ITT

Goulds Pumps

Installation, Operation, and Maintenance Manual

Model 3296 EZMAG

Engineered for life

Table of Contents

Introduction and Safety

Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

Requesting other information

Special versions can be supplied with supplementary instruction leaflets. See the sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or in the sales documents, please contact the nearest ITT representative.

Always specify the exact product type and identification code when requesting technical information or spare parts.

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- This manual clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Do not change the service application without the approval of an authorized ITT representative.

CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard levels

Hazard level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury
 **CAUTION:**	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:

Electrical Hazard:

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

Environmental safety

The work area

Always keep the station clean to avoid and/or discover emissions.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.

- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

Recycling guidelines

Always follow local laws and regulations regarding recycling.

User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Helmet
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

Magnetic precautions

WARNING:

Magnetic drive pumps contain very strong magnets that can pose health risks. Always observe these guidelines:

- Avoid working with, being in proximity of, or handling the magnets contained in this pump if you have any of these conditions:
  - An artificial cardiac pacemaker
  - An implanted defibrillator
  - A metallic prosthetic heart valve
  - Internal wound clips, from surgery
  - Prosthetic joints
  - Metallic wiring
  - Any other type of metallic, prosthetic device
- Individuals who have had any surgery, especially to the chest or head, and do not know if metallic clips were surgically implanted need to avoid work on this unit unless their physician can confirm that no metallic devices exist.

Wash the skin and eyes

Do the following if chemicals or hazardous fluids have come into contact with your eyes or your skin:

If you need to wash your...	Then...
Eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least one minute. 3. Seek medical attention, if required.

Safety regulations for Ex-approved products in potentially explosive atmospheres

Guidelines for compliance

Compliance is only fulfilled when the pump is operated within its intended use, for example within its intended hydraulic range. The conditions of the service must not be changed without approval of an authorized ITT representative. When installing or maintaining explosion-proof pumps, follow these guidelines:

- Always install ATEX-approved equipment in compliance with the directive and applicable standards (IEC/EN 60079–14).

WARNING:

This manual clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.

If there are any questions regarding these requirements, the intended use, or if the equipment requires modification, contact an ITT representative before you proceed.

Personnel requirements

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas and/or vapor present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example IEC/EN 60079-17).

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data stated on the nameplates.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Never start a pump without the proper priming.
- Before you start working with the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Make sure that the equipment is properly maintained:
  - Monitor the pump components and the end temperature of the liquid.
  - Maintain proper bearing lubrication.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that have been provided by an authorized ITT representative.

Equipment for monitoring

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Pressure gauges
- Flow meters
- Level indicators
- Motor load readings
- Temperature detectors
- Bearing monitors
- Leak detectors

Product warranty

Coverage

ITT undertakes to remedy faults in products from ITT under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to an ITT representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by ITT-authorized personnel.
- Genuine ITT parts are used.
- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

Limitations

The warranty does not cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting ITT
- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

Spare parts

ITT guarantees that spare parts will be available for 10 years after the manufacture of this product has been discontinued.

Transportation and Storage

Inspect the delivery

Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

Inspect the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

Transportation guidelines

Pump handling

WARNING:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- These pumps might use carbon or ceramic silicon carbide components. Do not drop the pump or subject it to shock loads as this can damage the internal ceramic components.

NOTICE: Use a forklift truck or an overhead crane with sufficient capacity to move the pallet with the pump unit on top. Failure to do so can result in equipment damage.

Lifting methods

WARNING:

- Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Do not attach sling ropes to shaft ends.

Table 1: Methods

Pump type	Lifting method
A bare pump without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A base-mounted pump	Use slings under the pump casing and the drive unit, or under the base rails.

Examples

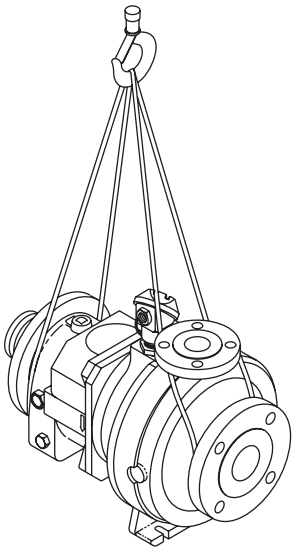


Figure 1: Proper lifting method for a bare pump

NOTICE:
Do not use this lifting method to life a Polyshield ANSI Combo with the pump and motor mounted. This can result in equipment damage.

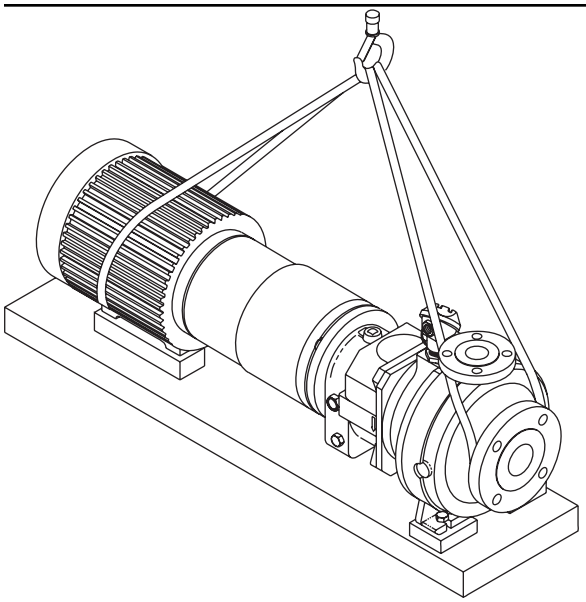


Figure 2: Proper lifting method for a pump with a base and driver

NOTICE:
Do not use this lifting method to life a Polyshield ANSI Combo with the pump and motor mounted. This can result in equipment damage.

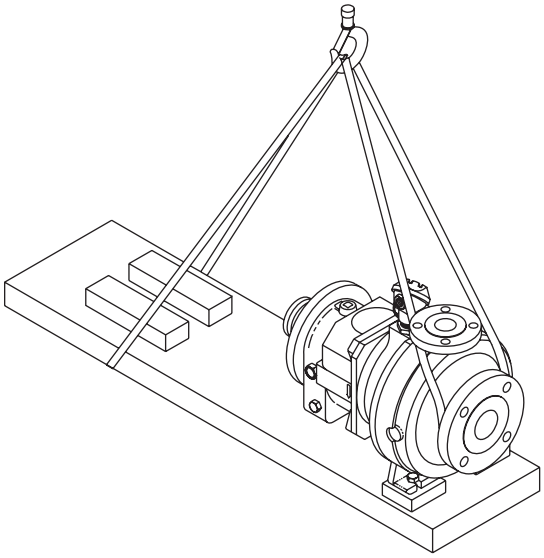


Figure 3: Proper lifting method for a pump with a base and no driver

Storage guidelines

Pump storage requirements

Storage requirements depend on the amount of time that you store the pump. The normal packaging is designed only to protect the pump during shipping.

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	• Store in a covered and dry location. • Store the unit free from dirt and vibrations.
Long-term (more than six months)	• Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations. • Rotate the shaft by hand several times at least every three months.

Treat bearing and machined surfaces so that they are well preserved. Refer to drive unit and coupling manufacturers for their long-term storage procedures.

You can purchase long-term storage treatment with the initial pump order or you can purchase it and apply it after the pumps are already in the field. Contact your local ITT sales representative.

Product Description

General description

Model 3296 EZMAG

The Model 3296 EZMAG is a sealless centrifugal pump with an enclosed impeller that is driven by a synchronous magnetic coupling. Model 3296 EZMAG meets the dimensional standards of ANSI B73.1.

Casing

The casing is top centerline discharge and is self-venting. It incorporates a fully-confined gasket with ANSI Class 150 flanges that are serrated and raised-faced. The 3296 EZMAG is designed to have a metal-to-metal fit between the casing and the backplate.

Magnetic coupling

The magnetic coupling is a coaxial synchronous type that uses rare earth magnets. This concept results in a compact design and allows the impeller to turn at the same speed as the motor, which means that there is no slip between the drive and the driven magnets.

Magnets

Two types of rare earth magnets are available:

- Neodymium Iron (NdFe) is used when pumped liquid temperatures are less than 365°F (180°C).
- Samarium Cobalt (SmCo) is used when pumped liquid temperatures are between 365°F (180°C) and 536°F (280°C).

Containment shell

The containment shell isolates the pumped liquid from the atmosphere and is constructed from Hastelloy-C.

Sleeve bearings and thrust bearings

Goulds standard bearing material is Pure Sintered Alpha Grade Silicon Carbide. Dryguard™ bearings are available for dry-run protection.

Impeller

The 3296 EZMAG uses an enclosed impeller that is hydraulically-balanced and keyed to the shaft.

Bearing frame

The standard configuration is cast iron with ball bearings that are flood oil–lubricated. Greased-for-life bearings systems are available as an option. Bronze bearing isolators are provided for protection and reliability of the bearings and the lubricant.

Nameplate information

Important information for ordering

Every pump has nameplates that provide information about the pump. The nameplates are located on the casing and the bearing frame.

When you order spare parts, identify this pump information:

- Model
- Size
- Serial number
- Item numbers of the required parts

Refer to the nameplate on the pump casing for most of the information. See Parts List for item numbers.

Nameplate types

Nameplate	Description
ATEX	If applicable, your pump unit might have an ATEX nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the ATEX specifications of this pump.

Nameplate on the pump casing using English units

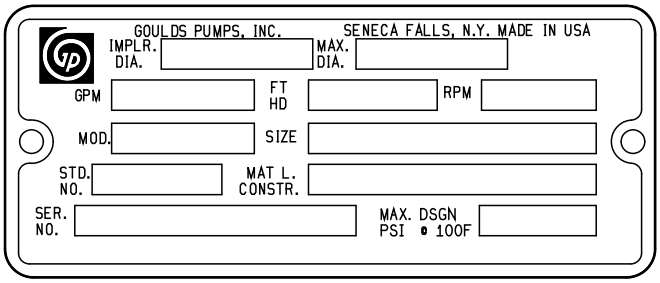


Table 2: Explanation of nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute
FT HD	Rated pump head, in feet
RPM	Rated pump speed, revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST.	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX DSGN PSI @ 100F	Maximum pressure at 100ºF according to the pump design

Nameplate on the pump casing using metric units

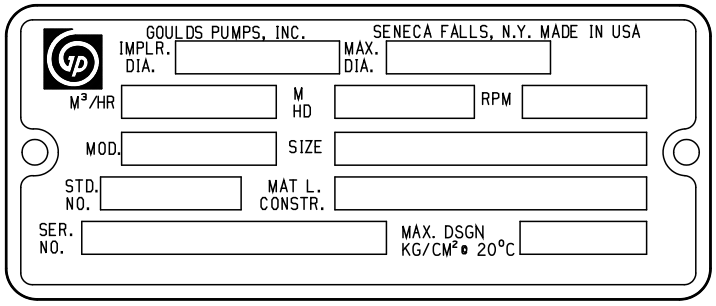


Table 3: Explanation of the nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter
MAX. DIA.	Maximum impeller diameter
M^3/HR	Rated pump flow, in cubic meters per hour

Nameplate field	Explanation
M HD	Rated pump head, in meters
RPM	Rated pump speed, in revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX. DSGN KG/CM^3 @ 20°C	Kilograms per cubic centimeter at 20°C

Nameplate on the bearing frame

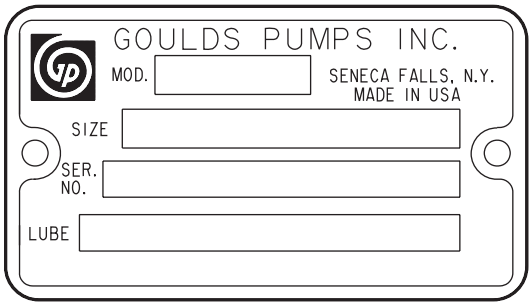


Table 4: Explanation of the nameplate on the bearing frame

Nameplate field	Explanation
MOD.	Pump model
SIZE	Size of the pump
SER. NO.	Serial number of the pump
LUBE	Lubricant, oil or grease

ATEX nameplate

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
T4	Temperature class

Table 5: Temperature class definitions

Code	Maximum permissible surface temperature in °F (°C)	Minimum permissible surface temperature in °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)

Code	Maximum permissible surface temperature in °F (°C)	Minimum permissible surface temperature in °F (°C)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

NOTICE: Make sure that the code classifications on the pump are compatible with the specific environment in which you plan to install the equipment. If they are not compatible, do not operate the equipment and contact your ITT representative before you proceed.

Installation

Preinstallation

Precautions

WARNING:

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.

NOTICE: Supervision by an authorized ITT representative is recommended to ensure proper installation. Failure to do so may result in equipment damage or decreased performance.

Evaluate the installation in order to determine that the Net Positive Suction Head Available ($NPSH_A$) meets or exceeds the Net Positive Suction Head Required ($NPSH_R$), as stated by the pump performance curve.

Pump location guidelines

WARNING:

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.

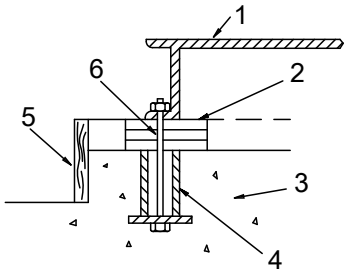
Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
If you require lifting equipment such as a hoist or tackle, make sure that there is enough space above the pump.	This makes it easier to properly use the lifting equipment and safely remove and relocate the components to a safe location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: • Pressure relief valves • Compression tanks • Pressure controls • Temperature controls • Flow controls If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.

Foundation requirements

Requirements

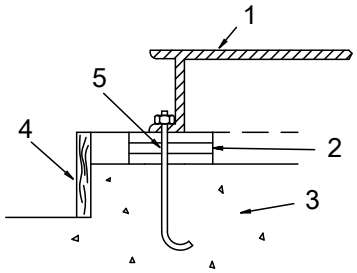
- The foundation must be able to absorb any type of vibration and form a permanent, rigid support for the pump unit.
- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.
- Sleeve-type and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.

Sleeve-type bolts



1. Baseplate
2. Shims or wedges
3. Foundation
4. Sleeve
5. Dam
6. Bolt

J-type bolts



1. Baseplate
2. Shims or wedges
3. Foundation
4. Dam
5. Bolt

Baseplate-mounting procedures

Prepare the baseplate for mounting

1. Remove all the attached equipment from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with an epoxy primer.

   Use an epoxy primer only if you used an epoxy-based grout.
4. Remove the rust-proofing coat from the machined mounting pads using an appropriate solvent.
5. Remove water and debris from the foundation-bolt holes.

Install the baseplate using shims or wedges

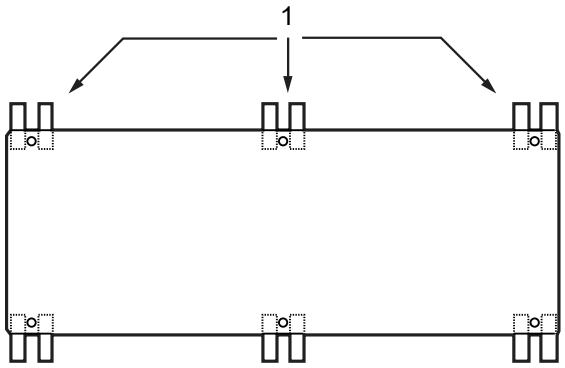
Required tools:

- Two sets of shims or wedges for each foundation bolt
- Two machinist's levels
- Baseplate-leveling worksheet

This procedure is applicable to cast iron and fabricated steel baseplates.

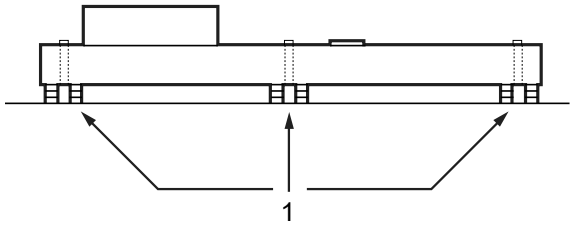
1. Remove water and debris from the anchor bolt holes and sleeves.
2. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt holes.
3. Put the sets of wedges or shims on each side of each foundation bolt.

   Make sure that the wedges extend 0.75 in. (19 mm) to 1.5 in. (38 mm) above the foundation to provide adequate space for grouting. The wedges will provide adequate support for the baseplate after it is grouted.



1. Shims or wedges

Figure 4: Top view



1. Shims or wedges

Figure 5: Side view

4. Lower the baseplate carefully onto the foundation bolts.
5. Put the machinist's levels across the mounting pads of the driver and the mounting pads of the pump.

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

6. Level the baseplate both lengthwise and across by adding or removing shims or moving the wedges.

   These are the leveling tolerances:

   - A maximum difference of 0.125 in. (3.2 mm) lengthwise
   - A maximum difference of 0.059 in. (1.5 mm) across

   You can use the baseplate-leveling worksheet when you take the readings.
7. Hand-tighten the nuts for the foundation.

Install the baseplate using jackscrews

Tools required:

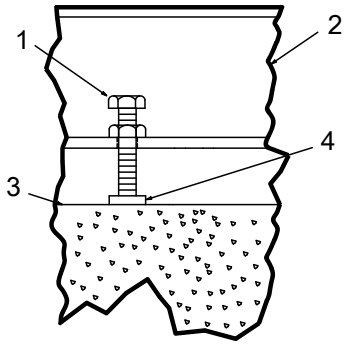
- Anti-seize compound
- Jackscrews
- Bar stock
- Two machinist's levels
- Baseplate-leveling worksheet

This procedure applies to the feature-fabricated steel baseplate and the advantage base baseplate.

1. Apply an anti-seize compound on the jackscrews.

   The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:
   a) Cut the plates from the bar stock and chamfer the edges of the plates in order to reduce stress concentrations.
   b) Put the plates between the jackscrews and the foundation surface.
   c) Use the four jackscrews in the corners in order to raise the baseplate above the foundation.

      Make sure that the distance between the baseplate and the foundation surface is between 0.75 in. (19 mm) and 1.50 in. (38 mm).
   d) Make sure that the center jackscrews do not touch the foundation surface yet.



1. Jackscrew
2. Baseplate
3. Foundation
4. Plate

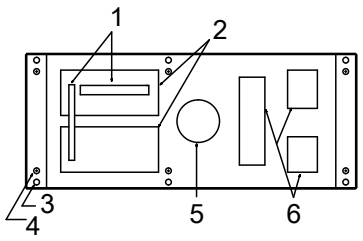
3. Level the driver mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

   a) Put one machinist's level lengthwise on one of the two pads.
   b) Put the other machinist's level across the ends of the two pads.
   c) Level the pads by adjusting the four jackscrews in the corners.

      Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.

      Use the baseplate-leveling worksheet when you take the readings.



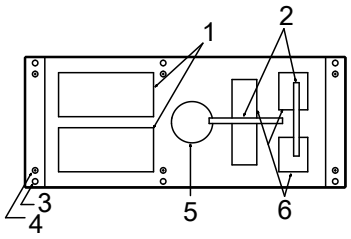
1. Machinist's levels
2. Driver's mounting pads
3. Foundation bolts
4. Jackscrews
5. Grout hole
6. Pump's mounting pads

4. Turn the center jackscrews down so that they rest on their plates on the foundation surface.
5. Level the pump mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

a) Put one machinist's level lengthwise on one of the two pads.
b) Put the other level across the center of the two pads.
c) Level the pads by adjusting the four jackscrews in the corners.

   Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.



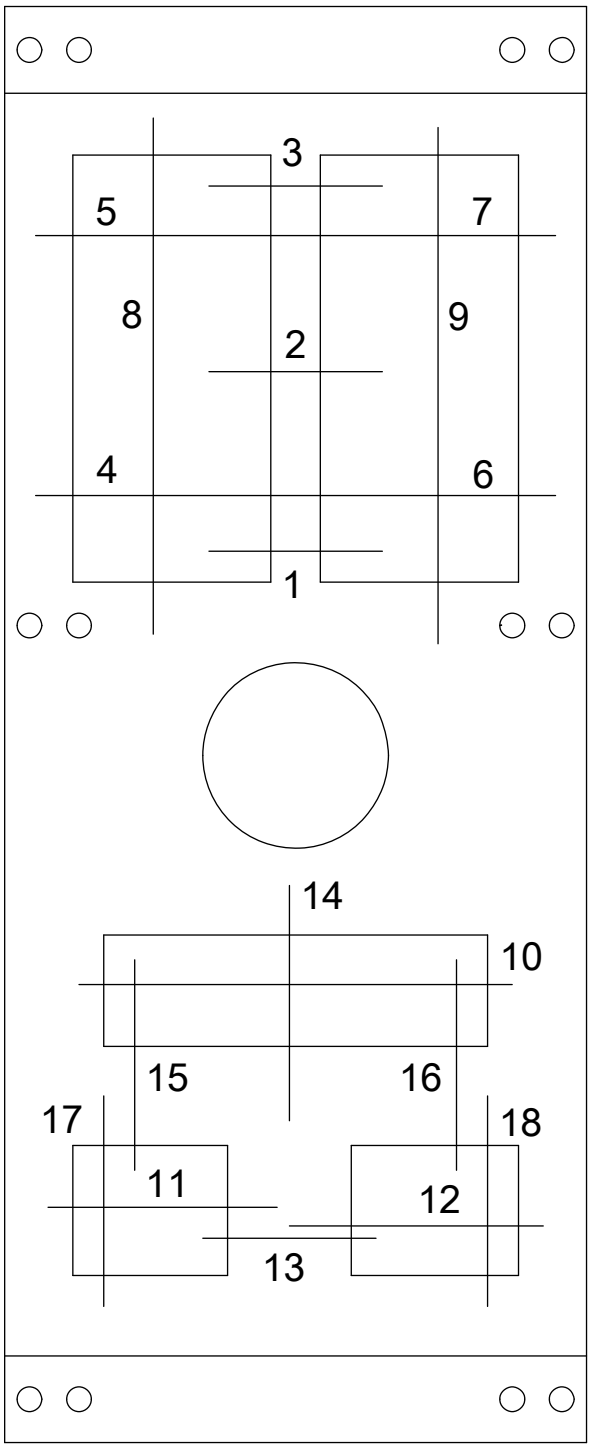
1. Driver's mounting pads
2. Machinist's levels
3. Foundation bolts
4. Jackscrews
5. Grout hole
6. Pump's mounting pads

6. Hand-tighten the nuts for the foundation bolts.
7. Check that the driver's mounting pads are level and adjust the jackscrews and the foundation bolts if necessary.

   The correct level measurement is a maximum of 0.002 in./ft (0.0167 mm/m).

Baseplate-leveling worksheet

Level measurements



1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

9)_____

10)_____

11)_____

12)_____

13)_____

14)_____

15)_____

16)_____

17)_____

18)_____

Pump-to-driver alignment

Precautions

WARNING:

- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

NOTICE: Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of frame-mounted units before you operate the unit. Failure to do so can result in equipment damage or decreased performance.

Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

- The process temperature changes.
- The piping changes.
- The pump has been serviced.

Types of alignment checks

Type of check	When it is used
Initial alignment (cold alignment) check	Prior to operation when the pump and the driver are at ambient temperature.
Final alignment (hot alignment) check	After operation when the pump and the driver are at operating temperature.

Initial alignment (cold alignment) checks

When	Why
Before you grout the baseplate	This ensures that alignment can be accomplished.
After you grout the baseplate	This ensures that no changes have occurred during the grouting process.
After you connect the piping	This ensures that pipe strains have not altered the alignment. If changes have occurred, you must alter the piping to remove pipe strains on the pump flanges.

Final alignment (hot alignment) checks

When	Why
After the first run	This ensures correct alignment when both the pump and the driver are at operating temperature.
Periodically	This follows the plant operating procedures.

Permitted indicator values for alignment checks

NOTICE: The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. You must use the correct tolerances. Failure to do so can result in misalignment and reduced pump reliability.

When dial indicators are used to check the final alignment, the pump and drive unit are correctly aligned when these conditions are true:

- The total indicator runout is a maximum of 0.002 in. (0.05 mm) at operating temperature.
- The tolerance of the indicator is 0.0005 in./in. (0.0127 mm/mm) of indicator separation at operating temperature.

Cold settings for parallel vertical alignment

Introduction

This section shows the recommended preliminary (cold) settings for electric motor-driven pumps based on different temperatures of pumped fluid. Consult driver manufacturers for recommended cold settings for other types of drivers such as steam turbines and engines.

Recommended settings

Pumped fluid temperature	Recommended setting for driver shaft
50°F (10°C)	0.002 in. (0.05 mm), low
150°F (65°C)	0.001 in. (0.03 mm), high
250°F (120°C)	0.005 in. (0.12 mm), high
350°F (175°C)	0.009 in. (0.23 mm), high
450°F (218°C)	0.013 in. (0.33 mm), high

Alignment measurement guidelines

Guideline	Explanation
Rotate the pump coupling half and the driver coupling half together so that the indicator rods have contact with the same points on the driver coupling half.	This prevents incorrect measurement.
Move or shim only the driver in order to make adjustments.	This prevents strain on the piping installations.
Make sure that the hold-down bolts for the driver feet are tight when you take indicator measurements.	This keeps the driver stationary since movement causes incorrect measurement.
Make sure that the hold-down bolts for the driver feet are loose before you make alignment corrections.	This makes it possible to move the driver when you make alignment corrections.
Check the alignment again after any mechanical adjustments.	This corrects any misalignments that an adjustment may have caused.

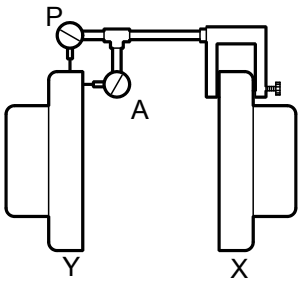
Attach the dial indicators for alignment

You must have two dial indicators in order to complete this procedure.

1. Attach two dial indicators on the pump coupling half (X):
   a) Attach one indicator (P) so that the indicator rod comes into contact with the perimeter of the driver coupling half (Y).

      This indicator is used to measure parallel misalignment.
   b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.

      This indicator is used to measure angular misalignment.



2. Rotate the pump coupling half (X) in order to check that the indicators are in contact with the driver coupling half (Y) but do not bottom out.
3. Adjust the indicators if necessary.

Pump-to-driver alignment instructions

Perform angular alignment for a vertical correction

1. Set the angular alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The coupling halves are farther apart at the bottom than at the top. Perform one of these steps: • Add shims in order to raise the feet of the driver at the shaft end. • Remove shims in order to lower the feet of the driver at the other end.
Positive	The coupling halves are closer at the bottom than at the top. Perform one of these steps: • Remove shims in order to lower the feet of the driver at the shaft end. • Add shims in order to raise the feet of the driver at the other end.

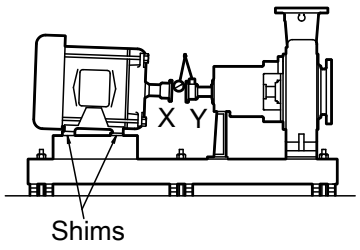


Figure 6: Side view of an incorrect vertical alignment

4. Repeat the previous steps until the permitted reading value is achieved.

Perform angular alignment for a horizontal correction

1. Set the angular alignment indicator (A) to zero on left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the left. • Slide the opposite end to the right.
Positive	The coupling halves are closer together on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the right. • Slide the opposite end to the left.

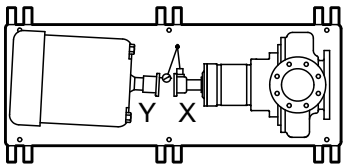


Figure 7: Top view of an incorrect horizontal alignment

4. Repeat the previous steps until the permitted reading value is achieved.

Perform parallel alignment for a vertical correction

Before you start this procedure, make sure that the dial indicators are correctly set up.

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

When aligning a cold unit, see the Cold settings for vertical parallel alignment table.

1. Set the parallel alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half.
2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The pump coupling half (X) is lower than the driver coupling half (Y). Remove shims of a thickness equal to half of the indicator reading value under each driver foot.
Positive	The pump coupling half (X) is higher than the driver coupling half. Add shims of a thickness equal to half of the indicator reading value to each driver foot.

NOTICE:

You must use an equal amount of shims with each driver foot to prevent misalignment. Failure to do so can result in equipment damage or decreased performance.

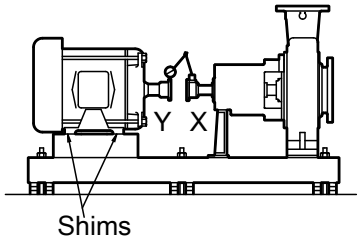


Figure 8: Side view of an incorrect vertical alignment

4. Repeat the previous steps until the permitted reading value is achieved.

Perform parallel alignment for a horizontal correction

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

1. Set the parallel alignment indicator to zero on the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The driver coupling half is to the left of the pump coupling half.
Positive	The driver coupling half is to the right of the pump coupling half.

4. Slide the driver carefully in the appropriate direction.

NOTICE: Make sure to slide the driver evenly. Failure to do so can negatively affect horizontal angular correction.

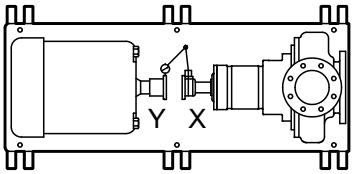


Figure 9: Top view of an incorrect horizontal alignment

5. Repeat the previous steps until the permitted reading value is achieved.

Perform complete alignment for a vertical correction

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart.

1. Set the angular and parallel dial indicators to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicators to the bottom-center position (6 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

Perform complete alignment for a horizontal correction

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart.

1. Set the angular and parallel dial indicators to zero at the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicators through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

Grout the baseplate

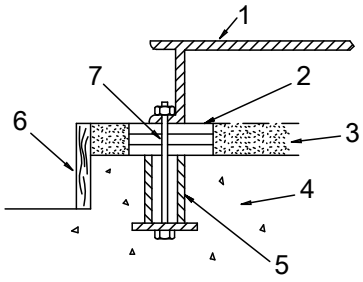
Required equipment:

- Cleaners: Do not use an oil-based cleaner because the grout will not bond to it. See the instructions provided by the grout manufacturer.
- Grout: Non-shrink grout is recommended.

1. Clean all the areas of the baseplate that will come into contact with the grout.
2. Build a dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.
4. Pour grout through the grout hole into the baseplate up to the level of the dam.

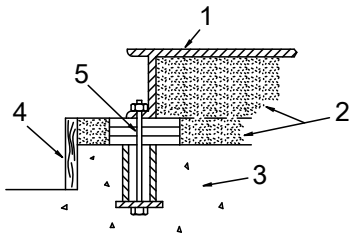
   When you pour the grout, remove air bubbles from it by using one of these methods:

   - Puddle with a vibrator.
   - Pump the grout into place.
5. Allow the grout to set.



1. Baseplate
2. Shims or wedges
3. Grout
4. Foundation
5. Sleeve
6. Dam
7. Bolt

6. Fill the remainder of the baseplate with grout, and allow the grout to set for at least 48 hours.



1. Baseplate
2. Grout
3. Foundation
4. Dam
5. Bolt

7. Tighten the foundation bolts.
8. Recheck the alignment.

Piping checklists

Fastening

WARNING:

- Only use fasteners of the proper size and material.
- Replace all corroded fasteners.
- Make sure that all fasteners are properly tightened and that there are no missing fasteners.

General piping checklist

Precautions

CAUTION:

- Never draw piping into place by using force at the flanged connections of the pump. This can impose dangerous strains on the unit and cause misalignment between the pump and driver. Pipe strain adversely affects the operation of the pump, which results in physical injury and damage to the equipment.
- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

NOTICE:

Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump. Deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.

Piping guidelines

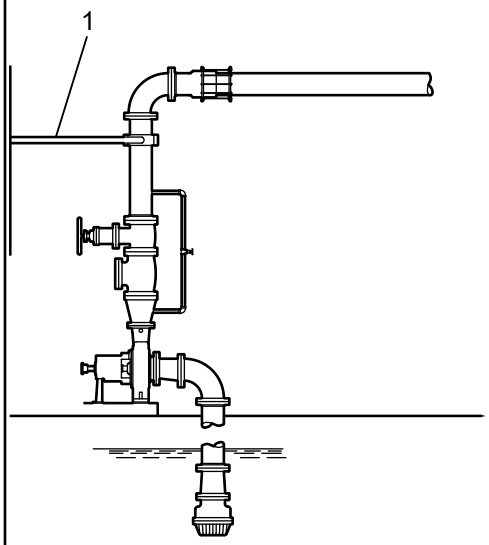
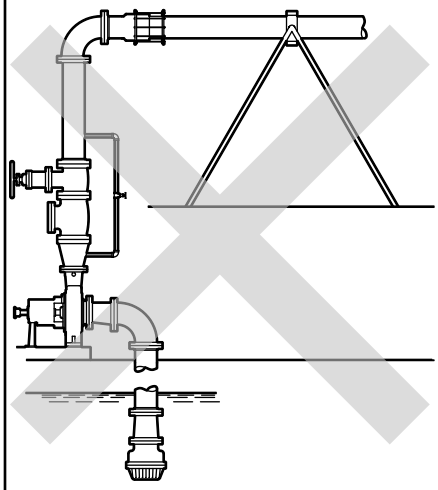
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: • Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings, seal, and shafting	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: • The grout for the baseplate or sub-base becomes hard. • The hold-down bolts for the pump and the driver are tightened.	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	

Check	Explanation/comment	Checked
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	

Example: Installation for expansion

Correct	Incorrect
 1. Expansion loop/joint	

Suction-piping checklist

Performance curve reference

Net positive suction head available ($NPSH_A$) must always exceed NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.

Refer to the Hydraulic Institute for NPSH and pipe friction values needed in order to evaluate suction piping.

Suction-piping checks

Check	Explanation/comment	Checked
Flush all suction piping before you connect it to the pump.	This reduces the risk of pump operation problems.	
Check that the suction piping fittings and joints are airtight and have no leaks.	—	
Check that the distance between the inlet flange of the pump and the closest elbow is at least two pipe diameters.	This minimizes the risk of cavitation in the suction inlet of the pump due to turbulence. See the Example sections for illustrations.	
Check that elbows in general do not have sharp bends.	See the Example sections for illustrations.	
Check that the suction piping is one or two sizes larger than the suction inlet of the pump.	The suction piping must never have a smaller diameter than the suction inlet of the pump.	

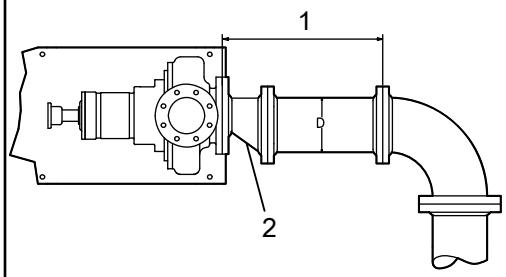
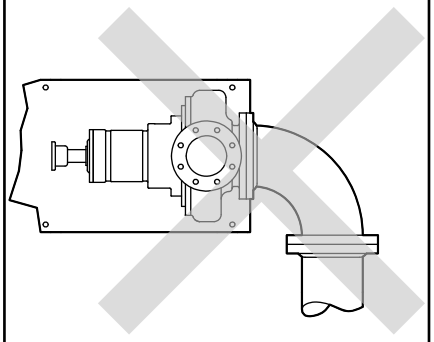
Check	Explanation/comment	Checked
Install an eccentric reducer between the pump inlet and the suction piping.	See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: • Sloping side down • Horizontal side at the top	See the example illustrations.	
If suction strainers or suction bells are used, check that they are at least three times the area of the suction piping.	Suction strainers help to prevent clogging. Mesh holes with a minimum diameter of 1/16 in. (1.6 mm) are recommended.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	

Liquid source below the pump

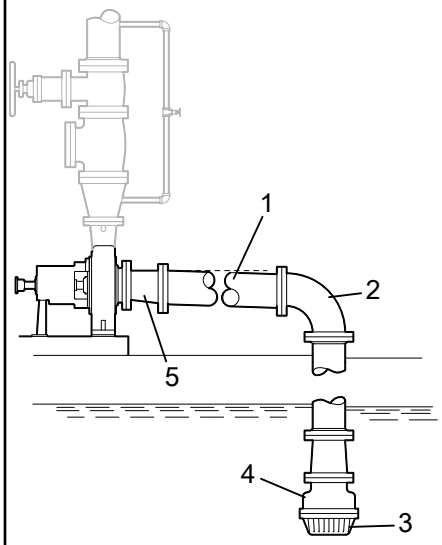
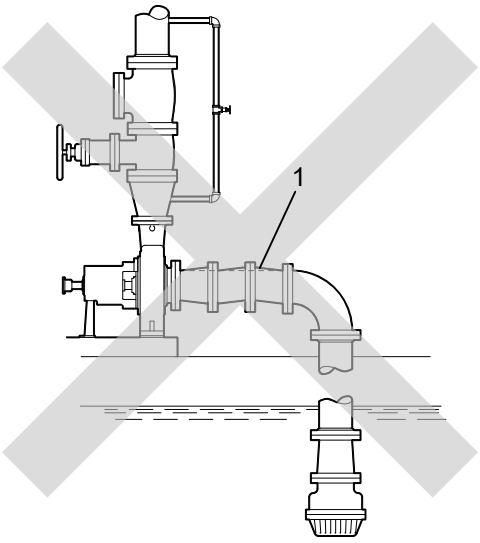
Check	Explanation/comment	Checked
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the suction piping slopes upwards from the liquid source to the pump inlet.	—	
If the pump is not self-priming, check that a device for priming the pump is installed.	Use a foot valve with a diameter that is at least equivalent to the diameter of the suction piping.	

Liquid source above the pump

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	This permits you to close the line during pump inspection and maintenance. Do not use the isolation valve to throttle the pump. Throttling can cause these problems: • Loss of priming • Excessive temperatures • Damage to the pump • Voiding the warranty	
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the piping is level or slopes downward from the liquid source.	—	
Make sure that no part of the suction piping extends below the suction flange of the pump.	—	
Make sure that the size of the entrance from the supply is one or two sizes larger than the suction pipe.	—	
Make sure that the suction piping is adequately submerged below the surface of the liquid source.	This prevents air from entering the pump through a suction vortex.	

Correct	Incorrect
The correct distance between the inlet flange of the pump and the closest elbow is at least two pipe diameters.  1. Enough distance to prevent cavitation 2. Eccentric reducer with a level top	

Example: Suction piping equipment

Correct	Incorrect
 1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top	 1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source

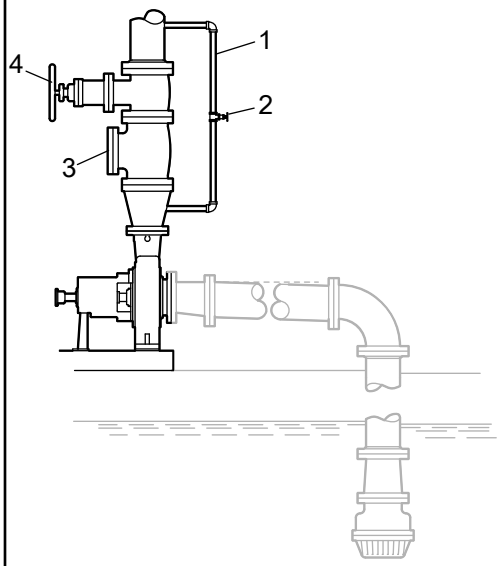
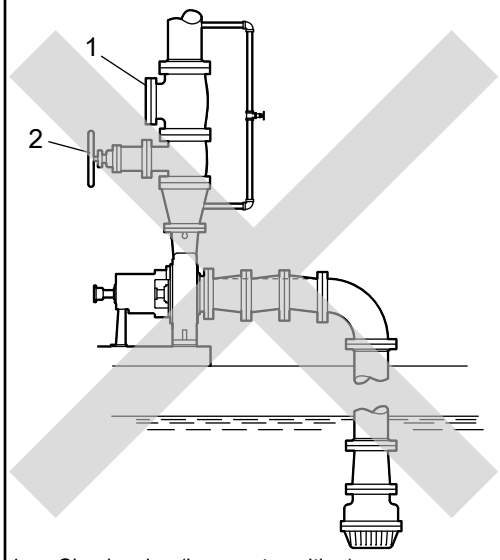
Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump See Example: Discharge piping equipment for illustrations.	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow.	

Check	Explanation/comment	Checked
	See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

Example: Discharge piping equipment

Correct	Incorrect
	
1. Bypass line 2. Shut-off valve 3. Check valve 4. Discharge isolation valve	1. Check valve (incorrect position) 2. The isolation valve should not be positioned between the check valve and the pump.

Final piping checklist

WARNING:

A build-up of gases within the pump, sealing system, or process piping system may result in an explosive environment. Make sure the process piping system, pump and sealing system are properly vented prior to operation.

Check	Explanation/comment	Checked
Check that the shaft rotates smoothly.	Rotate the shaft by hand. Make sure there is no rubbing that can lead to excess heat generation or sparks.	
Re-check the alignment to make sure that pipe strain has not caused any misalignment.	If pipe strain exists, then correct the piping.	

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

WARNING:

- Failure to follow these precautions before you start the pump will lead to serious personal injury and equipment failure.
- Never operate the pump without the coupling guard correctly installed.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.

Precautions

NOTICE:

- Verify the driver settings before you start the pump.
- Make sure that the warm-up rate does not exceed 2.5°F (1.4°C) per minute.

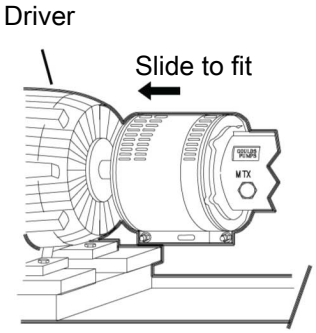
You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 100°F (38°C) of the fluid temperature.

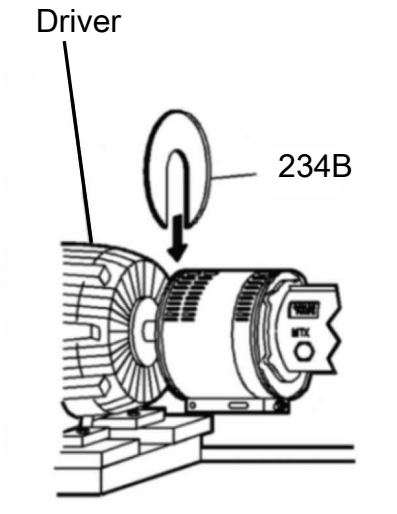
At initial startup, do not adjust the variable-speed drivers or check for speed governor or over-speed trip settings while the variable-speed driver is coupled to the pump. If the settings have not been verified, then uncouple the unit and refer to instructions supplied by the driver manufacturer.

Remove the coupling guard

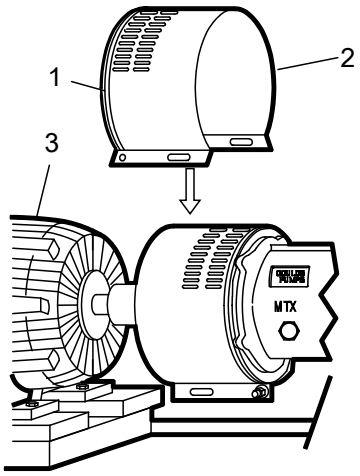
1. Remove the nut, bolt, and washers from the slotted hole in the center of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.



3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver-side end plate.



5. Remove the driver half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.

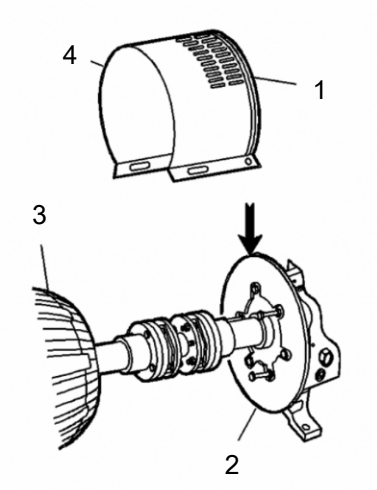


1. Annular groove
2. Driver half of the coupling guard
3. Driver

6. Remove the remaining nut, bolt, and washers from the pump half of the coupling guard.

   It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.

7. Remove the pump half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.



1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

Check the rotation

WARNING:

- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

1. Lock out power to the driver.
2. Make sure that the coupling hubs are fastened securely to the shafts.
3. Make sure that the coupling spacer is removed.

   The pump ships with the coupling spacer removed.
4. Unlock power to the driver.
5. Make sure that everyone is clear, and then jog the driver long enough to determine that the direction of rotation corresponds to the arrow on the bearing housing, or close-coupled frame.
6. Lock out power to the driver.

Couple the pump and driver

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

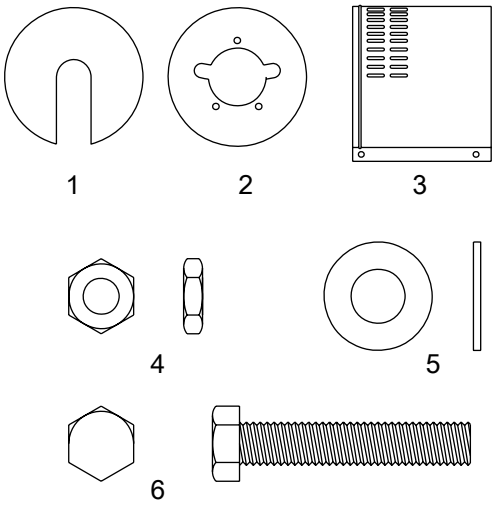
Couplings must have proper certification to be used in an ATEX classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling.

Install the coupling guard

WARNING:

- Never operate a pump without a properly installed coupling guard. Personal injury will occur if you run the pump without a coupling guard.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- The coupling used in an Ex-classified environment must be properly certified and must be constructed from a non-sparking material.

Required parts:



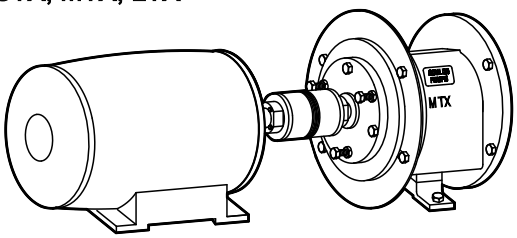
1. End plate, drive end
2. End plate, pump end
3. Guard half, 2 required
4. 3/8-16 nut, 3 required
5. 3/8 in. washer
6. 3/8-16 x 2 in. hex head bolt, 3 required

1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
2. Put the pump-side end plate in place.

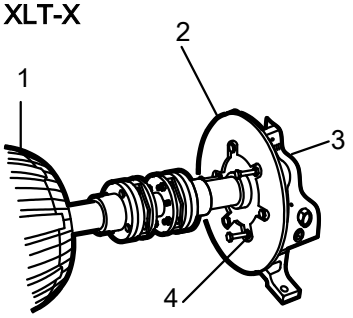
   If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.

If the pump size is...	Then...
STX, MTX, LTX	Align the pump-side end plate to the bearing frame. You do not need to adjust the impeller.
XLT-X	1. Align the end plate on the pump side to the bearing housing so that you meet these conditions: a. The large slots on the end plate do not touch the bearing housing tap bolts. b. The small slots align with the impeller adjusting bolts. 2. Fasten the end plate to the bearing housing using the jam nuts on the impeller adjusting bolts. 3. Check the impeller clearance. Refer to the impeller clearance table for the correct impeller clearance.

STX, MTX, LTX

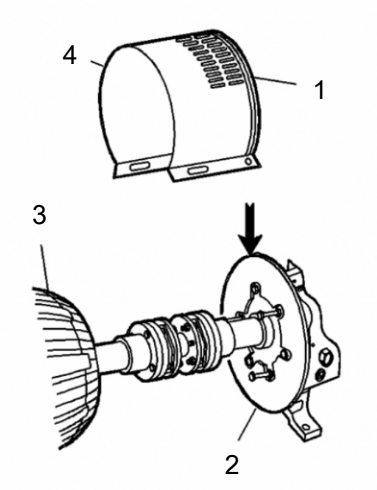


XLT-X



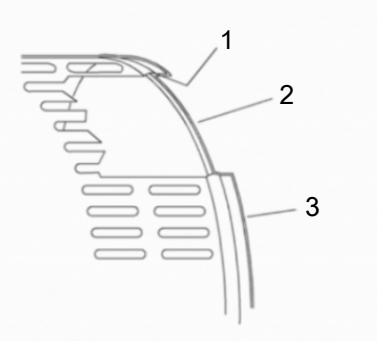
1. Driver
2. Pump end plate
3. Bearing housing
4. Jam nut

3. Put the pump-half of the coupling guard in place:
   a) Slightly spread the bottom apart.
   b) Place the coupling guard half over the pump-side end plate.



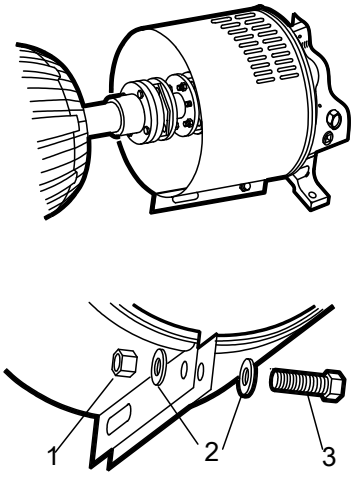
1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

The annular groove in the coupling guard half must fit around the end plate.



1. Annular groove
2. End plate (pump end)
3. Guard half

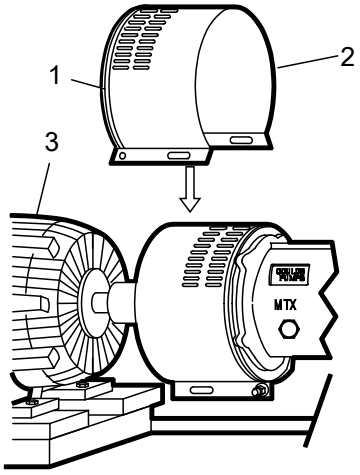
4. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Tighten securely.



1. Nut
2. Washer
3. Bolt

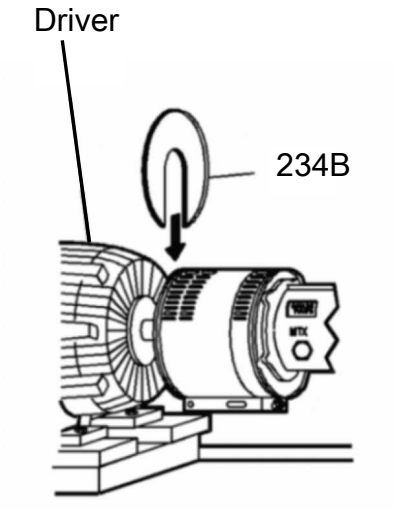
5. Put the driver half of the coupling guard in place:
   a) Slightly spread the bottom apart.

b) Place the driver half of the coupling guard over the pump half of the coupling guard.
The annular groove in the coupling guard half must face the motor.

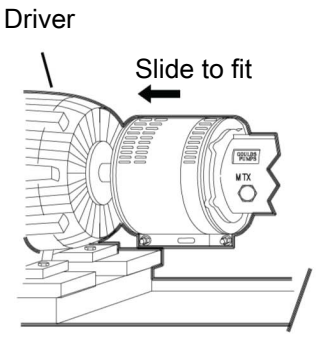


1. Annular groove
2. Driver half of the coupling guard
3. Driver

6. Place the driver-side end plate over the motor shaft.



7. Place the driver-side end plate in the annular groove of the driver-half of the coupling guard.
8. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Hand-tighten only.
   The hole is located on the driver-side of the coupling guard half.
9. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.



10. Use a nut, a bolt, and two washers to secure the coupling guard halves together.
11. Tighten all nuts on the guard assembly.

WARNING:
Never operate the pump without the coupling guard correctly installed.

Bearing lubrication

WARNING:
Pumps are shipped without oil. Oil-lubricated anti-friction bearings must be lubricated at the job site.

These bearing lubrication sections list different pumped-fluid temperatures. If your pump is ATEX certified and your pumped-fluid temperature exceeds the permitted temperature values, then consult your ITT representative.

Lubrication requirements

Pump type	Requirements
Close coupled	Close-coupled pumps do not have bearings that require lubrication.
Frame mounted	• The oil level is measured through the sight glass. • The oil level must not fall below the center of the sight glass. • An increase in oil level may be noted after startup due to oil circulation within the bearing frame.

Lubricating-oil requirements

Oil quality requirements

Use a high-quality turbine oil with rust and oxidation inhibitors rated at 68 cSt. at 100°F (38°C).

Oil requirements based on temperature

For the majority of operating conditions, bearing temperatures run between 120°F (49°C) and 180°F (82°C), and you can use an oil of ISO viscosity grade 68 at 100°F (38°C). If temperatures exceed 180°F (82°C), refer to the table for temperature requirements.

Temperature	Oil requirement
Bearing temperatures exceed 180°F (82°C)	Use ISO viscosity grade 100. Bearing temperatures are generally about 20°F (11°C) higher than bearing-housing outer surface temperatures.
Pumped-fluid temperatures exceed 350°F (177°C)	Use synthetic lubrication.

Acceptable oil for lubricating bearings

Acceptable lubricants

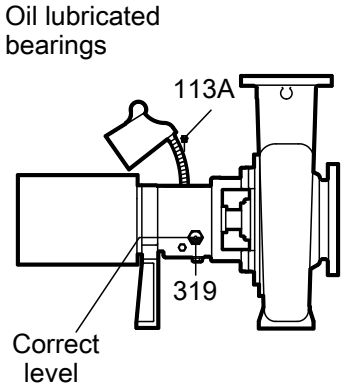
Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Mobil	DTE 26 300 SSU @ 100°F (38°C)
Philips	Mangus Oil 315
Shell	Tellus Oil 68
Royal Purple	SYNFILM ISO VG 68 Synthetic Lube
Gulf	Harmony 68

Lubricate the bearings with oil

Use a high-quality turbine oil with rust and oxidation inhibitors.

1. Remove the fill plug.
2. Fill the bearing frame with oil through the filler connection, which is located on top of the bearing frame.

   Fill the bearing frame with oil until the oil level reaches the middle of the sight glass (319).



3. Replace the fill plug.

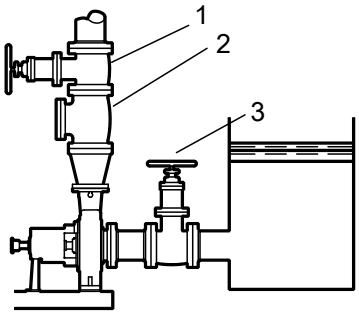
Greased-for-life bearing lubrication

The bearing manufacturer fills greased-for-life bearings with grease and seals them at the factory. You do not need to lubricate or seal these bearings. Refer to the Maintenance chapter for re-greasing and maintenance procedures for these bearings.

Pump priming

Prime the pump with the suction supply above the pump

1. Slowly open the suction isolation valve.
2. Open the air vents on the suction and discharge piping until the pumped fluid flows out.
3. Close the air vents.



1. Discharge isolation valve
2. Check valve
3. Suction isolation valve

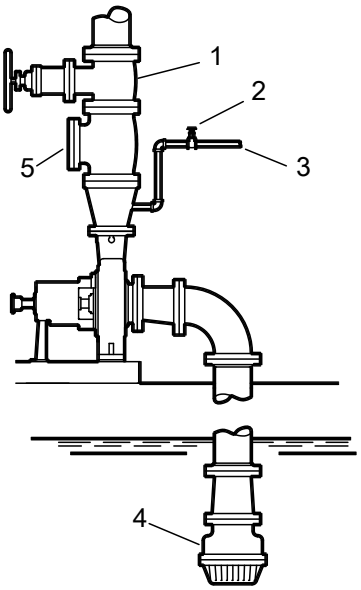
Prime the pump with the suction supply below the pump

Use a foot valve and an outside source of liquid in order to prime the pump. The liquid can come from one of these sources:

- A priming pump
- A pressurized discharge line
- Another outside supply

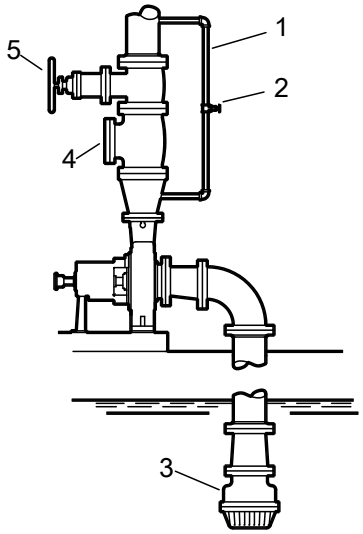
1. Close the discharge isolation valve.
2. Open the air vent valves in the casing.
3. Open the valve in the outside supply line until only liquid escapes from the vent valves.
4. Close the vent valves.
5. Close the outside supply line.

This illustration is an example of priming the pump with a foot valve and an outside supply:



1. Discharge isolation valve
2. Shutoff valve
3. From outside supply
4. Foot valve
5. Check valve

This illustration is an example of priming the pump with a foot valve using a bypass around the check valve:



1. By-pass line
2. Shutoff valve
3. Foot valve
4. Check valve
5. Discharge isolation valve

Other methods of priming the pump

You can also use these methods in order to prime the pump:

- Prime by ejector
- Prime by automatic priming pump

Start the pump

WARNING:

Continuous operation against a closed discharge valve can vaporize liquid. This condition can cause an explosion due to confined vapor that is under high pressure and temperature.

CAUTION:

- Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart the pump.
- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.
- Continuous operation against a closed discharge valve will cause the pump to overheat. Overheating the magnetic drive assembly will weaken or ruin the magnets.

Before you start the pump, you must perform these tasks:

- Open the suction valve.
- Open any recirculation or cooling lines.

1. Fully close or partially open the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.

5. If the pump fails to reach the correct pressure, perform these steps:
   a) Stop the driver.
   b) Prime the pump again.
   c) Restart the driver.
6. Monitor the pump while it is operating:
   a) Check the pump for bearing temperature, excessive vibration, and noise.
   b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

      A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
7. Repeat steps 5 and 6 until the pump runs properly.

Minimum continuous recommended flow

NOTICE:
These measurements are based on water with a Specific Gravity of 1.0 and a Specific Heat of 1.0.

Table 6: Minimum flow in GPM (m^3/hr)

Group	Size	3500 rpm	2900 rpm	1750 rpm	1450 rpm
S	1 x 1½ - 6	23 (5)	15 (4)	11 (3)	8 (2)
	1½ x 3 - 6	30 (7)	25 (6)	15 (4)	13 (3)
	2 x 3 - 6	56 (12.5)	47 (11)	28 (6)	23 (5)
	1 x 1½ - 8	10 (2.5)	7 (2)	3 (1)	2 (1)
	1½ x 3 - 8	34 (8)	29 (7)	17 (4)	14 (3)
S/M	2 x 3 - 8	74 (17)	61 (14)	37 (9)	20 (5)
M (8 in.)	3 x 4 - 7	157 (36)	127 (29)	78 (18)	64 (15)
	3 x 4 - 8G	159 (36)	129 (30)	79 (18)	65 (15)
M (10 in.)	1 x 2 - 10	21 (5)	13 (3)	9 (2)	7 (2)
	2 x 3 - 10	78 (18)	65 (15)	38 (9)	31 (7)
	3 x 4 - 10	173 (40)	144 (33)	86 (20)	72 (16)

Pump operation precautions

General considerations

CAUTION:
- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side since this can result in decreased performance, unexpected heat generation, and equipment damage.
- Do not overload the driver. Driver overload can result in unexpected heat generation and equipment damage. The driver can overload in these circumstances:
  - The specific gravity of the pumped fluid is greater than expected.
  - The pumped fluid exceeds the rated flow rate.
- Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.

Operation at reduced capacity

WARNING:
Never operate any pumping system with a blocked suction and discharge. Operation, even for a brief period under these conditions, can cause confined pumped fluid to overheat, which results in a violent explosion. You must take all necessary measures to avoid this condition.

CAUTION:

- Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
- Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
- Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that is inside the pump and the cooling coils. Failure to do so can cause liquid to freeze and damage the pump.

Temperature ratings

CAUTION:

Do not operate the pump above the rated temperature range of the magnets. This will weaken or ruin the magnets. The rated temperature is 250°F (121°C) for all sizes.

Magnetic types	Drive destination	Rated temperature
Neodymium iron (NdFe)	A, B, C, D, E, F, G, H, I, J, K	356°F (180°C)
Samarium Cobalt (SmCo)	AA, BB, CC, DD, EE, FF, GG, HH, II, JJ, KK	536°F (280°C)

Shut down the pump

WARNING:

The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

1. Slowly close the discharge valve.
2. Shut down and lock the driver to prevent accidental rotation.

Make the final alignment of the pump and driver

WARNING:

- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.

You must check the final alignment after the pump and driver are at operating temperature. For initial alignment instructions, see the Installation chapter.

1. Run the unit under actual operating conditions for enough time to bring the pump, driver, and associated system to operating temperature.
2. Shut down the pump and the driver.
3. Remove the coupling guard.

See Remove the coupling guard in the Maintenance chapter.

4. Check the alignment while the unit is still hot.
   See Pump-to-driver alignment in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

Maintenance

Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

- Routine maintenance
- Routine inspections
- Three-month inspections
- Annual inspections

Shorten the inspection intervals appropriately if the pumped fluid is abrasive or corrosive or if the environment is classified as potentially explosive.

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.
- Perform a vibration analysis.
- Monitor the discharge pressure.
- Monitor the temperature.

Routine inspections

Perform these tasks whenever you check the pump during routine inspections:

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Change the oil every three months (2000 operating hours) at minimum.
  - Change the oil more often if there are adverse atmospheric or other conditions that might contaminate or break down the oil.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

- Check the pump capacity.
- Check the pump pressure.
- Check the pump power.

If the pump performance does not satisfy your process requirements, and the process requirements have not changed, then perform these steps:

1. Disassemble the pump.
2. Inspect it.
3. Replace worn parts.

Bearing maintenance

Lubrication schedule

Type of bearing	First lubrication	Lubrication intervals
Oil lubricated	Change the oil after 200 hours for new bearings.	After the first 200 hours, change the oil every 4000 operating hours or every six months.

Disassembly

Disassembly precautions

WARNING:

- Chemical hazard. You must individually decontaminate each component according to all federal, state, local, and company environmental regulations.
- A build up of gases within the pump, sealing system, or process-piping system can result in an explosive environment within the pump. Make sure that the process piping system, pump, and sealing system are properly vented prior to operation.
- Process fluid leaks can result in an explosive atmosphere. Follow all pump and seal assembly procedures.
- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, open vent or drain valves, or disconnect the piping.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

CAUTION:

- You must keep the shop area clean and free of any substances that can contaminate the magnets, such as ferrous metals.
- The magnets in this unit are extremely powerful. Beware of serious injury to fingers and hands. Keep magnetic drive components and magnetic tools apart by a minimum of 3 ft (1 m).

NOTICE:

Use a bench with a non-magnetic work surface such as wood or brass when you work on the pump.

Required tools

WARNING:

This pump contains extremely strong magnets. You must use non-magnetic tools and work surfaces.

Tools

- Assorted metric open-end or socket sizes 13 mm, 17 mm, 18 mm, 19 mm, and 24 mm
- Hex wrenches, sizes 2.5 mm, 3 mm, 5 mm, and 6 mm with a 4.75 in. (12.07 cm) minimum reach
- Hex wrench, size 8 mm with 6 in. (15 cm) minimum reach
- Torque wrench

- Strap wrench
- 3/8 in. eyebolt

Prepare the pump for disassembly

1. Lock out power to the driver.

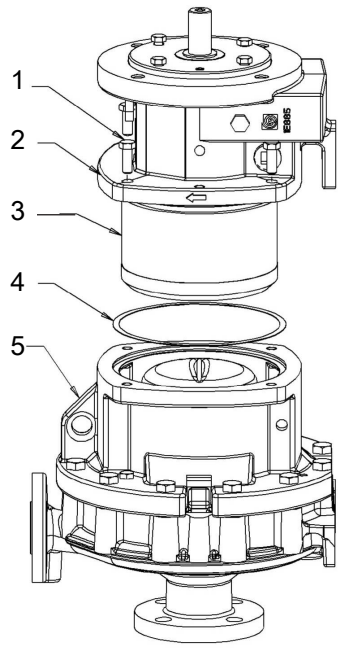
WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

2. Shut off all valves that control flow to and from the pump.
3. Drain and flush the pump before you remove it from the piping.
4. Isolate the pump from the system and then flush the pump using a compatible liquid.
5. Disconnect all piping and auxiliary equipment.
6. For the frame-mounted pump, remove the coupling guard and coupling.
7. Remove the casing foot and frame and C-face motor-support foot bolts.
8. Remove the pump from the baseplate.
9. For the frame-mounted pump, drain the oil.
10. Decontaminate the pump:
    a) Connect a clean-flush liquid supply to the discharge nozzle.
    b) Collect the flushed liquid as it drains out of the drain connection.
    c) Flush the pump in order to remove residue.

Remove the frame assembly and shaft (frame-mounted pump)

1. Secure the pump on a workbench or worktop with the suction nozzle facing down.
2. Screw the 3/8 in. eyebolt into the drive shaft.
3. Remove the screws (370B) holding the bearing frame to the frame adapter.



1. Frame-to-adapter hex screw (370B)
2. Frame assembly
3. Mag drive carrier
4. Frame-to-adapter gasket (360W)
5. Adapter

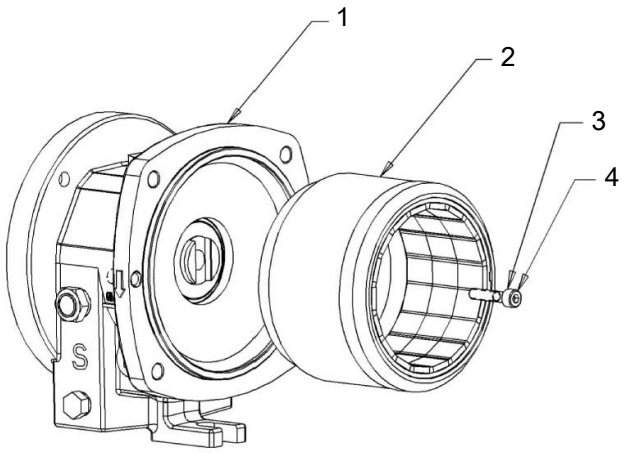
4. If required, use jackscrews to separate the parts using the two threaded holes in the bearing frame.

Pump size	Screw type
S-Group	M12
M-Group	M14

5. Lift the bearing frame assembly off the adapter.

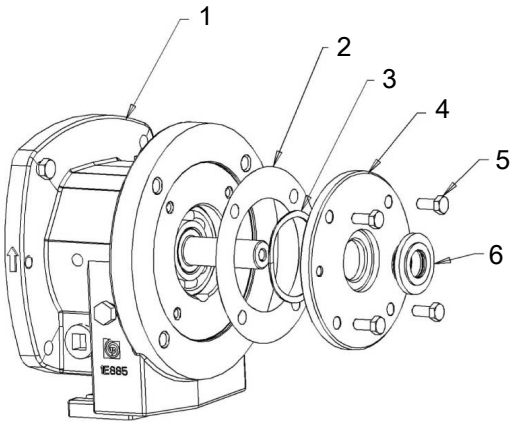
   Use a crane, if available.

6. Remove the frame-to-adapter gasket (360W).
7. Secure the drive shaft so that it cannot rotate.
8. Remove the capscrew (791D) and the lockwasher (382) from the drive shaft.



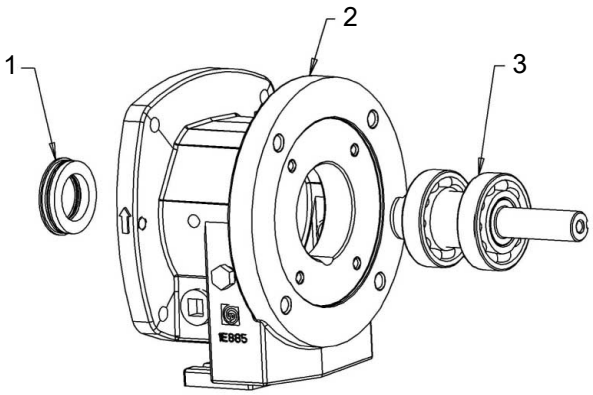
1. Frame assembly
2. Drive carrier assembly (740B)
3. Internal tooth lockwasher (382)
4. Drive-to-shaft capscrew (791D)

9. Remove the drive magnet assembly (740B).
10. Remove the bearing-end cover screws (370C) and the bearing-end cover (109A).



1. Frame
2. End cover gasket (360A)
3. Wave washer (529)
4. Frame end cover (109A)
5. End cover hex screw (370C)
6. Labyrinth oil seal (332A)

11. Remove the wavy spring washer (529) and end-cover gasket (360A).
12. Remove the drive shaft with both bearings attached.



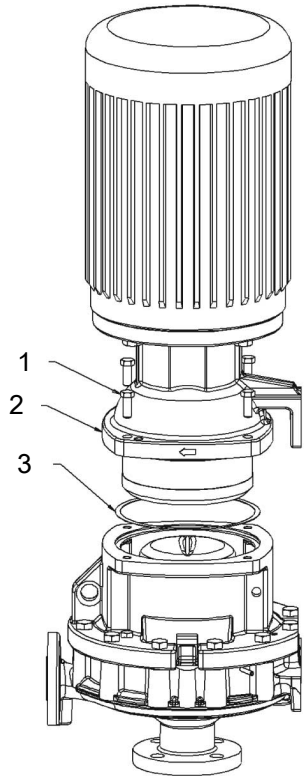
1. Labyrinth oil seal (333D)
2. Bearing frame (228)
3. Drive with shaft bearings

13. Remove the labyrinth oil seals (332A and 333D).
14. Remove both radial ball bearings using a press.

    The radial ball bearings lie against the shaft collar.

Remove the frame assembly and shaft (close-coupled pump)

1. Secure the complete pump on a workbench in either a horizontal or a vertical position.
2. Remove the hex screws (370B) that hold the motor adapter (503) to the frame adapter (108).



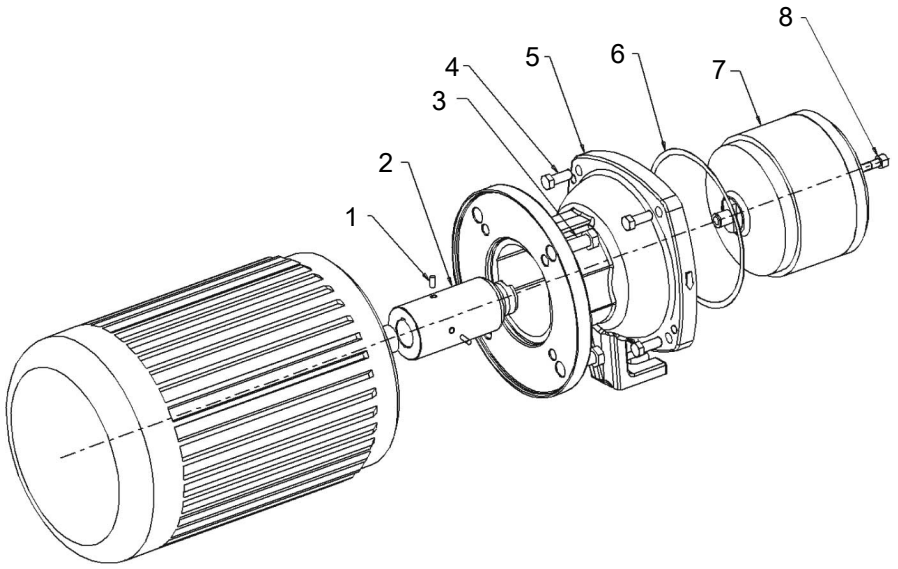
1. Frame-to-adapter hex screw (370B)
2. Close-coupled adapter (503)
3. Frame-to-adapter gasket (360W)

3. If necessary, remove the motor adapter (503) from the frame adapter (108) using two levers or pry-bars.

   There are also two threaded holes (size M12) in the close-coupled motor adapter (503) for jackscrews.
4. Lift the motor and motor adapter assembly off the frame adapter.

   Use a crane, if necessary.
5. Remove the gasket (360W).

6. Remove the hex screw (791D) and lockwasher (382) from the drive magnet (740B).
7. Remove the drive magnet (740B) from the stub shaft (122A).

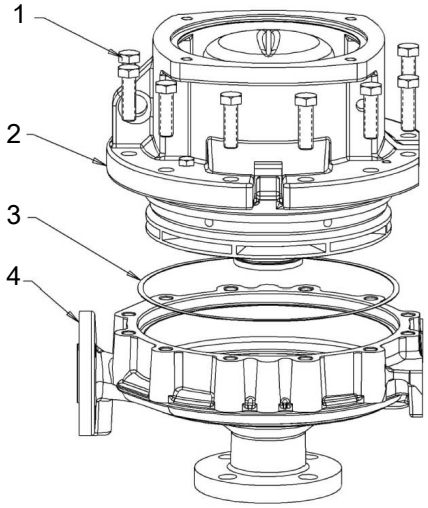


1. Stub shaft–to-motor setscrew (222L)
2. Shaft (122A)
3. Motor-to-adapter hex screw (371)
4. Frame-to-adapter hex screw (370B)
5. Close-coupled adapter (503)
6. Frame-to-adapter gasket (360W)
7. Drive carrier assembly (740B)
8. Drive-to-adapter capscrew (791D), internal tooth lockwasher (382)

8. Remove the hex screws (371) that hold the motor to the motor adapter (503).
9. Pull the motor adapter (503) off the motor flange.
10. Loosen the setscrew (222L) that holds the stub shaft onto the motor shaft.
11. Remove the stub shaft (122A) from the motor.

Disassemble the liquid end

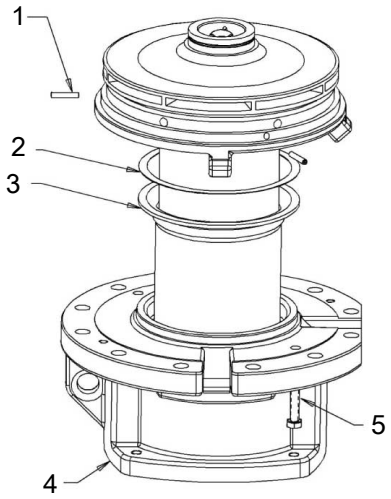
1. Remove the hex screws (370) that hold the adapter to the case.



1. Adapter-to-case hex screw (370)
2. Frame adapter (108)
3. Backplate-to-case gasket (351)
4. Casing (100)

NOTICE:

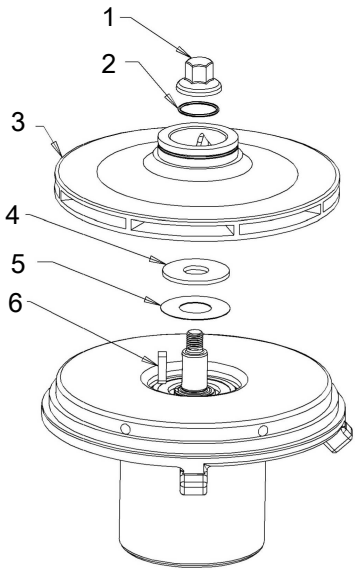
Do not remove the three setscrews (222E on the 6 in. S-group) or two hex screws (370V on all other sizes). These setscrews hold the adapter (108), backplate (444), and containment shell (750).



1. Adapter-to-backplate setscrew 222E (6 in. S-group only)
2. Containment shell gasket (540N)
3. Containment shell (750)
4. Frame adapter (108)
5. Adapter-to-backplate hex screw (370V)

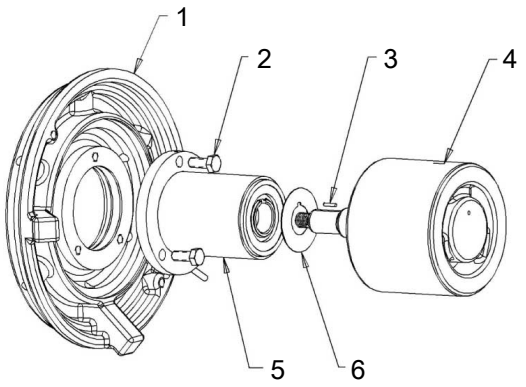
2. Remove the entire assembly from the casing (100).
3. If you need to remove the assembly from the casing, insert jackscrews through the threaded holes in the adapter (108).

   S- and M-groups use M8 screws.
4. Place the adapter, backplate, and impeller assembly on a bench with the impeller facing upwards.
5. Remove the three setscrews, (222E for 6 in. S-group) or two hex screws (370V for all other sizes).
6. Remove the adapter (108) and the containment shell (750).
7. Place the remaining part of the unit on a workbench with the driven magnet facing downwards.



1. Impeller nut (304)
2. Impeller nut O-ring (412A)
3. Impeller (101)
4. Distance washer (199)
5. Intermediate ring spacer (351X)
6. Impeller key (178)

8. Place the strap wrench on the impeller and remove the impeller nut (304) and O-ring (412A).
9. Slide the impeller (101) off the shaft.
10. Remove the impeller key (178), distance washer (199), and gasket (351X).
11. Pull the backplate (444) and bearing cartridge (849) from the shaft.



1. Backplate (444)
2. Cartridge-to-backplate hex screw (791E)
3. Parallel pin (445A)
4. Driven carrier assembly (740A)
5. Bearing cartridge assembly (849)
6. Intermediate ring spacer (351X)

12. Remove the second gasket (351X).
13. Undo the screws (791E) and remove the bearing cartridge (849) from the backplate (444).

    The driven magnet assembly (740A) is a two-piece assembly on S-group pumps held with a drive-key. Item 740A is a single-piece component on M-group pumps with a parallel pin (445A) to drive the bearing cartridge.

    The bearing cartridge (849) is one unit that is replaced completely.

Pre-assembly inspections

Guidelines

Before you assemble the pump parts, make sure you follow these guidelines:

- Inspect the pump parts according to the information in these pre-assembly topics before you reassemble your pump. Replace any part that does not meet the required criteria.
- Make sure that the parts are clean. Clean the pump parts in solvent in order to remove oil, grease, and dirt.

NOTICE: Protect machined surfaces while you clean the parts. Failure to do so may result in equipment damage.

Replacement guidelines

Casing check and replacement

Inspect the casing for cracks and excessive wear or pitting. Thoroughly clean gasket surfaces and alignment fits in order to remove rust and debris.

Repair or replace the casing if you notice any of these conditions:

- Localized wear or grooving that is greater than 1/8 in. (3.2 mm) deep
- Pitting that is greater than 1/8 in. (3.2 mm) deep
- Irregularities in the casing-gasket seat surface

Casing areas to inspect

The arrows point to the areas to inspect for wear on the casing:

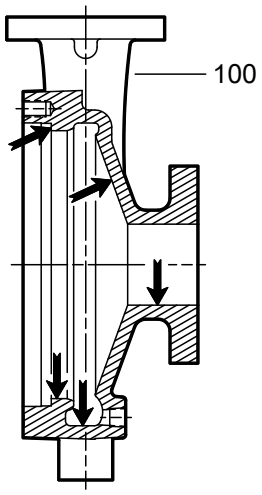


Figure 10: 3296 EZMAG casing

Impeller replacement

This table shows the criteria for replacing the impeller:

Impeller parts	When to replace
Vane edges	When you see cracks, pitting, or corrosion damage
Wear ring surfaces	When the clearance to the casing wear ring has increased by 50% over the values in the Minimum running clearances table

Gaskets, O-rings, and seats replacement

- Replace all gaskets and O-rings at each overhaul and disassembly.
- Inspect the seats. They must be smooth and free of physical defects.
- Replace parts if the seats are defective.

Frame adapter

- Check the frame adapter (108) for cracks or excessive corrosion damage. Replace if any of these conditions exist.
- Make sure that the gasket surface is clean.

Silicon carbide bearings, bearing cartridge

Inspect the bearings (849) for cracks, chips, or excessive wear. Replace the cartridge if any of these conditions exist.

Containment shell

- Make sure that the wall thickness of the containment shell (750) is a minimum of 0.039 in. (0.991 mm).
- Make sure that the containment shell is free from pitting or cracks.
- Replace the containment shell if there are any grooves in excess of 0.005 in. (0.127 mm).

Magnet inspections

WARNING:

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of 6 ft. (2 m). Serious injury to fingers and hands will result if you do not follow this precaution.

Driven magnet assembly inspections

Perform these checks on the driven magnet assembly (740A):

- Check that the assembly is free from bulges.
- Check that the assembly is free from pits and scratches that exceed 0.005 in. (0.127 mm) deep.
- Check that the assembly is free from erosion or corrosion that exceeds 0.005 in. (0.127 mm) deep.
- Check the pump-out vanes for cracks and corrosion.
- Check that the circulation holes are open.

Drive magnet assembly

The magnets are extremely brittle. It is normal to have chips that amount to 10% of the magnet surface per MMPA Standard No. 0100-90.

Perform these checks on the drive magnet assembly (740B):

- Check that the magnets are free of major cracks and extent over 50% of the surface and are free of imperfections that create loose particles.
- Replace the magnets if the magnets and drive magnet carrier were exposed to any pumped fluid.
- Check the drive magnet carrier for cracks and replace if any cracks are found.
- Check the drive magnet carrier hub OD is free from grooves and scratches that are greater than 0.005 in. (0.127 mm).
- Check the magnets for proper bonding to the metal carrier.

Bearing-frame inspection

Checklist

Check the bearing frame for these conditions:

- Visually inspect the bearing frame and frame foot for cracks.
- Check the inside surfaces of the frame for rust, scale, or debris. Remove all loose and foreign material.
- Make sure that all lubrication passages are clear.
- Inspect the inboard-bearing bores.

  The maximum acceptable bore is 2.836 in. (7.203 cm) for S-group pumps and 3.544 in. (9.002 cm) for M-group pumps.
- Inspect the labyrinth seal O-rings for cuts and cracks.
- Inspect the ball bearings for containment and damage.
- Make sure the gasket surfaces are clean.
- Visually inspect the bearing end cover for cracks and pits.

Bearings inspection

Condition of bearings

Do not reuse bearings. The condition of the bearings provides useful information on operating conditions in the bearing frame.

Checklist

Perform these checks when you inspect the bearings:

- Inspect the ball bearings for contamination and damage.
- Note any lubricant condition and residue.
- Inspect the ball bearings to see if they are loose, rough, or noisy when you rotate them.
- Inspect the silicon carbide bearings for cracks, chips, or excessive wear. If any of these conditions exist, replace the bearing cartridge.
- Investigate any bearing damage to determine the cause. If the cause is not normal wear, correct the issue before you return the pump to service.

Minimum running clearances

This table provides the radial wear ring clearances:

Group	Size	New, inches (mm)	Replace, inches (mm)
S	1 x 1½ - 6 1½ x 3 - 6 2 x 3 - 6 1 x 1½ - 8 1½ x 3 - 8 2 x 3 - 8	0.010–0.13 (0.25–0.32)	0.018 (0.44)
M	3 x 4 - 7 4 x 4 - 8G 3 x 4 - 10 1 x 2 - 10 2 x 3 - 10	0.014–0.016 (0.35–0.42)	0.022 (0.59)

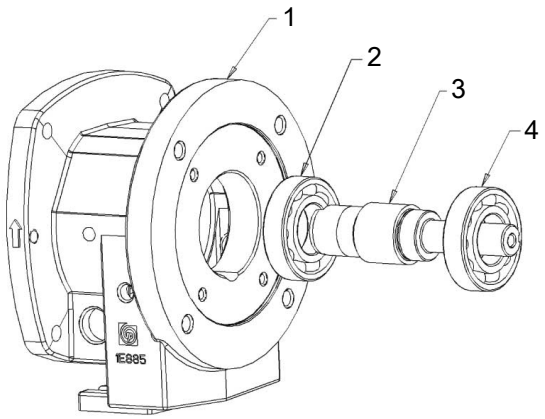
Reassembly

Reassemble the frame assembly and shaft (frame-mounted pumps)

1. Press both radial ball bearings (112) onto the drive shaft (122B).

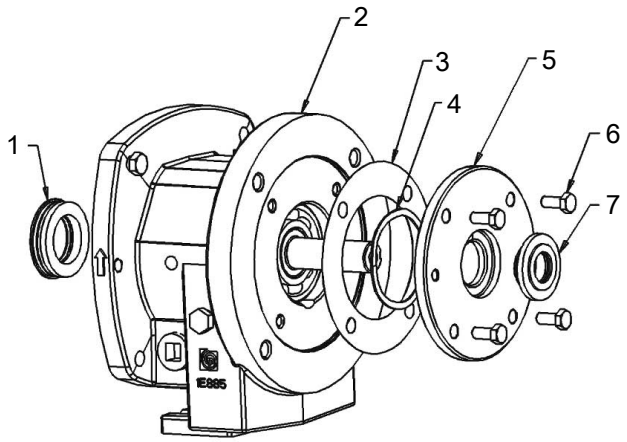
NOTICE:

There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings.



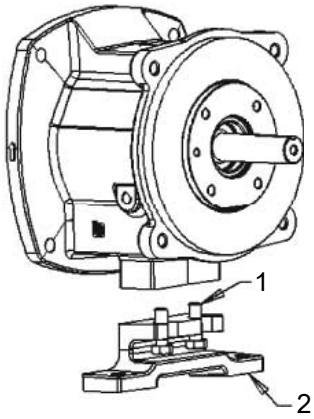
1. Bearing frame (228)
2. Ball bearing (112)
3. Drive shaft (122B)
4. Ball bearing (112)

2. Install the pre-assembled drive shaft in the bearing frame (228) from the motor side.
3. Insert the wave washer (529).



1. Labyrinth oil seal (333)
2. Bearing frame (228)
3. End cover gasket (360A)
4. Wave washer (529)
5. Frame end cover (109A)
6. End cover hex screw (370C)
7. Labyrinth oil seal (332A)

Figure 11: Bearing frame cover and seals

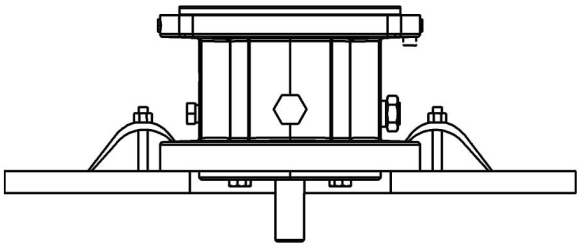


1. Foot-to-frame hex screw (370F)
2. Frame foot (241)

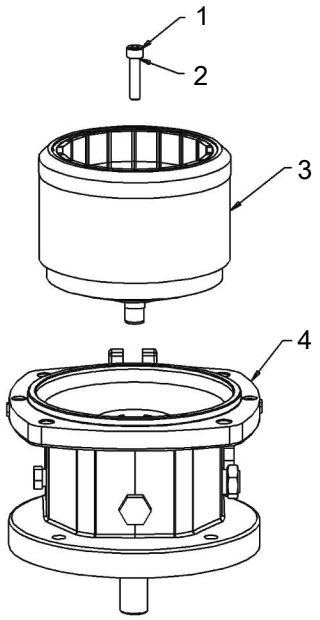
Figure 12: Frame foot (M-group only)

4. Insert the end-cover gasket (360A) into the bearing frame.
5. Mount the bearing-end cover (109A) using the hex screws (370C).
6. Press the inboard labyrinth seal (333D) and the outboard labyrinth seal (332A) into the corresponding bores on the bearing frame.

   Press the seals until they are fully-seated in the bore. Make sure to keep the oil return slot on the inside of the seal at the 6 o'clock position.
7. Mount the bearing frame foot (241) with hex screws (370F) and lockwashers (M-group only).
8. Clamp the pre-assembled bearing frame assembly in a vice with the motor end of the shaft facing downwards.



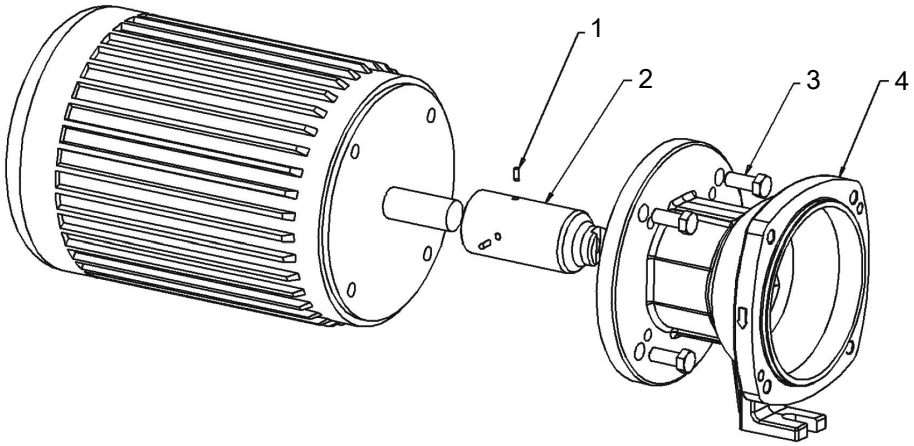
9. Mount the drive magnet assembly (740B) onto the drive shaft so that the driver cams engage. Secure the drive magnet assembly using the lockwasher (382) and capscrew (791D).



1. Drive-to-shaft capscrew (791D)
2. Internal tooth lockwasher (382)
3. Drive carrier assembly (740B)
4. Bearing frame (228)

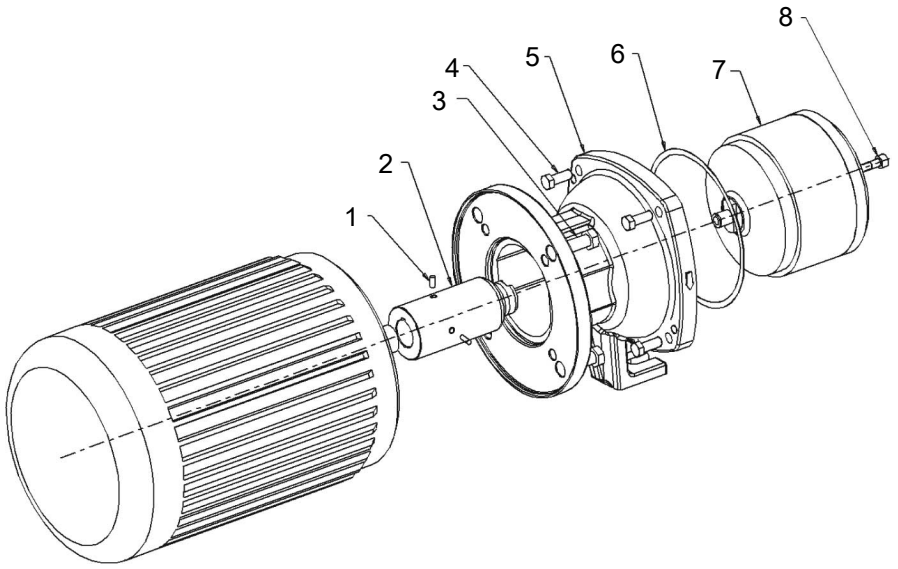
Reassemble the frame assembly and shaft (close-coupled pumps)

1. Slide the stub shaft (122A) onto the motor shaft and secure it with the setscrew (222L).



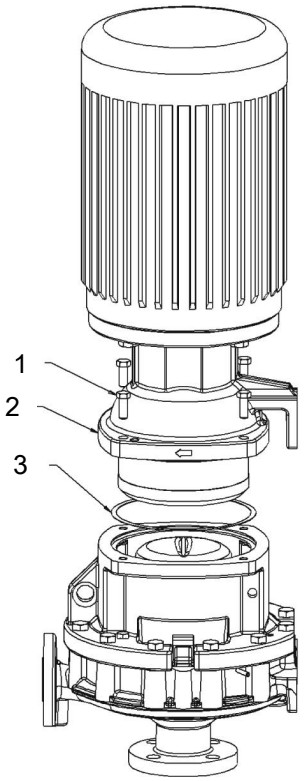
1. Setscrew (122L)
2. Stub shaft (380)
3. Motor-to-adapter hex screw (371)
4. Close-coupled adapter (503)

2. Mount the motor adapter (503) onto the motor using hex screws (371).
3. Mount the drive magnet (740B) onto the stub shaft (122A) so that the driver cams are fully-engaged.



1. Stub shaft–to-motor setscrew (222L)
2. Stub shaft (380)
3. Motor-to-adapter hex screw (371)
4. Frame-to-adapter hex screw (370B)
5. Close-coupled adapter (503)
6. Frame-to-adapter gasket (360W)
7. Drive carrier assembly (740B)
8. Drive-to-shaft capscrew (791D), internal tooth lockwasher (382)

4. Insert the lockwasher (382) and capscrew (791D) in order to secure the magnet to the shaft.

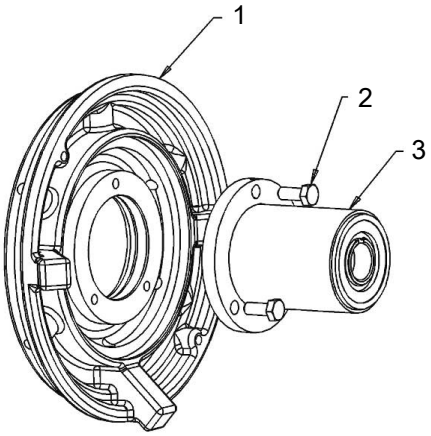


1. Frame-to-adapter hex screw (370B)
2. Close-coupled adapter (503)
3. Frame-to-adapter gasket (360W)

Figure 13: Close-coupled pump assembly

Reassemble the liquid end

1. Insert the bearing cartridge (849) into the backplate (444).



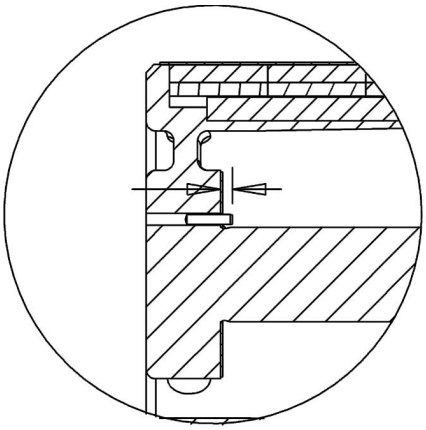
1. Backplate (444)
2. Cartridge-to-backplate hex screw (791E)
3. Bearing cartridge assembly (849)

2. Rotate the bearing cartridge until all three holes line up and secure with hex screws (791E).

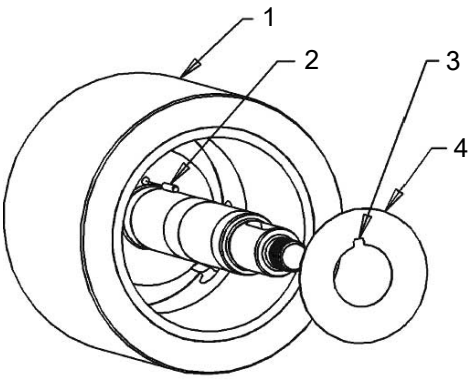
   See *Bolt torque values* (page 65).

3. For M-group pumps, if the driven carrier pin (445A) in the driven magnet assembly (740A) must be replaced, then drive in the carrier pin carefully until it protrudes approximately 0.12 in. (3.05 mm) towards the impeller.

   The S-group has a drive key, which is automatically placed into position during installation when installed.



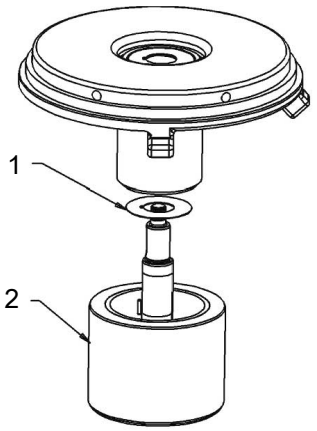
4. Cut out a small notch on the inside diameter of the intermediate ring gasket (351X) in order to create a recess for the driven carrier pin (445A) or key, depending on size.



1. Driven carrier assembly (740A)
2. Driven carrier pin (445A)
3. Notch
4. Intermediate ring spacer (351X)

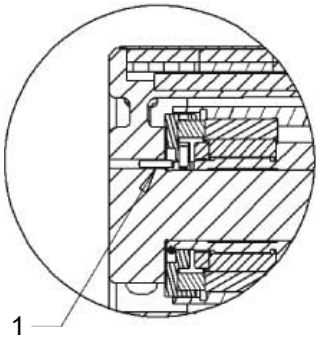
5. Apply anti-seizing compound to the shaft and shaft threads.
6. Mount the intermediate ring gasket (351X) onto the shaft of the driven magnet assembly (740A).

Intermediate ring gasket mounting



1. Intermediate ring spacer (351X)
2. Driven carrier assembly (740A)

Driven pin aligned with the slot in the cartridge

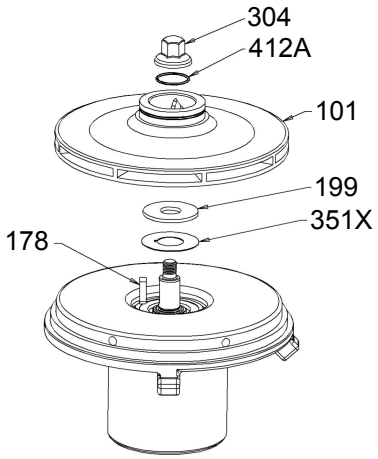


1. Driven carrier pin (445A)

7. Place the driven magnet assembly (740A) on the workbench, and then mount the pre-assembled bearing cartridge (849) and backplate (444) assembly onto the driven magnet assembly from above. Make sure the driven carrier pin or key (445A) engages the carrier groove in the bearing cartridge (849).

   If the pin or key at the bottom of the shaft does not properly engage the slot in the bearing cartridge, then the impeller key in step 9 will not fit.

   You can turn the backplate slightly in order to help with alignment.
8. Mount the second intermediate ring gasket (351X) and distance washer (199) onto the drive shaft.



1. Impeller key (178)
2. Impeller nut (304)
3. Impeller nut O-ring (412A)
4. Impeller (101)
5. Distance washer (199)
6. Intermediate ring spacer (351X)

9. Install the impeller:
   a) Insert the impeller key (178) into the key-slot on the shaft.

      If the impeller key does not fit into the keyway due to interference with the distance washer, then go back to step 7 and re-assemble the bearing cartridge to the shaft.
   b) Mount the impeller (101) onto the shaft.
   c) Insert the impeller nut O-ring (412A) into the groove on the rear side of the impeller nut (304).

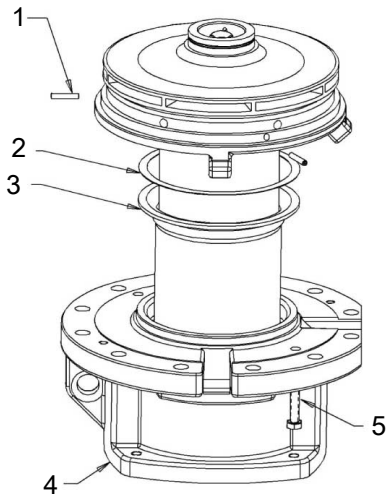
d) Secure the driven magnet assembly with a strap wrench and tighten the impeller nut to the appropriate torque value.

See *Bolt torque values* (page 65).

NOTICE:

Check that you can rotate the backplate freely by hand. When you raise the backplate, make sure that the axial play is approximately 0.040 in. (1.02 mm) in order to ensure proper assembly. The axial play of the plain bearings is automatically set during assembly.

10. Place the containment shell gasket (540N) and containment shell (750) onto the backplate (444).

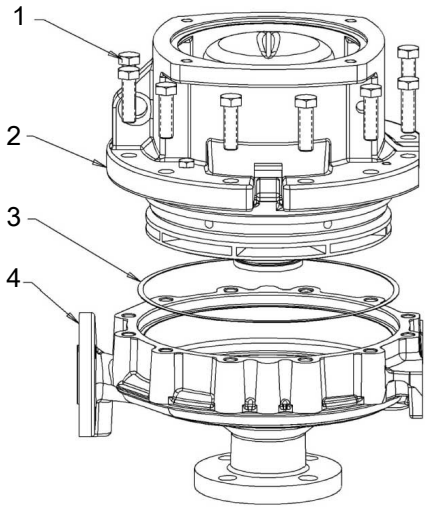


1. Adapter-to-backplate setscrew (222E, 6 in. S-group only)
2. Containment shell gasket (540N)
3. Containment shell (750)
4. Frame adapter (108)
5. Adapter-to-backplate hex screw (370V)

11. Screw the three setscrews (222E for S-group pumps) or two connection screws (370V for M-group pumps) of the adapter (108) into the backplate and tighten.

    This holds the containment shell in place.

12. Secure the casing (100) to the workbench with the suction flange facing downwards.



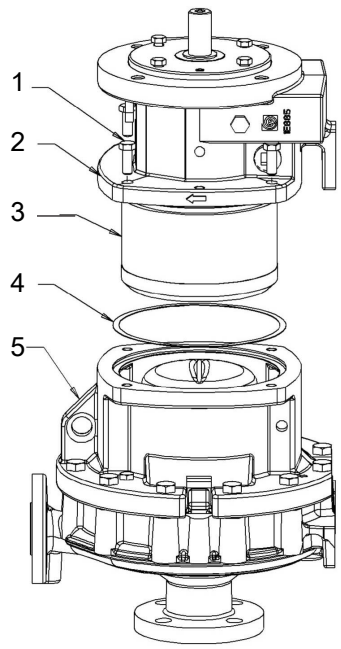
1. Adapter-to-case hex screw (370)
2. Frame adapter (108)
3. Backplate-to-case gasket (351)
4. Casing (100)

13. Insert the casing gasket (351) into the casing.

14. Insert the pre-assembled unit into the casing so that the crane hook of the adapter (108) faces the center of the discharge nozzle.
15. Secure the adapter to the casing using hex screws (370) to the appropriate torque value.
    See *Bolt torque values* (page 65).

Complete the pump reassembly

1. Insert the gasket (360W) into the adapter.



1. Frame-to-adapter hex screw (370B)
2. Frame assembly
3. Mag drive carrier
4. Frame-to-adapter gasket (360W)
5. Adapter

2. Secure the bearing frame and drive magnet assembly:
   a) Place the bearing frame and drive magnet assembly already assembled on the workbench with the drive magnet facing downwards.
   b) Screw a 3/8 in. eyebolt into the end of the drive shaft.
   c) Place the bearing frame assembly onto the adapter using a crane.
   d) Screw in the hex screws (370B) in order to secure the bearing frame to the adapter.
   e) Turn the drive shaft by hand to make sure that the shaft can rotate freely.
      Check by looking into the suction nozzle to make sure the impeller is rotating.

Bolt torque values

NOTICE:

Make sure to tighten in a diametrically opposite sequence.

Description	Group	Dry, ft-lbs (Nm)	Standard lube, ft-lbs (Nm)
Adapter to casing screws (370)	S/M (M12)	65 (88)	49 (66)
	10 in. M (M16)	161 (219)	120 (164)
Impeller nut (304)	S	47 (64)	26 (35)
	M	116 (158)	52 (70)

Description	Group	Dry, ft-lbs (Nm)	Standard lube, ft-lbs (Nm)
Cartridge to backplate screws (791E)	S/M	12 (16)	9 (12)

Troubleshooting

Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Reprime the pump and check that the pump and suction line are full of liquid.
	The suction line is clogged.	Check the suction line pressure. If it is low, locate and remove any obstructions.
	The impeller is clogged.	Disassemble the impeller and remove the blockage.
	The magnet is de-coupling.	Shut down the pump and check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
The pump is not producing rated flow or head.	There is an air leak in the suction line.	Check for leaks and repair the lines.
	The impeller is partly clogged.	Back flush the pump to clean the impeller.
	The impeller rings are worn.	Replace the defective ring as required.
	There is insufficient suction head.	Make sure that the suction line shutoff valve is fully open and the line is unobstructed. Check the suction pressure.
	The impeller is either worn or broken.	Inspect and replace the impeller if necessary.
	The rotation is wrong.	Correct the wiring.
Pump starts and then stops pumping.	The pump is not primed correctly.	Reprime the pump.
	There is an air leak in the suction line.	Check for leaks and correct.
	The magnet is de-coupling.	Shut down the pump. Check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
	There are either air or vapor pockets in the suction line.	Rearrange the piping to eliminate air pockets.
The bearings run hot.	The bearings are not lubricated properly.	Check the suitability and level of the lubricant.
	The lubricant is cooling.	Check the cooling system.
	The pump is not aligned properly.	Check the pump alignment.
Pump is noisy or vibrates.	The pump or driver is not aligned properly.	Align the shafts.
	There is a partially-clogged impeller causing the imbalance.	Disassemble the impeller and remove the blockage.
	There is a broken or bent impeller or shaft.	Replace as required.
	The base is not rigid enough.	Tighten the pump and motor hold-down bolts or adjust the stilts. Then check the grout.
	The suction or discharge piping is not anchored or properly supported.	Anchor the piping per the Hydraulic Institute Standards recommendations (Edition 14, centrifugal pump section).
	The pump is cavitating.	Increase the NPSH available.

Symptom	Cause	Remedy
The motor requires excessive power.	The head is lower than the rating and the pump has too much liquid.	Install a throttle valve.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The head is higher than the rating, which is at capacity.	Check the impeller diameter.
	The rotating parts are binding or are severely worn.	Check the internal wearing parts for proper clearances.
	The motor rotation is incorrect.	Correct the wiring.
The condition monitoring device shuts down the pump.	The sleeve and thrust bearings are damaged.	Replace as required.
	There is a plugged recirculation circuit.	Disassemble and remove the blockage. Then determine and correct the cause of the blockage.
	There is recirculation liquid vaporization.	Correct all of these as necessary: • Check the actual liquid temperature versus the design temperature. • Check the actual NPSH available versus the design. • Check the minimum flow requirement for the pump size.
	The containment shell is damaged.	Replace as required.
	The magnets are de-coupling.	Check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
	The pump is running dry.	• Check the control device for proper operation. • Check the suction line for blockage. • Reprime the pump.
	There is excessive motor power.	The system head is lower than the rating and pumps too much liquid. Check the rotating parts for binding and wear. The liquid is heavier than expected.

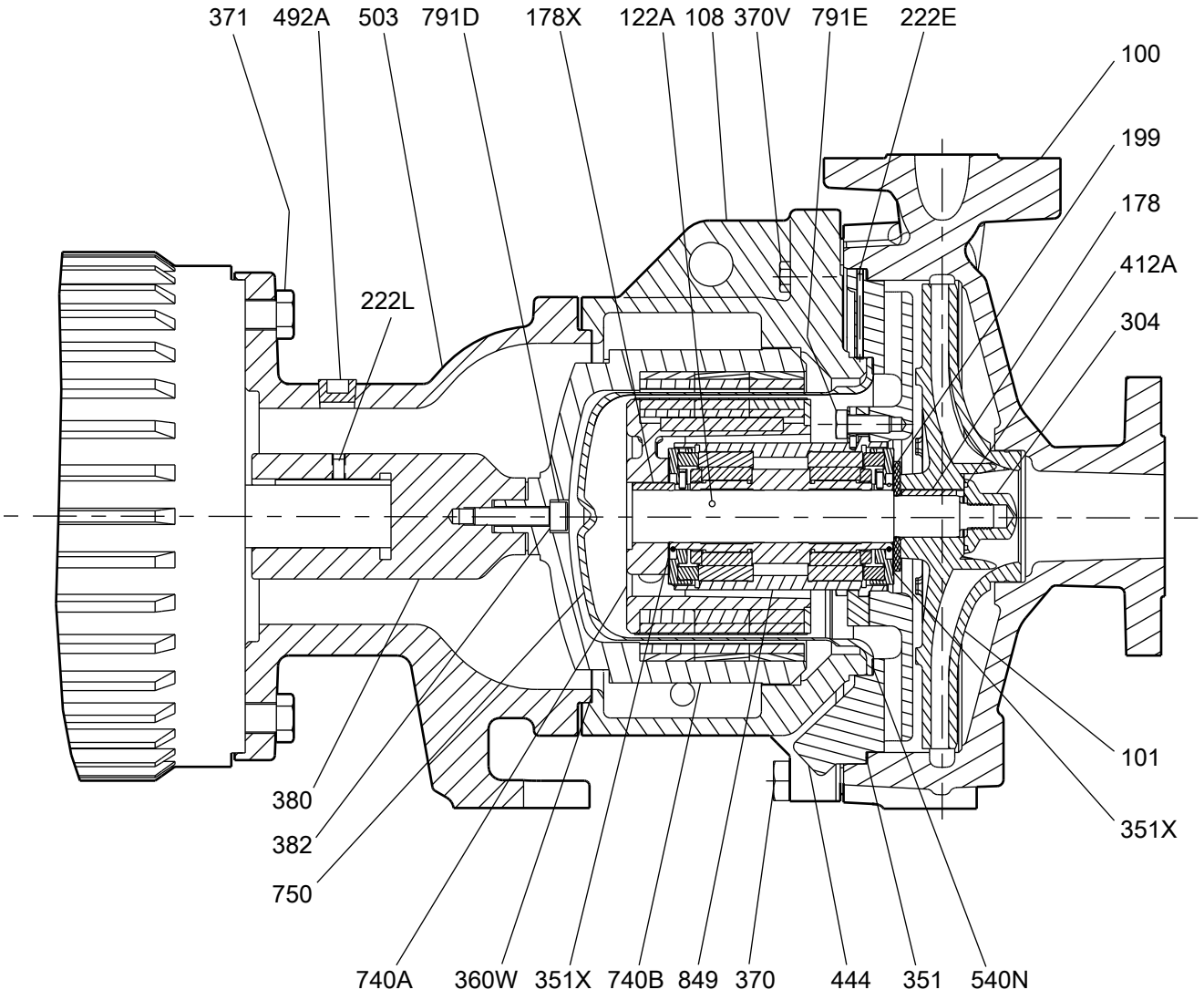
Alignment troubleshooting

Symptom	Cause	Remedy
Horizontal (side-to-side) alignment cannot be obtained (angular or parallel).	The driver feet are bolt-bound.	Loosen the pump's hold-down bolts, and slide the pump and driver until you achieve horizontal alignment.
	The baseplate is not leveled properly and is probably twisted.	1. Determine which corners of the baseplate are high or low. 2. Remove or add shims at the appropriate corners. 3. Realign the pump and driver.
Vertical (top-to-bottom) alignment cannot be obtained (angular or parallel).	The baseplate is not leveled properly and is probably bowed.	1. Determine if the center of the baseplate should be raised or lowered. 2. Level screws equally at the center of the baseplate. 3. Realign the pump and driver.

Parts Listings and Cross-Sectional Drawings

Close-coupled S-group (all) and M-group (2 x 3 - 8 only) — stainless steel

Cross-sectional drawing



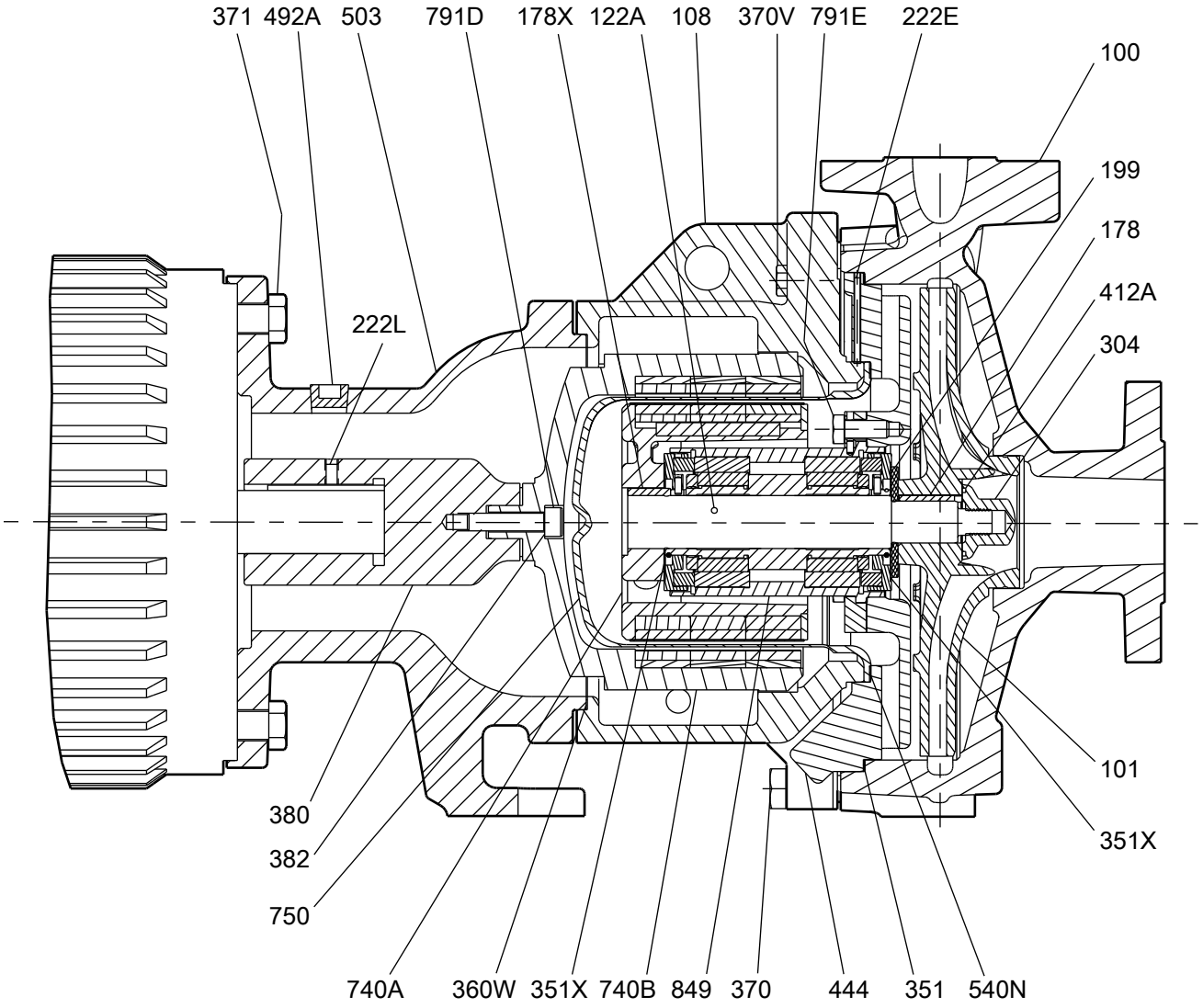
Parts list

Item	Quantity	Part name	Material
100	1	Casing	Stainless steel (1.4408)
101	1	Impeller	Stainless steel (1.4408)
108	1	Frame adapter	Ductile iron
122A*	1	Driven shaft	Duplex SS (1.4462)
178	1	Impeller key	303SS
178X*	1	Driven carrier key	Stainless steel (1.4571)
199	1	Distance washer	Stainless steel (1.4571)

Item	Quantity	Part name	Material
222E	3	Adapter-to-backplate setscrew (6 in. size pumps)	Steel
222L	2	Stub shaft–to-motor setscrew	Steel
304	1	Impeller nut	Duplex SS (1.4517)
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capscrew (not illustrated)	Steel
370V	2	Adapter-to-backplate hex capscrew (8 in. pumps)	Steel
371	4	Motor-to-adapter hex capscrew	Steel
380	1	Stub shaft	Steel
382	1	Internal tooth lockwasher	Steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Stainless steel (1.4408)
492A	1	Frame plug, setscrew access	Steel
503	1	Close-coupled adapter	Cast iron
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Duplex SS/NdFeB (1.4517)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy-C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Stainless steel
849	1	Bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Duplex SS/SmCo (1.4517)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly.			

Close-coupled S-group (all) and M-group (2 x 3 - 8 only) — Hastelloy-C

Cross-sectional drawing



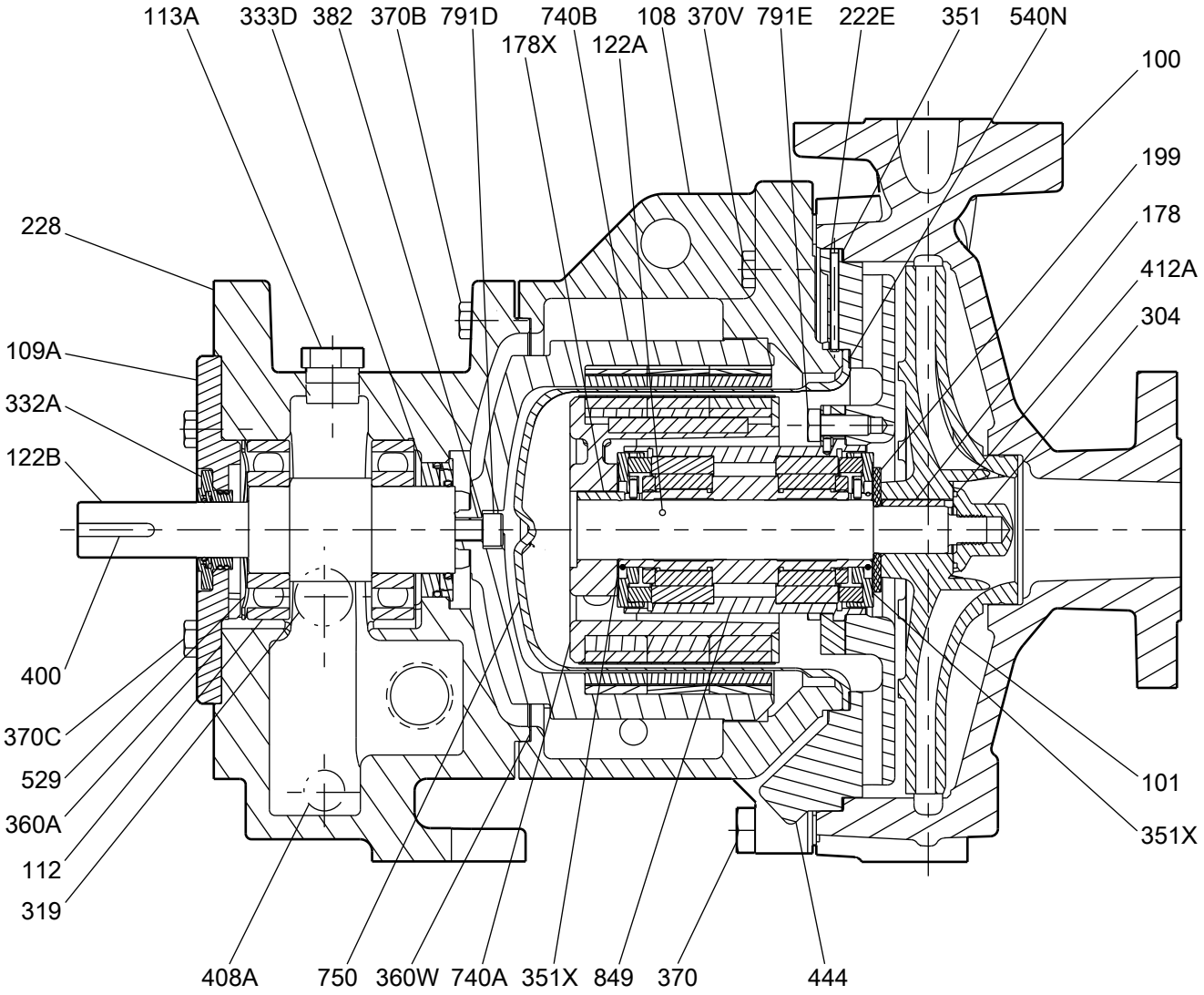
Parts list

Item	Quantity	Part name	Material
100	1	Casing	Hastelloy-C (2.4686)
101	1	Impeller	Hastelloy-C (2.4686)
108	1	Frame adapter	Ductile iron
122A*	1	Driven shaft	Hastelloy-C (2.4610)
178	1	Impeller key	Hastelloy-C
178X*	1	Driven carrier key	Hastelloy-C (2.4610)
199	1	Distance washer	Hastelloy-C (2.4610)
222E	3	Adapter-to-backplate setscrew (6 in. pumps)	Steel
222L	2	Stub shaft-to-motor setscrew	Steel
304	1	Impeller nut	Hastelloy-C (2.4610)

Item	Quantity	Part name	Material
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capscrew (not illustrated)	Steel
370V	2	Adapter-to-backplate hex capscrew (8 in. pumps)	Steel
371	4	Motor-to-adapter hex capscrew	Steel
380	1	Stub shaft	Steel
382	1	Internal tooth lockwasher	Stainless steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Hastelloy-C (2.4686)
492A	1	Frame plug, setscrew access	Steel
503	1	Close-coupled adapter	Cast iron
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Hastelloy-C/NdFeB (2.4686)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy-C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Hastelloy-C
849	1	Bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Hastelloy-C/SmCo (2.4686)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly.			

S-group with bearing frame — stainless steel

Cross-sectional drawing



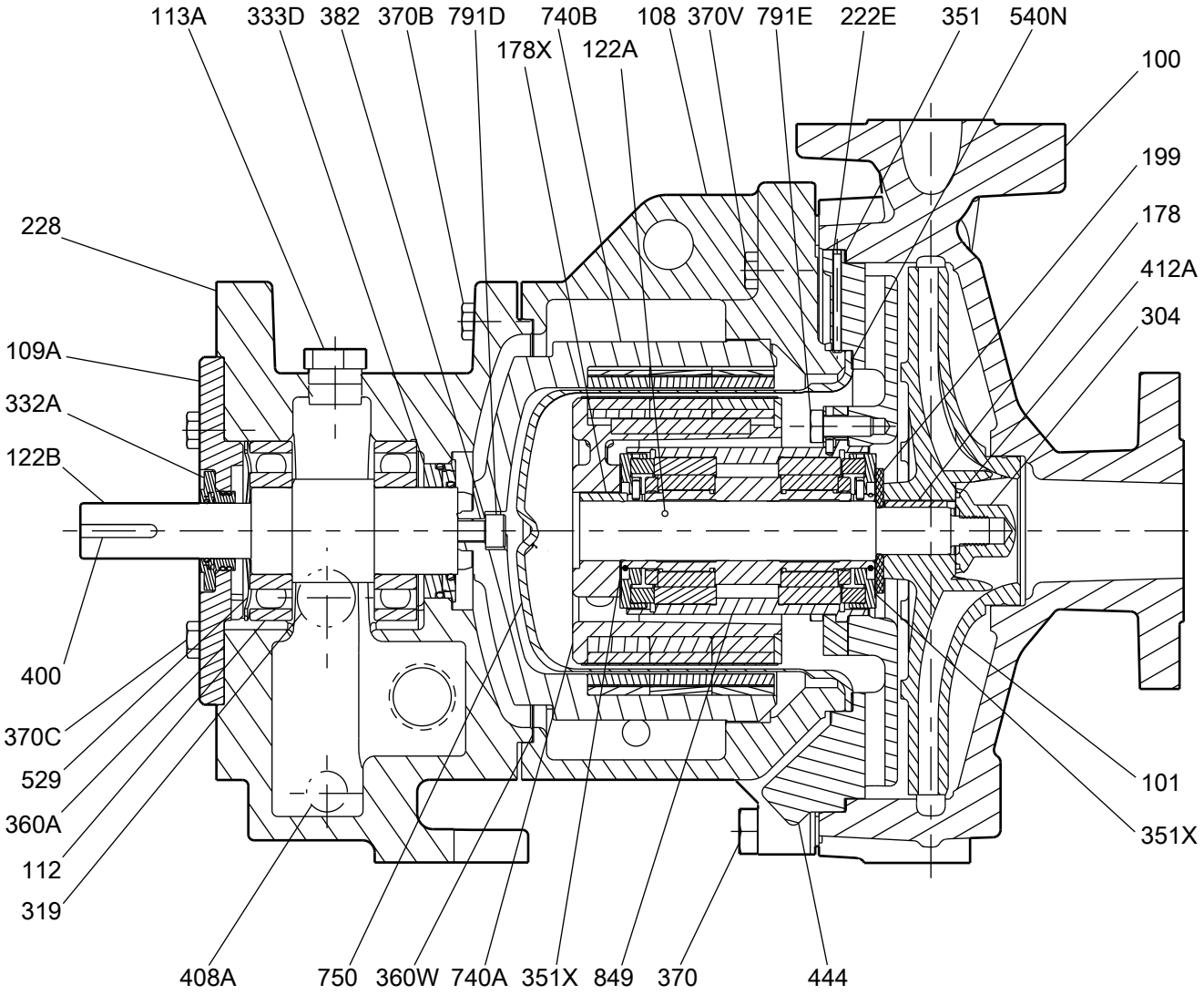
Parts list

Item	Quantity	Part name	Material
100	1	Casing	Stainless steel (1.4408)
101	1	Impeller	Stainless steel (1.4408)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Duplex SS (1.4462)
122B	1	Drive shaft	Steel 4140
178	1	Impeller key	303SS
178*	1	Driven carrier key	Stainless steel (1.4571)
199	1	Distance washer	Stainless steel (1.4571)
222E	3	Adapter-to-backplate setscrew (6 in. pumps)	Steel
228	1	Bearing frame	Cast iron

Item	Quantity	Part name	Material
304	1	Impeller nut	Duplex SS (1.4517)
319	1	Sight window	Steel/glass
332A	1	Labyrinth oil seal (coupling end)	Bronze/SS
333D	1	Labyrinth oil seal (radial end)	Carbon-filled Teflon
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360A	1	End cover gasket	Vellumiod
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capcrew	Steel
370C	1	End cover hex capscrew	Steel
370V	2	Adapter-to-backplate hex capscrew (8 in. pumps)	Steel
382	1	Internal tooth lockwasher	Stainless steel
370C	4	End cover hex capscrew	Steel
400	1	Coupling key	Steel
408A	1	Drain plug	Steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Stainless steel (1.4408)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Duplex SS/NdFeB (1.4517)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy-C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Stainless steel
849	1	Bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Duplex SS/SmCo (1.4517)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly.			

S-group with bearing frame — Hastelloy-C

Cross-sectional drawing



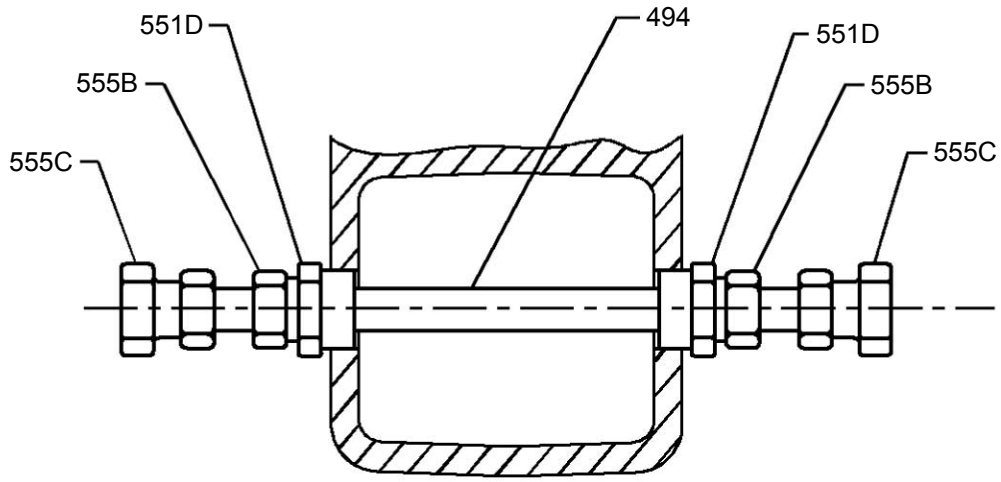
Parts list

Item	Quantity	Part name	Material
100	1	Casing	Hastelloy-C (2.4686)
101	1	Impeller	Hastelloy-C (2.4686)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Hastelloy-C (2.4610)
122B	1	Drive shaft	Steel 4140
178	1	Impeller key	Hastelloy-C
178*	1	Driven carrier key	Hastelloy-C (2.4610)
199	1	Distance washer	Hastelloy-C (2.4610)
222E	3	Adapter-to-backplate setscrew (6 in. pumps)	Steel
228	1	Bearing frame	Cast iron

Item	Quantity	Part name	Material
304	1	Impeller nut	Hastelloy-C (2.4610)
319	1	Sight window	Steel/glass
332A	1	Labyrinth oil seal (coupling end)	Bronze/SS
333D	1	Labyrinth oil seal (radial end)	Carbon-filled Teflon
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360A	1	End cover gasket	Vellumiod
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capscrew	Steel
370C	4	End cover hex capscrew	Steel
370V	2	Adapter-to-backplate hex capscrew (8 in. pumps)	Steel
382	1	Internal tooth lockwasher	Stainless steel
400	1	Coupling key	Steel
408A	1	Drain plug	Steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Hastelloy-C (2.4686)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Hastelloy/NdFeB (1.4517)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy-C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Hastelloy-C
849	1	Bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Hastelloy-C/SmCo (2.4686)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly.			

Frame cooling options

Cross-sectional drawing

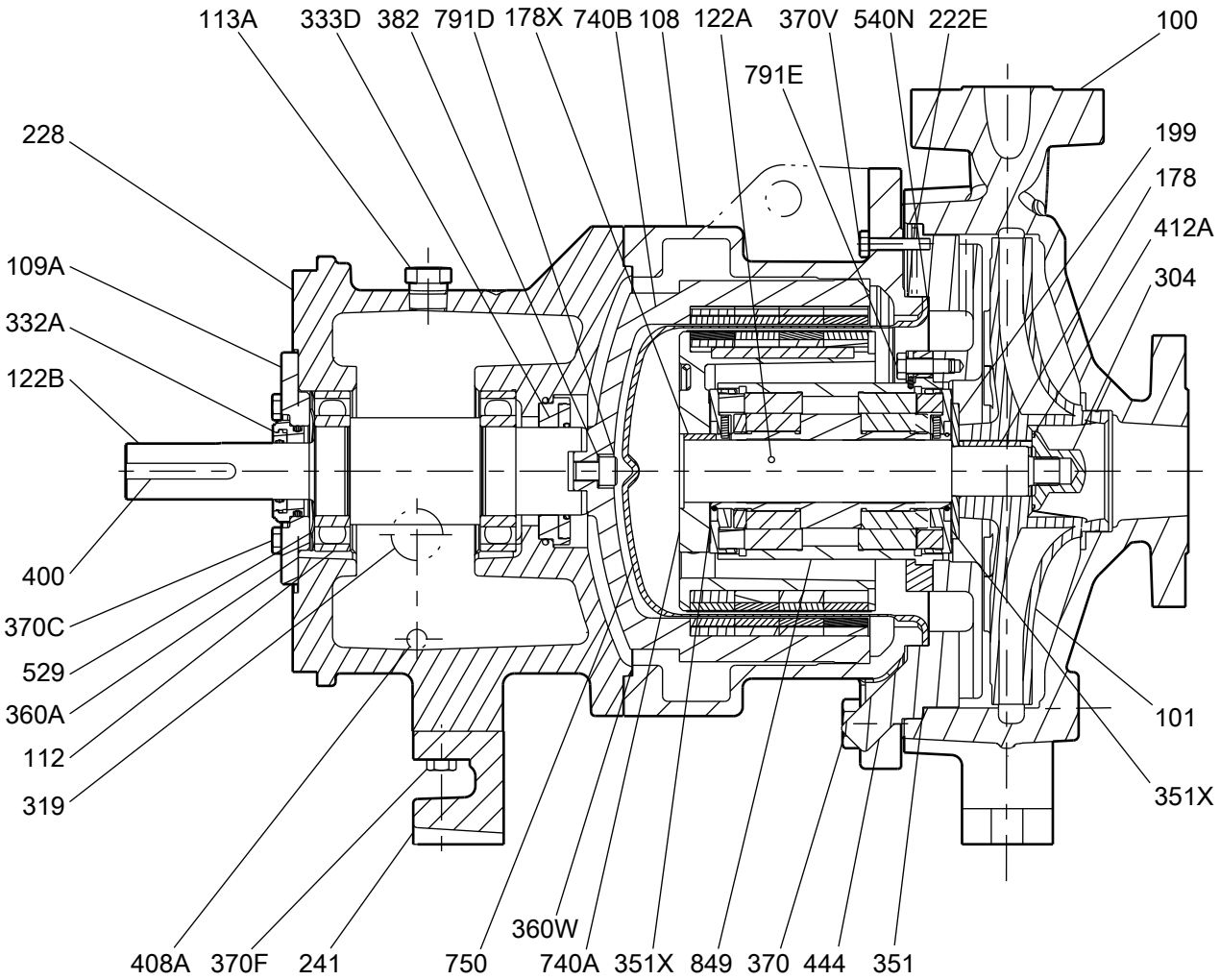


Parts list

Item	Quantity	Part name	Material
494	2	Cooling tube	Stainless steel
555B	2	Thermocouple fitting tube	Stainless steel
555C	2	Tube fitting str	Brass
551D	1	Hex bushing	Iron

M-group with bearing frame — stainless steel

Cross-sectional drawing



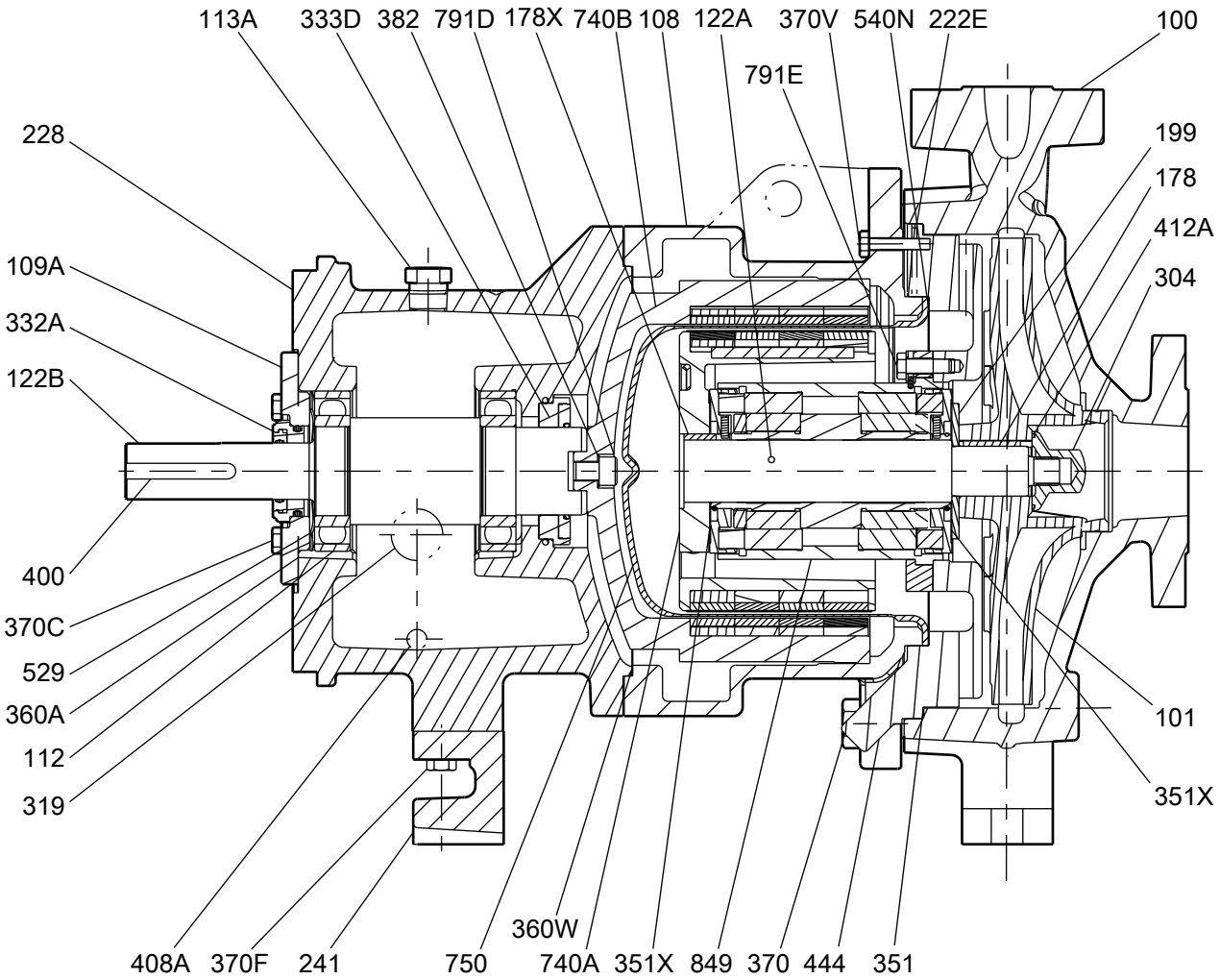
Parts list

Item	Quantity	Part name	Material
100	1	Casing	Stainless steel (1.4408)
101	1	Impeller	Stainless steel (1.4408)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Duplex SS (1.4462)
122B	1	Drive shaft	Steel 4140
178	1	Impeller key	303SS
178X*	1	Driven carrier key	Stainless steel (1.4571)
199	1	Distance washer	Stainless steel (1.4571)
222E**	3	Adapter-to-backplate setscrew	Steel
228	1	Bearing frame	Cast iron
241	1	Frame foot	Cast iron
304	1	Impeller nut	Duplex SS (1.4517)
319	1	Sight window	Steel/glass

Item	Quantity	Part name	Material
332A	1	Labyrinth oil seal (coupling end)	Bronze/SS
333D	1	Labyrinth oil seal (radial end)	Bronze/SS
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360A	1	End cover gasket	Vellumoid
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capscrew	Steel
370C	4	End cover hex capscrew	Steel
370F	2	Foot-to-frame hex capscrew	Steel
370V	2	Adapter-to-backplate hex capscrew (8 in. pumps)	Steel
382	1	Internal tooth lockwasher	Stainless steel
400	1	Coupling key	Steel
408A	1	Drain plug	Steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Stainless steel (1.4408)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Duplex SS/NdFeB (1.4517)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Stainless steel
849	1	Bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Duplex SS/SmCo (1.4517)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Duplex SS/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly. **Used on 3x4-7 and 3x4-8G pumps only.			

M-group with bearing frame — Hastelloy-C

Cross-sectional drawing



Parts list

Item	Quantity	Part name	Material
100	1	Casing	Hastelloy-C (2.4686)
101	1	Impeller	Hastelloy-C (2.4686)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Hastelloy-C (2.4610)
122B	1	Drive shaft	Steel 4140
178	1	Impeller key	Hastelloy-C
178X*	1	Driven carrier key	Hastelloy-C (2.4610)
199	1	Distance washer	Hastelloy-C (2.4610)
222E	3	Adapter-to-backplate setscrew (6 in. pumps)	Steel
228	1	Bearing frame	Cast iron
241	1	Frame foot	Cast iron
304	1	Impeller nut	Hastelloy-C (2.4610)

Item	Quantity	Part name	Material
319	1	Sight window	Steel/glass
332A	1	Labyrinth oil seal (coupling end)	Bronze/SS
333D	1	Labyrinth oil seal (radial end)	Bronze/SS
351	1	Backplate-to-case gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: • TFM1600 (PTFE) (standard) • Viton B (optional)
360A	1	End cover gasket	Vellumiod
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	8 for 6 in. pumps, 12 for 8 in. pumps	Adapter-to-case hex capscrew	Steel
370B	4	Frame-to-adapter hex capscrew	Steel
370C	4	End cover hex capscrew	Steel
370F	2	Foot-to-frame hex capscrew	Steel
370V	2	Adapter-to-backplate hex capscrew (except on 3x4-7 and 3x4-8G)	Steel
382	1	Internal tooth lockwasher	Stainless steel
400	1	Coupling key	Steel
408A	1	Drain plug	Steel
412A	1	Impeller nut O-ring	Teflon
444	1	Backplate	Hastelloy-C (2.4686)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
740A	1	Driven carrier assembly	Hastelloy-C/NdFeB (2.4686)
740B	1	Drive carrier assembly	Ductile iron/NdFeB (0.7043)
750	1	Containment shell	Hastelloy-C (2.4610)
791D	1	Drive-to-shaft capscrew socket head	Steel
791E	3	Cartridge-to-backplate hex capscrew	Hastelloy-C
849	1	Bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
High temperature optional components			
351	1	Backplate-to-case gasket	Grafoil
540N	1	Containment shell gasket	Grafoil
740A	1	Driven carrier assembly	Hastelloy-C/SmCo (2.4686)
740B	1	Drive carrier assembly	Ductile iron/SmCo (0.7043)
849	1	High temperature bearing cartridge assembly	Hastelloy-C/SSiC
		Silicon Carbide (standard)	
		Dryguard Silicon Carbide (optional)	
*Included in 740A driven carrier assembly.			

Spare and repair parts

Recommended spare parts

Item	Quantity	Part	Material
351	1	Backplate to case gasket	Aramid fiber with EPDM rubber
112	2	Ball bearing	Steel
351X	2	Intermediate ring spacer	Grafoil
360A	1	End-cover gasket	Vellumoid
360W	1	Frame-to-adapter gasket	Aramid fiber with EPDM rubber
740A	1	Driven carrier assembly	Duplex SS/NdFeB
740B	1	Drive carrier assembly	Ductile iron/NdFeB
750	1	Containment shell	Hastelloy-C
849	1	Bearing cartridge assembly	Duplex SS/SSiC

Repair parts

- Impeller (101)
- Impeller nut and O-ring (304 and 412A)
- Impeller key (178)
- Driven magnet assembly (740A)
- Drive magnet assembly (740B)
- Containment shell (750)
- Driven shaft (122B)
- Labyrinth oil seals (332A and 333D)

Interchangeability drawings

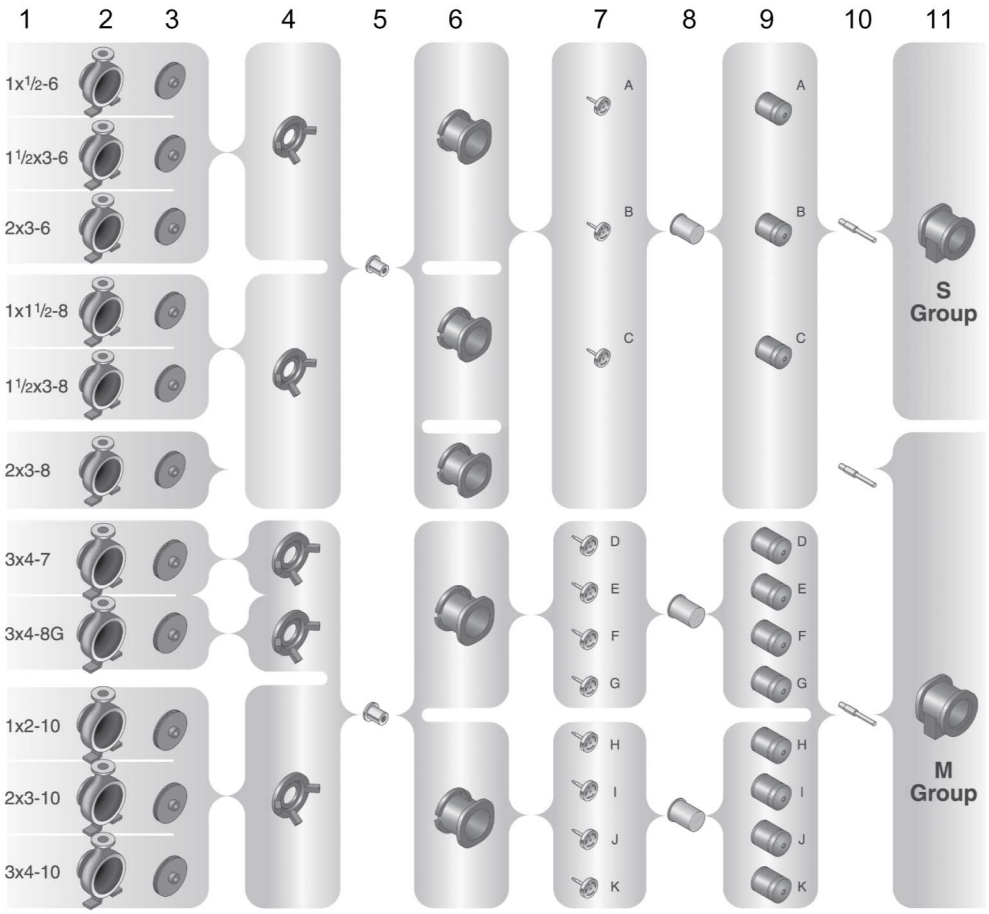


Figure 14: Frame-mounted 3296 EZMAG

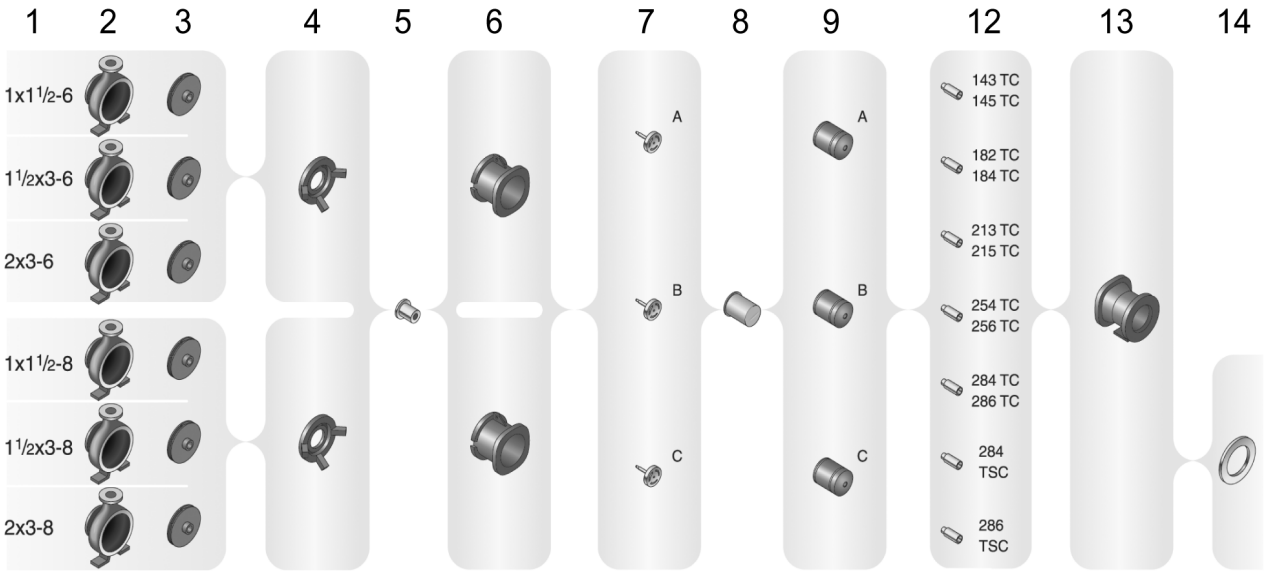


Figure 15: Close-coupled 3296 EZMAG

Interchangeability drawings parts list

1. Size	6. Frame adapter	11. Bearing frame
2. Casing	7. Driven magnet	12. Stub shaft
3. Impeller	8. Shell	13. Motor adapter
4. Backplate	9. Drive magnet	14. Adapter plate
5. Bearing cartridge	10. Drive shaft	—

Other Relevant Documentation or Manuals

Condensed power monitor

Description

ITT offers various power-monitoring devices for specific pump sizes, speeds, and impeller diameters. Power-monitoring devices are designed to protect pumps from:

- Dry-running
- Running against a closed discharge valve
- Running outside of the recommended operating region

Power monitors were designed to detect power relative to load, which is a linear function, as opposed to measuring amperage relative to load, which is a parabolic function. The linear characteristic of measuring power vs. load enhances sensitivity at low power conditions where increments in power are critical. This figure shows a comparison of power measurements vs. amperage measurements. A properly-adjusted and installed power monitor is an insurance policy for securing extended pump life.

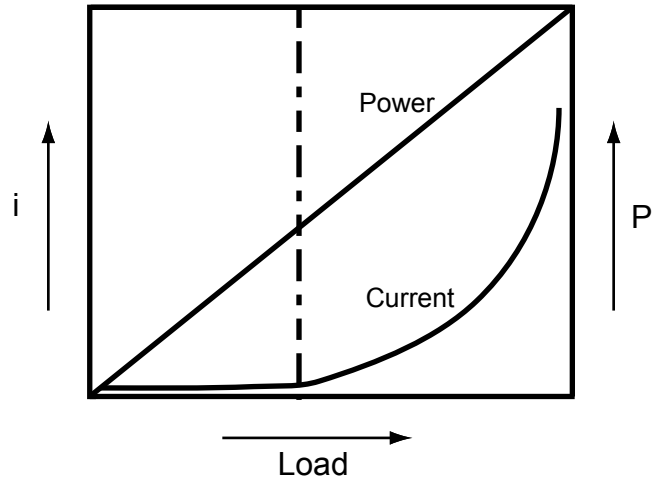


Figure 16: Power vs. amperage measurements

Since the current curve is so flat, load changes are difficult to detect when you measure only the current in this range. If you misread these changes, nuisance tripping or a dry-running pump can result. If you measure power as well, then this problem is eliminated.

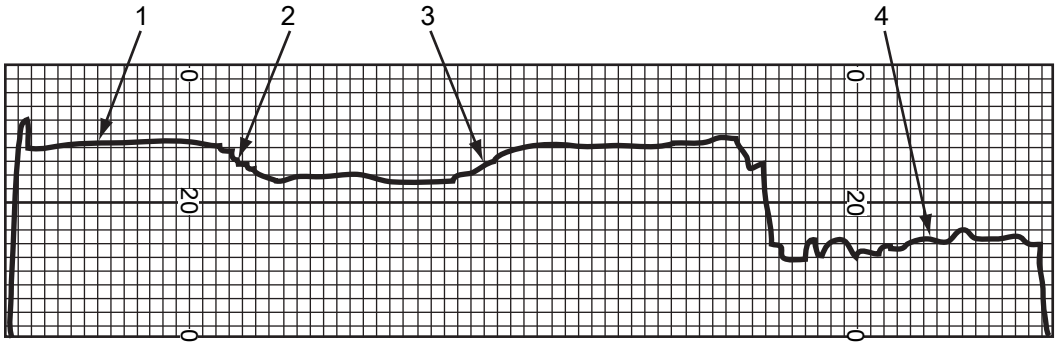
Power draw measuring

Power monitors can be strategically calibrated to protect your pump by measuring the power draw from any of these conditions:

- Dry running
- Closed discharge valve
- No prime
- Inadequate suction conditions/plugged suction
- Cavitation
- Air lock
- Decoupled magnets
- Solidified, plugged, or frozen discharge line
- Fluctuating viscosities, precipitation, or coagulation
- Broken or damaged shaft
- Broken or damaged coupling
- Jammed impeller

- Bad bearings
- Rapid cycling

The power draw at each of these conditions can be simulated in a plant test or estimated through calculations or interpolations from the pump performance curve. By defining these dangerous power fluctuations, appropriate calibration of the power-monitoring unit will prevent avoidable pump failures. This figure shows a typical power evaluation recorded from a common centrifugal pump electric motor.



1. The pump is in operation.
2. The valve is closing.
3. The valve is opening.
4. There is no fluid being pumped.

Figure 17: Typical power evaluation

Contact your ITT representative for assistance and power analysis for your specific system. For further details and evaluation of power monitoring units, a comprehensive power monitor user guide is available from ITT.

Calibration tips

Use these tips to assist you when you select and calibrate power monitors:

- Read your power monitor installation instructions and wiring diagram before you attempt to calibrate the unit.
- Understand the recommended operating envelope of your pump that is provided by ITT.
- Understand the requirements and limitations of your system.
- Understand the full range of your operating duty, including power requirements at the rated minimum and maximum flow conditions.
- Identify potential failures that would be characteristic of your specific process and pump type.
- Understand the power scope and torque scope of the selected electric motor.
- When feasible, further define your operating range to run as close to best efficiency point (BEP) as practical.
- Select either a single trip unit or dual trip unit as practical for your specific system. A dual trip unit is recommended for the 3296 EZMAG. Always use a low setting in order to protect against dry run. A high setting detects if an upset condition has occurred. This results in bearing damage.
- Set a low power trip point at the required power draw when operation is at the recommended minimum flow of the manufacturer or higher, but less that the normal operating point.
- Set a high power trip point at the required power draw when operation is at the recommended maximum flow of the manufacturer or lower, or at the flow rate that will prevent cavitation.
- When using dual trip power monitors, select high and low trip points designed to protect your specific system within the recommended pump operating region defined by ITT. This method creates boundaries for a safe pump operating envelope.
- Set the nuisance trip feature for each power trip. Set the nuisance trip device to an interval that allows the system to experience momentary fluctuations in power draw. Set it during an appropriate time-frame that prevents the pump from experiencing excessive heat or dangerous operating conditions.
- Set the delay timer for start-up conditions that allow the system to come to normal operating power within a time-frame that maximizes protection of your pump.
- For variable speed operation, consult ITT or the power monitor manufacturer for appropriate auxiliary devices designed for operating at multiple speeds or fluctuating frequencies.

- Select an electrical enclosure that is suitable for the operating environment, or install the unit in an appropriate electrical panel.
- Do not activate the manual override of the power monitor until a thorough examination of the source of the problem is defined and corrected.
- Investigate and select power monitor features that are most suitable for your particular application and plant safety.

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