Liquiflo™
Chemical Processing Pumps

INSTALLATION, OPERATION & MAINTENANCE MANUAL

ENDURA® MC-SERIES

MAGNETICALLY-COUPLED, ANSI-DIMENSIONAL
CENTRIFUGAL PUMPS

Model MC 3 x 2 x 8
with Group I Drive Section

Document No.: 3.02.003

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Introduction

This manual provides instructions for the installation, operation and maintenance of the Liquiflo Endura® MC-Series ANSI-Dimensional & Magnetically-Coupled Centrifugal Pump – **Group II Model MC 3x2x8 with Group I Drive Section**. This is a special configuration which allows this Group II model to be driven by a standard Group I Magnetic Coupling and Motor Frame when the application torque and power requirement are within the capability of the coupling and motor frame at the operating temperature. 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.

If it is desirable to use this product for services other than originally specified, consult Liquiflo or your local Liquiflo distributor.

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 Endura® MC-Series Mag-Drive Centrifugal Pump, **Group II Model MC 3x2x8 with Group I Drive Section**.

1.1 Model Number & Serial Number

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

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 pump is based on a 10-position *Model Coding* system that is described in **Section 1.4**.

1.2 General Instructions

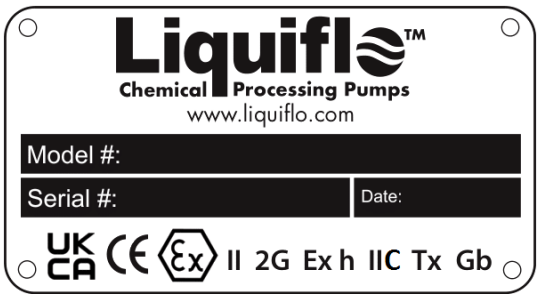
The materials of construction of the pump are selected based upon the chemical compatibility of the fluid being pumped. The user must verify that the materials are suitable for the surrounding atmosphere.

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 below is attached to the pump:



Refer to **Appendix 8** 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		Unit
Pump Size (1)	3 x 2 x 8	**in**
Impeller Type	Closed	—
Port Type	Flanged (ANSI RF 150# or 300#)	—
Mounting Bracket	Close-Coupled, Motor Supported (2)	—
Motor Frame (C-Face)	NEMA 182TC thru 286TC/TSC, IEC 90 thru 160 (2)	—

1 - Suction Port Size x Discharge Port Size x Impeller Diameter
2 - Power Frame option is available for long-coupling pump mounting bracket to other motor frames.

Table 2: Absolute Temperature, Pressure & Speed Ratings

Specification			Unit
Operating Temperature Range	**Std. Temperature**	-20 to 350	**°F**
	Low Temperature	-100 to 100	**°F**
Maximum Operating Pressure		275 (3)	**PSIG**
Maximum Operating Speed		3600	**RPM**

3 - Above 100°F, maximum pressure is linearly de-rated to 205 PSIG at 350°F.

Table 3: Pump Materials

Components		Materials
Pump Body, Shaft & Impeller		316 Stainless Steel or Alloy-C
Containment Can		316 SS, Alloy-C or Zirconia (Ceramic)
Magnetic Coupling	**Magnets**	Neodymium Iron Boron (NdFeB) or Samarium Cobalt (SmCo)
	Casing	Inner Magnet: 316 SS or Alloy-C; Outer Magnet: Carbon Steel
Bearings		Silicon Carbide (pure, self-sintered)
O-Rings/Gaskets		Teflon (PTFE), Kalrez 4079 (Standard Grade) or Graphoil
Mounting Bracket		Epoxy-painted Cast Iron
Mounting Hardware		18-8 Stainless Steel
Adapter Plate(s)		Carbon Steel/Epoxy-painted or Anodized Aluminum
Power Frame		Frame: Cast Iron/Epoxy-painted; Shaft: Carbon Steel

1.4 Model Coding

Model Coding Example: MCN1S2TSA0C

1	2	3	4	5	6	7	8	9	10
MC	N	1	S	2	T	S	A	0	C

Pos. 1: **MC** = Magnetically-Coupled
Pos. 2: **N** = Normal Temperature
Pos. 3: **1** = 3 x 2 x 8 Pump Size (Group 2)
Pos. 4: **S** = 316 SS Construction
Pos. 5: **2** = ANSI 150# Flanges
Pos. 6: **T** = Teflon O-Rings
Pos. 7: **S** = 316 SS Containment Can
Pos. 8: **A** = NdFeB 1" Magnets - Metal Can (Group 1)
Pos. 9: **0** = Close-Coupled
Pos. 10: **C** = NEMA 182/184TC Motor

Table 4: Model Coding for Endura® Model MC 3 x 2 x 8 (Group II) w/ Group 1 Drive

Position	Description	Code	Selection
1	**Pump Model**	**MC**	Magnetically Coupled
2	**Temperature**	**N**	Normal Temperature (-20 to 350 °F)
		L	Low Temperature (-100 to 100 °F)
3	**Size**	**1**	**3 x 2 x 8 (Group II)**
4	**Wet End, Material of Construction**	**S**	316 Stainless Steel
		H	Alloy-C
5	**Casing Flanges**	**2**	ANSI RF 150# (Standard)
		3	ANSI RF 300# (Optional)
6	**O-Rings/Gaskets**	**T**	Teflon
		K	Kalrez 4079
		G	Graphoil
7	**Containment Can**	**S**	Stainless Steel
		H	Alloy-C
		Z	Transformation Toughened Zirconia (TTZ)
8	**Magnetic Coupling (Group I)**	**A**	NdFeB 1" – Metal Can
		B	NdFeB 1.5" – Metal Can
		C	NdFeB 2" – Metal Can
		E	SmCo 1" – Metal Can
		F	SmCo 1.5" – Metal Can
		G	SmCo 2" – Metal Can
		L	NdFeB 1.5" – Ceramic Can
		M	NdFeB 2" – Ceramic Can
		Q	SmCo 1.5" – Ceramic Can
		R	SmCo 2" – Ceramic Can
9	**Coupling Option**	**0**	Close-Coupled (Select Motor Code in Position 10)
		1	Power Frame (Position 10 is Not Applicable)
10	**Motor Frame Size – Group I Drive** (NA if Pos. 9 Code = 1)	**C**	NEMA 182/184TC
		D	NEMA 213/215TC
		E	NEMA 254/256TC
		F	NEMA 284/286TC
		J	NEMA 284/286TSC
		S	IEC 90 (B5)
		T	IEC 100/112 (B5)
		U	IEC 132 (B5)
		V	IEC 160 (B5)

Note: See **Appendix 5** for consolidated Bill of Materials.

1.5 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		
1	**RMA #**	(Supplied by Distributor)
2	**Distributor Name**	
3	**Item(s) Returned**	
4	**Serial Number(s)**	
5	**Reasons for Return**	
6	**Fluid(s) Pumped**	
7	**Time in Service**	

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

Section 2: Safety Precautions

2.1 General Precautions

Caution!
This pump cannot be run dry. Ensure the pump is primed before starting.

- **Never** start the pump without making sure that the pump is primed
- **Never** operate the pump with suction and/or discharge valves closed
- **Never** operate a long-coupled pump without the coupling guard installed
- **Never** use heat to disassemble the pump
- **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
- 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
- When performing maintenance, pay attention to all cautionary statements given in this manual. **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.

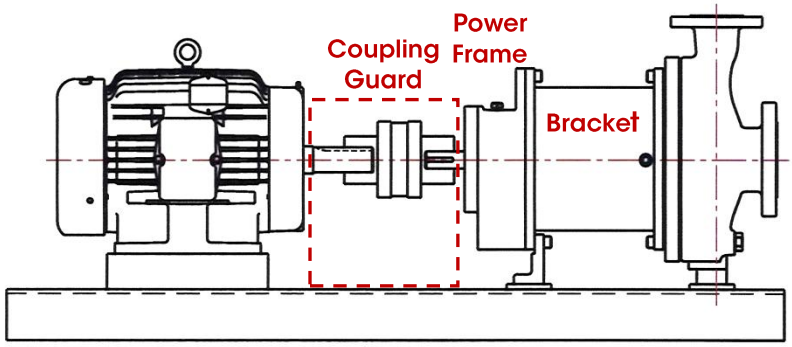
1) **The pump inlet should be as close to the liquid source as practical and preferably below it.** Centrifugal pumps cannot be used in a suction lift arrangement unless the pump is primed before starting. Many issues can be avoided with a flooded suction arrangement.

2) For Long-Coupled Pumps utilizing the Power Frame:

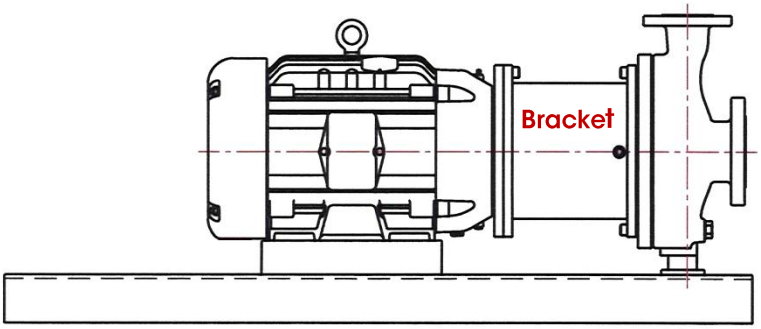
   (a) **The mechanical coupling between the motor and Power Frame has a flexible insert that must be free to move axially** – typically a distance of 1/16 to 1/8 inches – to prevent axial loads from being transmitted to the power frame.

   (b) **The motor and Power Frame shafts must be manually aligned to eliminate radial loads on the pump that will cause vibration and lead to premature pump failure.** Alignment of long-coupled pumps is critical and should be checked by taking measurements of angularity and parallelism at the coupling. If these are off by more than 0.015 inches (0.4 mm), the assembly should be realigned. Flexible couplings are not intended to compensate for severe misalignment. (NOTE: If the pump was delivered as a complete long-coupled assembly, it was properly aligned at the factory.)

   (c) **Install the coupling guard over the mechanical coupling and fasten to the base plate.** (NOTE: If the pump was delivered as a complete long-coupled assembly, the coupling guard was properly installed at the factory.)



3) For Close-Coupled pumps, the mounting bracket also serves as a coupling guard and no alignment procedure between the pump and motor is required.



NOTE: See documents on Liquiflo Website for dimensional specifications.

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.

3.3 Strainers & Solids Handling

1) Endura MC pumps have very close clearances between the rotating and stationary radial sleeve bearings. If small abrasive particles are present, they can get in between the bearings and accelerate wear over an extended period of time. Although some solids can be tolerated, **pumping abrasive particles is not suggested with these pumps.**

2) **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 life.

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 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 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

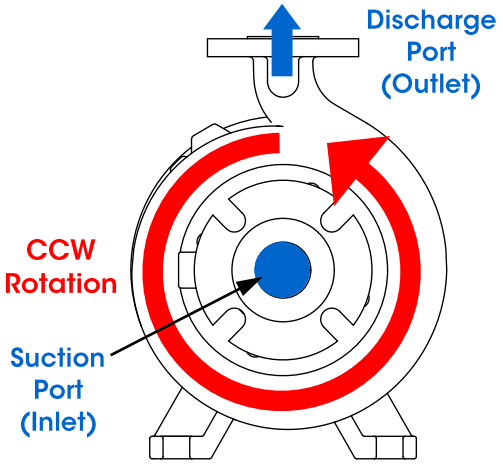
The maximum viscosity for the Endura MC pump is similar to any comparable ANSI pump and is generally applied at less than 200 centipoise (cP). For fluid viscosities over 2 cP, a **Viscosity Correction per Standard ANSI/HI 9.6.7** is required to size the pump and motor. For sizing of viscous fluid applications 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 10** of the pump model code (see Table 4 on page 5 for reference).
2) For the **Long-Coupled** configuration, the motor is mechanically-coupled to the Power Frame ancillary device. In this case, any suitable motor frame can be used.
3) For all configurations of the pump, the motor frame must be equipped with feet for mounting to a base (see diagrams on page 8).
4) 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.
5) 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** above). Additional power is required to overcome the friction losses due to viscosity.
6) For a pump utilizing a **metal containment can**, power losses from eddy currents induced in the can are added to the brake horsepower to determine the required motor power. These power losses are proportional to the square of the speed. Doubling the pump speed will quadruple the power losses. Utilizing a non-conductive ceramic Zirconia containment shell will completely eliminate eddy current losses and significantly increase pump efficiency.

3.10 Motor Shaft Direction

The motor shaft must turn in the direction required by the centrifugal pump. As seen looking at the pump end, the motor shaft direction of rotation must be **counter-clockwise (CCW)**, as shown:



Section 4: Start-Up & Operation

4.1 Starting the Pump

Before operating the pump, inspect the pumping system and verify the following:

1) **Pump Construction:** The materials of construction of the pump must be compatible with the fluid to be pumped.

2) **Pump Mounting:** The pump must be securely fastened to the base and ground using the basic installation procedures as outlined by the Hydraulic Institute.

3) **Alignment:** Pumps that are close-coupled to a motor do not require manual alignment. Those that are long-coupled to a motor, using the power frame option, will require alignment of the motor and power frame shafts.

4) **Piping Layout:** Process piping procedures are extremely important and must be performed in accordance with the Hydraulic Institute. As a minimum, inlet piping must be equal to or larger in diameter than the pump inlet size. Twists and bends of pump inlet piping should be kept to an absolute minimum. Ensure that adequate NPSH is available for the pump to operate properly.

5) **Motor Enclosure:** The motor enclosure must be suitable for the conditions of service.

6) **Electrical Hook-up:** The electrical connections to the motor should be performed by a qualified electrician. It is critical that the supply voltage match the motor nameplate voltage or serious motor damage or fire can result.

7) **Safety:** Never operate a long-coupled pump without the coupling guard installed. A power sensor should be installed to stop the motor in the event of a loss-of-load or overload condition.

8) **Valves:** All suction and discharge valves must be open during start-up and operation or damage or malfunction may result.

9) **Priming & Direction of Rotation:** Prime the pump and fill the containment can; then briefly jog the motor to assure proper motor direction. Motor shaft direction must be counter-clockwise, as seen from the pump end (see diagram on page 11).

Caution!
Never run this pump dry; serious damage can result.

4.2 Operation & Troubleshooting

Reference the Performance Curves for model **MC 3 x 2 x 8** at the operating speed (see documents on Liquiflo website). Prime the pump with liquid and be sure to allow a few minutes to fill the containment can. Monitor the pump for 15 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 7** for troubleshooting.

Section 5: Maintenance & Repair

The most common maintenance items for the pump are the bearings. If a leak develops, a decrease in head is observed or an increase in power is required, repair is necessary. When rebuilding the pump, **O-rings, gaskets and tolerance rings should be replaced; never re-used.** Whenever possible, use of anti-seize on stainless steel bolts is highly recommended.

5.1 Work Safety

Before performing maintenance on the pump, **review the safety precautions in Section 2** (see page 7). Observe the following:

1) Use common sense and basic workshop safety when rebuilding the pump.
2) Pump may have been used for hazardous or toxic fluids. Be sure to flush pump prior to removal.
3) Components of this pump are heavy; use proper lifting techniques.
4) Be sure power is disconnected and valves are locked out before starting maintenance.

5.2 PUMP DISASSEMBLY

Refer to Pump Assembly section for pictures of components or **Appendix 6** for reference drawings. Drawing reference numbers are given in parentheses.

5.2.1 Module Removal & Disassembly

Step 1. Be sure the motor power is disconnected, all valves are closed, and the pump is empty of fluid by using the Drain Plug (**20**) located on the bottom of the casing.

NOTE: The pump has a back-pullout design. This feature makes it unnecessary to disconnect the Casing (**1**) from the system piping.

Step 2. Remove the eight Casing Bolts (**90**) and pull back the Driver-Pump assembly from the Casing (**1**). Discard the Casing Gasket (**89**).

Step 3. Remove the four Bolts (**56**) securing Mounting Bracket (**10**) to motor adapter or power frame. Separate the Bracket-Module-Casing Adapter Assembly from the driver.

Caution!
The bracket-module-casing adapter assembly is heavy. Force will need to be applied to overcome the attraction of the magnetic coupling. Do not place hands or fingers between the Bracket and Driver. Move the assembly to a safe work area.

Step 4. Remove the Nut (**3**) and then separate the Impeller (**2**) from the Shaft (**17**). A bar may be used to prevent the impeller from rotating.

Step 5. Remove eight Bolts (**60**) and then separate the Casing Adapter (**65**) from the Bracket (**10**) and Bearing Housing (**5**). Discard the O-ring (**70**).

Step 6. Remove two Bolts (**56**) to disconnect the Module (less impeller) from the Bracket (**10**); then separate the Module from the Bracket.

Step 7. Remove the Thrust Bearing (**22**) from the Shaft (**17**) and set aside the Key, impeller (**18**) and Pin, thrust bearing (**31**) for use during re-assembly.

Step 8. Remove eight Bolts (**49**) and separate the Containment Can (**6** or **6c**) from the Bearing Housing (**5**). Discard the O-ring (**71**). **Caution – Some fluid may still remain inside the Containment Can.**

Step 9. Carefully pull the Shaft Assembly from the Bearing Housing (**5**).

5.2.2 Removal of Bearings

Caution – Safety glasses are required for these steps

Step 1. The Rotating Bearings (**30**) are pressed onto the shaft and held in place with Tolerance Rings (**32**). If the bearings require replacement, the best way to remove them from the shaft is to break them. Wrap a rag around the bearing and gently crack the top-most bearing apart with a hammer. **Caution – Sharp fragments may remain on the rag.**

Step 2. After the first bearing is removed, loosen the Set Screw (**58**) and remove the Spacer (**34**). Then use an arbor press to gently push the shaft out of the Inner Magnet (**16**). The second bearing will also be removed during this procedure. **Caution – Place a rag over the assembly during this step as a shield in case the bearing fractures.**

Step 3. Remove the second Thrust Bearing (**22**) and set aside the Key, inner magnet (**19**) and Pin, thrust bearing (**31**) for use during re-assembly. **Caution – Move the Inner Magnet to a safe location away from other magnets, tools and other metal objects.**

Step 4. The Stationary Bearings (**23**) are pressed into the Bearing Housing (**5**) and secured in place with an O-ring (**33**). Gently tap around the inside lip of the bearing to push the bearing out of the Bearing Housing. **Caution – Bearings may fracture during this step.**

Step 5. Carefully dispose of any fragments of the old bearings as well as the Tolerance Rings and O-rings.

Step 6. Examine pump components for signs of wear; replace if needed.

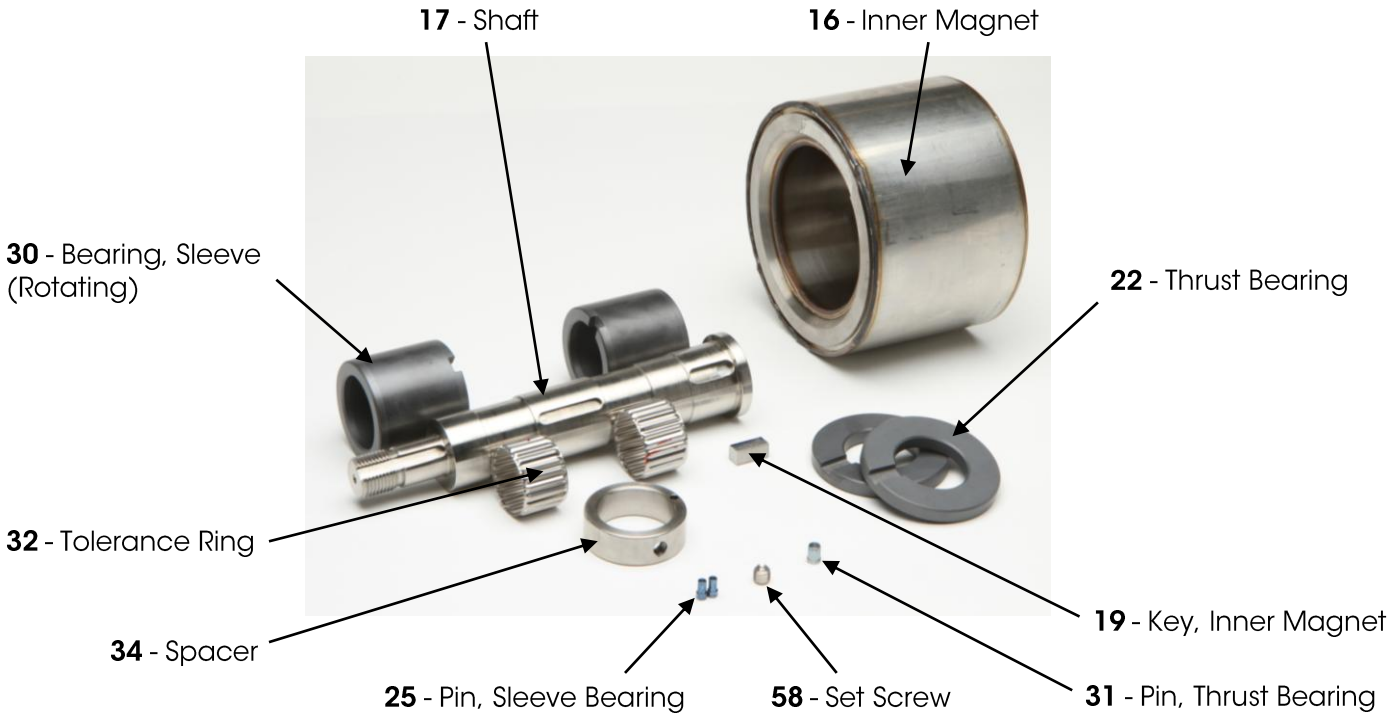
END OF DISASSEMBLY PROCEDURE

5.3 PUMP ASSEMBLY

Follow the procedure below and refer to the reference drawings in **Appendix 6**. Drawing reference numbers are given in parentheses in the following procedure.

5.3.1 Shaft Assembly

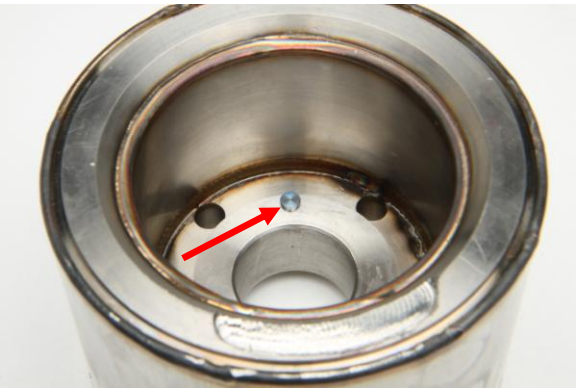
NOTE: A supplementary Shaft Assembly procedure with diagrams is given in **Appendix 3**.



NOTE: The pump shaft has a line laser-etched at 90° from the keyway, as shown. This line is a guide for aligning the grooves in the rotating sleeve bearings with the pins in the spacer. Older pumps may not have this line etched on the shaft. In this case, the line can be drawn on the shaft using Tool **2976-070** or a straight edge.

Step 1. Install Key, inner magnet (**19**) to Shaft (**17**).

Step 2. Insert Pin (**31**) into Inner Magnet (**16**). Tap lightly with punch and hammer if needed.

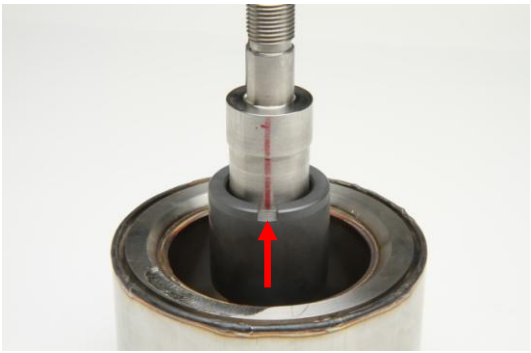


Step 3. Install Inner Magnet (**16**) oriented as shown onto shaft.

Step 4. Install Thrust Bearing (**22**) with the groove down and aligned to Pin (**31**)

Step 5. Install one Tolerance Ring (**32**) onto the shaft, into the groove as shown.

Step 6. Slide one Bearing, rotating (**30**) onto shaft and align single notch with line previously marked on shaft, as shown.



Step 7. Using an arbor press, and assembly tool (**2975-070**), support the shaft (not the inner magnet) with a washer or assembly tool (**2977-070**) as shown; then apply slow and even pressure to press the Bearing (**30**) over the Tolerance Ring (**32**) and seat it against the Thrust Bearing (**22**).

Caution – **Do NOT use a hammer for this step; the bearing may crack.**

Step 8. Install one Pin (**25**) into each side of Spacer (**34**) such that the step of the pin is flush with the spacer, as shown. Install Set Screw (**58**) into spacer but do not tighten.

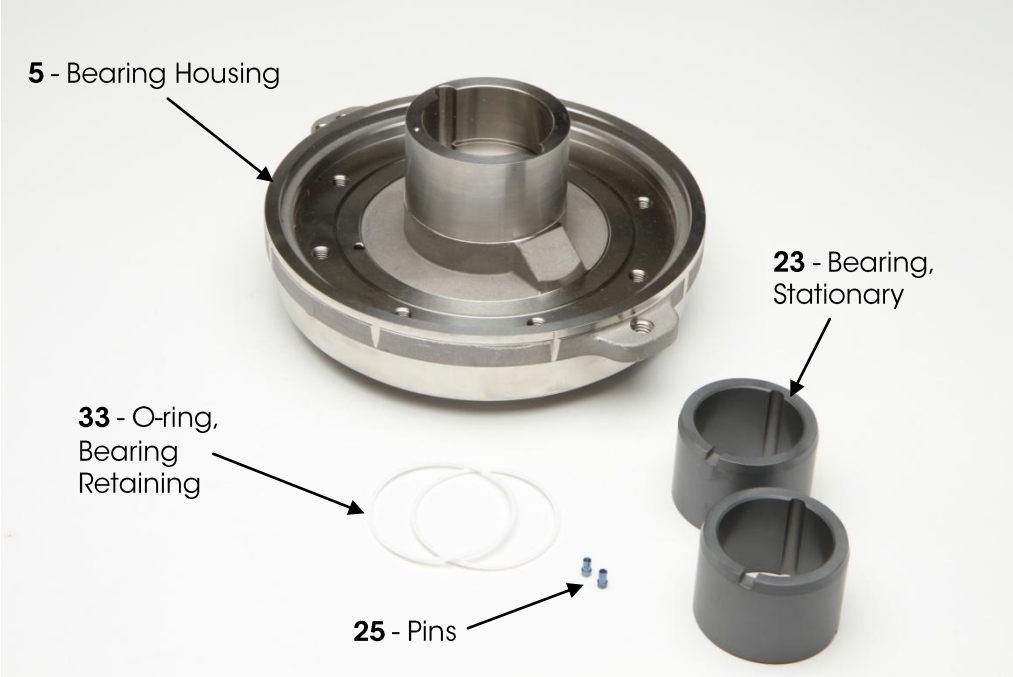
Step 9. Install Spacer (**34**) onto shaft, aligning Pin (**25**) into notch in Bearing (**30**). Do not tighten Set Screw (**58**) yet.

Step 10. Install second Tolerance Ring (**32**) into tolerance ring groove on shaft.

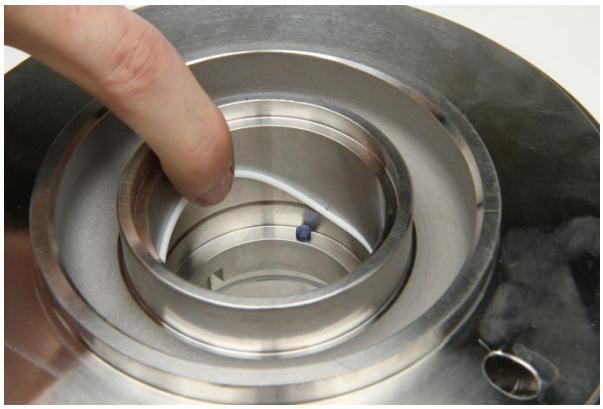
Step 11. Install second Bearing (**30**) onto shaft. Align the single notch in the bearing facing down and aligned with the Pin (**25**) in Spacer (**34**), as shown.

Step 12. Similar to Step 7, press Bearing (**30**) onto shaft. Then tighten Set Screw (**58**).

5.3.2 Bearing Housing Assembly



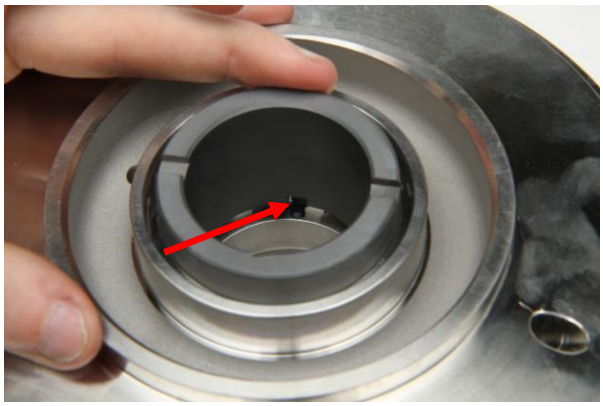
Step 1. Place Bearing Housing (**5**) on a bench with the large diameter (pump side) facing up, as shown at right. **Assembly MUST begin from this side to prevent damage to bearings.**



Step 2. Install Pin (**25**) into Bearing Housing (**5**) such that the head of the pin is properly seated. Tap lightly if necessary.

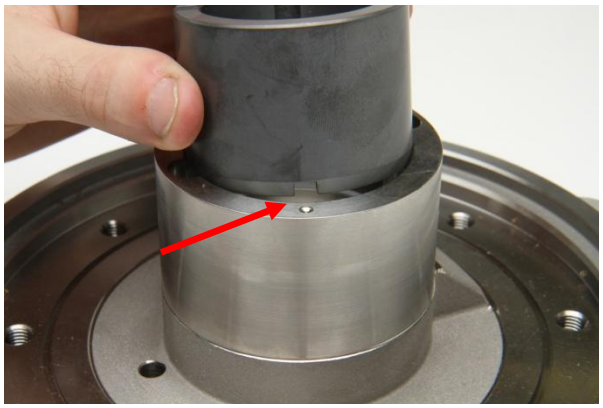
Step 3. Install O-ring, bearing retaining (**33**) into O-ring groove in Bearing Housing.
Caution **– Do not re-use O-ring.**

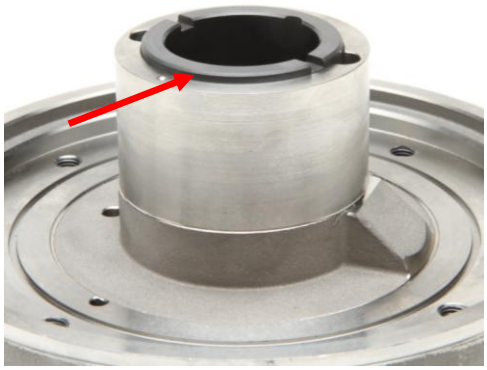
Step 4. Install Bearing, stationary (**23**) into Bearing Housing with the single notch aligned to the Pin (**25**) as shown.



Step 5. Using assembly tool (**2974-070**) and an arbor press, press the bearing through the O-ring. The bottom of the bearing must seat against the Bearing Housing.

Step 6. Repeat Steps 1 to 5 for the other side of the Bearing Housing. **NOTE:** The bottom of the bearing should seat flush against the Bearing Housing, but the top of the second bearing will stick up approximately 1/16 in. above the Bearing Housing.

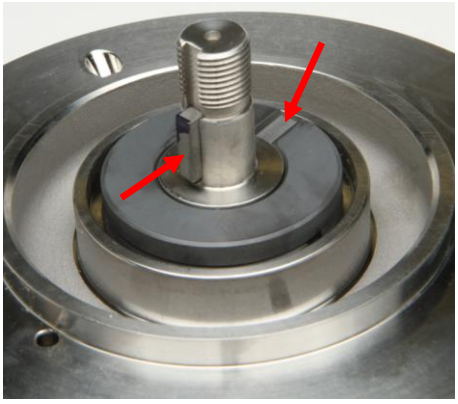




5.3.3 Module Impeller Assembly

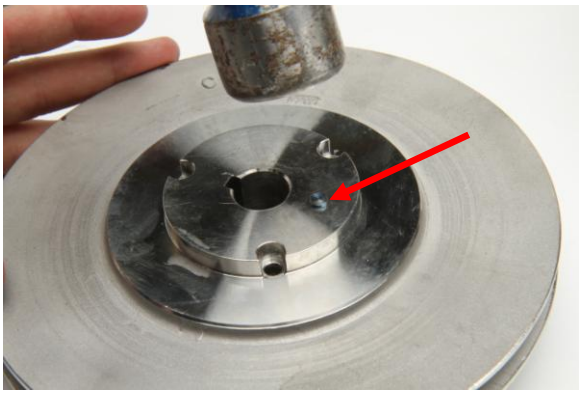
Step 1. Install the Bearing Housing assembly over the Shaft assembly in the direction shown. Assure the Shaft assembly rotates freely in the bearings of the Bearing Housing.

Step 2. Install the second Thrust Bearing (**22**) over the shaft with the groove facing up.

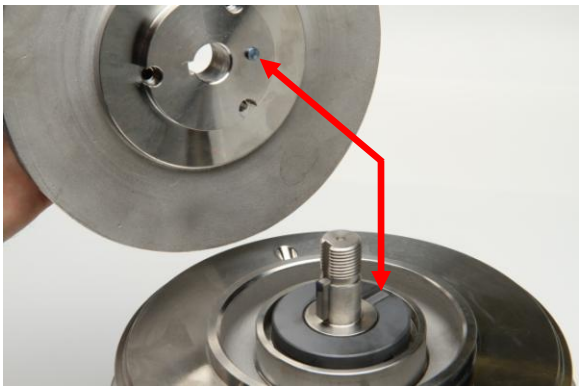


Step 3. Install Impeller Key (**18**) into shaft.

Step 4. Install Pin (**31**) into Impeller (**2**) such that the head of the Pin is properly seated. Tap with hammer if needed.



Step 5. Install Impeller (**2**) into Bearing Housing assembly, aligning the Pin (**25**), with the groove in the Thrust Bearing (**22**).



Step 6. Install Nut, impeller (**3**) onto Shaft and tighten by hand only at this time.

NOTE: The impeller will be removed later in the procedure to allow for the installation of the **Group 1 to Group 2 (8")) Casing Adapter** (**65**) to the Mounting Bracket (**10**).

5.3.4 Containment Can Assembly

Step 1. Carefully turn over the assembly to gain access to the inner magnet side.

Step 2. Using a clean rag, wipe any dirt or small magnetic particles from the inner magnet.

Step 3. Install O-ring, containment can (**71**) into groove. **Caution – Do not re-use O-ring.**

Step 4. **Ceramic Can Only** – Install O-ring, bumper (**6a**) into Flange (**6b**); then install Flange over Containment Can, Ceramic (**6c**).

Step 5. Install Containment Can (**6** or **6c**) onto Bearing Housing. Apply anti-seize to eight 5/16-24 Bolts (**49**) and tighten. **Caution – Be careful when tightening; the inner magnet will attract metal tools.**

NOTE: Refer to **Appendix 1** for the torque specifications of the fasteners. **Torque the bolts to 85% of the maximum torque value when anti-seize compound is used.** 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.

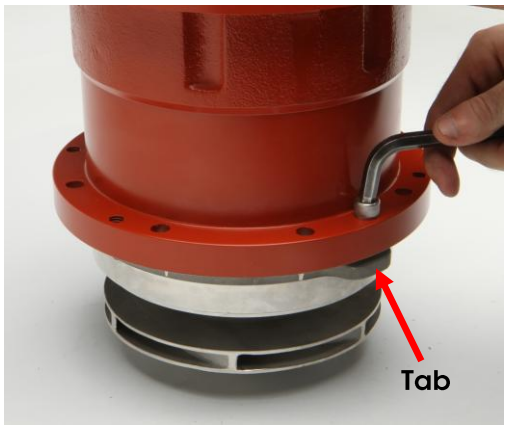
This completes the **Module** assembly. See **Appendix 6** for Module reference drawings.

5.3.5 Bracket-to-Module Assembly

Step 1. Install Mounting Bracket (**10**) onto Bearing Housing (**5**) of the pump Module. **Note the orientation.** The drilled hole shown is a Containment Can drain hole. Orient this hole so that it is towards the bottom; then assemble the bracket with the eyebolt hole facing to the top of the pump, as shown below.

Step 2. Install two Bolts (**56**) through Mounting Bracket (**10**) and into tabs on Bearing Housing (**5**).

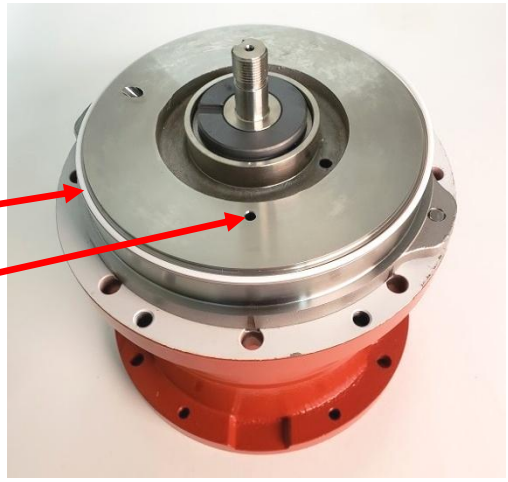
NOTE: The holes used in the bracket for this step are located "between" the hole pattern used for the casing adapter.



Step 3. Loosen Nut (**3**) and remove Impeller (**2**) from Shaft (**17**).

Step 4. Place O-ring, casing adapter (**70**) onto Bearing Housing (**5**).

Caution – Do not re-use O-ring.

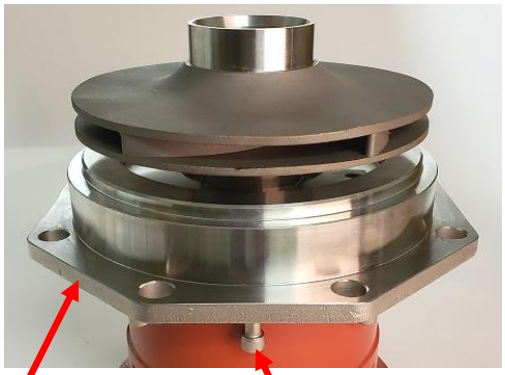


Step 5. Place Casing Adapter (**65**) onto Bearing Housing (**5**), as shown below.

Step 6. Secure Casing Adapter (**65**) to Bracket (**10**) with eight 3/8-24 x 2 Bolts (**60**). (See **NOTE** on previous page.)

Step 7. Re-install Impeller (**2**) and Nut (**3**) to the Shaft (**17**) and tighten the nut with a wrench. A bar in the side of the impeller can be used to prevent the impeller from rotating.

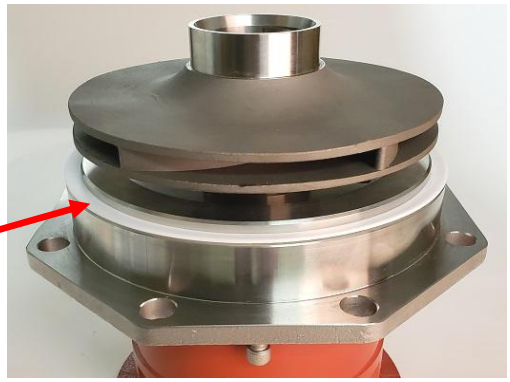
NOTE: Before installing the Impeller Nut, apply **anti-seize compound** to the threads of the **316 SS** Acorn Nut. Torque the Nut to **65 ft-lbs**.



5.3.6 Casing Assembly

Step 1. Place Gasket, casing (**89**) onto Casing Adapter (**65**), as shown.

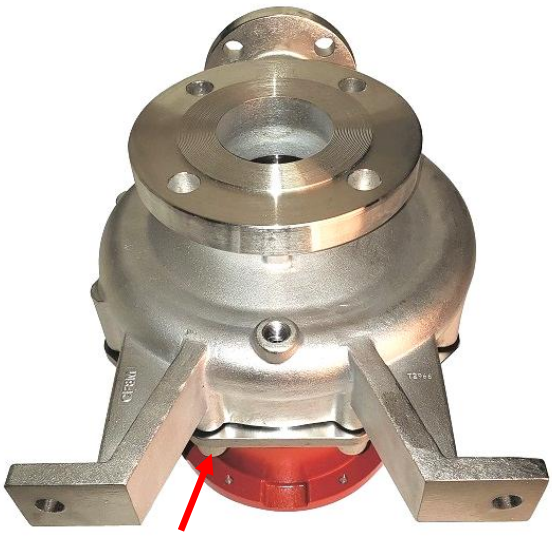
Caution – **Do not re-use Gaskets.**



Step 2. Carefully place Casing (**1**) onto Casing Adapter (**65**) of pump assembly. Gently lower the Casing until the Impeller is aligned with the Casing. Note the orientation of the Casing discharge port to eyebolt hole in bracket.

Step 3. Apply anti-seize to threads and secure the Casing Adapter (**65**) to the Casing (**1**) with eight 5/8-11 x 1-1/2 Bolts (**90**).

NOTE: Refer to **Appendix 1** for the torque specifications of the fasteners. **Torque the bolts to 85% of the maximum torque value when anti-seize compound is used.** When tightening the bolts, use a star pattern torque sequence on the fasteners to ensure even compression on the Gasket's surface. With Teflon (PTFE) Gaskets, 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.

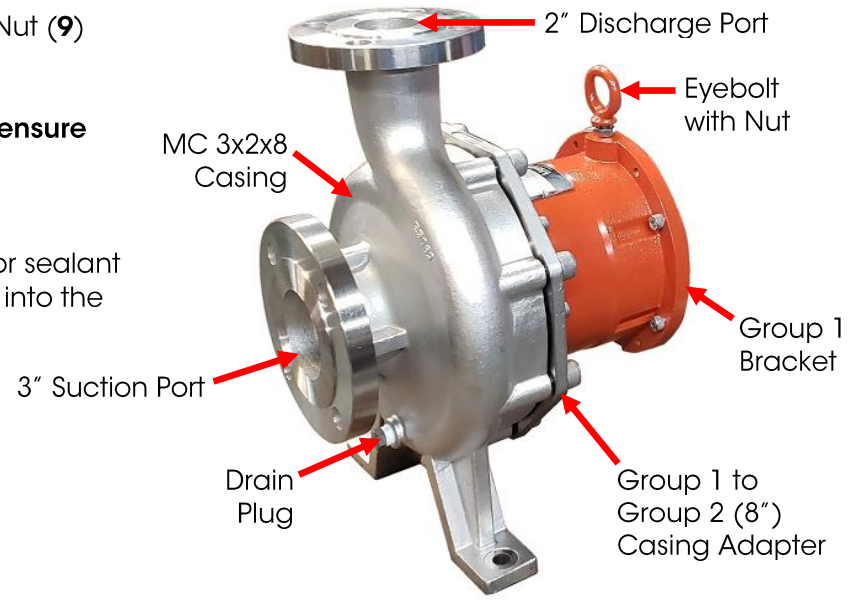


5.3.7 Eyebolt & Drain Plug Assembly

Step 1. Install Eyebolt (**8**) and Nut (**9**) to the Bracket (**10**), as shown.

Caution – **Eyebolt is for lifting; ensure sufficient thread engagement.**

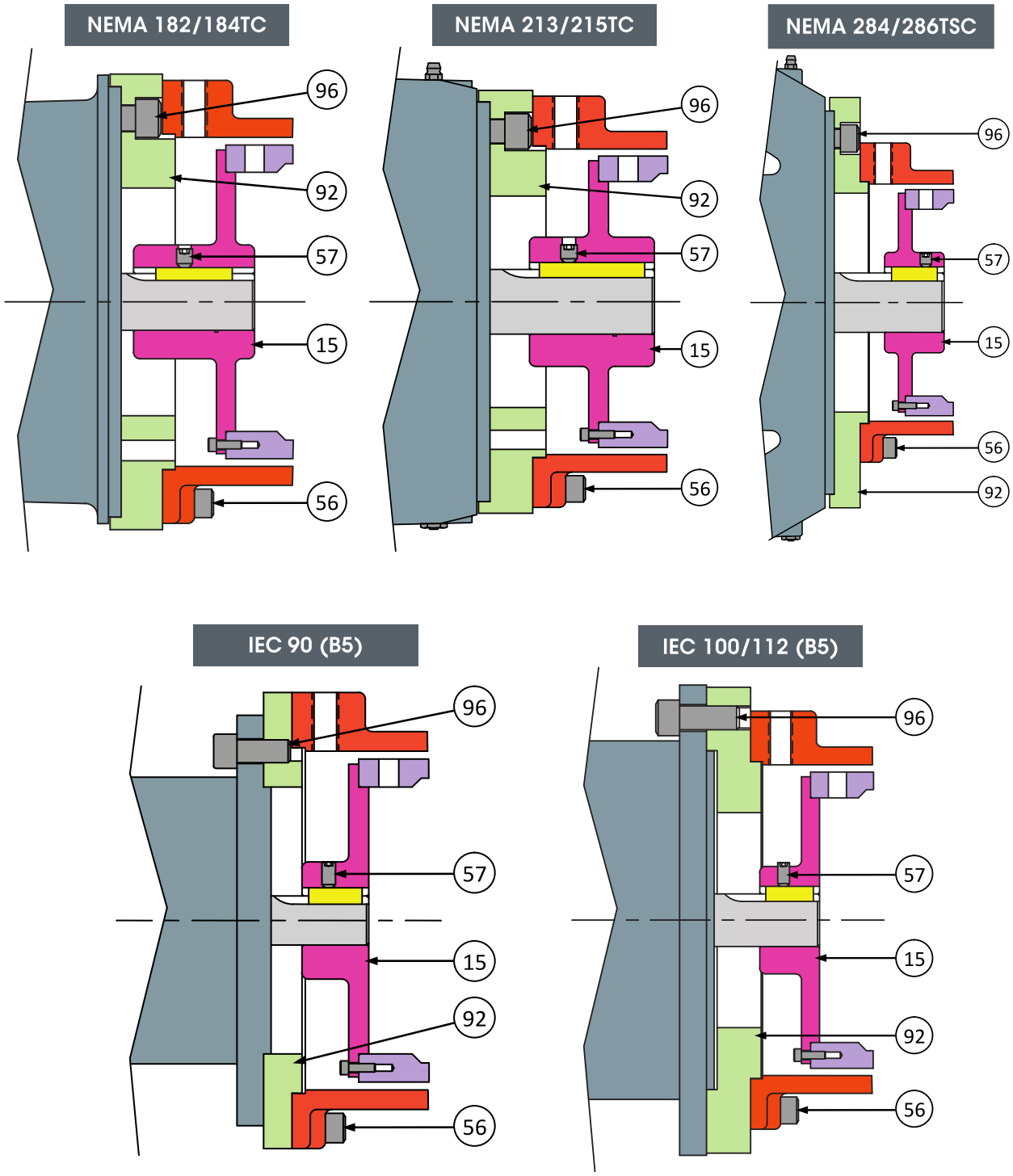
Step 2. Wrap with Teflon tape or sealant and then install Drain Plug (**20**) into the Casing (**1**), as shown.



5.3.8 Adapter-to-Motor Assembly

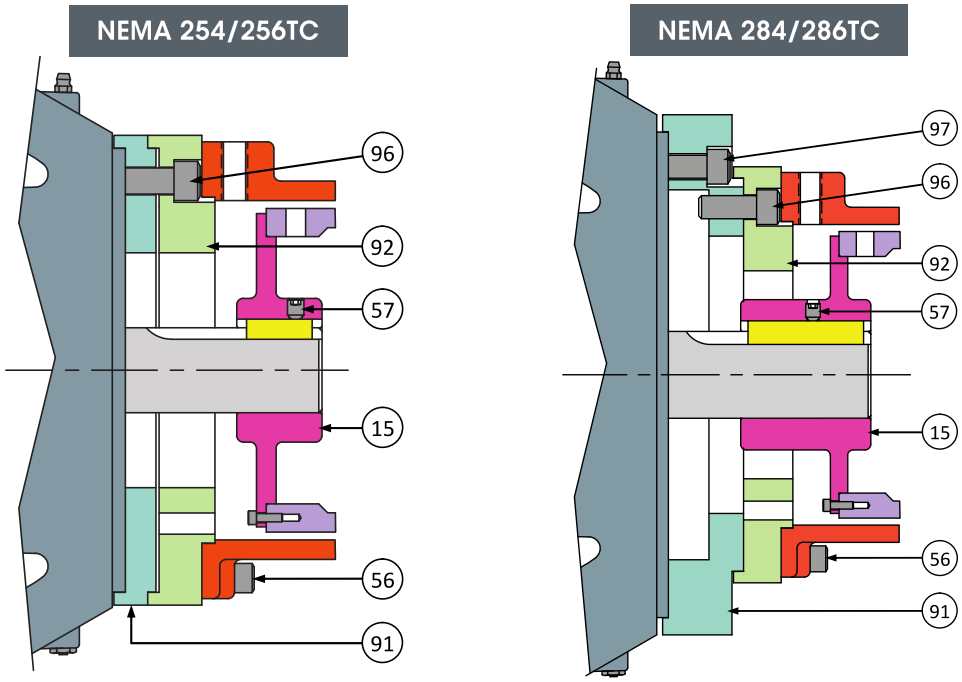
Step 1. For Close-Coupled pumps, install Motor Adapter(s) as follows:

(a) NEMA 182-215TC, 284/286TSC & IEC 90/100/112 (B5 Flange) motors: Install Adapter, motor (**92**) onto motor with four Bolts (**96**).



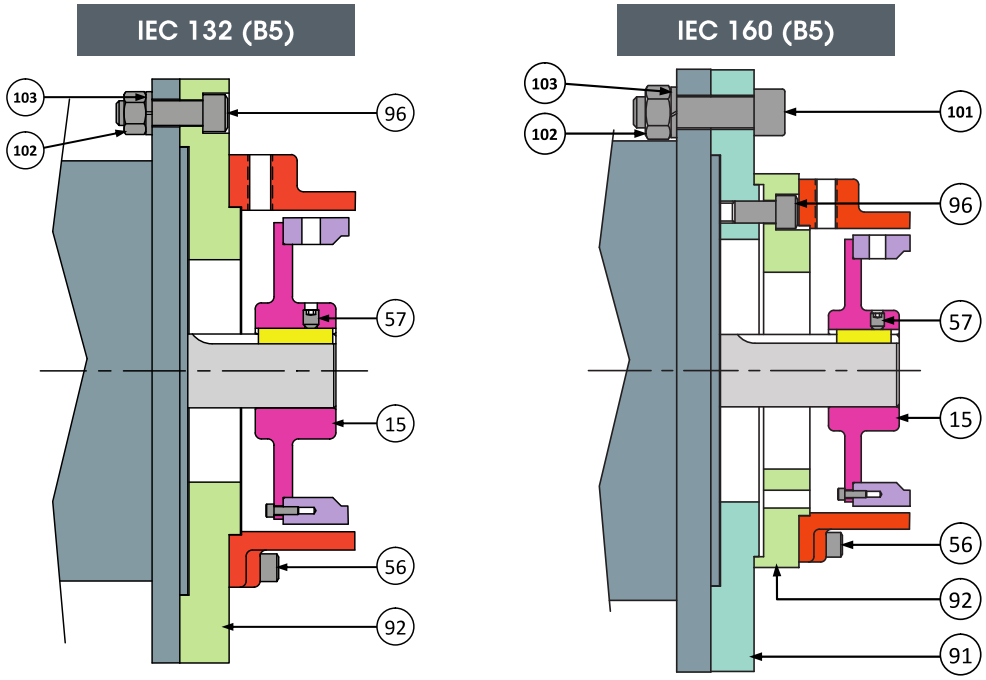
(b) NEMA 254/256TC motors: Place Adapter, motor (**91**) onto motor; then place Adapter, motor (**92**) onto Adapter (**91**); then secure both Adapters with four Bolts (**96**).

(c) NEMA 284/286TC motors: Install Adapter, motor (**91**) onto motor with four Bolts (**97**); then install Adapter, motor (**92**) onto Adapter (**91**) with four Bolts (**96**).



(d) IEC 132 (B5 Flange) motor: Install Adapter, motor (**92**) onto motor with four sets of Bolts (**96**), Nuts (**102**) and Lock-Washers (**103**).

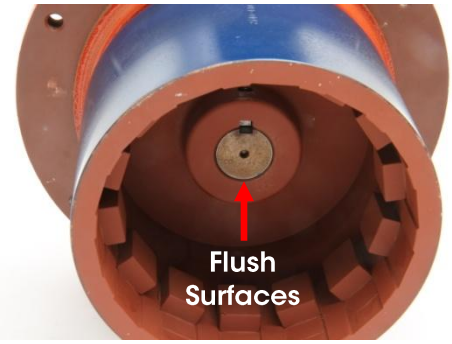
(e) IEC 160 (B5 Flange) motor: Install Adapter, motor (**91**) onto motor with four sets of Bolts (**101**), Nuts (**102**) and Lock-Washers (**103**); then install Adapter, motor (**92**) onto Adapter (**91**) with four Bolts (**96**).



5.3.9 Outer Magnet-to-Driver Assembly

Step 1. Install key (provided with motor or power frame) and slide Outer Magnet Assembly onto driver shaft.

Step 2. Install Outer Magnet Assembly such that the inside surface of the Hub (**15**) is flush with the end of the shaft. Magnet alignment is important to prevent excessive wear on the pump.

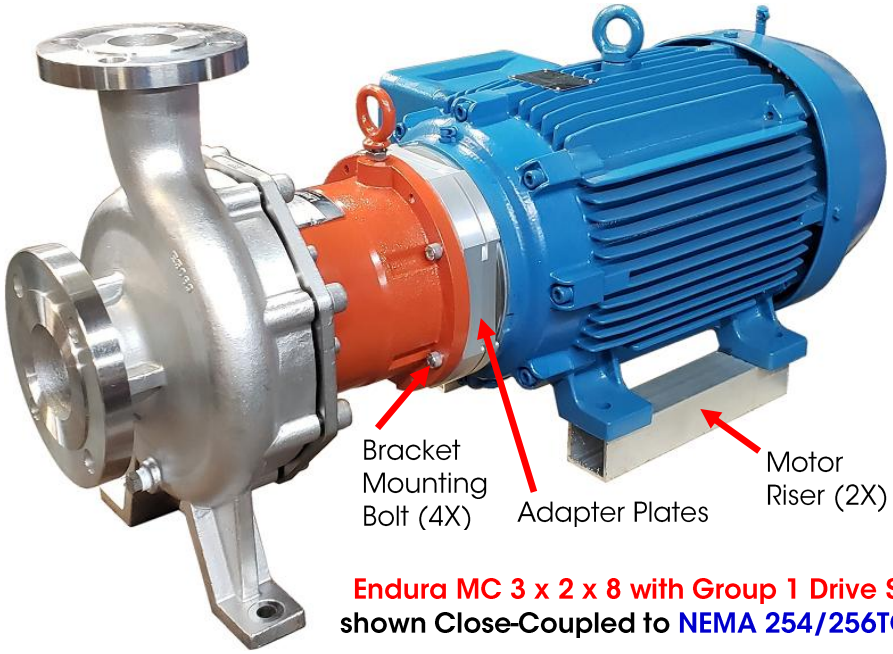


Step 3. Tighten two Set Screws (**57**) to secure assembly onto shaft.

5.3.10 Bracket-to-Driver Assembly

Step 1. Carefully install Bracket (**10**) onto Motor/Adapter or Power Frame with four 3/8-16 x 1-1/4 SHCS Bolts (**56**). **Caution – Magnets will attract each other. Do not place hands or fingers between Bracket and Driver.**

Step 2. Check that all bolts have been properly tightened. Refer to **Appendix 1** for the torque specifications of the fasteners.



Endura MC 3 x 2 x 8 with Group 1 Drive Section shown Close-Coupled to NEMA 254/256TC Motor

END OF ASSEMBLY PROCEDURE

NOTE: Before operating the MC pump, refer to the information in **Section 4**.

Appendix 1: Fastener Torque Specifications

Maximum Torque Values for 18-8 Stainless Steel Bolts

Bolt Size	Max Torque Specifications		Bolt Size	Max Torque Specifications	
	(in-lb)	(N-m)		(in-lb)	(N-m)
8-32 (UNC)	19.8	2.24	3/8-24 (UNF)	259	29.3
1/4-28 (UNF)	94.0	10.6	7/16-14 (UNC)	376	42.5
5/16-24 (UNF)	142	16.0	1/2-13 (UNC)	517	58.4
3/8-16 (UNC)	236	26.7	5/8-11 (UNC)	1110	125.4

Appendix 2: Maintenance Tool List

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

2977-070 – Shaft Support Tool

2976-070 – Sleeve Bearing Alignment Tool

2975-070 – Sleeve Bearing Assembly Tool

2974-070 – Stationary Bearing Assembly Tool

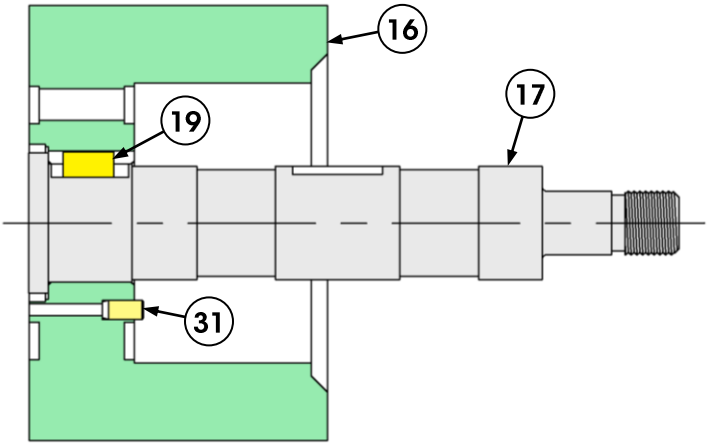
Additional Tools
Allen Wrench Set, Inch
15/16" Socket & Ratchet
Punch
Hammer
Arbor Press

Appendix 3: Shaft Assembly Procedure

This section gives a supplementary Shaft Assembly procedure for **Section 5.3.1** on pages 15-17. Drawing reference numbers correspond to the drawings in **Appendix 6**.

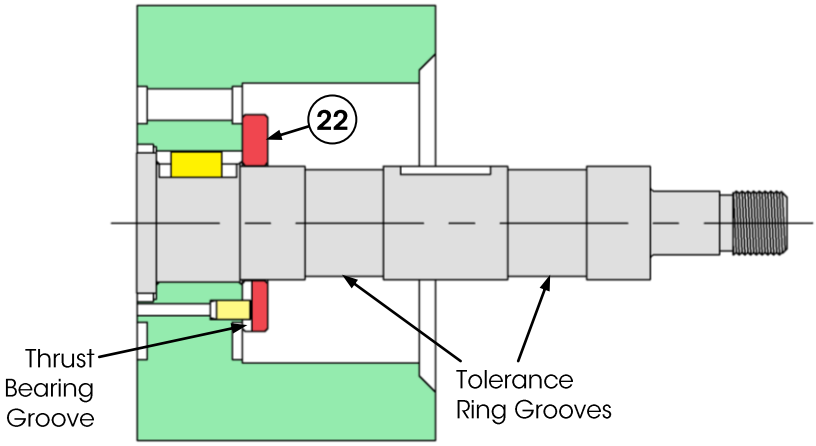
I. Inner Magnet Installation

1. Install Key (**19**) onto Shaft (**17**).
2. Install Pin (**31**) into Inner Magnet (**16**).
3. Install Inner Magnet (**16**) to Shaft (**17**).



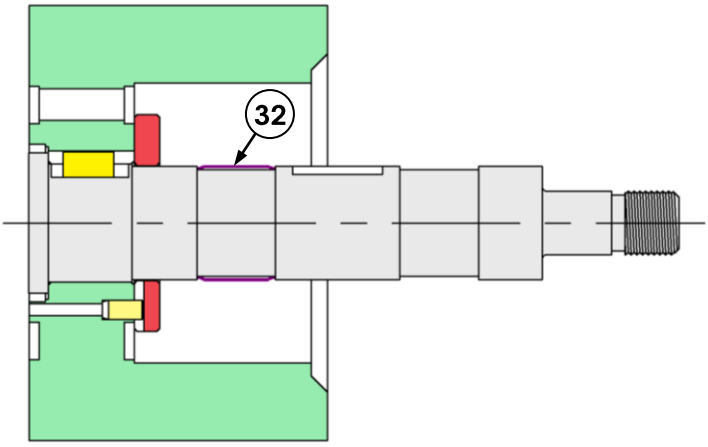
II. Thrust Bearing Installation

4. Install Thrust Bearing (**22**) with its groove aligned over the pin (**31**) in the Inner Magnet, as shown.



III. 1st Tolerance Ring Installation

5. Install the first Tolerance Ring (**32**) into the tolerance ring groove of the shaft that is located inside the magnet, as shown.

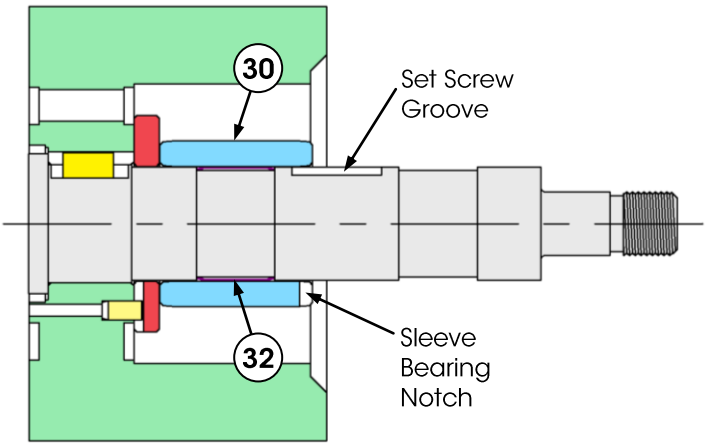


Appendix 3: Shaft Assembly Procedure (Continued)

IV. 1st Sleeve Bearing Installation

6. With the bearing notch aligned with the guide line on the shaft, install the first Rotating Sleeve Bearing (**30**) over the Tolerance Ring (**32**) and against the Thrust Bearing, as shown.

Note: An arbor press should be used for this step. With the base of the shaft supported, apply slow and even pressure on the bearing rim to push it into place. The tools shown in **Appendix 2** (2975-070 and 2977-070), or equivalents, should be used.

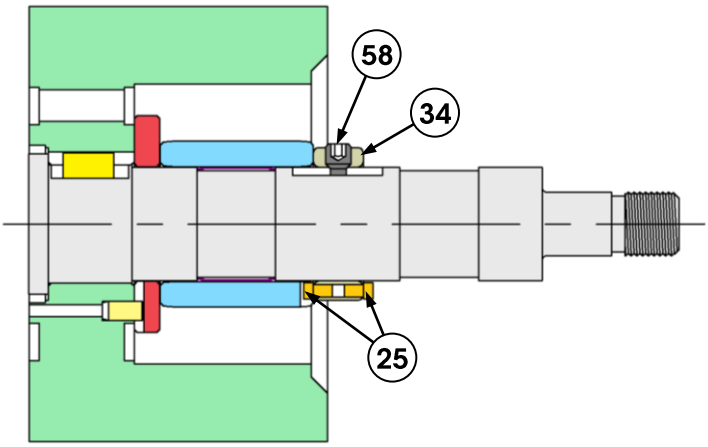


V. Spacer Installation

7. Install the Bearing Anti-Rotation Pins (**25**) into the sides of the Spacer (**34**).

8. Install Set Screw (**58**) into the Spacer (**34**) but do not tighten.

9. Install Spacer (**34**) onto shaft with the Set Screw (**58**) aligned to the set screw groove in shaft and one Bearing Pin (**25**) aligned with the bearing notch, as shown. **Do not tighten Set Screw.**



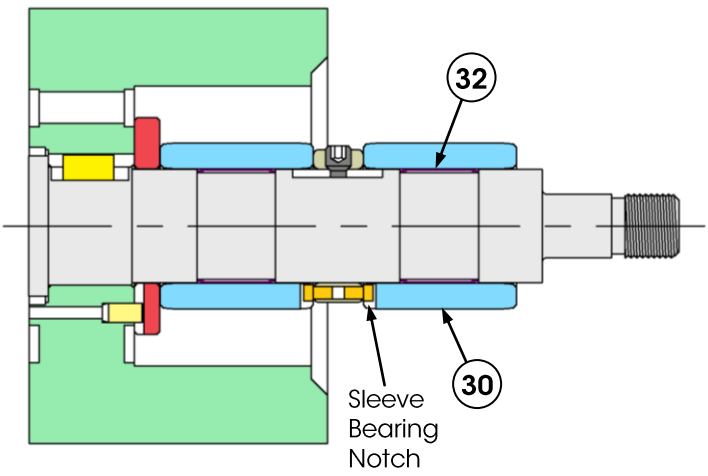
VI. 2nd Tol. Ring & Bearing Installation

10. Install the second Tolerance Ring (**32**) into the tolerance ring groove of the shaft.

11. With the bearing notch aligned to the Bearing Pin (**25**) in the Spacer (**34**), install the second Rotating Sleeve Bearing (**30**) over the Tolerance Ring (**32**) and against the Spacer, as shown.

Note: An arbor press should be used for this step, similar to Step 6 above.

12. Tighten the Set Screw to the shaft.



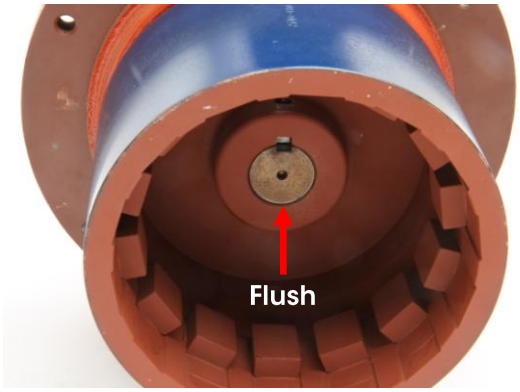
END OF PROCEDURE

Appendix 4: Power Frame Maintenance

If your pump is equipped with a Power Frame, below are the assembly/disassembly instructions. Refer to the drawing on the next page. Drawing reference numbers are given in parentheses.

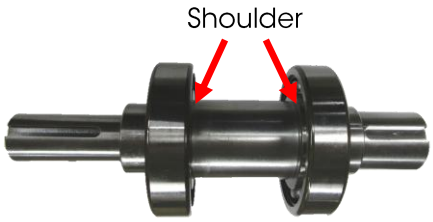
Step 1. Install or Remove Outer Magnet from Power Frame Shaft (**11**). Use a 5/32 Allen wrench.

Magnet hub on power frame models should be set flush with end of shaft.



Step 2. Install or Remove Bolts (**4**). Use a 3/16 Allen wrench.

Step 3. Install or Remove End Cap (**2**).

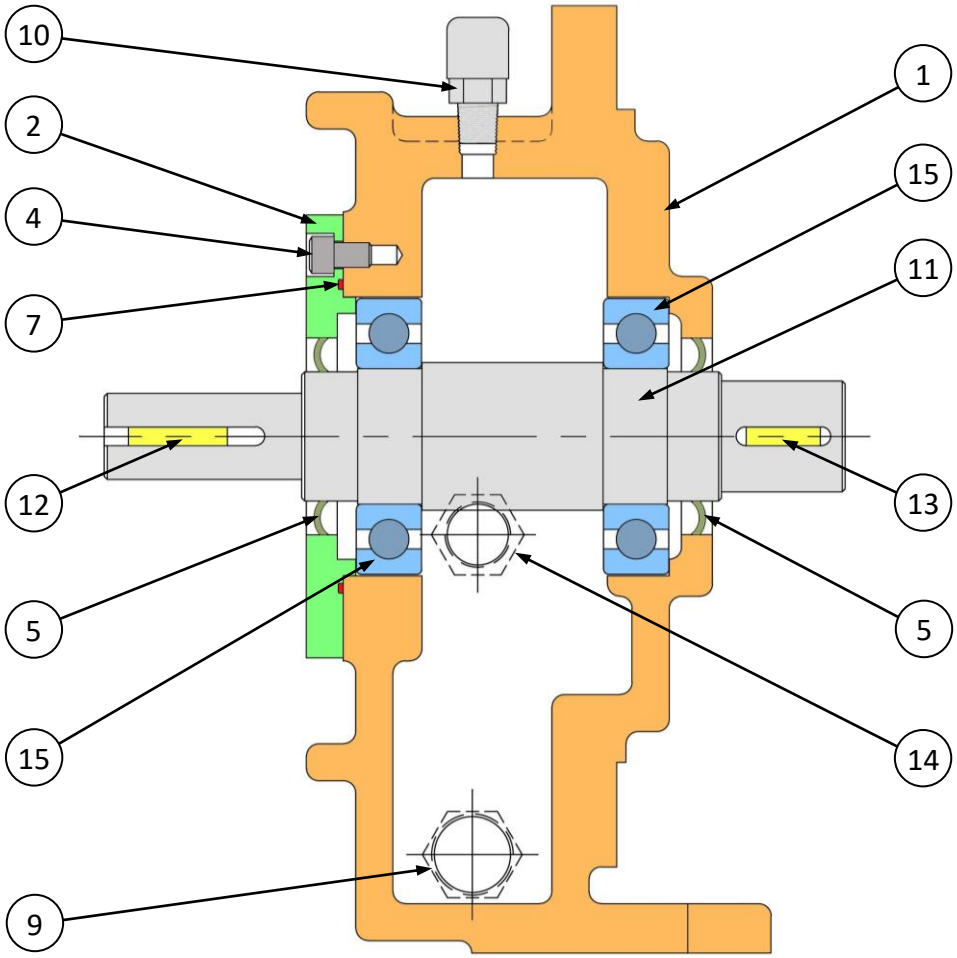


Step 4. Install or Remove Ball Bearings (**15**) and Shaft (**11**). Bearings are pressed onto Shaft up to shoulder. Push on inner race only to avoid damaging bearing.

NOTE: General Purpose 10W-30 oil may be used. Consideration must be given to installation environment, temperature and usage conditions.

Appendix 4: Power Frame Maintenance (Continued)

Reference Drawing – Power Frame, Group I



Parts List for Power Frame (Part No. 2629-190)			
Ref. #	**Qty.**	**Part Number**	**Description**
1	1	2526-190	Case, Power Frame
2	1	2525-050	End Cap, Coupling End
3	–	–	–
4	4	2716-060	Bolts, End Cap
5	2	2671-180	Seal, Oil
6	–	–	–
7	1	2658-220	O-Ring (2-041), End Cap
8	–	–	–
9	1	2730-050	Plug, 1/2 NPT
10	1	2674-050	Breather, 1/8 NPT
11	1	2523-050	Shaft, Power Frame
12	1	2613-050	Key, Shaft, Coupling End
13	1	2614-050	Key, Shaft, Magnet End
14	1	3219-050	Sight Glass, 3/8-18
15	2	2673-050	Bearing, Ball

Appendix 5: Bill of Materials

Endura®	Bill of Materials – Model MC 3x2x8 w/ Group I Drive Section

Code	Part Description		Ref #	Material	Position 3 - Pump Size 3 x 2 x 8 Code: 1 Part #	Qty
Position 1 - Pump Type						
MC	**Magnetically Coupled**					
	Eyebolt		8	CS/Epoxy	2620-050	1
	Nut, Eyebolt		9	18-8SS	2621-060	1
	Mounting Bracket, Standard Group 1		10	CI/Epoxy	2589-190	1
	Bolt, Bracket/Casing Adapter (3/8-24 x 2 SHCS)		60	18-8SS	2850-060	8
	Bolt, Casing Adapter/Casing (5/8-11 x 1-1/2 SHCS)		90	18-8SS	5174-060	8
	Bolt, Bracket/Bearing Housing (3/8-16 x 1-1/4 SHCS)		56	18-8SS	2709-060	2
	Bolt, Bracket/Motor Adapter (3/8-16 x 1-1/4 SHCS)		56	18-8SS	2709-060	4
	Bolt, Hub/Outer Magnet (#8-32 x 1/2 SHCS)		55	Carbon Steel	2771-050	8
	Bearing, Thrust		22	Silicon Carbide	2502-110	2
	Bearing, Radial, Stationary	Normal Temperature	23	Silicon Carbide	2501-110	2
		Low Temperature		Carbon 60	2551-130 (1)	
	Bearing, Sleeve, Rotating	Normal Temperature	30	Silicon Carbide	2500-110	2
		Low Temperature		440C SS	2978-011 (1)	
	Tolerance Ring, Shaft		32	Alloy-C	2532-020	2
	Tolerance Ring, Bearing Housing (2)		33	Alloy-C	2531-020	2
	Name Plate		-	304SS	2723-013	1
Position 2 - Temperature						
N	**Normal Temperature (-20 to +350 °F)**					
L	**Low Temperature (-100 to +100 °F)**					
Position 3 - Pump Size						
1	3 x 2 x 8					

1 Low Temperature Part (Position 2 = **L**)
2 Low Temperature Part; replaces Ref. No. 33 in Position 6 (O-ring, Bearing Retaining)

Appendix 5: Bill of Materials (Continued)

Code	Part Description		Ref #	Material	3 x 2 x 8	Qty
Position 4 - Wet End, Material of Construction						
S	**316 Stainless Steel**					
	Impeller, MC 3x2x8, Modified (Closed)		2	316SS	5093-010	1
	Nut, Impeller, MC (5/8-18 Acorn, 15/16" Hex)		3	316SS	2619-010	1
	Bearing Housing, Group 1 MC	Normal Temperature	5	316SS	2503-010	1
		Low Temperature			3082-010 (1)	
	Shaft, Group 1 MC		17	316SS	2504-010	1
	Key, Impeller		18	316SS	2612-010	1
	Key, Inner Magnet		19	316SS	2611-010	1
	Drain Plug, 3/8" NPT (Hex Head)		20	316SS	2804-010	1
	Pin, Sleeve/Radial Bearing		25	316SS	2772-010	4
	Pin, Thrust Bearing		31	316SS	2615-010	2
	Spacer (Bearings)		34	316SS	2520-010	1
	Set Screw, Spacer/Shaft (1/4-28 x 1/4 SHSS-HD)		58	316SS	2720-010	1
	Adapter, Casing (G1 Bracket to G2 8" Casing)		65	316SS	5090-010	1
Position 5 - Casing Flanges						
2	Casing, 150# RF ANSI		1	316SS	5069-010	1
3	Casing, 300# RF ANSI		1	316SS	5294-010	1
Position 6 - O-Rings/Gaskets						
T	**Teflon**					
	Gasket, Casing (Group 2, 8")		89	Teflon	5169-210	1
	O-ring, Casing Adapter (2-166)		70	Teflon	2661-210	1
	O-ring, Containment Can (2-049)		71	Teflon	2660-210	1
	O-ring, Bearing Retaining (2-034) (3)		33	Teflon	2675-210	2
K	**Kalrez 4079**					
	Gasket, Casing (Group 2, 8")		89	Kalrez 4079	5169-240	1
	O-ring, Casing Adapter (2-166)		70	Kalrez 4079	2661-240	1
	O-ring, Containment Can (2-049)		71	Kalrez 4079	2660-240	1
	O-ring, Bearing Retaining (2-034) (3)		33	Kalrez 4079	2675-240	2
G	**Graphoil**					
	Gasket, Casing (Group 2, 8") (1)		89	Graphoil	5169-225	1
	Gasket, Casing Adapter (1)		70	Graphoil	3088-225	1
	Gasket, Containment Can (1)		71	Graphoil	3087-225	1

1 Low Temperature Part (Position 2 = **L**) **3** Part for Normal Temperature model only

Appendix 5: Bill of Materials (Continued)

Code	Part Description	Ref #	Material	3 x 2 x 8	Qty
Position 7 - Containment Can, Material of Construction					
S	**316 Stainless Steel**				
	Containment Can (Metal)	6	316SS	2512-010	1
	Bolt, Metal Can (5/16-24 x 3/4 SHCS)	49	18-8SS	2713-060	8
H	**Hastelloy C**				
	Containment Can (Metal)	6	Alloy-C	2512-020	1
	Bolt, Metal Can (5/16-24 x 5/8 FH-SHCS)	49	18-8SS	S641109 [4]	8
Z	**Zirconia (TTZ)**				
	Containment Can (Ceramic)	6c	Zirconia (TTZ)	2951-140	1
	Flange, Ceramic Containment Can	6b	303SS	2779-015	1
	O-ring, Flange Bumper, Ceramic Can (2-159)	6a	Teflon	2669-210	1
	Bolt, Ceramic Can (5/16-24 x 1 SHCS)	49	18-8SS	2714-060	8
Position 8 - Magnetic Coupling (Group I)					
A	**NdFeB 1.0" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 1.0"	7	CS/NdFeB	2740-410	1
	Inner Magnet, 1.0"	16	316SS/NdFeB	2627-370	1
B	**NdFeB 1.5" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 1.5"	7	CS/NdFeB	2734-410	1
	Inner Magnet, 1.5"	16	316SS/NdFeB	2625-370	1
C	**NdFeB 2.0" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 2.0"	7	CS/NdFeB	3138-410	1
	Inner Magnet, 2.0"	16	316SS/NdFeB	2939-370	1
E	**SmCo 1.0" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 1.0"	7	CS/SmCo	2740-420	1
	Inner Magnet, 1.0"	16	316SS/SmCo	2627-380	1
F	**SmCo 1.5" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 1.5"	7	CS/SmCo	2734-420	1
	Inner Magnet, 1.5"	16	316SS/SmCo	2625-380	1
G	**SmCo 2.0" - Metal Can Only**				
	Outer Magnet, Less Hub, Metal Can, 2.0"	7	CS/SmCo	3138-420	1
	Inner Magnet, 2.0"	16	316SS/SmCo	2939-380	1

4 If **Hastelloy C** Containment Can (2512-020) is ordered as a separate part, the 8 mounting bolts (S641109) will be included.

Appendix 5: Bill of Materials (Continued)

Code	Part Description	Ref #	Material	3 x 2 x 8	Qty
Position 8 Continued - Magnetic Coupling (Group 1)					
L	**NdFeB 1.5" - Ceramic Can Only**				
	Outer Magnet, Less Hub, Ceramic Can, 1.5"	7	CS/NdFeB	2752-410	1
	Inner Magnet, 1.5"	16	316SS/NdFeB	2625-370	1
M	**NdFeB 2.0" - Ceramic Can Only**				
	Outer Magnet, Less Hub, Ceramic Can, 2.0"	7	CS/NdFeB	2913-410	1
	Inner Magnet, 2.0"	16	316SS/NdFeB	2939-370	1
Q	**SmCo 1.5" - Ceramic Can Only**				
	Outer Magnet, Less Hub, Ceramic Can, 1.5"	7	CS/SmCo	2752-420	1
	Inner Magnet, 1.5"	16	316SS/SmCo	2625-380	1
R	**SmCo 2.0" - Ceramic Can Only**				
	Outer Magnet, Less Hub, Ceramic Can, 2.0"	7	CS/SmCo	2913-420	1
	Inner Magnet, 2.0"	16	316SS/SmCo	2939-380	1
Position 9 - Mounting					
0	**Close Coupled** (Select Motor Code in Pos. 10)				
1	**Power Frame** (Leave Position 10 blank)				
	Power Frame Assembly - Group I	99	CI/Epoxy/Misc	2629-190	1
	Hub, Outer Magnet - **1-1/8"** Bore (Power Frame)	15	Carbon Steel	2524-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Bolt, Power Frame/Bracket (3/8-16 x 1-1/4 SHCS)	56	18-8SS	2709-060	4

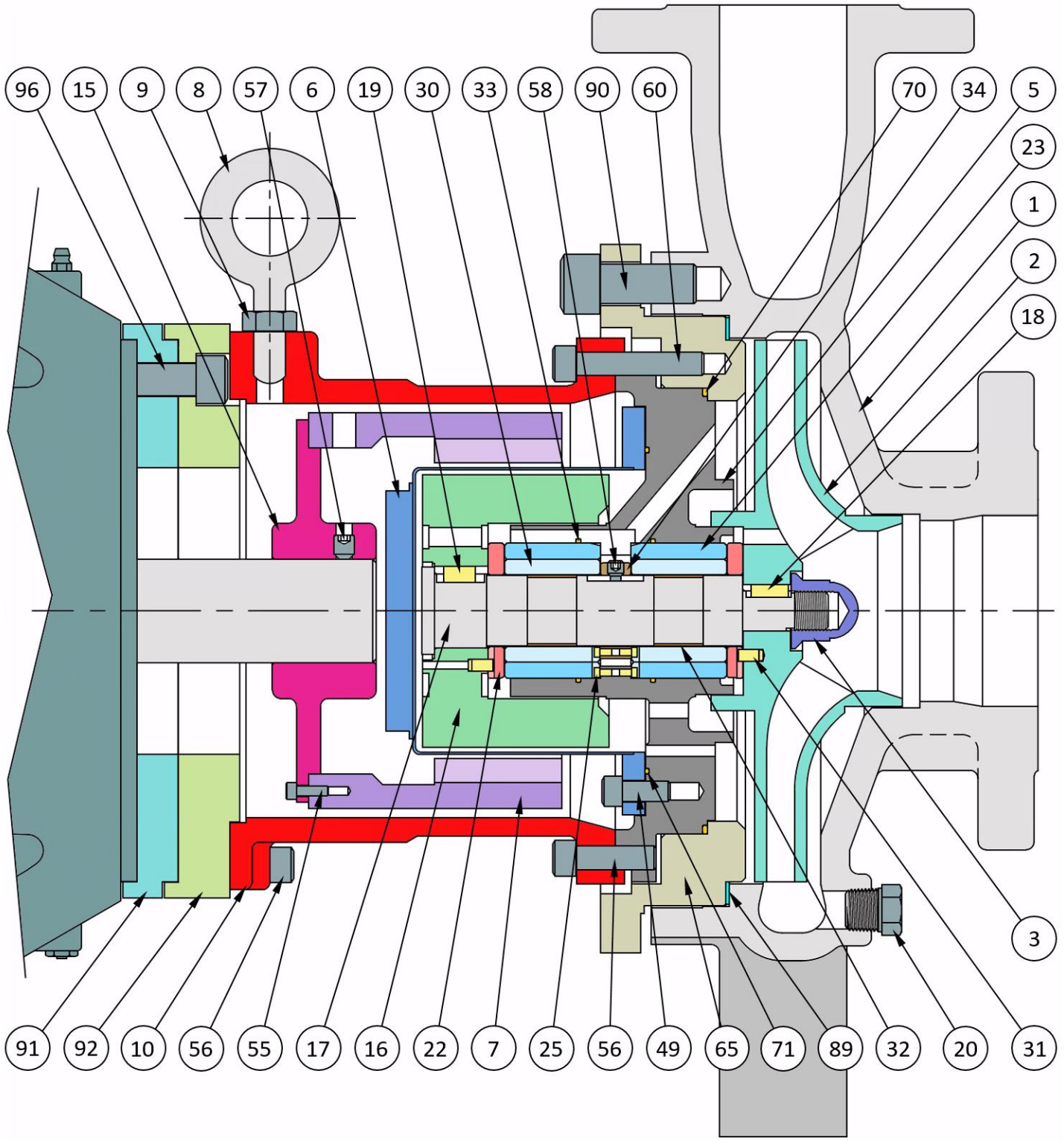
Appendix 5: Bill of Materials (Continued)

Code	Part Description	Ref #	Material	3 x 2 x 8	Qty
Position 10 - Motor Frame Size (If Close-Coupled Mounted)					
C	**NEMA 182/184TC Motor**				
	Hub, Outer Magnet - **1-1/8"** Bore	15	Carbon Steel	2553-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, 56C-286TC, Group I	92	Al, Anodized	2555-070	1
	Bolt, Motor/Adapter (1/2-13 x 1 SHCS)	96	Carbon Steel	2708-050	4
D	**NEMA 213/215TC Motor**				
	Hub, Outer Magnet - **1-3/8"** Bore	15	Carbon Steel	2514-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, 56C-286TC, Group I	92	Al, Anodized	2555-070	1
	Bolt, Motor/Adapter (1/2-13 x 1 SHCS)	96	Carbon Steel	2708-050	4
E	**NEMA 254/256TC Motor**				
	Hub, Outer Magnet - **1-5/8"** Bore	15	Carbon Steel	2891-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, 56C-286TC, Group I	92	Al, Anodized	2555-070	1
	Adapter, 254/256TC, Group I	91	Al, Anodized	2890-070	1
	Bolt, Motor/Adapters (1/2-13 x 1-3/4 SHCS)	96	18-8SS	2935-060	4
F	**NEMA 284/286TC Motor**				
	Hub, Outer Magnet - **1-7/8"** Bore	15	Carbon Steel	2515-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, 56C-286TC, Group I	92	Al, Anodized	2555-070	1
	Adapter, 284/286TC, Group I	91	CS/Epoxy	2896-050	1
	Bolt, Adapter/Adapter (1/2-13 x 1-1/4 SHCS)	96	18-8SS	3153-060	4
	Bolt, Motor/Adapter (1/2-13 x 1-3/4 SHCS)	97	18-8SS	2935-060	4
J	**NEMA 284/286TSC Motor**				
	Hub, Outer Magnet - **1-5/8"** Bore	15	Carbon Steel	2891-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, 284/286TSC, Group I	92	CS/Epoxy	2897-050	1
	Bolt, Motor/Adapter (1/2-13 x 1 SHCS)	96	Carbon Steel	2708-050	4
S	**IEC 90 Motor**				
	Hub, Outer Magnet - **24 mm** Bore	15	Carbon Steel	3296-050	1
	Set Screw, Hub/Shaft (1/4-28 x 1/4 SHSS-CP)	57	316SS	2718-010	2
	Adapter, IEC 90, B5, Group I	92	CS/Epoxy	2590-050	1
	Bolt, Adapter to Motor (7/16-14 x 1 SHCS)	96	18-8SS	2535-060	4

Appendix 5: Bill of Materials (Continued)

Code	Part Description	Ref #	Material	3 x 2 x 8	Qty
Position 10 Continued - Motor Frame Size (If Close-Coupled Mounted)					
T	**IEC 100/112 Motor**				
	Hub, Outer Magnet - **28 mm** Bore	15	Carbon Steel	2552-050	1
	Set Screw, Hub/Shaft (1/4-28 x 1/4 SHSS-CP)	57	316SS	2718-010	2
	Adapter, IEC 100/112, B5, Group I	92	Al, Anodized	2591-070	1
	Bolt, Adapter to Motor (1/2-13 x 1-1/4 SHCS)	96	18-8SS	3153-060	4
U	**IEC 132 Motor**				
	Hub, Outer Magnet - **38 mm** Bore	15	Carbon Steel	3589-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, IEC 132, B5, Group I	92	Al, Anodized	3588-070	1
	Bolt, Adapter to Motor (1/2-13 x 1-1/2 SHCS)	96	18-8SS	2847-060	4
	Nut, Adapter to Motor (1/2-13 Hex)	102	18-8SS	2621-060	4
	Lock-Washer, Adapter to Motor (1/2)	103	18-8SS	2970-060	4
V	**IEC 160 Motor**				
	Hub, Outer Magnet - **42 mm** Bore	15	Carbon Steel	3149-050	1
	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	57	18-8SS	2719-060	2
	Adapter, IEC 160, B5, Group I	91	Al, Anodized	2893-070	1
	Adapter, 56C-286TC, Group I	92	Al, Anodized	2555-070	1
	Bolt, Adapter to Adapter (1/2-13 x 1 SHCS)	96	Carbon Steel	2708-050	4
	Bolt, Adapter to Motor (3/4-10 x 2-3/4 SHCS)	101	18-8SS	5298-060	4
	Nut, Adapter to Motor (3/4-10 Hex)	102	18-8SS	5299-060	4
	Lock-Washer, Adapter to Motor (3/4)	103	18-8SS	5297-060	4
Add-Ons					
-	Guard, Coupling (Motor/Power Frame)	-	304SS	2731-013	1
-	Base Plate #138E (38" x 15" x 3.4" Channel)	-	CS/Epoxy	3519-050	1
-	Base Plate #148 (48" x 15" x 3.4" Channel)	-	CS/Epoxy	3520-050	1
-	Base Plate #254E (54" x 18" x 4" Channel)	-	CS/Epoxy	3527-050	1
-	Motor Riser	-	CS/Epoxy	CF	2
-	Power Frame Riser	-	CS/Epoxy	CF	1
-	PMP-25 Motor Load Control	-	Misc	3622-000	1

Appendix 6: Reference Drawings
3x2x8 w/ Group 1 Drive & Metal Containment Can

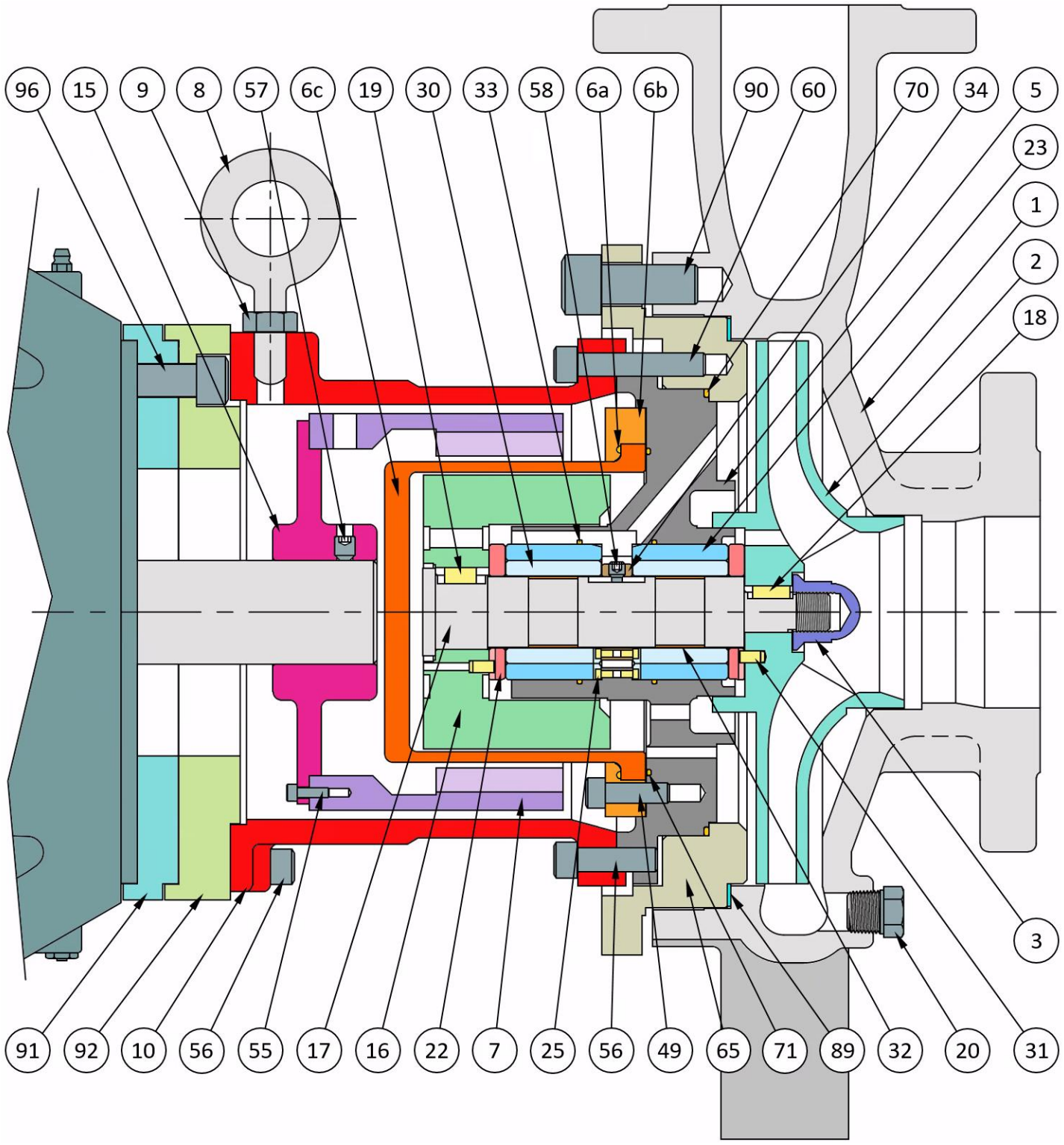


Appendix 6: Reference Drawings (Continued)
3x2x8 w/ Group 1 Drive & Metal Containment Can

Ref. No.	Part Description	Qty.
1	Casing, Flanged (ANSI RF 150# or 300#)	1
2	Impeller, MC 3x2x8, Modified (Closed)	1
3	Nut, Impeller, MC (5/8-18 Acorn)	1
5	Bearing Housing, Standard Group 1 MC	1
6	Containment Can, Metal	1
7	Outer Magnet (without Hub)	1
8	Eyebolt	1
9	Nut, Eyebolt	1
10	Mounting Bracket (Standard Group 1)	1
15	Hub, Outer Magnet	1
16	Inner Magnet	1
17	Shaft, Group 1 MC	1
18	Key, Impeller	1
19	Key, Inner Magnet	1
20	Drain Plug, 3/8" NPT	1
22	Bearing, Thrust	2
23	Bearing, Radial, Stationary	2
25	Pin, Sleeve/Radial Bearing	4
30	Bearing, Sleeve, Rotating	2
31	Pin, Thrust Bearing	2
32	Tolerance Ring, Shaft	2
33	O-Ring, Bearing Retaining (2-034)	2
34	Spacer, Sleeve Bearings	1
49	Bolt, Metal Can (5/16-24 x 3/4 SHCS)	8
55	Bolt, Hub/Outer Magnet (#8-32 x 1/2 SHCS)	8
56	Bolt, Bracket/Bearing Housing (3/8-16 x 1-1/4 SHCS)	2
	Bolt, Bracket/Motor Adapter (3/8-16 x 1-1/4 SHCS)	4
57	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	2
58	Set Screw, Spacer/Shaft (1/4-28 x 1/4 SHSS-HD)	1
60	Bolt, Bracket/Casing Adapter (3/8-24 x 2 SHCS)	8
65	Casing Adapter (G1 Bracket to G2 8" Casing)	1
70	O-Ring, Casing Adapter (2-166)	1
71	O-Ring, Containment Can (2-049)	1
89	Gasket, Casing (Group 2, 8")	1
90	Bolt, Casing Adapter/Casing (5/8-11 x 1-1/2 SHCS)	8
91	**Adapter #2, Group I** (Used for select motor frames)	1
92	**Adapter #1, Group I** (Used for all motor frames)	1
96	**Bolt, Adapter** (Size varies per motor frame)	4

NOTE: For Liquiflo Part Numbers, see **Appendix 5**

Appendix 6: Reference Drawings (Continued)
3x2x8 w/ Group 1 Drive & Ceramic Containment Can

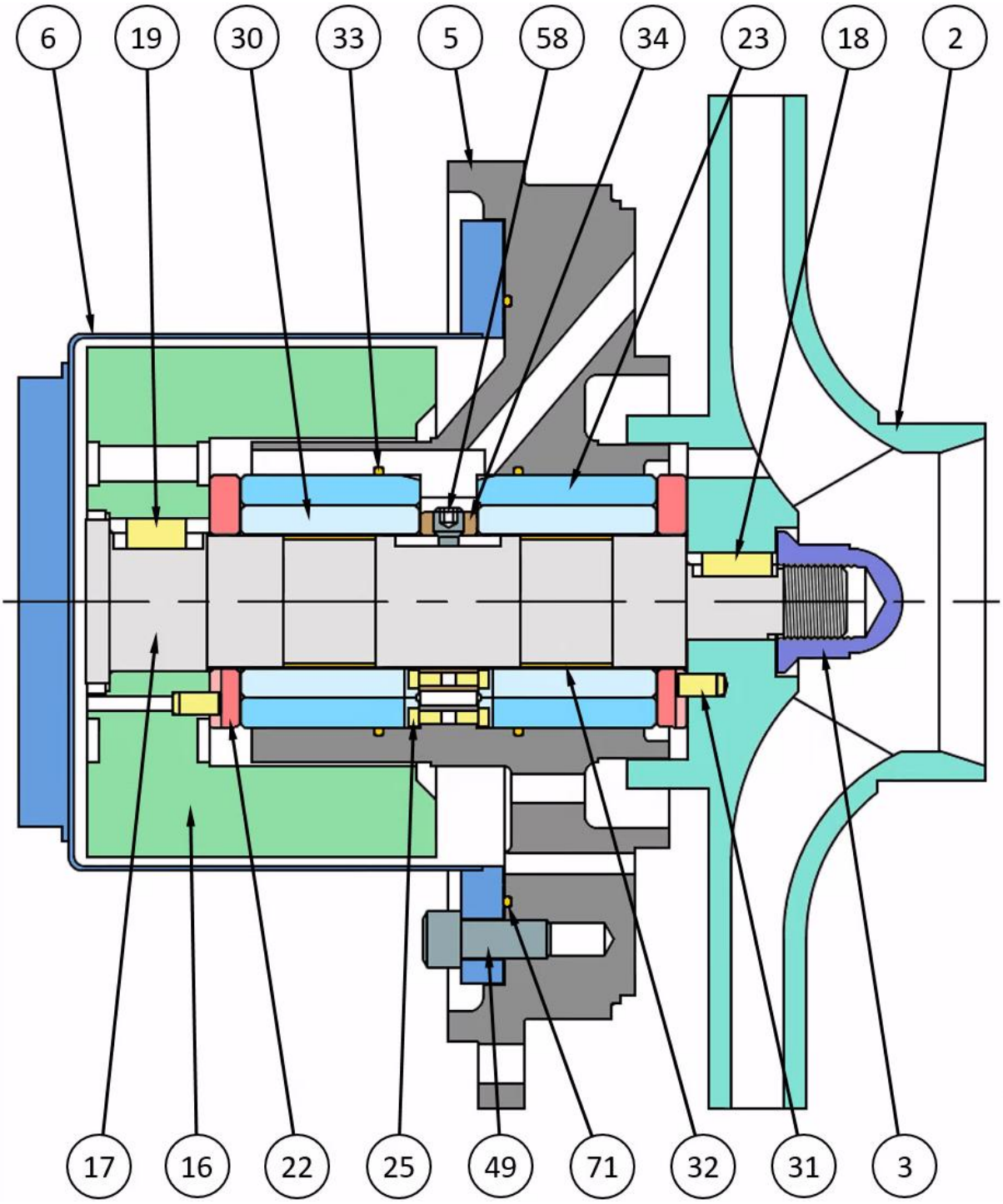


Appendix 6: Reference Drawings (Continued)
3x2x8 w/ Group 1 Drive & Ceramic Containment Can

Ref. No.	Part Description	Qty.
1	Casing, Flanged (ANSI RF 150# or 300#)	1
2	Impeller, MC 3x2x8, Modified (Closed)	1
3	Nut, Impeller, MC (5/8-18 Acorn)	1
5	Bearing Housing	1
6a	O-Ring, Flange Bumper, Ceramic Cont. Can (2-159)	1
6b	Flange, Ceramic Containment Can	1
6c	Containment Can, Ceramic	1
7	Outer Magnet (without Hub)	1
8	Eyebolt	1
9	Nut, Eyebolt	1
10	Mounting Bracket (Standard Group 1)	1
15	Hub, Outer Magnet	1
16	Inner Magnet	1
17	Shaft	1
18	Key, Impeller	1
19	Key, Inner Magnet	1
20	Drain Plug, 3/8" NPT	1
22	Bearing, Thrust	2
23	Bearing, Radial, Stationary	2
25	Pin, Sleeve/Radial Bearing	4
30	Bearing, Sleeve, Rotating	2
31	Pin, Thrust Bearing	2
32	Tolerance Ring, Shaft	2
33	O-Ring, Bearing Retaining (2-034)	2
34	Spacer, Sleeve Bearings	1
46	Adapter, Casing (1.5 x 1 x 8)	1
49	Bolt, Ceramic Can (5/16-24 x 1 SHCS)	8
55	Bolt, Hub/Outer Magnet (#8-32 x 1/2 SHCS)	8
56	Bolt, Bracket/Bearing Housing (3/8-16 x 1-1/4 SHCS)	2
	Bolt, Bracket/Motor Adapter (3/8-16 x 1-1/4 SHCS)	4
57	Set Screw, Hub/Shaft (5/16-24 x 3/8 SHSS-CP)	2
58	Set Screw, Spacer/Shaft (1/4-28 x 1/4 SHSS-HD)	1
60	Bolt, Bracket/Casing Adapter (3/8-24 x 2 SHCS)	8
65	Casing Adapter (G1 Bracket to G2 8" Casing)	1
70	O-Ring, Casing Adapter (2-166)	1
71	O-Ring, Containment Can (2-049)	1
89	Gasket, Casing (Group 2, 8")	1
90	Bolt, Casing Adapter/Casing (5/8-11 x 1-1/2 SHCS)	8
91	**Adapter #2, Group I** (Used for select motor frames)	1
92	**Adapter #1, Group I** (Used for all motor frames)	1
96	**Bolt, Adapter** (Size varies per motor frame)	4

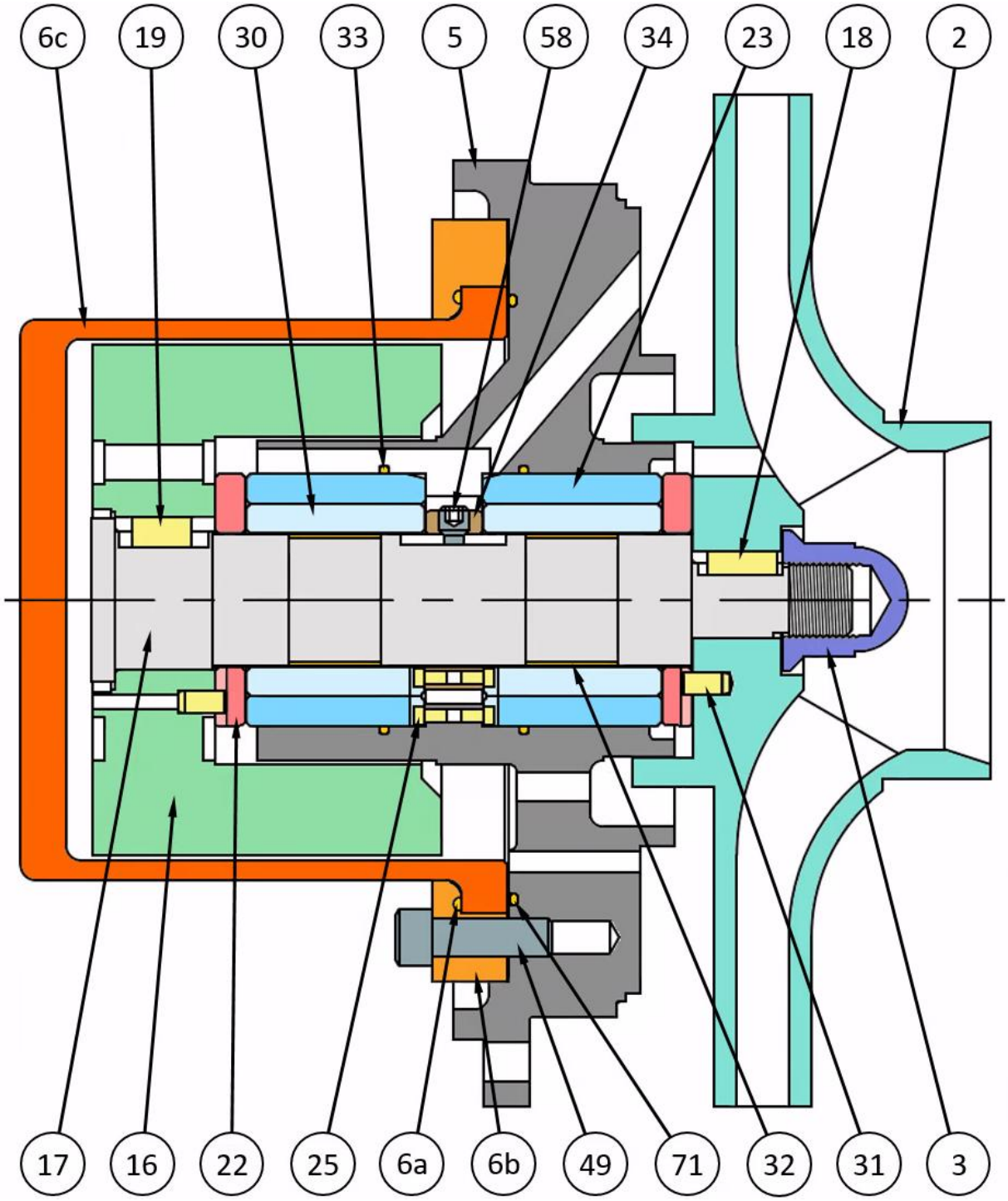
NOTE: For Liquiflo Part Numbers, see **Appendix 5.**

Appendix 6: Reference Drawings (Continued)
3x2x8 Module w/ Metal Containment Can



Refer to Part Descriptions on page 39.

Appendix 6: Reference Drawings (Continued)
3x2x8 Module w/ Ceramic Containment Can



Refer to Part Descriptions on page 41.

Appendix 7: Troubleshooting Guide

Troubleshooting Guide – Part 1

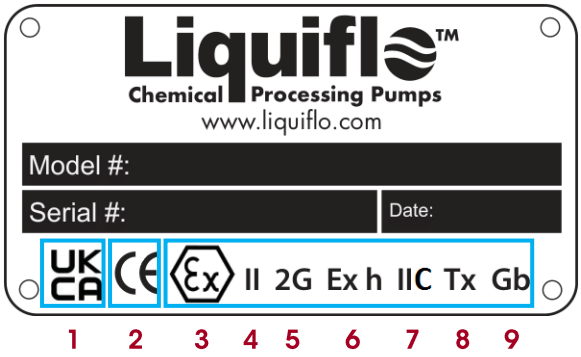
Problem	Possible Cause	Corrective Action
No discharge	Pump not primed	Verify suction pipe is submerged. Increase suction pressure. Open suction valve.
	Wrong direction of rotation	Reverse motor leads.
	Valves closed	Open all suction and discharge valves.
	Bypass valve open	Close bypass valve.
	Air leak(s) 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. Check position of outer magnet on shaft of motor or power frame. Ensure discharge valve is not fully open at start-up, causing high power demand. Increase time for motor to reach full speed (i.e., use slow start device or VFD).
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	Re-prime pump.
	Air leak(s) 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 7: Troubleshooting Guide (Continued)

Troubleshooting Guide – Part 2

Problem	Possible Cause	Corrective Action
Rapid pump wear	Abrasives in fluid	Install suction strainer. Limit solids concentration. Reduce pump speed or use larger pump running at lower speed.
	Corrosion wear	Use materials of construction that are acceptable for fluid being pumped.
	Extended dry running	Install power sensor to stop pump.
	Discharge pressure too high	Increase pipe diameter. Decrease pipe run.
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 8: Tag Certification Markings



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

No.	Marking	Meaning
1	UK CA	This marking confirms that this pump meets the requirements of the UK Regulation **SI 2016/1107** – The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016. **UK Conformity Assessed (UKCA) marking** is a certification mark that indicates conformity with the applicable requirements for products sold within Great Britain. The UKCA marking became part of UK law on EU exit day, January 31, 2020.
2	CE	This marking confirms that this pump is compliant with the European Union's **Machinery Directive 2006/42/EC**. **Conformitè Europëenne (CE) marking** (French for "European Conformity") indicates that a product has been assessed by the manufacturer and certified to meet EU safety, health and environmental protection requirements. The CE marking originated in 1985 and is mandatory for any products marketed in the EU and the European Economic Area (EEA).
3	Ex	This marking confirms that this pump meets the requirements of **ATEX 114 "equipment" Directive 2014/34/EU** – Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres (published on March 29, 2014 by the European Parliament). **ATEX** is a codeword which comes from the French description – "Appareils destinés à être utilisés en **AT**mosphères **EX**plosives." The English translation is: "Devices intended for use in explosive atmospheres."
4	II	**Equipment Group II** indicates that this pump is suitable for surface (non-mining) applications and can be used in areas having explosive gases or liquids.
5	2G	**Equipment Category 2 – Gases/Vapors (G)**: This indicates that the pump is suitable for use in Zones 1 & 2: **Zone 1 (gases):** An area in which an explosive mixture is likely to occur in normal operation **Zone 2 (gases):** An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will only exist for a short time
6	Ex h	This marking indicates **Explosion Protection** of the pump as defined in standard **EN ISO 80079-37**. Protection type is Constructional Design Safety (**c**).
7	IIC	This marking indicates that the pump is suitable for use in atmospheres containing **Ignitable Gases: Group IIC** (e.g., hydrogen, acetylene, CS_2 or gases of similar hazard).
8	Tx	This marking indicates the **Temperature Class** (Maximum Allowable Surface Temperature) of the pump which depends on the materials of construction. **It is the responsibility of the operator to ensure that the fluid temperature does not exceed the maximum use temperature of the pump's materials.** Refer to ATEX document on Liquiflo website.
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.

NOTES