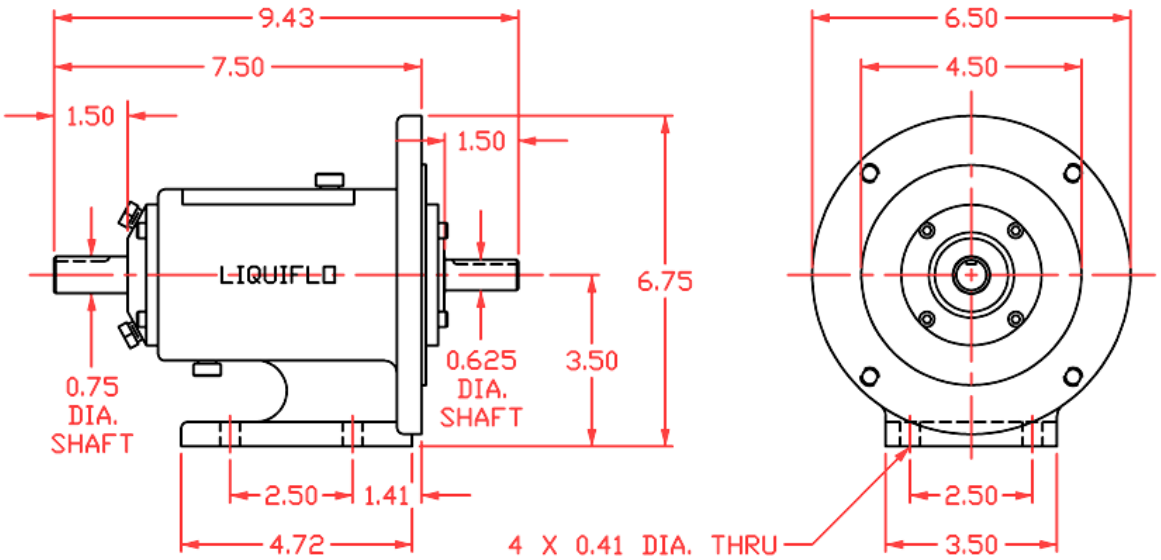


Units: inches

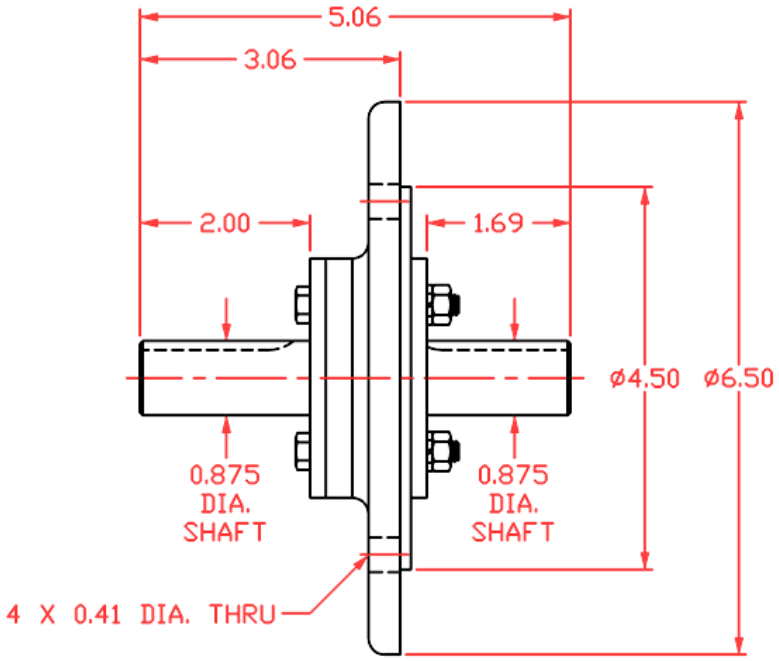
Appendix 4: Reference Drawings (Continued)

Dimensional Drawing #4 – Power Frame & S-Adapter

POWER FRAME



S-ADAPTER



Units: inches

Appendix 5: Troubleshooting Guide

Troubleshooting Guide – Part 1

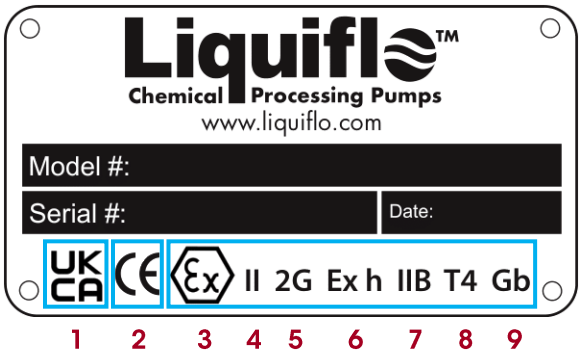
Problem	Possible Cause	Corrective Action
No discharge	Pump not primed	Verify suction pipe is submerged. Increase suction pressure. Open suction valve.
	Wrong direction of rotation	Reverse motor leads.
	Valves closed	Open all suction and discharge valves.
	Bypass valve open	Close bypass valve.
	Air leak in suction line	Tighten connections. Apply sealant to all threads. Verify suction pipe is submerged.
	Clogged strainer	Clean strainer.
	Clogged impeller	Disassemble and remove blockage.
	Impeller greatly worn or damaged	Disassemble and replace impeller.
	Magnetic coupling has decoupled	Stop driver and check temperature and viscosity of fluid. Verify position of outer magnet. Consider stronger magnetic coupling.
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.
	Partly clogged impeller	Disassemble and remove blockage.
	Speed too low	Increase driver speed, if possible. Use larger size pump, if required.
	Impeller worn or damaged	Disassemble and replace impeller.
Loss of suction after satisfactory operation	Pump not properly primed	Reprime pump.
	Air leaks 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.
	Liquid specific gravity higher than expected	Reduce pump speed. Increase driver horsepower.
	Total head greater than specified	Increase pipe diameter. Decrease pipe run.
	Total head lower than specified, pumping higher flow than expected	Install throttle valve.
	Total head higher than rating with flow at rating	Install impeller with correct diameter.
	Rotating parts binding or severely worn	Disassemble and replace worn parts.

Appendix 5: 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.
Excessive noise and vibration	Partly clogged impeller causing imbalance	Disassemble and remove blockage.
	Damaged impeller and/or shaft	Disassemble and replace damaged parts.
	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.
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 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 6: 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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