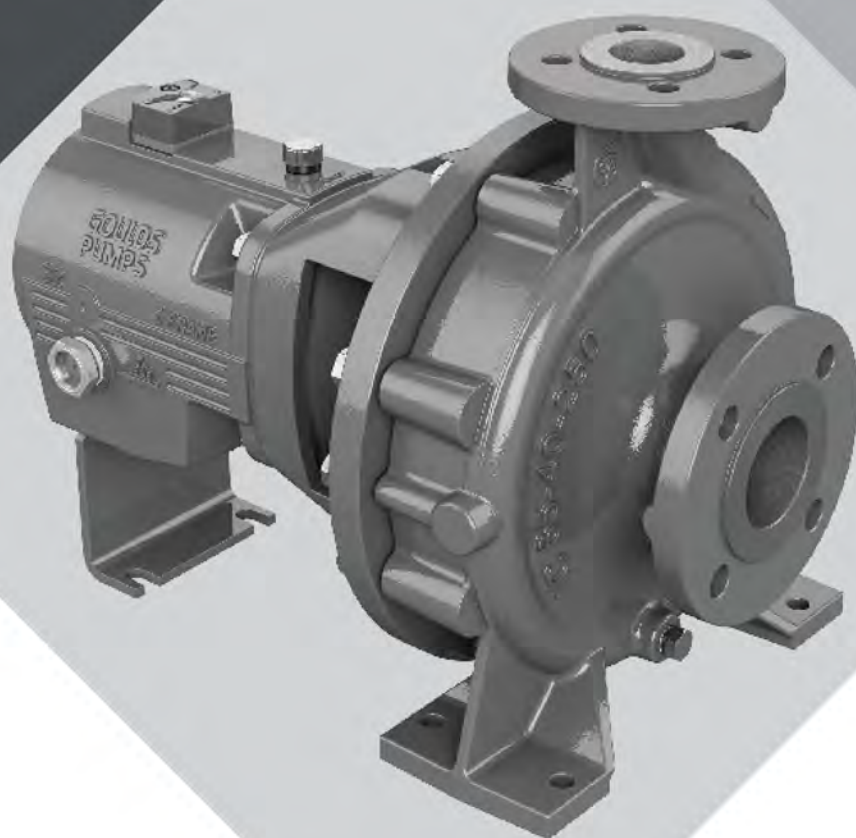




Installation, Operation, and Maintenance Manual

Model ICO i-FRAME, ICOH i-FRAME



ITT

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1 Introduction and Safety

1.1 Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance



CAUTION:

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

NOTICE:

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

1.1.1 Requesting other information

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

Always specify the exact product type and serial number when requesting technical information or spare parts.

1.2 Safety



WARNING:

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

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

**CAUTION:**

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




1.2.1 Safety terminology and symbols

About safety messages

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

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

Hazard levels

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

Hazard categories

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

Electrical hazards are indicated by the following specific symbol:



ELECTRICAL HAZARD:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

1.2.1.1 The Ex symbol

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



1.2.2 Environmental safety

The work area

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

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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



WARNING:

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

Electrical installation

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

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 User safety

General safety rules

These safety rules apply:

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

Safety equipment

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

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

Electrical connections

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

Noise



WARNING:

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

Temperature



WARNING:

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

1.2.3.1 Precautions before work

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

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.

- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

1.2.3.2 Precautions during work

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



CAUTION:

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

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

1.2.4 Hazardous liquids

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

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

1.2.5 Wash the skin and eyes

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

Condition	Action
Chemicals or hazardous fluids in eyes	<ol style="list-style-type: none">1. Hold your eyelids apart forcibly with your fingers.2. Rinse the eyes with eyewash or running water for at least 15 minutes.3. Seek medical attention.

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

1.2.6 Ex-approved products



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



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

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.

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.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

1.2.6.1 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.

1.2.6.2 Guidelines for compliance

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

1.3 Product approval standards

Regular standards



WARNING:

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

All standard products are approved according to CSA standards in Canada and UL standards in USA. The drive unit degree of protection follows IP68 according to standard IEC 60529.

1.4 Product warranty

Coverage

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

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

Limitations

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

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



1.5 ATEX Considerations and Intended Use

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

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).

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

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

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

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



Figure 1: Typical ATEX pump nameplate

The CE and the Ex designate the ATEX compliance. The code below reads as follows:

II - Group – Non Mining Equipment

2G – Category – Category 2 – Gas

Ex – required by ISO 80079 – 36:2016

h – h indicates mechanical equipment

IIB – Gas Group

T1 – T4 – Permitted Maximum Surface Temperature

Gb – Atmosphere + Equipment Protection Level

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

2 Transportation and Storage

2.1 Inspect the delivery

2.1.1 Inspect the package

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

2.1.2 Inspect the unit

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

2.2 Transportation guidelines

2.2.1 Pump handling and lifting

Precautions for moving the pump

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



WARNING:

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



CAUTION:

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

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

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

Precautions for lifting the pump



WARNING:

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

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

NOTICE:

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

Lifting the pump

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

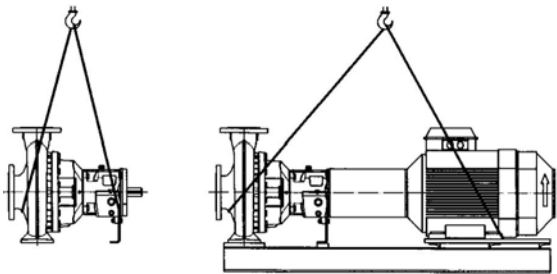


Figure 2: Example of proper lifting method

2.3 Storage guidelines

2.3.1 Long-term storage

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

- Store in a covered and dry location.
- Store the unit free from heat, dirt, and vibrations.
- Rotate the shaft by hand several times at least every three months.

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

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

3 Product Description

3.1 General description

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



Casing

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

Impeller

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

Seal chamber

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

Power end

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

Frame adapter

- Provides safe and accurate alignment for the liquid end to the bearing frame.
- Large access windows make installation and maintenance of seal and auxiliary support systems trouble-free.

Bearings

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

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

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

Shaft

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

3.2 General description i-ALERT®2 Equipment Condition Monitor

Description

The i-ALERT®2 Equipment Condition Monitor is a compact, battery-operated monitoring device that continuously measures the vibration and temperature of the pump power end. The i-ALERT®2 sensor uses blinking red LEDs and wireless notification to alert the pump operator when the pump exceeds vibration and temperature limits. This allows the pump operator to make changes to the process or the pump before a catastrophic failure occurs. The Condition Monitor is also equipped with a single green LED to indicate when it is operational and has sufficient battery life. (i-ALERT®2 Bluetooth Equipment Condition Monitor option available. The i-ALERT®2 monitor allows customers to identify potential problems before they become costly failures. It tracks vibration, temperature and run-time hours and wirelessly syncs the data with a smart phone or tablet the i-ALERT®2 mobile app. More information available on

More information available on <http://www.ittproservices.com/aftermarket-products/monitoring/i-alert2/i-ALERT2.com>

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

3.3 Nameplate information

Pump nameplate

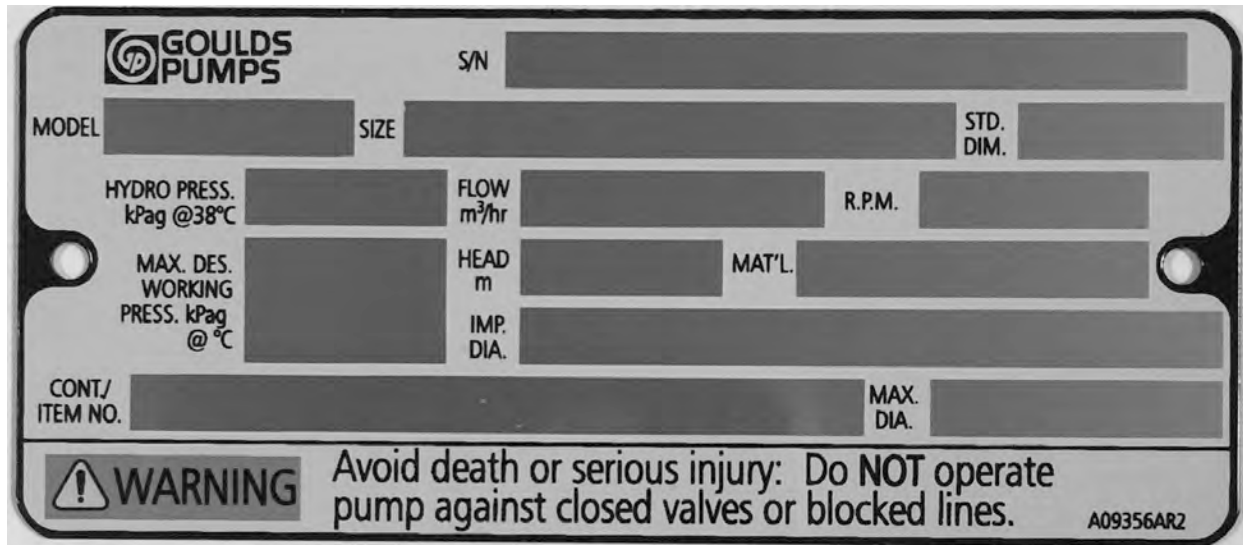


Figure 3: Pump nameplate

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

4 Installation

4.1 Pre-installation

Precautions



WARNING:

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

NOTICE:

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

4.1.1 Pump location guidelines



WARNING:

Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.



WARNING:

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

4.1.2 Foundation requirements

Requirements

- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three times the weight of the pump.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.
- Sleeve-type and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.
- The concrete foundation must have sufficient firmness according to DIN 1045 or equal standard.

4.2 Baseplate-mounting procedures

4.2.1 Prepare the baseplate for mounting

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

4.2.2 Prepare the foundation for mounting

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

NOTICE:

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

2. Remove water or debris from the foundation bolt holes or sleeves.
3. If the baseplate uses sleeve-type bolts, then fill the sleeves with a non-binding, moldable material.
Seal the sleeves in order to prevent the grout from entering.
4. Coat the exposed portion of the anchor bolts with a non-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.

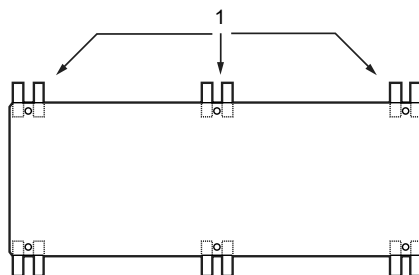
4.2.3 Install the baseplate using shims or wedges

Required tools:

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

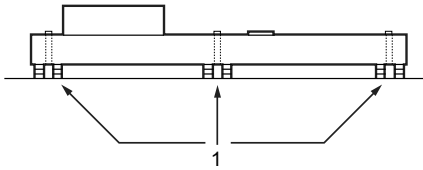
This procedure is applicable to fabricated steel baseplates.

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



1. Shims or wedges

Figure 4: Top view



1. Shims or wedges

Figure 5: Side view

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

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

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

These are the leveling tolerances:

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

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

6. Hand-tighten the nuts for the foundation.

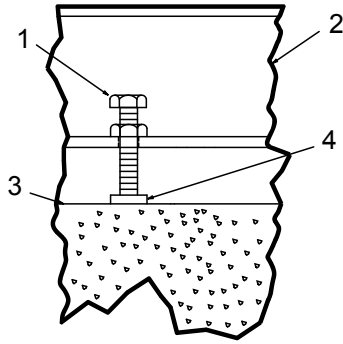
4.2.4 Install the baseplate using jackscrews

Tools required:

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

This procedure is applicable to the fabricated steel baseplate.

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



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

Figure 6: Jackscrews

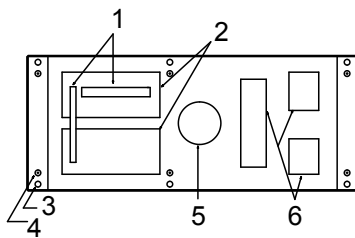
3. Level the driver mounting pads:

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

- a) Put one machinist's level lengthwise on one of the two pads.
- b) Put the other machinist's level across the ends of the two pads.
- c) Level the pads by adjusting the four jackscrews in the corners. Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.

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



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

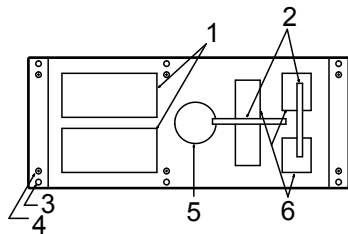
Figure 7: Level driver mounting pads

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

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

- a) Put one machinist's level lengthwise on one of the two pads.
- b) Put the other level across the center of the two pads.
- c) Level the pads by adjusting the four jackscrews in the corners. Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.



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

Figure 8: Level pump mounting pads

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

The correct level measurement is a maximum of 0.167 mm/m | 0.002 in./ft .

4.2.5 Install the baseplate using spring mounting

NOTICE:

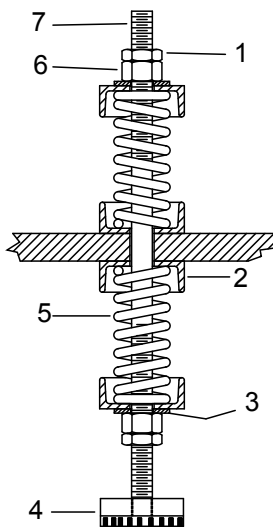
The spring-mounted baseplate is designed only to support piping loads from thermal expansion. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

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

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

1. Put the baseplate on a support above the foundation/floor. Make sure that there is enough space between the baseplate and the foundation/floor in order to install the spring assemblies.

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



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

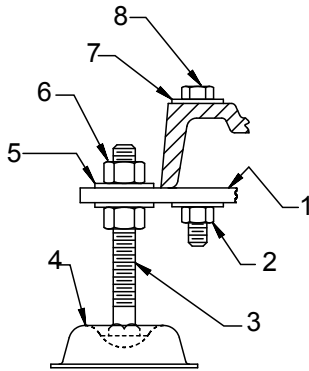
Figure 9: Example of an installed spring assembly

4.2.6 Install the baseplate using stilt mounting

NOTICE:

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

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

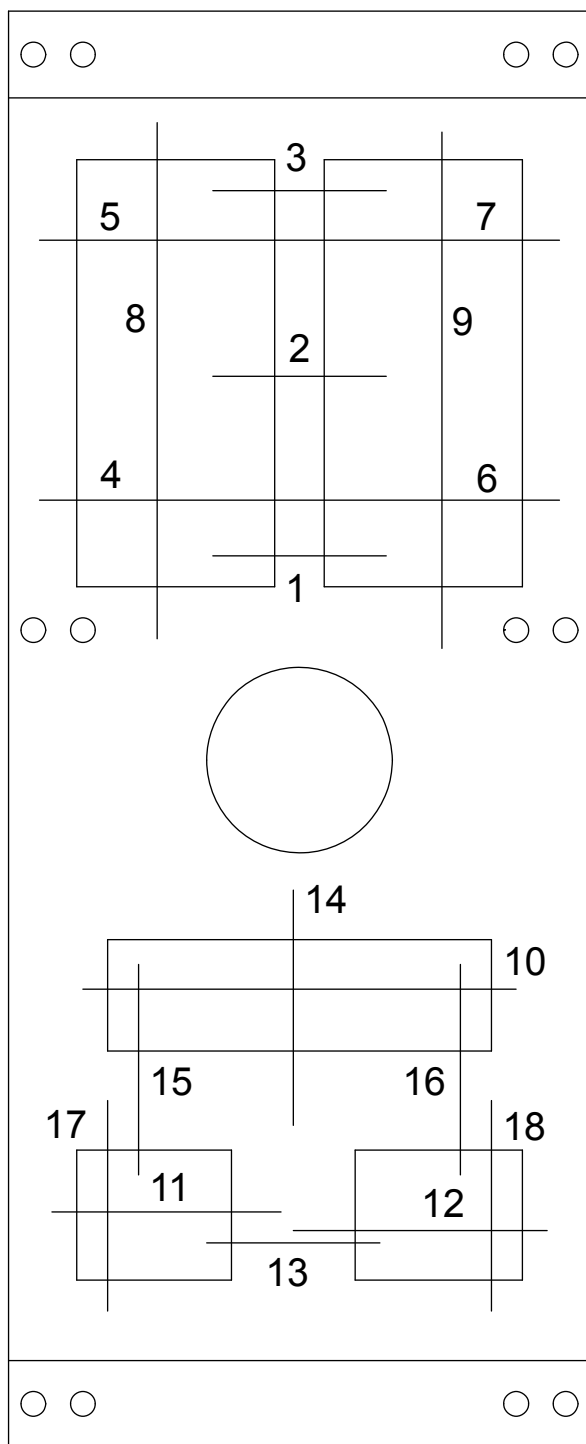


1. Mounting plate
2. Mounting nut
3. Stilt bolt
4. Foundation cups
5. Washer
6. Upper adjustment nut
7. Mounting washer
8. Mounting bolt

Figure 10: Example of an installed stilt assembly

4.2.7 Baseplate-leveling worksheet

Level measurements



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

4.3 Install the pump, driver, and coupling

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

4.4 Pump-to-driver alignment

Precautions



WARNING:

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

4.4.1 Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

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

Types of alignment checks

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

Initial alignment (cold alignment) checks

When	Why
Before you	This ensures that alignment can be accomplished.
After you	This ensures that no changes have occurred during the .
After you connect the piping	This ensures that pipe strains have not altered the alignment.

Final alignment (hot alignment) checks

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

4.4.2 Permitted indicator values for alignment checks**4.4.2.1 Cold settings for parallel vertical alignment****Introduction**

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

4.4.3 Alignment measurement guidelines

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

4.4.4 Attach the dial indicators for alignment

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

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

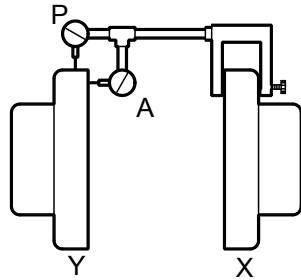


Figure 11: Dial indicator attachment

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

4.4.5 Pump-to-driver alignment instructions

4.4.5.1 Perform angular alignment for a vertical correction

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

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

4.4.5.2 Perform angular alignment for a horizontal correction

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

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

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

4.4.5.3 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 as measured at four points 90° apart at the operating temperature.

1. Set the parallel alignment indicator (P) 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 pump coupling half (X) is lower than the driver coupling half (Y). Remove shims of a thickness equal to half of the indicator reading value under each driver foot.
Positive	The pump coupling half (X) is higher than the driver coupling half (Y). Add shims of a thickness equal to half of the indicator reading value to each driver foot.

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

NOTICE:

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

4.4.5.4 Perform parallel alignment for a horizontal correction

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

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

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

4. Slide the driver carefully in the appropriate direction.

NOTICE:

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

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

4.4.5.5 Perform complete alignment for a vertical correction

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

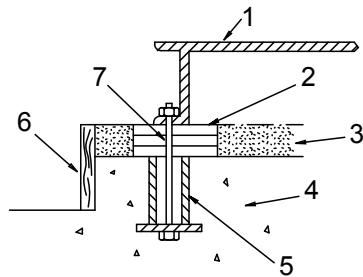
4.4.5.6 Perform complete alignment for a horizontal correction

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

4.5 Grout the baseplate

Required equipment:

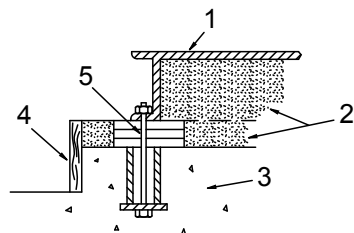
- Cleaners: Do not use an oil-based cleaner because the grout will not bond to it. See the instructions provided by the grout manufacturer.
 - Grout: Non-shrink grout is recommended.
1. Clean all the areas of the baseplate that will come into contact with the grout.
 2. Build a dam around the foundation.
 3. Thoroughly wet the foundation that will come into contact with the grout.
 4. Pour grout through the grout hole into the baseplate up to the level of the dam.
When you pour the grout, remove air bubbles from it by using one of these methods:
 - Puddle with a vibrator.
 - Pump the grout into place.
 5. Allow the grout to set.



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

Figure 12: Pour grout into baseplate

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



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

Figure 13: Fill remainder of baseplate with grout

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

4.6 Piping checklists

4.6.1 General piping checklist

Precautions



WARNING:

- Risk of premature failure. Casing deformation can result in misalignment and contact with rotating parts, causing excess heat generation and sparks. Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump.
 - Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
 - Use fasteners of the proper size and material only.
 - Replace all corroded fasteners.
 - Ensure that all fasteners are properly tightened and that there are no missing fasteners.
-



CAUTION:

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



CAUTION:

Never draw piping into place at the flanged connections of the pump. This can impose dangerous strains on the unit and cause misalignment between the pump and driver. Pipe strain adversely affects the operation of the pump, which results in physical injury and damage to the equipment.



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

NOTICE:

Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

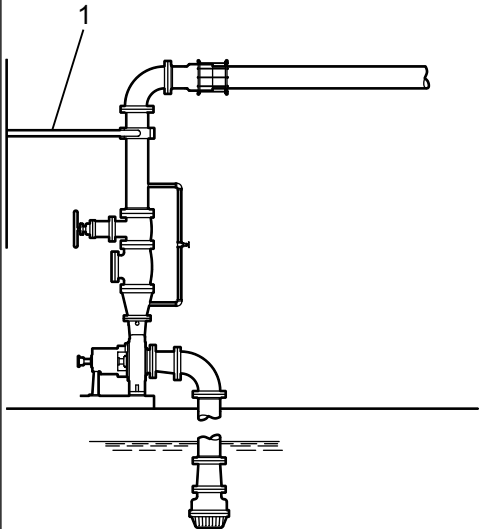
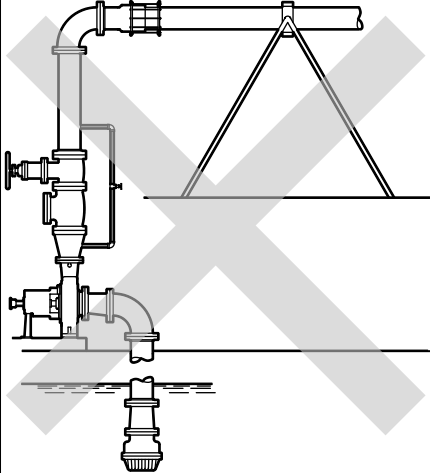
Piping guidelines

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

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	<ul style="list-style-type: none"> • Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings and the coupling 	
Check that only necessary fittings are used.	This helps to minimize friction losses.	

Example: Installation for expansion

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

4.6.2 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 (ungrouted).
- 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 grouted).
- All values for forces and torques refer to standard materials EN-GJS400-18LT and 1.4408.

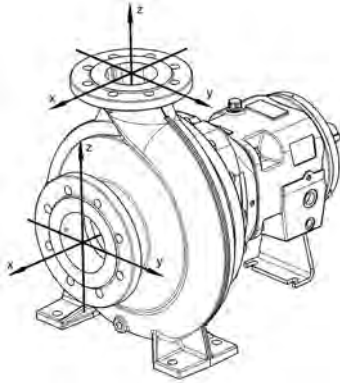


Figure 14: External Forces and Moments on Nozzles

Table 1: Suction nozzle

Sizes	Ø DN	Forces in N lbf				Torques in Nm ft-lb			
		F _x	F _y	F _z	ΣF	M _x	M _y	M _z	ΣM
40-25-160	40	880 198	770 173	700 157	1,370 308	900 663	630 465	740 546	1,330 981
40-25-200	40	880 198	770 173	700 157	1,370 308	900 663	630 465	740 546	1,330 981
40-25-250	40	880 198	770 173	700 157	1,370 308	900 663	630 465	740 546	1,330 981
50-32-160	50	1,150 259	1,050 236	950 214	1,820 409	980 723	700 516	800 590	1,450 1,069
50-32-200	50	1,150 259	1,050 236	950 214	1,820 409	980 723	700 516	800 590	1,450 1,069
50-32-250	50	1,150 259	1,050 236	950 214	1,820 409	980 723	700 516	800 590	1,450 1,069
50-32-315	50	1,150 259	1,050 236	950 214	1,820 409	980 723	700 516	590 800	1,450 1,069
65-40-160	65	1,470 330	1,300 292	1,200 270	2,300 517	1,050 774	770 568	840 620	1,550 1,143
65-40-200	65	1,470 330	1,300 292	1,200 270	2,300 517	1,050 774	770 568	840 620	1,550 1,143
65-40-250	65	1,470 330	1,300 292	1,200 270	2,300 517	1,050 774	770 568	840 620	1,550 1,143
65-40-315	65	1,470 330	1,300 292	1,200 270	2,300 517	1,050 774	770 568	840 620	1,550 1,143
80-50-160	80	1,750 393	1,580 355	1,440 324	2,760 620	1,120 826	800 590	910 671	1,650 1,217
80-50-200	80	1,750 393	1,580 355	1,440 324	2,760 620	1,120 826	800 590	910 671	1,650 1,217
80-50-250	80	1,750 393	1,580 355	1,440 324	2,760 620	1,120 826	800 590	910 671	1,650 1,217
80-50-315	80	1,750 393	1,580 355	1,440 324	2,760 620	1,120 826	800 590	910 671	1,650 1,217
100-65-160	100	2,350 528	2,100 472	1,900 427	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342

Sizes	Ø DN	Forces in N lbf				Torques in Nm ft-lb			
		Fx	Fy	Fz	ΣF	Mx	My	Mz	ΣM
100-65-200	100	2,350 528	2,100 472	1,900 427	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
100-65-250	100	2,350 528	2,100 472	1,900 427	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
100-65-315	100	2,350 528	2,100 472	1,900 427	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
125-80-160	125	2,765 622	2,485 559	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-80-200	125	2,765 622	2,485 559	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-80-250	125	2,765 622	2,485 559	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-80-315	125	2,765 622	2,485 559	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-80-400	125	2,765 622	2,485 559	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-100-200	125	2,750 622	2,500 562	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-100-250	125	2,750 622	2,500 562	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-100-315	125	2,750 622	2,500 562	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
125-100-400	125	2,750 622	2,500 562	2,240 504	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
150-125-250	150	3,500 787	3,150 708	2,850 641	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888
150-125-315	150	3,500 787	3,150 708	2,850 641	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888
150-125-400	150	3,500 787	3,150 708	2,850 641	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888
200-150-250	200	4,700 1,057	4,200 944	3,780 850	7,350 1,652	2,280 1,682	1,610 1,187	1,850 1,364	3,350 2,471
200-150-315	200	4,700 1,057	4,200 944	3,780 850	7,350 1,652	2,280 1,682	1,610 1,187	1,850 1,364	3,350 2,471
200-150-400	200	4,700 1,057	4,200 944	3,780 850	7,350 1,652	2,280 1,682	1,610 1,187	1,1,850 364	3,350 2,471

Table 2: Discharge nozzle

Sizes	Ø DN	Forces in N lbf				Torques in Nm ft-lb			
		Fx	Fy	Fz	ΣF	Mx	My	Mz	ΣM
40-25-160	25	530 119	490 110	600 135	920 207	630 465	420 310	490 361	920 679
40-25-200	25	530 119	490 110	600 135	920 207	630 465	420 310	490 361	920 679
40-25-250	25	530 119	490 110	600 135	920 207	630 465	420 310	490 361	920 679
50-32-160	32	630 142	600 135	740 166	1,160 261	770 568	530 391	600 443	1,120 826
50-32-200	32	630 142	600 135	740 166	1,160 261	770 568	530 391	600 443	1,120 826
50-32-250	32	630 142	600 135	740 166	1,160 261	770 568	530 391	600 443	1,120 826
50-32-315	32	630 142	600 135	740 166	1,160 261	770 568	530 391	600 443	1,120 826
65-40-160	40	770 173	700 157	880 198	1,370 308	900 664	630 465	740 546	1,330 981
65-40-200	40	770 173	700 157	880 198	1,370 308	900 664	630 465	740 546	1,330 981

Sizes	Ø DN	Forces in N lbf				Torques in Nm ft-lb			
		Fx	Fy	Fz	ΣF	Mx	My	Mz	ΣM
65-40-250	40	770 173	700 157	880 198	1,370 308	900 664	630 465	740 546	1,330 981
65-40-315	40	770 173	700 157	880 198	1,370 308	900 664	630 465	740 546	1,330 981
80-50-160	50	1,050 236	950 214	1,150 259	1,820 409	980 723	700 516	800 590	1,450 1,069
80-50-200	50	1,050 236	950 214	1,150 259	1,820 409	980 723	700 516	800 590	1,450 1,069
80-50-250	50	1,050 236	950 214	1,150 259	1,820 409	980 723	700 516	800 590	1,450 1,069
80-50-315	50	1,050 236	950 214	1,150 259	1,820 409	980 723	700 516	800 590	1,450 1,069
100-65-160	65	1,300 292	1,200 270	1,470 330	2,300 517	1,050 774	770 568	840 620	1,550 1,143
100-65-200	65	1,300 292	1,200 270	1,470 330	2,300 517	1,050 774	770 568	840 620	1,550 1,143
100-65-250	65	1,300 292	1,200 270	1,470 330	2,300 517	1,050 774	770 568	840 620	1,550 1,143
100-65-315	65	1,300 292	1,200 270	1,470 330	2,300 517	1,050 774	770 568	840 620	1,550 1,143
125-80-160	80	1,580 355	1,440 324	1,750 393	2,760 620	1,120 826	800 590	910 671	1,650 1,217
125-80-200	80	1,580 355	1,440 324	1,750 393	2,760 620	1,120 826	800 590	910 671	1,650 1,217
125-80-250	80	1,580 355	1,440 324	1,750 393	2,760 620	1,120 826	800 590	910 671	1,650 1,217
125-80-315	80	1,580 355	1,440 324	1,750 393	2,760 620	1,120 826	800 590	910 671	1,650 1,217
125-80-400	80	1,580 355	1,440 324	1,750 393	2,760 620	1,120 826	800 590	910 671	1,650 1,217
125-100-200	100	2,100 472	1,900 427	2,350 528	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
125-100-250	100	2,100 472	1,900 427	2,350 528	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
125-100-315	100	2,100 472	1,900 427	2,350 528	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
125-100-400	100	2,100 472	1,900 427	2,350 528	3,670 825	1,230 907	880 649	1,020 752	1,820 1,342
150-125-250	125	2,500 562	2,240 504	2,750 618	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
150-125-315	125	2,500 562	2,240 504	2,750 618	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
150-125-400	125	2,500 562	2,240 504	2,750 618	4,350 978	1,470 1,084	1,050 774	1,330 981	2,140 1,578
200-150-250	150	3,150 708	2,850 641	3,500 787	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888
200-150-315	150	3,150 708	2,850 641	3,500 787	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888
200-150-400	150	3,150 708	2,850 641	3,500 787	5,500 1,236	1,750 1,291	1,230 907	1,450 1,069	2,560 1,888

4.6.3 Suction-piping checklist

Suction-piping checks

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and the closest elbow is at least five pipe diameters.	This minimizes the risk of cavitation in the suction inlet of the pump due to turbulence. See the Example sections for illustrations.	
Check that elbows in general do not have sharp bends.	See the Example sections for illustrations. —	
Check that the suction piping is one or two sizes larger than the suction inlet of the pump. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump. See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: <ul style="list-style-type: none"> • Sloping side down • Horizontal side at the top 	See the example illustrations.	
Suggested suction strainers are used. Check that they are at least three times the area of the suction piping. Monitor the pressure drop across the suction strainer. An increased pressure drop across the strainer of 34.5 kPa 5 psi indicates that the strainer should be removed and cleaned. After a period of time (24 hours minimum) system flushing should be complete and the suction strainer can be removed.	Suction strainers help to prevent debris from entering the pump. Mesh holes with a minimum diameter of 1.6 mm 1/16 in. are recommended. Liquids with specific gravity less than 0.60 a pressure drop across the suction strainer may be due to ice buildup. Ice buildup can cause turbulence, low pressure areas and pumpage vaporization.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance and prevent vapor locking especially with specific gravity of liquid less than 0.60.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	
Assure adequate insulation is applied for liquids with specific gravity less than 0.60.	To assure sufficient NPSHa.	

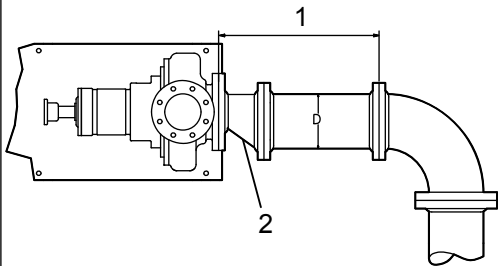
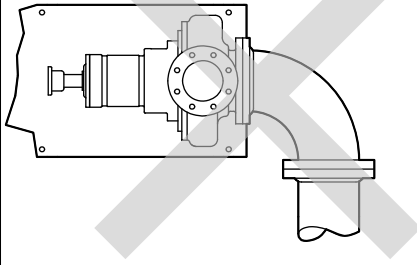
Liquid source below the pump

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

Liquid source above the pump

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	<p>This permits you to close the line during pump inspection and maintenance.</p> <p>Do not use the isolation valve to throttle the pump. Throttling can cause these problems:</p> <ul style="list-style-type: none"> • Loss of priming • Excessive temperatures • Damage to the pump • Voiding the warranty 	
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the piping is level or slopes downward from the liquid source.	—	
Make sure that no part of the suction piping extends below the suction flange of the pump.	—	
Make sure that the 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"> 1. Enough distance to prevent cavitation 2. Eccentric reducer with a level top 	

Example: Suction piping equipment

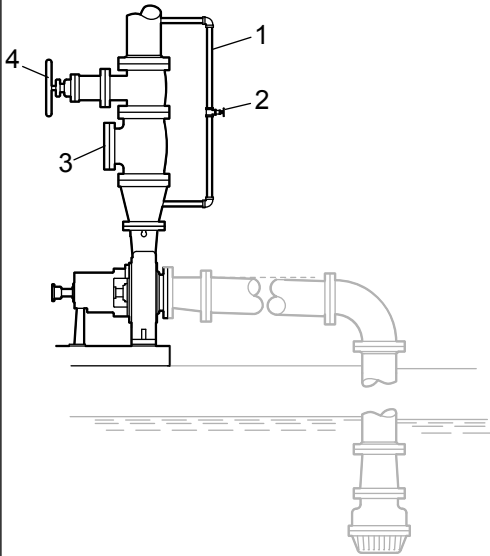
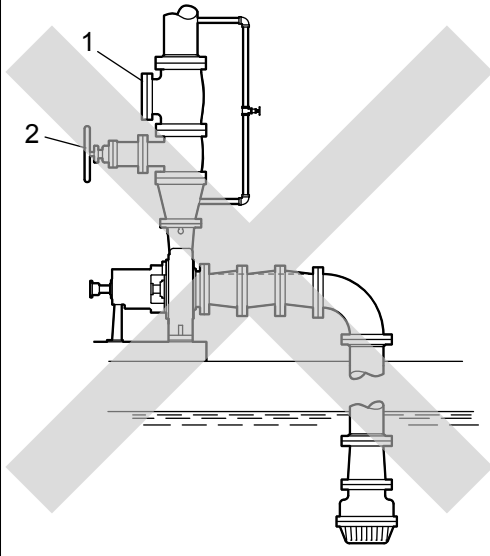
Correct	Incorrect
<p>1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top</p>	<p>1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source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

4.6.4 Discharge piping checklist**Checklist**

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

Check	Explanation/comment	Checked
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

Example: Discharge piping equipment

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

4.6.5 Bypass-piping considerations

When to use a bypass line

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

When to install a minimum-flow orifice

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

When a minimum-flow orifice is unavailable

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

4.6.6 Auxiliary-piping checklist

Precautions



CAUTION:

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

NOTICE:

Auxiliary cooling and flush systems must be operating properly to prevent excess heat generation, sparks, and/or premature failure. Ensure auxiliary piping is installed as specified on the pump data sheet prior to startup.

When to install

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

Checklist

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

4.6.7 Final piping checklist

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

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup



WARNING:

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



WARNING:

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

Precautions

WARNING:

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



CAUTION:

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

NOTICE:

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

NOTICE:

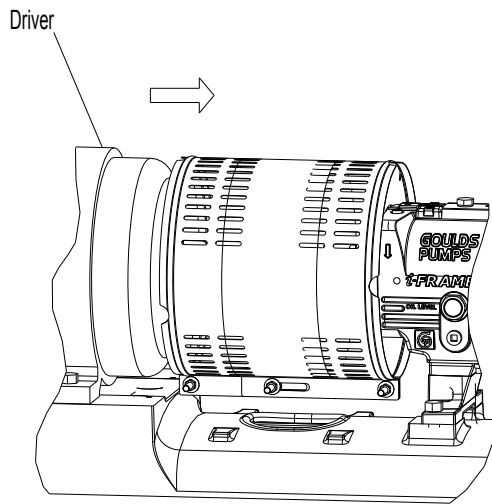
You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
 - Bring variable-speed drivers to the rated speed as quickly as possible.
 - Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.
 - If temperatures of the pumped fluid will exceed 93°C | 200°F, then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 38°C | 100°F of the fluid temperature. Accomplish this by flowing fluid from pump inlet to discharge drain (optionally, the casing vent can be included in warm-up circuit but not required). Soak for (2) hours at process fluid temperature.
-

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

5.2 Remove the coupling guard

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



3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver half of the coupling guard:
 - a) Slightly spread the bottom apart.
 - b) Lift upwards.
5. Remove the remaining nut, bolt, and washers from the pump half of the coupling guard. It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.
6. Remove the pump half of the coupling guard:
 - a) Slightly spread the bottom apart.
 - b) Lift upwards.

5.3 Check the rotation



WARNING:

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

1. Lock out power to the driver.
2. Make sure that the coupling hubs are fastened securely to the shafts.
3. Make sure that the coupling spacer is removed.
The pump ships with the coupling spacer removed.
4. Unlock power to the driver.

5. Make sure that everyone is clear, and then jog the driver long enough to determine that the direction of rotation corresponds to the arrow on the bearing housing or close-coupled frame.
6. Lock out power to the driver.

5.4 Couple the pump and driver



WARNING:

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

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



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

5.5 Install the coupling guard



WARNING:

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

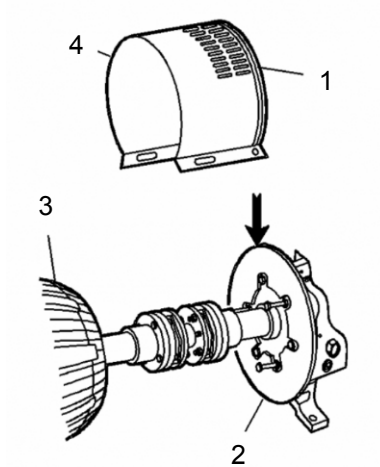


WARNING:

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

Required parts:

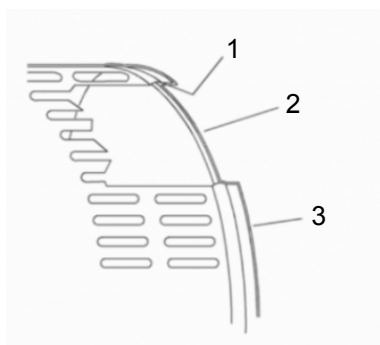
1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
 2. Put the pump-half of the coupling guard in place:
 - a) Slightly spread the bottom apart.
 - b) Place the coupling guard half over the pump-side end plate.
-



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

Figure 15: Guard half installation

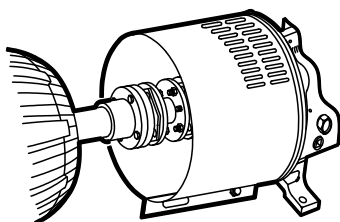
The annular groove in the coupling guard half must fit around the end plate.

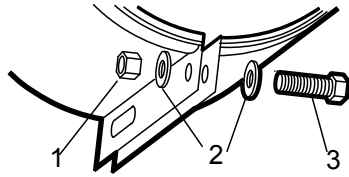


Item	Description
1.	Annular groove
2.	End plate (pump end)
2.	Guard half

Figure 16: Annular groove in coupling guard

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





Item	Description
1.	Nut
2.	Washer
3.	Bolt

Figure 17: Secure coupling guard half to end plate

4. Put the driver half of the coupling guard in place:
 - a) Slightly spread the bottom apart.
 - b) Place the driver half of the coupling guard over the pump half of the coupling guard. The annular groove in the coupling guard half must face the motor.

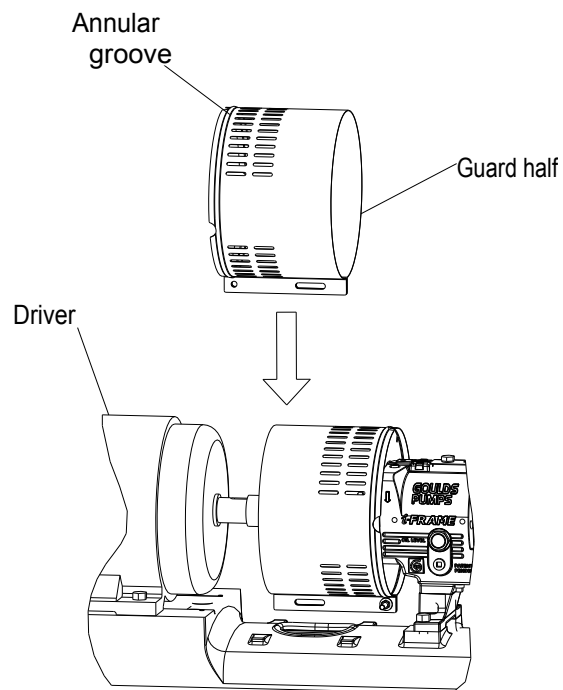


Figure 18: Placement of driver half of coupling guard

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

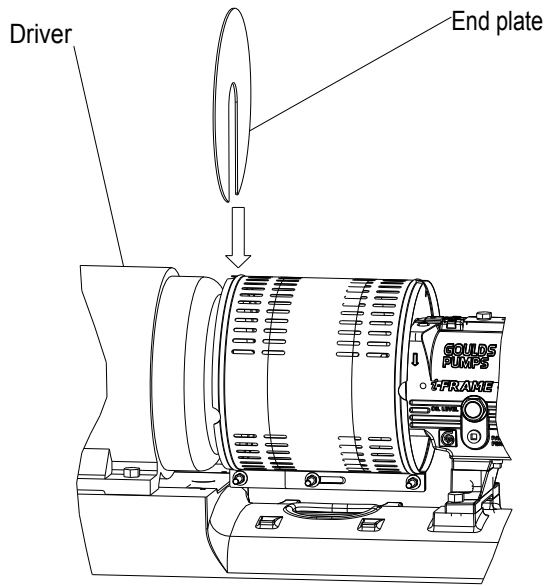


Figure 19: Placement of driver half of coupling guard

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

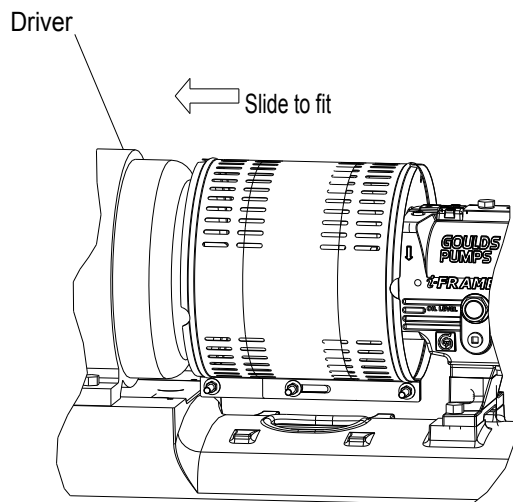


Figure 20: Slide driver-half of coupling guard towards motor

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

5.6 Bearing lubrication


WARNING:

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

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

Grease-lubricated bearings are lubricated at the factory.

The bearing manufacturer fills greased-for-life bearings with grease and seals them at the factory. You do not need to lubricate or seal these bearings.

5.6.1 Lubricating oil requirements

Oil quality requirements

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

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

Oil quantity requirements

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

5.6.2 Lubricate the bearings with oil


WARNING:


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

NOTICE:

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

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

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

5.6.2.1 Fill the bearing frame with oil

NOTICE:

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

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



Figure 21: Oil level sight glass

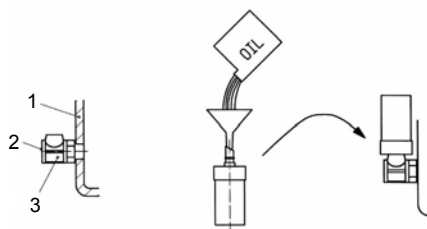
5.6.2.2 Fill the bearing frame with an optional oiler

NOTICE:

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

The constant level oiler is supplied loose.

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



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

Figure 22: Filling bearing frame oiler

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

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

5.6.3 Lubricating-grease requirements

Precautions

NOTICE:

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

Grease quality requirements

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

Grease lubrication

Consider this information when you lubricate with grease:

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

5.7 Shaft-sealing options

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

This model uses these types of shaft seals:

- Cartridge mechanical seal
- Conventional inside-component mechanical seal

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

5.7.1 Mechanical seal options

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

These are the mechanical seal options for this pump:

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

5.7.2 Connection of sealing liquid for mechanical seals

Seal lubrication is required

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

Seal flushing methods

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

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

5.7.3 Packed stuffing box option



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.

5.7.4 Connection of sealing liquid for a packed stuffing box

NOTICE:

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

You must use an external sealing liquid under these conditions:

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

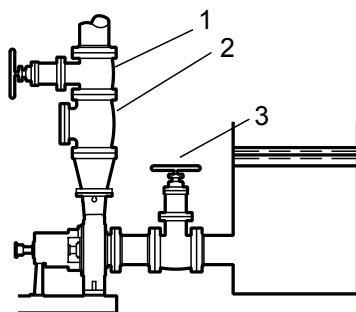
Conditions for application of an external liquid

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

5.8 Pump priming

5.8.1 Prime the pump with the suction supply above the pump

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



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

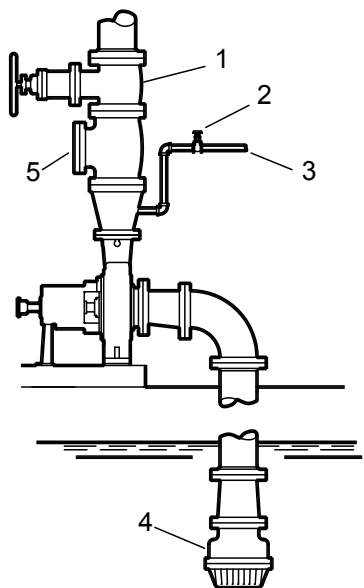
Figure 23: Suction supply above pump

5.8.2 Prime the pump with the suction supply below the pump

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

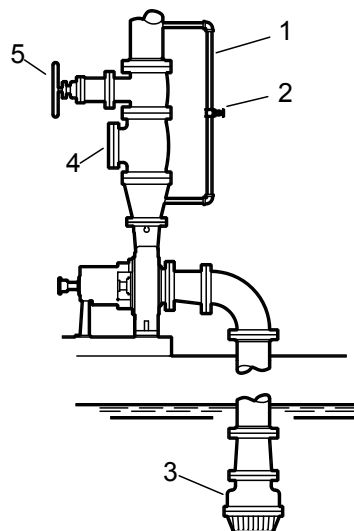
- A priming pump
 - A pressurized discharge line
 - Another outside supply
1. Close the discharge isolation valve.
 2. Open the air vent valves in the casing.

3. Open the valve in the outside supply line until only liquid escapes from the vent valves.
4. Close the vent valves.
5. Close the outside supply line.



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

Figure 24: Pump priming with suction supply below pump with foot valve and an outside supply



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

Figure 25: Pump priming with suction supply below pump with foot valve using bypass around check valve

5.8.3 Other methods of priming the pump

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

- Prime by ejector
- Prime by automatic priming pump

5.9 Start the pump



WARNING:

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

NOTICE:

- Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.
 - On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.
-

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

- Open the suction valve.
 - Open any recirculation or cooling lines.
1. Fully close or partially open the discharge valve, depending on system conditions.
 2. Start the driver.
 3. Slowly open the discharge valve until the pump reaches the desired flow.
 4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
 5. If the pump fails to reach the correct pressure, perform these steps:
 - a) Stop the driver.
 - b) Prime the pump again.
 - c) Restart the driver.
 6. Monitor the pump while it is operating:
 - a) Check the pump for bearing temperature, excessive vibration, and noise.
 - b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

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

5.10 i-ALERT®2 Equipment Health Monitor



WARNING:

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

For all information refer to the i-ALERT®2 Equipment Health Monitor Installation, Operation and Maintenance manual. <http://www.ittproservices.com/aftermarket-products/monitoring/i-alert2/i-ALERT2.com>

5.11 Pump operation precautions

General considerations

NOTICE:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

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

Operation at reduced capacity



WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.
 - Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.
-

NOTICE:

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

Operation under freezing conditions

NOTICE:

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

5.12 Shut down the pump



WARNING:

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

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

5.13 Deactivate the i-ALERT[®]2 Equipment Health Monitor

NOTICE:

Always deactivate the health monitor when the pump is going to be shut down for an extended period of time. Failure to do so will result in reduced battery life.

1. Touch and hold a small magnet to the health monitor over the ITT logo until the red LEDs blink three times.
This should take 10-15 seconds if the health monitor is in normal operating mode and approximately five seconds if the condition monitor is in alarm mode.
2. Remove the magnet.

If the deactivation is successful, solid red LEDs will be displayed.

5.14 Make the final alignment of the pump and driver



WARNING:

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

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

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

6 Maintenance

6.1 Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.

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.

NOTICE:

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

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- Change the oil every three months (2000 operating hours) at minimum.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

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

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

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

6.2 Bearing maintenance

⚠ 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 ITT representative.

Bearing lubrication schedule

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

Oil change schedule

Oil must be changed at least once a year.

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

NOTICE:

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

6.2.1 Lubricating oil requirements

Oil quality requirements

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

Lubricating oil type	<ul style="list-style-type: none"> • CLP46 • DIN 51517 • HD 20W/20 SAE
----------------------	---

Symbol	DIN 51502
Kinematic viscosity at 40°C 104°F	46 ±4 mm ² /sec 0.0713 ±0.006 in. ² /sec
Flash point (Cleveland)	175°C 347°F
Setting point (Pourpoint)	-15°C 5°F
Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below -10°C 14°F.	Higher than permitted bearing temperature

Oil quantity requirements

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

6.2.2 Change the oil

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

6.2.3 Lubricating-grease requirements

Precautions

NOTICE:

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

Grease quality requirements

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

Grease lubrication

Consider this information when you lubricate with grease:

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

6.2.4 Regrease the grease-lubricated bearings

NOTICE:

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

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

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

6.3 Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- 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.

NOTICE:

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

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- Change the oil every three months (2000 operating hours) at minimum.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

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

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

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

6.4 Bearing maintenance

⚠ 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 ITT representative.

Bearing lubrication schedule

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

Oil change schedule

Oil must be changed at least once a year.

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

NOTICE:

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

6.4.1 Lubricating oil requirements

Oil quality requirements

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

Lubricating oil type	<ul style="list-style-type: none"> • CLP46 • DIN 51517 • HD 20W/20 SAE
Symbol	DIN 51502
Kinematic viscosity at 40°C 104°F	46 ±4 mm ² /sec 0.0713 ±0.006 in. ² /sec
Flash point (Cleveland)	175°C 347°F
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6.4.2 Change the oil

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

6.4.3 Lubricating-grease requirements

Precautions

NOTICE:

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

Grease quality requirements

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

Grease lubrication

Consider this information when you lubricate with grease:

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

6.4.4 Regrease the grease-lubricated bearings

NOTICE:

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

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

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

6.5 Shaft seal maintenance

6.5.1 Mechanical-seal maintenance



WARNING:



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



WARNING:

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



CAUTION:

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

Cartridge-type mechanical seals

Cartridge-type mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require disengagement of the holding clips prior to operation, allowing the seal to slide into place. If the seal has been installed in the pump by ITT, these clips have already been disengaged.

Other mechanical seal types

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

Reference drawing

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

Before you start the pump

Check the seal and all flush piping.

Mechanical seal life

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

6.5.2 Packed stuffing-box maintenance



WARNING:

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



WARNING:

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

Accepted leakage rate

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

Adjustment of gland

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

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

Tightening of packing

NOTICE:

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

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

6.6 Disassembly

6.6.1 Disassembly precautions



WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
 - Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
 - Handling heavy equipment poses a crush hazard. Use caution during handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.
 - Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
 - Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
 - Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.
-



CAUTION:

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

6.6.2 Tools required

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

- Bearing puller

- Brass drift punch
- Cleaning agents and solvents
- Dial indicators
- Drill
- Feeler gauges
- Hex wrenches
- Hydraulic press
- Induction heater
- Leveling blocks and shims
- Lifting sling
- Micrometer
- Rubber mallet
- Screwdriver
- Snap-ring pliers
- Wrenches
- Lifting eyebolt (dependent on pump / motor size)

6.6.3 Drain the pump



CAUTION:

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

1. Leave the 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.
2. Remove the coupling guard.

6.6.4 Remove the coupling

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

6.6.5 Remove the back pull-out assembly



WARNING:

Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

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

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

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

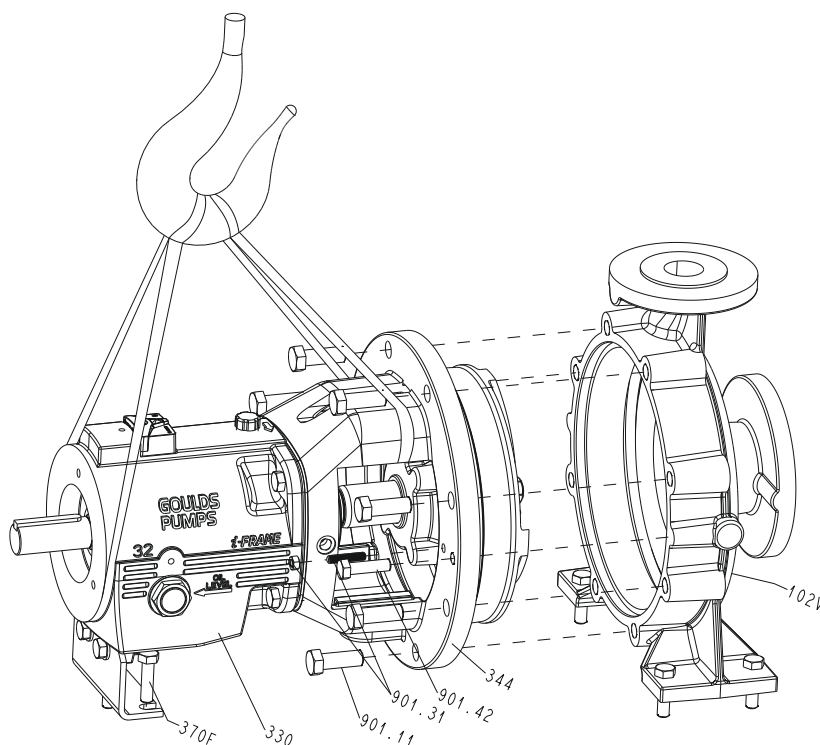


Figure 26: Back pullout removal

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



WARNING:

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

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

6.6.6 Remove the coupling hub

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

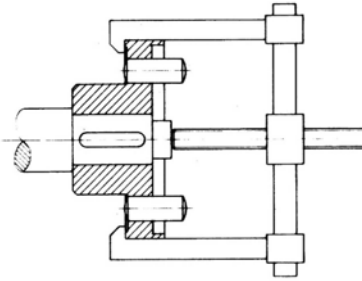


Figure 27: Coupling hub removal

6.6.7 Remove the impeller



WARNING:

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



CAUTION:

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

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

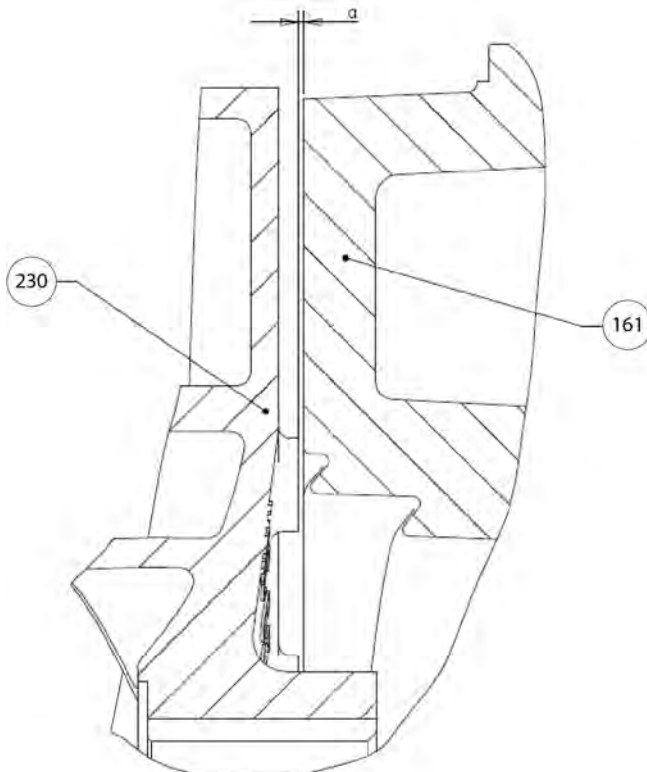


Figure 28: Back clearance check

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

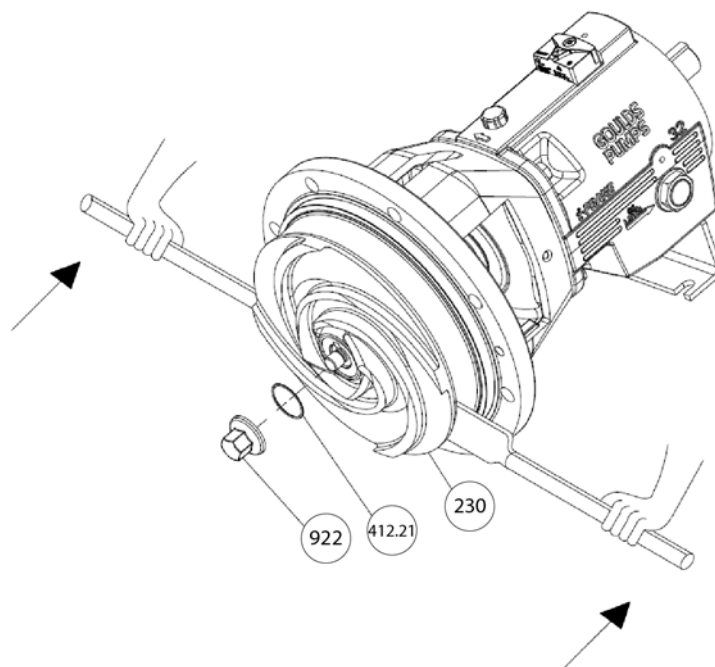


Figure 29: Impeller removal method

NOTICE:

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

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

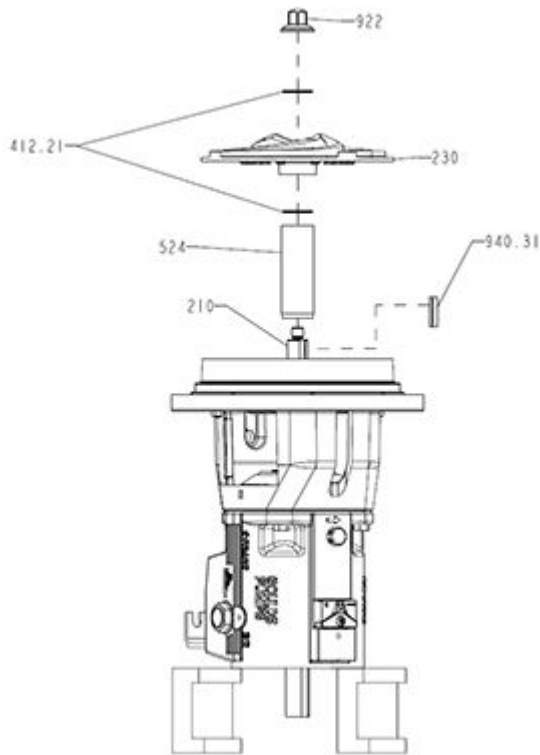


Figure 30: Rotor components

6.6.8 Remove the seal-chamber cover

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

NOTICE:

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

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

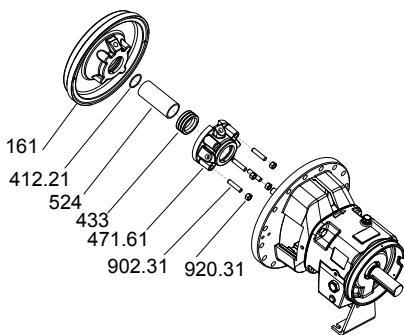


Figure 31: Gland removal

6.6.9 Remove the stuffing-box cover

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

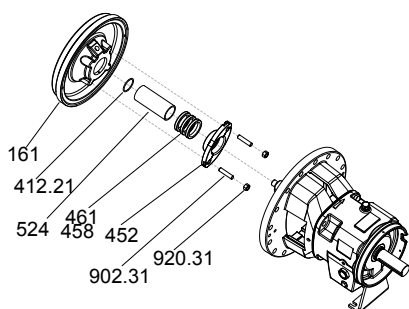


Figure 32: Packing and lantern ring removal

6.6.10 Disassemble the power end

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

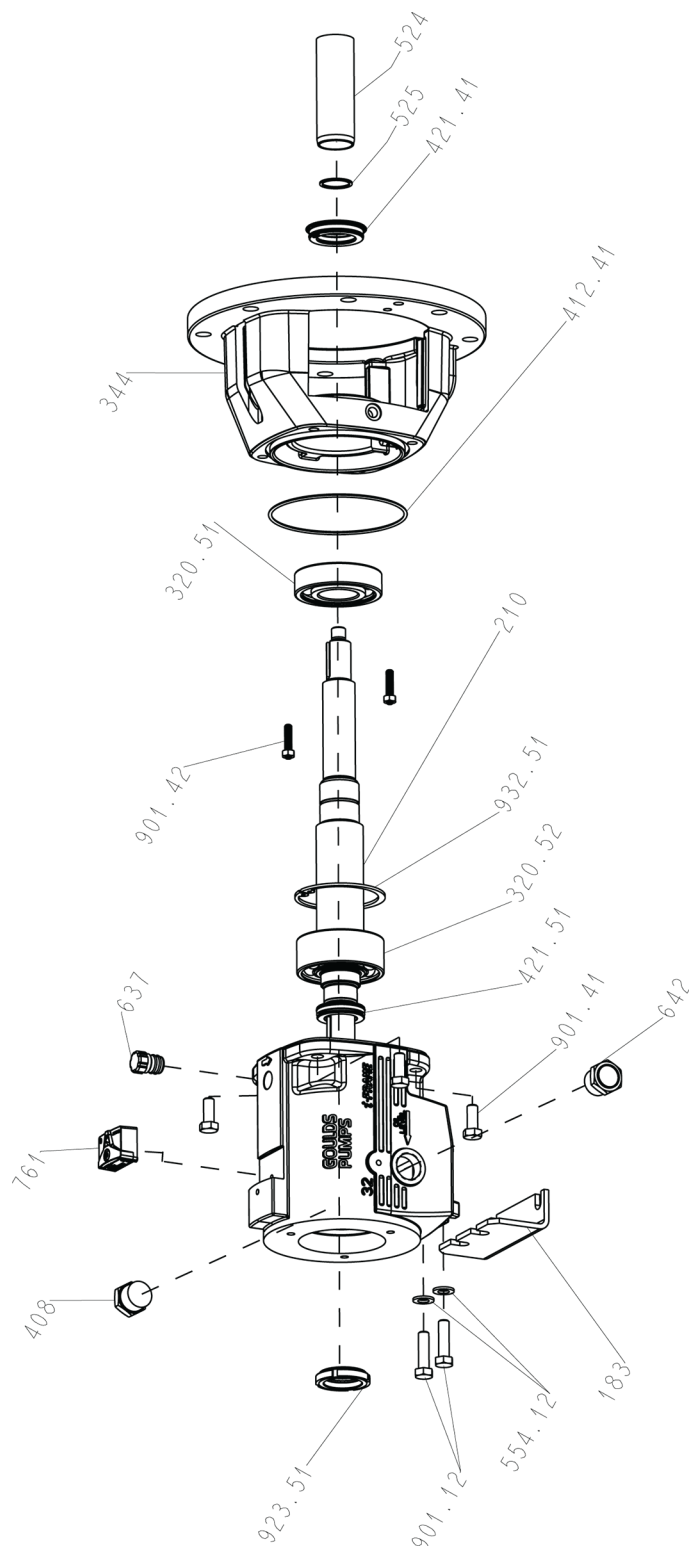


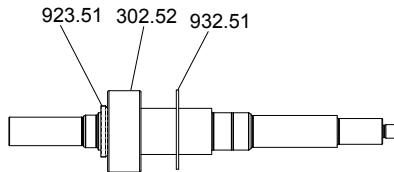
Figure 33: Bearing frame cross-section

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

Bearing frame size	Pliers size	Minimum length of pliers
24 i-FRAME	94/C 40	200 mm 8 in.

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

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



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

6.7 Pre-assembly inspections

Guidelines

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

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

NOTICE:

Protect machined surfaces while cleaning the parts. Failure to do so may result in equipment damage.

6.7.1 Replacement guidelines

Casing check and replacement



WARNING:

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

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

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

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

Casing areas to inspect

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

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

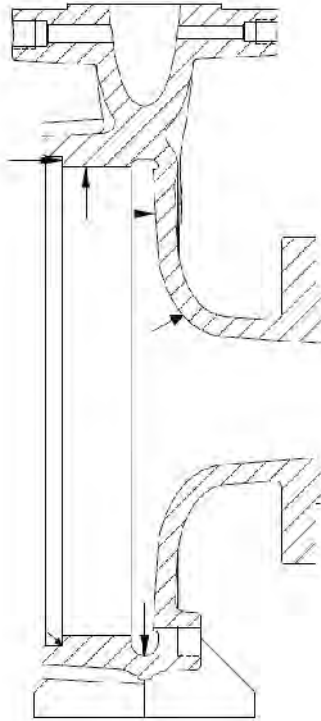


Figure 34: Areas to inspect on the casing

Impeller replacement

This table shows the criteria for replacing the impeller:

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

Frame adapter check and replacement

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

Oil seal replacement

Replace the oil seal if it has cuts or cracks.

Gaskets, O-rings, and seats replacement



WARNING:

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

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



WARNING:

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

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

6.7.2 Shaft replacement guidelines

Straightness check

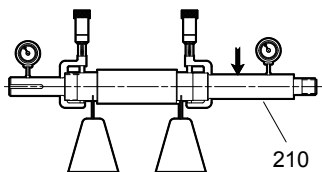


Figure 35: Straightness check

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

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

Sleeve fit in millimeters inches
0.051 0.002

Shaft and sleeve check

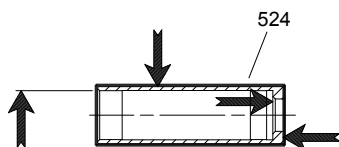


Figure 36: Shaft and sleeve check

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

6.7.3 Bearing-frame inspection

Checklist

Check the bearing frame for these conditions:

- Visually inspect the bearing frame 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.

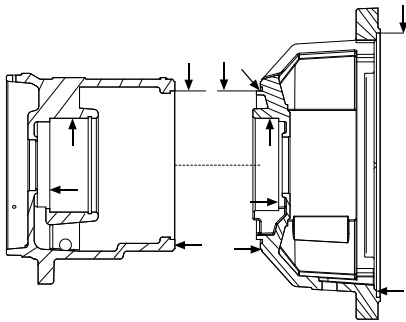


Figure 37: Inside and outside inspection locations

6.7.4 Seal chamber and stuffing box cover inspection

Checklist

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

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

These images point to the areas to inspect:

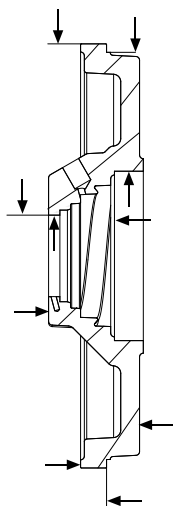


Figure 38: Seal chamber

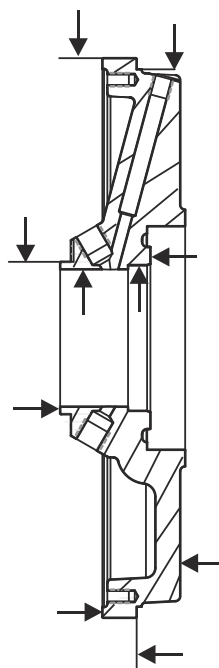


Figure 39: Stuffing box cover

6.7.5 Bearings inspection

Condition of bearings

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

Checklist

Perform these checks when you inspect the bearings:

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

6.8 Reassembly

6.8.1 Assemble the rotating element and bearing frame



WARNING:

Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.



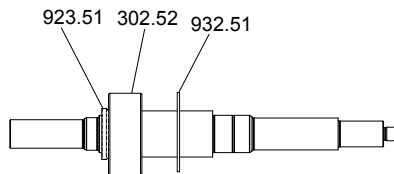
CAUTION:

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

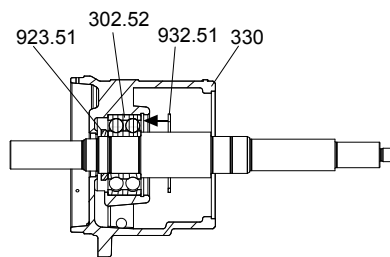
NOTICE:

- Ensure that the pipe threads are clean. Apply thread sealant to the plugs and fittings. Failure to do so may result in oil leaks and equipment damage.
- There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings. Bearings can get hot and can cause physical injury.

1. Install the bearings:
 - 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.

**Figure 40: Shaft assembly**

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.

**Figure 41: Shaft / bearing frame assembly**

- 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

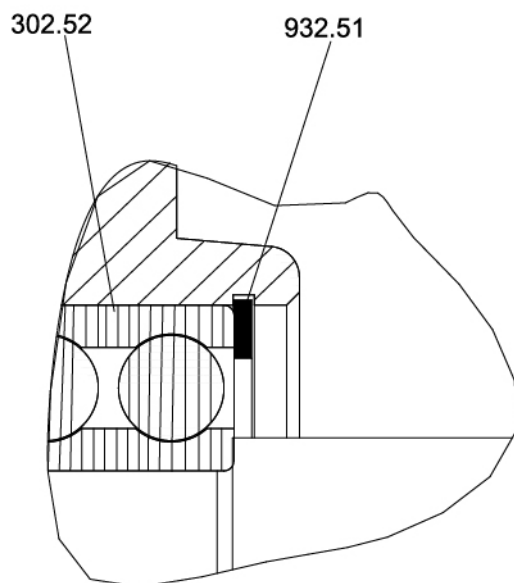
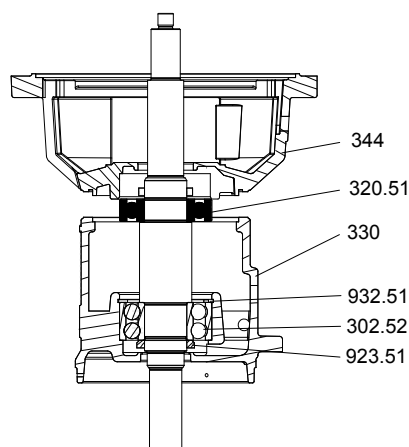


Figure 42: Snap ring detail

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



- j) Remove the stud that was used to align frame adapter and frame. Bolt the bearing frame (330) to the frame adapter (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.

- k) Press the inboard (421.41) labyrinth oil seal into the Lantern (344) and the outboard (421.51) labyrinth oil seal into the Bearing Frame (330).

Ensure that the oil return slot in both seals is positioned in the bottom (6 o'clock) position when the pump is horizontal. Refer to Assemble the INPRO labyrinth oil seal installation.

6.8.2 Install the impeller and casing



WARNING:

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



CAUTION:

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

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

NOTICE:

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

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

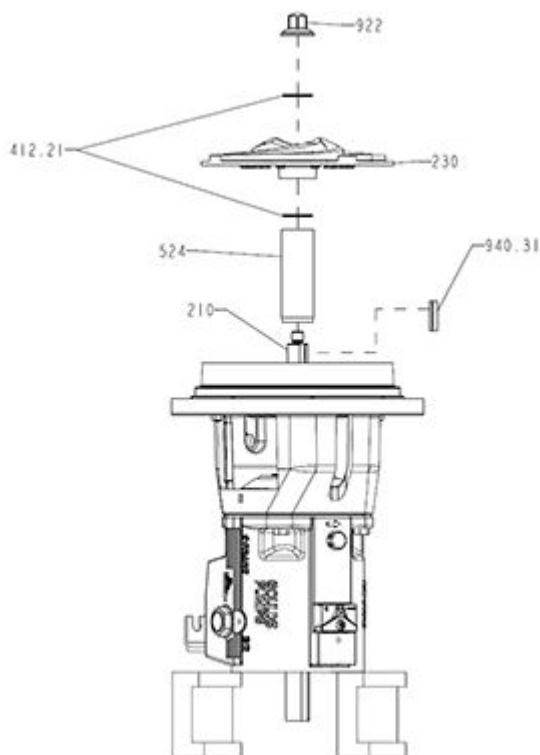


Figure 43: Impeller installation

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

NOTICE:

- During Casing (102V) installation rotate shaft (210) consistently while tightening casing bolts (901.11) to ensure no binding occurs.
 - Use casing bolts (901.11) to maintain a consistent gap between casing (102V) and casing cover (161) during assembly.
7. Where possible, verify front clearance between casing (102V) and impeller (230) through the discharge nozzle.

Table 5: Acceptable front clearances

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

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

6.8.3 Shaft sealing

**WARNING:**

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

**CAUTION:**

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

Before proceeding with seal installation, complete the [6.8.6.4 ICO assembly worksheet on page 94](#) on shim measurement method and installation. Follow [6.8.3.3 Seal the shaft with a cartridge mechanical seal on page 89](#).

NOTICE:

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

6.8.3.1 Shim measurement method and installation

1. Assemble the rotating element and bearing frame per [6.8.1 Assemble the rotating element and bearing frame on page 79](#) IOM instructions.
2. Orient the assembly vertically on appropriately sized blocks -- See [Figure 44: Assembly arrangement on page 85](#).

**WARNING:**

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

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

NOTICE:

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

5. Install casing cover (161) on frame adapter (344) - ensure proper orientation with flush tap accessible through top of frame adapter (344).
 6. Using a dead blow hammer fully seat casing cover (161) into frame adapter (344).
 7. Install cover retention nuts (920.32) and tighten per [6.8.6.1 Bolt torque values on page 92](#).
-

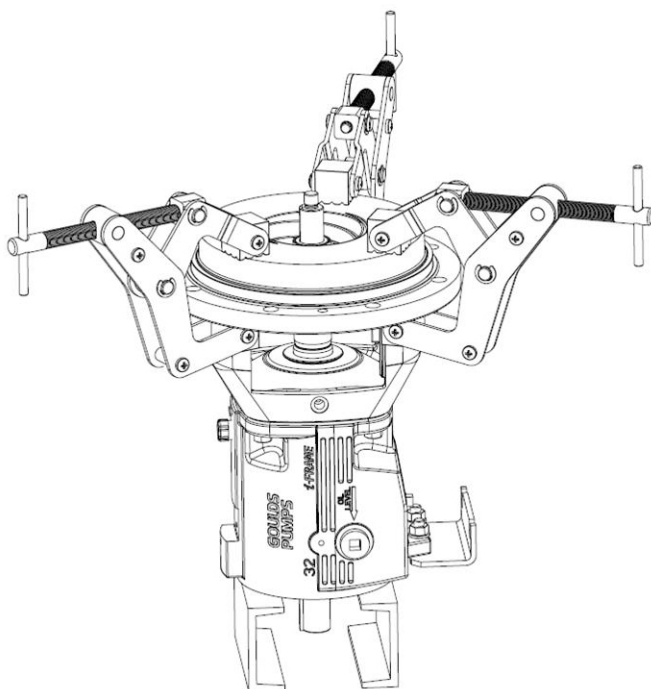


Figure 44: Assembly arrangement

8. If casing cover (161) to frame adapter (344) retention studs (920.32) are not supplied, install clamps as shown in [Figure 44: Assembly arrangement on page 85](#) after seating casing cover (161) in frame adapter (344) with dead blow or lead hammer.
9. Install shaft sleeve (524).

Do not install shaft sleeve O-ring (412.21) at this time.

10. Adjacent to the current assembly, orient the casing (102V), suction flange down, on a stable work surface.

NOTICE:

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

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

NOTICE:

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

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

NOTICE:

If using ITT/Goulds K14153A gauge bar kit, see [Figure 45: Goulds gauge bar method on page 86](#), If using a generic bar see [Figure 46: Generic gauge bar method on page 86](#).

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

NOTICE:

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

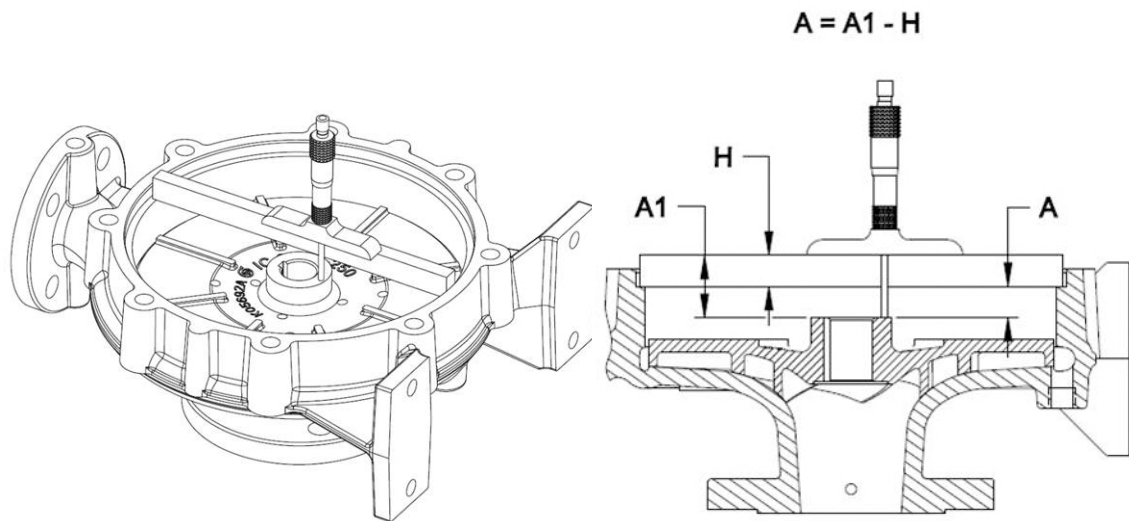


Figure 45: Goulds gauge bar method

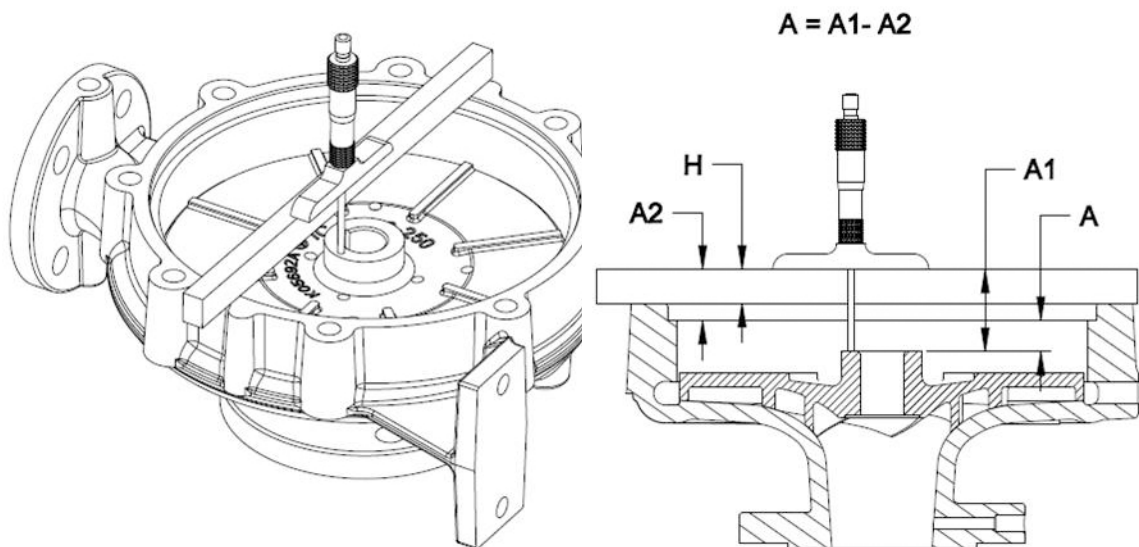


Figure 46: Generic gauge bar method

17. Measure from top of bar to impeller (230) back hub face as shown in [Figure 45: Goulds gauge bar method on page 86](#) and record in A1 field.
18. Measure from top of bar to casing (102V) gasket surface as shown in [Figure 45: Goulds gauge bar method on page 86](#) and recorded in A2 field.

NOTICE:

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

19. Subtract A2 from A1 and record in the A field ($A = A1 - A2$) -- Refer to [Figure 46: Generic gauge bar method on page 86](#).
20. Continue to Step 22 for casing cover (161) to sleeve (524) measurement -- Refer to [Figure 46: Generic gauge bar method on page 86](#).
21. Measure from top of appropriate K14153A bar to impeller (230) back hub face as shown in [Figure 44: Assembly arrangement on page 85](#) and record value in A1 field.
22. Subtract H from A1 to and record in A field ($A = A1 - H$) -- Refer to [Figure 45: Goulds gauge bar method on page 86](#).

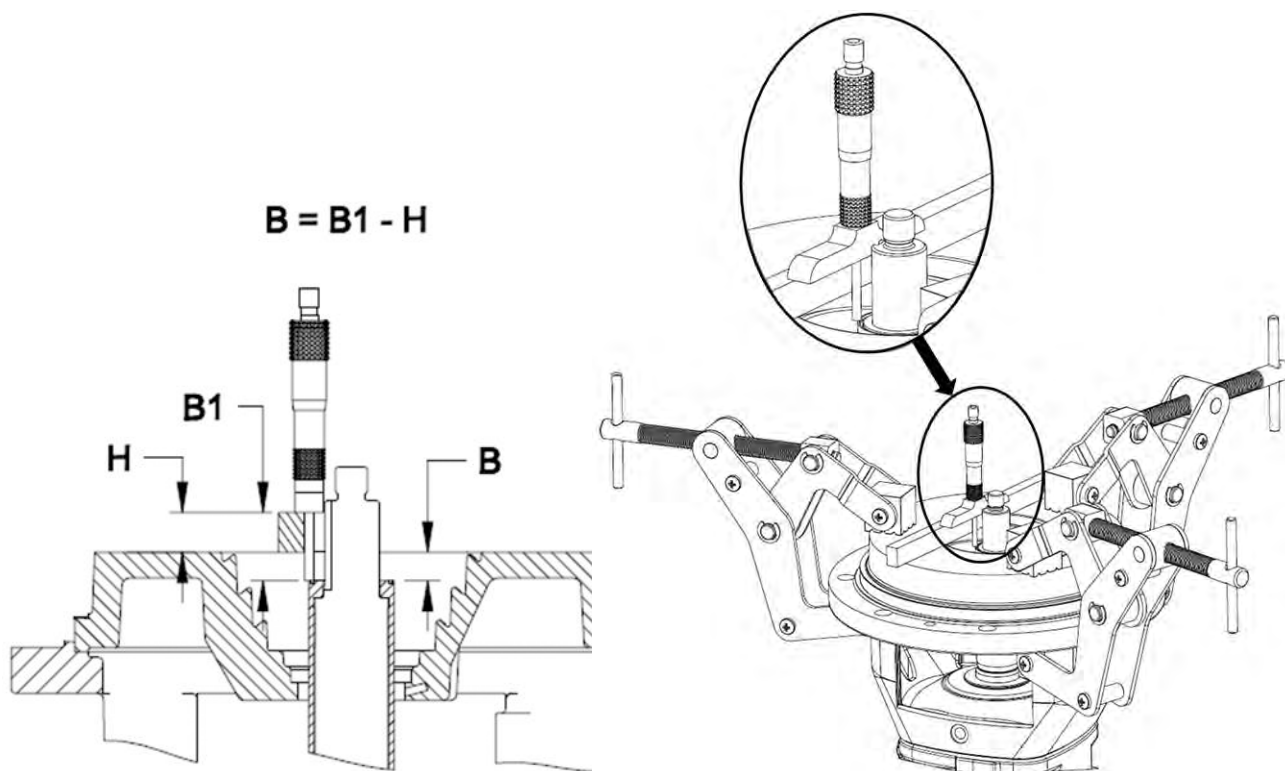


Figure 47: Casing cover to sleeve measurement

23. Place bar (Goulds or Generic) across casing cover (161) as shown in [Figure 47: Casing cover to sleeve measurement on page 87](#), measure top of bar to sleeve (524) shoulder, and record in B1 field.
24. Subtract H from B1 and record in field B ($B = B1 - H$) -- Refer to [Figure 47: Casing cover to sleeve measurement on page 87](#).
25. Refer to [Table 6: "C" Value table on page 95](#) and match pump size with fluid temperature - Record this value in "C" field.
26. Refer to gasket [Table 7: "D" Value Table on page 96](#) and record value in "D" field.

NOTICE:

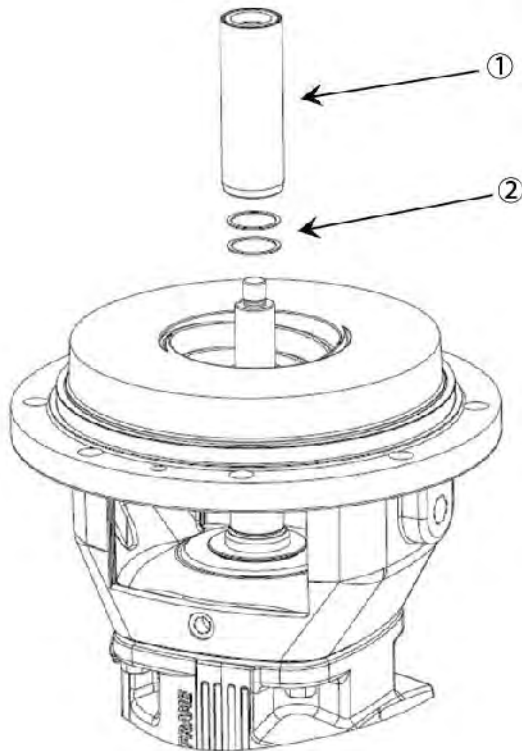
Most common gasket type is AFM-34.

27. Determine shim (525) height by using the following formula: $\text{SHIM HEIGHT} = A + B - C + D$.
28. With shim thickness determined, combine shims as needed to approximate this value.

29. Using the shim kit provided in the assembly components, determine a combination of shims that matches the calculated shim height
Shim pack consists of one of each of the following thicknesses:

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

30. Once shim(s) combination is determined, install shim(s) (525) and sleeve (222) on the shaft (210), refer to [Figure 47: Casing cover to sleeve measurement on page 87](#).



1. Sleeve
2. Shims (as required)

Figure 48: Shim and sleeve assembly

6.8.3.2 Seal the shaft with a packed stuffing box



WARNING:

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

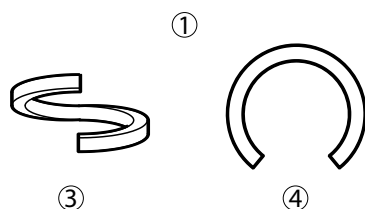
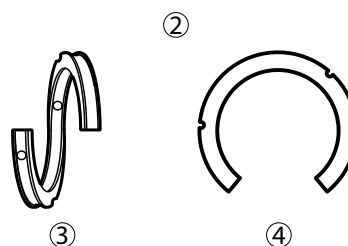


WARNING:

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

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

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

Packing rings**Lantern rings**

1. Packing rings
2. Lantern rings
3. Correct
4. Incorrect

Figure 49: Packing rings and lantern rings

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

NOTICE:

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

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

6.8.3.3 Seal the shaft with a cartridge mechanical seal**WARNING:**

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



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

**CAUTION:**

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

1. Before proceeding with seal installation, complete Steps 1-30 in [6.8.3.1 Shim measurement method and installation on page 84](#).

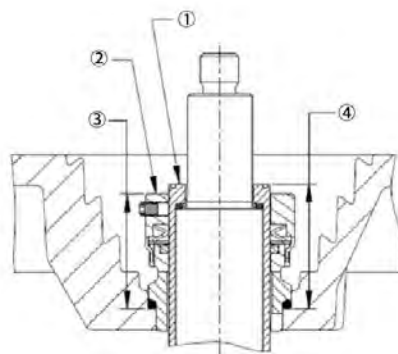
NOTICE:

Reference Cartridge seal installation instructions.

2. Remove casing cover (161) from frame adapter (344).
3. Slide the cartridge seal onto the shaft or sleeve until it contacts the inboard labyrinth oil seal.
4. Install casing cover (161) on frame adapter (344) - ensure proper orientation with flush tap accessible through top of frame adapter (344).
5. Slide the cartridge seal into the seal chamber and secure using the four studs and nuts.
6. Complete Pump Assembly before tightening seal rotating section set screws and removing centering clips.

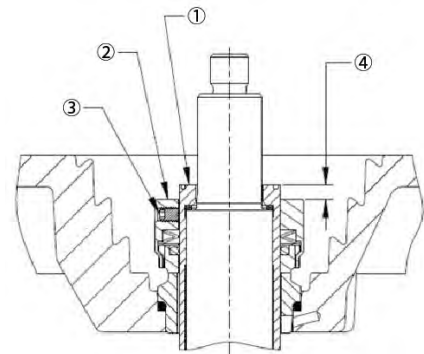
6.8.3.4 Seal the shaft with a conventional inside-component mechanical seal

1. Before proceeding with seal installation, complete Steps 1-29 on [6.8.3.1 Shim measurement method and installation on page 84](#).
2. Measure distance from the shaft sleeve face (524) to rotating component seat in casing cover (161) and record this value as "L1" - see [Figure 50: Initial seal measurement on page 90](#).



1. Sleeve face
2. Seal rotating component
3. Seal instructions " L_{1K} "
4. Initial measurement " $L1$ "

Figure 50: Initial seal measurement



1. Sleeve face
2. Seal rotating component
3. Set screw
4. Seal offset = $L1 - L_{1K}$

Figure 51: Setting seal at determined value

3. Consult seal instructions for component L_{1K} dimensions and subtract L_{1K} from $L1$ ($L1 - L_{1K}$ = Seal Offset) - See [Figure 50: Initial seal measurement on page 90](#).
4. Install Stationary seal component in casing cover (161) using appropriate O-ring lubricant.
5. Remove the shaft sleeve (524) and rotating component assembly from the shaft - Leave shims (525) on the shaft.

NOTICE:

Check sleeve to ensure no shims were retained after removal.

6. Slide rotating seal component on shaft sleeve (524) using appropriate O-ring lubricant.
7. Move the rotating component down the shaft sleeve to the determined seal offset ($L1 - L_{1K}$ = Seal Offset).
8. Tighten set screws per the seal manufacturers guidelines.
9. Replace shaft sleeve / seal assembly on shaft.

6.8.4 Install the back pull-out assembly



WARNING:

Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

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

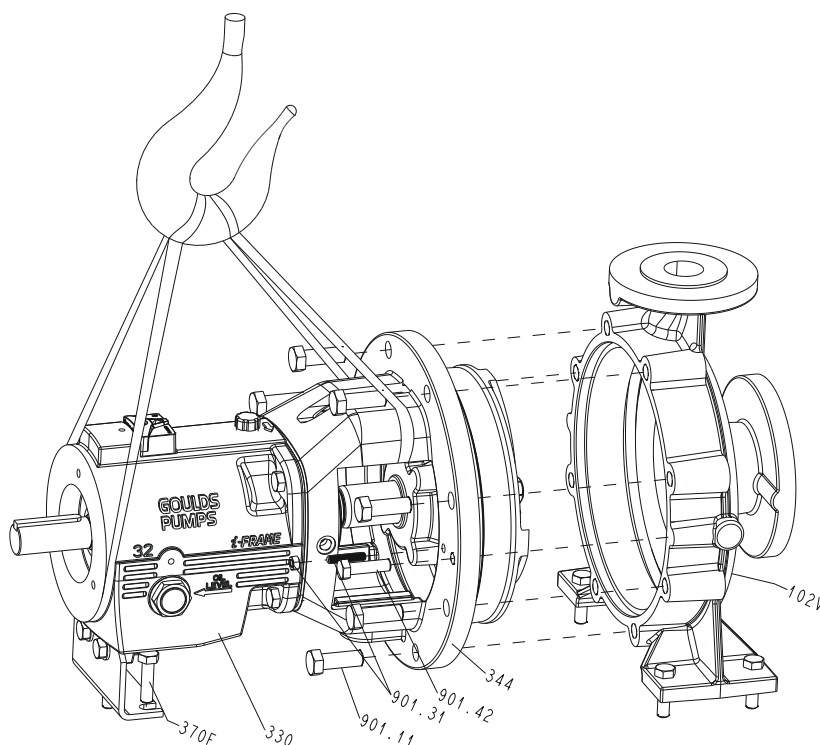


Figure 52: Install back pull-out assembly

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

NOTICE:

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

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

NOTICE:

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

6.8.5 Post-assembly checks

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

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

6.8.6 Assembly references

6.8.6.1 Bolt torque values

Screw torque values

This table provides the recommended screw torque values.

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

Nut torque values

This table provides the recommended nut torque values.

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

6.8.6.2 Bearing types

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

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

6.8.6.3 Spare parts

Spare pumps kept for stand-by usage

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

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

Number of spare parts to keep in stock

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

Calculation note

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

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

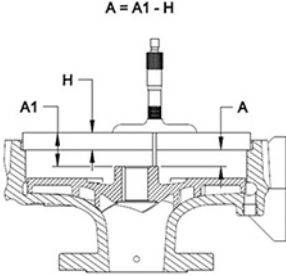
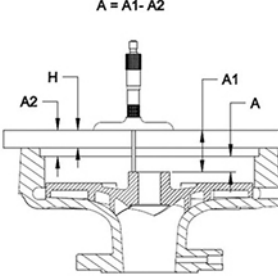
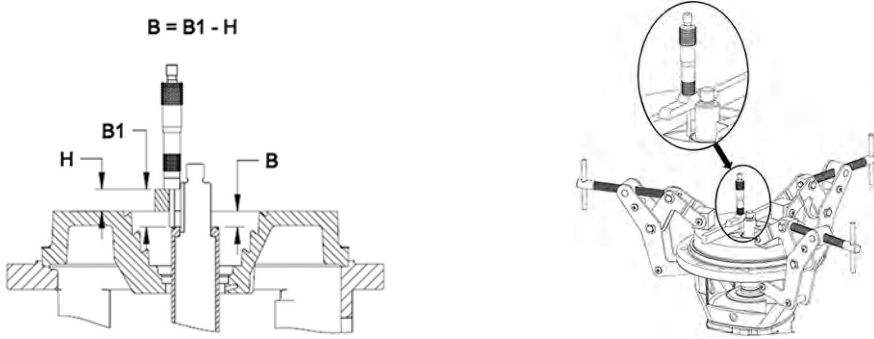
Spare parts order

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

- Pump model and size

- Serial number (order number)
- Part name
- Sectional drawing, item number

6.8.6.4 ICO assembly worksheet

<p>"A" Determination using ITT/Goulds K14153A gauge bars</p> <p style="text-align: center;">$A = A1 - H$</p>  <p>Figure 53: Goulds gauge bar</p>	<p>"A" Determination using generic gauge bar (Straight edge or other flat parallel bar)</p> <p style="text-align: center;">$A = A1 - A2$</p>  <p>Figure 54: Generic gauge bar</p>		
<p style="text-align: center;">$B = B1 - H$</p>  <p>Figure 55: Cover/sleeve measurement</p>			
<p>Step Instructional information for shim determination</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; vertical-align: top; padding: 5px;"> <p>1 Determine gasket type and fluid temperature - record in the provided fields.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: If using ITT/Goulds K14153A gauge bar kit refer to Figure 53: Goulds gauge bar on page 94, for a generic bar see Figure 54: Generic gauge bar on page 94.</p> </div> <p>2 Select appropriate length gauge bar to match pump features, measure height, record in "H".</p> <p>3 If using ITT/Goulds gauge bar K14153A kit proceed to Step 8.</p> <p>4 Measure from top of bar to impeller hub feature as shown in Figure 54: Generic gauge bar on page 94 and record in "A1" field.</p> <p>5 Measure from top of bar to casing gasket surface as shown in Figure 54: Generic gauge bar on page 94 and record in "A2" field</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: Casing gasket must not be installed and feature must be clean and free of defects.</p> </div> </td> <td style="width: 30%; vertical-align: top; padding: 5px;"> <p>Gasket type: _____</p> <p>Fluid temp: _____</p> <p>H = _____</p> <p>A1 = _____</p> <p>A2 = _____</p> </td> </tr> </table>		<p>1 Determine gasket type and fluid temperature - record in the provided fields.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: If using ITT/Goulds K14153A gauge bar kit refer to Figure 53: Goulds gauge bar on page 94, for a generic bar see Figure 54: Generic gauge bar on page 94.</p> </div> <p>2 Select appropriate length gauge bar to match pump features, measure height, record in "H".</p> <p>3 If using ITT/Goulds gauge bar K14153A kit proceed to Step 8.</p> <p>4 Measure from top of bar to impeller hub feature as shown in Figure 54: Generic gauge bar on page 94 and record in "A1" field.</p> <p>5 Measure from top of bar to casing gasket surface as shown in Figure 54: Generic gauge bar on page 94 and record in "A2" field</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: Casing gasket must not be installed and feature must be clean and free of defects.</p> </div>	<p>Gasket type: _____</p> <p>Fluid temp: _____</p> <p>H = _____</p> <p>A1 = _____</p> <p>A2 = _____</p>
<p>1 Determine gasket type and fluid temperature - record in the provided fields.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: If using ITT/Goulds K14153A gauge bar kit refer to Figure 53: Goulds gauge bar on page 94, for a generic bar see Figure 54: Generic gauge bar on page 94.</p> </div> <p>2 Select appropriate length gauge bar to match pump features, measure height, record in "H".</p> <p>3 If using ITT/Goulds gauge bar K14153A kit proceed to Step 8.</p> <p>4 Measure from top of bar to impeller hub feature as shown in Figure 54: Generic gauge bar on page 94 and record in "A1" field.</p> <p>5 Measure from top of bar to casing gasket surface as shown in Figure 54: Generic gauge bar on page 94 and record in "A2" field</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTICE: Casing gasket must not be installed and feature must be clean and free of defects.</p> </div>	<p>Gasket type: _____</p> <p>Fluid temp: _____</p> <p>H = _____</p> <p>A1 = _____</p> <p>A2 = _____</p>		

Step	Instructional information for shim determination	
6	Subtract A2 from A1 and record in the "A" field ($A=A1-A2$) -- see Figure 54: Generic gauge bar on page 94 .	A = _____ —
7	Continue to Step 10.	
8	Measure from top of bar to impeller hub feature as shown in Figure 53: Goulds gauge bar on page 94 and record value in "A1" field.	A1 = _____ —
9	Subtract "H" from "A1" and record in "A" field ($A=A1-H$) -- See Figure 55: Cover/sleeve measurement on page 94 .	A = _____ —
10	Place bar across casing cover as shown in Figure 54: Generic gauge bar on page 94 , measure top of bar to sleeve shoulder, and record in "B1" field.	B1 = _____ —
11	Subtract "H" from B1 to obtain B ($B=B1-H$).	B = _____ —
12	Refer to Table 6: "C" Value table on page 95 and match pump size with fluid temperature - record this value in "C" field.	C = _____ —
13	Refer to gasket Table 7: "D" Value Table on page 96 and record value in "D" field.	D = _____ —
NOTICE: Most common gasket type is AFM-34 (0.5mm thick).		
14	Determine shim height for your application by using following formula: shim height = $A+B-C+D$.	Shim = _____ —
15	With the ideal shim thickness determined, combine shims as needed to approximate this value.	
16	Refer to IOM or ICO assembly procedure for additional assembly details.	
	Pump size: _____ By: _____ Date: _____	

Table 6: "C" Value table

Bea ring fra me size	Pump size	"C" (mm) up to 70°C 160°F	"C" (mm) up to 80°C 180°F	"C" (mm) up to 110°C 230°F	"C" (mm) up to 140°C 285°F	"C" (mm) up to 170°C 340°F	"C" (mm) up to 200°C 395°F	"C" (mm) up to 230°C 450°F	"C" (mm) up to 260°C 500°F
24	40-25-160								
	50-32-160	20.26	20.27	20.30	20.34	20.37	20.40	20.43	20.46
	65-40-160								
	80-50-160								
	40-25-200								
	50-32-200	21.26	21.27	21.30	21.34	21.37	21.40	21.43	21.46
	65-40-200								
	80-50-200								
32	100-65-160	28.26	28.27	28.29	28.32	28.35	28.37	28.40	28.42
	125-80-160								
	100-65-200								
	125-80-200	28.26	28.27	28.29	28.32	28.35	28.37	28.40	28.42
	125-100-200								
	40-25-250								
	50-32-250	33.26	33.27	33.29	33.32	33.35	33.37	33.40	33.42
	65-40-250								

Bearing frame size	Pump size	"C" (mm) up to 70°C 160°F	"C" (mm) up to 80°C 180°F	"C" (mm) up to 110°C 230°F	"C" (mm) up to 140°C 285°F	"C" (mm) up to 170°C 340°F	"C" (mm) up to 200°C 395°F	"C" (mm) up to 230°C 450°F	"C" (mm) up to 260°C 500°F
42	80-50-250 100-65-250 125-80-250								
	50-32-315 65-40-315 80-50-315	26.26	26.27	26.29	26.32	26.35	26.37	26.40	26.42
	125-100-250 150-125-250 200-150-250	43.26	43.27	43.30	43.33	43.36	43.38	43.41	43.44
	100-65-315 125-80-315 125-100-315 150-125-315	29.26	29.27	29.30	29.33	29.36	29.38	29.41	29.44
	125-80-400 125-100-400 150-125-400	33.26	33.27	33.30	33.33	33.36	33.38	33.41	33.44
	200-150-315 200-150-400	53.26	53.27	53.30	53.34	53.37	53.40	53.43	53.46

Table 7: "D" Value Table

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

7 Troubleshooting

7.1 Operation troubleshooting

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

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

7.2 Alignment troubleshooting

Symptom	Cause	Remedy
Horizontal (side-to-side) alignment cannot be obtained (angular or parallel).	The driver feet are bolt-bound.	Loosen the pump's hold-down bolts, and slide the pump and driver until you achieve horizontal alignment.
	The baseplate is not leveled properly and is probably twisted.	<ol style="list-style-type: none"> 1. Determine which corners of the baseplate are high or low. 2. Remove or add shims at the appropriate corners. 3. Realign the pump and driver.
Vertical (top-to-bottom) alignment cannot be obtained (angular or parallel).	The baseplate is not leveled properly and is probably bowed.	<ol style="list-style-type: none"> 1. Determine if the center of the baseplate should be raised or lowered. 2. Level screws equally at the center of the baseplate. 3. Realign the pump and driver.

7.3 Assembly troubleshooting

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

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.

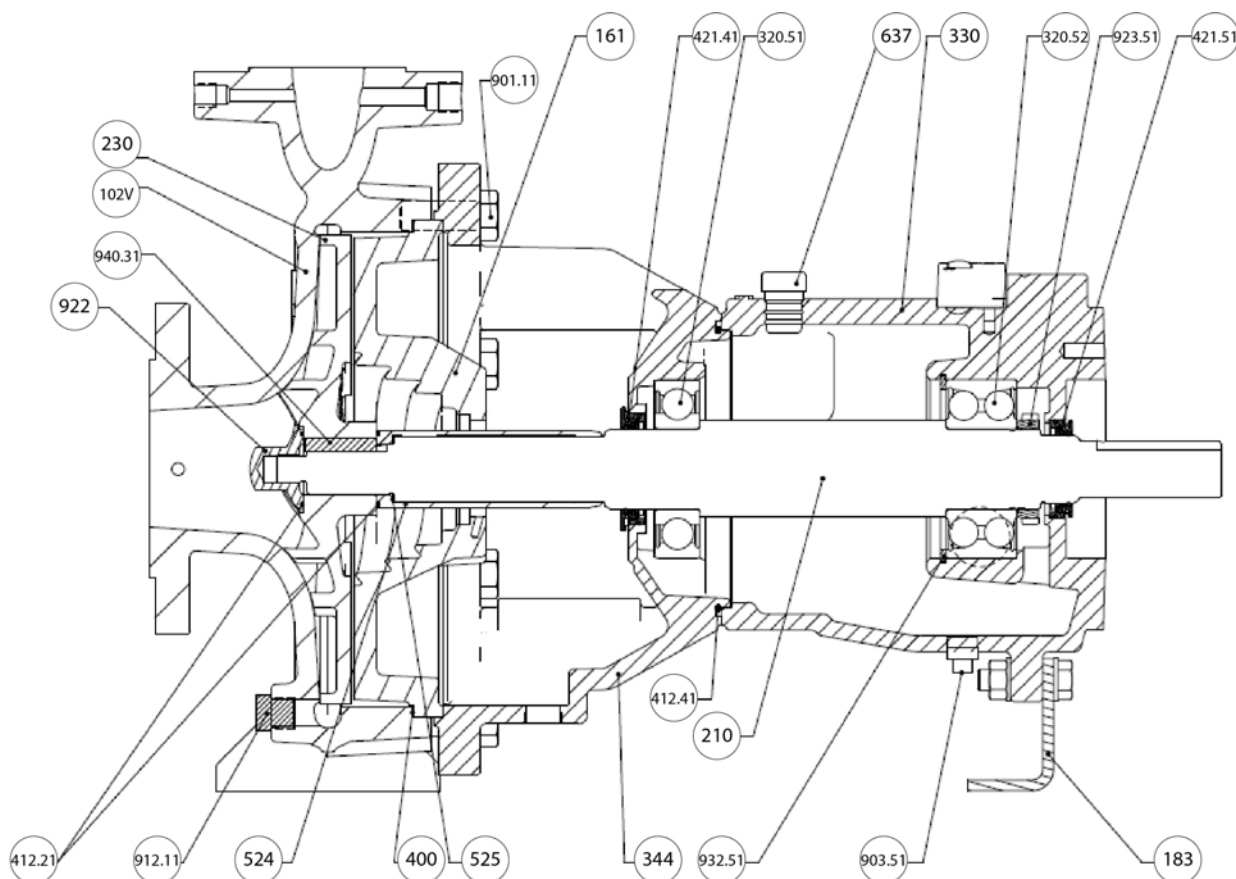
7.4 i-ALERT®2 Equipment Health Monitor troubleshooting

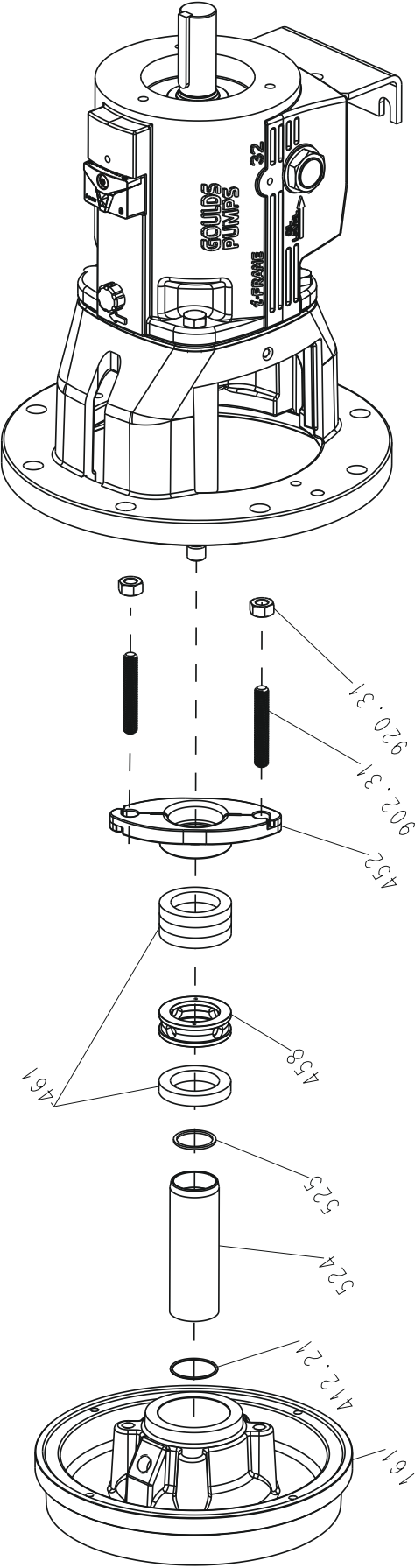
To troubleshoot the i-ALERT®2 Equipment Health Monitor, please refer to the i-ALERT®2 Equipment Health Monitor IOM or <https://www.itproservices.com/Our-Services/Aftermarket-Products/Monitoring/i-ALERT2-condition-monitor/>

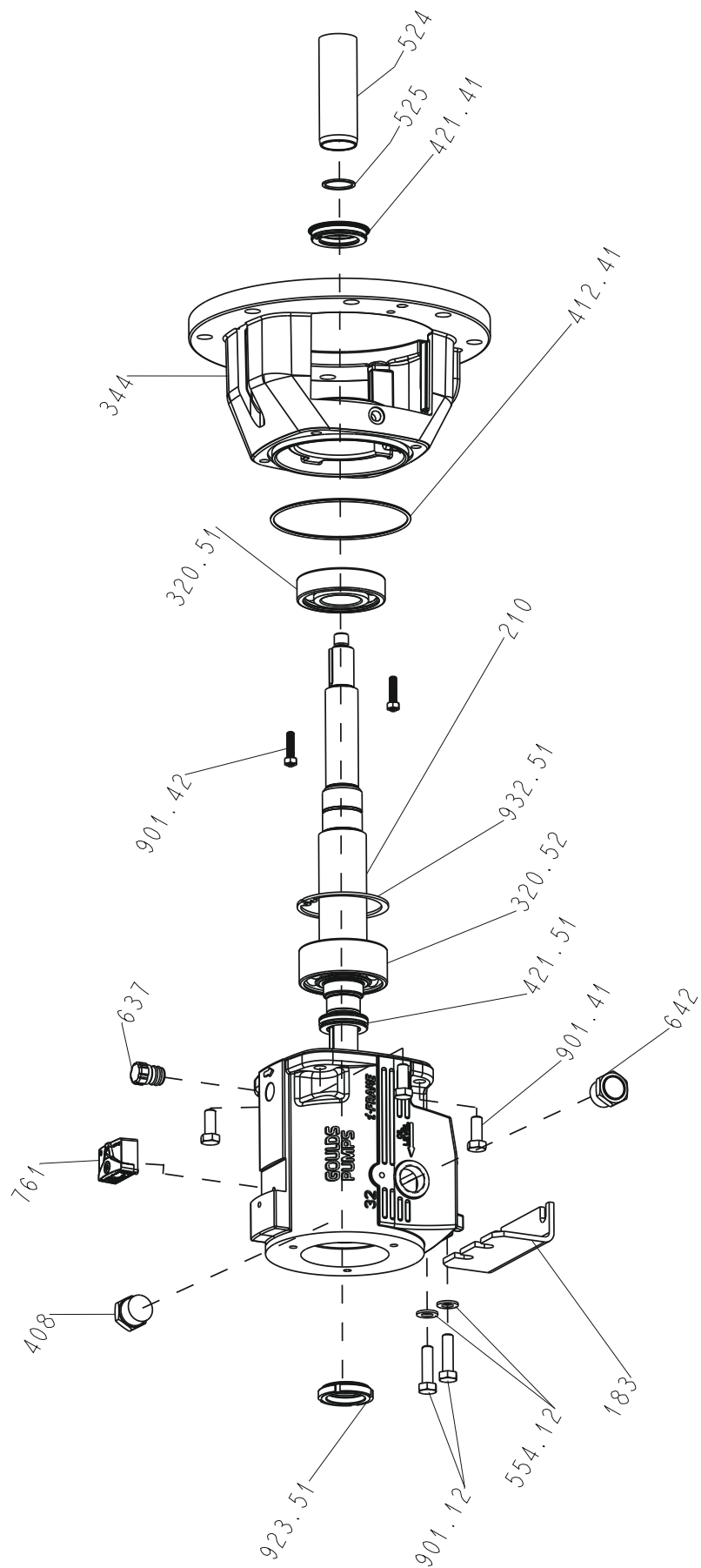
8 Parts Listings and Cross-Sectional Drawings

8.1 Parts list

Cross-sectional drawings







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

9 Local ITT Contacts

9.1 Local ITT Contacts

9.1.1 Regional offices

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North America (Headquarters)	ITT - Goulds Pumps 240 Fall Street Seneca Falls, NY 13148 USA	+1 315-568-2811	+1 315-568-2418
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Los Angeles	Vertical Products Operation 3951 Capitol Avenue City of Industry, CA 90601-1734 USA	+1 562-949-2113	+1 562-695-8523
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