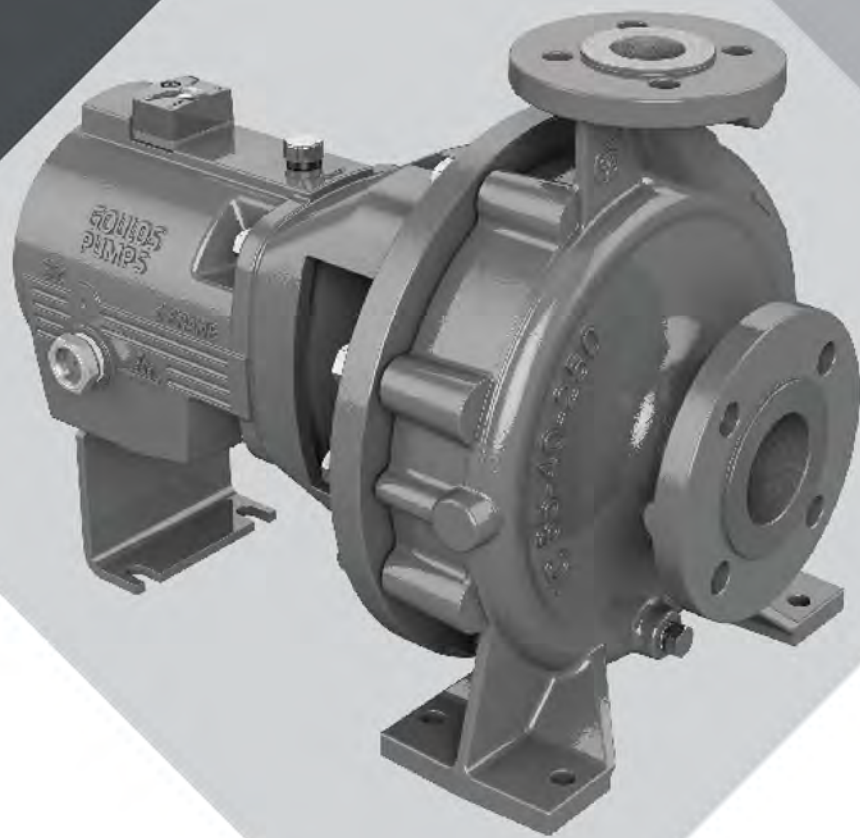




# Installation, Operation, and Maintenance Manual

Model ICO i-FRAME, ICOH i-FRAME



**ITT**



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# 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.

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### **NOTICE:**

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

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### 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.

Specifications such as weights, dimensions or centers of gravity of the pump, pump unit or subassemblies are described in the supplier's applicable documentation.

### 1.1.2 Standard manufacturer

ITT Bornemann GmbH  
Industriestr. 2  
D-31683 Obernkirchen  
GERMANY

The actual manufacturer is indicated on the name plate and the data sheet supplied.

## 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 build-up 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.
- In the case of hot pumped media, ensure that personnel cannot touch hot surfaces on the pump and pipelines.

**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.




## 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
 <b>DANGER:</b>	A hazardous situation which, if not avoided, will result in death or serious injury
 <b>WARNING:</b>	A hazardous situation which, if not avoided, could result in death or serious injury
 <b>CAUTION:</b>	A hazardous situation which, if not avoided, could result in minor or moderate injury
<b>NOTICE:</b>	<ul style="list-style-type: none"> <li>• A potential situation which, if not avoided, could result in undesirable conditions</li> <li>• A practice not related to personal injury</li> </ul>

### 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

### 1.2.1.1 The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.



### 1.2.2 Environmental safety

#### The work area

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



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#### **WARNING:**

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

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#### 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.



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#### **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.

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#### 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.

Provide LOTO procedures to prevent unexpected start-up.

Install an Emergency Stop that meets the requirements of EN ISO 13850. If it can be shown that a normal cut-off device functions as an Emergency Stop with the same efficiency this is admissible and it shall be marked as such.

#### Noise



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**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.

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#### Temperature



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**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

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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.

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### 1.2.3.1 Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

### 1.2.3.2 Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:



---

**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.

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- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.
- For gas group IIA and IIB minimum brass material needs to be used for coupling guard. For gas group IIC stainless steel is required.

### 1.2.4 Hazardous liquids

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who work with biologically hazardous liquids are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.
- A small amount of liquid will be present in certain areas like the seal chamber.

## 1.2.5 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"> <li>1. Hold your eyelids apart forcibly with your fingers.</li> <li>2. Rinse the eyes with eyewash or running water for at least 15 minutes.</li> <li>3. Seek medical attention.</li> </ol>
Chemicals or hazardous fluids on skin	<ol style="list-style-type: none"> <li>1. Remove contaminated clothing.</li> <li>2. Wash the skin with soap and water for at least 1 minute.</li> <li>3. Seek medical attention, if necessary.</li> </ol>

## 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.



## 1.4 Ex Considerations and Intended Use

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).
- All work that causes sparking has to be carried out outside the potentially explosive atmosphere (e.g. welding, hammering, grinding).

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 operating range and permitted limits of use (see applicable documents, especially pump data sheet). Install safety and monitoring devices to ensure the operation in normal range.
- 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.
- Install safety and monitoring devices to ensure the correct liquid level at any time.
- 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.
- Do not apply additional paint or coatings to the pump when in an ATEX 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.
- 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.
- Do not operate the pump in processes that can cause shock waves or adiabatic compression (e.g. high pressure gases or oxidizing gases).
- Operate the pump with mounted suction strainers with mesh size according to pump size.

- Inspect the pump housing for corrosion and gaps in sealing for wear regularly. If the gaps exceed the defined tolerance limits replace the worn parts.
- Operate the pump within the maximum permitted design pressure according to the name plate.
- Check coupling regularly for wear. Change coupling if coupling is used for more than 3 years.
- Keep housing surfaces dust-free. Clean surfaces carefully so that no potentially explosive atmosphere can occur.
- If using a casing heating, ensure that the maximum temperature of the heating medium is at least 15 K lower than the permitted temperature class of the pump.
- Make sure that supplied electric and non-electric equipment correspond to the specific pump application in the potentially explosive atmosphere (e.g. zone, category, temperature class). Check declaration of conformity of the supplier.
- If using a motor speed control (hydrovar), install device outside of the potentially explosive atmosphere. Transmitters used in the potentially explosive atmosphere must be designed in the appropriate ignition protection type. Check declaration of conformity of the supplier.

### 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.

The ATEX directives are a specification enforced in only Europe. The UK Ex directives are a specification enforced in only the United Kingdom.

Explosive directives in other regions and countries depend on local regulations.

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.

### 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).

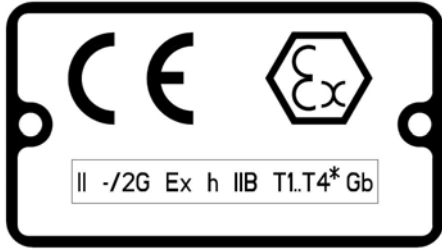
1. Monitoring the pump frame liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

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 baseplate 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 ATEX nameplate**

- II - Group – Non Mining Equipment
- 2G – Category – Category 2 – Gas
- Ex – required by ISO 80079 – 36:2016
- h – h indicates mechanical equipment
- IIB – Gas Group
- T1 – T4 – Permitted Maximum Surface Temperature
- Gb – Atmosphere + Equipment Protection Level



**Figure 2: Typical UKCA ATEX 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 12](#) 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.

**ISO 80079-37:2016 Section 5.7**

Recommended bearing replacement interval (based on L10 life) = 17,500 hours of operation.

**Equipment for monitoring**

For process monitoring, condition-monitoring devices may be utilized. 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
- PumpSmart control system

**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).
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge. If not, a static electric discharge may occur when the pump is drained and disassembled for maintenance purposes.
- 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 (Refer to [Table 1: Temperature class definitions on page 12](#) 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. For gas group IIA and IIB minimum brass material needs to be used for coupling guard. For gas group IIC stainless steel is required.
- 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.
- If the pump is equipped with a seal flushing system, the proper function of the seal flushing system must be ensured. 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 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: Temperature class definitions on page 12](#), then that temperature is not valid. Should this situation occur, please consult with your ITT/ Goulds 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. 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.
-



# 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 and lifting

#### Precautions for moving the pump

Use care when moving pumps. Consult with a lifting and rigging specialist before lifting or moving the pump to avoid possible damage to the pump or injury to personnel.



---

**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.
  - The pump or the unit must be transported properly. It must be ensured that during transport the pump/unit remains in the horizontal position and does not slip out of the transport suspension points.
- 



---

**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.

---

Keep the pump unit in the same position in which it was shipped from the factory.

Close the suction and discharge ends of the pump with plugs for transport and storage.

#### Precautions for lifting the pump



---

**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.

- 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.
  - 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.
  - 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.
- 
- 

### NOTICE:

- Make sure that the lifting equipment supports the entire assembly and is only used by authorized personnel.
  - Do not attach sling ropes to shaft ends.
- 

### Lifting the pump

Baseplate-mounted units have lifting points for use with proper lifting devices.

Hoist the pump using a suitable sling under solid points such as the casing, flanges, or frame.

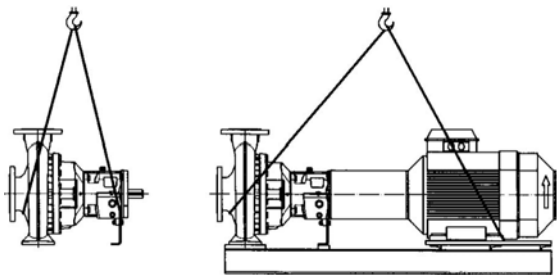


Figure 3: Example of proper lifting method

## 2.3 Storage guidelines

### 2.3.1 Short-term storage

Storage requirements short-term (less than six month).

Store in a covered and dry location.

### 2.3.2 Long-term storage

If the unit is stored for more than 6 months, these requirements apply:

- 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 the drive unit and coupling manufacturers for their long-term storage procedures.

For questions about possible long-term storage treatment services, please contact your local ITT sales representative.

# 3 Product Description

## 3.1 General description

The model ICO i-FRAME is a single-stage volute casing pump. Hydraulic design and dimensions comply with ISO 2858/ EN 22858. The technical design complies with ISO 5199/EN 25199. Model ICOH i-FRAME additionally have cooling or heating of the casing cover and/or the volute casing.



### Casing

- Heavy-duty, top centerline discharge
- Integral cast feet
- Back pullout design
- Standard 3/8 in. NPT casing drain

### Impeller

The impeller is semi-open and key driven by the shaft. Standard back vanes or balance holes reduce axial thrust and seal chamber pressures.

### Seal chamber

- Wide choice of sealing arrangements for maximum sealing flexibility
- Patented “cyclone” seal chamber for improved lubrication, heat removal, and solids handling
- Confined casing gasket

### Power end

- Redesigned i-FRAME large capacity oil sump reduces oil temperature for extended bearing life.
- Heavy-duty cast iron frame gives rigid support to the shaft and bearings for longer service.
- Magnetic drain plug maintains a clean oil environment for extended bearing life.
- Standard hybrid stainless steel/bronze labyrinth oil seals at the pump and coupling end maintain a seal tight, clean operating environment.
- O-ring seal between the frame and adapter for optimized alignment and sealing.

### Frame adapter

- Provides safe and accurate alignment for the liquid end to the bearing frame.

- Large access windows make installation and maintenance of seal and auxiliary support systems trouble-free.

### Bearings

Heavy-duty ball bearings provide L10 bearing life in excess of 17,500 hours.

The size of the bearing frame is shown in the data sheet and/or order confirmation.

Bearing frame	Bearing type	
	Pump side	Drive side
24 i-FRAME	6307 - C3	3307A - C3
32 i-FRAME	6309 - C3	3309A - C3
42 i-FRAME	6311 - C3	3311A - C3
48 i-FRAME	6313 - C3	3313A - C3

### Shaft

Rigid shaft designed for less than 0.05 mm shaft deflection. Standard 400 series stainless steel shaft (1.4021) provides reliable power transmission and corrosion resistance at both the pump and coupling ends.

## 3.2 General description i-ALERT® Equipment Health Monitor

### Description

The i-ALERT® Equipment Health Monitor is a compact, battery-operated monitoring device that continuously measures the vibration and temperature of the pump power end. The i-ALERT® sensor uses blinking LED and wireless notification to alert the pump operator when the pump exceeds vibration and temperature limits. This allows the pump operator to make changes to the process or the pump before a catastrophic failure occurs. The i-ALERT® monitor allows customers to identify potential problems before they become costly failures. It tracks vibration, temperature, change in electromagnetic field and run-time hours and wirelessly syncs the data with the i-ALERT Gateway or with a smart phone or tablet using i-ALERT® mobile app.

More information available on <https://www.i-alert.com/products/>

Current IOMs are available at <http://www.gouldspumps.com/en-us/tools-and-resources/literature/> - and - resources/literature/ IOMs, <https://www.i-alert.com/> or your local ITT Goulds Pumps Sales Rep.

### Alarm mode

The condition monitor enters alarm mode when either vibration or temperature limits are exceeded over two consecutive readings within a user defined period. Alarm mode is indicated with red flashing LED.

**Table 2: Temperature and vibration limits**

Variable	Limit
Temperature	100°C   195°F Surface Temperature
Vibration	100% increase over the baseline level

### Battery life

The i-ALERT® Condition Monitor battery is replaceable.

The battery life is not covered as part of the standard pump warranty.

This table shows the average condition monitor battery life under normal and alarm-mode operating conditions.

Condition monitor operational state	Battery life
Normal operating and environmental conditions	Three to five years

<b>Condition monitor operational state</b>	<b>Battery life</b>
Alarm mode	One year

### 3.3 Nameplate information

#### Pump nameplate

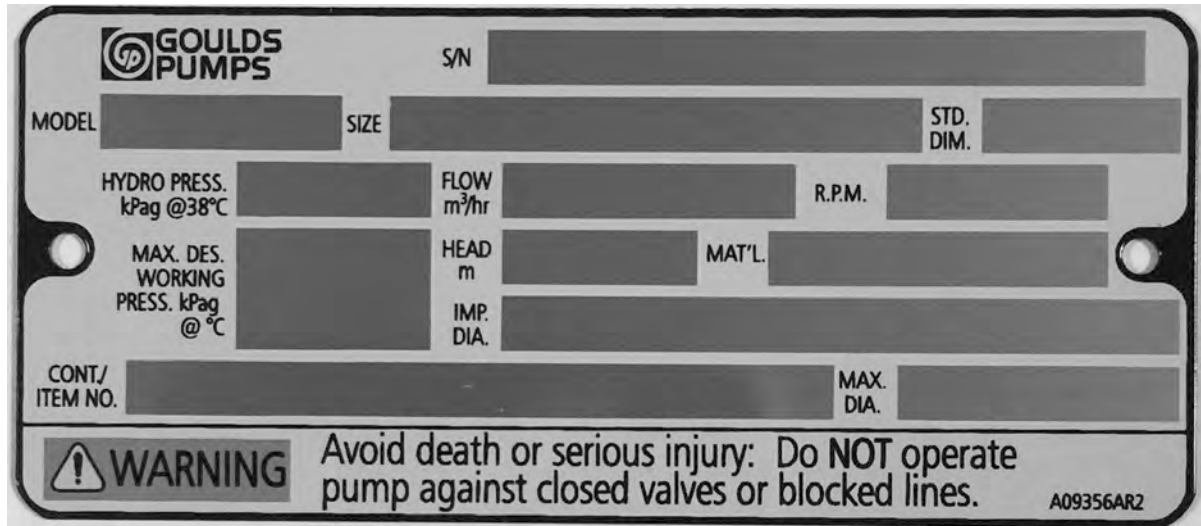


Figure 4: Pump nameplate

Nameplate Field	Explanation
S/N	Serial number of the pump
MODEL	Pump Model
SIZE	Size of Pump
STD DIM	ANSI Std designation – Not applicable ISO Pumps
HYDRO PRESS	Pump Test Pressure in kPag
FLOW	Rated pump flow in cubic metres per hour
RPM	Rated pump speed in revolutions per minute
MAX DESIGN WORKING PRESS	Maximum Design pressure in kPag at rated temperature in degrees Centigrade
HEAD	Rated pump head in metres
MATL	Material of which the pump is constructed
IMP DIA	Impeller diameter fitted
CONT/ITEM NO	Contract or tag number
MAX DIA	Maximum impeller diameter

# 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.
- Install and operate electrical equipment for a pump unit according to the suppliers' instructions.

### 4.1.1 Pump location guidelines



**WARNING:**

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.



**WARNING:**

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

Guideline	Explanation/comment
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.

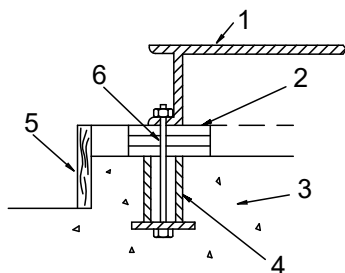
Guideline	Explanation/comment
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: <ul style="list-style-type: none"> <li>• Pressure relief valves</li> <li>• Compression tanks</li> <li>• Pressure controls</li> <li>• Temperature controls</li> <li>• Flow controls</li> </ul> <p>If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.</p>
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.
If the pump location is overhead, undertake special precautions to reduce possible noise transmission.	Consider a consultation with a noise specialist.

## 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.
- The foundation must weigh between two and three times the weight of the pump.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.
- Sleeve-type and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.
- The concrete foundation must have sufficient firmness according to DIN 1045 or equal standard.

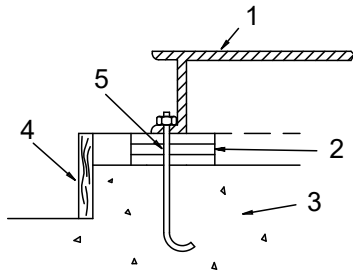
### Sleeve-type bolts



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

**Figure 5: Sleeve type bolts**

**J-type bolts**



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

**Figure 6: 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 Prepare the foundation for mounting

1. Chip the top of the foundation to a minimum of 25.0 mm | 1.0 in. in order to remove porous or low-strength concrete.  
If you use a pneumatic hammer, make sure that it does not contaminate the surface with oil or other moisture.

---

**NOTICE:**

Do not chip the foundation using heavy tools such as jackhammers. This can damage the structural integrity of the foundation.

---

2. Remove water or debris from the foundation bolt holes or sleeves.
3. If the baseplate uses sleeve-type bolts, then fill the sleeves with a non-binding, moldable material. Seal the sleeves in order to prevent the grout from entering.
4. Coat the exposed portion of the anchor bolts with a non-binding compound such as paste wax in order to prevent the grout from adhering to the anchor bolts.  
Do not use oils or liquid wax.
5. If recommended by the grout manufacturer, coat the foundation surface with a compatible primer.

### 4.2.3 Install the baseplate using shims or wedges

Required tools:

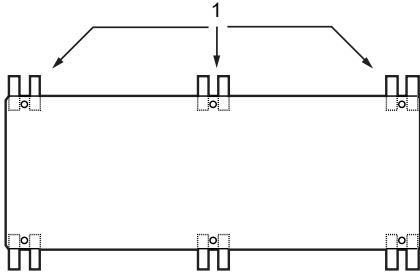
- Two sets of shims or wedges for each foundation bolt



- Two machinist's levels
- Baseplate-leveling worksheet

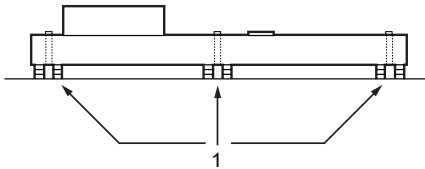
This procedure is applicable to fabricated steel baseplates.

1. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt holes.
2. Put the sets of wedges or shims on each side of each foundation bolt.  
The sets of wedges should have a height of between 19 mm | 0.75 in. and 38 mm | 1.50 in.



1. Shims or wedges

**Figure 7: Top view**



1. Shims or wedges

**Figure 8: Side view**

3. Lower the baseplate carefully onto the foundation bolts.
4. 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.

---

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

These are the leveling tolerances:

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

You can use the [4.2.7 Baseplate-leveling worksheet on page 29](#) when you take the readings.

6. Hand-tighten the nuts for the foundation.

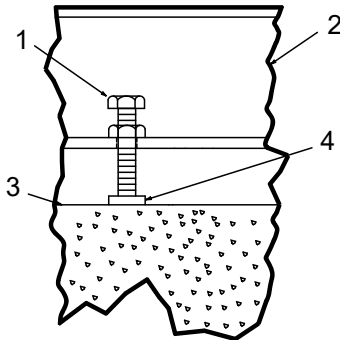
## 4.2.4 Install the baseplate using jackscrews

Tools required:

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

This procedure is applicable to the fabricated steel 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 9: Jackscrews**

3. Level the driver mounting pads:

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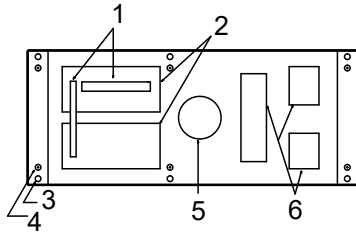
**NOTICE:**

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 10: 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:

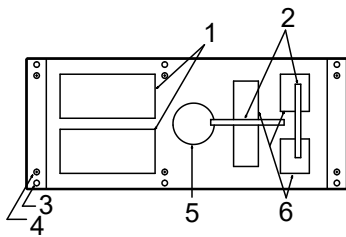
---

**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 11: 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 .

## 4.2.5 Install the baseplate using spring mounting

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### **NOTICE:**

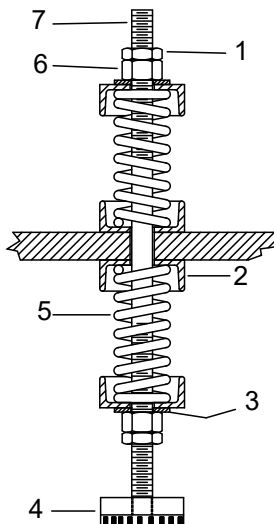
The spring-mounted baseplate is designed only to support piping loads from thermal expansion. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

---

The foundation pads are not provided with the baseplate. Make sure that the foundation pads are 316 stainless-steel plates, which have a 16-20 micro-inch surface finish.

Before you start this procedure, make sure that the foundation pads are correctly installed on the foundation/floor (see the manufacturer's instructions).

1. Put the baseplate on a support above the foundation/floor.  
Make sure that there is enough space between the baseplate and the foundation/floor in order to install the spring assemblies.
2. Install the lower part of the spring assembly:
  - a) Screw the lower jam nut onto the spring stud.
  - b) Screw the lower adjusting nut onto the spring-stud, on top of the jam nut.
  - c) Set the lower adjusting nut to the correct height.  
The correct height depends on the required distance between the foundation/floor and the baseplate.
  - d) Put a washer, a follower, a spring, and one more follower onto the lower adjusting nut.
3. Install the spring assembly on the baseplate:
  - a) Insert the spring assembly into the baseplate's anchorage hole from below.
  - b) Put a follower, a spring, another follower, and a washer onto the spring stud.
  - c) Fasten the spring assembly with the upper adjusting nut by hand.
4. Thread the upper jam nut onto the spring stud by hand.
5. Repeat steps 2 through 4 for all the spring assemblies.
6. Lower the baseplate so that the spring assemblies fit into the foundation pads.
7. Level the baseplate and make the final height adjustments:
  - a) Loosen the upper jam nuts and adjusting nuts.
  - b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
  - c) When the baseplate is level, tighten the top adjusting nuts so that the top springs are not loose in their followers.
8. Fasten the lower and upper jam nuts on each spring assembly.



1. Upper jam nut
2. Follower
3. Washer
4. Foundation pads
5. Spring
6. Upper adjusting nut
7. Spring stud

**Figure 12: Example of an installed spring assembly**

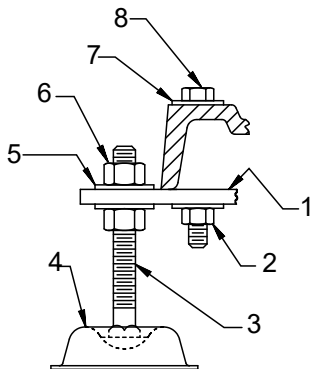
### 4.2.6 Install the baseplate using stilt mounting

**NOTICE:**

The stilt-mounted baseplate is not designed to support static piping loads. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

1. Put the baseplate on a support above the foundation/floor. Make sure that there is enough space between the baseplate and the foundation/floor to install the stilts.
2. Install the lower part of the stilt assembly:
  - a) Screw the lower jam nut and adjusting nut onto the stilt.
  - b) Set the lower adjusting nut to the correct height. The correct height depends on the required distance between the foundation/floor and the baseplate.
  - c) Put a washer onto the lower adjusting- nut.
3. Install the stilt assembly on the baseplate:
  - a) Insert the stilt assembly into the baseplate's anchorage hole from below.
  - b) Put a washer onto the stilt.
  - c) Fasten the stilt assembly with the upper adjusting nut by hand.
4. Screw the upper jam nut onto the stilt by hand.
5. Repeat steps 2 through 4 for all the stilt assemblies.
6. Lower the baseplate so that the stilts fit into the foundation cups.
7. Level the baseplate and make the final height adjustments:
  - a) Loosen the upper jam nuts and adjusting nuts.

- b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
  - c) When the baseplate is level, tighten the top adjusting nuts.
8. Fasten the lower and upper jam nuts on each stilt.

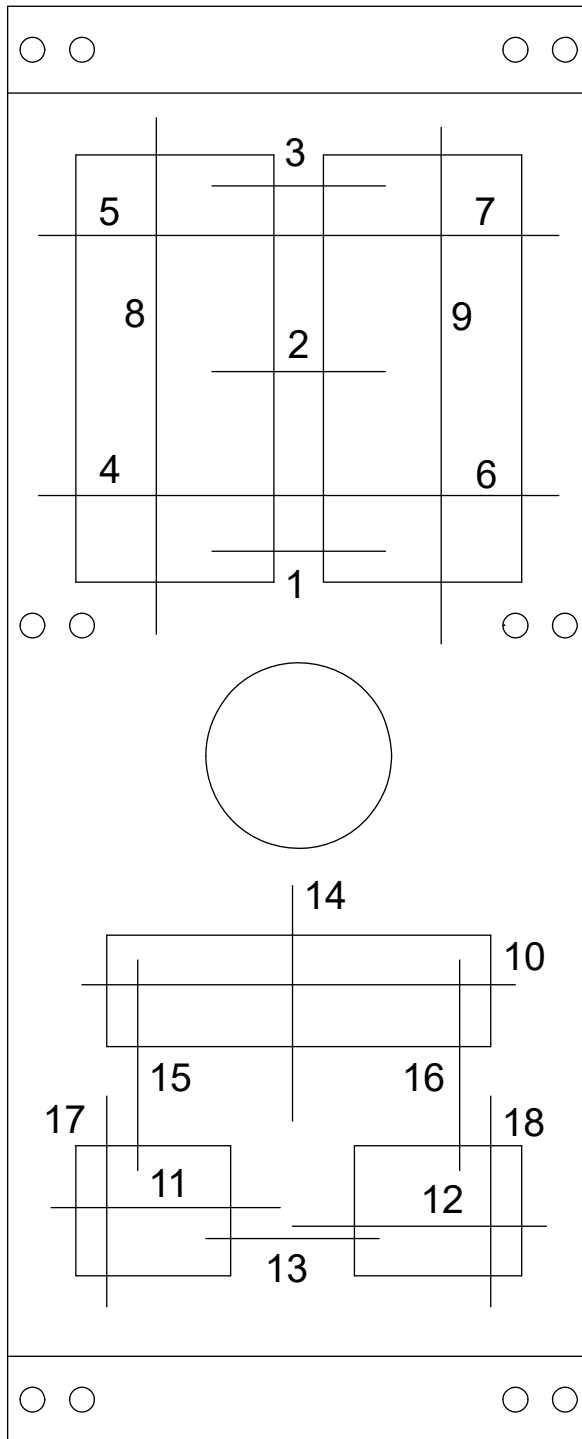


- 1. Mounting plate
- 2. Mounting nut
- 3. Stilt bolt
- 4. Foundation cups
- 5. Washer
- 6. Upper adjustment nut
- 7. Mounting washer
- 8. Mounting bolt

**Figure 13: Example of an installed stilt assembly**

### 4.2.7 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 Install the pump, driver, and coupling

1. Mount and fasten the pump on the baseplate. Use applicable bolts.

2. Mount the driver on the baseplate. Use applicable bolts and hand tighten.
3. Install the coupling.  
See the installation instructions from the coupling manufacturer.

## 4.4 Pump-to-driver alignment

### Precautions



#### WARNING:

- 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.
- 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.

### 4.4.1 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 .
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.



When	Why
Periodically	This follows the plant operating procedures.

## 4.4.2 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.

### IMPORTANT

- For electric motors, the motor shaft initial (cold) parallel vertical alignment setting should be 0.05 to 0.10 mm | 0.002 to 0.004 in. lower than the pump shaft.
- For other drivers such as turbines and engines, follow the driver manufacturer's recommendations.
- The driver shaft initial (cold) parallel vertical alignment setting should be lower than the pump shaft. Follow the driver manufacturer's recommendations.

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.

### 4.4.2.1 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.

### NOTICE:

For electric motors, the motor shaft setting should be 0.05–0.1 mm | 0.002–0.004 in lower than the pump shaft. For other drivers, follow the driver manufacturer's recommendations.

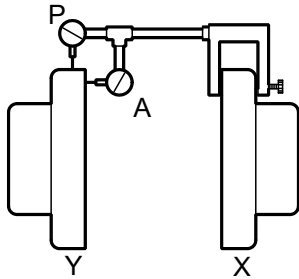
## 4.4.3 Alignment measurement guidelines

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.

## 4.4.4 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 14: 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.

## 4.4.5 Pump-to-driver alignment instructions

### 4.4.5.1 Perform angular alignment for a vertical correction

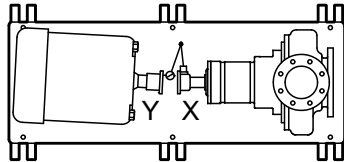
1. Set the angular alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The coupling halves are farther apart at the bottom than at the top. Perform one of these steps: <ul style="list-style-type: none"> <li>• Add shims in order to raise the feet of the driver at the shaft end.</li> <li>• Remove shims in order to lower the feet of the driver at the other end.</li> </ul>
Positive	The coupling halves are closer at the bottom than at the top. Perform one of these steps: <ul style="list-style-type: none"> <li>• Remove shims in order to lower the feet of the driver at the shaft end.</li> <li>• Add shims in order to raise the feet of the driver at the other end.</li> </ul>

### 4.4.5.2 Perform angular alignment for a horizontal correction

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

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: <ul style="list-style-type: none"> <li>Slide the shaft end of the driver to the left.</li> <li>Slide the opposite end to the right.</li> </ul>
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"> <li>Slide the shaft end of the driver to the right.</li> <li>Slide the opposite end to the left.</li> </ul>



**Figure 15: Top view of an incorrect horizontal alignment**

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

Maximum permitted value for angular alignment:

#### 4.4.5.3 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.

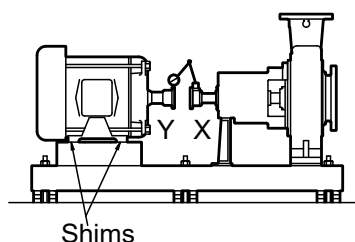
Before you start this procedure, make sure that the dial indicators are correctly set up.

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.

Recommended settings [4.4.2.1 Cold settings for parallel vertical alignment on page 31](#)

- 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 16: Side view of an incorrect vertical alignment**

4. 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.

**4.4.5.4 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 temperature rise and the pump operating temperature.

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.

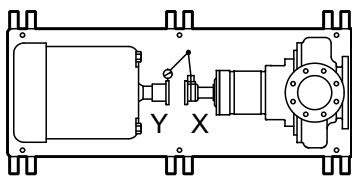
1. Set the parallel alignment indicator (P) to zero on the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The driver coupling half (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).

4. Slide the driver carefully in the appropriate direction.

**NOTICE:**

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



**Figure 17: Top view of an incorrect horizontal alignment**

5. 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.

**4.4.5.5 Perform complete alignment for a vertical correction**

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

#### 4.4.5.6 Perform complete alignment for a horizontal correction

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.

## 4.5 Grout the baseplate

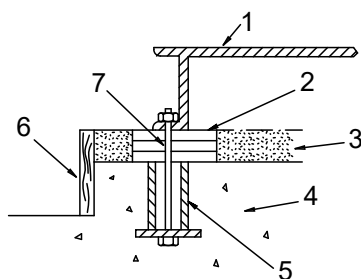
Required equipment:

- 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.

### NOTICE:

It is assumed that the installer who grouts the baseplate has knowledge of acceptable methods. More detailed procedures are described in various publications, including API Standard 610, latest edition, Appendix L; API RP 686, Chapter 5; and other industry standards.

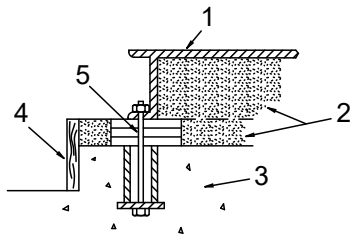
1. Clean all the areas of the baseplate that will come into contact with the grout.
2. Build a dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.
4. Pour grout through the grout hole into the baseplate up to the level of the dam.  
When you pour the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



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

Figure 18: Pour grout into baseplate

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 19: Fill remainder of baseplate with grout**

7. Remove the leveling jackscrews after the grout hardens in order to remove any stress points.
8. Tighten the foundation bolts.
9. Make sure that treatment of the concrete is in accordance with DIN 1045.

## 4.6 Piping checklists

### 4.6.1 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. Casing deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.

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**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.

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### Piping guidelines

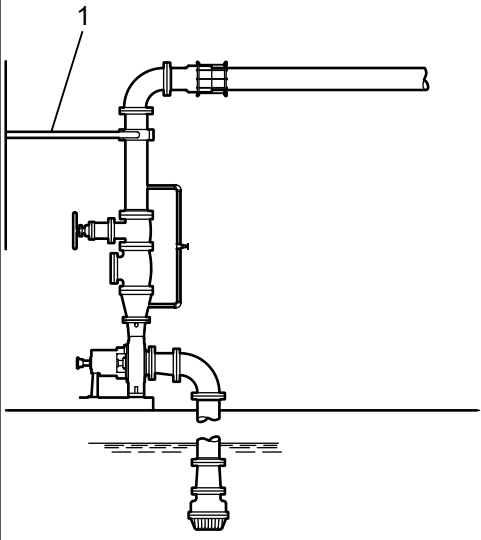
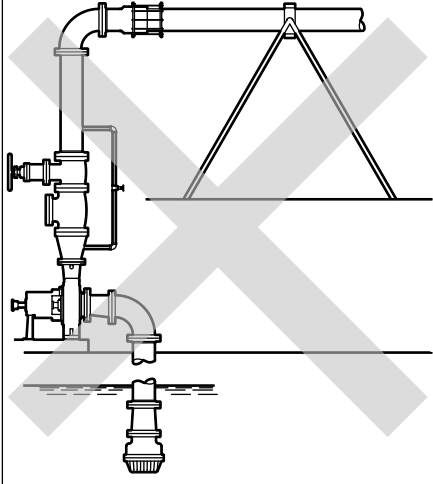
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

### 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"> <li>• Strain on the pump</li> <li>• Misalignment between the pump and the drive unit</li> <li>• Wear on the pump bearings and the coupling</li> </ul>	
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: <ul style="list-style-type: none"> <li>• The grout for the baseplate or sub-base becomes hard.</li> <li>• The grout for the pit cover becomes hard.</li> <li>• The hold-down bolts for the pump and the driver are tightened.</li> </ul>	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump	—	

Check	Explanation/comment	Checked
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> 

**4.6.2 Suction-piping checklist**

**Suction-piping checks**

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and the closest elbow is at least five 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	Explanation/comment	Checked
Check that the eccentric reducer at the suction flange of the pump has the following properties: <ul style="list-style-type: none"> <li>Sloping side down</li> <li>Horizontal side at the top</li> </ul>	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 NPSHa.	

#### Liquid source below the pump

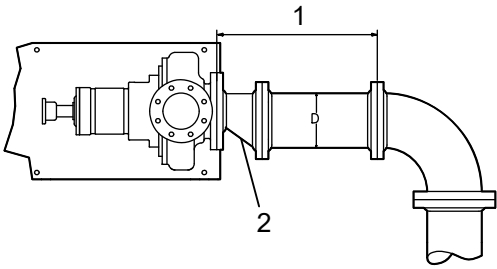
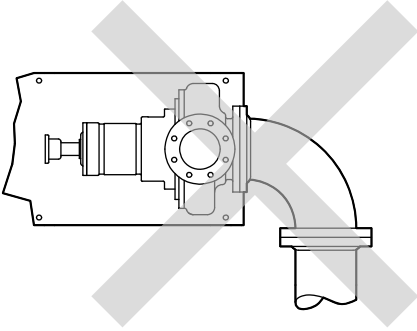
Check	Explanation/comment	Checked
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the suction piping slopes upwards from the liquid source to the pump inlet.	—	
If the pump is not self-priming, check 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

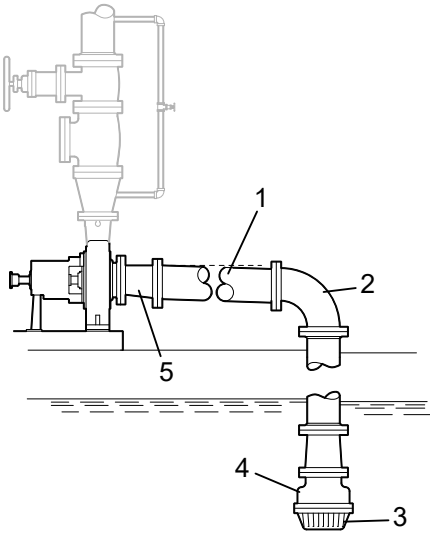
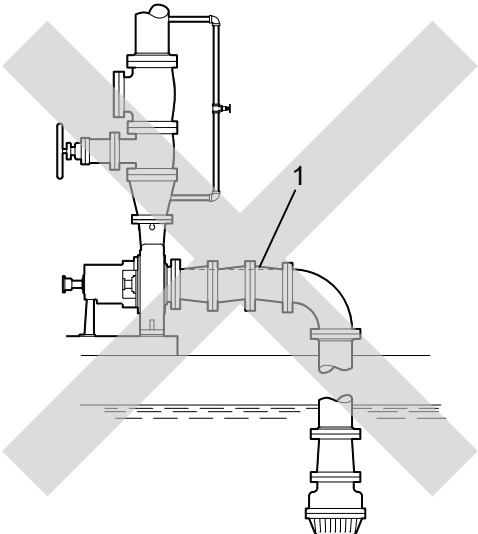
Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	This permits you to close the line during pump inspection and maintenance. Do not use the isolation valve to throttle the pump. Throttling can cause these problems: <ul style="list-style-type: none"> <li>Loss of priming</li> <li>Excessive temperatures</li> <li>Damage to the pump</li> <li>Voiding the warranty</li> </ul>	
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.	—	

Check	Explanation/comment	Checked
Make sure that no part of the suction piping extends below the suction flange of the pump.	—	
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.	

**Example: Elbow close to the pump suction inlet**

Correct	Incorrect
<p>The correct distance between the inlet flange of the pump and the closest elbow must be at least five pipe diameters.</p>  <ol style="list-style-type: none"> <li>Enough distance to prevent cavitation</li> <li>Eccentric reducer with a level top</li> </ol>	

**Example: Suction piping equipment**

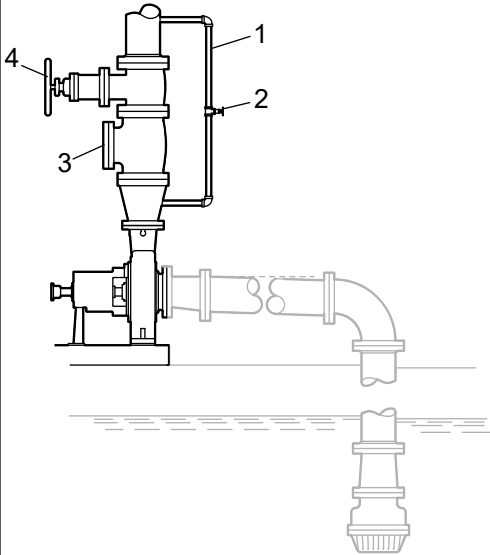
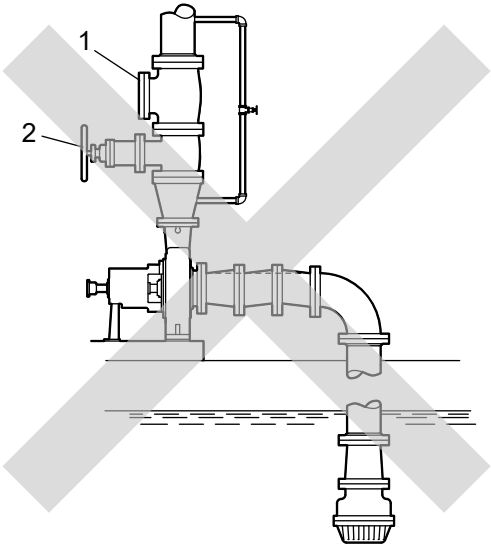
Correct	Incorrect
 <ol style="list-style-type: none"> <li>Suction pipe sloping upwards from liquid source</li> <li>Long-radius elbow</li> <li>Strainer</li> <li>Foot valve</li> <li>Eccentric reducer with a level top</li> </ol>	 <ol style="list-style-type: none"> <li>Air pocket, because the eccentric reducer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

## 4.6.3 Discharge piping checklist

### Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line. For specific gravity less than 0.60, minimize distance from pump discharge.	The isolation valve is required for: <ul style="list-style-type: none"> <li>• Priming</li> <li>• Regulation of flow</li> <li>• Inspection and maintenance of the pump</li> <li>• Reduce risk of pumpage vaporization and vapor locking at low flow rates for low specific gravity liquids.</li> </ul> See Example: Discharge piping equipment for illustrations.	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve.  The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow.  See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

### Example: Discharge piping equipment

Correct	Incorrect
 <ol style="list-style-type: none"> <li>1. Bypass line</li> <li>2. Shut-off valve</li> <li>3. Check valve</li> <li>4. Discharge isolation valve</li> </ol>	 <ol style="list-style-type: none"> <li>1. Check valve (incorrect position)</li> <li>2. The isolation valve should not be positioned between the check valve and the pump.</li> </ol>

## 4.6.4 Bypass-piping considerations

### When to use a bypass line

Provide a bypass line for systems that require operation at reduced flows for prolonged periods. Connect a bypass line from the discharge side (before any valves) to the source of suction.

### When to install a minimum-flow orifice

You can size and install a minimum-flow orifice in a bypass line in order to prevent bypassing excessive flows. Consult your ITT representative for assistance in sizing a minimum-flow orifice.

### When a minimum-flow orifice is unavailable

Consider an automatic recirculation control valve or solenoid-operated valve if a constant bypass (minimum-flow orifice) is not possible.

## 4.6.5 Auxiliary-piping checklist

### Precautions



#### CAUTION:

- Risk of heat generation, seal failure, and possible physical injury. Sealing systems that are not self-purging or self-venting, such as plan 23, require manual venting prior to operation.
- Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

#### NOTICE:

- Auxiliary cooling and flush systems must be operating properly to prevent excess heat generation, sparks, and/or premature failure. Ensure auxiliary piping is installed as specified on the pump data sheet prior to startup.
- Make sure that the ignition temperature of the cooling liquid is at least 50 K higher than the surface temperature of the bearing frame, if the pump is used in potentially explosive environment.

### When to install

You may need to install auxiliary piping for bearing cooling, seal-chamber cover cooling, mechanical seal flush, or other special features supplied with the pump. Consult the pump data sheet for specific auxiliary piping recommendations.

### Checklist

Check	Explanation/comment	Checked
Check that the minimum flow for each component is 4 lpm   1 gpm.	—	
Check that the cooling water pressure does not exceed 7.0 kg/cm <sup>2</sup>   100 psig .	—	

## 4.6.6 Final piping checklist

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




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### 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.
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### WARNING:

- Risk of death, serious personal injury, and property damage. Heat and pressure build-up 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.
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### Precautions




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### WARNING:

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

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### 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

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## 5.2 Remove the coupling guard

prevents seal or shaft sleeve damage by ensuring that the seal is properly installed and centered on the sleeve.

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**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.

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**NOTICE:**

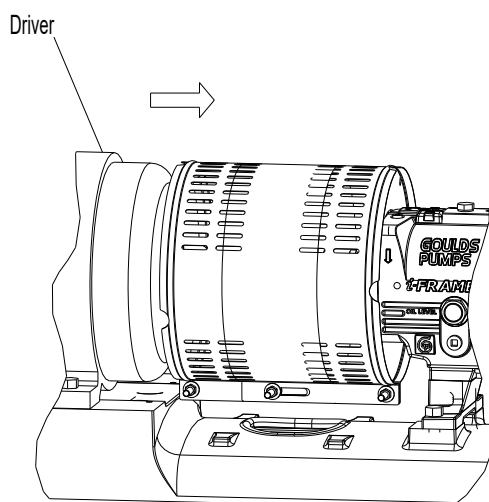
You must follow these precautions before you start the pump:

- 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.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.
- 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.

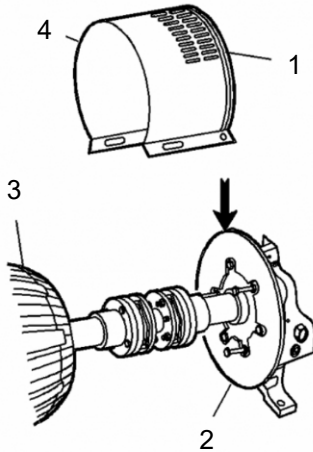
## 5.2 Remove the coupling guard

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. 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 - Frame Mounted



### 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 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 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.
- 

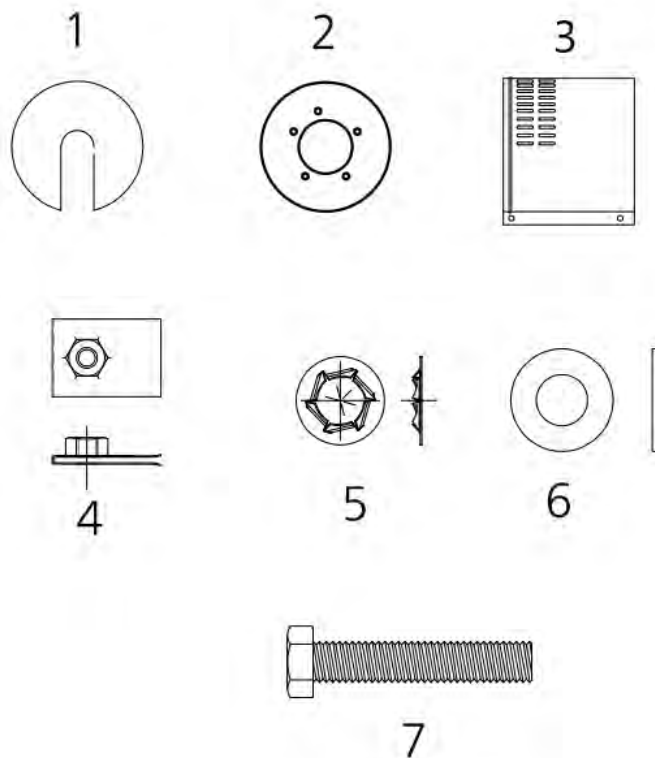


**WARNING:**

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

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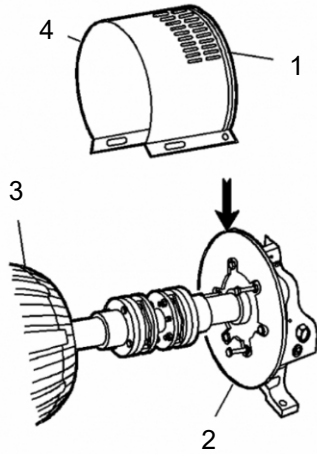




Part No.	Description	Part No.	Description
1	Cover driver	5	Retainer (Qty 3)
2	Cover plate	6	Washer (Qty 4)
3	Guard (Qty 2)	7	Hex head bolt (Qty 3)
4	U-nut (Qty 3)		

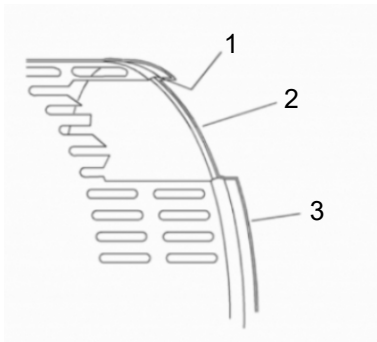
**Figure 20: Required parts**

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.
3. Slightly spread the opening of the coupling guard half and place it over the pump end plate.
  - a) The annular groove in the guard is located around the end plate.
  - b) Position the opening (flange) so that it does not interfere with the piping but still allows for access when you install the bolts.



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

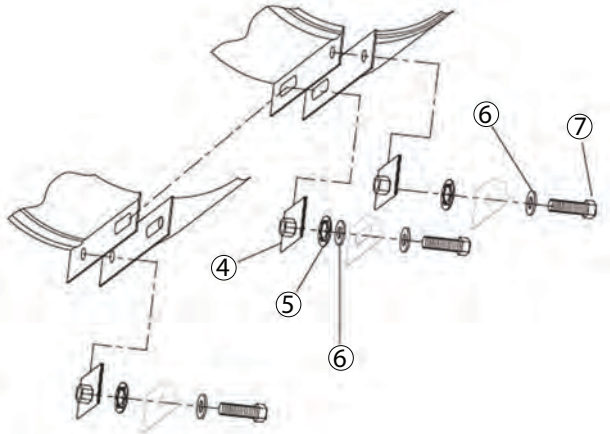
**Figure 21: Align pump end guard half with annular groove**



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

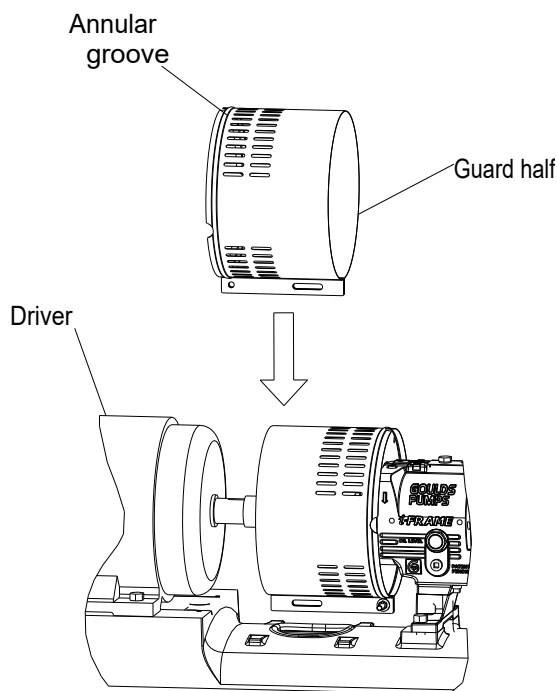
**Figure 22: Annular groove in coupling guard**

- Place one washer over the bolt and insert the bolt through the round hole at the front end of the guard half.



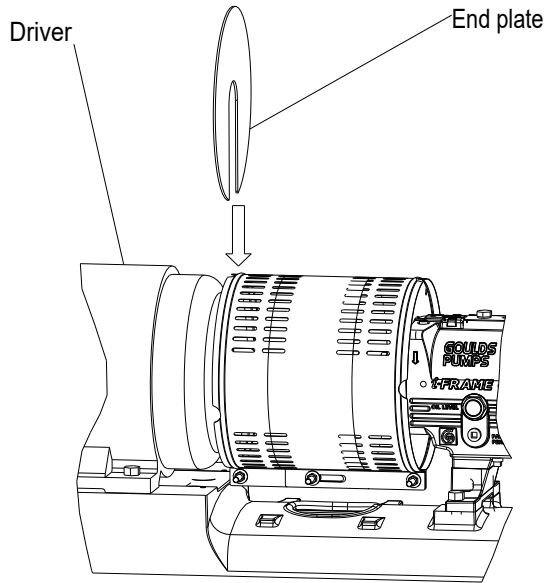
**Figure 23: Captured hardware component assembly**

5. Install the bolt retainer over the exposed end of the bolt, and the U-Nut into the slot in the coupling guard if it was not done from the factory.
6. Thread bolt into the U-Nut and tighten firmly.
7. Slightly spread the opening of the remaining coupling guard half and place it over the installed coupling guard half so that the annular groove in the remaining coupling guard half faces the motor.



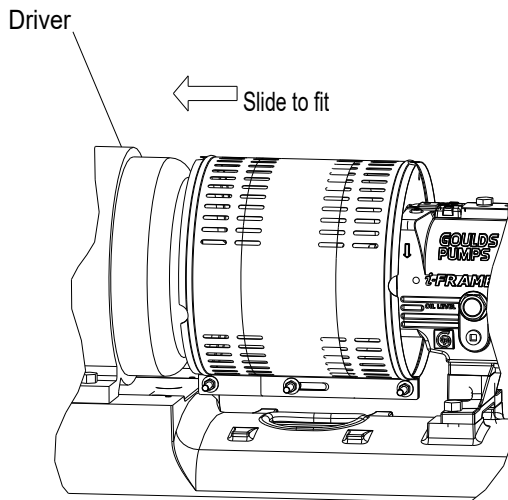
**Figure 24: Placement of driver half of coupling guard**

8. Place the end plate over the driver shaft and locate the end plate in the annular groove at the rear of the coupling guard half.



**Figure 25: Placement of driver half of coupling guard**

9. Hand-tighten only. Repeat Steps 4 through 6 for the rear end of the coupling guard half. The hole is located on the driver-side of the coupling guard half.
10. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.



**Figure 26: Slide driver-half of coupling guard towards motor**

11. Repeat Steps 4 through 6 for the center slots in the coupling guard.
12. Tighten all nuts on the guard assembly.

## 5.6 Bearing lubrication



**WARNING:**

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

---

**NOTICE:**

Grease can settle in equipment left idle leaving bearings improperly lubricated. Check the greasing on a pump that has been out of service for a long period of time and re-grease if necessary.

Pumps are shipped without oil. You must lubricate oil-lubricated bearings at the job site.

Grease-lubricated bearings are lubricated at the factory.

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.

## 5.6.1 Lubricating oil requirements

### Oil quality requirements

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

Lubricating oil type	<ul style="list-style-type: none"> <li>• CLP46</li> <li>• DIN 51517</li> <li>• HD 20W/20 SAE</li> </ul>
Symbol	DIN 51502
Kinematic viscosity at 40°C   104°F	46 ±4 mm <sup>2</sup> /sec   0.0713 ±0.006 in. <sup>2</sup> /sec
Flash point (Cleveland)	175°C   347°F
Setting point (Pourpoint)	-15°C   5°F
Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below -10°C   14°F.	Higher than permitted bearing temperature

### Oil quantity requirements

Bearing frame size	Oil quantity in liters   quarts
24 i-FRAME	0.5   0.53
32 i-FRAME	1.1   1.16
42 i-FRAME	1.5   1.58
48 i-FRAME	2.1   2.21

## 5.6.2 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.

**NOTICE:**

The pump is not filled with oil when delivered. Fill with oil before operating the pump.

- Determine which procedure to use in order to fill the bearing frame with oil:

If...	Then...
The pump has an oil level sight glass (standard design)	Use the "Fill the bearing frame with oil" procedure.
The pump has a constant level oiler (optional)	Use the "Fill the bearing frame with an optional oiler" procedure.

### 5.6.2.1 Fill the bearing frame with oil

**NOTICE:**

Maintain an exact oil level. If the oil level is too high, the bearing temperature can increase. If the oil level is too low, the bearing will not be properly lubricated and could cause operational problems.

1. Remove the oil filling plug.
2. Pour oil into the opening.
3. Fill until the oil level rises to the center of the oil level sight glass.



Figure 27: Oil level sight glass

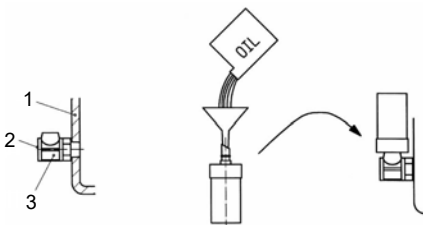
### 5.6.2.2 Fill the bearing frame with an optional oiler

**NOTICE:**

Maintain an exact oil level. If the oil level is too high, the bearing temperature can increase. If the oil level is too low, the bearing will not be properly lubricated and could cause operational problems.

The constant level oiler is supplied loose.

1. Unscrew the reservoir from the main body (right-threaded) and set aside.
2. Seal the main body to the bearing frame at the connection for the constant level oiler, using PTFE sealing tape.
3. Tighten until the threaded boss is in a vertical position.
4. Remove the oil filling plug near the upper side of the bearing frame.
5. Fill with oil by pouring into the connection opening until the oil level almost reaches the middle of the oil level sight glass in the main body.
6. Fill the reservoir using a funnel.



1. Bearing frame
2. Oil level sight glass
3. Main body

Figure 28: Filling bearing frame oiler

7. Place the O-ring on the reservoir spout.
8. Place your thumb over the reservoir spout.

9. Invert the spout and insert it into the internal threaded boss on the main body.
10. Tighten the reservoir.  
The oil then flows from the reservoir into the bearing chamber.
11. Repeat steps 6 through 10 until the reservoir remains two-thirds full.

Refill with oil whenever the oil level in the reservoir drops below one-third full.

### 5.6.3 Lubricating-grease requirements

#### Precautions

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#### **NOTICE:**

Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the grease type or consistency, remove the rotor and old grease from the housing before regreasing.

---

#### Grease quality requirements

Use a high-quality grease lubricant corresponding to NLGI Grade 2.

#### Grease lubrication

Consider this information when you lubricate with grease:

- Pumps are delivered from the manufacturer with lubricated bearings and are ready to be used.
- The bearings are filled with lithium-based grease, which is suitable for a temperature range from -30°C to 90°C | -22°F to 194°F when measured at the surface of the bearing frame.
- Make sure that bearing temperatures, measured at the bearing frame, are no more than 50°C | 122°F above the ambient temperature and never exceed 90°C | 194°F when checked weekly.

## 5.7 Shaft-sealing options

In most cases, the manufacturer seals the shaft before shipping the pump. If your pump does not have a sealed shaft, see the Shaft-seal maintenance section in the Maintenance chapter.

This model uses these types of shaft seals:

- Cartridge mechanical seal
- Conventional inside-component mechanical seal
- Conventional outside-component mechanical seal
- Packed-stuffing-box option

### 5.7.1 Mechanical seal options

Pumps are usually shipped with mechanical seals installed. If they are not, then refer to the mechanical seal manufacturer's installation instructions.

These are the mechanical seal options for this pump:

- Cartridge mechanical seal
- Conventional inside component mechanical seal
- Conventional outside component mechanical seal

### 5.7.2 Connection of sealing liquid for mechanical seals

#### Seal lubrication is required

Seal faces must have liquid film between them for proper lubrication. Locate the taps using the illustrations shipped with the seal.

## Seal flushing methods

**Table 3: You can use these methods in order to flush or cool the seal:**

Method	Description
Product flush	Run the piping so that the pump pushes the pumped fluid from the casing and injects it into the seal gland. If necessary, an external heat exchanger cools the pumped fluid before it enters the seal gland.
External flush	Run the piping so that the pump injects a clean, cool, compatible liquid directly into the seal gland. The pressure of the flushing liquid must be 0.35 to 1.01 kg/cm <sup>2</sup>   5 to 15 psi greater than the seal chamber pressure. The injection rate must be 2 to 8 lpm   0.5 to 2 gpm.
Other	You can use other methods that employ multiple gland or seal chamber connections. Refer to the mechanical seal reference drawing and piping diagrams.

### 5.7.3 Packed stuffing box option




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**WARNING:**

Packed stuffing boxes are not allowed in an Ex-classified environment.

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The factory does not install the packing, lantern ring, or split gland.

These parts are included with the pump in the box of fittings. Before you start the pump, you must install the packing, lantern ring, and split gland according to the Packed stuffing box maintenance section in the Maintenance chapter.

### 5.7.4 Connection of sealing liquid for a packed stuffing box

---

**NOTICE:**

Make sure to lubricate the packing. Failure to do so may result in shortening the life of the packing and the pump.

---

You must use an external sealing liquid under these conditions:

- The pumped fluid includes abrasive particles.
- The stuffing-box pressure is below atmospheric pressure when the pump is running with a suction lift or when the suction source is in a vacuum. Under these conditions, packing is not cooled and lubricated and air is drawn into pump.

#### Conditions for application of an external liquid

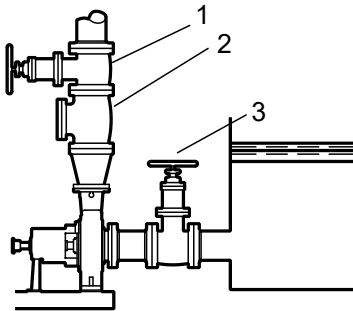
Condition	Action
The stuffing box pressure is above atmospheric pressure and the pumped fluid is clean.	Normal gland leaks of 40 to 60 drops per minute is usually sufficient to lubricate and cool the packing. You do not need sealing liquid.
The stuffing box pressure is below atmospheric pressure or the pumped fluid is not clean.	An outside source of clean compatible liquid is required.
An outside source of clean compatible liquid is required.	You must connect the piping to the lantern ring connection with a 40 to 60 drops-per-minute leak rate. The pressure must be 1.01 kg/cm <sup>2</sup>   15 psi above the stuffing box pressure.



## 5.8 Pump priming

### 5.8.1 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.



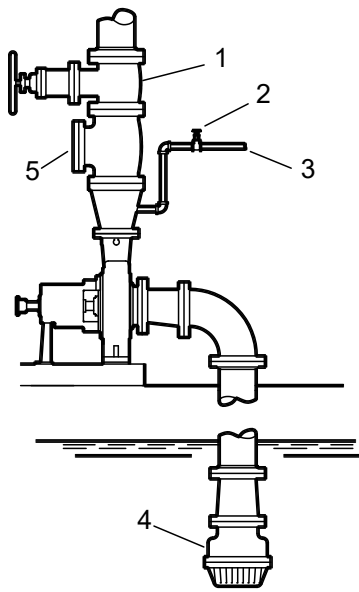
Item	Description
1.	Discharge isolation valve
2.	Check valve
3.	Suction isolation valve

**Figure 29: Suction supply above pump**

### 5.8.2 Prime the pump with the suction supply below the pump

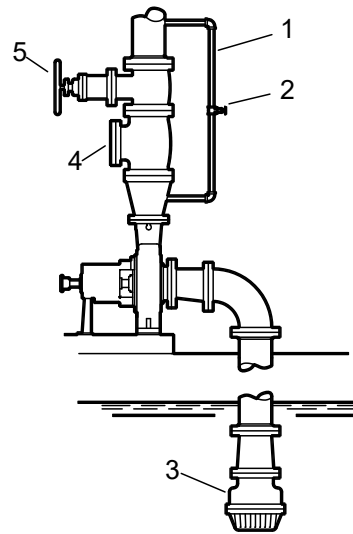
Use a foot valve and an outside source of liquid in order to prime the pump. The liquid can come from one of these sources:

- A priming pump
  - A pressurized discharge line
  - Another outside supply
1. Close the discharge isolation valve.
  2. Close the vent valves.
  3. 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 30: 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 31: Pump priming with suction supply below pump with foot valve using bypass around check valve**

### 5.8.3 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

## 5.9 Start the pump



### WARNING:

- Risk of equipment damage, seal failure and breach of containment. Ensure all flush and cooling systems are operating correctly prior to starting pump.
- Make sure that the ignition temperature of the cooling liquid is at least 50 K higher than the surface temperature of the bearing frame, if the pump is used in potentially explosive environment.

### 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, re-prime, 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.

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.

## 5.10 i-ALERT® Equipment Health Monitor



### WARNING:

Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

For all information refer to the i-ALERT® Equipment Health Monitor Installation, Operation and Maintenance manual. <https://www.i-alert.com/support/>

## 5.11 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.

### 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.
- Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
  - The specific gravity or viscosity of the fluid is greater than expected

- The pumped fluid exceeds the rated flow rate.
- 

### 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.
- 

#### **NOTICE:**

- Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available ( $NPSH_A$ ) always exceeds  $NPSH$  required ( $NPSH_R$ ) as shown on the published performance curve of the pump.
  - Do not run pump below minimum pressure at the suction side. Provide monitoring device with automatic switch-off function in case of low pressure.
- 

### 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.

---

## 5.12 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.
- 

## 5.13 Deactivate the i-ALERT® Equipment Health Monitor

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#### **NOTICE:**

Always deactivate the health monitor when the pump is going to be shut down for an extended period of time. Failure to do so will result in reduced battery life. Disengage the snap fit of the i-ALERT® using a flat head tool as shown below:



**Figure 32: Disengage the battery from the sensor when shutting the pump for an extended period of time**

## 5.14 Reset the i-ALERT® Health Monitor

To deactivate or reset the i-ALERT® monitor, please refer to the i-ALERT® IOM, <http://i-alert.com/>

Always reset the health monitor when the pump is started after maintenance, system change, or being shut down for an extended period of time. Failure to do so may result in false baseline levels that could cause the health monitor to alert in error.

## 5.15 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.

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.
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:



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**WARNING:**

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

---

- Lubricate the bearings.
- Inspect the seal.

### Routine inspections

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



---

**WARNING:**

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

---

- 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.\*
- Inspect the discharge pressure.
- Inspect the temperature.\*
- Check the seal chamber and stuffing box for leaks.
  - Ensure that there are no leaks from the mechanical seal.
  - Adjust or replace the packing in the stuffing box if you notice excessive leaking.

### Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- 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

Change the bearings after 90% of the nominal bearing life time, if the pump is used in potentially explosive environment.

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

### Bearing lubrication schedule

Type of bearing	First lubrication	Lubrication intervals
Oil-lubricated bearings	Add oil before you install and start the pump.  Change the oil after 200-300 hours of operation, depending on bearing temperature.	See the Oil change schedule table.
Grease-lubricated bearings	N/A	Every 4000 hours of operation or once a year, whichever comes first  Every two years if the pump is left idle

### Oil change schedule

Oil must be changed at least once a year.

Bearing temperature	First oil change	Subsequent oil changes
Up to 60°C   140°F	After 300 hours of operation	Every 8760 hours of operation
60°C to 80°C   140°F to 176°F	After 300 hours of operation	Every 4000 hours of operation
80°C to 100°C   176°F to 212°F	After 200 hours of operation	Every 3000 hours of operation

#### NOTICE:

- Strictly maintain the oil changing schedule if the pump is operating in an potentially explosive environment.
- Change the oil every two years if the pump is left idle.
- Dispose of used oil in accordance with local environmental regulations.

### 6.2.1 Lubricating oil requirements

#### Oil quality requirements

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

Lubricating oil type	<ul style="list-style-type: none"> <li>• CLP46</li> <li>• DIN 51517</li> <li>• HD 20W/20 SAE</li> </ul>
Symbol	DIN 51502
Kinematic viscosity at 40°C   104°F	46 ±4 mm <sup>2</sup> /sec   0.0713 ±0.006 in. <sup>2</sup> /sec
Flash point (Cleveland)	175°C   347°F
Setting point (Pourpoint)	-15°C   5°F
Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below -10°C   14°F.	Higher than permitted bearing temperature

### Oil quantity requirements

Bearing frame size	Oil quantity in liters   quarts
24 i-FRAME	0.5   0.53
32 i-FRAME	1.1   1.16
42 i-FRAME	1.5   1.58
48 i-FRAME	2.1   2.21

## 6.2.2 Change the oil

1. Remove the oil drain plug (903.51).
2. Drain the oil.
3. Flush the pump with fresh oil.
4. Clean the oil drain plug.
5. Close the oil drain.
6. Fill the pump with new oil. See Lubricate the bearings with oil in the Commissioning, Startup, Operation, and Shutdown chapter.
7. Dispose of used oil in accordance with local environmental regulations.

## 6.2.3 Lubricating-grease requirements

### Precautions

#### NOTICE:

Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the grease type or consistency, remove the rotor and old grease from the housing before regreasing.

### Grease quality requirements

Use a high-quality grease lubricant corresponding to NLGI Grade 2.

### Grease lubrication

Consider this information when you lubricate with grease:

- Pumps are delivered from the manufacturer with lubricated bearings and are ready to be used.
- The bearings are filled with lithium-based grease, which is suitable for a temperature range from -30°C to 90°C | -22°F to 194°F when measured at the surface of the bearing frame.
- Make sure that bearing temperatures, measured at the bearing frame, are no more than 50°C | 122°F above the ambient temperature and never exceed 90°C | 194°F when checked weekly.



## 6.2.4 Regrease the grease-lubricated bearings

### NOTICE:

Risk of equipment damage. Ensure that the grease container, the greasing device, and the fittings are clean. Failure to do so can result in impurities entering the bearing housing while regreasing the bearings.

1. Wipe dirt from the grease fittings.
2. Fill the grease cavities through the fittings with a recommended grease.
3. Wipe off any excess grease.
4. Recheck the alignment.

The bearing temperature usually increases by 5°C to 10°C | 9°F to 18°F after you regrease due to an excess supply of grease. Temperatures return to normal in about two to four operating hours as the pump runs and purges the excess grease from the bearings.

## 6.3 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:



### WARNING:

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

- Lubricate the bearings.
- Inspect the seal.

### Routine inspections

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



### WARNING:

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

- 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.\*
- Inspect the discharge pressure.
- Inspect the temperature.\*
- Check the seal chamber and stuffing box for leaks.

- Ensure that there are no leaks from the mechanical seal.
- Adjust or replace the packing in the stuffing box if you notice excessive leaking.

### Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- 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.

## 6.4 Bearing maintenance

Change the bearings after 90% of the nominal bearing life time, if the pump is used in potentially explosive environment.

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

### Bearing lubrication schedule

Type of bearing	First lubrication	Lubrication intervals
Oil-lubricated bearings	Add oil before you install and start the pump.  Change the oil after 200-300 hours of operation, depending on bearing temperature.	See the Oil change schedule table.
Grease-lubricated bearings	N/A	Every 4000 hours of operation or once a year, whichever comes first  Every two years if the pump is left idle

### Oil change schedule

Oil must be changed at least once a year.

Bearing temperature	First oil change	Subsequent oil changes
Up to 60°C   140°F	After 300 hours of operation	Every 8760 hours of operation
60°C to 80°C   140°F to 176°F	After 300 hours of operation	Every 4000 hours of operation
80°C to 100°C   176°F to 212°F	After 200 hours of operation	Every 3000 hours of operation

**NOTICE:**

- Strictly maintain the oil changing schedule if the pump is operating in a potentially explosive environment.
- Change the oil every two years if the pump is left idle.
- Dispose of used oil in accordance with local environmental regulations.

## 6.4.1 Lubricating oil requirements

### Oil quality requirements

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

Lubricating oil type	<ul style="list-style-type: none"> <li>• CLP46</li> <li>• DIN 51517</li> <li>• HD 20W/20 SAE</li> </ul>
Symbol	DIN 51502
Kinematic viscosity at 40°C   104°F	46 ±4 mm <sup>2</sup> /sec   0.0713 ±0.006 in. <sup>2</sup> /sec
Flash point (Cleveland)	175°C   347°F
Setting point (Pourpoint)	-15°C   5°F
Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below -10°C   14°F.	Higher than permitted bearing temperature

### Oil quantity requirements

Bearing frame size	Oil quantity in liters   quarts
24 i-FRAME	0.5   0.53
32 i-FRAME	1.1   1.16
42 i-FRAME	1.5   1.58
48 i-FRAME	2.1   2.21

## 6.4.2 Change the oil

1. Remove the oil drain plug (903.51).
2. Drain the oil.
3. Flush the pump with fresh oil.
4. Clean the oil drain plug.
5. Close the oil drain.
6. Fill the pump with new oil. See Lubricate the bearings with oil in the Commissioning, Startup, Operation, and Shutdown chapter.
7. Dispose of used oil in accordance with local environmental regulations.

## 6.4.3 Lubricating-grease requirements

### Precautions

**NOTICE:**

Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the grease type or consistency, remove the rotor and old grease from the housing before regreasing.

### Grease quality requirements

Use a high-quality grease lubricant corresponding to NLGI Grade 2.

### Grease lubrication

Consider this information when you lubricate with grease:

- Pumps are delivered from the manufacturer with lubricated bearings and are ready to be used.
- The bearings are filled with lithium-based grease, which is suitable for a temperature range from -30°C to 90°C | -22°F to 194°F when measured at the surface of the bearing frame.
- Make sure that bearing temperatures, measured at the bearing frame, are no more than 50°C | 122°F above the ambient temperature and never exceed 90°C | 194°F when checked weekly.

## 6.4.4 Regrease the grease-lubricated bearings

### NOTICE:

Risk of equipment damage. Ensure that the grease container, the greasing device, and the fittings are clean. Failure to do so can result in impurities entering the bearing housing while regreasing the bearings.

1. Wipe dirt from the grease fittings.
2. Fill the grease cavities through the fittings with a recommended grease.
3. Wipe off any excess grease.
4. Recheck the alignment.

The bearing temperature usually increases by 5°C to 10°C | 9°F to 18°F after you regrease due to an excess supply of grease. Temperatures return to normal in about two to four operating hours as the pump runs and purges the excess grease from the bearings.

## 6.5 Shaft seal maintenance

### 6.5.1 Mechanical-seal maintenance



### WARNING:



The mechanical seal must have an appropriate seal flush system. Failure to do so will result in excess heat generation and seal failure.



### WARNING:

- Observe the requirements and operating limits in the manufacturers operating manual.



### CAUTION:

Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

### Cartridge-type mechanical seals

Cartridge-type mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require disengagement of

the holding clips prior to operation, allowing the seal to slide into place. If the seal has been installed in the pump by ITT, these clips have already been disengaged.

### Other mechanical seal types

For other types of mechanical seals, refer to the instructions provided by the seal manufacturer for installation and setting.

### Reference drawing

The manufacturer supplies a reference drawing with the data package. Keep this drawing for future use when you perform maintenance and seal adjustments. The seal drawing specifies the required flush fluid and attachment points.

### Before you start the pump

Check the seal and all flush piping.

### Mechanical seal life

The life of a mechanical seal depends on the cleanliness of the pumped fluid. Due to the diversity of operating conditions, it is not possible to give definite indications as to the life of a mechanical seal.

## 6.5.2 Packed stuffing-box maintenance




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### WARNING:

Packed stuffing boxes are not allowed in an Ex-classified environment.

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### WARNING:

Failure to disconnect and lock out driver power may result in serious physical injury. Never attempt to replace the packing until the driver is properly locked out.

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### Accepted leakage rate

It is not necessary to shut down or disassemble the pump to inspect the packing operation. During normal operation the packing should leak approximately 30-100 drops per minute.

### Adjustment of gland

Adjust the gland if the leakage rate is greater than or less than the specified rate.

Evenly adjust each of the two gland bolts with a one-quarter (1/4) turn until the desired leakage rate is obtained. Tighten the bolts to decrease the rate. Loosen the bolts to increase the rate.

### Tightening of packing

---

### NOTICE:

Never over-tighten packing to the point where less than one drop per second is observed. Over-tightening can cause excessive wear and power consumption during operation.

---

If you cannot tighten the packing to obtain less than the specified leakage rate, then replace the packing.

## 6.6 Disassembly

### 6.6.1 Disassembly 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.
  - 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.
  - Handling heavy equipment poses a crush hazard. Use caution during handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.
  - 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.
  - 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.
  - 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.
- 

**CAUTION:**

- Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.
- 

### 6.6.2 Tools required

In order to disassemble the pump, you need these tools:

- Bearing puller
- Brass drift punch
- Cleaning agents and solvents
- Dial indicators
- Drill
- Feeler gauges
- Hex wrenches
- Hydraulic press
- Induction heater
- Leveling blocks and shims
- Lifting sling
- Micrometer
- Rubber mallet

- Screwdriver
- Snap-ring pliers
- Wrenches
- Lifting eyebolt (dependent on pump / motor size)

### 6.6.3 Drain the pump



#### CAUTION:

- Risk of physical injury. Allow all system and pump components to cool before handling.
- If the pumped fluid is non-conductive, drain and flush the pump with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.

1. Leave the suction pipe drain valve open to drain the pump casing as much as possible.
2. Leave the drain valve open and remove the drain plug located on the bottom of the pump housing.  
Do not reinstall the plug or close the drain valve until the reassembly is complete.
3. Remove the coupling guard.

### 6.6.4 Remove the coupling

Remove the coupling in accordance with the recommendations of the coupling manufacturer.

### 6.6.5 Remove the back pull-out assembly



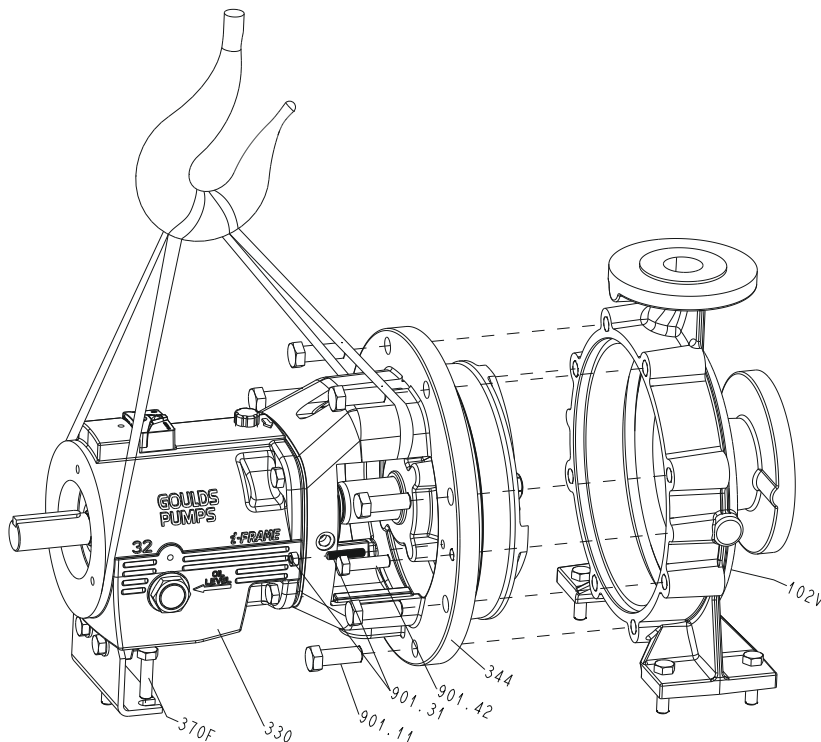
#### WARNING:

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.

1. Is your bearing frame oil lubricated?
  - If No: Proceed to step 2.
  - If Yes:
    1. Remove the bearing-frame drain plug (903.51) in order to drain oil from the bearing frame.
    2. Replace the plug after the oil is drained.

Oil analysis should be part of a preventive maintenance program that determines the cause of a failure. Save the oil in a clean container for inspection.

2. The back pull out assembly consists of all parts except the casing (100). Drain the casing, by removing the casing drain plug (if equipped).
3. Place one sling from the hoist through the frame adapter (344) and a second sling from the hoist to the bearing frame (330).



**Figure 33: Back pullout removal**

4. Remove the hold-down bolts of the bearing frame foot.
5. Remove the casing bolts.



**WARNING:**

- Risk of severe physical injury or death from explosion of trapped liquid. Never use heat to remove parts unless explicitly stated in this manual.

6. Tighten the jackscrews evenly, using an alternating pattern, in order to remove the back pull-out assembly.  
You can use penetrating oil if the adapter to the casing joint is corroded.
7. Remove the back pull-out assembly from the casing (102V).
8. Mark and remove the shims from under the frame foot and save them for reassembly.
9. Remove and discard the casing gasket.  
You will insert a new casing gasket during reassembly.
10. Remove the jackscrews.
11. Clean all gasket surfaces.  
Clean surfaces prevent the casing gasket from partially adhering to the casing due to binders and adhesives in the gasket material.

### 6.6.6 Remove the coupling hub

1. Clamp the frame adapter securely to the workbench.
2. Remove the coupling hub.  
Mark the shaft for relocation of the coupling hub during reassembly.



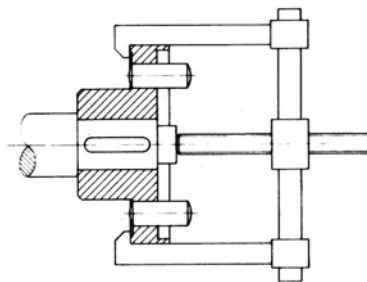


Figure 34: Coupling hub removal

### 6.6.7 Remove the impeller



#### WARNING:

- Risk of severe physical injury or death from explosion of trapped liquid. Never use heat to remove parts unless explicitly stated in this manual.
- Risk of serious physical injury or equipment damage. Pump and components are heavy. Ensure all equipment is properly supported while working. Wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.



#### CAUTION:

Risk of physical injury from sharp edges. Wear heavy work gloves when handling impellers.

1. the axial clearance (a) between the impeller and the casing cover .

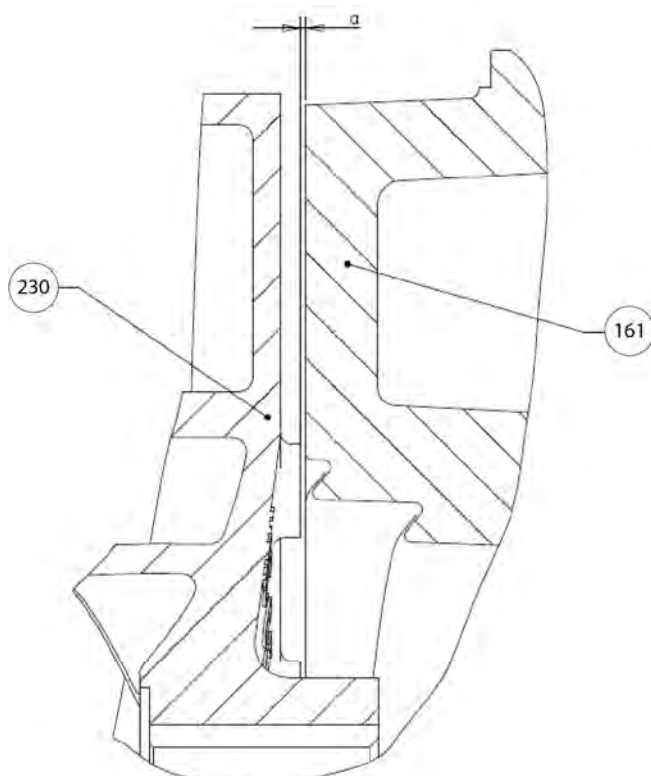
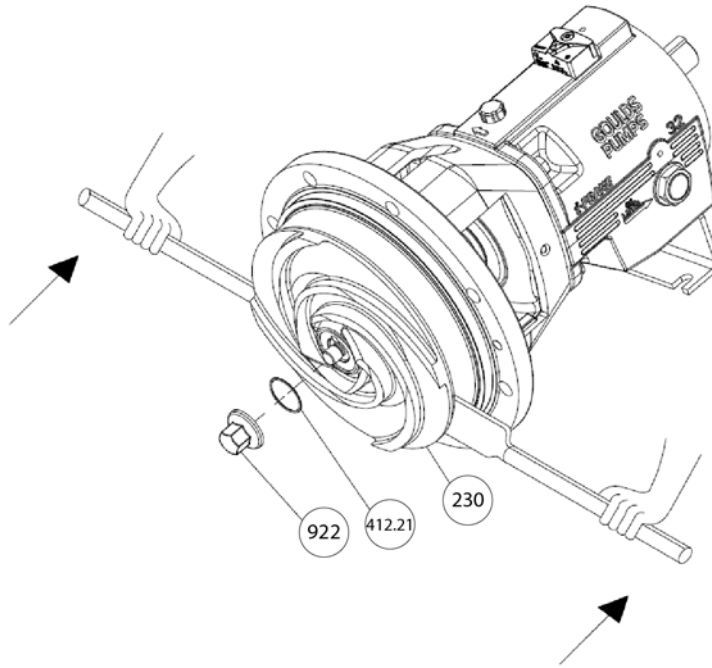


Figure 35: Back clearance check

2. Secure the rotor at the end and loosen the impeller nut (right-threaded).
3. Remove the impeller with two screwdrivers or pry bars.

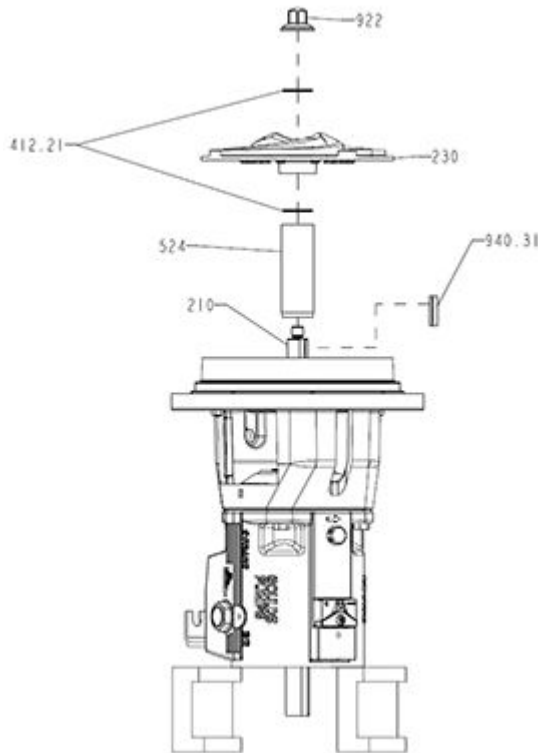


**Figure 36: Impeller removal method**

**NOTICE:**

- Remove shaft guard using a prying tool.
- Be sure to align the pry bars with the impeller vanes in order to prevent damage to the impeller.

4. Remove the impeller key .
5. Place the back pull-out assembly in a vertical position before you proceed with the disassembly.



**Figure 37: Rotor components**

### 6.6.8 Remove the seal-chamber cover

1. Remove the gland stud nuts.
2. Remove the seal-chamber stud nuts.
3. Remove the seal chamber (161).
4. Remove the shaft sleeve (524).  
The mechanical seal is attached to the sleeve.

---

#### NOTICE:

Be careful with the mechanical seal. Carbon or ceramic components are brittle and easily broken.

---

5. Remove shims from shaft (check sleeve to ensure no shims were retained after removal).
6. Remove the rotary portion of the seal from the sleeve by loosening the setscrews and sliding it off the sleeve.  
Refer to the mechanical-seal instructions for more information.
7. Remove the gland (452), the stationary portion of the seal, and the O-ring (412.21).

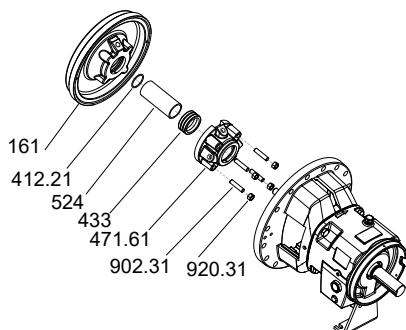


Figure 38: Gland removal

### 6.6.9 Remove the stuffing-box cover

1. Remove the gland nuts and the gland (452).
2. Remove the stuffing-box-cover nuts.
3. Remove the stuffing-box cover (161).
4. Remove the shaft sleeve (524).
5. Remove shims from shaft (check sleeve to ensure no shims were retained after removal).
6. Remove the packing (461) and lantern ring (458) from the stuffing-box cover (161).

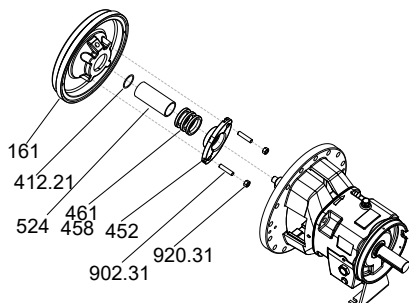
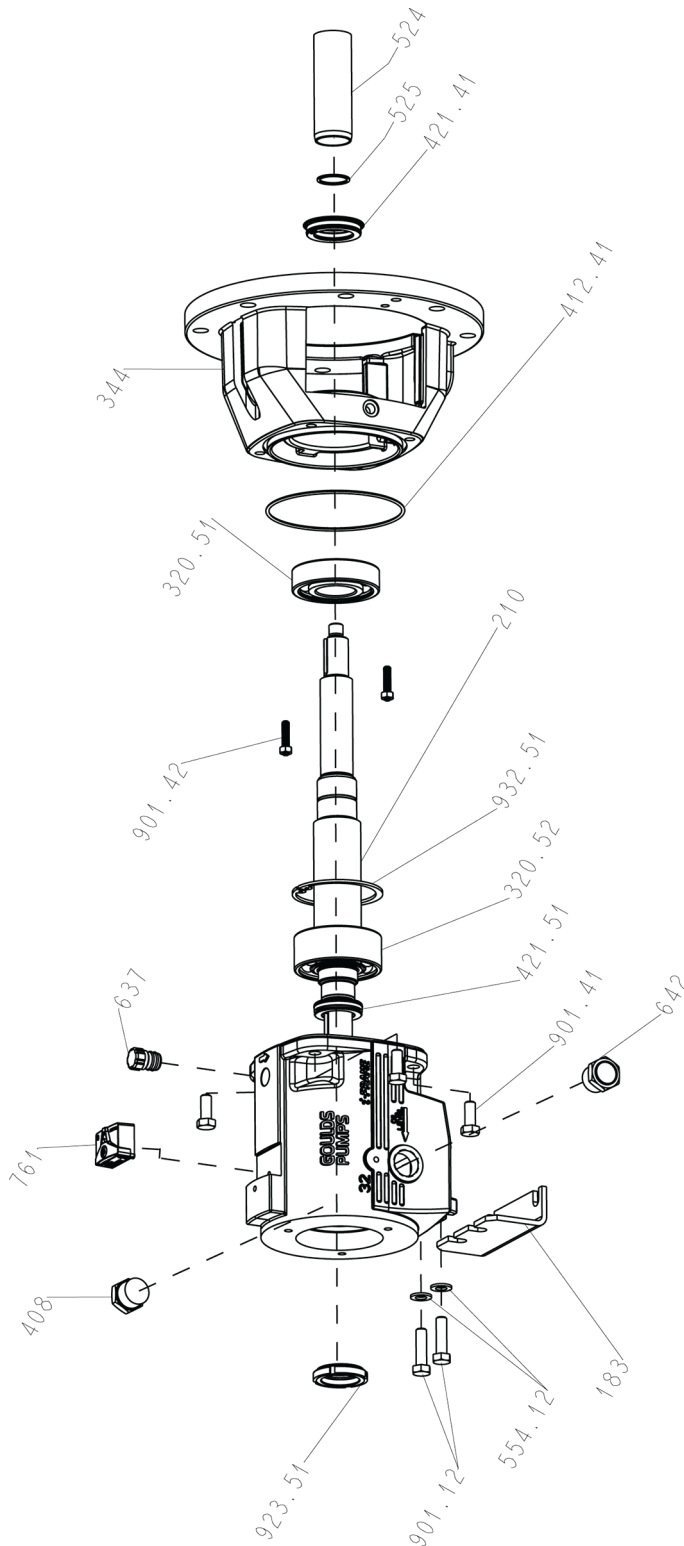


Figure 39: Packing and lantern ring removal

### 6.6.10 Disassemble the power end

1. Loosen and remove the hexagon bolts (901.41) that hold the frame adapter to the bearing frame.
2. Remove the frame adapter (344) from the bearing frame (330).

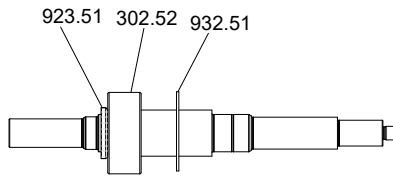


**Figure 40: Bearing frame cross-section**

3. Reach inside the frame and remove the snap ring (932.51) using the designated snap ring pliers. Use snap ring pliers according to DIN 5256-C. Refer to this table for the correct size:

Bearing frame size	Pliers size	Minimum length of pliers
24 i-FRAME	94/C 40	200 mm   8 in.
32, 42 i-FRAME	94/C 85	250 mm   10 in.
48 i-FRAME	94/C 85	300 mm   12 in.

- Remove the shaft (210), with the radial and thrust bearings (320.51 and 320.52) and the bearing nut (923.51) attached, from the bearing frame (330).



- Remove the bearing nut (923.51).  
The bearing nut is right-hand threaded and is self-locking. It can be reused up to five times, if handled properly.
- Use a hydraulic press or bearing puller in order to remove the radial and thrust bearings (320.51 and 320.52) from the shaft.

### 6.6.11 Guidelines for i-ALERT<sup>®</sup> Equipment Health Monitor disposal

#### Precautions



#### WARNING:

- Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

#### Guidelines

The battery contained in the condition monitor does not contain enough lithium to qualify as reactive hazardous waste. Use these guidelines when disposing of the condition monitor.

- The condition monitor is safe for disposal in the normal municipal waste stream.
- Adhere to local laws when you dispose of the condition monitor.

## 6.7 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 re-assemble 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.

## 6.7.1 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.

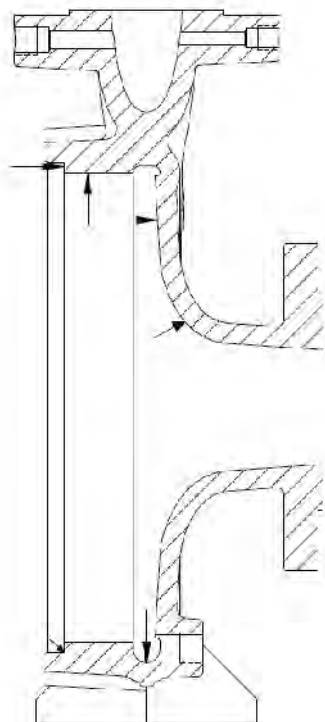
Repair or replace the casing if you notice any of these conditions:

- 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:

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



**Figure 41: Areas to inspect on the casing**

### Impeller replacement

This table shows the criteria for replacing the impeller:

Impeller parts	When to replace
Impeller vanes	<ul style="list-style-type: none"> <li>• When grooved deeper than 1.6 mm   1/16 in., or</li> <li>• When worn evenly more than 0.8 mm   1/32 in.</li> </ul>
Pumpout vanes	When worn or bent more than 0.8 mm   1/32 in.

Impeller parts	When to replace
Vane edges	When you see cracks, pitting, or corrosion damage

### Frame adapter check and replacement

- Replace the frame adapter if it has cracks or excessive corrosion damage.
- Make sure the O-ring surface is clean.

### Oil seal replacement

Replace the oil seal if it has cuts or cracks.

### 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.

- Replace all gaskets and O-rings at each overhaul and disassembly.
- Inspect the seats. They must be smooth and free of physical defects. In order to repair worn seats, skin cut them in a lathe while you maintain dimensional relationships with other surfaces.
- Replace parts if the seats are defective.



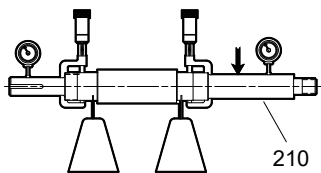
#### **WARNING:**

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.

## 6.7.2 Shaft replacement guidelines

### Straightness check

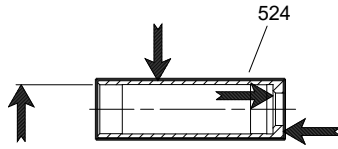


**Figure 42: Straightness check**

Replace the shaft (210) if runout exceeds the values in this table:

**Table 4: Shaft runout tolerances for sleeve fit and coupling fit**

Sleeve fit in millimeters   inches
0.051   0.002

**Shaft and sleeve check****Figure 43: Shaft and sleeve check**

- Check the shaft and sleeve (524) surface for grooves and pitting.
- Replace the shaft and sleeve if any grooves or pits are found.

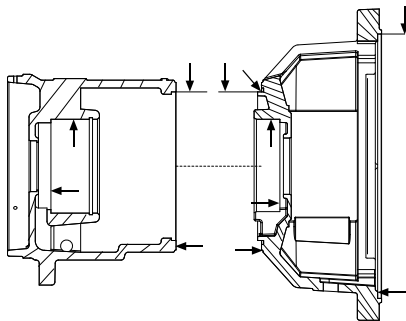
**6.7.3 Bearing-frame inspection****Checklist**

Check the bearing frame for these conditions:

- Visually inspect the bearing frame 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.
- If the frame has been exposed to pumped fluid, inspect the frame for corrosion or pitting.

**Surface inspection locations**

This figure shows the areas to inspect for wear on the bearing frame inside and outside surface.

**Figure 44: Inside and outside inspection locations****6.7.4 Seal chamber and stuffing box cover inspection****Checklist**

Perform these checks when you inspect the seal chamber and stuffing box cover:

- Make sure that these surfaces are clean:
  - Seal chamber and stuffing box cover
  - Mounting
- Make sure there is no pitting or wear greater than 3.2 mm | 1/8 in. deep.  
Replace the seal chamber and stuffing box cover if pitting or wear exceeds this measurement.
- Inspect the machined surfaces and mating faces noted in the figures.

These images point to the areas to inspect:



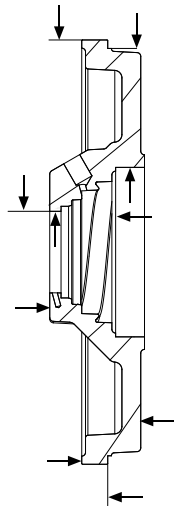


Figure 45: Seal chamber

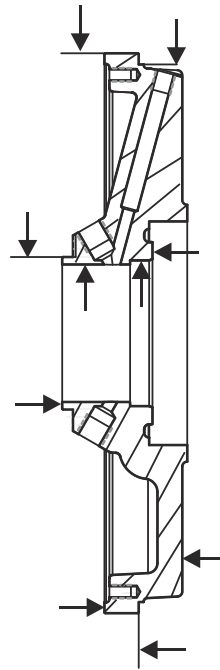


Figure 46: Stuffing box cover

## 6.7.5 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 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.
- 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.

## 6.8 Reassembly

### 6.8.1 Assemble the rotating element and bearing frame



#### **WARNING:**

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.



#### **CAUTION:**

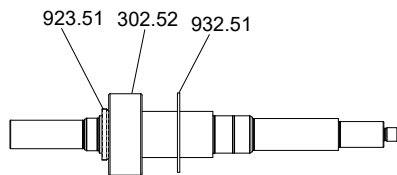
Risk of physical injury from hot bearings. Wear insulated gloves when using a bearing heater.

**NOTICE:**

- Ensure that the pipe threads are clean. Apply thread sealant to the plugs and fittings. Failure to do so may result in oil leaks and equipment damage.
- 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. Bearings can get hot and can cause physical injury.

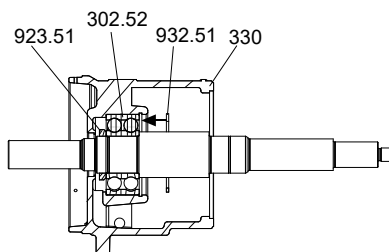
## 1. Install the bearings:

- Heat the bearings to 100°C | 212°F in an oil bath or with a bearing heater.
- Clamp the shaft (210) in a bench vise with the thrust bearing surface extending beyond the end of the vise. Use soft jaws to protect the shaft surface.
- Install the properly-heated thrust bearing (302.52) onto the shaft. If necessary, position a tube against the inner ring of the bearing and gently tap the tube with a hammer in order to force the bearing onto the shaft. Hold the outer ring of the bearing in order to prevent vibration damage to the bearing.
- Apply Thread-EZE to the bearing locknut threads on the shaft.
- Thread the bearing locknut (923.51) onto the thrust end of the shaft. The bearing nut is right-hand threaded and is self-locking. It can be reused up to five times, if handled properly.
- Allow the bearing to cool for 10 minutes and retighten.

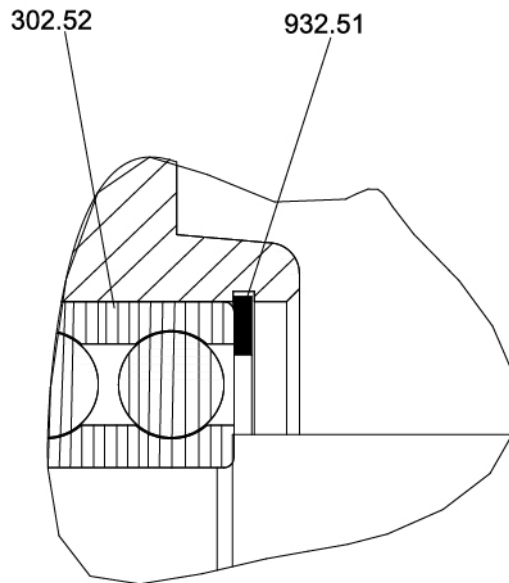
**Figure 47: Shaft assembly**

## 2. Install the shaft assembly into the bearing frame:

- Coat the outside of the bearings with oil.
- Coat all the internal surfaces of the bearing frame (330) with oil.
- Turn the bearing frame (330) vertically with the larger open end pointing up.
- Install the shaft assembly into the bearing frame (330). Make sure that the shaft rotates freely.

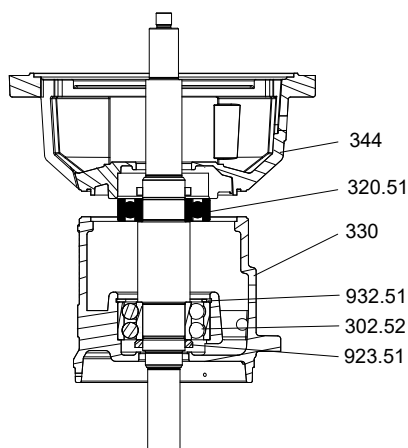
**Figure 48: Shaft / bearing frame assembly**

- Slide the snap ring (932.51) onto the shaft. Use the designated snap ring pliers to compress the snap ring and place it into the locking groove in the bearing frame (330). Make sure that the snap ring is properly seated in the groove by pressing on the snap ring with a flat head screwdriver.



**Figure 49: Snap ring detail**

- f) As a recommendation, thread a stud into one of the four threaded bolt holes in the frame adapter (344), and finger tighten only. The stud must be between 40 and 50 mm in length. This helps you to align the adapter bolt holes to the frame bolt holes during assembly.
- g) Slide the properly heated radial bearing (320.51) onto the shaft. The bearing slides easily into place against the shoulder on the shaft.
- h) Place the frame adapter (344) over the radial bearing. Allow the radial bearing to cool for at least 10 minutes.
- i) When bearing is cool, gently tap the frame adapter until the radial bearing is properly seated in the frame adapter. Make sure that the bolt holes are aligned.



- j) Remove the stud that was used to align frame adapter and frame. Bolt the bearing frame (330) to the frame adapter (344) with the hexagon head bolts (901.41). Make sure to position the bolts in the center of the drilled holes in order to ensure the proper oil settings. Tighten according to the Bolt torque values table.
- k) Press the inboard (421.41) labyrinth oil seal into the Lantern (344) and the outboard (421.51) labyrinth oil seal into the Bearing Frame (330). Ensure that the oil return slot in both seals is positioned in the bottom (6 o'clock) position when the pump is horizontal. Refer to Assemble the INPRO labyrinth oil seal installation.

## 6.8.2 Install the impeller and casing



### WARNING:

Crush hazard. Make sure that the back pull-out assembly cannot tip over.



### CAUTION:

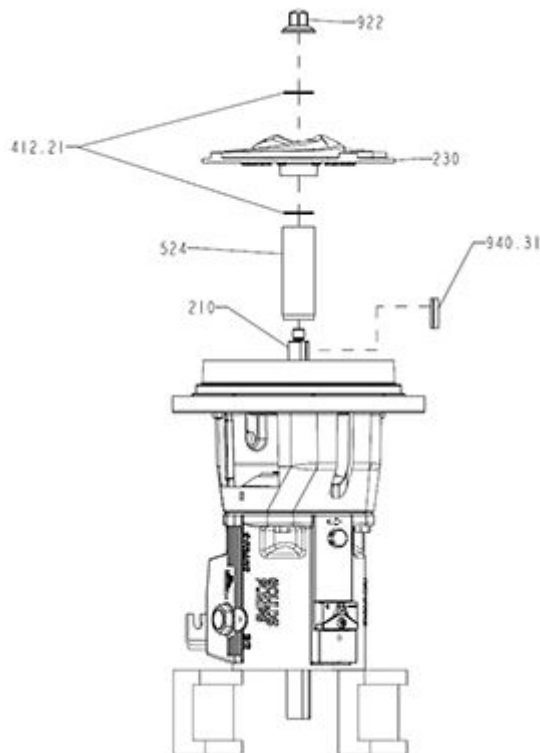
Risk of physical injury from sharp edges. Wear heavy work gloves when handling impellers.

For the fitting threads and for tight tolerances, use a suitable anti-seize compound. Use this, for example, between the shaft sleeve and the shaft or between the impeller and the shaft. This makes the assembly and the next disassembly easier to perform.

### NOTICE:

Anti-seize compounds must be compatible with the pumped fluid.

1. Install O-ring (412.21) on shaft Sleeve (524).
2. Install impeller key (940.31).
3. Install O-ring (412.21) on impeller nut (922).
4. Install Impeller (230) on shaft (210) and tighten impeller nut (922) to IOM specified value.



**Figure 50: Impeller installation**

5. Locate and install casing gasket (400) on casing gasket feature. Use vacuum grease or other inert assembly paste to locate gasket in sealing feature. Any compound used must be compatible with pumped fluid.
6. Lower casing (102V) onto back pull-out assembly and tighten casing bolts (901.11) to IOM specified torque values.

### NOTICE:

- During Casing (102V) installation rotate shaft (210) consistently while tightening casing bolts (901.11) to ensure no binding occurs.

- Use casing bolts (901.11) to maintain a consistent gap between casing (102V) and casing cover (161) during assembly.
7. Where possible, verify front clearance between casing (102V) and impeller (230) through the discharge nozzle.

**Table 5: Acceptable front clearances**

Size	mm
160	0.38 -0.12/+0.00
200	0.38 -0.12/+0.00
250	0.38 -0.00/+ .12
315	0.38 -0.00/+ .12
400	0.38 -0.00/+ .12

8. If using a cartridge seal, tighten set screws in seal locking ring to secure seal to shaft and remove centering clips, verify and follow all seal manufacturer instructions prior to startup.

### 6.8.3 Shaft sealing

**WARNING:**

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

**CAUTION:**

Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

Before proceeding with seal installation, complete the [6.8.6.5 ICO assembly worksheet on page 93](#) on shim measurement method and installation. Follow [6.8.3.3 Seal the shaft with a cartridge mechanical seal on page 88](#).

**NOTICE:**

The mechanical seal must have an appropriate seal-flush system. Failure to do so will result in excess heat generation and seal failure.

#### 6.8.3.1 Shim measurement method and installation

1. Assemble the rotating element and bearing frame per [6.8.1 Assemble the rotating element and bearing frame on page 79](#) IOM instructions.
2. Orient the assembly vertically on appropriately sized blocks -- See [Figure 51: Assembly arrangement on page 84](#).

**WARNING:**

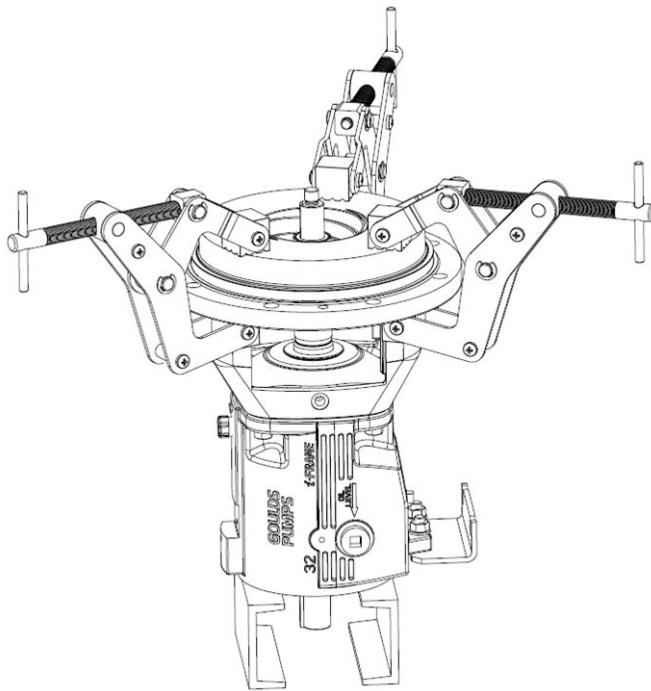
Crush hazard. Make sure that the back pull-out assembly cannot tip over.

3. Frame adapter (344) and flinger (507) should already be installed at this stage of reassembly.
4. If casing cover (161) to frame adapter (344) retention studs (920.32) are supplied, install and tighten in cover (161).

**NOTICE:**

For the fitting threads and for tight tolerances, use a suitable anti-seize compound. Use this, for example, between the shaft sleeve and the shaft or between the impeller and the shaft. This makes the assembly and the next disassembly easier to perform. Anti-seize compounds must be compatible with the pumped fluid.

5. Install casing cover (161) on frame adapter (344) - ensure proper orientation with flush tap accessible through top of frame adapter (344).
6. Using a dead blow hammer fully seat casing cover (161) into frame adapter (344).
7. Install cover retention nuts (920.32) and tighten per [6.8.6.2 Bolt torque values on page 92](#).



**Figure 51: Assembly arrangement**

8. If casing cover (161) to frame adapter (344) retention studs (920.32) are not supplied, install clamps as shown in [Figure 51: Assembly arrangement on page 84](#) after seating casing cover (161) in frame adapter (344) with dead blow or lead hammer.
9. Install shaft sleeve (524).  
Do not install shaft sleeve O-ring (412.21) at this time.
10. Adjacent to the current assembly, orient the casing (102V), suction flange down, on a stable work surface.

**NOTICE:**

Avoid damaging the suction flange gasket face - Use a protective material such as cardboard or a soft metal like aluminum.

11. Locate the impeller (230) and place it in the casing (102V) with suction eye down.
12. Ensure the impeller (230) is centered in the casing (102V) by spinning and/or shifting the impeller (230) until full contact between vanes and casing (102V) has been achieved.

**NOTICE:**

There should be no rocking or tipping of the impeller once centered - This is imperative for accurate shim (525) measurements.

13. With components assembled and oriented as defined, take measurements to determine axial shim (525) thickness required for correct front clearance.
14. Determine gasket type and fluid temperature - record in the provided fields.

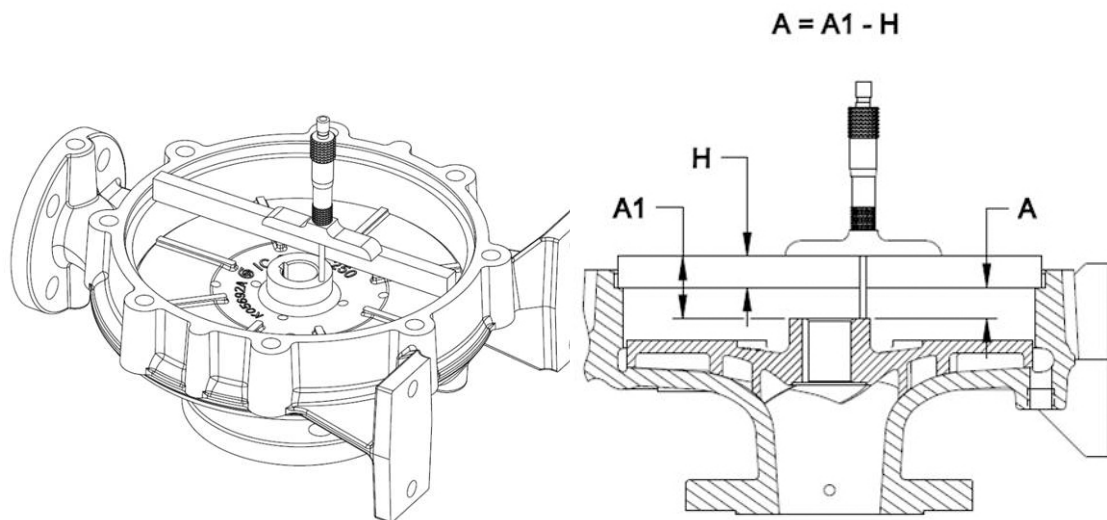
**NOTICE:**

If using ITT/Goulds K14153A gauge bar kit, see [Figure 52: Goulds gauge bar method on page 85](#), If using a generic bar see [Figure 53: Generic gauge bar method on page 85](#).

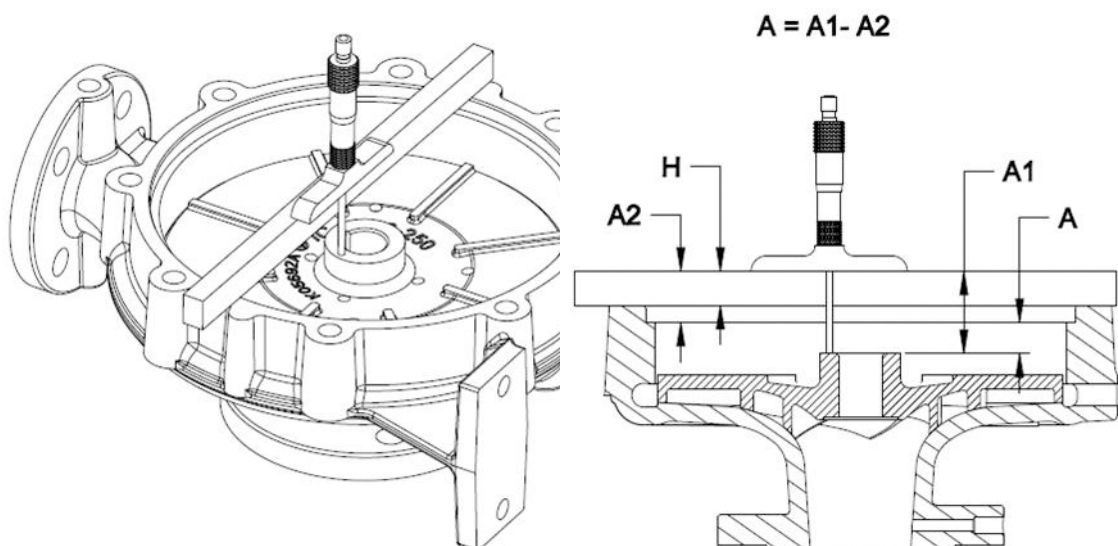
15. Select an appropriate length gauge bar to match pump features, measure height and record as dimension "H".
16. If using ITT/GOULDS gauge bar K14153A kit proceed to Step 20.

**NOTICE:**

K14153A is a set of gauge bars designed to fit within the gasket sealing feature of ICO casings but is not a required tool.



**Figure 52: Goulds gauge bar method**



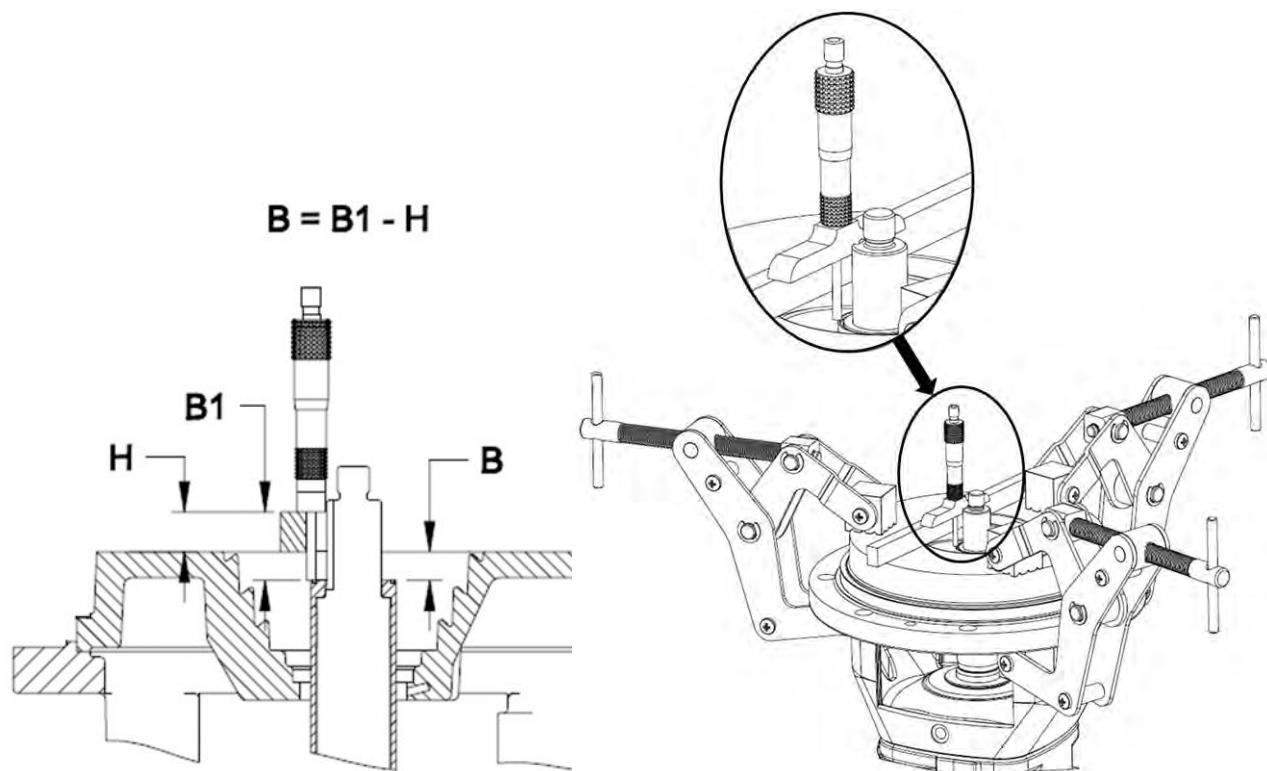
**Figure 53: Generic gauge bar method**

17. Measure from top of bar to impeller (230) back hub face as shown in [Figure 52: Goulds gauge bar method on page 85](#) and record in A1 field.
18. Measure from top of bar to casing (102V) gasket surface as shown in [Figure 52: Goulds gauge bar method on page 85](#) and recorded in A2 field.

**NOTICE:**

Casing Gasket (400) must not be installed and feature must be clean and free of foreign materials.

19. Subtract A2 from A1 and record in the A field ( $A = A1 - A2$ ) -- Refer to [Figure 53: Generic gauge bar method on page 85](#).
20. Continue to Step 22 for casing cover (161) to sleeve (524) measurement -- Refer to [Figure 53: Generic gauge bar method on page 85](#).
21. Measure from top of appropriate K14153A bar to impeller (230) back hub face as shown in [Figure 51: Assembly arrangement on page 84](#) and record value in A1 field.
22. Subtract H from A1 to and record in A field ( $A = A1 - H$ ) -- Refer to [Figure 52: Goulds gauge bar method on page 85](#).



**Figure 54: Casing cover to sleeve measurement**

23. Place bar (Goulds or Generic) across casing cover (161) as shown in [Figure 54: Casing cover to sleeve measurement on page 86](#), measure top of bar to sleeve (524) shoulder, and record in B1 field.
24. Subtract H from B1 and record in field B ( $B = B1 - H$ ) -- Refer to [Figure 54: Casing cover to sleeve measurement on page 86](#).
25. Refer to [Table 6: "C" Value table on page 95](#) and match pump size with fluid temperature - Record this value in "C" field.
26. Refer to gasket [Table 7: "D" Value Table on page 96](#) and record value in "D" field.

**NOTICE:**

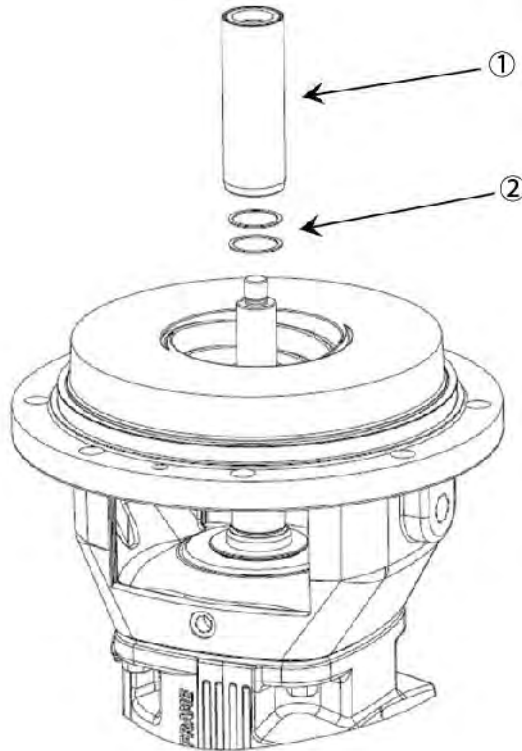
Most common gasket type is AFM-34.

27. Determine shim (525) height by using the following formula:  $SHIM\ HEIGHT = A + B - C + D$ .
28. With shim thickness determined, combine shims as needed to approximate this value.
29. Using the shim kit provided in the assembly components, determine a combination of shims that matches the calculated shim height  
Shim pack consists of one of each of the following thicknesses:



(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
0.025	0.001	0.15	0.006	0.5	0.020	1.5	0.059
0.05	0.002	0.2	0.008	1	0.039	2	0.079
0.1	0.004	0.3	0.012	1.2	0.047		

30. Once shim(s) combination is determined, install shim(s) (525) and sleeve (222) on the shaft (210), refer to [Figure 54: Casing cover to sleeve measurement on page 86](#).



1. Sleeve
2. Shims (as required)

**Figure 55: Shim and sleeve assembly**

### 6.8.3.2 Seal the shaft with a packed stuffing box



**WARNING:**

- Packed stuffing boxes are not allowed in an Ex-classified environment.

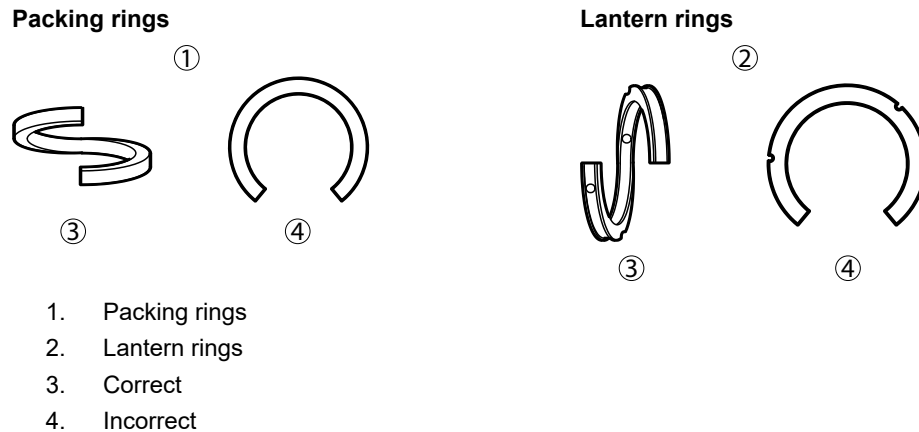


**WARNING:**

Failure to disconnect and lock out driver power may result in serious physical injury. Never attempt to replace the packing until the driver is properly locked out.

Pumps are shipped without the packing, lantern ring, or split gland installed. These parts are included with the box of fittings shipped with each pump and must be installed before startup.

1. Carefully clean the stuffing-box bore.
2. Twist the packing enough to get it around the shaft.



**Figure 56: Packing rings and lantern rings**

3. Insert the packing and stagger the joints in each ring by 90°. Install the stuffing-box parts in this order:
  - a) One packing ring
  - b) One lantern ring (two-piece)
  - c) Three packing rings

**NOTICE:**

Make sure that the lantern ring is located at the flushing connection to ensure that flush is obtained. Failure to do so may result in decreased performance.

4. Install the gland halves and evenly hand-tighten the nuts .

### 6.8.3.3 Seal the shaft with a cartridge mechanical seal



**WARNING:**



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.



**CAUTION:**

Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

1. Before proceeding with seal installation, complete Steps 1-30 in [6.8.3.1 Shim measurement method and installation on page 83](#).

**NOTICE:**

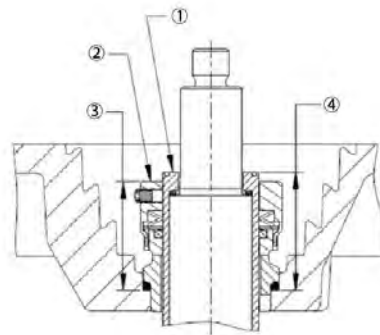
Reference Cartridge seal installation instructions.

2. Remove casing cover (161) from frame adapter (344).
3. Slide the cartridge seal onto the shaft or sleeve until it contacts the inboard labyrinth oil seal.

4. Install casing cover (161) on frame adapter (344) - ensure proper orientation with flush tap accessible through top of frame adapter (344).
5. Slide the cartridge seal into the seal chamber and secure using the four studs and nuts.
6. Complete Pump Assembly before tightening seal rotating section set screws and removing centering clips.

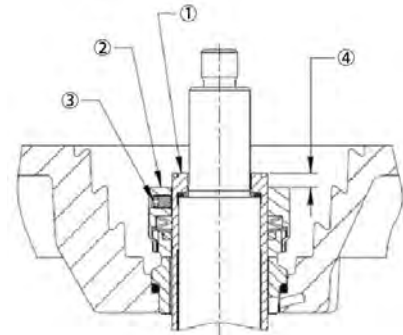
### 6.8.3.4 Seal the shaft with a conventional inside-component mechanical seal

1. Before proceeding with seal installation, complete Steps 1-29 on [6.8.3.1 Shim measurement method and installation on page 83](#).
2. Measure distance from the shaft sleeve face (524) to rotating component seat in casing cover (161) and record this value as "L1" - see [Figure 57: Initial seal measurement on page 89](#).



1. Sleeve face
2. Seal rotating component
3. Seal instructions "L<sub>1K</sub>"
4. Initial measurement "L1"

**Figure 57: Initial seal measurement**



1. Sleeve face
2. Seal rotating component
3. Set screw
4. Seal offset =  $L_1 - L_{1K}$

**Figure 58: Setting seal at determined value**

3. Consult seal instructions for component  $L_{1K}$  dimensions and subtract  $L_{1K}$  from  $L_1$  ( $L_1 - L_{1K}$  = Seal Offset) - See [Figure 57: Initial seal measurement on page 89](#).
4. Install Stationary seal component in casing cover (161) using appropriate O-ring lubricant.
5. Remove the shaft sleeve (524) and rotating component assembly from the shaft - Leave shims (525) on the shaft.

#### NOTICE:

Check sleeve to ensure no shims were retained after removal.

6. Slide rotating seal component on shaft sleeve (524) using appropriate O-ring lubricant.
7. Move the rotating component down the shaft sleeve to the determined seal offset ( $L_1 - L_{1K}$  = Seal Offset).
8. Tighten set screws per the seal manufacturers guidelines.
9. Replace shaft sleeve / seal assembly on shaft.

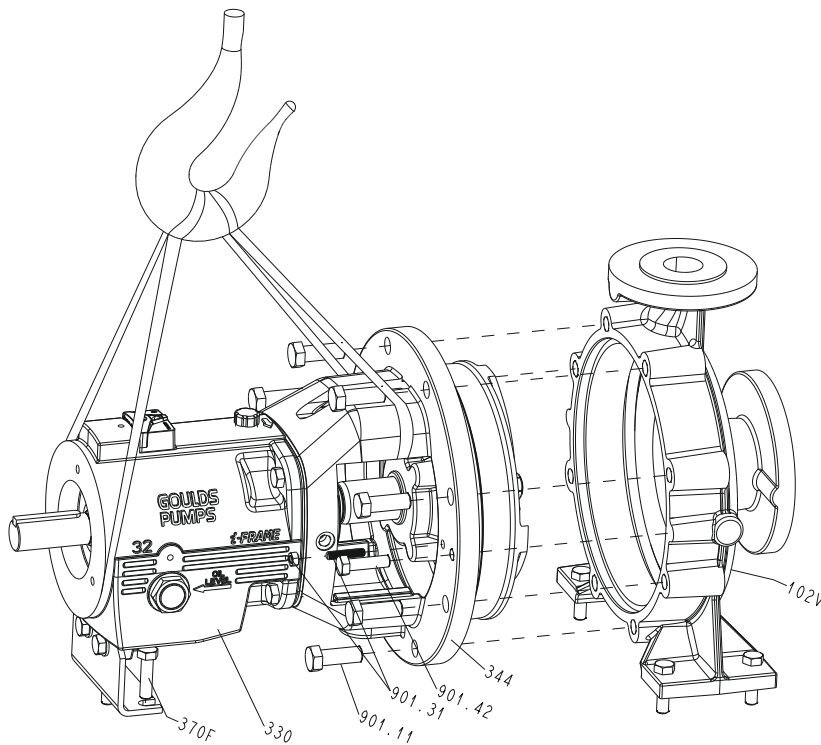
### 6.8.4 Install the back pull-out assembly



#### WARNING:

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.

1. Clean the casing fit and install the casing gasket (400) on the seal chamber and stuffing-box cover.
2. Install the back pull-out assembly in the casing.



**Figure 59: Install back pull-out assembly**

3. Install and then hand-tighten the casing bolts (901.11). Refer to the bolt torque values for information on how to tighten the casing bolts.
4. Install and tighten the casing jackscrews.

---

**NOTICE:**

Do not overtighten the casing jackscrews. Doing so may result in equipment damage.

---

5. Turn the shaft by hand in order to make sure that it moves freely. The shaft seal can cause a slight resistance, but there must not be any metal-to-metal contact.
6. Reinstall the shims under the frame foot and tighten the frame foot to the baseplate. Make sure that you use the proper shim. Mount a dial indicator in order to measure the distance between the top of the frame and the baseplate. Make sure that the distance does not change as you tighten the frame-foot bolts.
7. Replace the auxiliary piping.
8. Fill the pump with the proper lubricant. See Lubricating-oil requirements.
9. Reinstall the coupling guard. See Install the coupling guard for more information.

---

**NOTICE:**

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.

---

### 6.8.5 Post-assembly checks

Perform these checks after you assemble the pump, then continue with pump startup:

- Rotate the shaft by hand in order to make sure that it rotates easily and smoothly and that there is no rubbing.
- Open the isolation valves and check the pump for leaks.

## 6.8.6 Assembly references

### 6.8.6.1 Sound pressure levels

#### Sound pressure levels $L_{pA}$ in dB(A)

Sound pressure level  $L_{pA}$  measured in 1 m distance from pump surface acc. to DIN 45635, part 1 and 24. Room and foundation influences are not considered. The tolerance for these values is  $\pm 3$  dB(A).

Addition with 60 Hz-operation:

Pump alone: -

Pump with motor: +4 dB(A)

Pump Size	Sound Pressure Level (dBa)			
	Speed (rpm)			
	3600	2900	1750	1450
40-25-160	63	59.2	50.3	47
40-25-200	64.9	61.1	52.2	48.9
40-25-250	69	65.2	56.3	53
50-32-160	64.2	60.4	51.5	48.2
50-32-200	66.4	62.6	53.7	50.4
50-32-250	71	67.2	58.3	55
50-32-315	74.5	70.7	61.8	58.5
65-40-160	65.6	61.8	52.9	49.6
65-40-200	68.2	64.4	55.5	52.3
65-40-250	71.3	67.5	58.6	55.3
65-40-315	76	72.2	63.3	60
80-50-160	68.3	64.5	55.6	52.3
80-50-200	70.8	67	58.1	54.8
80-50-250	74.5	70.7	61.8	58.5
80-50-315	77.3	73.5	64.6	61.3
100-65-160	70.2	66.4	57.5	54.1
100-65-200	73.2	69.4	60.5	57.2
100-65-250	77	73.2	64.3	61
100-65-315	80.1	76.3	67.4	64.1
125-80-160	72.8	69	60.1	56.8
125-80-200	75.2	71.4	62.5	59.2
125-80-250	78.3	74.5	65.6	62.3
125-80-315	82	78.2	69.3	66
125-80-400	NA	NA	72.3	69
125-100-200	77.4	73.6	64.7	61.4
125-100-250	80.4	76.6	67.7	64.4
125-100-315	83.5	79.7	70.8	67.5
125-100-400	NA	NA	74.2	70.9
150-125-250	NA	NA	70.4	67.1
150-125-315	NA	NA	73.1	69.8
150-125-400	NA	NA	75.8	72.5
200-150-250	NA	NA	72.6	69.3
200-150-315	NA	NA	76.3	73

Pump Size	Sound Pressure Level (dBa)			
	Speed (rpm)			
	3600	2900	1750	1450
200-150-400	NA	NA	79	75.7

### 6.8.6.2 Bolt torque values

#### Screw torque values

This table provides the recommended screw torque values.

Location	Bolt size	Torque for lubricated threads in Nm   lb-ft	Torque for dry threads in Nm   lb-ft
Casing screws	M12	35   26	50   37
	M16	105   77	150   111
	M20	210   155	305   225
All other screws	M10	40   30	50   37
	M12	60   44	90   66
	M16	150   111	220   162

#### Nut torque values

This table provides the recommended nut torque values.

Location	Frame size	Torque for lubricated threads in Nm   lb-ft	Torque for dry threads in Nm   lb-ft
Impeller nut	24	35   26	45   33
	32	105   77	130   96
	42	210   155	260   192
	48	380   280	475   350

### 6.8.6.3 Bearing types

Use this table in order to determine the correct bearings for the pump. You can find the size of the bearing frame in the data sheet or the order confirmation.

Bearing frame size	Radial bearing	Thrust bearing
24 i-FRAME	6307 - C3	3307A - C3
32 i-FRAME	6309 - C3	3309A - C3
42 i-FRAME	6311 - C3	3311A - C3
48 i-FRAME	6313 - C3	3313A - C3

### 6.8.6.4 Spare parts

#### Spare pumps kept for stand-by usage

When you stock spare, stand-by pumps, consider these guidelines:

- In plants where failure of a pump could endanger human life or cause damage to property or high costs, you must keep a sufficient number of stand-by pumps in stock.
- Store stand-by pumps according to the instructions in Transportation and Storage.

#### Number of spare parts to keep in stock

Component	Number of Pumps (includes stand-by pumps)						
	2	3	4	5	6/7	8/9	10+
	Number of Spare Parts						
Impeller	1	1	1	2	2	2	20% (see calculation note)

Component	Number of Pumps (includes stand-by pumps)						
	2	3	4	5	6/7	8/9	10+
	Number of Spare Parts						
Wear ring	2	2	2	3	3	4	50% (see calculation note)
Shaft with key and nuts	1	1	1	2	2	2	20% (see calculation note)
Ball bearing set	1	1	2	2	2	3	25% (see calculation note)
Shaft sleeve	2	2	2	3	3	4	50% (see calculation note)
Shim pack	2	2	2	3	3	4	50% (see calculation note)
Lantern ring	1	1	2	2	2	3	30% (see calculation note)
Packing ring	16	16	24	24	24	32	100% (see calculation note)
Casing gaskets	4	6	8	8	9	12	150% (see calculation note)
Other gaskets	4	6	8	8	9	10	100% (see calculation note)
Mechanical seals	1	1	2	2	2	3	25% (see calculation note)
Power end (bearing frame, adapter, shaft, bearings, and other parts)	—	—	—	—	—	—	2

#### Calculation note

In order to determine the number of spare parts to stock for a part used on 10 or more pumps, use this calculation:

1. Count the number of times the part is used for one pump.
2. Multiple that number by the number of pumps.
3. Multiple the result by the percentage listed in the table for that part.

#### Spare parts order

Provide this information when you order spare parts. You can find the required information in the data sheet and the relevant sectional drawing:

- Pump model and size
- Serial number (order number)
- Part name
- Sectional drawing, item number

#### 6.8.6.5 ICO assembly worksheet

"A" Determination using ITT/Goulds K14153A gauge bars	"A" Determination using generic gauge bar (Straight edge or other flat parallel bar)
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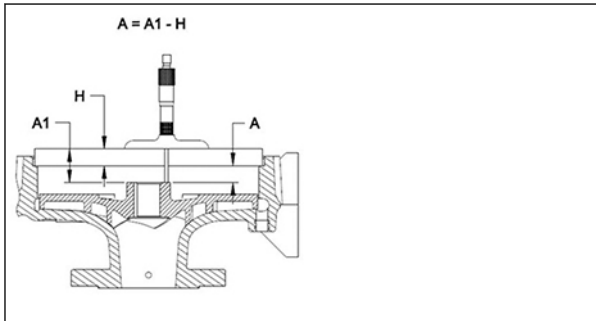


Figure 60: Goulds gauge bar

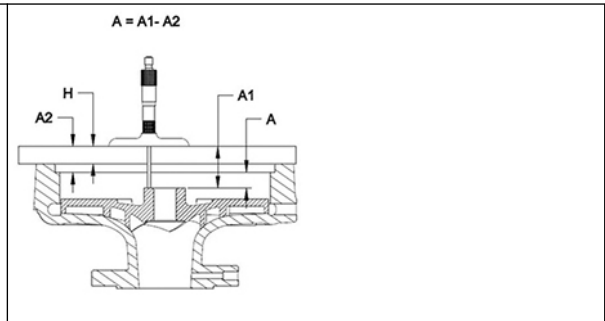


Figure 61: Generic gauge bar

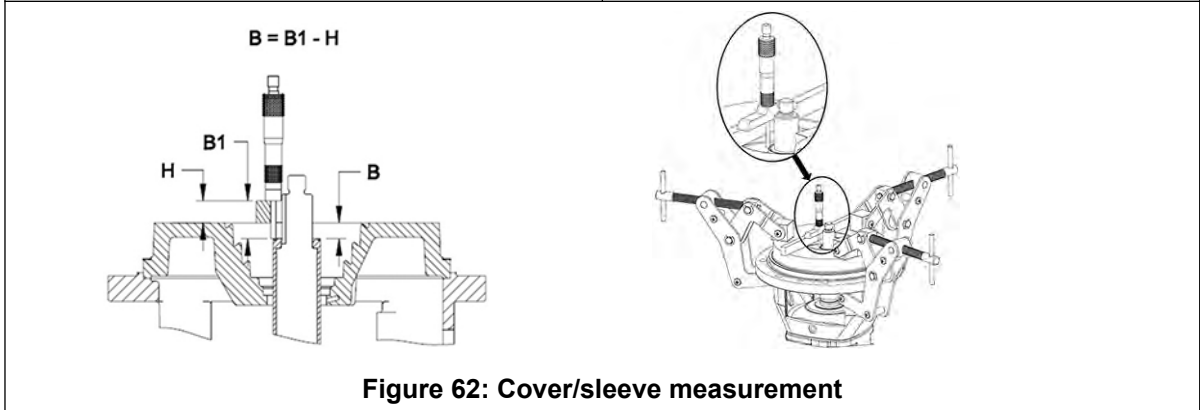


Figure 62: Cover/sleeve measurement

**Step Instructional information for shim determination**

1	Determine gasket type and fluid temperature - record in the provided fields.	Gasket type: _____ Fluid temp: _____
<p><b>NOTICE:</b> If using ITT/Goulds K14153A gauge bar kit refer to <a href="#">Figure 60: Goulds gauge bar on page 94</a>, for a generic bar see <a href="#">Figure 61: Generic gauge bar on page 94</a>.</p>		
2	Select appropriate length gauge bar to match pump features, measure height, record in "H".	H = _____
3	If using ITT/Goulds gauge bar K14153A kit proceed to Step 8.	-
4	Measure from top of bar to impeller hub feature as shown in <a href="#">Figure 61: Generic gauge bar on page 94</a> and record in "A1" field.	A1 = _____
5	Measure from top of bar to casing gasket surface as shown in <a href="#">Figure 61: Generic gauge bar on page 94</a> and record in "A2" field	A2 = _____
<p><b>NOTICE:</b> Casing gasket must not be installed and feature must be clean and free of defects.</p>		
6	Subtract A2 from A1 and record in the "A" field (A=A1-A2) -- see <a href="#">Figure 61: Generic gauge bar on page 94</a> .	A = _____
7	Continue to Step 10.	-
8	Measure from top of bar to impeller hub feature as shown in <a href="#">Figure 60: Goulds gauge bar on page 94</a> and record value in "A1" field.	A1 = _____
9	Subtract "H" from "A1" and record in "A" field (A=A1-H) -- See <a href="#">Figure 62: Cover/sleeve measurement on page 94</a> .	A = _____
10	Place bar across casing cover as shown in <a href="#">Figure 61: Generic gauge bar on page 94</a> , measure top of bar to sleeve shoulder, and record in "B1" field.	B1 = _____
11	Subtract "H" from B1 to obtain B (B=B1-H).	B = _____
12	Refer to <a href="#">Table 6: "C" Value table on page 95</a> and match pump size with fluid temperature - record this value in "C" field.	C = _____



Step		Instructional information for shim determination	
13	Refer to gasket <a href="#">Table 7: "D" Value Table on page 96</a> and record value in "D" field.	D = _____	_____
<p><b>NOTICE:</b> Most common gasket type is AFM-34 (0.5mm thick).</p>			
14	Determine shim height for your application by using following formula: shim height =A+B-C+D.	Shim = _____	_____
15	With the ideal shim thickness determined, combine shims as needed to approximate this value.		
16	Refer to IOM or ICO assembly procedure for additional assembly details.		
	Pump size: _____ By: _____ Date: _____		

Table 6: "C" Value table

Bearing frame size	Pump size	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)
		up to 70°C   160°F	up to 80°C   180°F	up to 110°C   230°F	up to 140°C   285°F	up to 170°C   340°F	up to 200°C   395°F	up to 230°C   450°F	up to 260°C   500°F
24	40-25-160	20.26	20.27	20.30	20.34	20.37	20.40	20.43	20.46
	50-32-160								
	65-40-160								
	80-50-160								
	40-25-200	21.26	21.27	21.30	21.34	21.37	21.40	21.43	21.46
	50-32-200								
	65-40-200								
	80-50-200								
32	100-65-160	28.26	28.27	28.29	28.32	28.35	28.37	28.40	28.42
	125-80-160								
	100-65-200	28.26	28.27	28.29	28.32	28.35	28.37	28.40	28.42
	125-80-200								
	125-100-200								
	40-25-250	33.26	33.27	33.29	33.32	33.35	33.37	33.40	33.42
	50-32-250								
	65-40-250								
	80-50-250								
	100-65-250								
	125-80-250								
	50-32-315	26.26	26.27	26.29	26.32	26.35	26.37	26.40	26.42
65-40-315									
80-50-315									
42	125-100-250	43.26	43.27	43.30	43.33	43.36	43.38	43.41	43.44
	150-125-250								
	200-150-250	29.26	29.27	29.30	29.33	29.36	29.38	29.41	29.44
	100-65-315								
	125-80-315								

Bearing frame size	Pump size	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)	"C" (mm)
		up to 70°C   160°F	up to 80°C   180°F	up to 110°C   230°F	up to 140°C   285°F	up to 170°C   340°F	up to 200°C   395°F	up to 230°C   450°F	up to 260°C   500°F
	125-100-315								
	150-125-315								
	125-80-400 125-100-400 150-125-400	33.26	33.27	33.30	33.33	33.36	33.38	33.41	33.44
48	200-150-315 200-150-400	53.26	53.27	53.30	53.34	53.37	53.40	53.43	53.46

Table 7: "D" Value Table

Bearing frame size	Pump size	Gasket type	"D"	"D"
			(mm)	(in)
All	All	AFM-34 (NBR) -- 0.05mm	0.00	0.000
		GYLON 3500 (FAWN) -- 0.8mm	0.26	0.010
		GYLON 3504 (BLUE) -- 0.8mm	0.04	0.002
		GYLON 3510 (OFF-WHITE) -- 0.8mm	0.27	0.011
		KLINGER SLS-AS (GRAPHITE) -- 0.8mm	0.01	0.001

# 7 Troubleshooting

## 7.1 Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Re-prime the pump and check that the pump and suction line are full of liquid.
	The suction line is clogged.	Remove the obstructions.
	The impeller is clogged.	Back-flush the pump in order to clean the impeller.
	The shaft is rotating in the wrong direction.	Change the rotation. The rotation must match the arrow on the bearing housing or pump casing.
	The foot valve or suction pipe opening is not submerged enough.	Consult an ITT representative for the proper submersion depth. Use a baffle in order to eliminate vortices.
	The suction lift is too high.	Shorten the suction pipe.
The pump is not producing the rated flow or head.	The gasket or O-ring has an air leak.	Replace the gasket or O-ring.
	The stuffing box has an air leak.	Replace or readjust the mechanical seal.
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
	The clearance between the impeller and the pump casing is excessive.	Adjust the impeller clearance.
	The suction head is not sufficient.	Make sure that the suction-line shutoff valve is fully open and that the line is unobstructed.
	The impeller is worn or broken.	Inspect and replace the impeller if necessary.
The pump starts and then stops pumping.	The pump is not primed.	Re-prime the pump and check that the pump and suction line are full of liquid.
	The suction line has air or vapor pockets.	Rearrange the piping in order to eliminate air pockets.
	The suction line has an air leak.	Repair the leak.
The bearings are running hot.	The pump and driver are not aligned properly.	Realign the pump and driver.
	There is not sufficient lubrication.	Check the lubricant for suitability and level.
	The lubrication was not cooled properly.	Check the cooling system.
The pump is noisy or vibrates.	The pump and driver are not aligned properly.	Realign the pump and driver.
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
	The impeller or shaft is broken or bent.	Replace the impeller or shaft as necessary.
	The foundation is not rigid.	Tighten the hold-down bolts of the pump and motor. Make sure the baseplate is properly grouted without voids or air pockets.
	The bearings are worn.	Replace the bearings.
	The suction or discharge piping is not anchored or properly supported.	Anchor the suction or discharge piping as necessary according to recommendations in the Hydraulic Institute Standards Manual.
	The pump is cavitating.	Locate and correct the system problem.
	The mechanical seal is leaking excessively.	
The packing gland is not adjusted properly.	Tighten the gland nuts.	
The stuffing box is not packed properly.	Check the packing and repack the box.	

Symptom	Cause	Remedy
	The mechanical seal parts are worn.	Replace the worn parts.
	The mechanical seal is overheating.	Check the lubrication and cooling lines.
	The shaft or shaft sleeve is scored (some models).	Machine or replace the shaft sleeve as necessary.
The motor requires excessive power.	The discharge head has dropped below the rated point and is pumping too much liquid.	Install a throttle valve. If this does not help, then trim the impeller diameter. If this does not help, then contact your ITT representative.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The stuffing-box packing is too tight.	Readjust the packing. If the packing is worn, then replace the packing.
	Rotating parts are rubbing against each other.	Check the parts that are wearing for proper clearances.
	The impeller clearance is too tight.	Adjust the impeller clearance.

## 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"> <li>Determine which corners of the baseplate are high or low.</li> <li>Remove or add shims at the appropriate corners.</li> <li>Realign the pump and driver.</li> </ol>
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"> <li>Determine if the center of the baseplate should be raised or lowered.</li> <li>Level screws equally at the center of the baseplate.</li> <li>Realign the pump and driver.</li> </ol>

## 7.3 Assembly troubleshooting

Symptom	Cause	Remedy
There is excessive shaft end play.	The internal clearance of the bearings exceeds the recommended amount.	Replace the bearings with a bearing of the correct type.
	The snap ring is loose in the bearing-housing groove.	Re-seat the snap ring.
There is excessive shaft and sleeve runout.	The sleeve is worn.	Replace the sleeve.
	The shaft is bent.	Replace the shaft.
There is excessive bearing-frame flange runout.	The shaft is bent.	Replace the shaft.
	The flange of the bearing frame is distorted.	Replace the bearing-frame flange.
There is excessive frame-adapter runout.	There is corrosion on the frame adapter.	Replace the frame adapter.
	The adapter-to-frame gasket is not seated properly.	Re-seat the frame adapter and make sure that the adapter-to-frame gasket is seated properly.
There is excessive seal chamber or stuffing-box cover runout.	The seal chamber or the stuffing-box cover is not properly seated in the frame adapter.	Re-seat the seal chamber or stuffing-box cover.
	There is corrosion or wear on the seal chamber or stuffing-box cover.	Replace the seal chamber or stuffing-box cover.

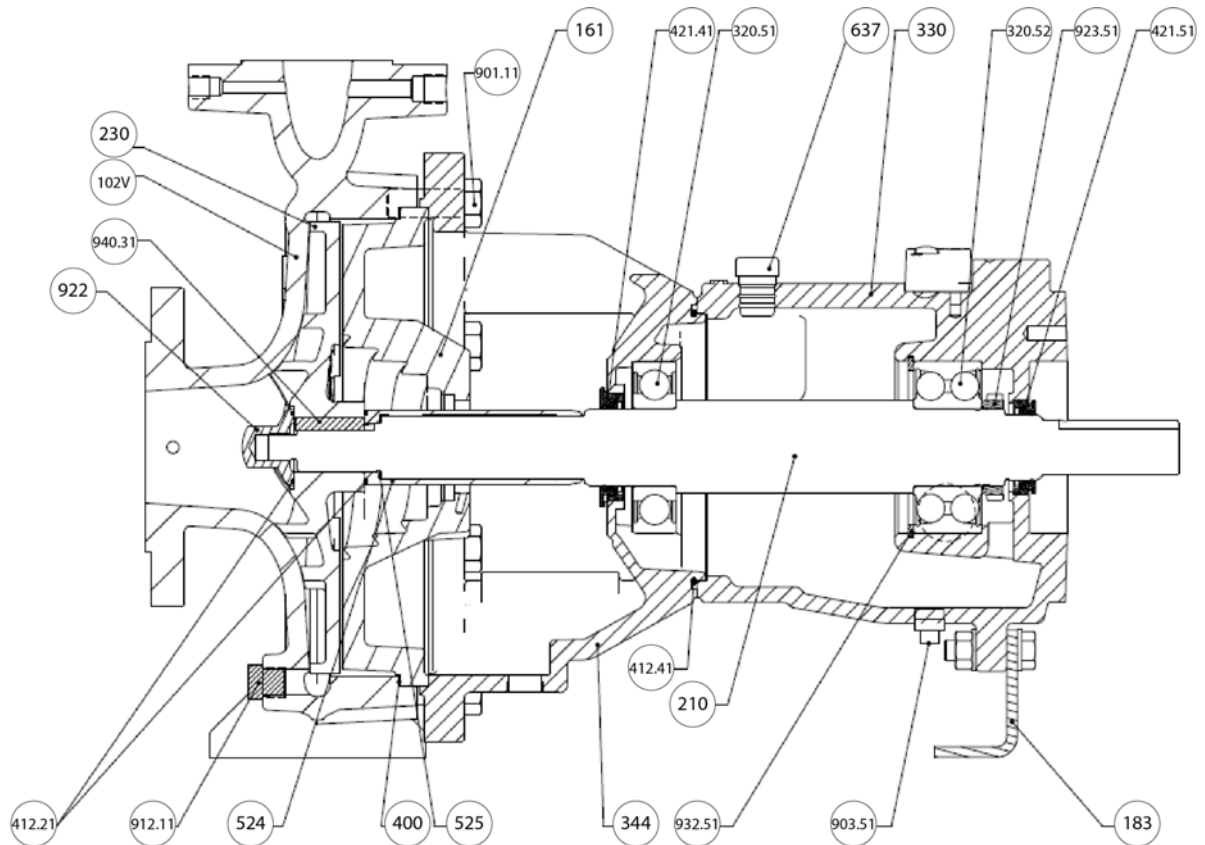
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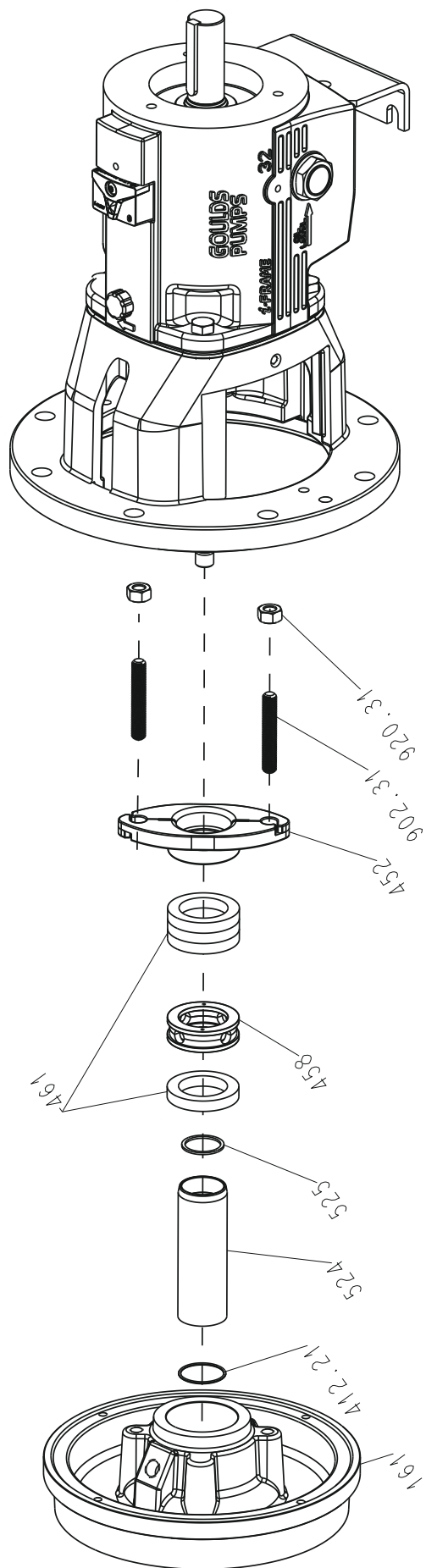
<b>Symptom</b>	<b>Cause</b>	<b>Remedy</b>
There is excessive vane-tip runout of the impeller.	The vane is bent.	Replace the impeller.

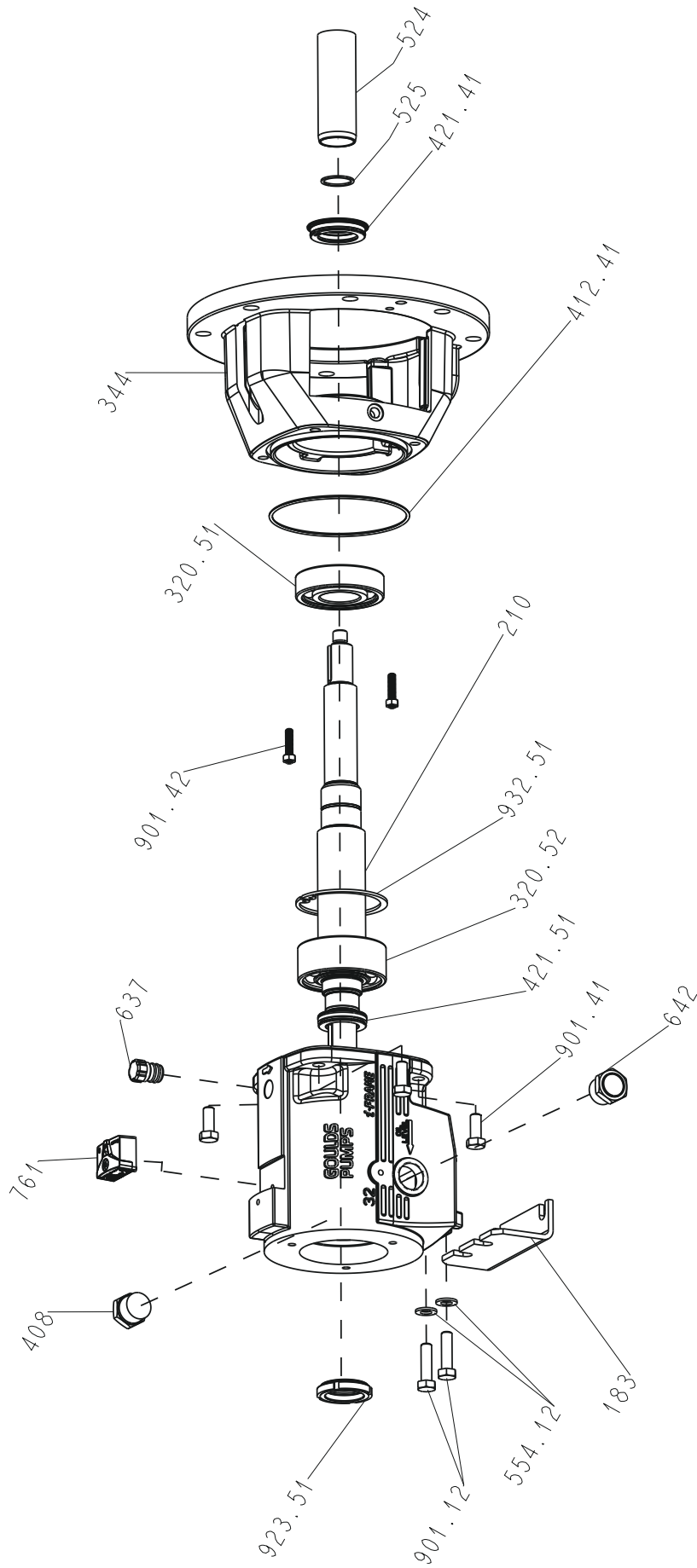
# 8 Parts Listings and Cross-Sectional Drawings

## 8.1 Parts list

### Cross-sectional drawings









Item	Part name	Pump material					
		Carbon Steel	316SS	Duplex	Alloy 20	Hastelloy	Titanium
102V	Casing	Carbon Steel	316SS	Duplex	Alloy 20	Hastelloy	Titanium
161	Seal chamber stuffing box cover	Ductile Iron	316SS	Duplex	Alloy 20	Hastelloy	Titanium
183	Support Foot	Carbon Steel					
210	Shaft	Stainless Steel					
230	Impeller	316SS	316SS	Duplex	Alloy 20	Hastelloy	Titanium
320.51	Radial Bearing	Single Row, Ball Bearing					
320.52	Thrust Bearing	Double Row Angular Contact Bearing					
330	Bearing Frame	Cast Iron					
344	Lantern	Ductile Iron					
400	Case Gasket	Non Asbestos Aramid Fibre					
412.21	O-Ring, Shaft Sleeve and Impeller Nut	PTFE					
412.41	O-Ring, Bearing Frame	NBR					
421.41	Oil Seal, Inboard	Bi-Metallic Labyrinth Seal (Steel & Bronze)					
421.51	Oil Seal, Outboard	Bi-Metallic Labyrinth Seal (Steel & Bronze)					
524	Shaft Sleeve	316LSS		Duplex	Alloy 20	Hastelloy	Titanium
525	Shims	Duplex					
637	Oil Vent / Filler Plug	Steel					
642	Oil Level Sight Glass	Glass/Plastic					
901.11	Casing Bolts, Hex Screw Cap	Stainless Steel					
901.12	Support Foot Bolt, Hex Cap Screw	Carbon Steel					
901.31	Lantern Cover, Hex Cap Screw	Stainless Steel					
901.41	Brg Bracket -to-Lantern Bolts, Hex Cap Screw	Carbon Steel					
901.42	Jacking Bolt	Stainless Steel					
903.51	Oil Sump Drain Plug	Carbon Steel					
912.11	Case Drain Plug	316SS		Duplex	Alloy 20	Hastelloy	Titanium
922	Impeller Nut	Duplex			Alloy 20	Hastelloy	Titanium
923.51	Bearing Lock Nut	Steel/Nylon					
932.51	Snap Ring	Carbon Steel					
940.31	Impeller Key	Carbon Steel					
Optional parts not shown							
452	Packing Gland	316SS					
458	Lantern Ring	Glass Filled PTFE					
461	Packing	PTFE Impregnated					

# 9 Decommissioning

## 9.1 Putting pump out of operation

This chapter contains information on decommissioning the pump. Decommissioning must be performed in the following situations:

- Before maintenance and servicing work
- Before removing the pump from the plant

### Emptying

1. Switch the drive system off and secure it to prevent a restart/being switched on again
2. Make sure that all interfaces for the pumping process are securely closed.
3. Relieve the pump and operator side pipelines of pressure in the safe area.

---

**NOTICE:**

Always safely collect any pumped medium that leaks out and dispose of this in accordance with applicable local regulations.

---

Empty the pump and operator side pipelines completely in the safe area.

### Clean

The following prerequisites for cleaning must be fulfilled:

- All interfaces for the pumping process are securely closed.
- The system is completely emptied and pressure-free.
  - Clean the pump thoroughly

## 9.2 Disposal

This chapter contains information on proper disposal. Ensure that the pump has been decommissioned properly prior to disposal

1. Drain lubricating oil from the bearing casing and collect it safely.
2. Thoroughly clean components and disassemble these in compliance with applicable local occupational safety and environmental protection regulations.

---

**NOTICE:**

If necessary, enclose a declaration of no objection (refer [10.1 Declaration of no objection on page 105](#) with each disassembled component.

---

3. Recycle disassembled components in accordance with local regulations. A typical procedure is:
  - Scrap metals
  - Give plastic elements to recycling
  - Dispose of remaining components

# 10 Certificates

## 10.1 Declaration of no objection

Please copy, fill it out and send it with the pump.

Statutory regulations oblige all commercial companies to protect their employees, the public and the environment from the hazardous effects of dangerous substances.

For this reason, repair and inspection of the components may only be undertaken once the following declaration has been correctly and fully filled out and signed by an authorised, qualified specialist.

If safety measures must be employed despite complete emptying and cleaning on the part of the operator, then this required information must be passed on. This declaration of no objection comprises part of the repair or inspection order.

**We hereby declare that the enclosed component**

Type: \_\_\_\_\_

Serial number: \_\_\_\_\_

- is free of hazardous materials. Special safety measures for further handling of the device are not necessary.
- The device has been fully emptied and thoroughly cleaned inside and out prior to dispatch.

The following media was previously conveyed by the \_\_\_\_\_  
pump:

The medium was hazardous:  YES  NO

The pump was emptied by the operating firm:  YES  NO

The pump was thoroughly cleaned inside and out by the operating firm:  YES  NO

The pump came into contact with hazardous substances:  YES  NO

If yes: Hazardous material number according to Ordinance  
on Hazardous Substances (GefStoffV): \_\_\_\_\_

or CAS registration number (Chemical Abstract Service): \_\_\_\_\_

Company/Institute: \_\_\_\_\_

Street: \_\_\_\_\_

Postcode, city: \_\_\_\_\_

Telephone: \_\_\_\_\_

Name: \_\_\_\_\_

Item: \_\_\_\_\_

Date: \_\_\_\_\_

Signature, \_\_\_\_\_  
Company stamp: \_\_\_\_\_

## 10.2 Declarations of conformity and incorporation



### EC-Declaration of Conformity

We herewith declare,

**ITT Bornemann GmbH**

Postfach 11 62, 31676 Obernkirchen, Germany  
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the machinery (centrifugal pump):

Order - No.:

Denomination:

Quantity:

Serial - No.:

Year of manufacture:

Is in conformity with the following EC-Directives, provided that the site conditions for the commissioning are met as specified in the engineering documents, in particular in the operation manual:

**Machinery - Directive (2006/42/EC)**

**EMC - Directive (2014/30/EU)**

Separate declarations of conformity are attached if marked below.

**ATEX - Directive (2014/34/EU)**

**PED- Directive (2014/68/EU)**

Harmonized standards used:

- |                       |                               |
|-----------------------|-------------------------------|
| • EN 349:1993+A1:2008 | • EN 12162:2001+A1:2009       |
| • EN 14120:2015       | • EN ISO 12100:2010           |
| • EN 13732-1:2008     | • EN 809:1998+A1:2009+AC:2010 |

Obernkirchen, date:

\_\_\_\_\_

Managing Director

\_\_\_\_\_

Technical Manager





### UKCA-Declaration of Conformity

We herewith declare,

**ITT Bornemann GmbH**

Postfach 11 62, 31676 Obernkirchen, Germany  
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the machinery (centrifugal pump):

Order - No.: ...

Denomination: ...

Quantity: ...

Serial - No.: ...

Year of manufacture: ...

Is in conformity with the following EC-Directives, provided that the site conditions for the commissioning are met as specified in the engineering documents, in particular in the operation manual:

**Supply of Machinery (Safety) Regulations 2008 No 1597**

**ECR - Directive (2016 No. 1091)**

Separate declarations of conformity are attached if marked below.

**UKEX - Directive (2016 No. 1107)**

**PESR- Directive (2016 No 1105)**

Designated standards used:

- |                       |                               |
|-----------------------|-------------------------------|
| • EN 349:1993+A1:2008 | • EN 12162:2001+A1:2009       |
| • EN 14120:2015       | • EN ISO 12100:2010           |
| • EN 13732-1:2008     | • EN 809:1998+A1:2009+AC:2010 |

Obernkirchen, date:

\_\_\_\_\_

Managing Director

\_\_\_\_\_

Technical Manager





EC-Declaration of Incorporation

According to directive on machinery 2006/42 EC appendix II B

**We herewith declare,**

**ITT Bornemann GmbH**

Postfach 11 62, 31676 Obernkirchen, Germany  
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

**that the incomplete machinery(centrifugal pump):**

**Order - No.:**

**Denomination:**

**Quantity:**

**Serial - No.:**

**Year of manufacture:**

**Conforms to the following basic requirements of the directive on machinery (2006/42/EC):  
appendix I, Article 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.3, 1.3.4, 1.3.7 and 1.7.3.**

**Harmonized standards used:**

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>• EN 13732-1:2008</li></ul> | <ul style="list-style-type: none"><li>• EN 12162:2001+A1 :2009</li><li>• EN ISO 12100:2010</li><li>• EN 809:1998+A1:2009+AC:2010</li></ul> |
|---|--|

The commissioning is prohibited until it has been established, that the machinery, into which the above mentioned machinery is to be installed, complies with the Directive machinery (2006/42/EC).

We also declare that the relevant technical documentation for this incomplete machine was prepared according to appendix VII, Part B and commit ourselves to provide them in copy on demand to the market surveillance authorities.

Obernkirchen, date:

\_\_\_\_\_

Managing Director

\_\_\_\_\_

Technical Manager





UKCA-Declaration of Incorporation

According to **Supply of Machinery (Safety) Regulations 2008 No 1597**

**We herewith declare,**

**ITT Bornemann GmbH**

Postfach 11 62, 31676 Obernkirchen, Germany  
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

**that the incomplete machinery(centrifugal pump):**

**Order - No.:**

**Denomination:**

**Quantity:**

**Serial - No.:**

**Year of manufacture:**

**Conforms to the following basic requirements of the directive on Machinery (Safety) Regulations 2008 No 1597: Annex I, Article 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.3, 1.3.4, 1.3.7 and 1.7.3.**

**Designated standards used:**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• EN 13732-1:2008</li> </ul> | <ul style="list-style-type: none"> <li>• EN 12162:2001+A1 :2009</li> <li>• EN ISO 12100:2010</li> <li>• EN 809:1998+A1:2009+AC:2010</li> </ul> |
|---|--|

The commissioning is prohibited until it has been established, that the machinery, into which the above mentioned machinery is to be installed, complies with the machinery directive (2008 No 1597).

We also declare that the relevant technical documentation for this incomplete machine was prepared according to appendix VII, Part B and commit ourselves to provide them in copy on demand to the market surveillance authorities.

Obernkirchen, date:

\_\_\_\_\_  
Managing Director

\_\_\_\_\_  
Technical Manager



# 11 Local ITT Contacts

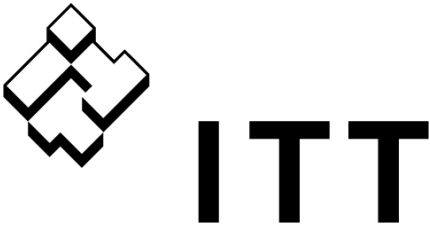
## 11.1 Local ITT Contacts

### 11.1.1 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
Houston office	12510 Sugar Ridge Boulevard Stafford, TX 77477 USA	+1 281-504-6300	+1 281-504-6399
Los Angeles	ITT - Goulds Pumps 880 W. Crowther Ave Placentia, CA 92870 USA	+1 562-908-4125	+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
Asia Pacific	ITT Goulds Pumps Ltd 35, Oksansandan-ro Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do 28101, Rep. of KOREA	+82 234444202	
Europe	ITT Bornemann GmbH Industriestrasse 2, 31683 Obern- kirchen, Germany	+49 5724 390 2340	+49 5724 390 290
Latin America	ITT - Goulds Pumps Camino La Colina # 1448 Condominio Industrial El Rosal Huechuraba Santiago 8580000 Chile	+562 544-7000	+562 544-7001
Middle East and Africa	ITT - Goulds Pumps Achileos Kyrou 4 Neo Psychiko 115 25 Athens Greece	+30 210-677-0770	+30 210-677-5642



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<http://www.gouldspumps.com>



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240 Fall Street  
Seneca Falls, NY 13148  
USA

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