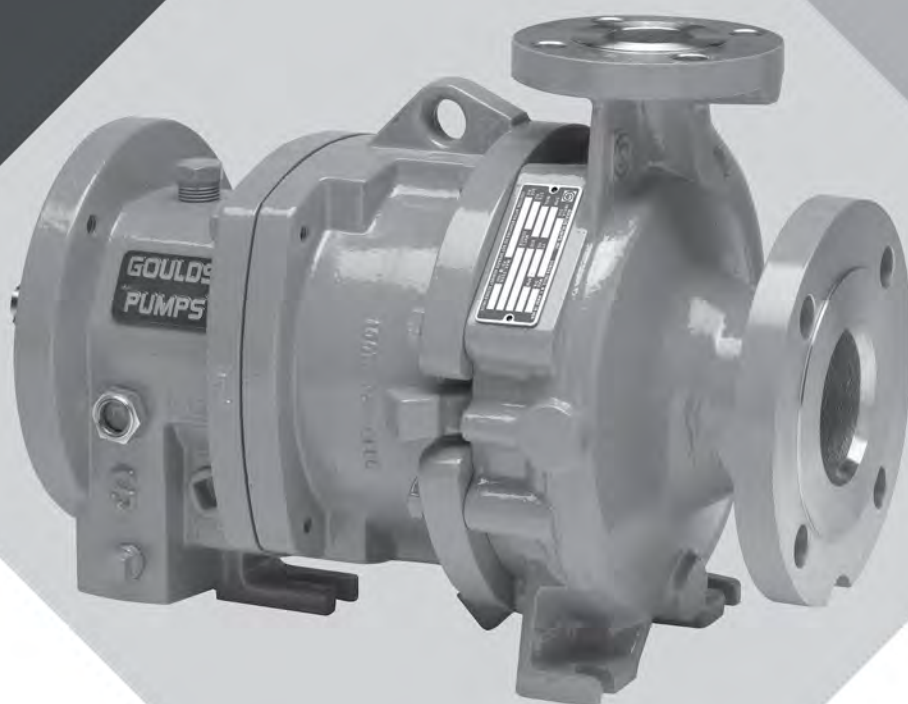


 **GOULDS PUMPS**

Installation, Operation, and Maintenance Manual

Model 3296 EZMAG



ITT

Table of Contents

1 Introduction and Safety	4
1.1 Introduction.....	4
1.1.1 Requesting other information	4
1.2 Safety	4
1.2.1 Safety terminology and symbols	5
1.2.2 Environmental safety.....	6
1.2.3 User safety	6
1.2.4 Safety regulations for Ex-approved products in potentially explosive atmospheres	8
1.3 Product warranty	13
1.3.1 Spare parts.....	13
2 Transportation and Storage.....	14
2.1 Inspect the delivery	14
2.1.1 Inspect the package	14
2.1.2 Inspect the unit.....	14
2.2 Transportation guidelines	14
2.2.1 Pump handling	14
2.2.2 Lifting methods.....	14
2.3 Storage guidelines.....	16
2.3.1 Pump storage requirements	16
3 Product Description	17
3.1 General description	17
3.2 Nameplate information	17
4 Installation.....	20
4.1 Pre-installation.....	20
4.1.1 Pump location guidelines	20
4.1.2 Foundation requirements	21
4.2 Baseplate-mounting procedures	22
4.2.1 Prepare the baseplate for mounting	22
4.2.2 Install the baseplate using shims or wedges.....	22
4.2.3 Install the baseplate using jackscrews	23
4.2.4 Baseplate-leveling worksheet	26
4.3 Pump-to-driver alignment	27
4.3.1 Alignment checks	27
4.3.2 Permitted indicator values for alignment checks.....	28
4.3.3 Alignment measurement guidelines	28
4.3.4 Attach the dial indicators for alignment	28
4.3.5 Pump-to-driver alignment instructions.....	29
4.4 Grout the baseplate.....	32
4.5 Piping checklists.....	33
4.5.1 Fastening	33
4.5.2 General piping checklist.....	33
4.5.3 Suction-piping checklist.....	36
4.5.4 Discharge piping checklist.....	38
4.5.5 Final piping checklist	39

5 Commissioning, Startup, Operation, and Shutdown	40
5.1 Preparation for startup.....	40
5.2 Remove the coupling guard	41
5.3 Check the rotation	43
5.4 Check the rotation - Close Coupled	43
5.5 Couple the pump and driver.....	43
5.5.1 Install the coupling guard	44
5.6 Bearing lubrication.....	49
5.6.1 Lubricating-oil requirements.....	49
5.6.2 Acceptable oil for lubricating bearings	50
5.6.3 Lubricate the bearings with oil.....	50
5.6.4 Greased-for-life bearing lubrication.....	50
5.7 Pump priming	51
5.7.1 Prime the pump with the suction supply above the pump.....	51
5.7.2 Prime the pump with the suction supply below the pump	51
5.7.3 Other methods of priming the pump.....	52
5.8 Start the pump.....	52
5.8.1 Minimum continuous recommended flow.....	53
5.9 Pump operation precautions	54
5.10 Shut down the pump	55
5.11 Make the final alignment of the pump and driver.....	55
6 Maintenance.....	57
6.1 Maintenance schedule	57
6.2 Bearing maintenance	58
6.3 Disassembly.....	58
6.3.1 Disassembly precautions	58
6.3.2 Required tools.....	59
6.3.3 Prepare the pump for disassembly	59
6.3.4 Remove the frame assembly and shaft (frame-mounted pump).....	60
6.3.5 Remove the frame assembly and shaft (close-coupled pump).....	62
6.3.6 Disassemble the liquid end	63
6.4 Pre-assembly inspections	66
6.4.1 Replacement guidelines.....	66
6.4.2 Magnet inspections	68
6.4.3 Bearing-frame inspection	68
6.4.4 Bearings inspection.....	69
6.4.5 Minimum running clearances	69
6.5 Reassembly.....	70
6.5.1 Reassemble the frame assembly and shaft (frame-mounted pumps)	70
6.5.2 Reassemble the frame assembly and shaft (close-coupled pumps).....	72
6.5.3 Reassemble the liquid end.....	73
6.5.4 Complete the pump reassembly	77
6.5.5 Bolt torque values	77
7 Troubleshooting	79
7.1 Operation troubleshooting	79
7.2 Alignment troubleshooting.....	80
8 Parts List and Cross-Sectionals	81
8.1 Close-coupled S-group (all) and M-group (2 x 3 - 8 only) — stainless steel.....	81

8.2 Close-coupled S-group (all) and M-group (2 x 3 - 8 only) — Hastelloy-C	83
8.3 S-group with bearing frame — stainless steel	85
8.4 S-group with bearing frame — Hastelloy-C	87
8.5 Frame cooling options	89
8.6 M-group with bearing frame — stainless steel	90
8.7 M-group with bearing frame — Hastelloy-C	92
8.8 Spare and repair parts	94
8.9 Interchangeability drawings	95
9 Other Relevant Documentation or Manuals	97
9.1 Condensed power monitor	97
10 Local ITT Contacts	100
10.1 Regional offices	100

1 Introduction and Safety

1.1 Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance



CAUTION:

Failure to observe the instructions contained in this manual could result in personal injury and/or property damage, and may void the warranty. Read this manual carefully before installing and using the product.

NOTICE:

Save this manual for future reference and keep it readily available.

1.1.1 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 serial number when requesting technical information or spare parts.

1.2 Safety



WARNING:

- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
- Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.
- Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.

- If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.

**CAUTION:**

- Risk of injury and/or property damage. Operating a pump in an inappropriate application can cause over pressurization, overheating, and/or unstable operation. Do not change the service application without the approval of an authorized ITT representative.

**WARNING:**

This product contains Carbon Black a chemical known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov




1.2.1 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:	<ul style="list-style-type: none"> • 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

1.2.2 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.



WARNING:

If the product has been contaminated in any way, such as from toxic chemicals or nuclear radiation, do NOT send the product to ITT until it has been properly decontaminated and advise ITT of these conditions before returning.

Electrical installation

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

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 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:

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

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.

Noise



WARNING:

Sound pressure levels may exceed 80 dbA in operating process plants. Clear visual warnings or other indicators should be available to those entering an area with unsafe noise levels. Personnel should wear appropriate hearing protection when working on or around any equipment, including pumps. Consider limiting personnel's exposure time to noise or, where possible, enclosing equipment to reduce noise. Local law may provide specific guidance regarding exposure of personnel to noise and when noise exposure reduction is required.

Temperature



WARNING:

Equipment and piping surfaces may exceed 130°F (54°C) in operating process plants. Clear visual warnings or other indicators should alert personnel to surfaces that may reach a potentially unsafe temperature. Do not touch hot surfaces. Allow pumps operating at a high temperature to cool sufficiently before performing maintenance. If touching a hot surface cannot be avoided, personnel should wear appropriate gloves, clothing, and other protective gear as necessary. Local law may provide specific guidance regarding exposure of personnel to unsafe temperatures.

1.2.3.1 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.

1.2.3.2 Wash the skin and eyes

1. Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	<ol style="list-style-type: none"> 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.
Chemicals or hazardous fluids on skin	<ol style="list-style-type: none"> 1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.2.4 Safety regulations for Ex-approved products in potentially explosive atmospheres



WARNING:

Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.

Special care must be taken in potentially explosive environments to ensure that the equipment is properly maintained. This includes but is not limited to:



Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

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, the vapor, or both present in hazardous areas.

- Any maintenance for Ex-approved products must conform to international and national standards (for example, EN 60079-17).

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

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.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- See the dimensional drawings of the product for the minimum permitted water level according to the Ex approval. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.
- Before you start work on 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, and that they are in use.
- 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.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

Description of Ex-Directives

The Ex-directives are a specification enforced in Europe and the United Kingdom for electrical and non-electrical equipment installed in those locations. Ex-directives deal with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmospheres. The relevance of the Ex-requirements is not limited to Europe or the UK. You can apply these guidelines to equipment installed in any potentially explosive atmosphere.

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an ITT representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079-14).

1. Monitoring the liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

The Ex conformance is only applicable when the pump unit is operated within its intended use. Operating, installing or maintaining the pump unit in any way that is not covered in the Instruction, Operation, and Maintenance manual (IOM) can cause serious personal injury or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT Goulds Pumps. If there is any question regarding the intended use of the equipment, please contact an ITT Goulds representative before proceeding.

Current IOMs are available at <https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/IOMs/> or from your local ITT Goulds Pumps Sales representative.

All pumping unit (pump, seal, coupling, motor and pump accessories) certified for use in an Ex classified environment, are identified by an Ex tag secured to the pump or the on which it is mounted. A typical tag would look like this:

If applicable, your pump may have either a CE Ex (ATEX) tag or UKCA Ex tag affixed to the pump. See the Safety section for a description of the symbols and codes. Typical nameplate only shown below, the actual area classification may be different.

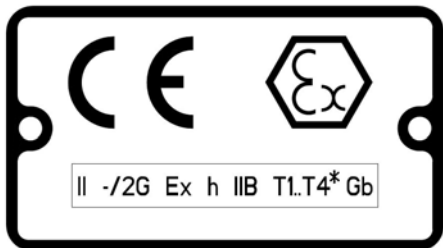


Figure 1: Typical Ex nameplate



Figure 2: Typical UKCA Ex nameplate

Table 1: Temperature class definitions

Code	Maximum permissible surface temperature in °C °F	Maximum permissible liquid temperature in °C °F
T1	440 824	372 700
T2	290 554	267 513
T3	195 383	172 342
T4	130 266	107 225
T5	Option not available	Option not available
T6	Option not available	Option not available

* Maximum liquid temperature may be limited by the pump model and order specific options. [Table 1: Temperature class definitions on page 10](#) is for the purpose of determining T'x' code for Ex applications with liquid temperatures exceeding 107°C | 225°F.

The code classification marked on the equipment must be in accordance with the specified area where the equipment will be installed. If it is not, do not operate the equipment and contact your ITT Goulds Pumps sales representative before proceeding.

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



WARNING:

- When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur

if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a Goulds representative before proceeding.

- If equipment is to be installed in a potentially explosive atmosphere and these procedures are not followed, personal injury or equipment damage from an explosion may result.
- Particular care must be taken when the electrical power source to the equipment is energized.
- Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.
- Lock out driver power to prevent electric shock, accidental start-up and physical injury.
- NEVER start pump without proper prime (all models), or proper liquid level in self-priming pumps (Model 3796 and SP3298).
- Equipment that will operate in a potentially explosive environment must be installed in accordance with the following instructions.
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge. This includes ensuring that the PFA lined pumps (Model 3198), ETFE lined pumps (Model 3298, SP3298, V3298), and the non-metallic liquid end pumps (Model NM3196) are pumping fluids that are conductive. If not, a static electric discharge may occur when the pump is drained and disassembled for maintenance purposes.
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge.
- When pumping fluids with conductivity less than 1000 ps/m follow IEC TS 60079 32-1 guidelines.
- Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.
- When installing in a potentially explosive environment, ensure that the motor and accessories are properly certified.
- The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
- The impeller and wear ring clearance setting procedures must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
- Service temperature in an Ex classified environment is limited to the area classification specified on the Ex tag affixed to the pump (reference Table 1 in the Safety section for Ex classifications).
- The coupling used in an Ex classified environment must be properly certified.
- The coupling guard used in an Ex classified environment must be constructed from a spark-resistant material.
- Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.
- The mechanical seal used in an Ex classified environment must be properly certified.
- The mechanical seal must have an appropriate seal flush system. Failure to do so will result in excess heat generation and seal failure.
- Packed stuffing boxes are not allowed in an Ex classified environment.
- Dynamic seals are not allowed in an Ex classified environment.
- Pumps that are not self-priming must be fully primed at all times during operation. The only model lines that are self-priming is the 3796 and SP3298.
- Pumps must be fully primed at all times during operation.

- The preventive maintenance section must be adhered to in order to keep the applicable Ex classification of the equipment. Failure to follow these procedures will void the Ex classification for the equipment. Bearing replacement intervals are given in the specific pump model IOM.
- Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.
- Throughout this section on bearing lubrication, different pumpage temperatures are listed. If the equipment is Ex certified and the listed temperature exceeds the applicable value shown in Table 1 under SAFETY, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goolds representative.
- Cooling systems, such as those for bearing lubrication, mechanical seal systems, etc., where provided, must be operating properly to prevent excess heat generation, sparks and premature failure.
- Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation, sparks and premature failure.
- Flange loads from the piping system, including those from thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts which can result in excess heat generation, sparks and premature failure.
- Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.
- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check for magnetism on the pump shaft and demagnetize the shaft if there is any detectable magnetism. Magnetism will attract ferritic objects to the impeller, seals and bearings which can result in excess heat generation, sparks and premature failure.
- Leakage of process liquid may result in creation of an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid.
- Leakage of process liquid may result in creation of an explosive atmosphere. Follow all pump and seal assembly procedures.
- A buildup of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.
- Sealing systems that are not self purging or self venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
- Do not apply additional paint or coatings to the pump when in an Ex environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
- Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
- Stray electrical currents may ignite explosive atmospheres. Ensure drives are certified for variable frequency drive operation by the manufacturer.
- User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.
- For variable speed motor applications, the electric motor must be specified with shaft grounding and used with a conductive type coupling suitable for the area classification.

- In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.
 - Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.
-

1.3 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.

1.3.1 Spare parts

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

2 Transportation and Storage

2.1 Inspect the delivery

2.1.1 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.

2.1.2 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.

2.2 Transportation guidelines

2.2.1 Pump handling



WARNING:

Dropping, rolling or tipping units, or applying other shock loads, can cause property damage and/or personal injury. Ensure that the unit is properly supported and secure during lifting and handling.



CAUTION:

Risk of injury or equipment damage from use of inadequate lifting devices. Ensure lifting devices (such as chains, straps, forklifts, cranes, etc.) are rated to sufficient capacity.

2.2.2 Lifting methods

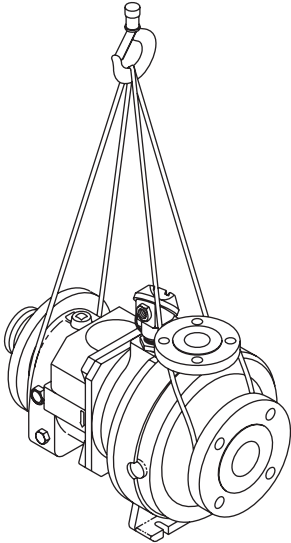
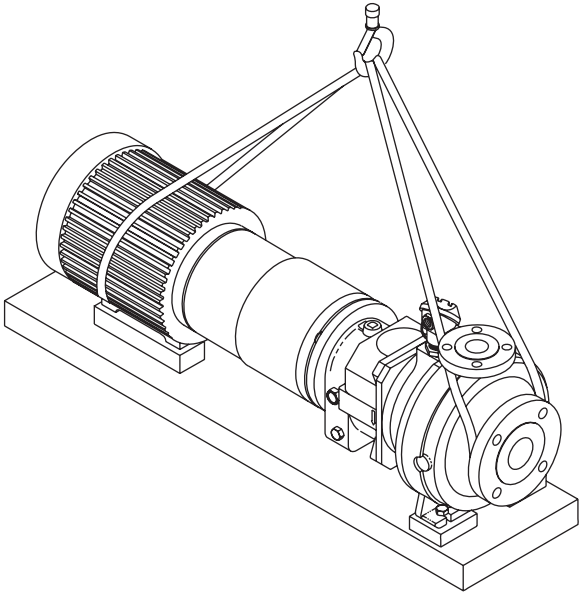


WARNING:

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
 - Safe lifting points are specifically identified in this manual. It is critical to lift the equipment only at these points. Integral lifting eyes or eye bolts on pump and motor components are intended for use in lifting the individual components only.
 - Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.
-

Table 2: Methods

Pump type	Lifting method
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 3: Proper lifting method for a bare pump****Figure 4: Proper lifting method for a pump with a base and driver**

NOTICE:

NOTICE:

Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

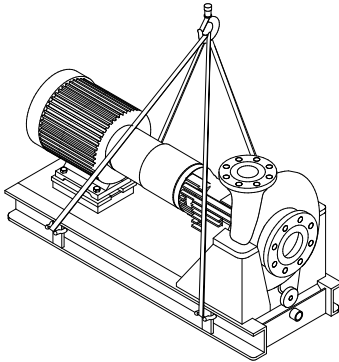


Figure 5: Example of a proper lifting method

2.3 Storage guidelines

2.3.1 Pump storage requirements

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

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	<ul style="list-style-type: none"> • Store in a covered and dry location. • Store the unit free from dirt and vibrations.
Long-term (more than six months)	<ul style="list-style-type: none"> • 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 unit order or you can purchase it and apply it after the units are already in the field. Contact your local ITT sales representative.

3 Product Description

3.1 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. ANSI Class 300 flanges that are serrated and raised-face are optional. 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 180°C | 365°F.
- Samarium Cobalt (SmCo) is used when pumped liquid temperatures are between 180°C | 365°F and 280°C | 536°F.

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.

3.2 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.

3.2 Nameplate information

When you order spare parts, identify this pump information:

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

Item numbers can be found in the spare parts list.

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

Nameplate types

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

Nameplate on the pump casing using English units

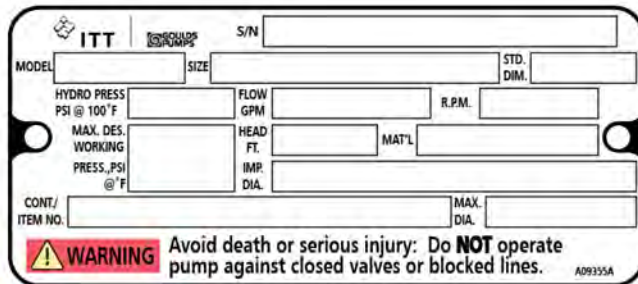


Figure 6: Nameplate on the pump casing using English units

Nameplate on the pump casing using metric units

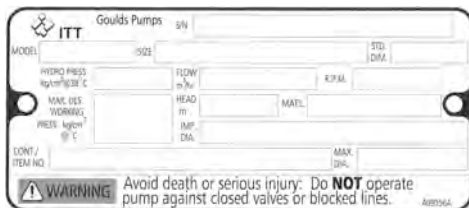


Figure 7: Metric units - nameplate on pump casing

Ex nameplate

All pumping unit (pump, seal, coupling, motor and pump accessories) certified for use in an Ex classified environment, are identified by an Ex tag secured to the pump or baseplate on which it is mounted. A typical tag would look like this:

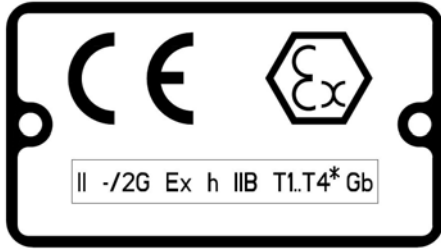


Figure 8: Typical Ex nameplate



Figure 9: Typical UKCA Ex nameplate

The code classification marked on the equipment should be in accordance with the specified area where the equipment will be installed. If it is not, please contact your ITT/Goolds representative before proceeding.



WARNING:

Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure the pump driver and all other auxiliary components meet the required area classification at the site. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

4 Installation

4.1 Pre-installation

Precautions



WARNING:

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to verify it is connected correctly.

NOTICE:

- Electrical connections must be made by certified electricians in compliance with all international, national, state and local regulations.
- Supervision by an authorized ITT representative is recommended to ensure proper installation. Improper installation 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.

4.1.1 Pump location guidelines

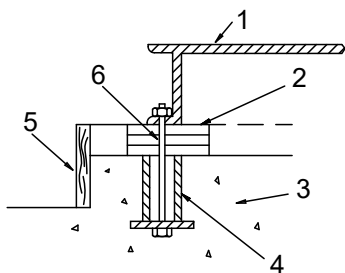
Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
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: <ul style="list-style-type: none"> • 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.

4.1.2 Foundation requirements

Requirements

- 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.

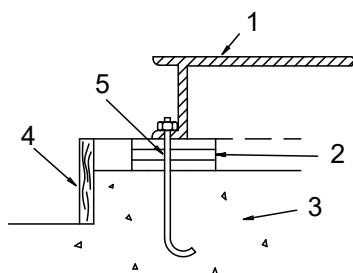
Sleeve-type bolts



Item	Description
1.	Baseplate
2.	Shims
3.	Foundation
4.	Sleeve
5.	Dam
6.	Bolt

Figure 10: Sleeve type bolts

J-type bolts



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

Figure 11: J-type bolts

4.2 Baseplate-mounting procedures

4.2.1 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 using 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.

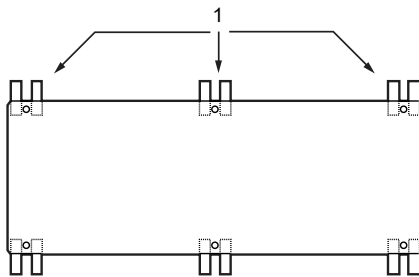
4.2.2 Install the baseplate using shims or wedges

Required tools:

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

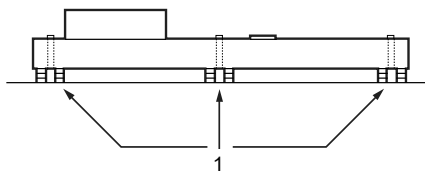
This procedure is applicable to cast iron and fabricated steel baseplates.

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 19 mm | 0.75 in. to 38 mm | 1.5 in. 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 12: Top view



1. Shims or wedges

Figure 13: 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 ensure that the correct leveling is achieved. 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:

You can use the baseplate-leveling worksheet when you take the readings.

7. Hand-tighten the nuts for the foundation.

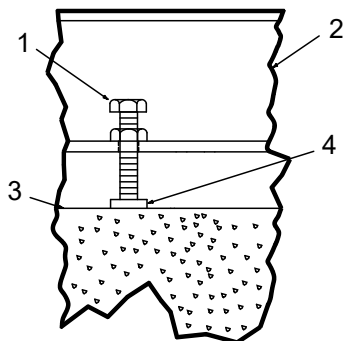
4.2.3 Install the baseplate using jackscrews

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 19 mm | 0.75 in. and 38 mm | 1.50 in.
 - d) Make sure that the center jackscrews do not touch the foundation surface yet.



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

Figure 14: Jackscrews

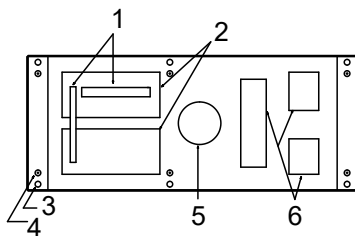
3. Level the driver mounting pads:

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. 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.



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

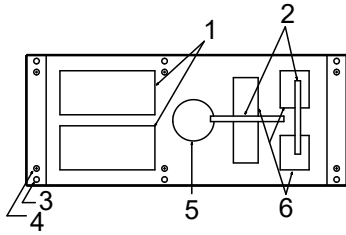
Figure 15: Level driver mounting pads

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 ensure that the correct leveling is achieved. 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.



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

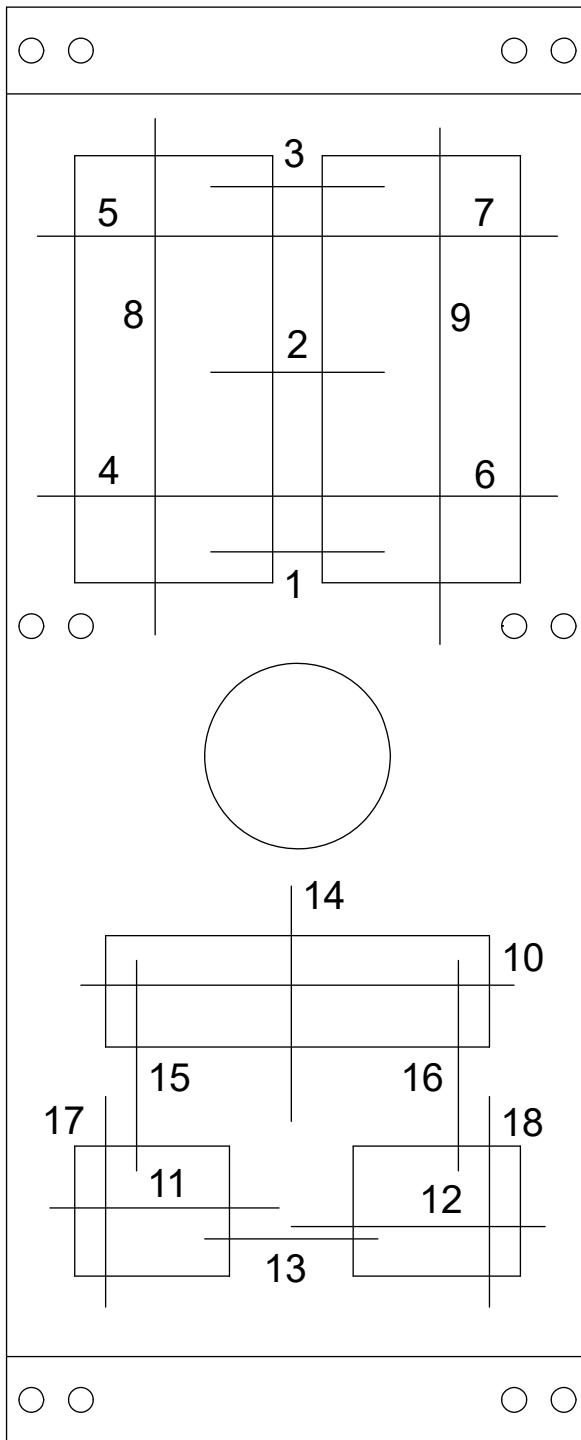
Figure 16: Level pump mounting pads

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 0.167 mm/m | 0.002 in./ft .

4.2.4 Baseplate-leveling worksheet

Level measurements



- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____
- 7) _____
- 8) _____
- 9) _____
- 10) _____
- 11) _____
- 12) _____
- 13) _____
- 14) _____
- 15) _____
- 16) _____
- 17) _____
- 18) _____

4.3 Pump-to-driver alignment

Precautions



WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

4.3.1 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.

4.3.2 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. The correct tolerances must be used. Failure to do so can result in misalignment. Contact ITT for further information.

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 Indicated Reading (T.I.R.) is at 0.05 mm | 0.002 in. or less at operating temperature.
- The tolerance of the indicator is 0.0127 mm per mm | 0.0005 in. per in. of indicator separation for the reverse dial indicator or laser method when the pump and driver are at operating temperature.

4.3.2.1 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
10°C 50°F	0.05 mm 0.002 in., low
65°C 150°F	0.03 mm 0.001 in., high
120°C 250°F	0.12 mm 0.005 in., high
175°C 350°F	0.23 mm 0.009 in., high
232°C 450°F	0.33 mm 0.013 in., high

4.3.3 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 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 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.

4.3.4 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.

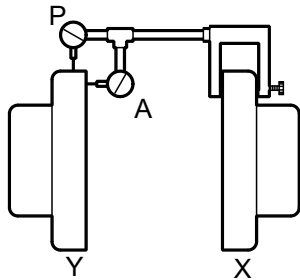


Figure 17: Dial indicator attachment

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.

4.3.5 Pump-to-driver alignment instructions

4.3.5.1 Perform angular alignment for a vertical correction

Before you start this procedure, make sure that the dial indicators are properly attached for measurement.

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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.

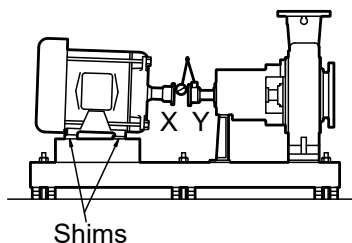


Figure 18: Side view of an incorrect vertical alignment

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

4.3.5.2 Perform angular alignment for a horizontal correction

Before you start this procedure, make sure that the dial indicators are properly attached for measurement.

- 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).
- Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
- 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Slide the shaft end of the driver to the right. Slide the opposite end to the left.

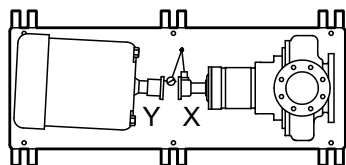


Figure 19: Top view of an incorrect horizontal alignment

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

Maximum permitted value for angular alignment:

4.3.5.3 Perform parallel alignment for a vertical correction

Refer to the alignment table in "Permitted indicator values for alignment checks" (see Table of Contents for location of table) for the proper cold alignment value based on the motor temperature rise and the pump operating temperature.

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 0.05 mm | 0.002 in. 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.

- Set the parallel alignment indicator (P) to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
- Rotate the indicator to the bottom-center position (6 o'clock).
- 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 (Y). Add shims of a thickness equal to half of the indicator reading value to each driver foot.

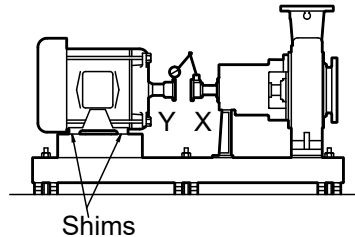


Figure 20: Side view of an incorrect vertical alignment

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

NOTICE:

The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. The correct tolerances must be used. Failure to do so can result in misalignment. Contact ITT for further information.

4.3.5.4 Perform parallel alignment for a horizontal correction

Refer to the alignment table in "Permitted indicator values for alignment checks" (see Table of Contents for location of table) for the proper cold alignment value based on the motor temperature rise and the pump operating temperature.

Before you start this procedure, make sure that the dial indicators are properly attached for measurement.

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

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

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

- 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.

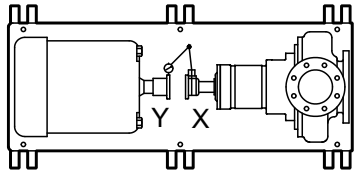


Figure 21: Top view of an incorrect horizontal alignment

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

4.3.5.5 Perform complete alignment for a vertical correction

Before you start this procedure, make sure that the dial indicators are properly attached for measurement.

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.05 mm | 0.002 in. 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.

When the procedure is complete, both the angular and parallel alignment must meet the permitted tolerances.

4.3.5.6 Perform complete alignment for a horizontal correction

Before you start this procedure, make sure that the dial indicators are properly attached for measurement.

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.05 mm | 0.002 in. 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.

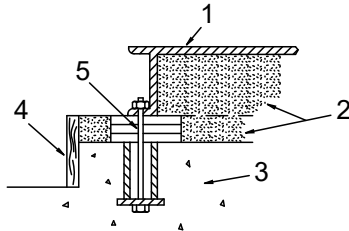
When the procedure is complete, both the angular and parallel alignment must meet the permitted tolerances.

4.4 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.
6. Fill the remainder of the baseplate with grout, and allow the grout to set for at least 48 hours.



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

Figure 22: Fill remainder of baseplate with grout

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

4.5 Piping checklists

4.5.1 Fastening



WARNING:

Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.

- Use fasteners of the proper size and material only.
- Replace all corroded fasteners.
- Ensure that all fasteners are properly tightened and that there are no missing fasteners.

4.5.2 General piping checklist

Precautions



WARNING:

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

- Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
 - Use fasteners of the proper size and material only.
 - Replace all corroded fasteners.
 - Ensure that all fasteners are properly tightened and that there are no missing fasteners.



CAUTION:

Do not move the pump to the pipe. This could make final alignment impossible.



CAUTION:

Never draw piping into place 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.

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.

NOTICE:

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.

Piping guidelines

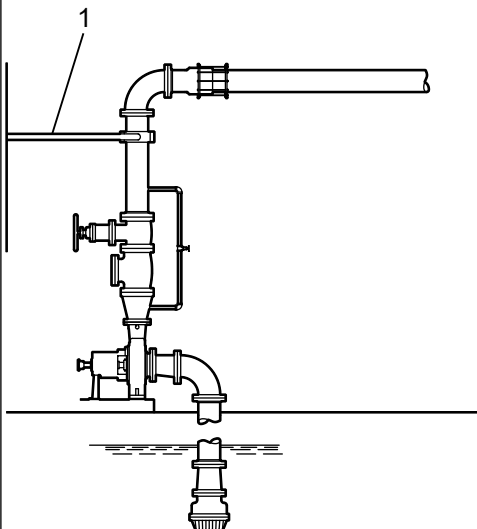
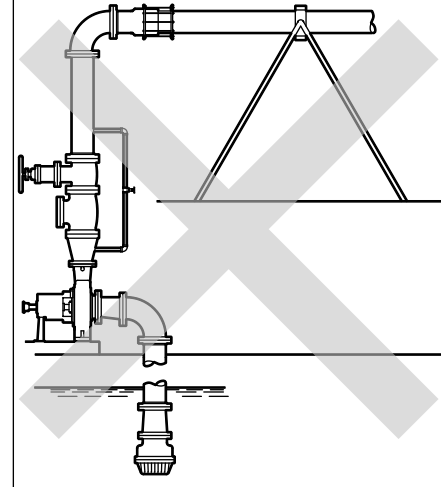
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	<ul style="list-style-type: none"> • Strain on the pump • Misalignment between the pump and the drive unit 	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Keep the piping as straight as possible. Avoid unnecessary bends. Use 45° or long radius 90° fittings where necessary.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Make sure that the inside diameters match properly when you use flange joints.	—	
Do not connect the piping to the pump until:	—	

Check	Explanation/comment	Checked
<ul style="list-style-type: none"> The grout for the baseplate or sub-base becomes hard. The grout for the pit cover 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.		
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.		
	This helps to prevent misalignment due to linear expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

Example: Installation for expansion

Correct	Incorrect
<p>This illustration shows a correct installation for expansion:</p>  <p>1. Expansion loop/joint</p>	<p>This illustration shows an incorrect installation for expansion:</p> 

4.5.3 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

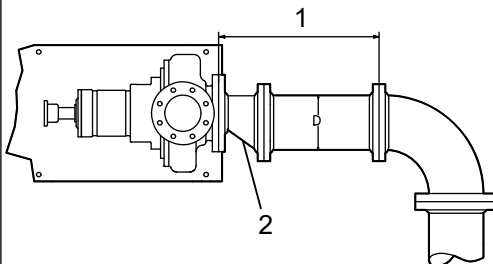
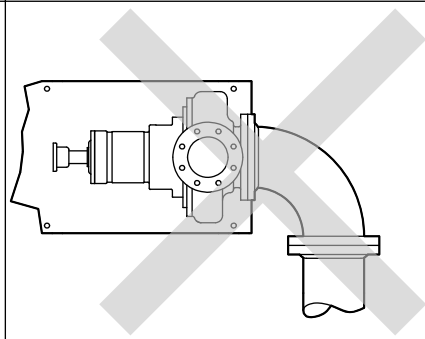
Check	Explanation/comment	Checked
Flush all suction piping before you connect it to the pump.	This reduces the risk of pump operation problems.	
Check that the suction piping fittings and joints are airtight and have no leaks.	—	
Check that the distance between the inlet flange of the pump and the closest 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. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump. See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: <ul style="list-style-type: none"> Sloping side down Horizontal side at the top 	See the example illustrations.	
Suggested suction strainers are used. Check that they are at least three times the area of the suction piping. Monitor the pressure drop across the suction strainer. An increased pressure drop across the strainer of 34.5 kPa 5 psi indicates that the strainer should be removed and cleaned. After a period of time (24 hours minimum) system flushing should be complete and the suction strainer can be removed.	Suction strainers help to prevent debris from entering the pump. Mesh holes with a minimum diameter of 1.6 mm 1/16 in. are recommended. Liquids with specific gravity less than 0.60 a pressure drop across the suction strainer may be due to ice buildup. Ice buildup can cause turbulence, low pressure areas and pumpage vaporization.	
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 and prevent vapor locking especially with specific gravity of liquid less than 0.60.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	
Assure adequate insulation is applied for liquids with specific gravity less than 0.60.	To assure sufficient NPSH _a .	

Liquid source below the pump

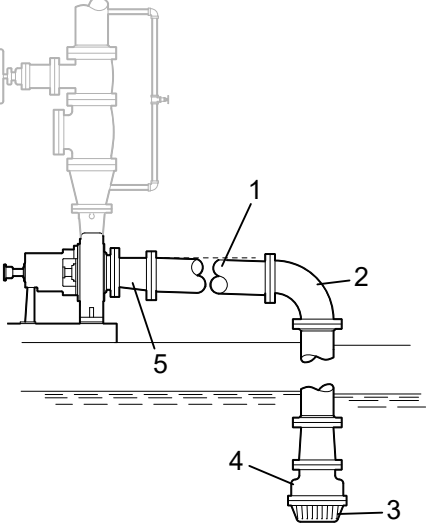
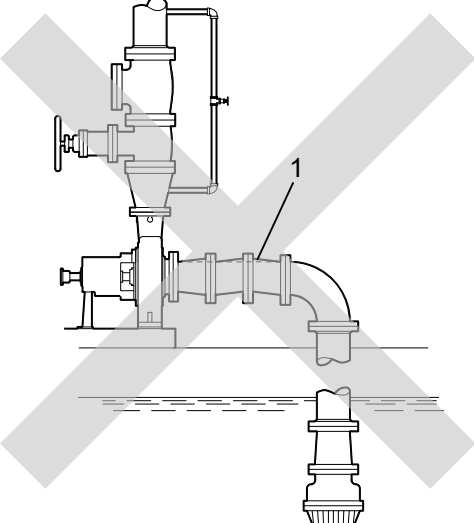
Check	Explanation/comment	Checked
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the suction piping slopes upwards from the liquid source to the pump inlet.	—	
If the pump is not self-priming, check 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: <ul style="list-style-type: none"> • 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
<p>The correct distance between the inlet flange of the pump and the closest elbow is at least two pipe diameters.</p>  <ol style="list-style-type: none"> 1. Enough distance to prevent cavitation 2. Eccentric reducer with a level top 	

Example: Suction piping equipment

Correct	Incorrect
 <ol style="list-style-type: none"> 1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top 	 <ol style="list-style-type: none"> 1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source

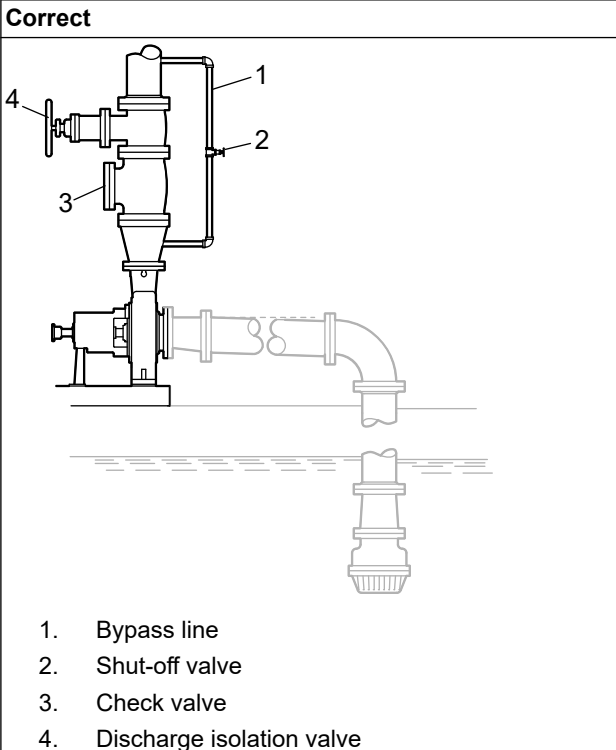
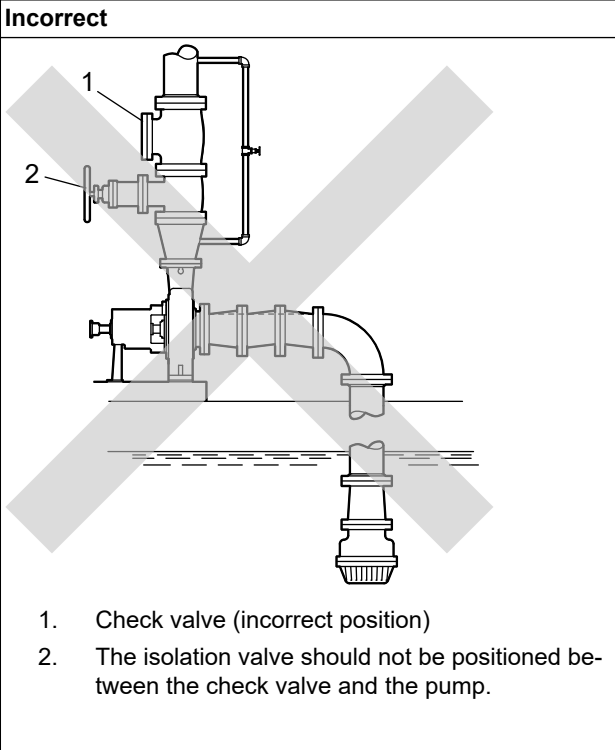
4.5.4 Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
<p>Check that an isolation valve is installed in the discharge line. For specific gravity less than 0.60, minimize distance from pump discharge.</p>	<p>The isolation valve is required for:</p> <ul style="list-style-type: none"> • Priming • Regulation of flow • Inspection and maintenance of the pump • Reduce risk of pumpage vaporization and vapor locking at low flow rates for low specific gravity liquids. <p>See Example: Discharge piping equipment for illustrations.</p>	
<p>Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.</p>	<p>The location between the isolation valve and the pump allows inspection of the check valve.</p> <p>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.</p> <p>See Example: Discharge piping equipment for illustrations.</p>	
<p>If increasers are used, check that they are installed between the pump and the check valve.</p>	<p>See Example: Discharge piping equipment for illustrations.</p>	

Check	Explanation/comment	Checked
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
 <p>1. Bypass line 2. Shut-off valve 3. Check valve 4. Discharge isolation valve</p>	 <p>1. Check valve (incorrect position) 2. The isolation valve should not be positioned between the check valve and the pump.</p>

4.5.5 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.	

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup



WARNING:

- Risk of serious physical injury or death. Exceeding any of the pump operating limits (e.g. - pressure, temperature, power, etc.) could result in equipment failure, such as explosion, seizure, or breach of containment. Assure that the system operating conditions are within the capabilities of the pump.
 - Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Ensure all openings are sealed prior to filling the pump.
 - Breach of containment can cause fire, burns, and other serious injury. Failure to follow these precautions before starting the unit may lead to dangerous operating conditions, equipment failure, and breach of containment.
 - Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
 - Risk of breach of containment and equipment damage. Ensure the pump operates only between minimum and maximum rated flows. Operation outside of these limits can cause high vibration, mechanical seal and/or shaft failure, and/or loss of prime.
-



WARNING:

- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
 - Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.
 - Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
 - Risk of seizure, breach of containment, or explosion. Ensure balance line is installed and piped back to either the pump suction or suction vessel. This prevents rapid vaporization of the pumped fluid.
-

Precautions



WARNING:

The mechanical seal used in an Ex-classified environment must be properly certified.

**CAUTION:**

When a cartridge mechanical seal is used, ensure that the set screws in the seal locking ring are tightened and that the centering clips have been removed prior to startup. This prevents seal or shaft sleeve damage by ensuring that the seal is properly installed and centered on the sleeve.

NOTICE:

- Verify the driver settings before you start any pump. Refer to the applicable drive equipment IOMs and operating procedures.
- Excessive warm-up rates can cause equipment damage. Ensure the warm-up rate does not exceed 1.4°C | 2.5°F per minute.

NOTICE:

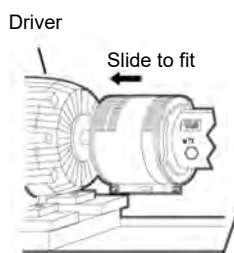
You must follow these precautions before you start the pump:

- 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 93°C | 200°F, then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 38°C | 100°F of the fluid temperature. Accomplish this by flowing fluid from pump inlet to discharge drain (optionally, the casing vent can be included in warm-up circuit but not required). Soak for (2) hours at process 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.

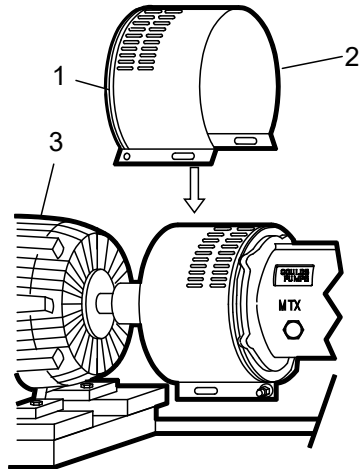
5.2 Remove the coupling guard

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.



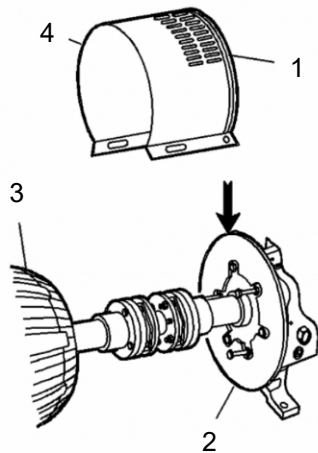
3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver half of the coupling guard:
 - a) Slightly spread the bottom apart.
 - b) Lift upwards.

5.2 Remove the coupling guard



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

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



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

5.3 Check the rotation



WARNING:

- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

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.

5.4 Check the rotation - Close Coupled



WARNING:

- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

1. Lock out power to the driver.
2. Make sure that everyone is clear. Jog the driver momentarily, about a half a second. You should be able to check motor rotation by observing the motor fan direction. The direction should be the same as the arrow on the close coupled frame.
3. Lock out power to the driver.

5.5 Couple the pump and driver



WARNING:

Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-



Couplings must have proper certification to be used in an Ex classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling. Refer to driver/coupling/gear manufacturers IOM for specific instructions and recommendations.

5.5.1 Install the coupling guard



WARNING:

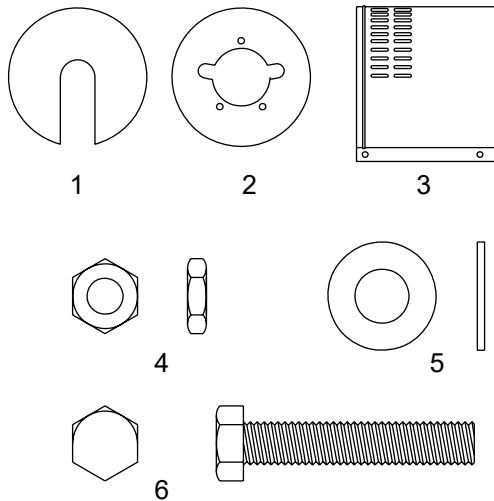
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.
 - Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-



WARNING:

The coupling guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.

Required parts:



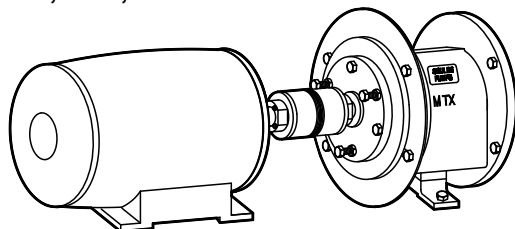
Item	Description	Item	Description
1.	End plate, drive end	4	3/8-16 nut, 3 required
2.	End plate, pump end	5	3/8 in. washer
3.	Guard half, 2 required	6	3/8-16 x 2 in. hex head bolt, 3 required

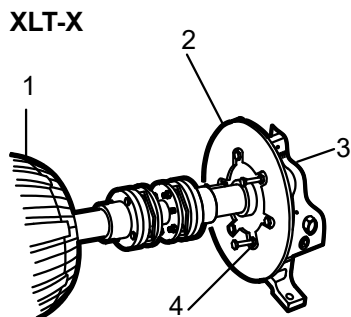
Figure 23: Required parts

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	<ol style="list-style-type: none"> 1. Align the end plate on the pump side to the bearing housing so that you meet these conditions: <ol style="list-style-type: none"> 1. The large slots on the end plate do not touch the bearing housing tap bolts. 2. 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.

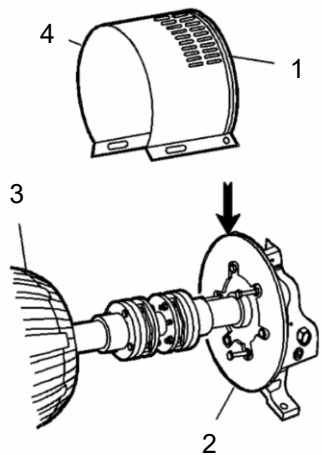
STX, MTX, LTX





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

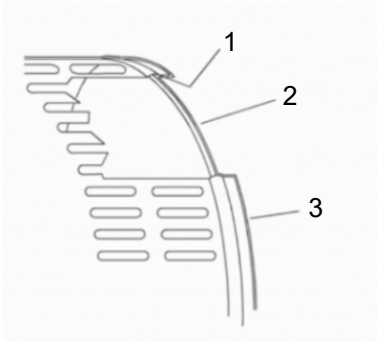
3. Put the pump-half of the coupling guard in place:
 - a) Slightly spread the bottom apart.
 - b) Place the coupling guard half over the pump-side end plate.



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

Figure 24: Guard half installation

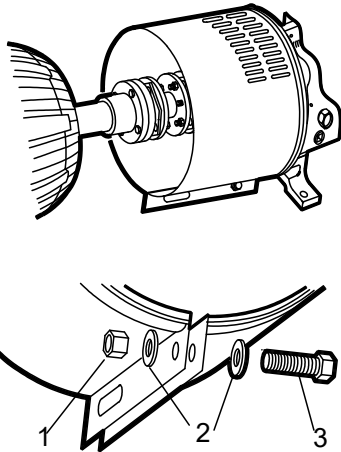
The annular groove in the coupling guard half must fit around the end plate.



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

Figure 25: Annular groove in coupling guard

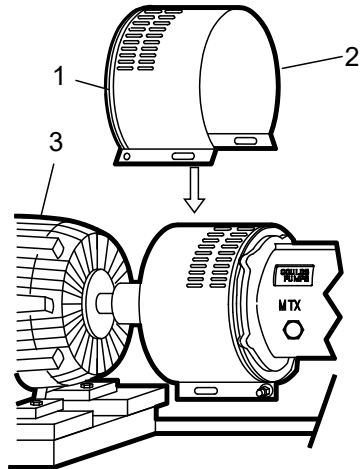
4. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Tighten securely.



Item	Description
1.	Nut
2.	Washer
3.	Bolt

Figure 26: Secure coupling guard half to end plate

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.



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

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

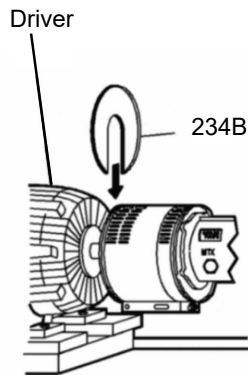


Figure 27: Placement of driver half of coupling guard

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.

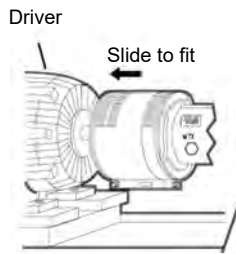


Figure 28: Slide driver-half of coupling guard towards motor

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

5.6 Bearing lubrication



WARNING:

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



Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

Lubrication requirements

Pump type	Requirements
Close coupled	Close-coupled pumps do not have bearings that require lubrication.
Frame mounted	<ul style="list-style-type: none"> • 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.

5.6.1 Lubricating-oil requirements

Oil quality requirements

Use a high-quality turbine oil with rust and oxidation inhibitors with rated viscosity shown below at 38°C | 100°F.

Oil requirements based on temperature

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

Temperature	Oil requirement
Bearing temperatures exceed 82°C 180°F	Use ISO viscosity grade 100. Bearing temperatures are generally about 11°C 20°F higher than bearing-housing outer surface temperatures.

5.6.2 Acceptable oil for lubricating bearings

Acceptable lubricants

Table 3: Acceptable lubricants

Brand	Lubricant type
Chevron	GST Oil 68
Exxon	Teresstic EP 68
Mobil	DTE Heavy Medium
Phillips 66	Turbine Oil VG68
Shell	Turbo T 68
Royal Purple	SYNFILM ISO VG 68 Synthetic Oil
Gulf	Harmony 68

5.6.3 Lubricate the bearings with oil



WARNING:

Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

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). The correct volume of oil required for each size of bearing frame can be found in the 'Oil Volume Requirements' section in the 'Bearing Maintenance' / 'Maintenance' portion of the IOM.

Oil lubricated bearings

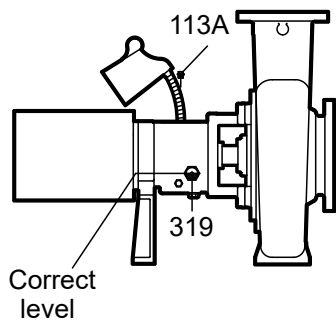


Figure 29: Oil filler connection

3. Replace the fill plug.

5.6.4 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.

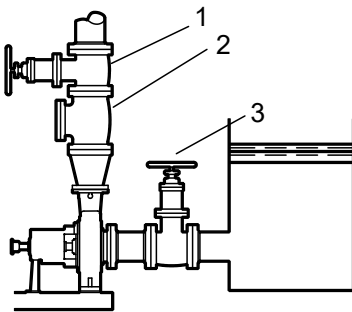
5.7 Pump priming

Potential for leaks or flooding. Make sure that you reinstall the drain plugs, check all joints for tightness, and flange bolts for the proper torque. Failure to follow these instructions can result in property damage and/or moderate personal injury.

Prior to filling the pump, install all plugs and blind flanges on casing and auxiliary piping. Make sure all openings are sealed off prior to priming pump.

5.7.1 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.



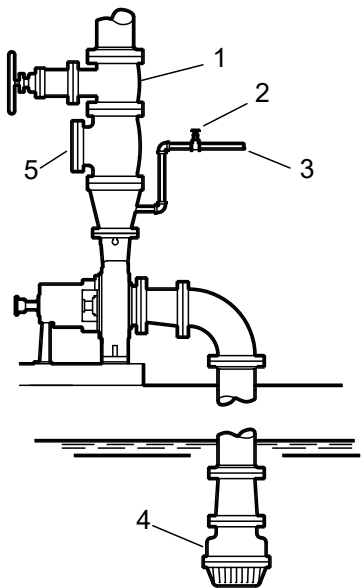
Item	Description
1.	Discharge isolation valve
2.	Check valve
3.	Suction isolation valve

Figure 30: Suction supply above pump

5.7.2 Prime the pump with the suction supply below the pump

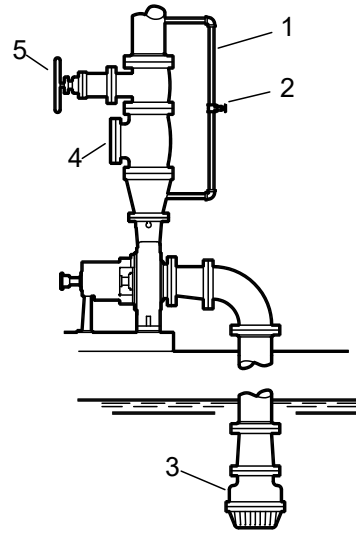
Use a foot valve and an outside source of liquid in order to prime the pump. The liquid can come from one of these sources:

- 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.



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

Figure 31: Pump priming with suction supply below pump with foot valve and an outside supply



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

Figure 32: Pump priming with suction supply below pump with foot valve using bypass around check valve

5.7.3 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

5.8 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.



WARNING:

Risk of equipment damage, seal failure and breach of containment. Ensure all flush and cooling systems are operating correctly prior to starting pump.

NOTICE:

- Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.
- On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.
- Continuous operation against a closed discharge valve will cause the pump to overheat. Overheating the magnetic drive assembly will weaken or ruin the magnets.

NOTICE:

Risk of equipment damage on pure or purge-oil mist-lubricated units. Remove the viewing port plugs to verify that oil mist is flowing properly. Reinstall the plugs after confirming.

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.

5.8.1 Minimum continuous recommended flow

Table 4: Minimum flow in GPM (m³/hr)

NOTICE:

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

Group	Size	3500 rpm	2900 rpm	1750 rpm	1450 rpm
S	1 x 1½ - 6	23 (5)	15 (4)	11 (3)	8 (2)
	1 x 1½ - 6G	7.0 (1.6)	4.9 (1.1)	1.8 (0.4)	1.2 (0.27)
	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)

Group	Size	3500 rpm	2900 rpm	1750 rpm	1450 rpm
	1 x 1½ - 8H	22 (5)	18 (4)	11 (2.5)	9 (2)
	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)
	1½ x 3 - 10	41.5 (9)	35 (8)	21 (5)	17.5 (4)
	2 x 3 - 10	78 (18)	65 (15)	38 (9)	31 (7)
	3 x 4 - 10	173 (40)	144 (33)	86 (20)	72 (16)
M (13 in.)	1½ x 3 - 13	53 (12)	44 (10)	26 (6)	22 (5)

5.9 Pump operation precautions

General considerations



WARNING:

- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.

NOTICE:

Operation at reduced capacity



WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.

NOTICE:

Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available (NPSH_A) always exceeds NPSH required (NPSH₃) as shown on the published performance curve of the pump.

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that will freeze that is inside the pump and any auxiliary equipment. Failure to do so can cause liquid to freeze and damage the pump. Note that different liquids freeze at different temperatures. Some pump designs do not drain completely and may require flushing with a liquid that doesn't freeze.

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 121°C | 250°F for all sizes.

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

5.10 Shut down the pump



WARNING:

Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.

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

5.11 Make the final alignment of the pump and driver



WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.
 - 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.

5.11 Make the final alignment of the pump and driver

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.
Refer to [4.3 Pump-to-driver alignment on page 27](#) in the Installation chapter.
5. Reinstall the coupling guard .
6. Restart the pump and driver.

6 Maintenance

6.1 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.*

NOTICE:

*If equipped, temperature and vibration levels can be retrieved by using your i-ALERT® monitoring sensor and app.

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.
- 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.

6.2 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.



For Ex applications bearing replacement (all) is recommended after 17,500 hours of operation.



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

6.3 Disassembly

6.3.1 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.
- Burn Hazard. Coupling may be hot. Use proper protection when handling.
- Burn Hazard. use proper protection when handling bearings.
- Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.
- Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.
- Process fluid leaks can result in an explosive atmosphere. Follow all pump and seal assembly procedures.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.

- Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
- Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.
- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with 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 1 m | 3 ft.

NOTICE:

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

6.3.2 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 12.07 cm | 4.75 in. minimum reach
- Hex wrench, size 8 mm with 15 cm | 6 in. minimum reach
- Torque wrench
- Strap wrench
- 3/8 in. eyebolt

6.3.3 Prepare the pump for disassembly

1. Lock out power to the driver.

**WARNING:**

Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

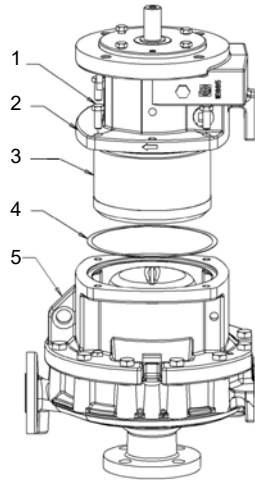
- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.

- Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

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.

6.3.4 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.

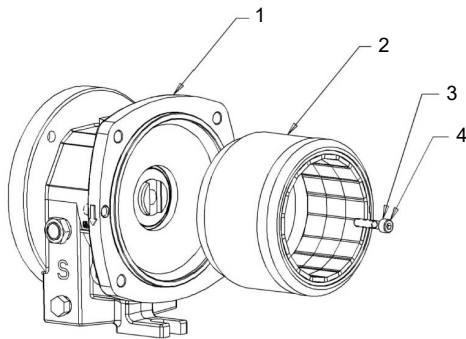


1. Frame-to-adaptor hex screw (370B)
 2. Frame assembly
 3. Mag drive carrier
 4. Frame-to-adaptor gasket (360W)
 5. Adapter
4. If required, use jackscrews to separate the parts using the two threaded holes in the bearing frame.

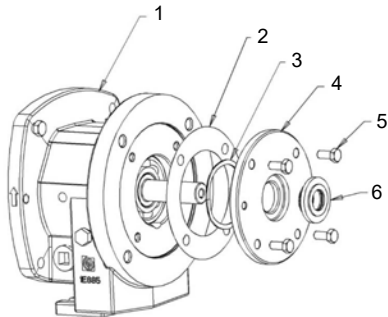
Pump size	Screw type
S-Group	M12
M-Group	M14

5. Lift the bearing frame assembly off the adapter.
Use a crane, if available.
6. Remove the frame-to-adaptor gasket (360W).

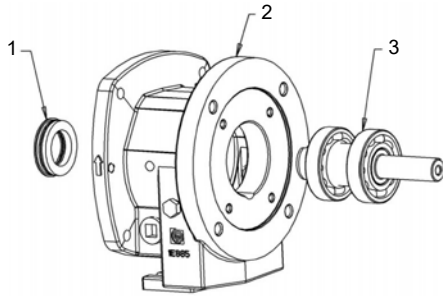
7. Secure the drive shaft so that it cannot rotate.
8. Remove the capscrew (791D) and the lockwasher (382) from the drive shaft.



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).



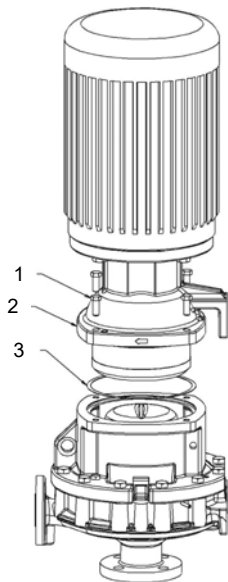
1. Frame
 2. End cover gasket (360A)
 3. Wave washer (529)
 4. Frame end cover (109A)
 5. End cover hex screw (370C)
 6. Labyrinth oil seal (332A)
11. Remove the wavy spring washer (529) and end-cover gasket (360A).
 12. Remove the drive shaft with both bearings attached.



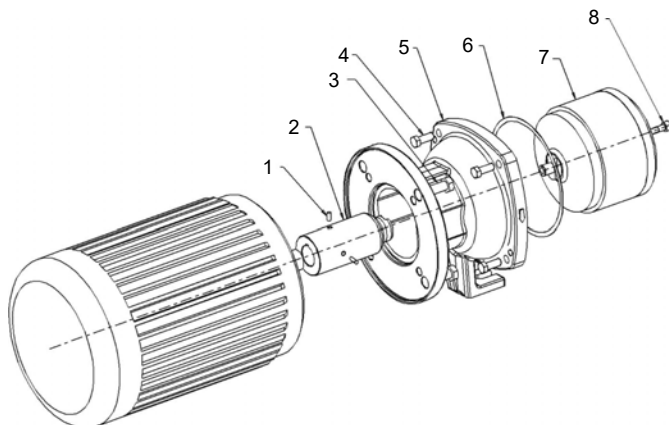
1. Labyrinth oil seal (333D)
 2. Bearing frame (228)
 3. Drive with shaft bearings
13. Remove the labyrinth oil seals (332A and 333D).
 14. Remove both radial ball bearings using a press.
The radial ball bearings lie against the shaft collar.

6.3.5 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).



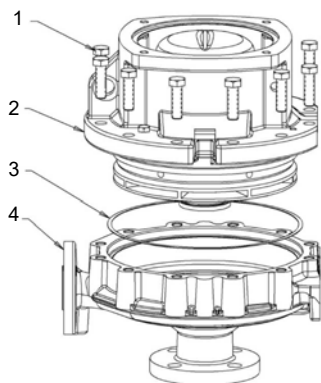
1. Frame-to-adapter hex screw (370B)
 2. Close-coupled adapter (503)
 3. Frame-to-adapter gasket (360W)
3. If necessary, remove the motor adapter (503) from the frame adapter (108) using two levers or pry-bars.
There are also two threaded holes (size M12) in the close-coupled motor adapter (503) for jack-screws.
 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.

6.3.6 Disassemble the liquid end

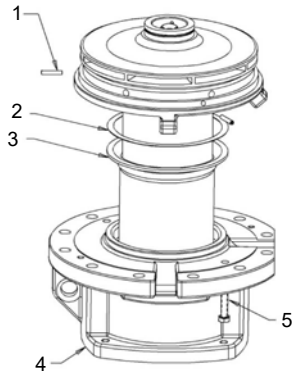
1. Remove the hex screws (370) that hold the adapter to the case.



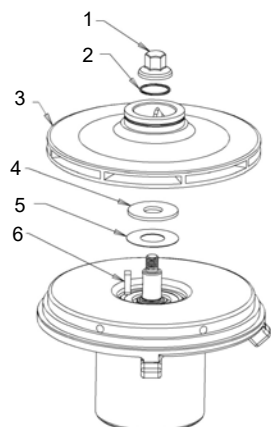
1. Adapter-to-case hex screw (370)
2. Frame adapter (108)
3. Backplate-to-case gasket (351)
4. Casing (100)

NOTICE:

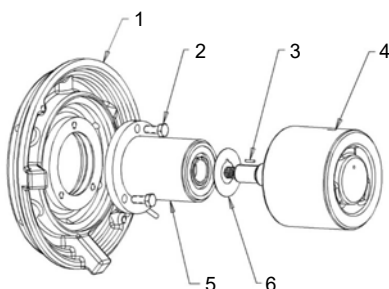
Do not remove the three setscrews (222E on the 6 in. S-group, 3 x 4-7, and 3 x 4-8G) or two hex screws (370V on all other sizes). These setscrews hold the adapter (108), backplate (444), and containment shell (750).



1. Adapter-to-backplate setscrew 222E (6 in. S-group, 3 x 4-7, and 3 x 4-8G)
 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, 3x4-7, and 3x4-8G) 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.

6.4 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 cleaning the parts. Failure to do so may result in equipment damage.

6.4.1 Replacement guidelines

Casing check and replacement



WARNING:

Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Inspect and ensure gasket sealing surfaces are not damaged and repair or replace as necessary.

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 3.2 mm | 1/8 in. deep
- Pitting that is greater than 3.2 mm | 1/8 in. 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:

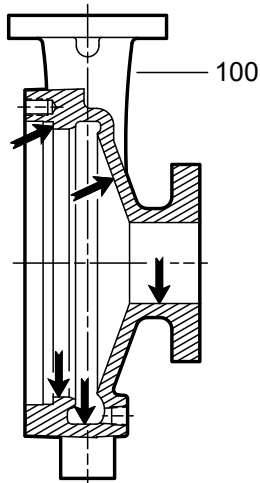


Figure 33: 3296 EZMAG casing

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

The CV 3196 impeller face is cast, not machined. You do not need to check the face runout.

Gaskets, O-rings, and seats replacement



WARNING:

Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Replace all gaskets and O-rings at each overhaul or disassembly.



WARNING:

Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.

- Use fasteners of the proper size and material only.
- Replace all corroded fasteners.
- Ensure that all fasteners are properly tightened and that there are no missing fasteners.

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 0.991 mm | 0.039 in.
- Make sure that the containment shell is free from pitting or cracks.
- Replace the containment shell if there are any grooves in excess of 0.127 mm | 0.005 in.

6.4.2 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 2 m | 6 ft. 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 0.127 mm | 0.005 in. deep.
- Check that the assembly is free from erosion or corrosion that exceeds 0.127 mm | 0.005 in. 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 0.127 mm | 0.005 in.
- Check the magnets for proper bonding to the metal carrier.

6.4.3 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 7.203 cm | 2.836 in. for S-group pumps and 9.002 cm | 3.544 in. 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.

6.4.4 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.

6.4.5 Minimum running clearances

This table provides the radial wear ring clearances:

Group	Size	New, mm inches	Replace, mm inches
S	1 x 1½ - 6	0.51–0.61 0.020–0.024	0.74 0.029
	1 x 1½ - 6G		
	1½ x 3 - 6		
	2 x 3 - 6		
	1 x 1½ - 8		
	1 x 1½ - 8H		
	1½ x 3 - 8		
	2 x 3 - 8		
M	1½ x 3 - 10	0.71–0.79 0.028–0.031	0.91 0.036
	3 x 4 - 7		
	4 x 4 - 8G		
	3 x 4 - 10		
	1 x 2 - 10		
	2 x 3 - 10		
	1½ x 3 - 13		

6.5 Reassembly

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

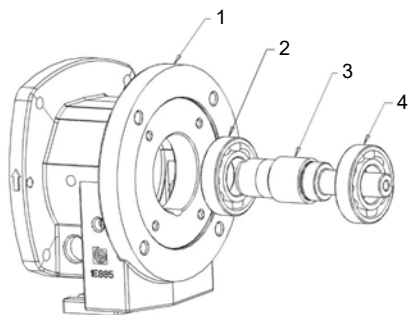
1. Press both radial ball bearings (112) onto the drive shaft (122B).

NOTICE:

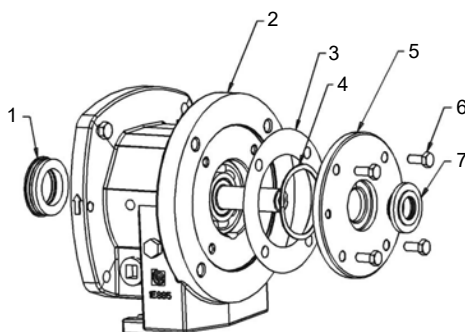
There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings.

Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the guarantee.

Do not use a flame to heat bearings. This will damage the bearing surfaces. Do not heat the bearings above 135°C | 275°F.

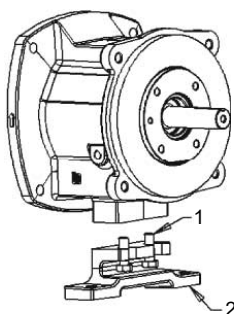


1. Bearing frame (228)
 2. Ball bearing (112)
 3. Drive shaft (122B)
 4. Ball bearing (112)
2. Install the pre-assembled drive shaft in the bearing frame (228) from the motor side.
 3. Insert the wave washer (529).



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)

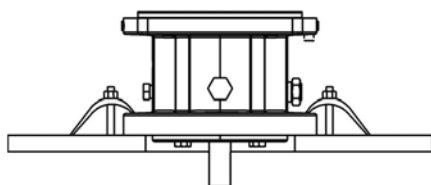
Figure 34: Bearing frame cover and seals



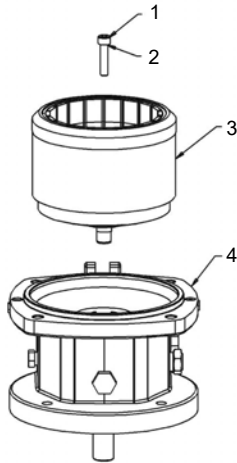
1. Foot-to-frame hex screw (370F)
2. Frame foot (241)

Figure 35: 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.



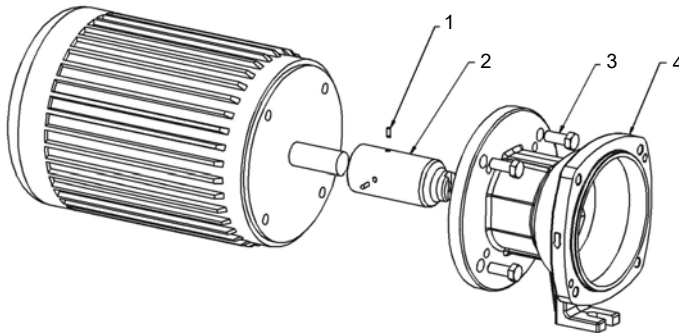
9. Mount the drive magnet assembly (740B) onto the drive shaft so that the driver cams engage. Secure the drive magnet assembly using the lockwasher (382) and cap screw (791D).



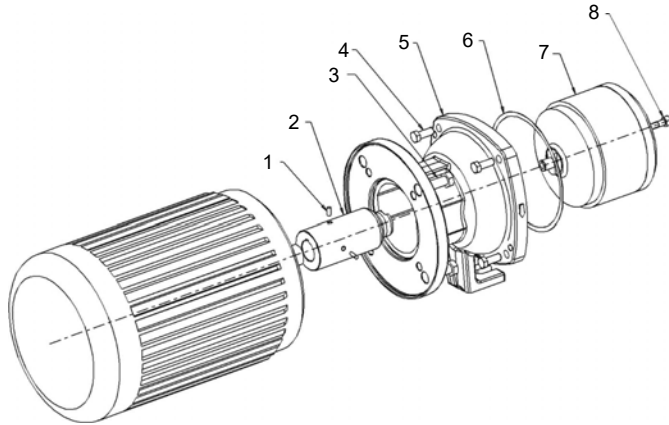
1. Drive-to-shaft capscrew (791D)
2. Internal tooth lockwasher (382)
3. Drive carrier assembly (740B)
4. Bearing frame (228)

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

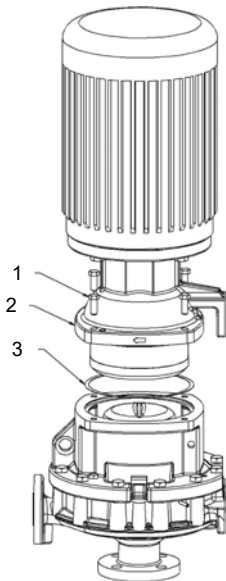
1. Slide the stub shaft (122A) onto the motor shaft and secure it with the setscrew (222L).



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.

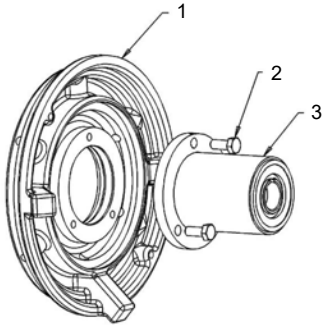


1. Frame-to-adapter hex screw (370B)
2. Close-coupled adapter (503)
3. Frame-to-adapter gasket (360W)

Figure 36: Close-coupled pump assembly

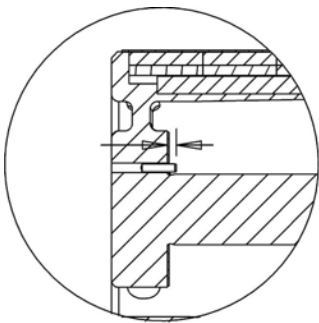
6.5.3 Reassemble the liquid end

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

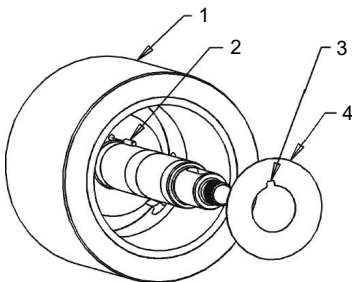


1. Backplate (444)
 2. Cartridge-to-backplate hex screw (791E)
 3. Bearing cartridge assembly (849)
2. Rotate the bearing cartridge until all three holes line up and secure with hex screws (791E). See [6.5.5 Bolt torque values on page 77](#).
 3. For M-group pumps, if the driven carrier pin (445A) in the driven magnet assembly (740A) must be replaced, then drive in the carrier pin carefully until it protrudes approximately 3.05 mm | 0.12 in. towards the impeller.

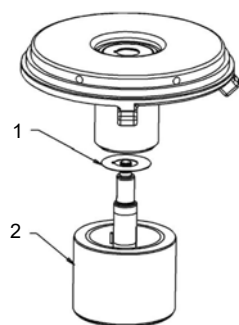
The S-group has a drive key, which is automatically placed into position during installation when installed.



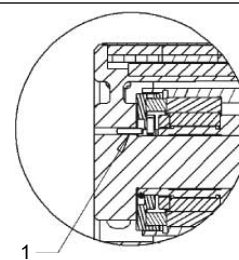
4. Cut out a small notch on the inside diameter of the intermediate ring gasket (351X) in order to create a recess for the driven carrier pin (445A) or key, depending on size.



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

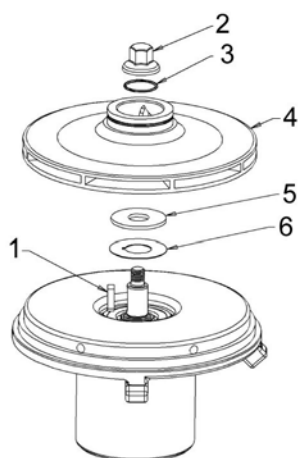
1. Driven carrier pin (445A)

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).

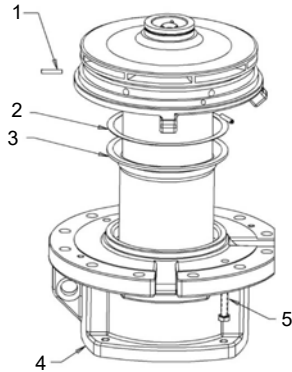
- d) Secure the driven magnet assembly with a strap wrench and tighten the impeller nut to the appropriate torque value.

See [6.5.5 Bolt torque values on page 77](#).

NOTICE:

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

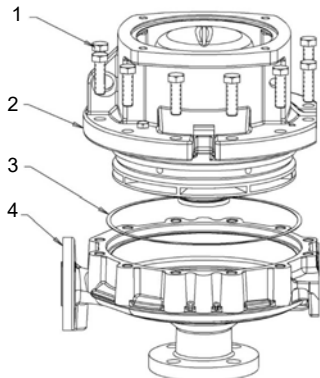
10. Place the containment shell gasket (540N) and containment shell (750) onto the backplate (444).



1. Adapter-to-backplate setscrew (222E, 6 in. S-group, 3 x 4-7, and 3 x 4-8G)
 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 the 6 in. S-group, 3 x 4-7, and 3 x 4-8G 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.



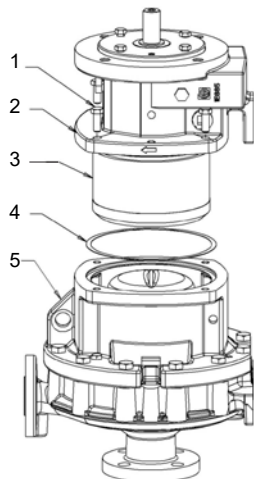
1. Adapter-to-case hex screw (370)
 2. Frame adapter (108)
 3. Backplate-to-case gasket (351)
 4. Casing (100)
13. Insert the casing gasket (351) into the casing.

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 [6.5.5 Bolt torque values on page 77](#).

6.5.4 Complete the pump reassembly

1. Insert the gasket (360W) into the adapter. Check that all plugs, labyrinth seals and lip seals are installed.



1.
 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.

6.5.5 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. & 13 in. M (M16)	161 (219)	120 (164)

6.5 Reassembly

Description	Group	Dry, ft-lbs (Nm)	Standard lube, ft-lbs (Nm)
Impeller nut (304)	S	47 (64)	26 (35)
	M	116 (158)	52 (70)
Cartridge to backplate screws (791E)	S/M	12 (16)	9 (12)

7 Troubleshooting

7.1 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: <ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Check the control device for proper operation. • Check the suction line for blockage. • Reprime the pump.
	There is excessive motor power.	<p>The system head is lower than the rating and pumps too much liquid.</p> <p>Check the rotating parts for binding and wear. The liquid is heavier than expected.</p>

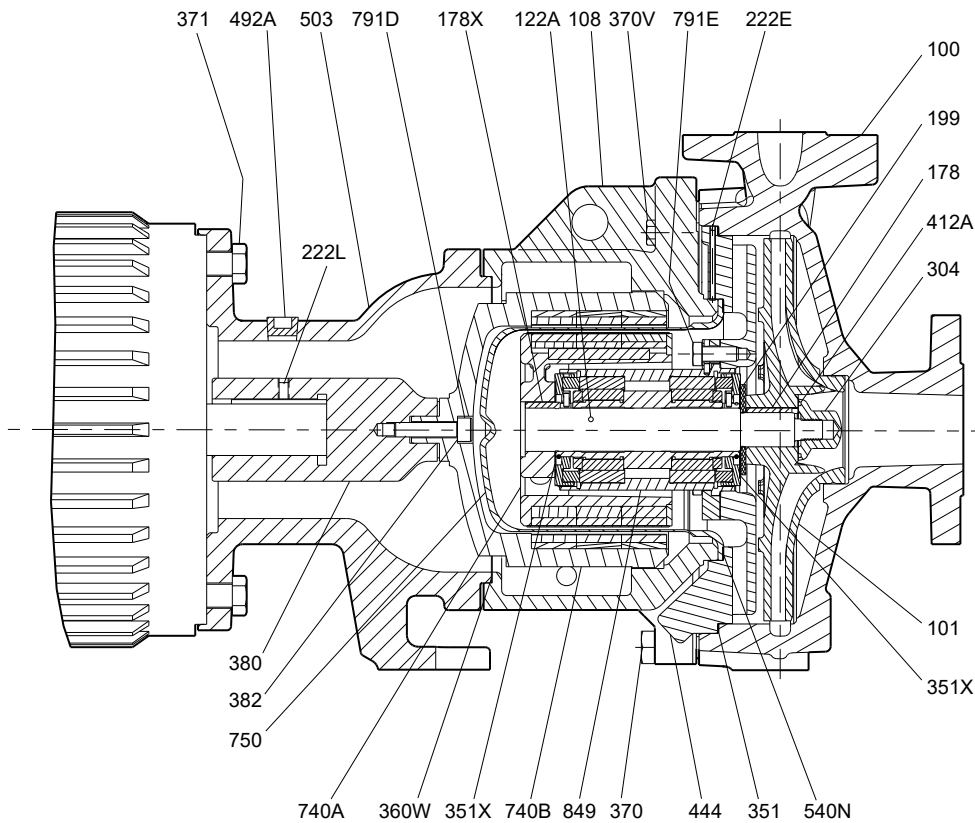
7.2 Alignment troubleshooting

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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.

8 Parts List and Cross-Sectionals

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

Cross-sectional drawing



Parts list

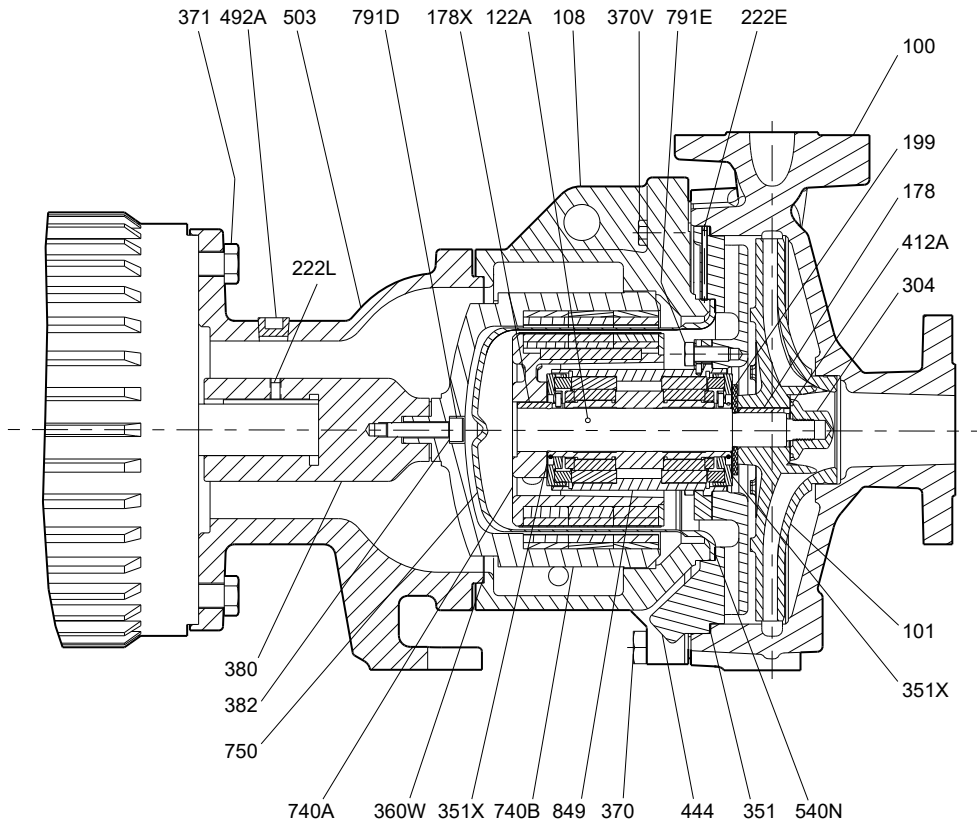
Item	Quantity	Part name	Material
100	1	Casing	Stainless steel (1.4408)
101	1	Impeller	Stainless steel (1.4408)
108	1	Frame adapter	Ductile iron
122A*	1	Driven shaft	Duplex SS (1.4462)
178	1	Impeller key	303SS
178X*	1	Driven carrier key	Stainless steel (1.4571)
199	1	Distance washer	Stainless steel (1.4571)
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: <ul style="list-style-type: none"> • Aramid fiber/EPDM (standard) • White gylon (optional)

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

Item	Quantity	Part name	Material
			<ul style="list-style-type: none"> Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> TFM1600 (PTFE) (standard) Viton B (optional)
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	12 for 7 in. and 8 in. pumps, 8 for 10 in. pumps, 16 for 13 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	PTFE
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: <ul style="list-style-type: none"> 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.			

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

Cross-sectional drawing



Parts list

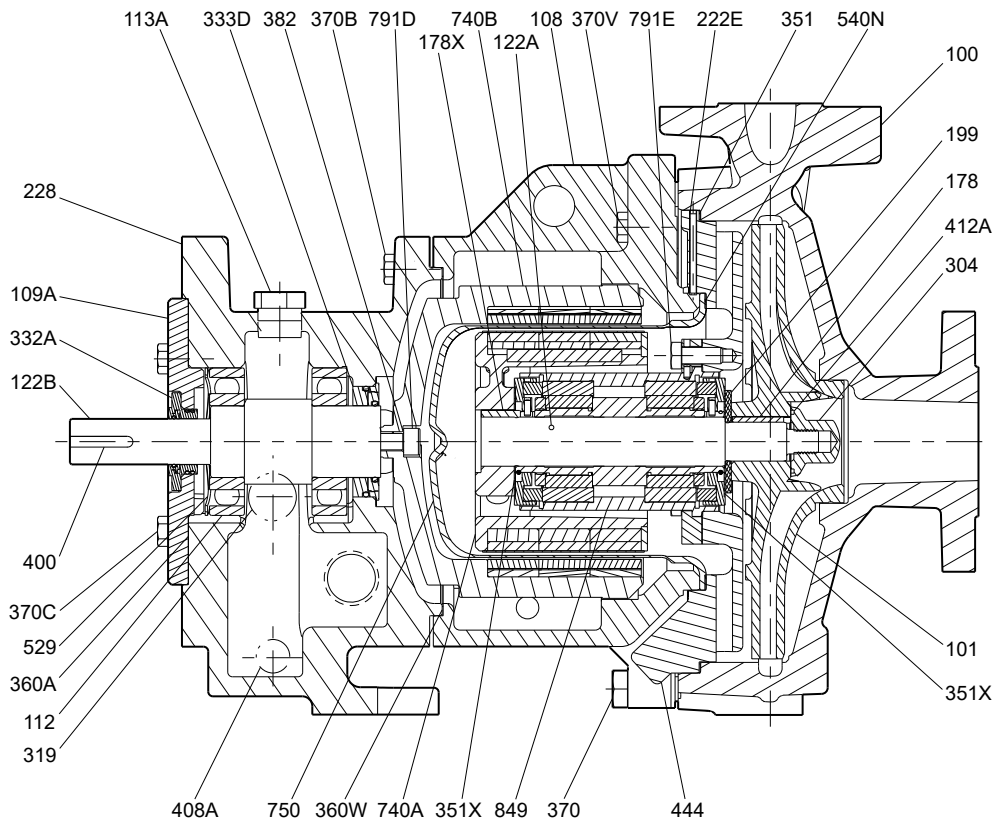
Item	Quantity	Part name	Material
100	1	Casing	Hastelloy-C (2.4686)
101	1	Impeller	Hastelloy-C (2.4686)
108	1	Frame adapter	Ductile iron
122A*	1	Driven shaft	Hastelloy-C (2.4610)
178	1	Impeller key	Hastelloy-C
178X*	1	Driven carrier key	Hastelloy-C (2.4610)
199	1	Distance washer	Hastelloy-C (2.4610)
222E	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)
351	1	Backplate-to-case gasket	Optional gasket material: <ul style="list-style-type: none"> Aramid fiber/EPDM (standard) White gylon (optional) Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> TFM1600 (PTFE) (standard)

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

Item	Quantity	Part name	Material
			<ul style="list-style-type: none"> 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	PTFE
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: <ul style="list-style-type: none"> 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.			

8.3 S-group with bearing frame — stainless steel

Cross-sectional drawing



Parts list

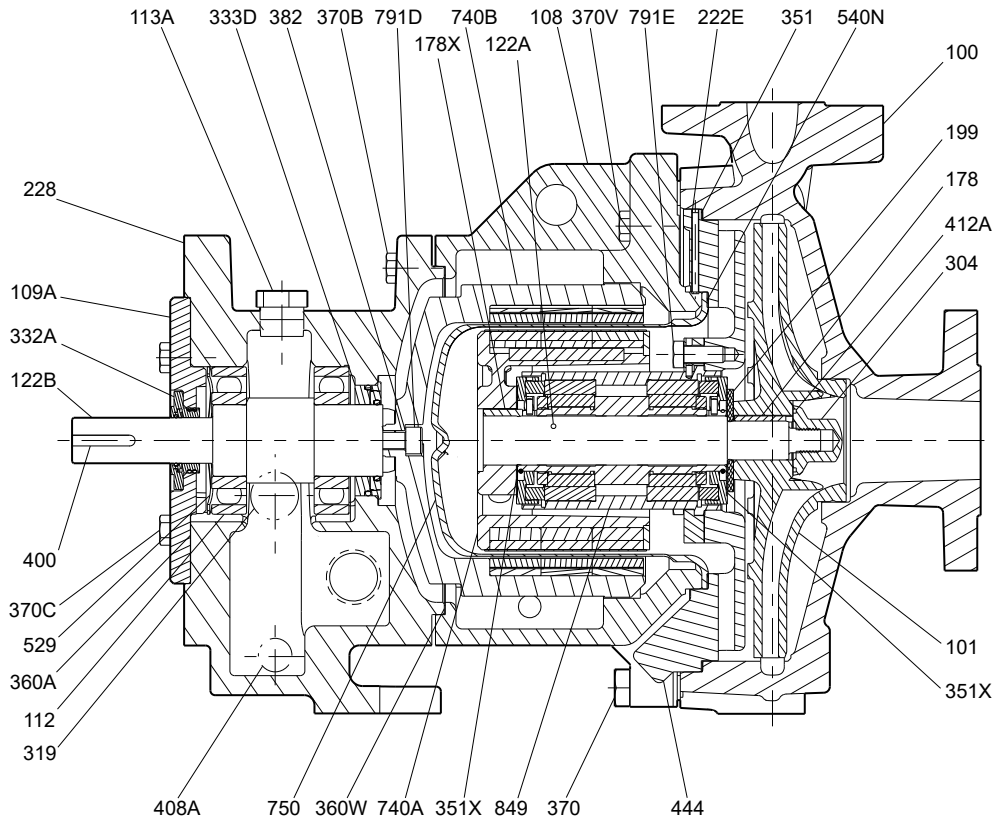
Item	Quantity	Part name	Material
100	1	Casing	Stainless steel (1.4408)
101	1	Impeller	Stainless steel (1.4408)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Duplex SS (1.4462)
122B	1	Drive shaft	Steel 4140
178	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
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 PTFE

8.3 S-group with bearing frame — stainless steel

Item	Quantity	Part name	Material
351	1	Backplate-to-case gasket	Optional gasket material: <ul style="list-style-type: none"> • Aramid fiber/EPDM (standard) • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> • 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	PTFE
444	1	Backplate	Stainless steel (1.4408)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: <ul style="list-style-type: none"> • 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.			

8.4 S-group with bearing frame — Hastelloy-C

Cross-sectional drawing



Parts list

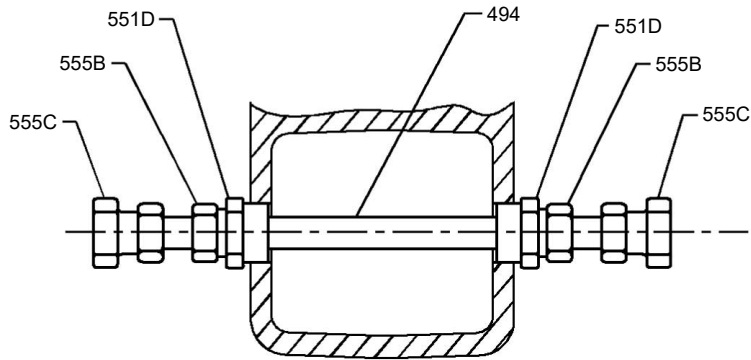
Item	Quantity	Part name	Material
100	1	Casing	Hastelloy-C (2.4686)
101	1	Impeller	Hastelloy-C (2.4686)
108	1	Frame adapter	Ductile iron
109A	1	Frame end cover	Ductile iron
112	2	Ball bearing	Steel
113A	1	Fill plug	Steel
122A*	1	Driven shaft	Hastelloy-C (2.4610)
122B	1	Drive shaft	Steel 4140
178	1	Impeller 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
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 PTFE

8.4 S-group with bearing frame — Hastelloy-C

Item	Quantity	Part name	Material
351	1	Backplate-to-case gasket	Optional gasket material: <ul style="list-style-type: none"> Aramid fiber/EPDM (standard) White gylon (optional) Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> 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	PTFE
444	1	Backplate	Hastelloy-C (2.4686)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: <ul style="list-style-type: none"> 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.			

8.5 Frame cooling options

Cross-sectional drawing

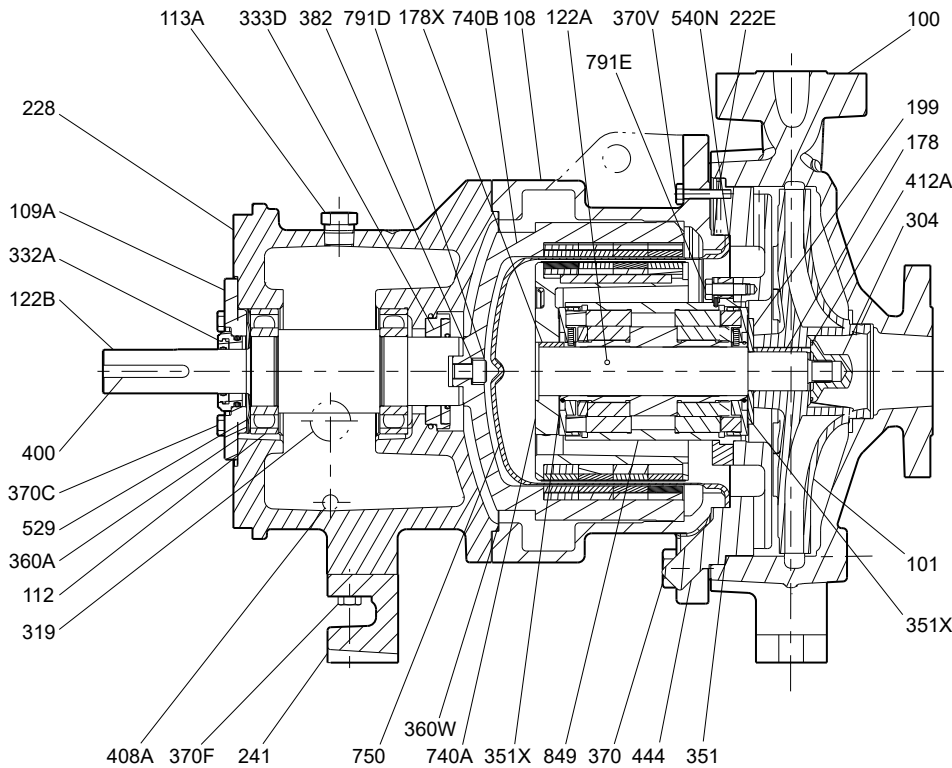


Parts list

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

8.6 M-group with bearing frame — stainless steel

Cross-sectional drawing



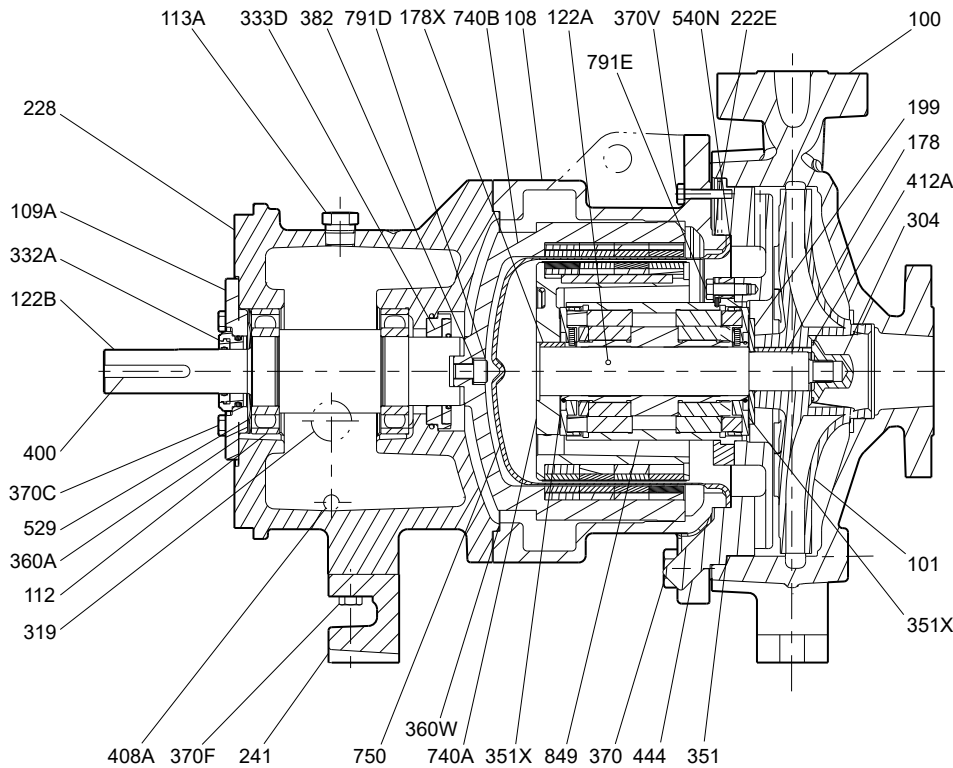
Parts list

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
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: <ul style="list-style-type: none"> • Aramid fiber/EPDM (standard)

Item	Quantity	Part name	Material
			<ul style="list-style-type: none"> • White gylon (optional) • Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> • TFM1600 (PTFE) (standard) • Viton B (optional)
360A	1	End cover gasket	Vellumoid
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	12 for 7 in. and 8 in. pumps, 8 for 10in. pumps, 16 for 13 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	PTFE
444	1	Backplate	Stainless steel (1.4408)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: <ul style="list-style-type: none"> • 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.			

8.7 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)
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:

Item	Quantity	Part name	Material
			<ul style="list-style-type: none"> Aramid fiber/EPDM (standard) White gylon (optional) Fawn gylon (optional)
351X	2	Intermediate ring spacer	Optional spacer material: <ul style="list-style-type: none"> TFM1600 (PTFE) (standard) Viton B (optional)
360A	1	End cover gasket	Vellumiod
360W	1	Frame-to-adapter gasket	Aramid fiber/EPDM
370	12 for 7 in. and 8 in. pumps, 8 for 10 in. pumps, 16 for 13 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	PTFE
444	1	Backplate	Hastelloy-C (2.4686)
529	1	Wave washer	Steel
540N	1	Containment shell gasket	Optional gasket material: <ul style="list-style-type: none"> 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.			

8.8 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)

8.9 Interchangeability drawings



Figure 37: Frame-mounted 3296 EZMAG

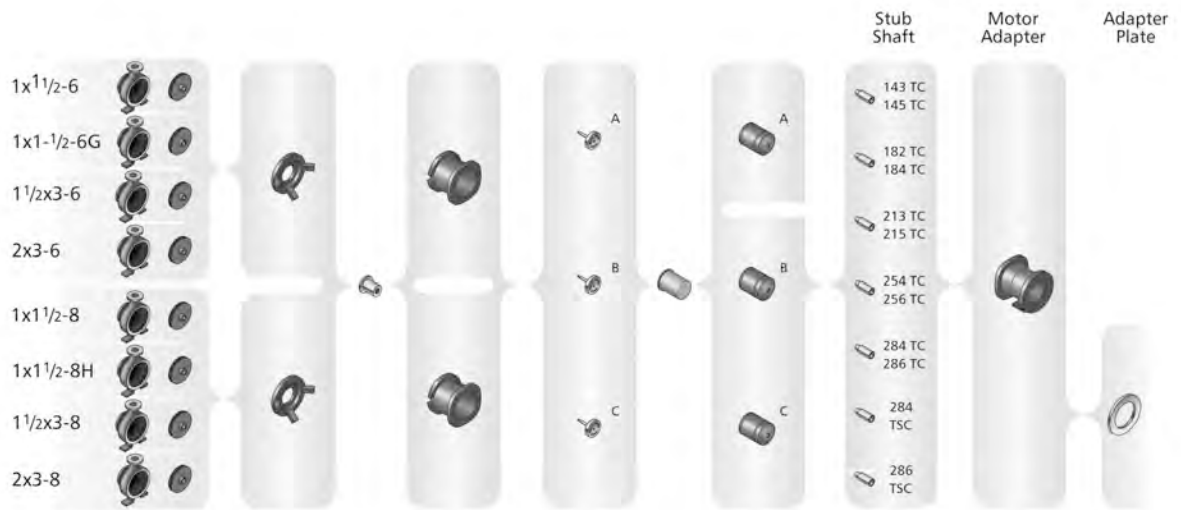


Figure 38: Close-coupled 3296 EZMAG

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	—

9 Other Relevant Documentation or Manuals

9.1 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.

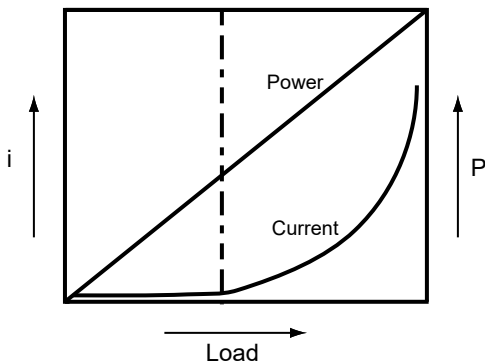


Figure 39: Power vs. amperage measurements

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, then nuisance tripping or a dry running pump can result. If you measure power as well, then this problem is eliminated.

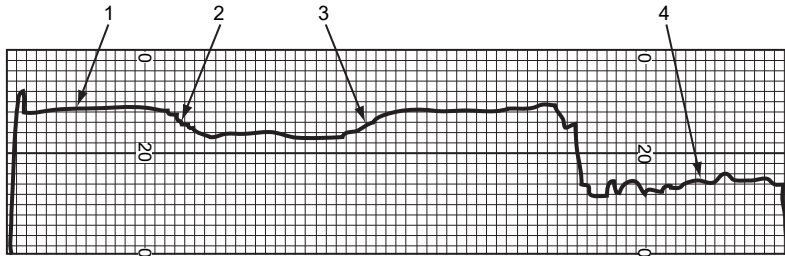
Power draw measuring

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 prevents 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 40: 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 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 than 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 that is 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 that are 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.

10 Local ITT Contacts

10.1 Regional offices

Region	Address	Telephone	Fax
North America (Headquarters)	ITT - Goulds Pumps 240 Fall Street Seneca Falls, NY 13148 USA	+1 315-568-2811	+1 315-568-2418
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Los Angeles	Vertical Products Operation 3951 Capitol Avenue City of Industry, CA 90601-1734 USA	+1 562-949-2113	+1 562-695-8523
Asia Pacific	ITT Fluid Technology Asia Pte Ltd 1 Jalan Kilang Timor #04-06 Singapore 159303	+65 627-63693	+65 627-63685
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