



# ITT

## Goulds Pumps

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# Installation, Operation, and Maintenance Manual

Model IC, ICI, ICH, ICIH



*Engineered for life*



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# Introduction and Safety

## Introduction

### Purpose of this manual

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

- Installation
- Operation
- Maintenance



#### **CAUTION:**

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

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#### **NOTICE:**

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

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### Requesting other information

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

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

## Safety



#### **WARNING:**

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

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

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## 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
 <p><b>DANGER:</b></p>	A hazardous situation which, if not avoided, will result in death or serious injury
 <p><b>WARNING:</b></p>	A hazardous situation which, if not avoided, could result in death or serious injury
 <p><b>CAUTION:</b></p>	A hazardous situation which, if not avoided, could result in minor or moderate injury
<p><b>NOTICE:</b></p>	<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

### The Ex symbol

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



## Environmental safety

### The work area

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

### Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

### Electrical installation

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

## Recycling guidelines

Always follow local laws and regulations regarding recycling.

## User safety

### General safety rules

These safety rules apply:

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

### Safety equipment

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

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

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#### **NOTICE:**

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

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### 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.

### Wash the skin and eyes

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



If you need to wash your...	Then...
Eyes	<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>
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 one minute.</li> <li>3. Seek medical attention, if required.</li> </ol>

## Ex-approved products

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, IEC/EN 60079-17).

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

### Product and product handling requirements

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

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

### Description of ATEX

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

### Guidelines for compliance

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

## 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.

# Transportation and Storage

## Inspect the delivery

### Inspect the package

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

### Inspect the unit

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

## Transportation guidelines

### Pump handling and lifting

#### Precautions for moving the pump

Use care when moving pumps.




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#### **WARNING:**

Make sure that the pump cannot roll or fall over and injure people or damage property.

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#### **NOTICE:**

Use a forklift truck with sufficient capacity to move the pallet with the pump unit on top.

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




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#### **WARNING:**

Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.

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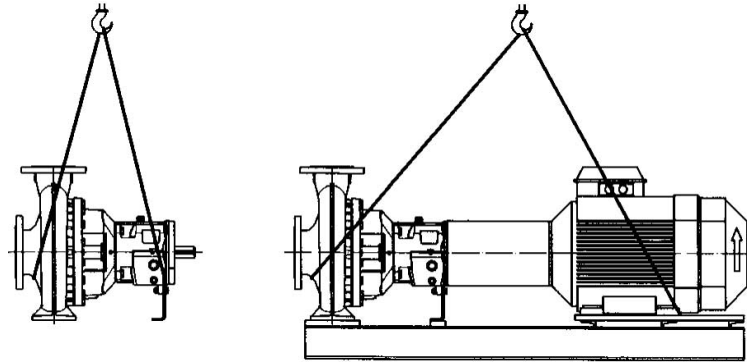
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#### **NOTICE:**

- 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.
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### Lifting the pump

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



## Storage guidelines

### Long-term storage

If the pump 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.

# Product Description

## General description

The model IC 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. The model ICI additionally has an inducer. Models ICH and ICIH 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
- Optional renewable wear ring

### Impeller

The impeller is fully enclosed 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

- 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 double lip 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 bracket is shown in the data sheet and/or order confirmation.

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

**Shaft**

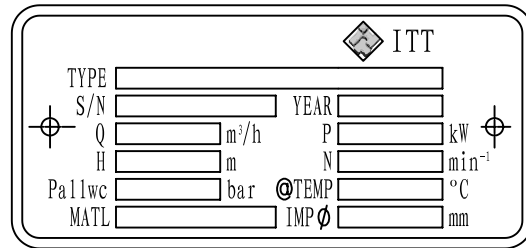
Rigid shaft designed for less than 0.05 mm shaft deflection. Standard 400 series stainless steel shaft (1.4021) provides reliable power transmission and corrosion resistance at both the pump and coupling ends.

**Intended applications**

- ISO chemical process
- Industrial process

## Nameplate information

**Pump nameplate**

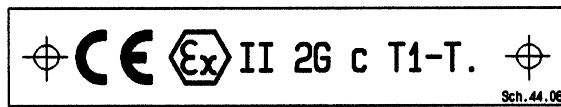


Nameplate field	Explanation
Type*	Type of pump
S/N*	Serial number
Q	Rated pump flow, in cubic meters per hour
P	Rated pump power, in kilowatts
H	Rated pump head, in meters
n	Rated pump speed, in min <sup>-1</sup>
P <sub>all w C</sub>	Maximum permitted casing-operation-pressure (Highest discharge pressure at the rated operating temperature to which the pump casing can be used)
t <sub>max op</sub>	Maximum permitted operating temperature of pumped liquid
Item No	Customer-related order number
Imp Ø	Outer diameter of the impeller
MATL	Material of construction

\*All details of design and materials are defined with this information. You must specify these details when you order spare parts.

**ATEX nameplate**

The conformity with the EC directive 94/9/EG "Appliances and Protection Systems for designated use in areas endangered to explosion" is declared by the issue of the EC Declaration of Conformity and the attachment of the ATEX label on the bearing bracket of the pump. The ATEX label is also attached to the pump nameplate.



Nameplate field	Explanation
CE	Marking of compliance with the EC directive 94/9/EG
Ex	Specific marking for explosion protection
II	Appliance group
2G	Category (2) and explosive atmosphere due to gases, vapors, or mist (G)
c	ignition protection in use: constructual safety (c)
T1-T.	Classification of the theoretically available range of the temperature classes

# Installation

## Preinstallation

### Precautions



**WARNING:**

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

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

### Pump location guidelines



**WARNING:**

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

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

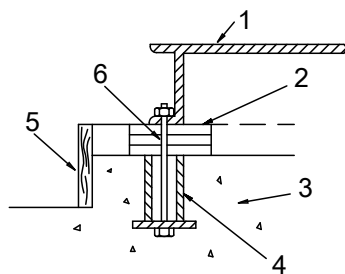


## Foundation requirements

### Requirements

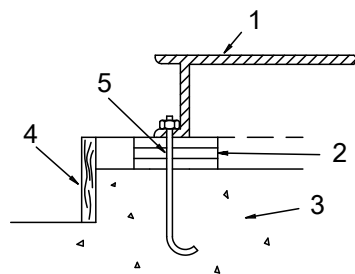
- The foundation must be able to absorb any type of vibration and form a permanent, rigid support for the pump unit.
- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three 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



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

### J-type bolts



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

## Baseplate-mounting procedures

### Prepare the baseplate for mounting

1. Remove all the attached equipment from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with an epoxy primer.  
Use an epoxy primer only if you used an epoxy-based grout.
4. Remove the rust-proofing coat from the machined mounting pads using an appropriate solvent.
5. Remove water and debris from the foundation-bolt holes.

## Prepare the foundation for mounting

1. Chip the top of the foundation to a minimum of 1.0 in. (25.0 mm) 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-bonding 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.

## Install the baseplate using shims or wedges

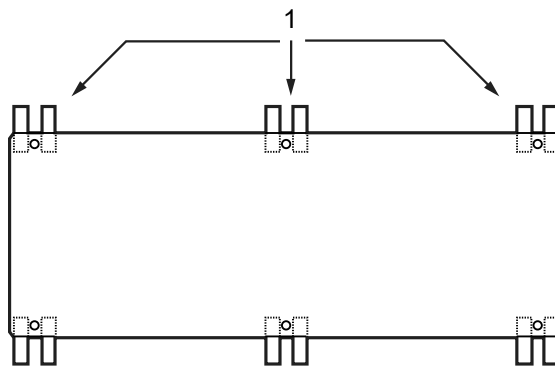
Required tools:

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

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

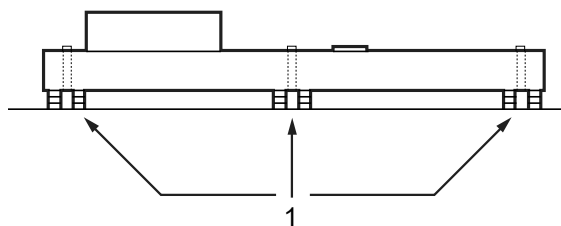
1. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt holes.
2. Put the sets of wedges or shims on each side of each foundation bolt.

The sets of wedges should have a height of between 0.75 in. (19 mm) and 1.50 in. (38 mm).



1. Shims or wedges

**Figure 1: Top view**



1. Shims or wedges

**Figure 2: 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 make sure that you achieve the correct leveling. 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 0.125 in. (3.2 mm) lengthwise
  - A maximum difference of 0.059 in. (1.5 mm) across
 You can use the baseplate-leveling worksheet when you take the readings.
6. Hand-tighten the nuts for the foundation.

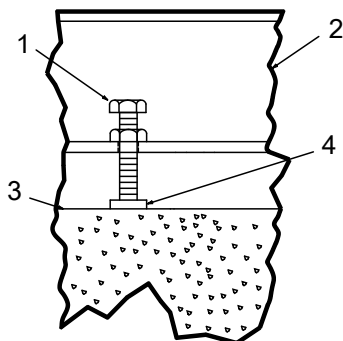
## Install the baseplate using jackscrews

Tools required:

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

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

1. Apply an anti-seize compound on the jackscrews. The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:
  - a) Cut the plates from the bar stock and chamfer the edges of the plates in order to reduce stress concentrations.
  - b) Put the plates between the jackscrews and the foundation surface.
  - c) Use the four jackscrews in the corners in order to raise the baseplate above the foundation. Make sure that the distance between the baseplate and the foundation surface is between 0.75 in. (19 mm) and 1.50 in. (38 mm).
  - d) Make sure that the center jackscrews do not touch the foundation surface yet.



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

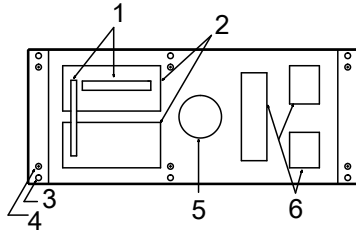
3. Level the driver mounting pads:

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

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

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

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

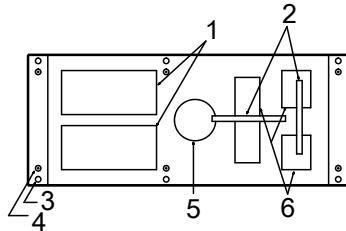


1. Machinist's levels
  2. Driver's mounting pads
  3. Foundation bolts
  4. Jackscrews
  5. Grout hole
  6. Pump's mounting pads
4. Turn the center jackscrews down so that they rest on their plates on the foundation surface.
  5. Level the pump mounting pads:

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

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

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



1. Driver's mounting pads
  2. Machinist's levels
  3. Foundation bolts
  4. Jackscrews
  5. Grout hole
  6. Pump's mounting pads
6. Hand-tighten the nuts for the foundation bolts.
  7. Check that the driver's mounting pads are level and adjust the jackscrews and the foundation bolts if necessary.

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

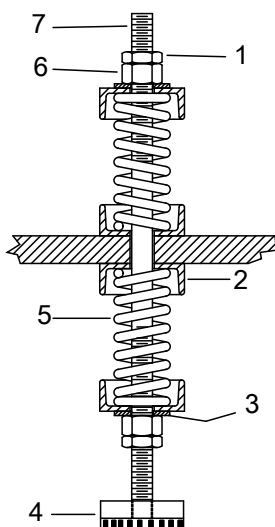
## Install the baseplate using spring mounting

**NOTICE:** The spring-mounted baseplate is designed only to support piping loads from thermal expansion. You must support the suction and discharge piping 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.



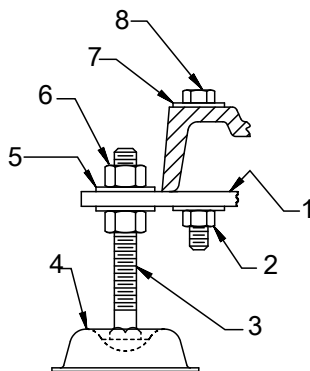
1. Upper jam nut
2. Follower
3. Washer
4. Foundation pads
5. Spring
6. Upper adjusting nut
7. Spring stud

**Figure 3: Example of an installed spring assembly**

## Install the baseplate using stilt mounting

**NOTICE:** The stilt-mounted baseplate is not designed to support static piping loads. Make sure to individually support the suction and discharge piping. 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.

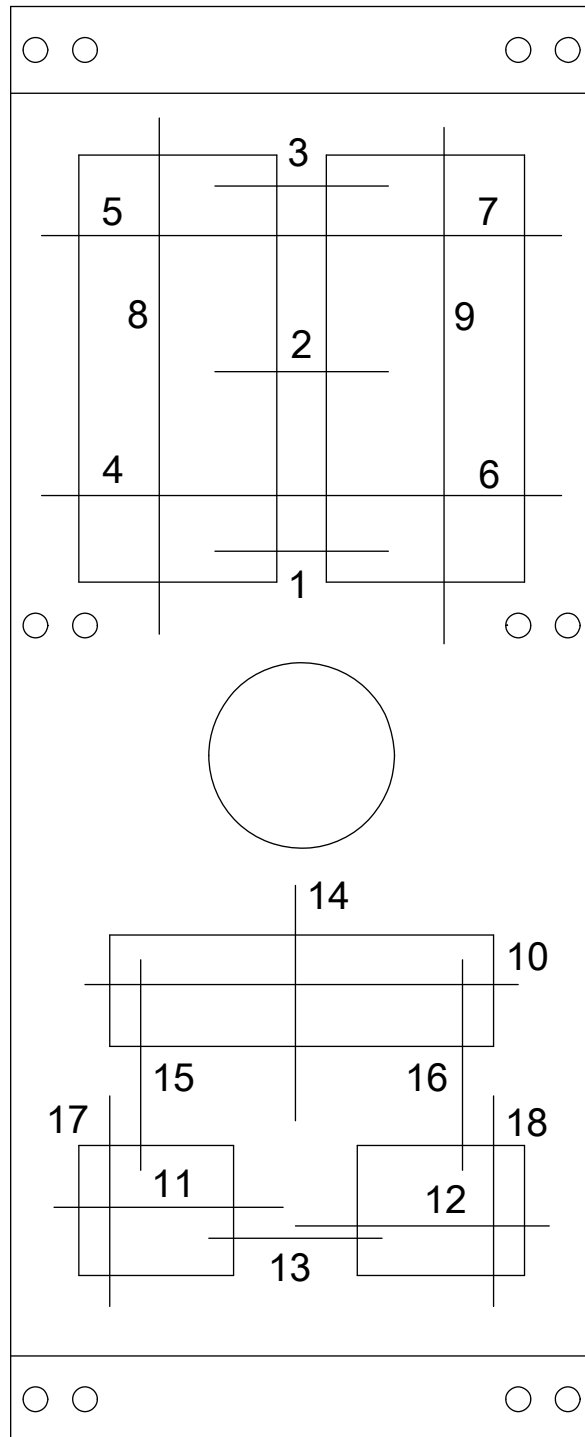


1. Mounting plate
2. Mounting nut
3. Stilt bolt
4. Foundation cups
5. Washer
6. Upper adjustment nut
7. Mounting washer
8. Mounting bolt

**Figure 4: Example of an installed stilt assembly**

# Baseplate-leveling worksheet

## Level measurements



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

## 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.

## Pump-to-driver alignment

### Precautions



#### WARNING:

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

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

## Alignment checks

### When to perform alignment checks

You must perform alignment checks under these circumstances:

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

### Types of alignment checks

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

### Initial alignment (cold alignment) checks

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

### Final alignment (hot alignment) checks

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



When	Why
Periodically	This follows the plant operating procedures.

## Permitted indicator values for alignment checks

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

### IMPORTANT

- For electric motors, the motor shaft initial (cold) parallel vertical alignment setting should be 0.002 to 0.004 in. (0.05 to 0.10 mm) lower than the pump shaft.
- For other drivers such as turbines and engines, 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 indicator runout is a maximum of 0.002 in. (0.05 mm) at operating temperature.
- The tolerance of the indicator is 0.0005 in./in. (0.0127 mm/mm) of indicator separation at operating temperature.

## Cold settings for parallel vertical alignment

### Introduction

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

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

### Recommended settings

Pumpage temperature	Recommended setting
50°F (10°C)	0.002 in. (0.05 mm), low
150°F (65°C)	0.001 in. (0.03 mm), high
250°F (120°C)	0.005 in. (0.12 mm), high
350°F (175°C)	0.009 in. (0.23 mm), high
450°F (218°C)	0.013 in. (0.33 mm), high
550°F (228°C)	0.017 in. (0.43 mm), high
650°F (343°C)	0.021 in. (0.53 mm), high
700°F (371°C)	0.023 in. (0.58 mm), high

## Alignment measurement guidelines

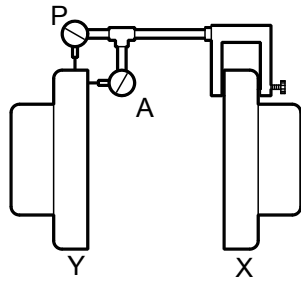
Guideline	Explanation
Rotate the pump coupling half and the driver coupling half together so that the indicator rods have contact with the same points on the driver coupling half.	This prevents incorrect measurement.
Move or shim only the driver in order to make adjustments.	This prevents strain on the piping installations.
Make sure that the hold-down bolts for the driver feet are tight when you take indicator measurements.	This keeps the driver stationary since movement causes incorrect measurement.

Guideline	Explanation
Make sure that the hold-down bolts for the driver feet are loose before you make alignment corrections.	This makes it possible to move the driver when you make alignment corrections.
Check the alignment again after any mechanical adjustments.	This corrects any misalignments that an adjustment may have caused.

## Attach the dial indicators for alignment

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

1. Attach two dial indicators on the pump coupling half (X):
  - a) Attach one indicator (P) so that the indicator rod comes into contact with the perimeter of the driver coupling half (Y).  
This indicator is used to measure parallel misalignment.
  - b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.  
This indicator is used to measure angular misalignment.



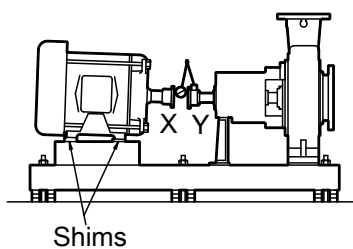
2. Rotate the pump coupling half (X) in order to check that the indicators are in contact with the driver coupling half (Y) but do not bottom out.
3. Adjust the indicators if necessary.

## Pump-to-driver alignment instructions

### Perform angular alignment for a vertical correction

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

When the reading value is...	Then...
Negative	The coupling halves are farther apart at the bottom than at the top. Perform one of these steps: <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>



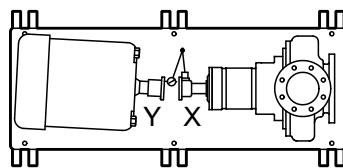
**Figure 5: Side view of an incorrect vertical alignment**

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

### Perform angular alignment for a horizontal correction

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

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: <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 6: Top view of an incorrect horizontal alignment**

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

### Perform parallel alignment for a vertical correction

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

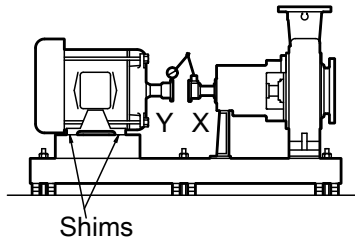
A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

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

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

**NOTICE:**

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



**Figure 7: Side view of an incorrect vertical alignment**

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

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

**Perform parallel alignment for a horizontal correction**

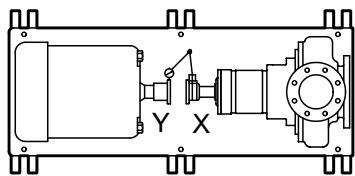
A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

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

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

- 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 8: Top view of an incorrect horizontal alignment**

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

---

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

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## Perform complete alignment for a vertical correction

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

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

## Perform complete alignment for a horizontal correction

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

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

## Grout the baseplate

Required equipment:

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

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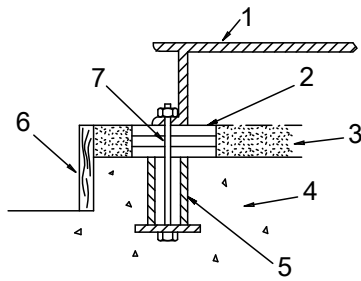
**NOTICE:** It is assumed that the installer who grouts the baseplate has knowledge of acceptable methods. More detailed procedures are described in various publications, including API Standard 610, 10th Edition, Appendix L; API RP 686, Chapter 5; and other industry standards.

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

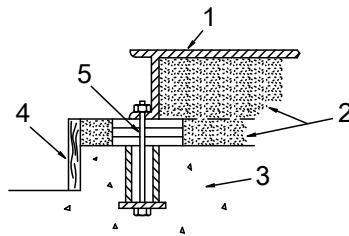
When you pour the grout, remove air bubbles from it by using one of these methods:

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



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

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



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

7. 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.

## Piping checklists

### General piping checklist

#### Precautions



#### CAUTION:

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

#### NOTICE:

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

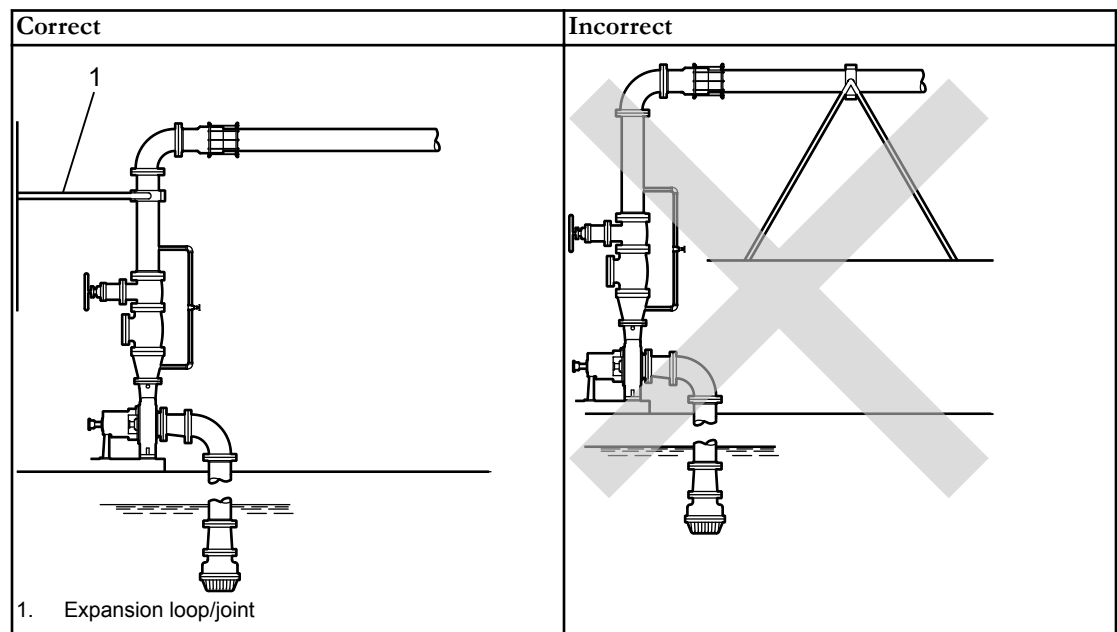
**Piping guidelines**

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

**Checklist**

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: <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> <li>• Wear on the pump bearings, seal, and shafting</li> </ul>	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: <ul style="list-style-type: none"> <li>• The grout for the baseplate or sub-base 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.	

**Example: Installation for expansion**



## Permitted nozzle loads and torques at the pump nozzles

### Designing suction and discharge piping

The suction and discharge piping must be designed so that a minimum of forces affect the pump. Do not exceed the force and torque values as shown in the following table. The values are valid for when the pump is operating or when it is idle.

### About the data in the table

The data in the following table has the following characteristics:

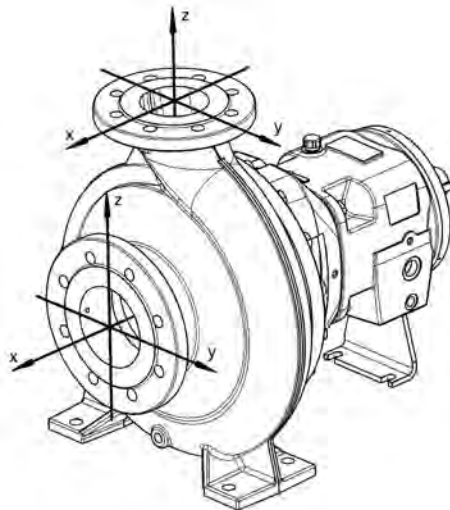
- The data complies with the Europump Recommendation for pumps according to ISO 5199.
- The data is only valid for static piping loads.
- The values are valid for pump units with standard IC base frames (ungrouded).
- All of the values refer to standard materials EN-GJS400-18LT and 1.4408.

### Permitted nozzle loads and torques at the pump nozzles

These nozzle loads and torques follow the Europump recommendations for this pump according to ISO 5199.

Table notes:

- The data for forces and torques are only valid for static piping loads.
- The values in these tables are valid for pump units with standard IC-base frames (not grouded).
- All values for forces and torques refer to standard materials EN-GJS400-18LT and 1.4408.



**Table 1: Suction nozzle**

Sizes	ØDN	Forces in lbf (N)				Torques in ft-lb (Nm)			
		F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	ΣF	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	ΣM
40-25-160	40	198 (880)	173 (770)	157 (700)	308 (1,370)	663 (900)	465 (630)	546 (740)	981 (1,330)
40-25-200	40	198 (880)	173 (770)	157 (700)	308 (1,370)	663 (900)	465 (630)	546 (740)	981 (1,330)
40-25-250	40	198 (880)	173 (770)	157 (700)	308 (1,370)	663 (900)	465 (630)	546 (740)	981 (1,330)
50-32-160	50	259 (1,150)	236 (1,050)	214 (950)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
50-32-200	50	259 (1,150)	236 (1,050)	214 (950)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
50-32-250	50	259 (1,150)	236 (1,050)	214 (950)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
50-32-315	50	259 (1,150)	236 (1,050)	214 (950)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
65-40-160	65	330 (1,470)	292 (1,300)	270 (1,200)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)



Sizes	ØDN	Forces in lbf (N)				Torques in ft-lb (Nm)			
		F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	ΣF	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	ΣM
65-40-200	65	330 (1,470)	292 (1,300)	270 (1,200)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
65-40-250	65	330 (1,470)	292 (1,300)	270 (1,200)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
65-40-315	65	330 (1,470)	292 (1,300)	270 (1,200)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
80-50-160	80	393 (1,750)	355 (1,580)	324 (1,440)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
80-50-200	80	393 (1,750)	355 (1,580)	324 (1,440)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
80-50-250	80	393 (1,750)	355 (1,580)	324 (1,440)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
80-50-315	80	393 (1,750)	355 (1,580)	324 (1,440)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
100-65-160	100	528 (2,350)	472 (2,100)	427 (1,900)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
100-65-200	100	528 (2,350)	472 (2,100)	427 (1,900)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
100-65-250	100	528 (2,350)	472 (2,100)	427 (1,900)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
100-65-315	100	528 (2,350)	472 (2,100)	427 (1,900)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
125-80-160	125	622 (2,765)	559 (2,485)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-80-200	125	622 (2,765)	559 (2,485)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-80-250	125	622 (2,765)	559 (2,485)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-80-315	125	622 (2,765)	559 (2,485)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-80-400	125	622 (2,765)	559 (2,485)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-100-200	125	622 (2,750)	562 (2,500)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-100-250	125	622 (2,750)	562 (2,500)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-100-315	125	622 (2,750)	562 (2,500)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
125-100-400	125	622 (2,750)	562 (2,500)	504 (2,240)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
150-125-250	150	787 (3,500)	708 (3,150)	641 (2,850)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)
150-125-315	150	787 (3,500)	708 (3,150)	641 (2,850)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)
150-125-400	150	787 (3,500)	708 (3,150)	641 (2,850)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)
200-150-250	200	1,057 (4,700)	944 (4,200)	850 (3,780)	1,652 (7,350)	1,682 (2,280)	1,187 (1,610)	1,364 (1,850)	2,471 (3,350)
200-150-315	200	1,057 (4,700)	944 (4,200)	850 (3,780)	1,652 (7,350)	1,682 (2,280)	1,187 (1,610)	1,364 (1,850)	2,471 (3,350)
200-150-400	200	1,057 (4,700)	944 (4,200)	850 (3,780)	1,652 (7,350)	1,682 (2,280)	1,187 (1,610)	1,364 (1,850)	2,471 (3,350)

**Table 2: Discharge nozzle**

Sizes	ØDN	Forces in lbf (N)				Torques in ft-lb (Nm)			
		F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	ΣF	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	ΣM
40-25-160	25	119 (530)	110 (490)	135 (600)	207 (920)	465 (630)	310 (420)	361 (490)	679 (920)

Sizes	ØDN	Forces in lbf (N)				Torques in ft-lb (Nm)			
		F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	ΣF	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	ΣM
40-25-200	25	119 (530)	110 (490)	135 (600)	207 (920)	465 (630)	310 (420)	361 (490)	679 (920)
40-25-250	25	119 (530)	110 (490)	135 (600)	207 (920)	465 (630)	310 (420)	361 (490)	679 (920)
50-32-160	32	142 (630)	135 (600)	166 (740)	261 (1,160)	568 (770)	391 (530)	443 (600)	826 (1,120)
50-32-200	32	142 (630)	135 (600)	166 (740)	261 (1,160)	568 (770)	391 (530)	443 (600)	826 (1,120)
50-32-250	32	142 (630)	135 (600)	166 (740)	261 (1,160)	568 (770)	391 (530)	443 (600)	826 (1,120)
50-32-315	32	142 (630)	135 (600)	166 (740)	261 (1,160)	568 (770)	391 (530)	443 (600)	826 (1,120)
65-40-160	40	173 (770)	157 (700)	198 (880)	308 (1,370)	664 (900)	465 (630)	546 (740)	981 (1,330)
65-40-200	40	173 (770)	157 (700)	198 (880)	308 (1,370)	664 (900)	465 (630)	546 (740)	981 (1,330)
65-40-250	40	173 (770)	157 (700)	198 (880)	308 (1,370)	664 (900)	465 (630)	546 (740)	981 (1,330)
65-40-315	40	173 (770)	157 (700)	198 (880)	308 (1,370)	664 (900)	465 (630)	546 (740)	981 (1,330)
80-50-160	50	236 (1,050)	214 (950)	259 (1,150)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
80-50-200	50	236 (1,050)	214 (950)	259 (1,150)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
80-50-250	50	236 (1,050)	214 (950)	259 (1,150)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
80-50-315	50	236 (1,050)	214 (950)	259 (1,150)	409 (1,820)	723 (980)	516 (700)	590 (800)	1,069 (1,450)
100-65-160	65	292 (1,300)	270 (1,200)	330 (1,470)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
100-65-200	65	292 (1,300)	270 (1,200)	330 (1,470)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
100-65-250	65	292 (1,300)	270 (1,200)	330 (1,470)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
100-65-315	65	292 (1,300)	270 (1,200)	330 (1,470)	517 (2,300)	774 (1,050)	568 (770)	620 (840)	1,143 (1,550)
125-80-160	80	355 (1,580)	324 (1,440)	393 (1,750)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
125-80-200	80	355 (1,580)	324 (1,440)	393 (1,750)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
125-80-250	80	355 (1,580)	324 (1,440)	393 (1,750)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
125-80-315	80	355 (1,580)	324 (1,440)	393 (1,750)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
125-80-400	80	355 (1,580)	324 (1,440)	393 (1,750)	620 (2,760)	826 (1,120)	590 (800)	671 (910)	1,217 (1,650)
125-100-200	100	472 (2,100)	427 (1,900)	528 (2,350)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
125-100-250	100	472 (2,100)	427 (1,900)	528 (2,350)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
125-100-315	100	472 (2,100)	427 (1,900)	528 (2,350)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
125-100-400	100	472 (2,100)	427 (1,900)	528 (2,350)	825 (3,670)	907 (1,230)	649 (880)	752 (1,020)	1,342 (1,820)
150-125-250	125	562 (2,500)	504 (2,240)	618 (2,750)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
150-125-315	125	562 (2,500)	504 (2,240)	618 (2,750)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
150-125-400	125	562 (2,500)	504 (2,240)	618 (2,750)	978 (4,350)	1,084 (1,470)	774 (1,050)	981 (1,330)	1,578 (2,140)
200-150-250	150	708 (3,150)	641 (2,850)	787 (3,500)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)
200-150-315	150	708 (3,150)	641 (2,850)	787 (3,500)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)
200-150-400	150	708 (3,150)	641 (2,850)	787 (3,500)	1,236 (5,500)	1,291 (1,750)	907 (1,230)	1,069 (1,450)	1,888 (2,560)

## Suction-piping checklist

### Performance curve reference



#### CAUTION:

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.

Net positive suction head available (NPSH<sub>A</sub>) must always exceed NPSH required (NPSH<sub>R</sub>) as shown on the published performance curve of the pump.

### 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	Explanation/comment	Checked
Check that elbows in general do not have sharp bends.	See the Example sections for illustrations.	
Check that the suction piping is one or two sizes larger than the suction inlet of the pump. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump. See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: <ul style="list-style-type: none"> <li>• Sloping side down</li> <li>• Horizontal side at the top</li> </ul>	See the example illustrations.	
If suction strainers or suction bells are used, check that they are at least three times the area of the suction piping.	Suction strainers help to prevent clogging. Mesh holes with a minimum diameter of 1/16 in. (1.6 mm) are recommended.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	

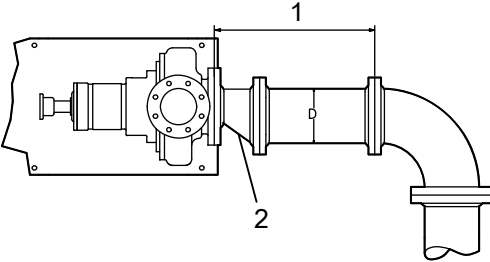
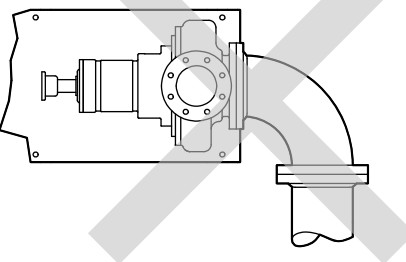
#### Liquid source below the pump

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

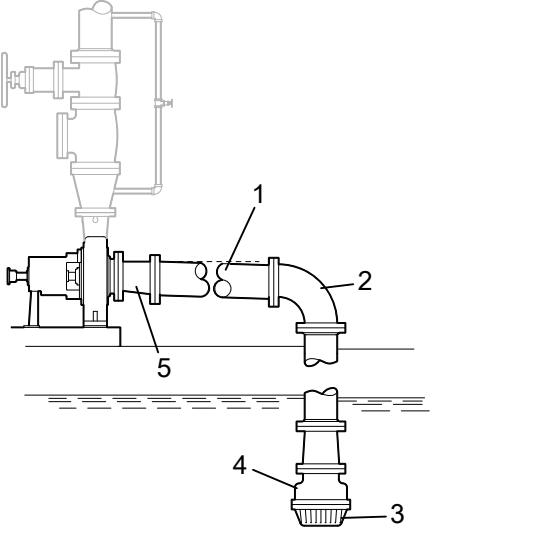
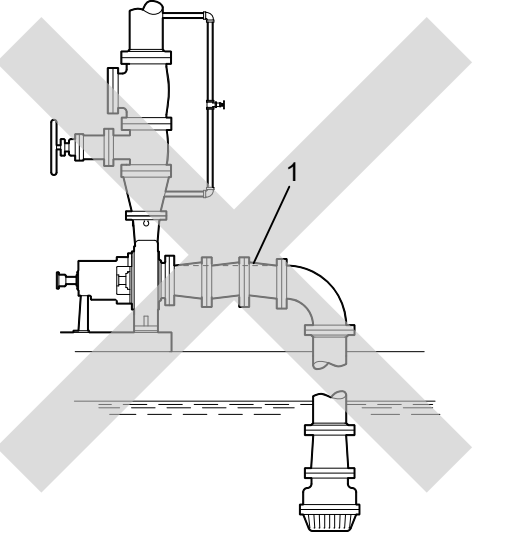
#### Liquid source above the pump

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	This permits you to close the line during pump inspection and maintenance. Do not use the isolation valve to throttle the pump. Throttling can cause these problems: <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.	—	
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>1. Enough distance to prevent cavitation</li> <li>2. Eccentric reducer with a level top</li> </ol>	

**Example: Suction piping equipment**

Correct	Incorrect
 <ol style="list-style-type: none"> <li>1. Suction pipe sloping upwards from liquid source</li> <li>2. Long-radius elbow</li> <li>3. Strainer</li> <li>4. Foot valve</li> <li>5. Eccentric reducer with a level top</li> </ol>	 <ol style="list-style-type: none"> <li>1. 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>

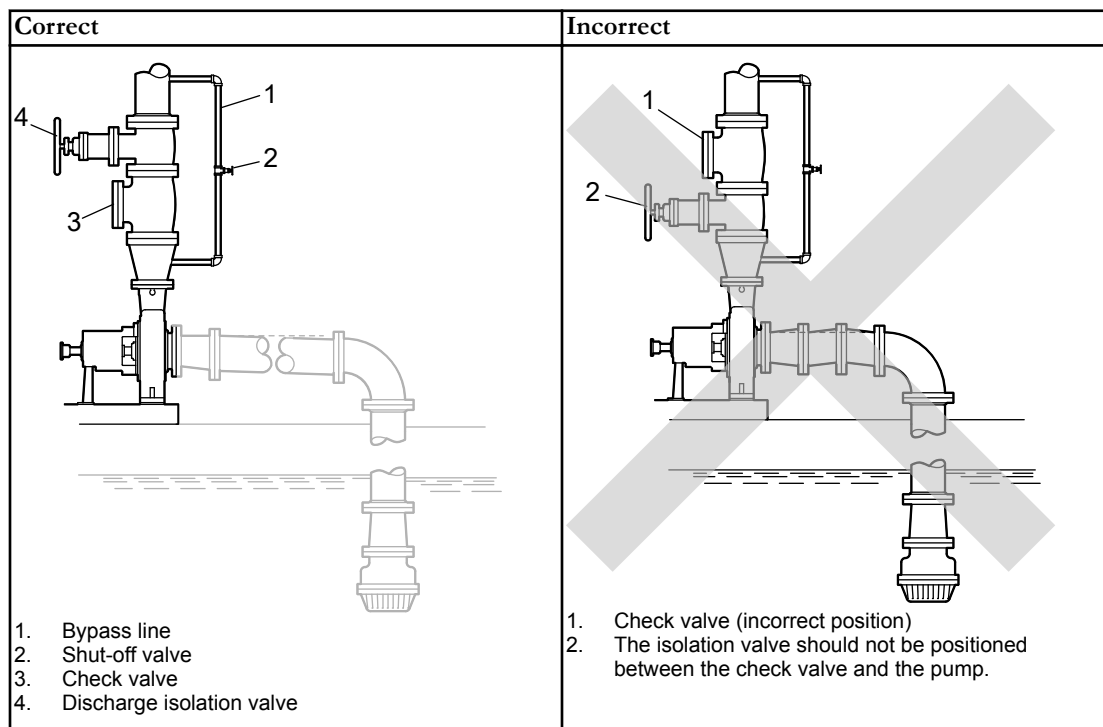
**Discharge piping checklist**

Checklist

Check	Explanation/comment	Checked
<p>Check that an isolation valve is installed in the discharge line.</p>	<p>The isolation valve is required for:</p> <ul style="list-style-type: none"> <li>• Priming</li> <li>• Regulation of flow</li> <li>• Inspection and maintenance of the pump</li> </ul> <p>See Example: Discharge piping equipment for illustrations.</p>	
<p>Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.</p>	<p>The location between the isolation valve and the pump allows inspection of the check valve.</p>	

Check	Explanation/comment	Checked
	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**



**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.

## Auxiliary-piping checklist

### Precautions



**WARNING:**

- Cooling systems such as those for bearing lubrication and mechanical-seal systems must be operating properly to prevent excess heat generation, sparks, and premature failure.
- 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.

**NOTICE:**

The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.

### 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 1 gpm (4 lpm). If the bearing and seal chamber cover cooling are provided, then the auxiliary piping must flow at 2 gpm (8 lpm).	–	
Check that the cooling water pressure does not exceed 100 psig (7.0 kg/cm <sup>2</sup> ).	–	

## 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.	

# Commissioning, Startup, Operation, and Shutdown

## Preparation for startup



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**WARNING:**

- Failure to follow these precautions before you start the pump will lead to serious personal injury and equipment failure.
  - Do not operate the pump below the minimum rated flows or with the suction or discharge valves closed. These conditions can create an explosive hazard due to vaporization of pumped fluid and can quickly lead to pump failure and physical injury.
  - Never operate the pump without the coupling guard correctly installed.
  - Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
  - Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- 

### Precautions

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**NOTICE:**

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

You must follow these precautions before you start the pump:

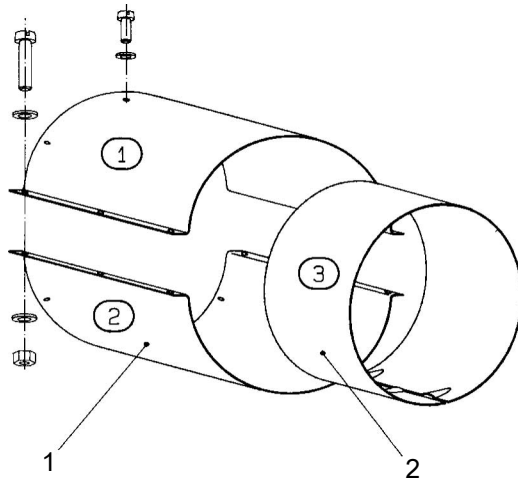
- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the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

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

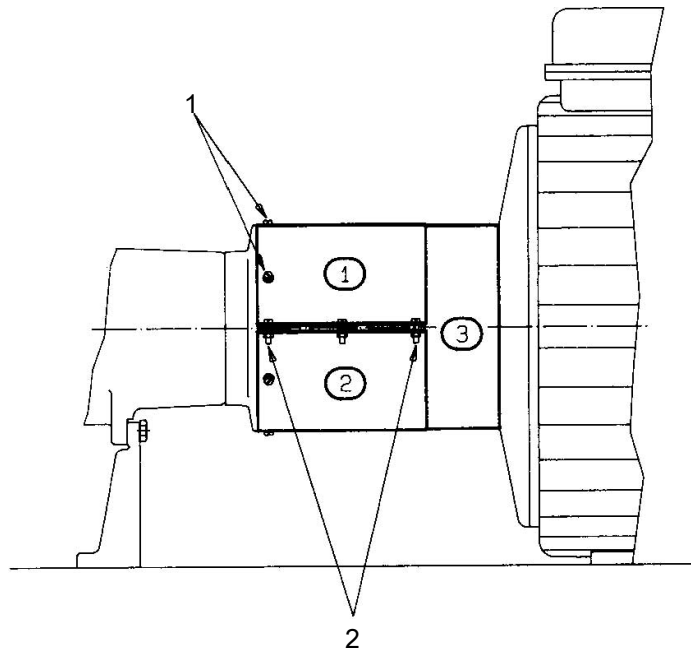
## Remove the coupling guard

1. Identify the parts of the coupling guard.

**IMPORTANT:** For pumps with CE conformance, the coupling guard fasteners have devices that keep them from completely detaching from the guard or the pump. Do not remove these devices or separate the fasteners from the guard or the pump.

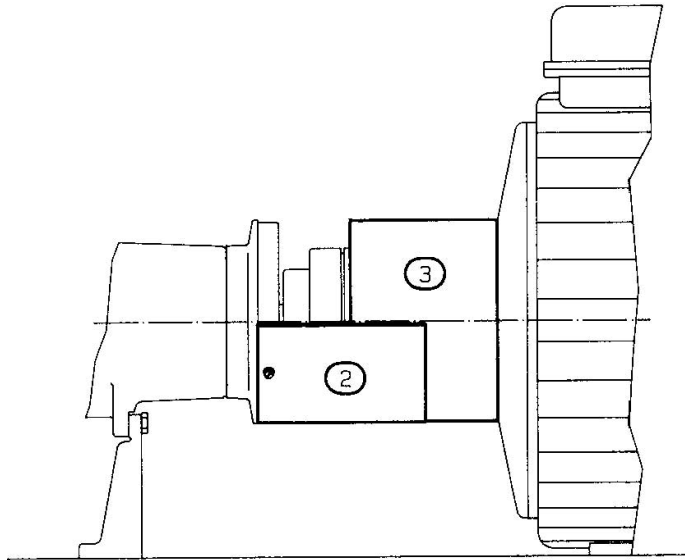


1. Coupling guard – two equal halves (parts 1 and 2)
  2. Adjusting piece (part 3)
2. Remove the screws (2) that attach the two halves (parts 1 and 2) of the coupling guard.

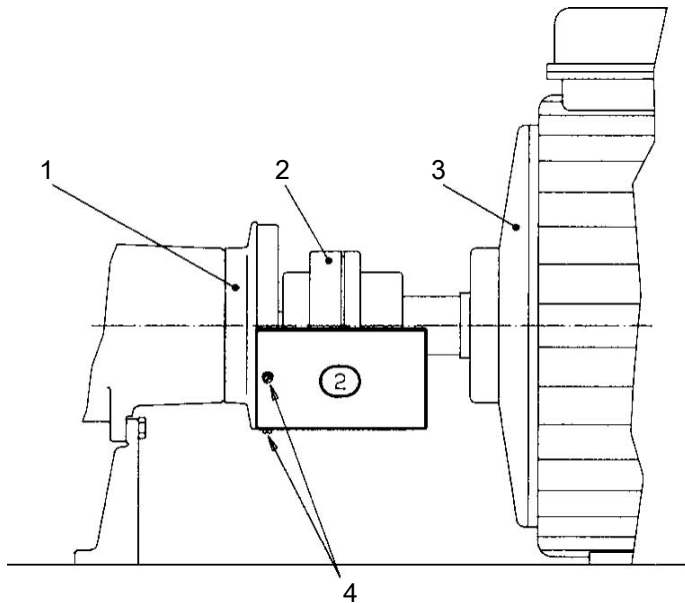


3. Remove the screws (1) that attach the top half (part 1) of the coupling guard to the bearing cover.
4. Remove the top half (part 1) of the coupling guard.
5. Remove the adjusting piece (part 3).





6. Remove the screws (4) that attach the bottom half (part 2) of the coupling guard to the bearing cover (1).



1. Bearing cover
2. Coupling
3. Motor
4. Screws

7. Remove the bottom half (part 2) of the coupling guard.

## Check the rotation



### WARNING:

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

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

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

## Couple the pump and driver

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### WARNING:

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

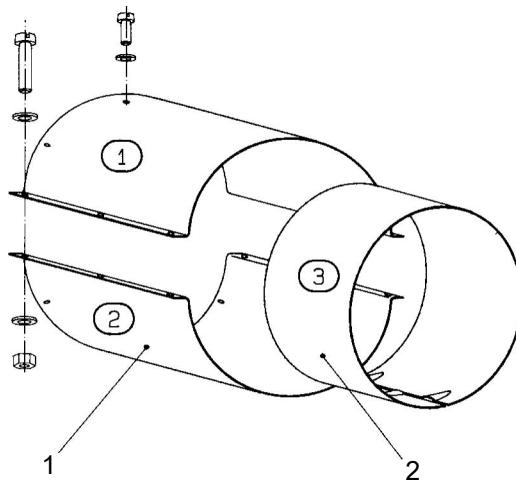
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Couplings must have proper certification to be used in an ATEX classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling.

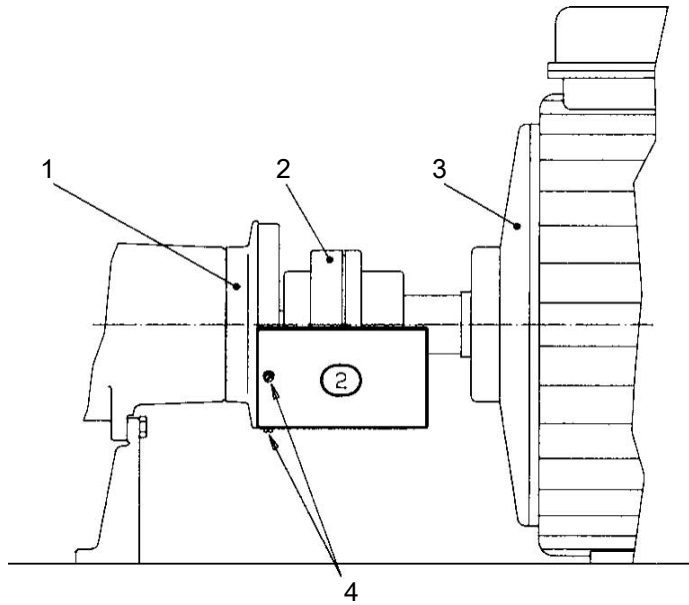
## Install the coupling guard

1. Identify the parts of the coupling guard.

**IMPORTANT:** For pumps with CE conformance, the coupling guard fasteners have devices that keep them from completely detaching from the guard or the pump. Do not remove these devices or separate the fasteners from the guard or the pump.

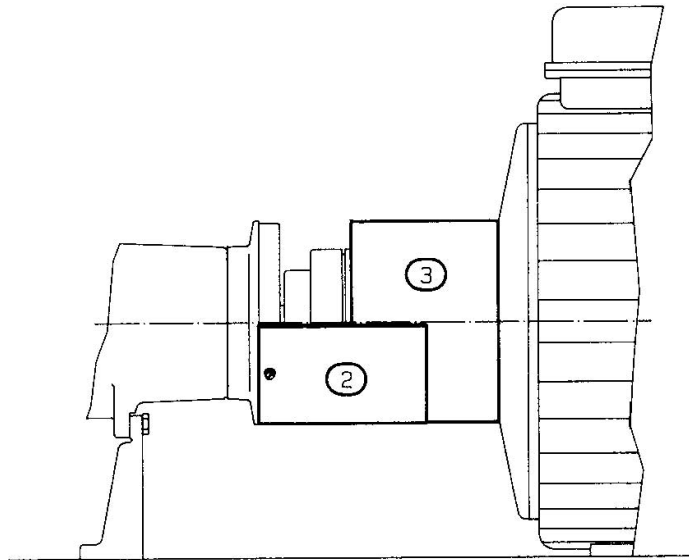


1. Coupling guard – two equal halves (parts 1 and 2)
  2. Adjusting piece (part 3)
2. Screw the bottom half (part 2) of the coupling guard to the bottom of the bearing cover (1).

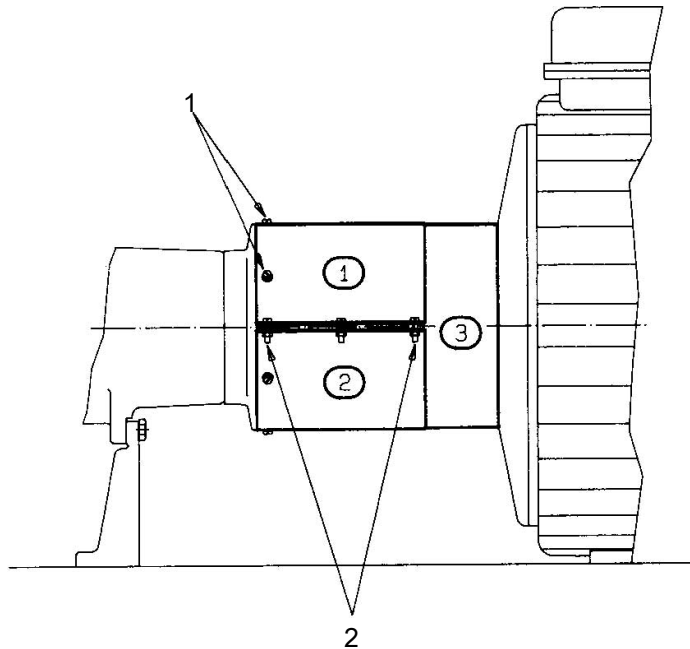


1. Bearing cover
2. Coupling
3. Motor
4. Screws

3. Insert the adjusting piece (part 3) with the slot facing down while you press axially to the motor.



4. Attach the top half (part 1) of the coupling guard to the bearing cover, using screws (1).



5. Attach both halves (parts 1 and 2) of the coupling guard, using screws (2). This action also secures the adjusting piece (part 3).

## Bearing lubrication



### WARNING:

Make sure to properly lubricate the bearings. Failure to do so can result in excess heat generation, sparks, and premature failure.

**NOTICE:** Be certain to 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.

## 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 104°F (40°C)	0.0713 ±0.006 in. <sup>2</sup> /sec (46 ±4 mm <sup>2</sup> /sec)
Flash point (Cleveland)	347°F (175°C)
Setting point (Pourpoint)	5°F (-15°C)

Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below 14°F [-10°C].)	Higher than permitted bearing temperature
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### Oil quantity requirements

Bearing frame size	Oil quantity in quarts (liters)
24	0.53 (0.5)
32	1.16 (1.1)
42	1.48 (1.4)
48	1.8 (1.7)

## Lubricate the bearings with oil



### WARNING:

Make sure to properly lubricate the bearings. Failure to do so can result in excess heat generation, sparks, and premature failure.

### 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.

## 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.

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



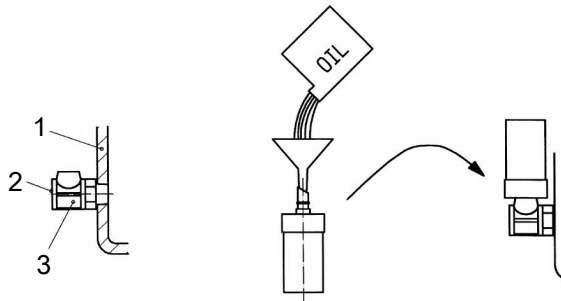
## Fill the bearing frame with an optional oiler

### 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

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.

## Lubricating-grease requirements

### 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 -22°F to 194°F (-30°C to 90°C) when measured at the surface of the bearing frame.
- Make sure that bearing temperatures, measured at the bearing frame, are no more than 122°F (50°C) above the ambient temperature and never exceed 194°F (90°C) when checked weekly.

## 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

## 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

## 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

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 5 to 15 psi (0.35 to 1.01 kg/cm <sup>2</sup> ) greater than the seal chamber pressure. The injection rate must be 0.5 to 2 gpm (2 to 8 lpm).
Other	You can use other methods that employ multiple gland or seal chamber connections. Refer to the mechanical seal reference drawing and piping diagrams.

## Packed stuffing box option



### WARNING:

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

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.

## Connection of sealing liquid for a packed stuffing box



### WARNING:

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

### 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.

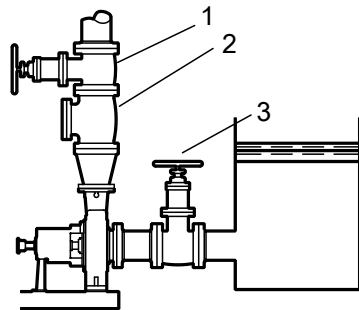
**Conditions for application of an external liquid**

If...	Then...
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 15 psi (1.01 kg/cm <sup>2</sup> ) above the stuffing box pressure.

## Pump priming

### Prime the pump with the suction supply above the pump

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



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

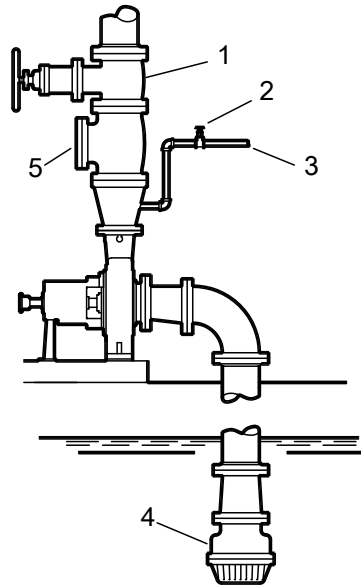
### Prime the pump with the suction supply below the pump

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

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

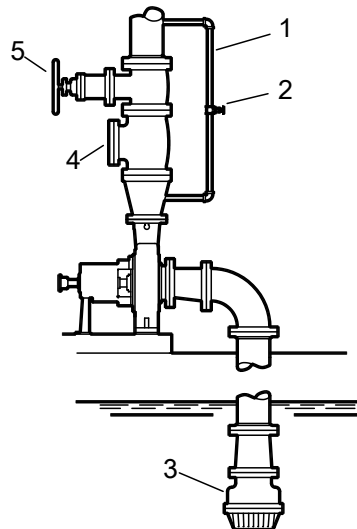


This illustration is an example of priming the pump with a foot valve and an outside supply:



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

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



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

## Other methods of priming the pump

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

- Prime by ejector
- Prime by automatic priming pump

## Start the pump



### CAUTION:

- Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart the pump.
- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

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.

## Limits of operation

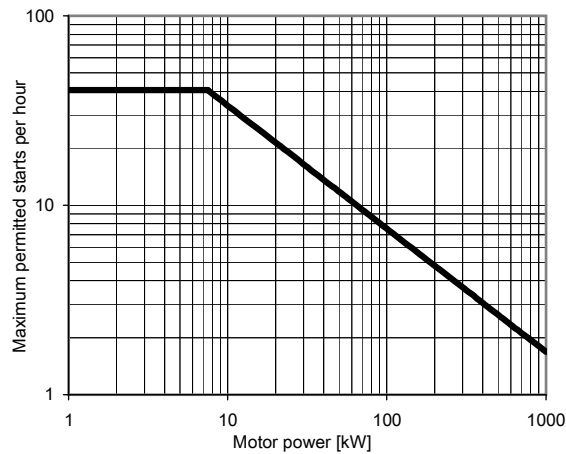
### Flow limits

These flow limits are valid unless other data is available in the curves or data sheets:

$Q_{\min} = 0.1 \times Q_{\text{BEP}}$	Short-term operation
$Q_{\min} = 0.3 \times Q_{\text{BEP}}$	Continuous operation
$Q_{\max} = 1.2 \times Q_{\text{BEP}}$	Short-term operation as long as $\text{NPSH}_{\text{facility}} > \text{NPSH}_{\text{pump}} + 1.64 \text{ ft (0.50 m)}$

### Permitted number of starts

Do not start the pump more than the number of times shown in this chart:



For pumps that use electric motors, do not start the motor more than the number of times listed in the motor operation instructions. If two different numbers are shown, the lower number of starts is the limit.

## Pump operation precautions

### General considerations



#### CAUTION:

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

### Operation at reduced capacity



#### WARNING:

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



#### CAUTION:

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

### Operation under freezing conditions

#### NOTICE:

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

## Shut down the pump

---



**WARNING:**

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

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

## Make the final alignment of the pump and driver

---



**WARNING:**

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

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

1. Run the unit under actual operating conditions for enough time to bring the pump, driver, and associated system to operating temperature.
2. Shut down the pump and the driver.
3. Remove the coupling guard.  
See Remove the coupling guard in the Maintenance chapter.
4. Check the alignment while the unit is still hot.  
See Pump-to-driver alignment in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

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# Maintenance

## Maintenance schedule

### Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

### Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.

### Routine inspections

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

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.
- 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.
  - Change the oil more often if there are adverse atmospheric or other conditions that might contaminate or break down the oil.
- Check the shaft alignment, and realign as required.

### Annual inspections

Perform these inspections one time each year:

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

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

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

## Bearing maintenance

These bearing lubrication sections list different temperatures of pumped fluid. If your pump is ATEX certified and the pumped fluid exceeds the permitted temperature values, then consult your IIT 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 140°F (60°C)	After 300 hours of operation	Every 8760 hours of operation
140°F to 176°F (60°C to 80°C)	After 300 hours of operation	Every 4000 hours of operation
176°F to 212°F (80°C to 100°C)	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.

## 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 104°F (40°C)	0.0713 ±0.006 in. <sup>2</sup> /sec (46 ±4 mm <sup>2</sup> /sec)
Flash point (Cleveland)	347°F (175°C)
Setting point (Pourpoint)	5°F (-15°C)
Application temperature (Contact your IIT representative to determine a suitable type of lubrication if ambient temperatures are below 14°F [-10°C].)	Higher than permitted bearing temperature

### Oil quantity requirements

Bearing frame size	Oil quantity in quarts (liters)
24	0.53 (0.5)

Bearing frame size	Oil quantity in quarts (liters)
32	1.16 (1.1)
42	1.48 (1.4)
48	1.8 (1.7)

## 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.

Dispose of used oil in accordance with local environmental regulations.

## Lubricating-grease requirements

### 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 -22°F to 194°F (-30°C to 90°C) when measured at the surface of the bearing frame.
- Make sure that bearing temperatures, measured at the bearing frame, are no more than 122°F (50°C) above the ambient temperature and never exceed 194°F (90°C) when checked weekly.

## Regrease the grease-lubricated bearings

### NOTICE:

Make sure that the grease container, the greasing device, and the fittings are clean. Failure to do this can result in impurities entering the bearing housing when you regrease 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 9°F to 18°F (5°C to 10°C) 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.

## Shaft seal maintenance

### Mechanical-seal maintenance



### WARNING:

The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.



**CAUTION:**

Never operate the pump without liquid supplied to mechanical seal. If you run a mechanical seal dry, even for a few seconds, this can cause seal damage. Physical injury can occur if a mechanical seal fails.

---

**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.

**Packed stuffing-box maintenance**

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**WARNING:**

- Packed stuffing boxes are not allowed in an ATEX-classified environment.
  - Never attempt to replace the packing until the driver is properly locked out and the coupling spacer is removed.
- 

**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 minute 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.



## Disassembly

### Disassembly precautions



---

**WARNING:**

- This manual clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, open vent or drain valves, or disconnect the piping.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

---

**NOTICE:**

Make sure that all replacement parts are available before you disassemble the pump for overhaul.

---

### Tools required

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

- Bearing puller
- Brass drift punch
- Cleaning agents and solvents
- Dial indicators
- Feeler gauges
- Hex wrenches
- Hydraulic press
- Induction heater
- Leveling blocks and shims
- Lifting sling
- Micrometer
- Rubber mallet
- Screwdriver
- Snap-ring pliers
- Torque wrench with sockets
- Wrenches

### Drain the pump



---

**CAUTION:**

- Allow all system and pump components to cool before you handle them to prevent physical injury.
- 

1. Close the isolation valves on the suction and discharge sides of the pump.

You must drain the system if no valves are installed.

2. Open the drain valve.  
Do not proceed until liquid stops coming out of the drain valve. If liquid continues to flow from the drain valve, the isolation valves are not sealing properly and you must repair them before you proceed.
3. 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.
4. Drain the liquid from the piping and flush the pump if it is necessary.
5. Disconnect all auxiliary piping and tubing.
6. Remove the coupling guard.

## Remove the coupling

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

## Remove the back pull-out assembly



### CAUTION:

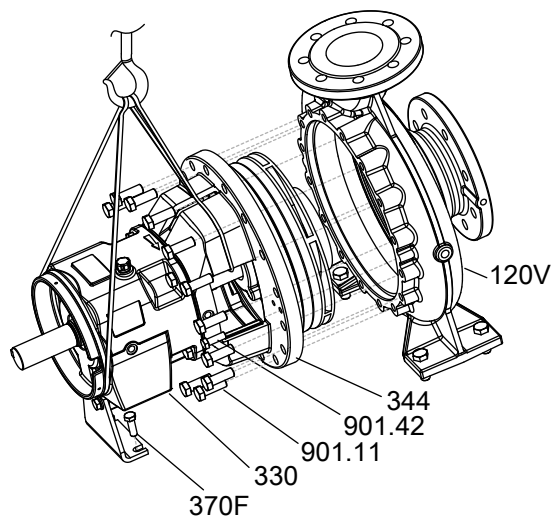
Never remove the back pull-out assembly without assistance.

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.
    3. Remove the oil reservoir, if equipped.

### NOTICE:

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. Place one sling from the hoist through the frame adapter (344) and a second sling from the hoist to the bearing frame (330).



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

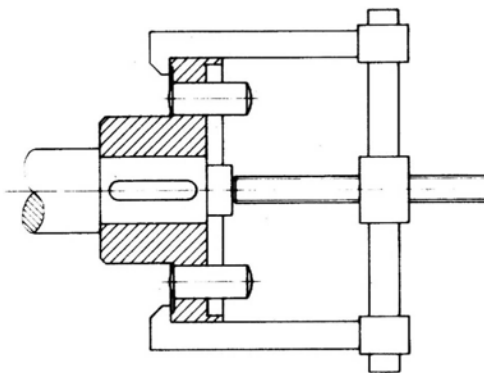
**WARNING:**

- Never use heat to disassemble the pump due to the risk of an explosion from trapped liquid.

5. 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.
6. Remove the back pull-out assembly from the casing (102V).
7. Mark and remove the shims from under the frame foot and save them for reassembly.
8. Remove and discard the casing gasket.  
You will insert a new casing gasket during reassembly.
9. Remove the jackscrews.
10. 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.

**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.

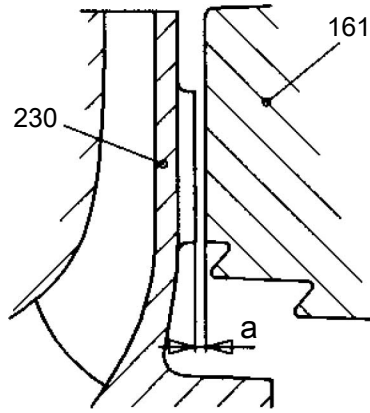
**Remove the impeller****WARNING:**

Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped liquid, resulting in severe physical injury and property damage.

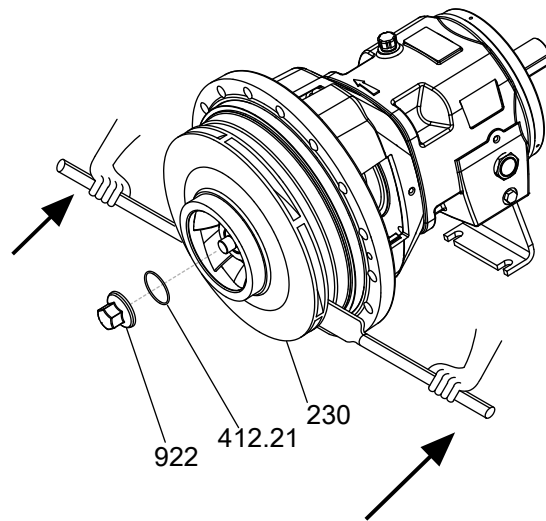
**CAUTION:**

Wear heavy work gloves when you handle impellers. The sharp edges can cause physical injury.

1. If the impeller has back vanes, note the axial clearance (a) between the impeller (230) and the casing cover (161).



2. Secure the rotor at the coupling end and loosen the impeller nut (922) (right-threaded).
3. Remove the impeller (230) with two screwdrivers or pry bars.



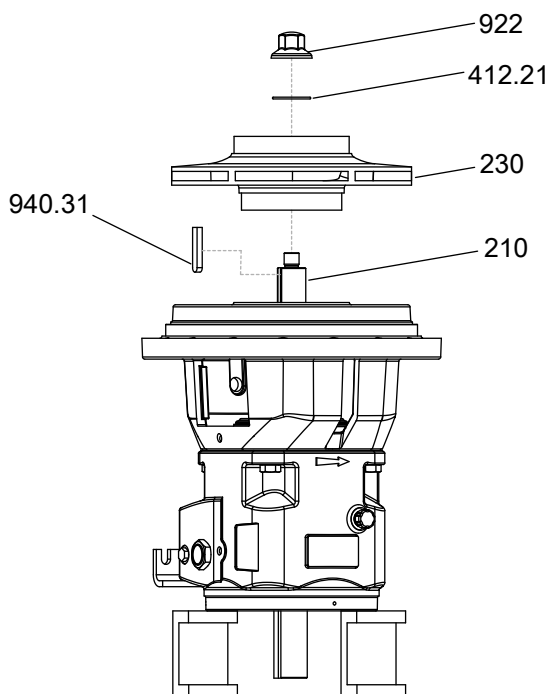
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**NOTICE:**

Be sure to locate the pry bars under the impeller vanes in order to prevent damage to the impeller.

---

4. Remove the impeller key (940.31).
5. Place the back pull-out assembly in a vertical position before you proceed with the disassembly.



---

**NOTICE:**

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

---

## 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) if it is used.

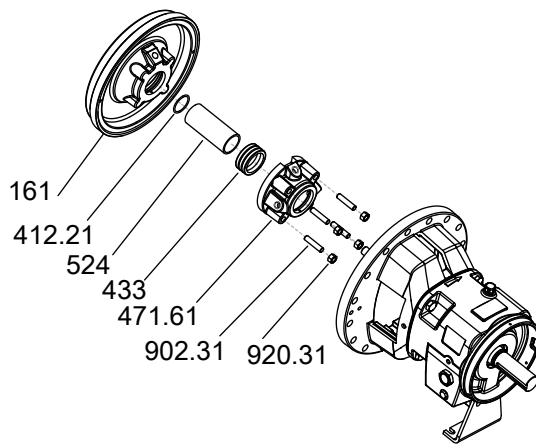
The mechanical seal is attached to the sleeve.

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**NOTICE:** Be careful with the stationary portion of the mechanical seal that is either clamped between the backplate and the gland or seated in the seal-chamber bore. Failure to do so may result in equipment damage.

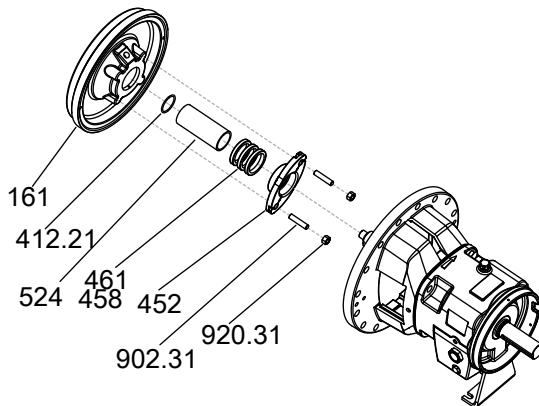
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5. Remove the rotary portion of the seal from the sleeve by loosening the setscrews and sliding it off the sleeve.  
Refer to the mechanical-seal instructions for more information.
6. Remove the gland (452), the stationary portion of the seal, and the O-ring (412.21).



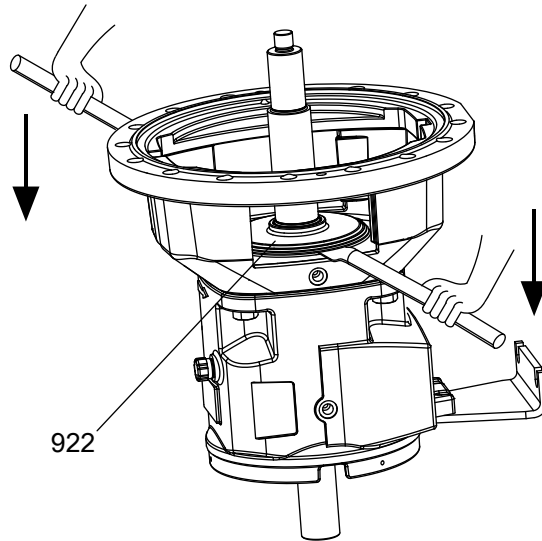
### Remove the stuffing-box cover

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 the packing (461) and lantern ring (458) from the stuffing-box cover (161).  
A lantern ring does not come with self-lubricating graphite packing.

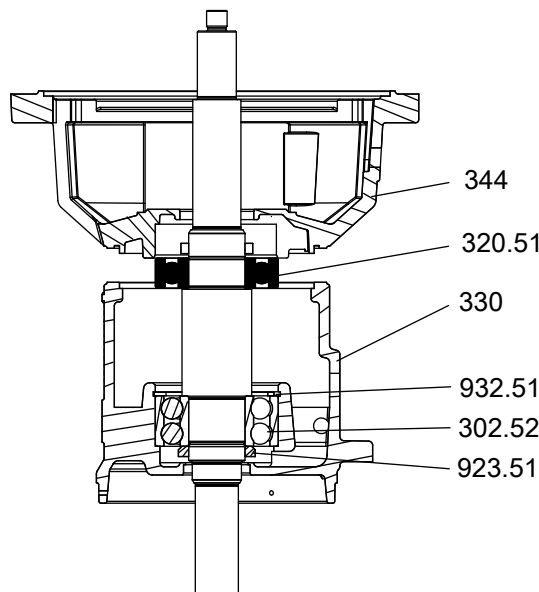


### Disassemble the power end

1. Use two screwdrivers in order to remove the flinger (507).



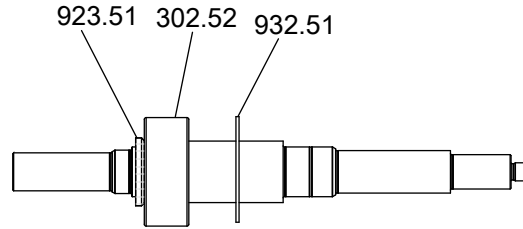
2. Loosen and remove the hexagon bolts (901.41) that hold the frame adapter to the bearing frame.
3. Remove the frame adapter (344) from the bearing frame (330).



4. 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	94/C 40	8 in. (200 mm)
32, 42	94/C 85	10 in. (250 mm)
48	94/C 85	12 in. (300 mm)

5. 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).



6. 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.
7. Use a hydraulic press or bearing puller in order to remove the radial and thrust bearings (320.51 and 320.52) from the shaft.

## Pre-assembly inspections

### Guidelines

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

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

---

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

---

## Replacement guidelines

### Casing check and replacement

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

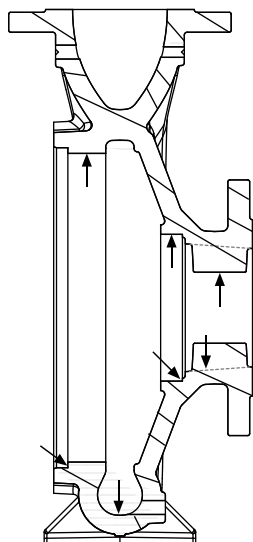
Repair or replace the casing if you notice any of these conditions:

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



### Casing areas to inspect

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



**Figure 9: Areas to inspect on the casing**

### Impeller replacement

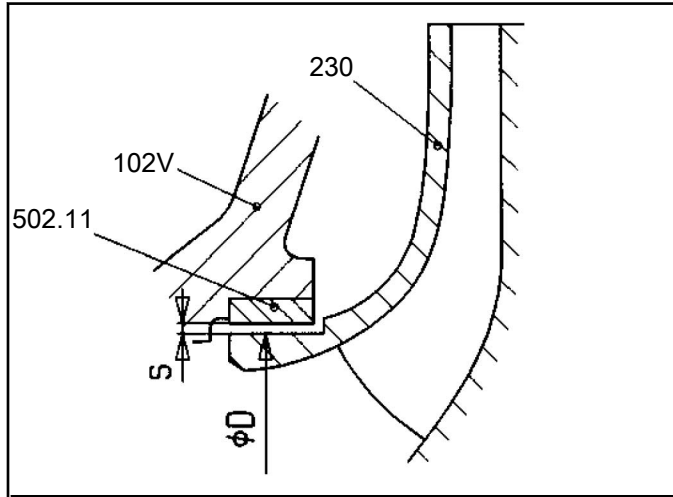
This table shows the criteria for replacing the impeller:

Impeller parts	When to replace
Impeller vanes	<ul style="list-style-type: none"> <li>• When grooved deeper than 1/16 in. (1.6 mm), or</li> <li>• When worn evenly more than 1/32 in. (0.8 mm)</li> </ul>
Vane edges	When you see cracks, pitting, or corrosion damage

### Impeller clearances and reconditioning

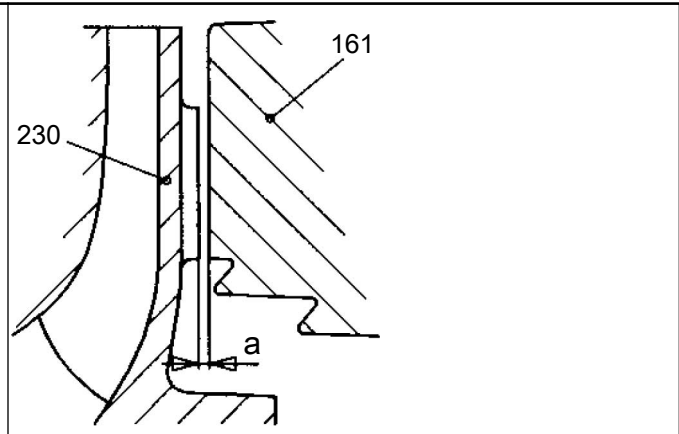
When you recondition the impeller, consider this information:

- For pumps installed in potentially explosive atmospheres, you must replace worn parts when the wear limits have been reached.
- For volute casings (102V) with a wear ring (502.11) and casing covers (161) with a wear ring (502.31), you can restore the correct clearance in one of two ways:
  - Replace the impeller and the wear ring.
  - Contact your ITT representative in order to acquire a customized wear ring (bored to fit) in order to avoid replacement of the impeller.
- When the volute casing (102V) or casing cover (161) without a wear ring must be repaired, you can install a wear ring in order to renew pump performance. The volute casing and/or the casing cover must be re-machined. Contact your ITT representative for assistance.



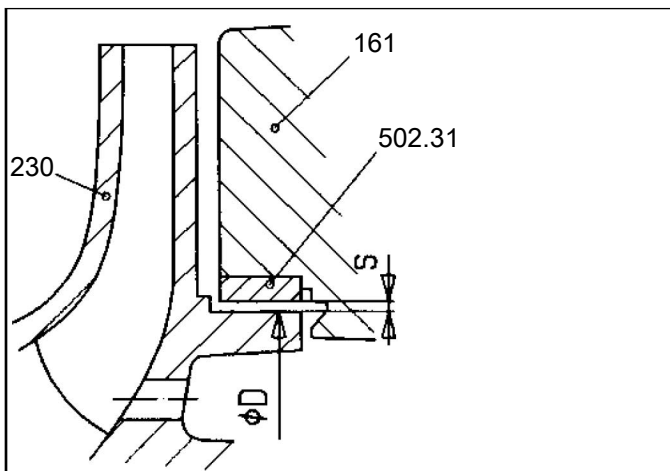
s	Radial clearance
D	Nominal diameter
102V	Volute casing
230	Impeller
502.11	Optional wear ring

**Figure 10: Impeller clearance, suction side**



a	Axial clearance
161	Seal chamber/stuffing box cover
230	Impeller

**Figure 11: Impeller clearance, back vanes**



Measure the radial clearance (s) on the drive side of the impeller on the following sizes only:

- 100-65-315
- 125-80-315
- 125-80-400
- 125-100-315
- 125-100-400
- 150-125-315
- 150-125-400
- 200-150-315
- 200-150-400

s	Radial clearance
D	Nominal diameter
161	Seal chamber/stuffing box cover
230	Impeller
502.31	Optional wear ring

**Figure 12: Impeller clearance, drive side**

**Table 3: Impeller clearance limits**

Nominal diameter D in mm			60/68	85	100/120/135	155/175	220
Radial clearance (s)	New	Min.	0.005 in. (0.15 mm)	0.007 in. (0.17 mm)	0.008 in. (0.20 mm)	0.009 in. (0.22 mm)	0.010 in. (0.25 mm)
		Max.	0.007 in. (0.19 mm)	0.009 in. (0.22 mm)	0.009 in. (0.24 mm)	0.010 in. (0.27 mm)	0.012 in. (0.30 mm)
	Wear limits		0.030 in. (0.78 mm)	0.033 in. (0.85 mm)	0.035 in. (0.90 mm)	0.041 in. (1.05 mm)	0.045 in. (1.15 mm)
Axial clearance (a)	New		0.031 to 0.047 in. (0.8 to 1.2 mm)				
	Wear limits		0.067 in. (1.7 mm)				

**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**

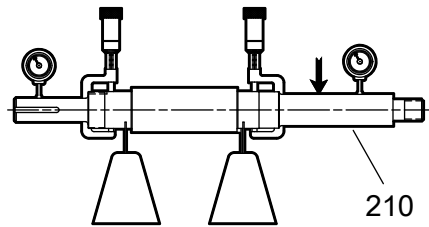
Replace the oil seal if it has cuts or cracks.

**Gaskets, O-rings, and seats replacement**

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

## Shaft and sleeve replacement guidelines

### Straightness check

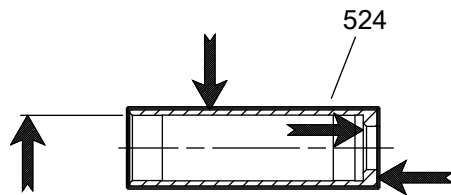


Replace the shaft (210) if runout exceeds the values in this table:

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

	Sleeve fit in inches (millimeters)	Coupling fit in inches (millimeters)
With sleeve	0.001 (0.025)	0.001 (0.025)
Without sleeve	0.002 (0.051)	0.001 (0.025)

### 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.

## Bearing-frame inspection

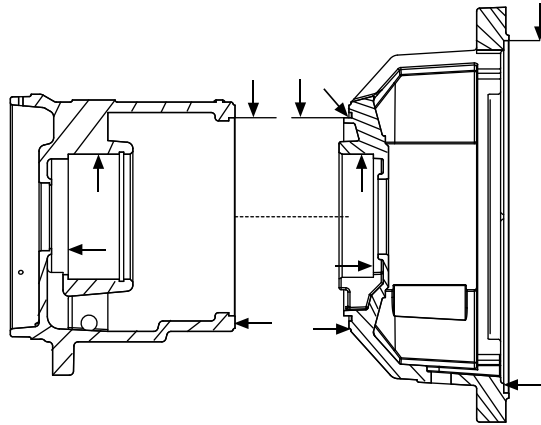
### Checklist

Check the bearing frame for these conditions:

- Visually inspect the bearing frame and frame foot for cracks.
- Check the inside surfaces of the frame for rust, scale, or debris. Remove all loose and foreign material.
- Make sure that all lubrication passages are clear.
- If the frame has been exposed to pumped fluid, inspect the frame for corrosion or pitting.
- Inspect the inboard-bearing bores.

### Surface inspection locations

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



**Figure 13: Inside and outside inspection locations**

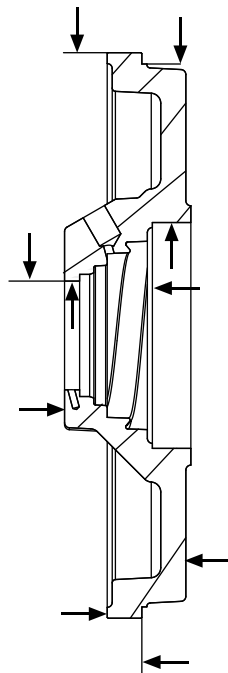
## Seal chamber and stuffing box cover inspection

### Checklist

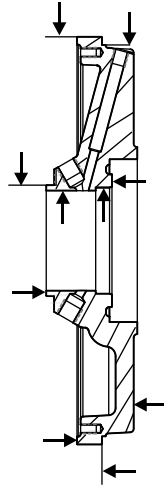
Perform these checks when you inspect the seal chamber and stuffing box cover:

- Make sure that these surfaces are clean:
  - Seal chamber and stuffing box cover
  - Mounting
- Make sure there is no pitting or wear greater than 1/8 in. (3.2 mm) 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 14: Seal chamber**



**Figure 15: Stuffing box cover**

## 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.

## Reassembly

### Assemble the rotating element and bearing frame



#### CAUTION:

Wear insulated gloves when you use a bearing heater. Bearings get hot and can cause physical injury.

#### NOTICE:

- Make sure that the pipe threads are clean, and that you apply thread sealant to the plugs and fittings.
- Use an induction heater that heats as well as demagnetizes the bearings when you install bearings.

#### 1. Install the bearings:

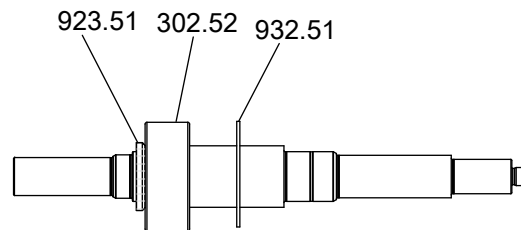
- a) Heat the bearings to 100°C (212°F) in an oil bath or with a bearing heater.
- b) Clamp the shaft (210) in a bench vise with the thrust bearing surface extending beyond the end of the vise. Use soft jaws to protect the shaft surface.
- c) Install the properly-heated thrust bearing (320.52) onto the 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.

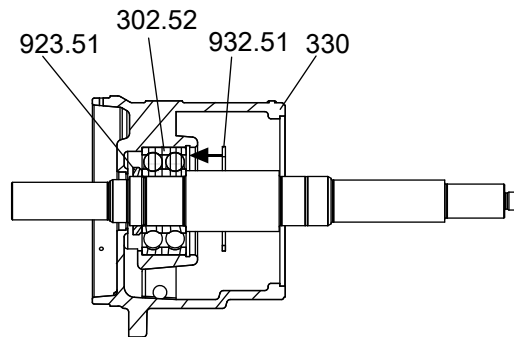
- d) Apply Thread-EZE to the bearing locknut threads on the shaft.
- e) Thread the bearing locknut (923.51) onto the thrust end of the shaft.

The bearing nut is right-hand threaded and is self-locking. It can be reused up to five times, if handled properly.

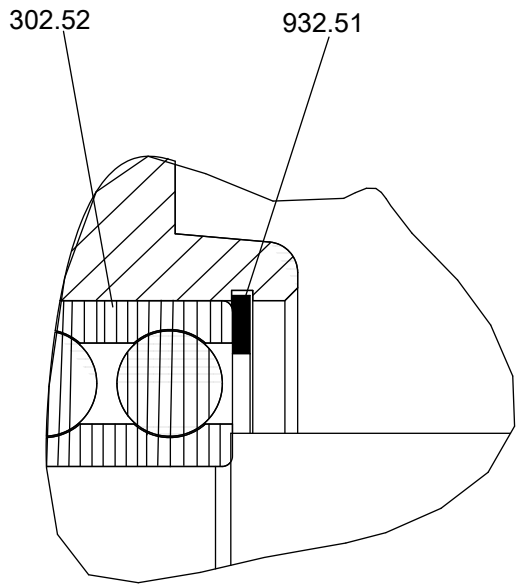
- f) Allow the bearing to cool for 10 minutes and retighten.



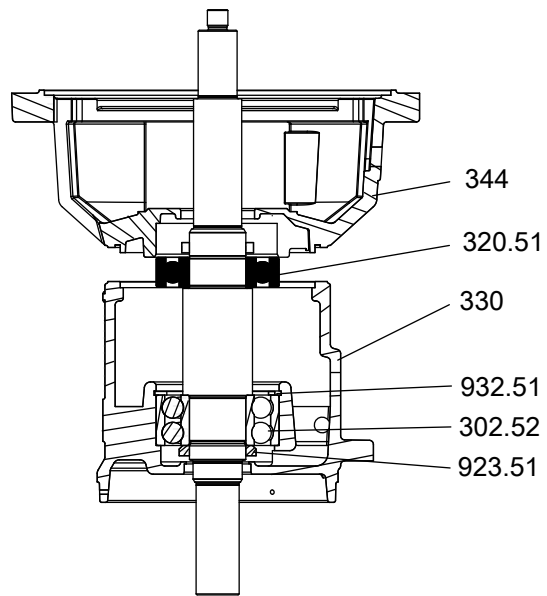
2. Install the shaft assembly into the bearing frame:
  - a) Coat the outside of the bearings with oil.
  - b) Coat all the internal surfaces of the bearing frame (330) with oil.
  - c) Turn the bearing frame (330) vertically with the larger open end pointing up.
  - d) Install the shaft assembly into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



- e) 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.

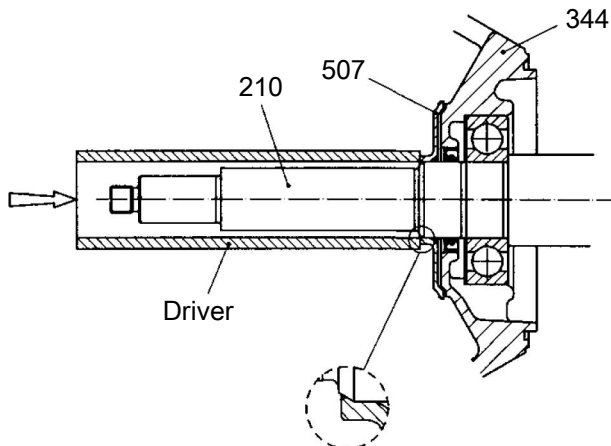


- f) As a recommendation, thread a stud into one of the four threaded bolt holes in the frame adapter (344), and finger tighten only.  
The stud must be between 40 and 50 mm in length. This helps you to align the adapter bolt holes to the frame bolt holes during assembly.
- g) Slide the properly heated 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 (334) 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.
3. Push the flinger (507) onto the shaft (210) until it rests axially against the shoulder of the shaft. Maintain a clearance of at least 0.028 in. (0.7 mm) between the flinger and the frame adapter (344). If necessary, use a driver in order to install the flinger. Do not use excessive force.



## Shaft sealing



### WARNING:

The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

### NOTICE:

The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.

## Seal the shaft with a packed stuffing box



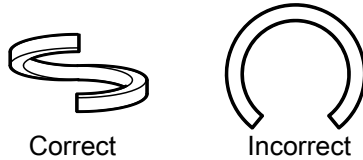
### WARNING:

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

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.

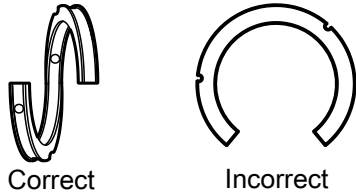
### Packing Rings



Correct

Incorrect

### Lantern Rings



Correct

Incorrect

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.

## Seal the shaft with a cartridge mechanical seal




---

#### WARNING:

The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

---

#### NOTICE:

The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.

---

1. Slide the cartridge seal onto the shaft or sleeve until it contacts the inboard labyrinth oil seal.
2. Assemble the seal chamber.
3. Slide the cartridge seal into the seal chamber and secure using the four studs and nuts.
4. Continue with the pump reassembly.
5. Tighten the setscrews in the seal locking ring in order to secure the seal to the shaft.
6. Remove the centering clips from the seal.

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




---

#### WARNING:

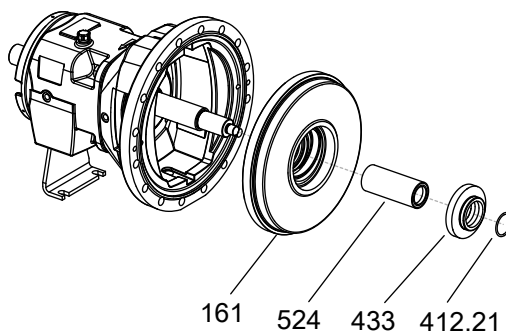
The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

---

**NOTICE:**

The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.

1. Assemble the seal chamber:
  - a) Install a seal-chamber cover and fasten with hexagon head screws.
  - b) Install the shaft sleeve (524).



2. Mark the shaft and sleeve at the face of the seal chamber.
3. Continue the complete reassembly of the pump, except for the mechanical seal.
4. Scribe a line on the marked shaft and sleeve at the face of the seal chamber.
5. Remove the casing, the impeller, and the seal chamber.
6. If applicable, slide the gland, with the stationary seat and gland gasket installed, onto the shaft until it contacts the inboard labyrinth oil seal.
7. Install the mechanical-seal rotary unit according to the manufacturer's instructions.  
Use the scribed line and the seal-reference dimension.
8. Reinstall the seal chamber.
9. Slide the gland on the seal-chamber studs and secure them with the gland nuts.  
Tighten the nuts evenly so that the gland is seated on the seal-chamber pilot and is perpendicular to the shaft.
10. Complete the reassembly of the pump.

## Install the impeller

**CAUTION:**

Wear heavy work gloves when you handle impellers. The sharp edges can cause physical injury.

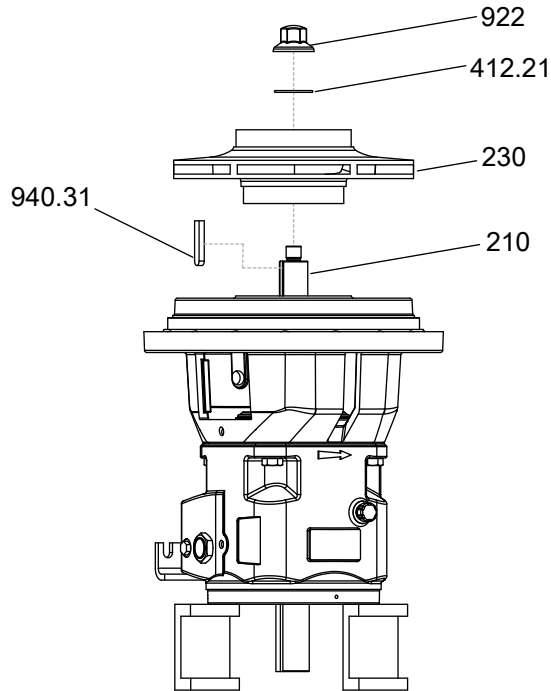
For the fitting threads and for tight tolerances, use a suitable anti-seize compound. Use this, for example, between the shaft sleeve and the shaft or between the impeller and the shaft. This makes the assembly and the next disassembly easier to perform.

**NOTICE:**

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

Perform these steps in order to install the impeller:

1. Insert the impeller key (940.31) in the shaft (210).
2. Slide the impeller (230) onto the shaft.
3. Secure the rotor at the coupling end and tighten the impeller nut (922) (right-threaded).
4. Tighten the impeller nut to the torques listed in the Torque values table.



---

**NOTICE:**

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

---

## Install the back pull-out assembly

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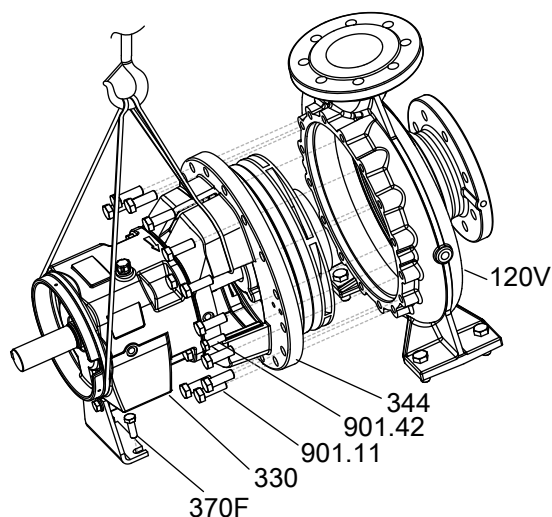


**CAUTION:**

Never remove the back pull-out assembly without assistance.

---

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.



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.

## 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.

## Assembly references

### Sound pressure levels

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

Nominal power $P_N$ in kW	Pump			Pump and motor		
	2950 min <sup>-1</sup>	1450 min <sup>-1</sup>	975 min <sup>-1</sup>	2950 min <sup>-1</sup>	1450 min <sup>-1</sup>	975 min <sup>-1</sup>
0,55	50,0	49,5	49,0	58,0	52,0	51,5
0.75	52,0	51,0	50,5	59,0	54,0	53,0
1,1	54,0	53,0	52,5	60,0	55,5	54,5
1,5	55,5	55,0	54,5	63,5	57,0	56,0
2,2	58,0	57,0	56,5	64,5	59,0	58,5
3,0	59,5	58,5	58,0	68,5	61,0	62,0

Nominal power $P_N$ in kW	Pump			Pump and motor		
	2950 min <sup>-1</sup>	1450 min <sup>-1</sup>	975 min <sup>-1</sup>	2950 min <sup>-1</sup>	1450 min <sup>-1</sup>	975 min <sup>-1</sup>
4,0	61,0	60,0	59,5	69,0	63,0	63,0
5,5	63,0	62,0	61,5	70,0	65,0	65,0
7,5	64,5	63,5	63,0	70,5	67,0	67,0
11,0	66,5	65,5	65,0	72,0	69,0	68,5
15,0	68,0	67,0	66,5	72,5	70,0	70,5
18,5	69,0	68,5	68,0	73,0	70,5	74,0
22,0	70,5	69,5	69,0	74,5	71,0	74,0
30,0	72,0	71,0	70,5	75,0	72,0	73,0
37,0	73,0	72,0	71,5	76,0	73,5	73,5
45,0	74,0	73,0	72,5	77,0	74,5	73,5
55,0	75,5	74,5	74,0	78,0	75,5	75,0
75,0	77,0	76,0	75,5	80,0	76,5	76,0
90,0	78,0	77,0	—	80,5	77,5	—
110,0	79,0	78,0	—	82,5	78,5	—
132,0	80,0	79,0	—	83,0	79,5	—
160,0	81,0	80,0	—	83,5	80,5	—

Table notes:

- Sound pressure level  $L_{pA}$  measured in 1 m distance from the pump surface according to DIN 45635, part 1 and 24.
- Room and foundation influences are not considered.
- The tolerance for these values is +/-3 dB(A).
- Addition with 60 Hz operation:
  - Pump: —
  - Pump with motor: +4 dB(A)

## Bolt torque values

### Screw torque values

This table provides the recommended screw torque values.

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

### Nut torque values

This table provides the recommended nut torque values.

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

## 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	6307 - C3	3307A - C3
32	6309 - C3	3309A - C3
42	6311 - C3	3311A - C3
48	6313 - C3	3313A - C3

## 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.

### Spare parts stock guidelines

When you stock spare parts, consider these guidelines:

- Stock spare parts in order to ensure two years of continuous operation.
- If no other guidelines apply, stock the recommended number of parts listed in the spare parts table.
- Make sure that you maintain an adequate number of spare parts, especially parts that require longer delivery times:
  - Mechanical seals
  - Parts made from special materials
  - Parts that need to be specially sized
- Store spare parts in dry, clean areas in their original packaging until you need them.

### 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)
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)
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



# Troubleshooting

## 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.

## Troubleshooting

Symptom	Cause	Remedy
The stuffing box is leaking excessively.	The packing gland is not adjusted properly (some models).	Tighten the gland nuts.
	The stuffing box is not packed properly.	Check the packing and repack the box.
	The mechanical seal parts are worn.	Replace the worn parts.
	The mechanical seal is overheating.	Check the lubrication and cooling lines.
	The 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 IIT 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.

## 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>

## Assembly troubleshooting

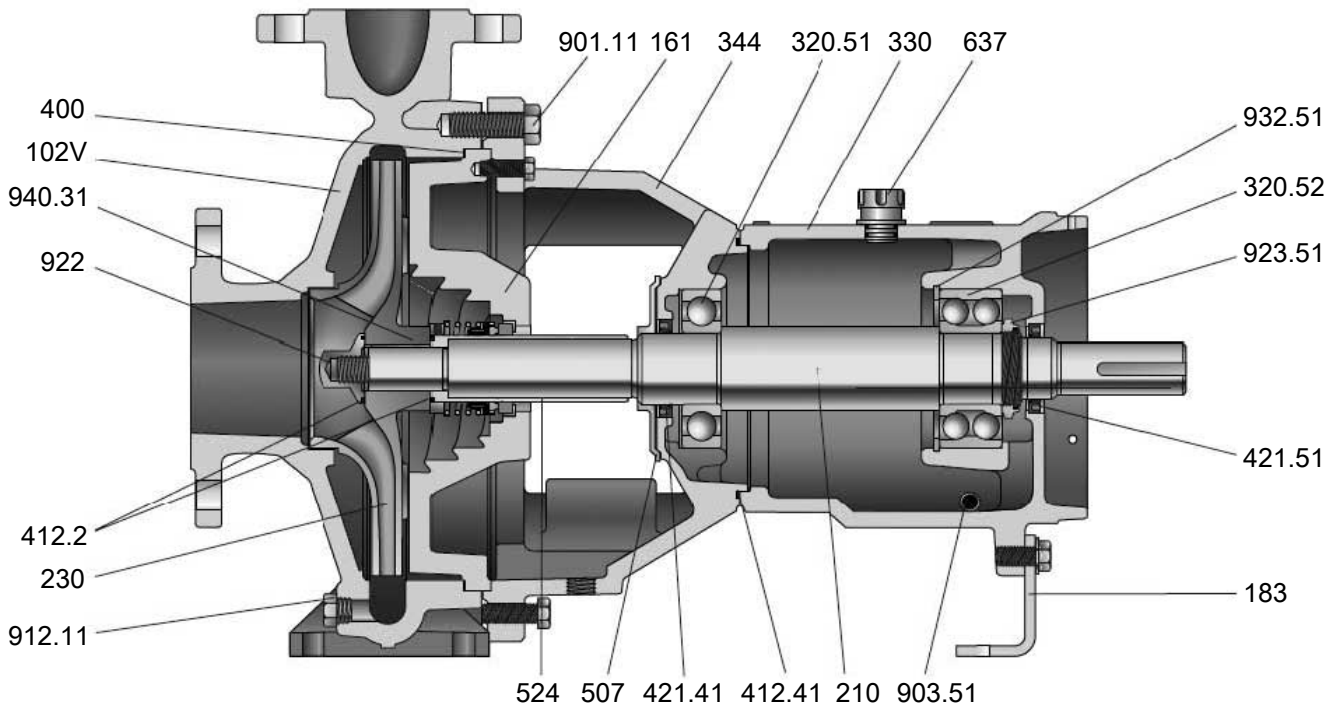
Symptom	Cause	Remedy
There is excessive shaft end play.	The internal clearance of the bearings exceeds the recommended amount.	Replace the bearings with a bearing of the correct type.
	The snap ring is loose in the bearing-housing groove.	Re-seat the snap ring.
There is excessive shaft and sleeve runoff.	The sleeve is worn.	Replace the sleeve.
	The shaft is bent.	Replace the shaft.
There is excessive bearing-frame flange runoff.	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 runoff.	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.

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

# Parts Listings and Cross-Sectional Drawings

## Parts list

Cross-sectional drawing



### Parts list and materials of construction

Item	Part name	Pump material					
		Ductile iron (NL)	316 SS (VV)	Duplex (WW)	Alloy 20 (AA)	Hastelloy (BB/CC)	Titanium (TT)
102V	Casing	Ductile iron	316 SS	Duplex SS	Alloy 20	Hastelloy	Titanium
161	Seal chamber / stuffing box cover	Ductile iron	316 SS	Duplex SS	Alloy 20	Hastelloy	Titanium
183	Support foot	Carbon steel					
210	Shaft	Stainless steel (1.4021)					
230	Impeller	Cast iron	316 SS	Duplex SS	Alloy 20	Hastelloy	Titanium
320.51	Radial bearing	Single row ball bearing					
320.52	Thrust bearing	Double row, angular contact ball bearing					
330	Bearing frame	Cast iron					
344	Frame adapter	Ductile iron					
400	Casing gasket	Non-asbestos aramid fiber					
412.21	O-ring, shaft sleeve and impeller nut	Teflon					
412.41	O-ring, bearing frame	Viton					
421.41	Oil seal, inboard	Lip seal (buna and steel)					

Item	Part name	Pump material					
		Ductile iron (NL)	316 SS (VV)	Duplex (WW)	Alloy 20 (AA)	Hastelloy (BB/CC)	Titanium (TT)
421.51	Oil seal, outboard	Lip seal (buna and steel)					
507	Flinger	Noryl 66					
524	Shaft sleeve	Duplex SS (1.4462)			Alloy 20	Hastelloy	Titanium
637	Oil vent	Steel					
901.11	Casing bolts, hexagon head capscrews	Stainless steel (A2)					
903.51	Drain plug	Steel, magnet-tipped					
912.11	Casing drain plug	316 SS			Alloy 20	Hastelloy	Titanium
922	Impeller nut	Duplex SS			Alloy 20	Hastelloy	Titanium
923.51	Bearing locknut	Steel/nylon					
932.51	Snap ring / circlip	Carbon steel					
940.31	Impeller key	Carbon steel					

**Parts not shown**

Item	Part name	Pump material					
		Ductile iron (NL)	316 SS (VV)	Duplex (WW)	Alloy 20 (AA)	Hastelloy (BB/CC)	Titanium (TT)
236	Inducer (optional)	Duplex SS (1.4462)			Alloy 20	Hastelloy	Titanium
452	Packing gland	316 SS					
458	Lantern ring	Glass-filled PTFE					
461	Packing	PTFE impregnated					
502.11	Wear ring (optional)	316 SS (1.4410)		Duplex SS	Alloy 20	Hastelloy	Titanium
642	Oil level sight glass	Glass/plastic					

# Other Relevant Documentation or Manuals

## For additional documentation

For any other relevant documentation or manuals, contact your ITT representative.

# Local ITT Contacts

## 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
Asia Pacific	ITT Industrial Process 10 Jalan Kilang #06-01 Singapore 159410	+65-627-63693	+65- 627-63685
Europe	ITT - Goulds Pumps Millwey Rise Industrial Estate Axminster, Devon, England EX13 5HU	+44-1297-630250	+44-1297-630256
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 Kyrrou 4 Neo Psychiko 115 25 Athens Greece	+30-210-677-0770	+30-210-677-5642









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Goulds Pumps  
240 Fall Street  
Seneca Falls, NY 13148  
USA  
Tel. 1-800-446-8537  
Fax (315) 568-2418