



Installation, Operation, and Maintenance Manual

Model API 3171 Flood Oil Lubrication



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.

1.2 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.
- Recognize the site emergency exits, eye wash stations, emergency showers and toilets.
- Allow all system and pump components to cool before you handle them.
- 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.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.
- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

1.2.3.2 Wash the skin and eyes

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

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



1.2.4 Ex-approved products

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

Personnel requirements

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

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

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



Product and product handling requirements

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

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.

- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.



1.2.4.1 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.

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 baseplate on which it is mounted. A typical tag would look like this:

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

* Maximum liquid temperature may be limited by the pump model and order specific options. *The Temperature class definitions* table is for the purpose of determining T'x' code for ATEX applications with liquid temperatures exceeding 107°C | 225°F.



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.



1.2.4.2 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 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.

2 Transportation and Storage

2.1 Transportation and Storage

2.1.1 Inspect the delivery

2.1.1.1 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.

2.1.1.2 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.

2.1.2 Transportation guidelines

2.1.2.1 Pump handling



WARNING:

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



CAUTION:

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

2.1.2.2 Lifting methods



WARNING:

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

- 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.
-

Use swivel hoist rings (available as an option) and suitable slings in order to lift the pump, without motor, to a vertical position and then lower the unit into the sump. Then use the lifting lugs on the motor and a suitable sling in order to hoist the motor into position. Use a tag line attached to the casing end in order to prevent the pump from swinging.

Examples

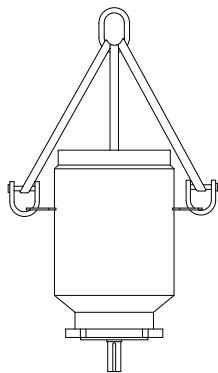


Figure 1: Example of lifting motor properly with lifting lugs

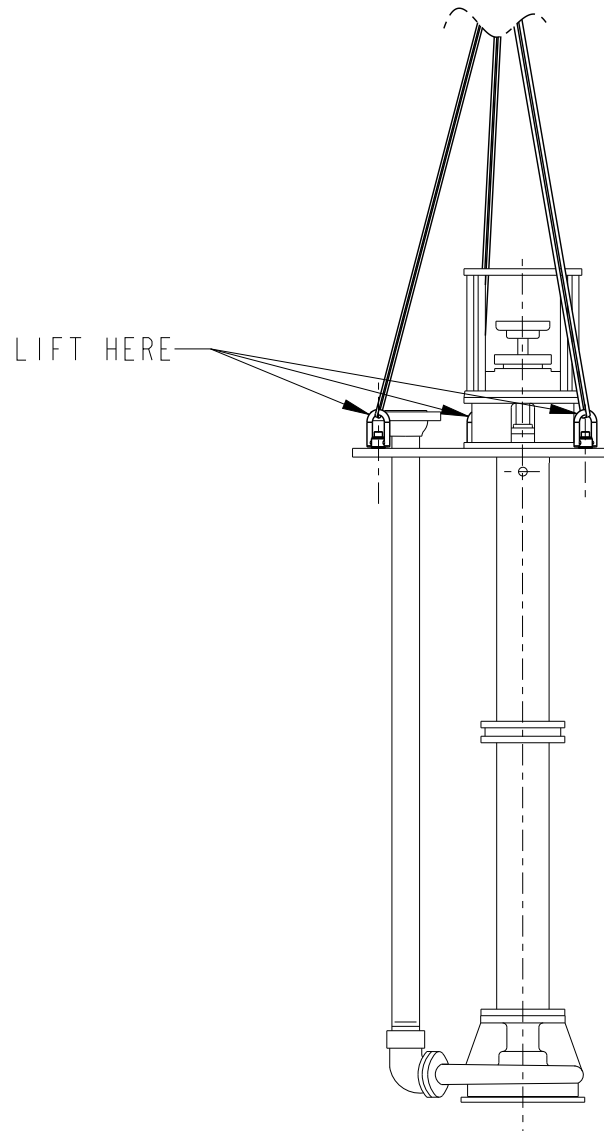


Figure 2: Example of lifting pump properly with sling

2.1.2.3 Storage guidelines

2.1.2.3.1 Pump storage requirements

Requirements

Vertical pumps require proper preparation for storage and regular maintenance during storage. The pump is considered in storage when it has been delivered to the job site and is awaiting installation.

For specific requirements for storing motors, gearboxes, engines, panels, sealing plans and other auxiliaries, contact the equipment manufacturer.

Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	<ul style="list-style-type: none"> Pave the area. Clean the area. Drain the area and keep it free from flooding.
Outdoor storage area (when indoor storage is not available)	<ul style="list-style-type: none"> Observe all indoor storage requirements. Use weather-proof coverings such as flame-resistant sheeting or tarpaulins. Place coverings in a manner that maximizes drainage and air circulation. Tie coverings down in order to protect the pump from wind damage.
Placement of pumps and component parts	<ul style="list-style-type: none"> Place the unit on skids, pallets, or shoring higher than 15 cm 6 in. from the ground for good air circulation. Sort the parts in order to permit easy access for inspection and/or maintenance without excessive handling.
Stacking of units or component parts	<ul style="list-style-type: none"> Make sure that racks, containers, or crates bear the full weight of units or parts in order to prevent distortion. Keep identification markings readily visible. Immediately replace any cover you remove for internal access.
Rotation of the pump shaft	<ul style="list-style-type: none"> Rotate the shaft clockwise once a month, at a minimum. Never leave the shaft in a previous position or in the extreme raised or lowered lateral position. Make sure that the shaft rotates freely.
Controlled storage facilities	<ul style="list-style-type: none"> Maintain an even temperature of 6°C 10°F or higher above the dew point. Keep the relative humidity to less than 50%. Make sure that there is little or no dust.
Uncontrolled storage facilities that have uneven temperatures, higher humidity, and/or dusty conditions)	<ul style="list-style-type: none"> Inspect the unit periodically to make sure that all preservatives are intact. Seal all pipe threads and flanged pipe covers with tape.

When pump is not in regular operation

If a pump has been installed, but is not in regular operation for an extended period of time, such as during a seasonal shutdown, then operate it for at least 15 minutes every two weeks.

2.1.2.3.2 Prepare the pump for long-term storage

For storage periods over six months, you must follow the [2.1.2.3.1 Pump storage requirements on page 12](#) above this procedure:

1. Inspect the lube-oil and seal-flush piping and either fill the piping with rust-preventative oil, or recoat the piping periodically in order to prevent corrosion.
2. Place 4.5 kg | 10 lbs of moisture-absorbing desiccant or 2.3 kg | 5.0 lbs of vapor-phase inhibitor crystals near the center of the pump.

3. If the unit is assembled, place an additional 0.5 kg | 1 lb in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
4. Install a moisture indicator near the perimeter of the unit.
5. Cover the unit with black polyethylene with a minimum thickness of 0.15 mm | 6.0 mil, and seal it with tape.
6. Provide a small ventilation hole approximately 12.0 mm | 0.5 in. diameter.
7. Provide a roof or shed shelter in order to protect the unit from direct exposure to the elements.
8. If a vertical pump will be stored in a horizontal position, be sure to support the pump sufficiently to avoid any deformation or bending of the pump.

3 Product Description

3.1 General description

Product description

The Model API 3171 is a vertical submerged bearing sump and process pump that meets the requirements of the 11th edition of API Standard 610 (ISO 13709).

This model is based on three bearing frames with 17 hydraulic sizes.

This table shows the number of hydraulic sizes available for each drive-unit size group. Note that each pump has a choice of two different discharge pipes which results in four combinations.

Drive-unit size group	Number of hydraulic sizes
S/ST	9
M/MT	10
L	2



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.

Casing

The casing has these features:

- A tangential discharge
- Is self-venting
- Has an integral bearing retainer
- Is precision-bored in order to ensure permanent alignment between the column casing, suction cover, and bearing

Impeller

The impeller is fully open, keyed to the shaft, and held in place by a self-locking capscrew in order to ensure positive locking and prevent damage from reverse rotation. Impellers are spin-balanced (single plane) to ISO G2.5. The impeller is provided with back vanes in order to reduce the axial thrust and prevent the entrance of solids.

The impellers on this pump do not meet the dimensional requirements for dynamic balancing.

Impeller clearance changes are accomplished by means of the EZ-Adjust (TM) bearing carrier (Patent Pending).

Strainer

The flat plate strainer is designed to maximize draw-down in a given sump depth. Openings are sized to prevent the entrance of large solids that are commonly found in open sumps.

Discharge elbow

The discharge elbow is designed to allow the pump to fit into the smallest possible opening. A threaded connection to the discharge pipe allows the pipe to be changed without removing the pump from the sump.

Column pipe

The column pipe has flanged connections that are machined in order to ensure true parallelism and to maintain steady bearings concentric with the shaft.

Shaft

The standard design uses a one-piece shaft in order to ensure accurate alignment. The shaft is precision-ground, polished, and straightened to keep vibration and deflection to a minimum. Standard bearing spans keep the shaft well below first critical speed for all sizes.

Bearings

The thrust bearing is flood oil lubricated and consists of a pair of single-row, angular contact ball bearings arranged back-to-back. The bearing is shouldered and locked to the bearing carrier and thrust bearing frame. This enables the bearing to carry all of the thrust loads and some of the radial load. All fits are precision-machined to industry standards. The steady bearings are press fit sleeve bearings. Fits are designed for optimum life under all operating conditions.

Thrust Bearing Frame

- Flood-oil lubrication is standard.
- No machining is required to convert from oil to oil-mist lubrication.
- Oil-mist lubrication is optional.
- The oil level is checked through a sight glass.
- The power end is sealed with labyrinth seals.
- Carbon steel construction and precision-machined
- The power end is made in the following sizes:
 - S
 - M
 - L

Seals

Seal type	Description
Upper labyrinth seal	This seal is used to exclude contaminants from the thrust bearing.
Carbon PTFE [®] casing collar	This seal is installed immediately behind the impeller in the casing in order to minimize recirculation back to the sump and maximize hydraulic efficiency.

Motor support

Motor supports are steel construction and precision-machined in order to maintain proper alignment between the motor and pump shaft. Motor supports are designed for NEMA/IEC vertical C-face as standard. It is also designed to keep the bearing frame elevated from the mounting plate allowing air to circulate for increased cooling. It also facilitates removal of bearing frame and mechanical seal without disturbing the motor.

Direction of rotation

The shaft rotates clockwise when you look down on the pump shaft.

3.1.1 Enclosed lineshaft

The enclosed lineshaft design lends itself well for applications where abrasives are present in the pumped fluid, or when a bearing lubricant other than the pumped fluid is required.

Lubrication system**CAUTION:**

The fluid must run continuously to ensure flow out of the column at all times. If the flush stops, the fluid in the sump can back up into the column. This contaminates the bearings.

The main feature of this modified design is a positive lubrication system for all bearings. This design requires a minimum of lubrication fluid due to the bushing located at the bottom of the column adapter housing directly above the impeller.

Acceptable leak rates

Leaks (flows) across the bushing for certain pressure differentials are shown in this table. Higher pressures will result in higher leaks.

Table 1: Bushing leak rate

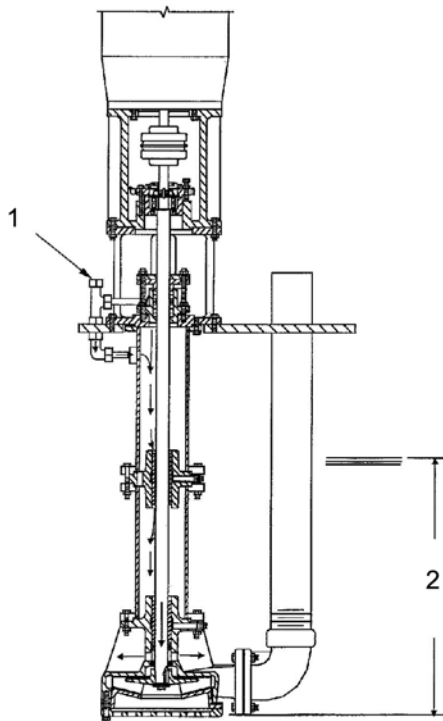
Pressure differential (PSI)	Approximate leak rate (GPM)
3.0	0.33
5.0	0.44
7.5	0.60

Standard materials of construction

- Floating bushings are 18-8 stainless steel housing and spring with a glass-filled PTFE bushing.
- Flush tubing is steel.

Drawing

Positive flow must be maintained at all times.



1. Flush Inlet connection 1/4 pressure = 3 PSI + "P" PSI
2. Maximum liquid level "P" PSI above suction

NOTICE:

Grease lubricated bearing frame used for illustration purposes

3.2 General description i-ALERT® Equipment Health Monitor

Description

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

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

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

Alarm mode

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

Table 2: Temperature and vibration limits

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

Battery life

The i-ALERT® Condition Monitor battery is replaceable.

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

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

Condition monitor operational state	Battery life
Normal operating and environmental conditions	Three to five years
Alarm mode	One year

3.3 Nameplate information

Important information for ordering

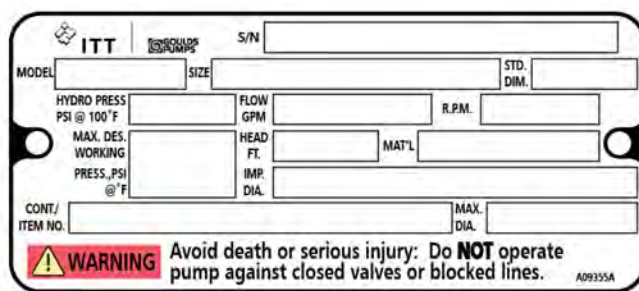
Every pump has a nameplate that provides information about the pump. The nameplate is located on the motor support.

When you order spare parts, identify this pump information:

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

Item numbers can be found in the spare parts list.

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

Nameplate on the pump casing using English units**Figure 3: Nameplate on the pump casing using English units****Table 3: Explanation of nameplate on the pump casing**

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute

3.3 Nameplate information

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

Nameplate on the pump casing using metric units

Figure 4: Metric units - nameplate on pump casing

Table 4: Explanation of the nameplate on the pump casing

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

Ex nameplate



Figure 5: Ex nameplate

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Use when gas and dust are present
T4	Temperature class

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

**WARNING:**

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

3.4 Permissible temperatures

Code	Maximum permissible surface temperature	Maximum permissible liquid temperature
T1	450°C 842°F	372°C 700°F
T2	300°C 572°F	277°C 530°F
T3	200°C 392°F	177°C 350°F
T4	135°C 275°F	113°C 235°F
T5	100°C 212°F	Option not available
T6	85°C 185°F	Option not available

NOTICE:

The code classification marked on the equipment must be in accordance with the specified area where you plan to install the equipment. If it is not, contact your ITT representative before you proceed.

4 Installation

4.1 Installation

4.1.1 Pre-installation

Precautions



WARNING:

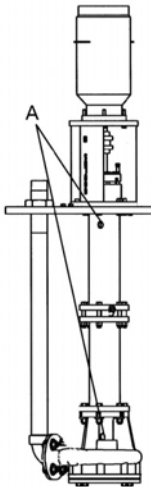
- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to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

4.1.1.1 Inspect the pump

1. Remove the plastic shipping plugs from the vent holes in the head column and the casing.



"A" represents the location of the plugs

Figure 6: Pump plug locations

2. Remove all the equipment from the shipping containers.
3. Completely clean the underside of the support plate and both sides of the optional pit cover, if supplied.
4. Remove any grease from the machined surfaces.

4.1.1.2 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.

Guideline	Explanation/comment
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
If you require lifting equipment such as a hoist or tackle, make sure that there is enough space above the pump.	This makes it easier to properly use the lifting equipment and safely remove and relocate the components to a safe location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: <ul style="list-style-type: none"> • Pressure relief valves • Compression tanks • Pressure controls • Temperature controls • Flow controls If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.

4.1.1.3 Concrete foundation requirements

Requirements

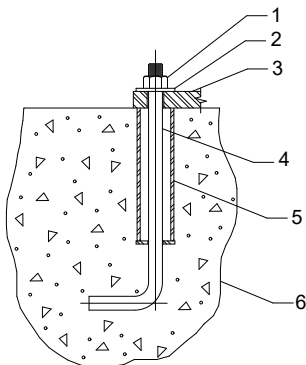
Make sure that you meet these requirements when you prepare the pump foundation:

- The foundation must be able to absorb any vibration.
- The foundation must be able to form a permanent and rigid support for the pumping unit.
- The foundation must be of adequate strength in order to support the complete weight of the pump and driver, plus the weight of the liquid that passes through it.
- There should be at least 12.7 mm | 0.5 in. clearance between the sides of the pump and any portion of the pit.

Typical installation

A typical installation has these characteristics:

- Bolts with a pipe sleeve that is two and a half times the size of the bolt diameter embedded in the concrete
- Properly sized
- Located in accordance with the dimensions given in the example drawing
- Enough space inside the pipe sleeves to allow the final position of the foundation bolts to align with the holes in the sub-base flange



1. Hex nut
2. Washer
3. Support plate
4. 12.5 mm | 0.5 in. anchor bolt
5. Anchor bolt sleeve
6. Foundation (by customer)

Figure 7: Example of a typical installation

4.1.2 Support plate installation

4.1.2.1 Install the support plate with a pit cover

If access to the bottom of the pit cover is not possible during the installation process, you must assemble and install the pump (without the motor), support plate, and pit cover as a unit. You must install the pit cover perfectly level in order to make sure that the pump remains straight up and down when installed.

The vapor-proof option includes machined, gasketed fits between the support plate/pit cover and the pit cover/foundation. You must install these gaskets in order to ensure emissions performance. Bolt the pit cover to a metal sole plate with a machined surface in order to ensure an air tight seal.

1. Carefully lower the pit cover onto the foundation bolts.
2. Use as long a level as possible in order to level the pit cover in all directions with shims or wedges.
3. Hand tighten the anchor bolts. Check the level and re-shim if necessary.
4. Tighten all anchor bolts in a star pattern in order to avoid distorting the pit cover.
5. If access to the bottom side is possible, carefully lower the pump and support plate onto the pit cover.
6. Install all bolts and hand tighten.
7. Check the level on the support plate and re-shim if necessary.
8. Tighten all bolts in a star pattern in order to avoid distorting the support plate.

4.1.2.2 Install the support plate without a pit cover

1. Carefully lower the pump and support plate onto the foundation bolts.
2. Level the support plate in all directions using shims and wedges.
3. If you use the vapor-proof option, then perform one of these actions in order to make sure that you have an air-tight seal:

Support plate type	Action
Standard	Insert the supplied gasket between the two flanges. Bolt the support plate to a metal sole plate that has a machined surface.
Tank flange	Install the supplied gasket between the two flanges. Make sure that the mating flange on the tank is level. Use gasket material between the flanges in order to make minor adjustments.

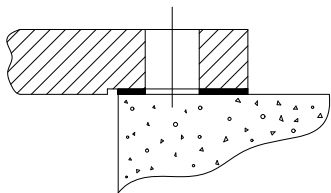
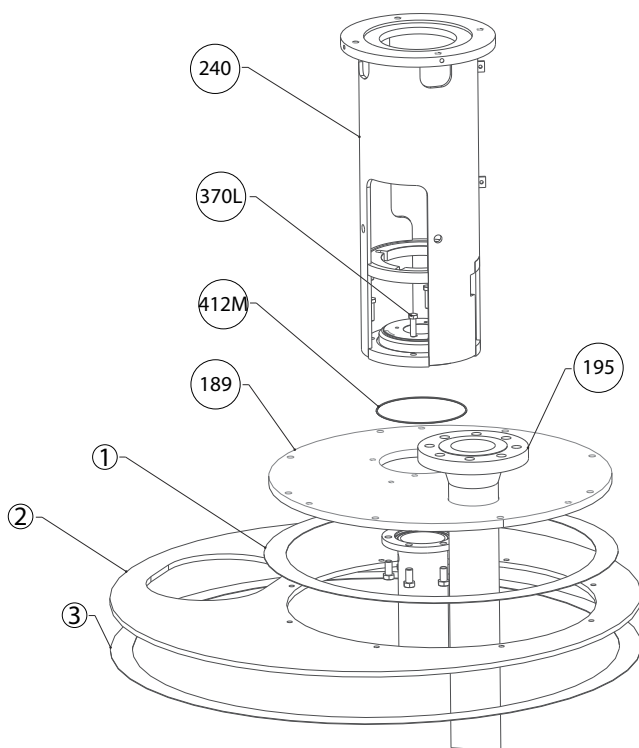


Figure 8: Layout for a standard support plate with the vapor-proof option

4. Hand tighten the anchor bolts. Check the level and re-shim if necessary.
5. Tighten all anchor bolts in a star pattern in order to avoid distorting the support plate.

4.1.3 Motor support and seal cover installation

The Motor support is designed to be assembled with a variety of seal covers which are designed for Packing, Mechanical Seal and Labyrinth seals without modification.



Item Number	Description	Part Number
1.	Support plate gasket	
2.	Pit cover	
3.	Pit cover gasket	
	Support plate	189
	Discharge pipe	195
	Motor support	240
	Hardware, Support to plate	370L
	O-ring	412M

Figure 9: Motor support and seal cover

4.1.4 Install the packed stuffing box

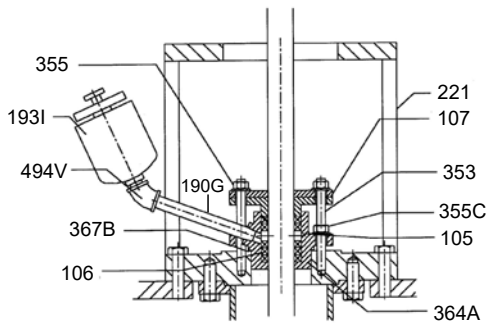


WARNING:

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

The stuffing box is packed at the factory. The packing is lubricated by a grease cup supplied with the pump.

1. Fill the grease cup with any lithium-based #2 grease.
2. Install the grease cup on the tapped opening on the stuffing box.
3. Turn the cap on the grease cup several turns in order to inject the grease into the packing.
4. Hand-tighten the gland nuts.



105	Lantern ring	353	Gland stud
106	Packing set	355	Gland nuts
107	Gland	355C	Insert nuts
190G	Pipe nipple	364A	Packed box insert
193I	Grease cup	367B	Insert gasket
240	Motor support	494V	Pipe elbow

Figure 10: Packed stuffing box

4.1.5 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.

4.1.6 Motor installation and coupling alignment



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.

4.1.6.1 Install the motor

Use NEMA/IEC Vertical C-face motors with this pump.

1. Install both coupling halves before you mount the motor.
Refer to the instructions from the coupling manufacturer.
2. Use the lifting lugs on the motor in order to carefully lower the motor onto the pump.
Make sure to align the bolt holes.
3. Before you connect the coupling, wire the motor and check the direction of rotation.
The rotation arrow is on the motor support. The correct rotation is clockwise as you look down from the drive at the impeller.

4.1.6.2 Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

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

Types of alignment checks

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

Initial alignment (cold alignment) checks

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

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.

4.1.6.3 Permitted indicator values for alignment checks

NOTICE:

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

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

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

4.1.6.4 Align the coupling



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 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.



- When installing in a potentially explosive environment, ensure that the motor is properly certified.



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

Alignment of the pump and motor is of extreme importance for trouble-free mechanical operation. Straight-edge alignment by an experienced installer is adequate for most installations. Use dial indicators for disc couplings and applications where alignment to tighter tolerances is desirable. In these cases, use standard dial indicator procedures.

1. Check for coupling alignment by using either the reverse dial indicator method or laser alignment tools.
2. Refer to the coupling manufacturer literature for proper alignment criteria.
3. Install discs between the hubs per the manufacturer's directions included with the pump data package.
4. Tighten all motor bolts.

4.1.7 Float control installation

ITT supplies several different float controls. Refer to the float control installation instructions provided with the controls for the proper installation procedure. This topic describes the Square D 9036 Simplex and Square D 9038 Duplex float controls.

How float controls work

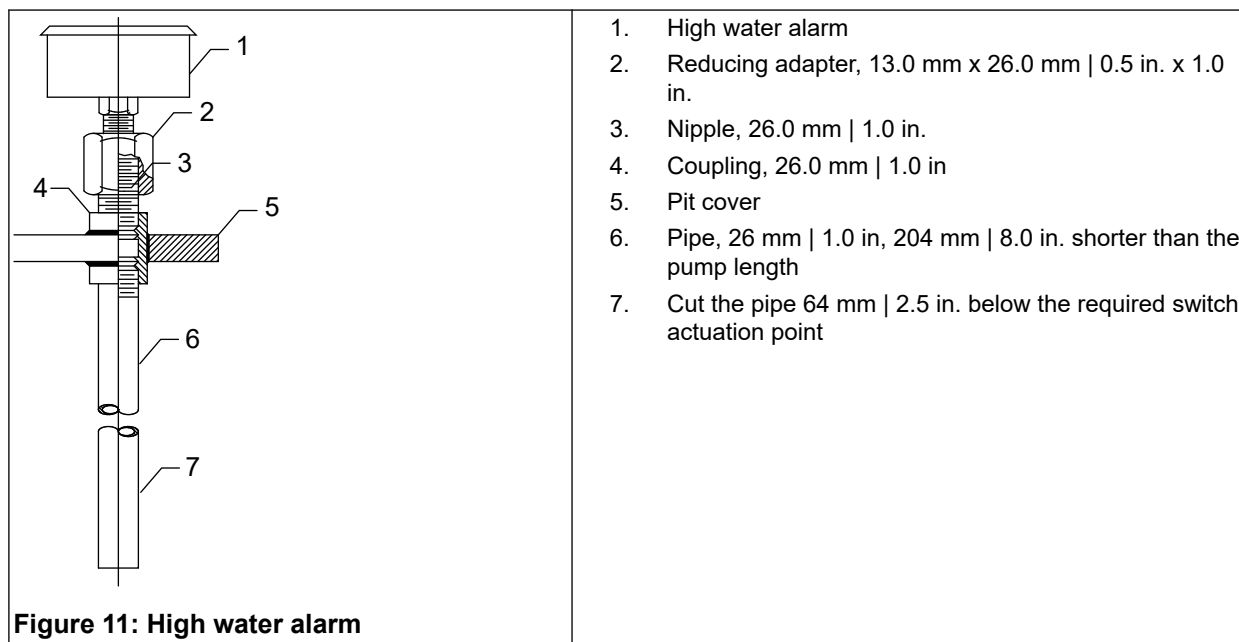
The on and off levels of the Square D 9036 simplex and the Square D 9038 duplex are controlled by adjusting the collars (335). As the liquid level rises, the float rises to contact the upper collar and the upward movement of the float rod causes the mechanical switch inside the control to close. This completes the circuit to the starter. Operation continues until the liquid level drops low enough for the float to contact the lower collar. This pulls the rod down, opening the switch and turning off the pump.

The only difference between the Square D 9036 simplex and the Square D 9038 duplex is in the operating sequence. For the Square D 9038 duplex, the first pump starts as the water level rises. This allows the float to contact the upper collar. When the water level drops down and shuts off the first pump, a lever arm inside the control mechanically switches to the second pump and it comes on for the next cycle.

If the first pump fails to keep up with demand, or not come on at all, then a continued rise in the level turns both pumps on. Both pumps run until the low-water level is reached. If both pumps are unable to keep up with the demand, then an optional high-water alarm switch can be supplied in the alternator to close a switch if the water level rises past the second pumps on the level. This switch can be wired into a customer-supplied alarm horn or light.

APEX high level alarm

The APEX high level alarm is an independent device used to sense fluid level and close a switch that activates a separate alarm. The switch is mounted on a pipe above the support plate. The pipe must extend into the sump 10 to 15 cm | 4 to 6 in. below the required actuation point. As the liquid level rises in the pipe, trapped air causes bellows inside the switch to inflate and trip a microswitch. The switch can then activate a light, horn, relay, solenoid valve, or other electric device.



Magnetrol displacer-type liquid level switch

The Magnetrol displacer-type liquid level switch is closed by a magnetic seal inside a sealed tube. Switch operation is controlled by the buoyancy of weighted displacers suspended on a spring. As liquid level

rises, the resulting change in buoyancy moves the spring upwards. The spring movement causes a magnetic sleeve to attract a pivoted magnet, closing the actuating switch. Refer to installation guide supplied by the manufacturer for proper installation and configuration.

Float ball switches

Float balls are individual switches that are used in multiple configurations to control the pump circuit. The float balls are suspended in the sump to the desired control level. When the fluid level rises to the float ball, the switch begins to float. The float is either anchored to a pipe or weighted. This allows the switch to tilt when the fluid continues to rise. When the float tilts, a switch closes that you can use in order to turn the pump on, activate a high-level alarm, or control any other electrical device.

4.1.8 Install the Square D 9036 simplex and 9038 duplex float controls

A single float and rod assembly is used with the 9036 float switch on a simplex unit or the 9038 duplex alternator. Refer to the wiring diagram from the manufacturer for the correct wiring of the switch.

If a pit cover is supplied with the pump, the float switch support pipe (435) and the upper rod guide (337) are installed by the factory. If the pit cover is supplied by others, you must locate, drill, and tap the holes before you install the switch.

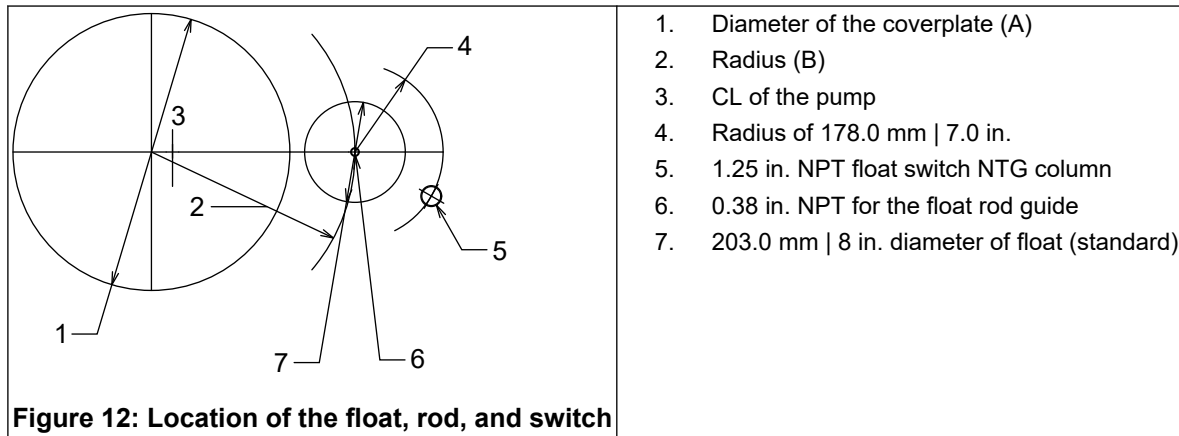


Figure 12: Location of the float, rod, and switch

Number	Coverplate diameter (A)	Radius (B)
1	559 mm 22 in.	368 mm 14.50 in.
2	673 mm 26.50 in.	419 mm 16.50 in.
3	787 mm 31.00 in.	470 mm 18.50 in.

1. Before you install the pump in the sump, attach the lower guide arm (366) and the float rod guide (336) to the correct suction cover bolt (based on the layout).
2. Thread the float switch support pipe (435) and the upper rod guide (337) into the pit cover.
3. Attach the float switch bracket (398) to the float switch support pipe.
You can rotate the float switch around the center line of the pump on the radius (B).
4. Install the float rod (334), float (342), and collars (335).
You must maintain the radius (4) between the float switch column and the float.

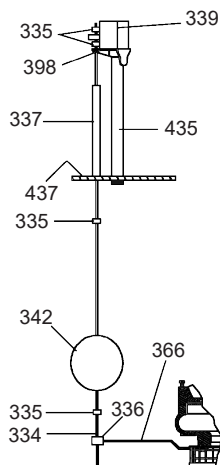


Figure 13: Radius between float switch column and float

4.1.9 Piping checklists

4.1.9.1 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:

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.

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.

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 	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Keep the piping as straight as possible. Avoid unnecessary bends. Use 45° or long radius 90° fittings where necessary.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Make sure that the inside diameters match properly when you use flange joints.	—	
Do not connect the piping to the pump until: <ul style="list-style-type: none"> • The grout for the pit cover becomes hard. • The hold-down bolts for the pump and the driver are tightened. 	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
	This helps to prevent misalignment due to linear expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

Alignment criteria for pump flanges

Type	Criteria
Axial	The flange gasket thickness ± 0.8 mm 0.03 in.
Parallel	Align the flange to be within 0.025 mm/mm to 0.8 mm/mm 0.001 in./in. to 0.03 in./in. of the flange diameter.
Concentric	You can easily install the flange bolts by hand.

4.1.9.2 Suction piping for optional dry pit, outside tank mount, and tailpipe applications

Checklist

Check	Explanation/comment	Checked
Install an elbow at the pump.	Whenever possible, perform these actions: <ul style="list-style-type: none"> • Use long radius elbows. • Move the elbow further from the suction. • Eliminate unneeded elbows. 	
Make sure that all joints are air tight.	—	
Provide a method to prime the pump.	For outside tank mount and dry pit applications, allow the fluid level inside the tank or pit to rise above the casing level. In tailpipe applications, submerge the casing before you start the pump.	
For outside tank mount and dry pit applications, install an isolation valve in the suction line at least two pipe diameters from the suction.	This allows the line to be closed for pump inspection and maintenance. The isolation valve must be kept fully open during operation.	
Make sure that the entrance to the suction pipe is kept adequately submerged below the free liquid surface.	This prevents vortices and air entrainment.	
For an outside tank mount application, make sure that a column equalizing pipe assembly is installed.	The column assembly allows the fluid that comes through the lower bushings to flow up through the column and back through the equalizing pipe at the top of the column back to the tank. Connect the equalizing pipe at the top of the pump column back to the source tank in order to prevent fluid from entering the thrust bearing.	

4.1.9.3 Steam lines

Checklist

Check	Explanation/comment	Checked
Before you install the pump, become familiar with the location of the steam lines.	There are three connections above the support plate: <ul style="list-style-type: none"> • Two steam connections • One condensate return connection. The steam connections are connected to the tops of the column and discharge jackets.	
Determine which method to use in order to connect the steam lines.	There are two methods you can use in order to connect the steam lines: <ul style="list-style-type: none"> • You can use both steam lines as input for steam (preferred method). • You can use one steam line as input for steam, while the other steam line is used as a feed through to additional pumps. Only use this method if absolutely necessary, because it is difficult to control the steam at subsequent pumps.	

4.1 Installation

Check	Explanation/comment	Checked
Before you install the pump, check the fittings for leaks. Use plant air or high pressure water.	The jackets are hydrottested by the factory at 100 psi before shipment. However, the tube fittings can become loose during transit. If you use air to check for leaks, use a soap solution at each joint in order to check for air bubbles.	
Provide source of steam at 35 psi and 149°C 300°F.	Less than ideal conditions require higher pressure steam in order to keep the correct temperature.	
After the pump is brought to temperature for the first time, shut down the unit temporarily and readjust the impeller clearance.	Refer to Impeller clearance setting in the Operations chapter.	

4.1.9.4 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 Commissioning, Startup, Operation, and Shutdown

5.1.1 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.
-

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.

5.1.2 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.

5.1.3 Lubricate bearings

5.1.3.1 Thrust bearing lubrication



WARNING:

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

NOTICE:

During operation the oil level will change and appear higher do to circulation and foaming, this is normal.

5.1.3.2 Flood oil lubrication

5.1.3.2.1 Oil volumes

5.1.3.2.1.1 Oil volume requirements

Table 5: This table shows the required amount of oil for oil-lubricated bearings.

Frame	ml	Quarts	Ounces
S	1065	1.12	36
M	1185	1.25	40
L	1950	2.06	66

5.1.3.2.1.2 Lubricating-oil requirements

Oil requirements based on temperature

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

Table 6: Oil requirements based on temperature

Temperature	Oil requirement
Bearing temperatures exceed 82°C 180°F	Use ISO viscosity grade 100
Pumped-fluid temperatures exceed 177°C 350°F	Use synthetic lubrication.

5.1.3.2.1.3 Acceptable oil for lubricating bearings

Table 7: High quality turbine oils

Examples of acceptable high quality turbine oils with rust and oxidation inhibitors.

Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Mobil	DTE 26 300 SSU @ 38°C 100°F
Philips	Mangus Oil 315
Shell	Tellus Oil 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Lube

Table 8: Synthetic lubricants

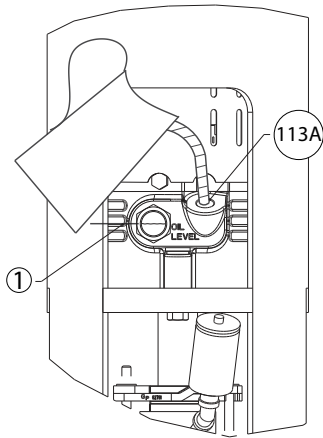
Examples of acceptable synthetic lubricants.

Brand	Lubricant type
Castrol	Hyspin R&O 220
Chevron	GST 220
Exxon	Teresstic 220
Mobil	DTE Oil BB
Shell	Marlina 220 Tellus 220
Sunoco	Sunvis 9220
Texaco	Regal R&O 220 Rando HD 220
Royal Purple	Synfilm GT 220 Synergy 220

5.1.3.2.2 Lubricate the flood oil bearings

1. Remove the fill plug (113A).
2. Fill the bearing frame with oil through the filler connection, which is located on the side of the bearing frame.

Fill the bearing frame with oil until the oil level reaches the middle of the sight glass (319). The correct volume of oil required for each size of bearing frame can be found in the 'Oil Volume Requirements' section in the 'Bearing Maintenance' / 'Maintenance' portion of the IOM.



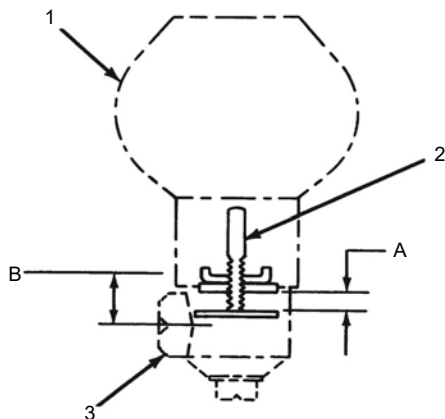
1. Correct level

Figure 14: Oil filler connection

3. Replace the fill plug.

5.1.3.2.3 Lubricate the bearings with oil

1. Remove the oiler.



1. Oiler
 2. Adjustment assembly
 3. Housing
2. Remove the adjustment assembly from the oiler.
 3. Adjust the bars to dimension A as specified in [5.1.3.2.4 Bar adjustment on page 40](#).
The oiler desired oil level setting should be 3.175 mm | 0.125" lower than the Frame oil level.
 4. Lock in position.
 5. Replace the adjustment assembly in the oiler.
 6. Install the oiler.
 7. Fill each bottle with oil and replace in the oiler housing.

The oil reservoir in the bearing housing is filled when the oil remains visible in the bottle. You will need to fill the bottle several times.

5.1.3.2.4 Bar adjustment

Specification	Measurement
Dimension A	9.5 mm 3/8 in.
Dimension B	13 mm 1/2 in.
Oiler size	#3 118 ml 4 oz

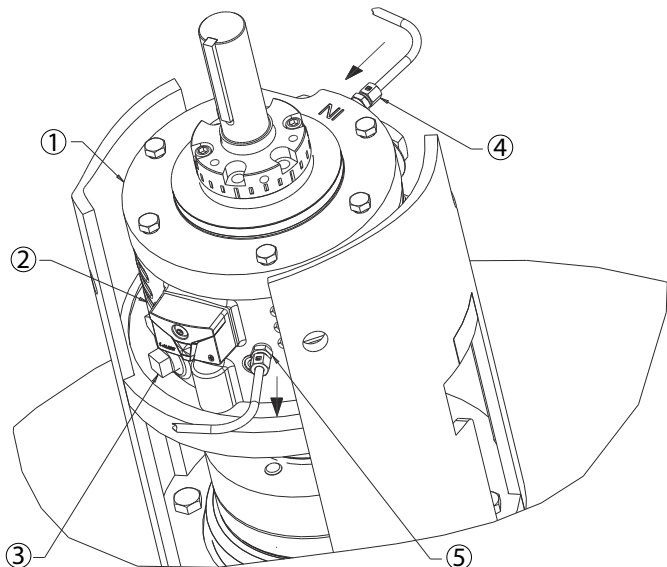
5.1.4 Pure oil-mist lubrication

The inlet (IN) is stamped and located bearing end cover item 109. The outlet and drain ports are located on the opposite side of the oil frame as shown in the figure below. Connect the oil mist system supply to the IN port of the bearing end cover. The outlet for the oil frame can be connected to the outlet port or drain port. The recommended oil for the oil mist is an ISO VG 100. See the table for recommended oil mist airflows. Follow the instructions from the oil mist system supplier. The oil mist system must be interconnected with the pump so that the pump will shut down if the mist system fails

Table 9: Recommended oil mist airflows

This data is based on an oil/air ratio of 0.4 cubic inch (0.22 ounce) per hour per cfm.

Frame size	Airflow in l/m cfm
S/ST	5.10 0.18
M/MT	6.80 0.24
L	9.63 0.34



1. Bearing end cover
2. Oil frame
3. 1/2 NPT drain
4. 1/4 NPT injection port
5. 1/4 NPT outlet port

Figure 15: Pure oil-mist lubrication

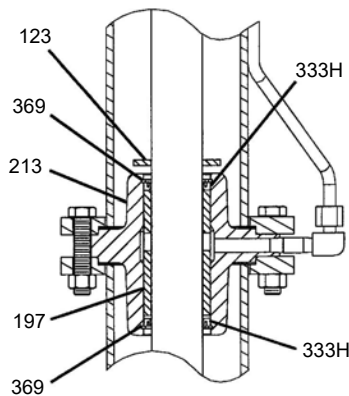
5.1.5 Flush the steady bearings

There are five 1/4-in. NPT pipe plugs on the standard support plate that you use to connect the flush lines. Each plug connects with each of the five bearings. Pumps with less than five bearings still have five plugs, but only the required number are connected to bearings.

1. Remove the plugs from the holes that are connected to flush lines.
2. Connect an external source of clean water to the taps.
The water source must be able to deliver 1 to 2 GPM to each bearing.
3. Turn on the water in order to begin the flush.

5.1.6 Sealed bearings

Sealed bearings have a lip seal above and below the bearing in order to keep grit out of the bearing. Sealed bearings use a spring-loaded grease cup for lubrication. The bearings are pre-lubricated at the factory, but the grease cups ship in a separate box in order to prevent shipping damage. Fill the grease cups with grease and screw the cups into the taps that are connected to the bearings. Refill the cups with fresh grease as needed. Frequently inspect the grease cups after startup in order to check usage and establish the best relubrication interval.



123	Deflector
197	Steady bearings
213	Housing, steady bearings
333H	Lip seal
369	Retaining ring, steady bearing

Figure 16: Sealed bearings

5.1.7 Lubricate the sealed bearings with grease cups

For models with grease-lubricated bearings, the spring-operated automatic grease cups are designed to maintain constant lubrication of the intermediate pump bearings that are fixed to the vertical pump housing.

The grease cups are shipped loose with the pump and will need to be assembled onto the support plate at start up. Be sure the lubrication lines are pre greased before assembling the cups. Each grease cup comes with an adapter to thread into the support plate. If the pump has more than one steady bearing then a coupling and pipe nipple will be provided to stagger the cup heights on the support plate.

The center stem protrudes out of the housing when the cup is full and gradually moves down into the housing as the grease is used. The stem lowers as grease is depleted. When the threaded portion of the stem is flush with the top of the cup, the grease reservoir is empty and you must refill it.

5.1.8 Fill the housing

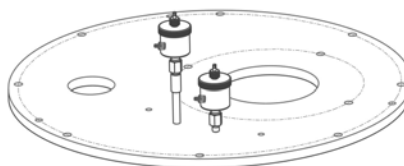
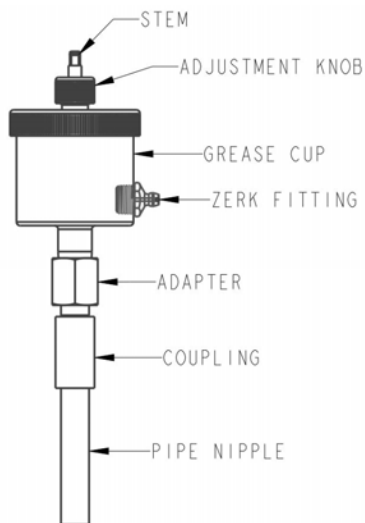
1. Tighten both the top stem (by turning the flat) and the colored stem adjustment knob – closing off the cups flow.
2. Fit a pressurized grease gun to the side zerk fitting and pump the grease cup full until the stem is fully protruding from the cup and/or a small amount of grease starts to come out of the top.
3. Re-open the stem and the knob allowing grease to flow from the cup into the lube lines.
4. If the stem immediately recedes into the housing and the bearing has been purged, then complete these steps:
 - a) Unthread the top lid in order to remove the top of the grease cup.
 - b) Inspect the plunger for defects.

If all the grease is found on the reverse (or back side) of the plunger, then it is defective and must be replaced.

5.1.9 Adjust the flow

1. Loosen the adjustment knob and turn the flat of the stem counter clockwise – opening the cups flow as much as possible.
2. Retighten the colored adjustment knob a few turns.
3. If your grease cup has a 1.75 oz capacity and the grease is completely consumed in 1 to 2 weeks operation, then the flow is correct and will maintain the proper amount of grease to the bearings.

If the flow was less than 1 week, the adjustment knob can be tightened more, closing the stem off more and reducing the rate of flow.
4. If your cup is a 3.5 oz capacity – then cup should be completely consumed over 3 to 4 weeks.



5.1.10 Shaft sealing with a mechanical seal

Precautions



WARNING:



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

NOTICE:

- Follow seal manufacturer's guidelines for proper seal installation procedures.

Shipping

Pumps may be shipped with or without a mechanical seal installed.

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.

Customers should always check to make sure the clips have been disengaged prior to starting the pump.

Other mechanical seal types

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

Other shaft sealing options

1. Packed box - may be provided as an alternative to mechanical seals
2. Labyrinth seal - the seal cover may be fitted with a labyrinth seal if vapor emissions is not a problem.

5.1.11 Steam jacket pumps (molten sulfur construction)

The steam jacketed connections are located on the support plate. The "steam in" line is connected to an appropriate source of steam, and the "steam out/condensate" connections are made as dictated by the installation requirements. A suitable trap should be used.

5.1.12 Impeller-clearance setting

Importance of a proper impeller clearance

A proper impeller clearance ensures that the pump runs at high performance.



WARNING:

The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation, and equipment damage.

5.1.12.1 Set the impeller clearance - Dial indicator method

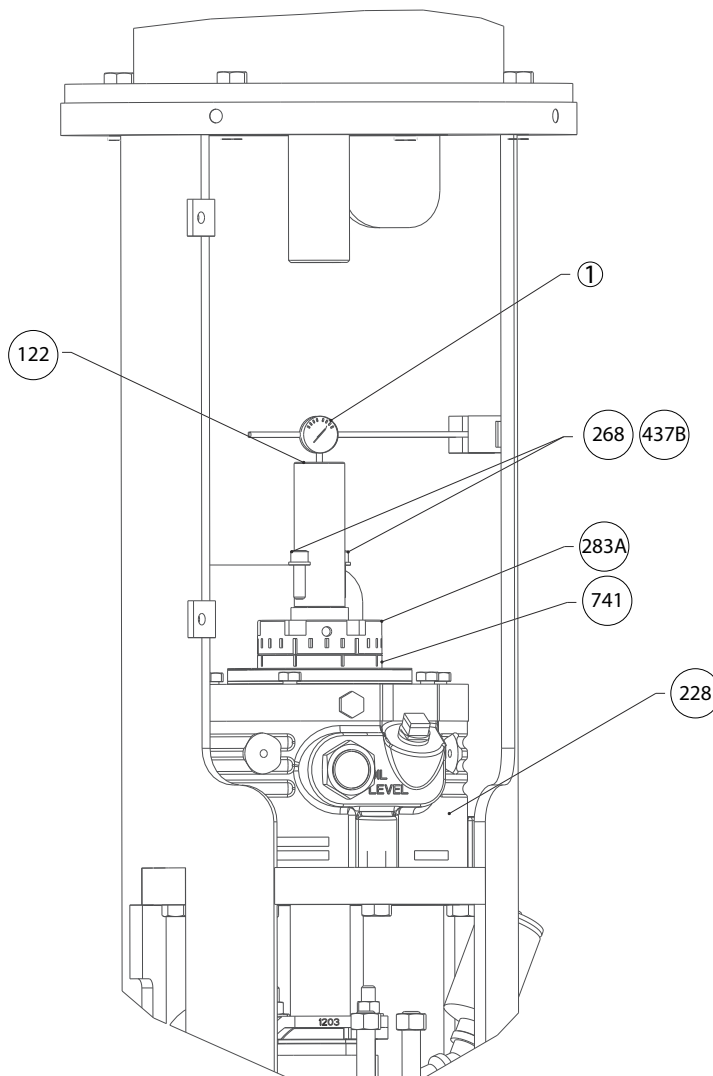


WARNING:

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 manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

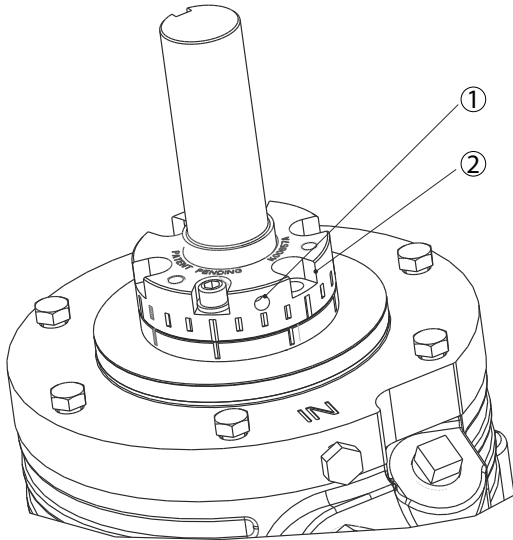
1. Lock out the driver power and remove the coupling guard.
2. Set the indicator so that the button contacts either the shaft end or the face of the coupling.



1. Dial indicator

Figure 17: Dial indicator setting

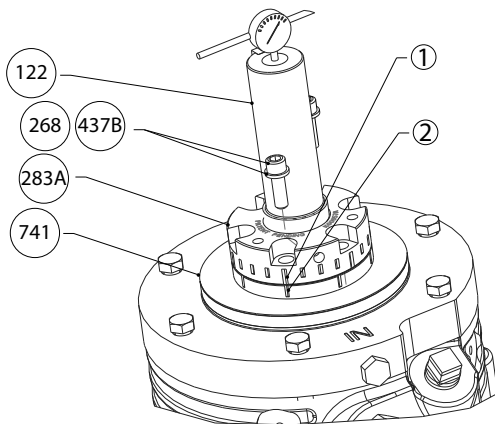
3. Remove Socket Head bolts (268) with Lockwasher (437B) from the EZ Adjust nut.
4. The EZ adjust nut (283A) can be rotated using both a 1/4" round pin or a hook style spanner wrench.



1. 1/4" spanner wrench holes
2. Use slots for hook style spanner wrench

Figure 18: Rotate EZ adjust nut

5. Using a spanner wrench, rotate the EZ Adjust nut (283A) until the adjusting nut surface disengages from the bearing carrier (741) surface, the impeller is now in contact with the casing.
6. Rotate the shaft to ensure that there is contact between the impeller and the casing.
7. Set the dial indicator to zero.
8. Using a spanner wrench, rotate the EZ adjust nut (283A) clockwise, moving the shaft (122) away from the Bearing Frame until the indicator shows a clearance of 0.381 mm | 0.015".
9. Locate the Adjustment markings on the perimeter of the EZ adjust nut (283A) and the Bolt hole locator markings on the Bearing Carrier (741). They are in the form of lines and run in line with the shaft (122). On the EZ Adjust nut (283A), there will be two lengths of lines, the longer lines are to help align the holes.



1. 283A EZ adjust nut adjustment markings
2. 741 bearing carrier bolt hole location markings

Figure 19: Adjustment markings

10. Locate the *Adjustment marking* which are closest to a Bearing Carrier locator marking and rotate the ES adjust nut until the lines align.
11. Make sure the shaft turns freely.
12. Replace the Socket head bolts (268) with Lockwasher (437B) into the aligned holes, there will be 2 holes aligned 180° apart.

13. The Dial indicator reading may have changed up to 0.05 mm | 0.002" this is acceptable.
14. Make sure the shaft turns freely.

5.1.12.2 Set the impeller clearance – EZ Adjust method

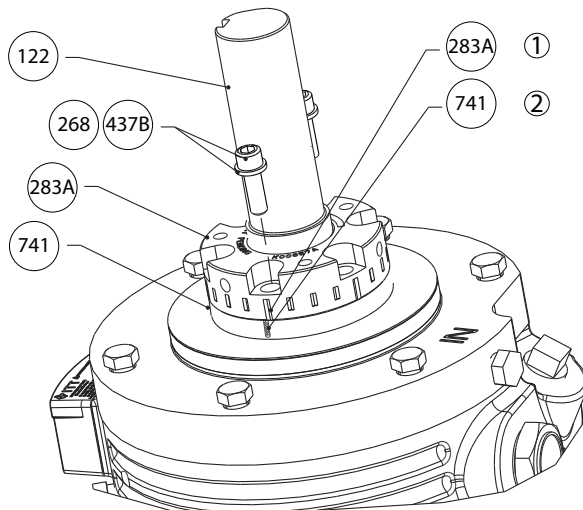


WARNING:

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 manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

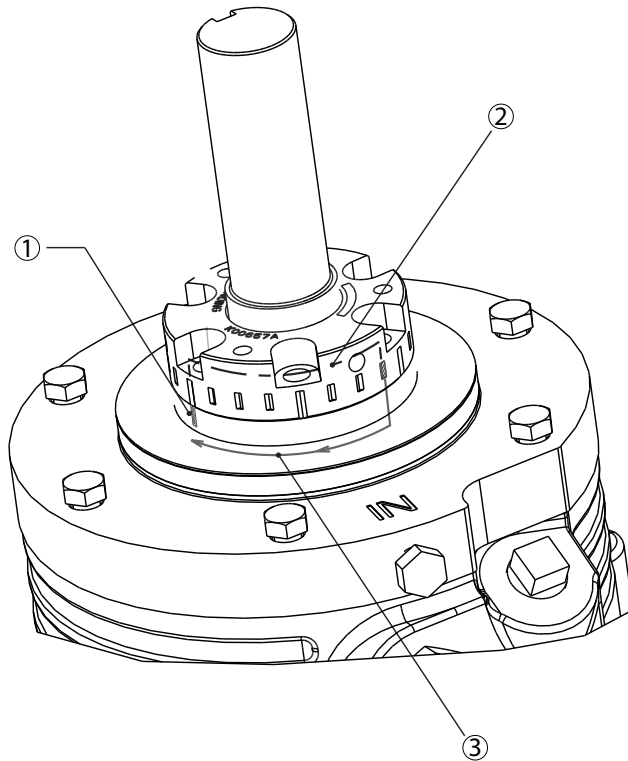
1. Lock out the driver power and remove the coupling guard.
2. Remove Socket Head bolts (268) with Lockwasher (437B) from the EZ Adjust nut.
3. Using a spanner wrench, rotate the EZ adjust nut (283A) counterclockwise until the adjusting nut surface disengages from the bearing carrier (741) surface, the impeller is now in contact with the casing.
4. Rotate the shaft to ensure that there is contact between the impeller and the suction cover.
5. Rotate the EZ adjust nut (283A) clockwise, until the adjusting nut surface comes in contact with the bearing carrier surface (741)
6. Locate the Adjustment markings on the perimeter of the EZ adjust nut (283A) and the Bolt hole locator markings on Bearing carrier (741). They are in the form of lines and run in line with the shaft (122). On the EZ adjust nut (283A), there will be two lengths of lines, the longer lines are to help align the holes
7. Locate the adjustment marking (short or long) on the EZ adjust nut that is closest to a bearing carrier Bolt hole marking. Rotate the EZ adjust nut until they align. This now will be your zero point.



1. 283A (Adjustment markings)
2. 741 (Bolt hole locator markings *Zero Reference Mark*)

Figure 20: Zero reference mark

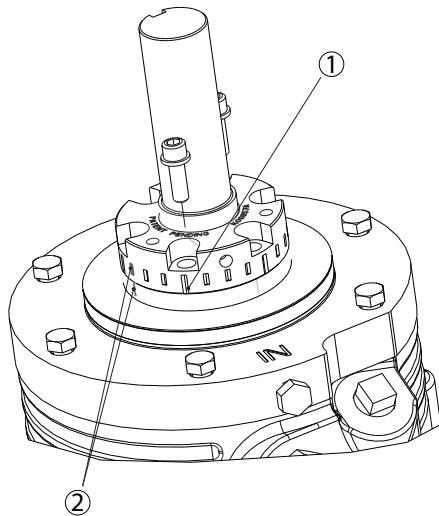
8. Count 7 markings (include all markings) on the EZ adjust nut, in a counter clockwise direction.
9. Rotate the EZ adjust nut (283A) clockwise until the 7th mark is aligned with the zero mark on the bearing carrier (741).



1. Zero Reference Mark
2. Count seven markings on EZ adjust nut
3. Rotate to zero mark

Figure 21: Rotate to zero mark

10. Look around the adjustment nut, there will now be two of the longer adjustment markings aligned with bearing carrier lines. Replace the Socket head bolts (283A) with Lockwasher (437B) into these aligned holes, there will 2 holes aligned 180° apart.



1. Locate the larger mark in the EZ adjust nut that aligns with a bearing carrier line. Insert Hardware.
2. Marks now aligned

Figure 22: Align marks

11. Make sure the shaft turns freely.
12. Replace the coupling.
13. Replace the coupling guard.

NOTICE:

Impeller clearance should be checked and re-adjusted after pump has reached equilibrium temperature using methods as described in the sections above.

5.1.13 Pump priming



WARNING:

Ensure sump level is at or above minimum submergence level prior to starting pump.



CAUTION:

Do not run the pump dry.

Never start the pump until it has been properly primed. Fully submerge the pump casing prior to starting the pump.

For dry pit/outside tank mount units:

1. Ensure the suction supply line has adequate fluid head to prime the pump.
2. Slowly open the suction valve.

5.1.14 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.

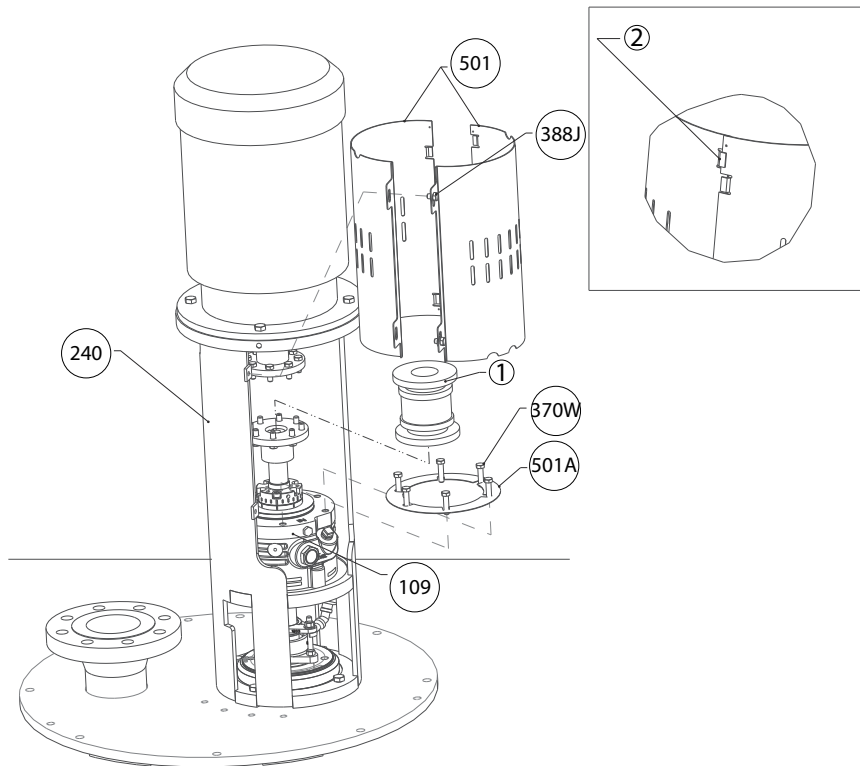


- The coupling guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.
-

This pump is shipped without the coupling guard installed, because the motor and coupling are also not installed.

1. Mount the Guard Endplate (501A) to the End cover (109) using the End cover hardware (370W).

2. Slide the two guard halves (501) between the Motor support and the bearing frame area. One in each direction to form a circle. Each half will have tabs on one side which will engage each other, and the other a flange to mount to motor support.
3. Install the guard mounting hardware (388J).



1. Coupling spacer
2. Guard engagement, tab side

Figure 23: Coupling Guard Installation

5.1.15 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.
- To avoid risk of equipment damage, observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.
- On frame mounted units, ensure that the oil level is correct prior to starting pump.

NOTICE:

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

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

- Open any recirculation or cooling lines.
 - Start the external bearing flush, if specified.
 - Make sure the shaft rotates freely.
1. Fully close 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.

5.1.16 i-ALERT[®] Equipment Health Monitor



WARNING:

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

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

5.1.17 Pump operation precautions

General considerations



WARNING:

- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
 - Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
-

NOTICE:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.
- Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
 - The specific gravity or viscosity of the fluid is greater than expected
 - The pumped fluid exceeds the rated flow rate.
- Do not operate pump past maximum flow. For maximum flow refer to pump performance curve.
- Do not operate pump below hydraulic or thermal minimum flow. For hydraulic minimum flows refer to technical manual and pump performance curves. To calculate thermal minimum flow, refer to HI Centrifugal Pump Design and Application ANSI/HI 1.3-2000.
- Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.

Operation at reduced capacity**WARNING:**

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

NOTICE:

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

Operation under freezing conditions**NOTICE:**

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

5.1.18 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.

5.1.19 Deactivate the i-ALERT® 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.

Disengage the snap fit of the i-ALERT® using a flat head tool as shown below:



Figure 24: Disengage the battery from the sensor when shutting the pump for an extended period of time

5.1.20 Reset the i-ALERT® Health Monitor

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

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

5.1.21 Make the final alignment of the pump and driver



WARNING:

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

- Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.
 - Follow the coupling installation and operation procedures from the coupling manufacturer.
-

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

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

6 Maintenance

6.1 Maintenance

6.1.1 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 inspections

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

- Check for unusual noise vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.*

NOTICE:

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

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.

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.

6.1.2 Bearing maintenance



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

NOTICE:

During operation the oil level will change and appear higher do to circulation and foaming, this is normal.

6.1.2.1 Thrust bearings

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

Table 10: Lubricating intervals in operating hours

Type of bearing	First lubrication	Lubrication intervals
Oil-lubricated bearings	Add oil before you install and start the pump. Change the oil after 200 hours for new bearings.	After the first 200 hours, change the oil every 2000 operating hours or every three months.

6.1.2.2 Lubricate the bearings after a shutdown period

1. Flush out the bearings and bearing frame with a light oil to remove contaminants. During flushing, make sure to rotate the shaft slowly by hand.
2. Flush the bearing housing with the proper lubricating oil to ensure oil quality after cleaning.
3. Refer to *Reassembly* section for proper bearing lubrication procedure.

6.1.2.3 Lubricating oil requirements

Refer to [5.1.3 Lubricate bearings on page 37](#).

6.1.2.4 Steady bearings

Check the ID of the casing collar (155) and steady bearing (197) per the dimensions in the Bearing fits and tolerances table. If the ID is greater than what is allowed, remove the snap ring (369) and use a suitable hydraulic press in order to remove these items for replacement. If sealed bearings are provided, then you must also remove the lip seals (333H).

The bearing ID is slightly larger before you press it into the housing in order to allow for ID shrinkage after you press it in place.

6.1.3 Shaft-seal maintenance

6.1.3.1 Removal and installation of Mechanical seal



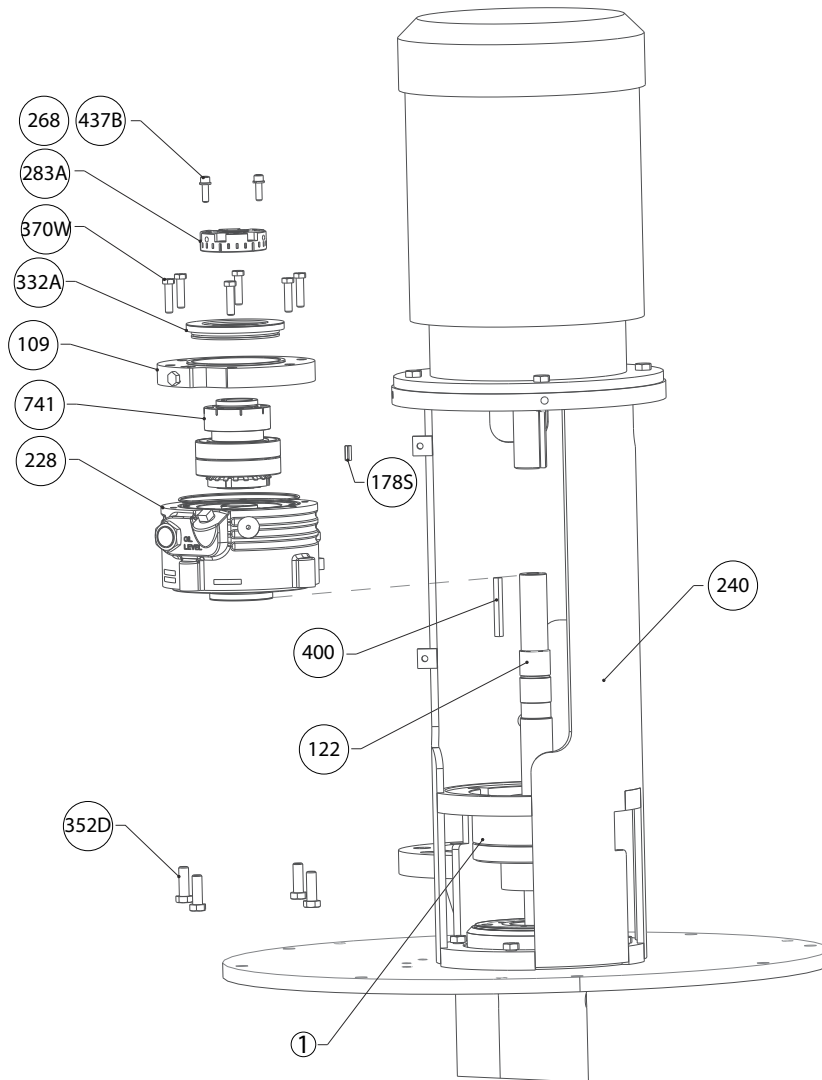
WARNING:

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.

1. Lock out the driver power and remove the coupling guard.
2. Drain oil from Bearing Frame (228).
3. Remove the Coupling spacer and pump half hub (233) and key.
4. Remove Socket head screws (268), Lockwasher (437B) and EZ adjust shaft nut (283A) from shaft.
5. Loosen and remove the End cover Hex Cap screws (370W) and Bearing frame End cover (109) with Laby seal (332A).
6. Pull out the Bearing carrier assembly (741) and remove bearing carrier key (178S) from shaft. (Place the carrier assembly on a clean, flat surface. Wrap the carrier assembly in a clean towel to keep any dust or dirt from getting on the Angular Contact Bearings. It is very important to keep these bearings as clean as possible.)
7. Remove the Bearing frame (228) and mounting hardware (352D) from motor support.
8. Remove and service Mechanical seal.
9. After Service reassemble in reverse order.



1. Mechanical seal

Figure 25: Mechanical seal

6.1.3.2 Mechanical-seal maintenance



WARNING:

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



CAUTION:

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.

If the pump is shipped with oil-lubricated seals, keep the seal faces lubricated with oil at all times.

6.1.3.3 Packed stuffing-box maintenance



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.



WARNING:

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

Lubrication intervals

The lubrication intervals vary and depend upon the temperature and gland tightness. Keep the grease cup full at all times.

Periodically make several turns on the grease-cup cap while you inject fresh grease into the stuffing box. Check the pump daily upon initial operation, and extend this interval as required.

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.

Packing replacement

Replace the packing in this sequence:

1. Three rings of packing
2. Lantern ring
3. Two rings of packing
4. Gland

6.2 Disassembly

6.2.1 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.
-

6.2.2 Tools required

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

- Bearing puller
- Brass drift punch
- Cleaning agents and solvents
- Dial indicators
- Feeler gauges
- Hydraulic press
- Induction heater
- Lifting sling
- Micrometer
- Rubber mallet
- Screwdriver
- Snap-ring pliers
- Spanner wrench
- Torque wrench with sockets
- Wrenches
- Lifting eyebolt (dependent on pump / motor size)

6.2.3 Drain the pump



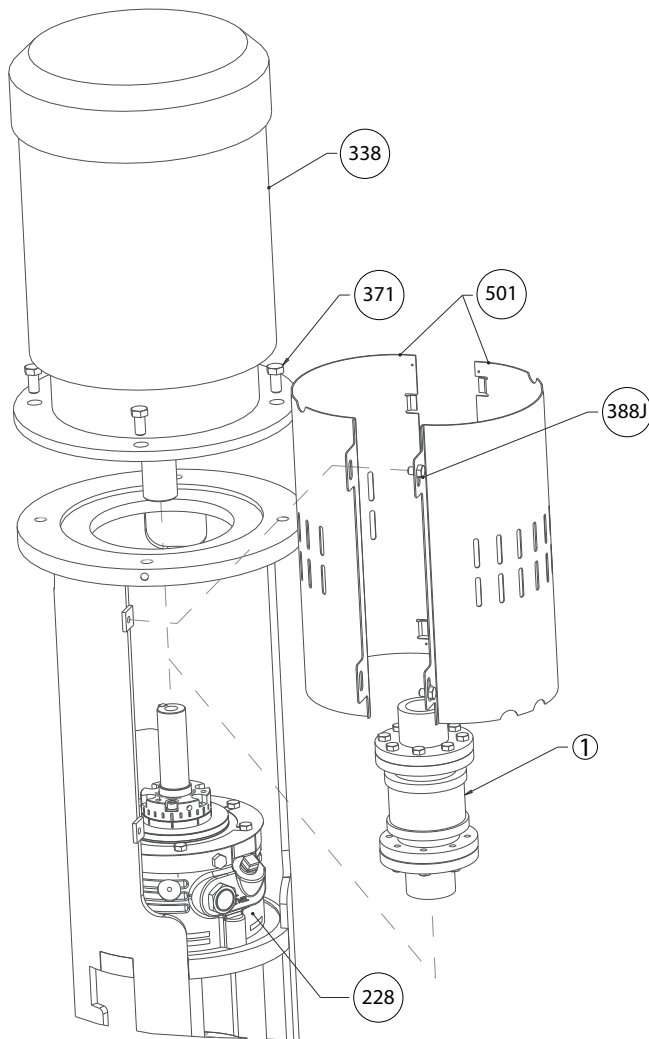
CAUTION:

- 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. Close the isolation valves on the suction and discharge sides of the pump.
You must drain the system if no valves are installed.
2. Open the drain valve.
Do not proceed until liquid stops coming out of the drain valve. If liquid continues to flow from the drain valve, the isolation valves are not sealing properly and you must repair them before you proceed.
3. Leave the drain valve open.
Do not close the drain valve until the reassembly is complete.
4. Drain the liquid from the piping and flush the pump if it is necessary.
5. Disconnect all auxiliary piping and tubing.
6. Remove the coupling guard.
7. Disconnect the coupling.
8. Drain the oil from the bearing frame by removing the drain plug.
9. If applicable secure the mechanical seal and disconnect the seal piping.

6.2.4 Remove the pump from the sump

1. Remove the motor bolts (371).



1. Coupling

Figure 26: Motor bolts removal

2. Place the sling on the motor lifting lugs and remove the motor.
3. Remove the support plate anchor bolts.
4. Attach the eyebolts to the support plate.
5. Use properly-sized slings in order to lift the pump from the sump. Refer to the Installation chapter for the proper handling procedure.
6. Lay the pump horizontally on proper supports where there is sufficient clearance to disassemble the pump.
7. Remove the bolts (317N) in order to remove the strainer (187).

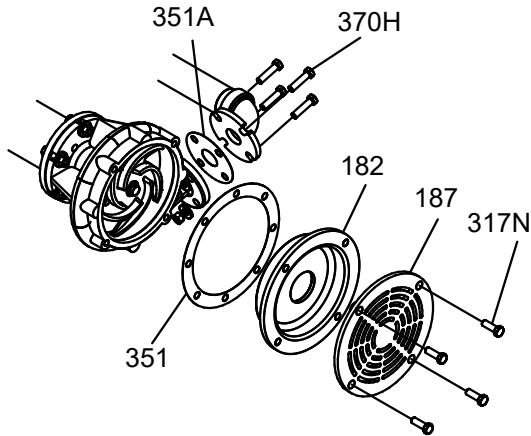


Figure 27: Remove bolts to remove strainer

8. Remove the suction cover (182).
9. Remove and discard the suction cover gasket (351).
Replace the gasket during reassembly.
10. Remove the discharge elbow-casing bolts (370H).
11. Disconnect any steady bearing flush tubing (190).

6.2.5 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.



CAUTION:

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

1. Loosen and remove the impeller screw (198) and washer (199).
2. Pull the impeller (101) from the shaft.
Use a spanning-type puller if required.

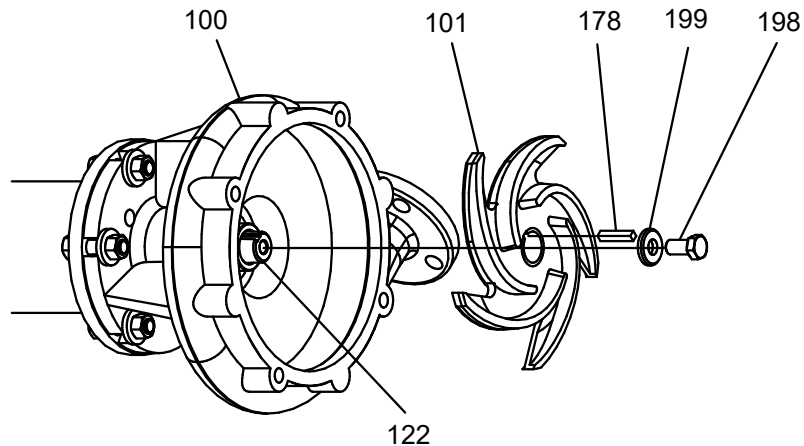


Figure 28: Remove impeller

3. Remove the impeller key (178).
Save the key for reassembly unless it is damaged.
4. For L group models only, do the following:
 - a) Remove the casing (100) to adapter (108) bolts.
 - b) Remove casing. Do not remove casing collar (155) at this time.
 - c) Remove the adapter (108) to column bolts.
 - d) Remove the adapter. Do not remove steady bearing (197) at this time.

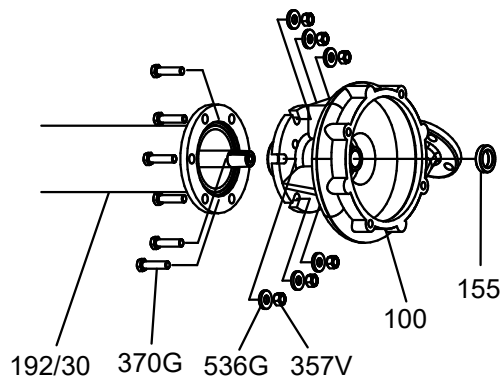


Figure 29: Remove adapter



CAUTION:

Two people should handle any shaft over 9 feet long. Improper handling can bend the shaft.

6.2.6 Disassemble bearing frame

1. Remove the pump half coupling hub (233) and key.
2. Remove Socket head screws (268) and EZ adjust shaft nut (283A) from shaft.

3. Loosen and remove the End cover Hex Cap screws (370W) and Bearing frame End cover (109) with Laby seal (332A).
4. Pull out the Bearing carrier assembly (741) and remove bearing carrier key (178S) from shaft. (Place the carrier assembly on a clean, flat surface. Wrap the carrier assembly in a clean towel to keep any dust or dirt from getting on the Angular Contact Bearings (112C). It is very important to keep these bearings as clean as possible.)
5. If applicable, loosen Packing Gland nut (355) and gland halves (107) or Mechanical seal gland hardware.
6. Remove the Bearing frame (228) and mounting hardware (352D) from Motor support.

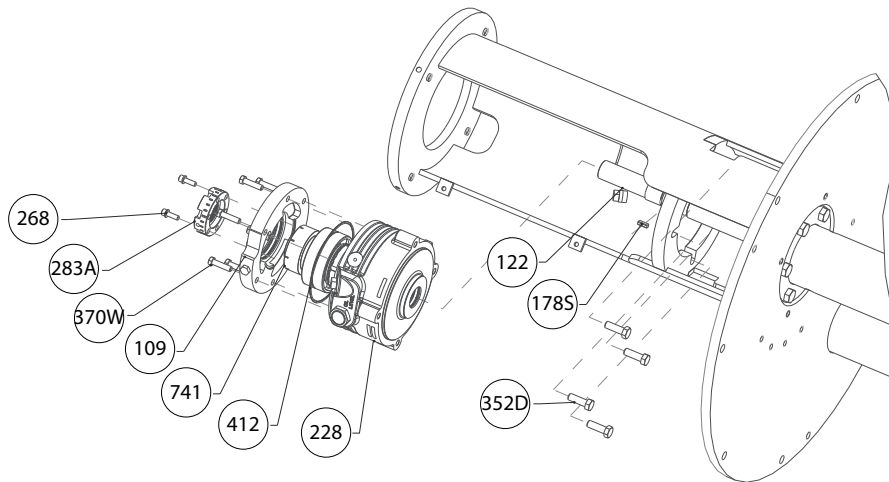


Figure 30: Bearing frame disassembly

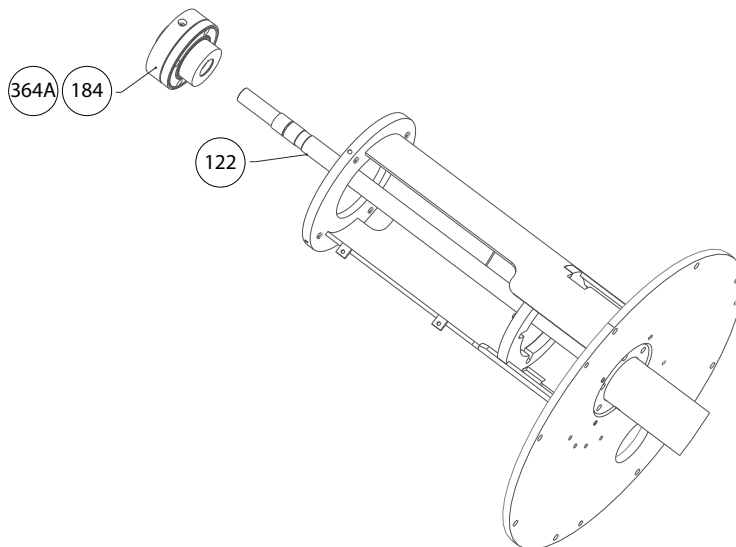


Figure 31: Seal removal

7. Remove packing insert (364A) with packing or Mechanical seal in seal cover (184).
8. Remove Shaft (122) through Motor support opening.

6.2.7 Disassemble the column

1. Remove the column down to the steady bearing housing bolts (372B).
If your pump has no intermediate steady bearings (only one column section), then skip this step since you do not have any column extension (306) or steady bearing housing (213).

- a) Start at the casing end of the pump and remove the column extensions (306), steady bearing housings (213), and deflectors (123) one at a time. Support the shaft in order to prevent bending while you remove these sections.

It is not necessary to remove the head column (192). Do not remove the steady bearings at this time. Refer to inspection procedures prior to removal.

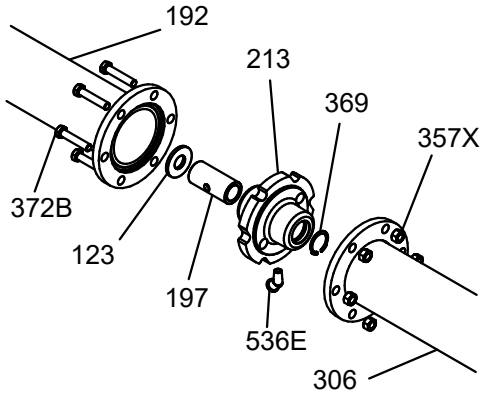


Figure 32: Disassemble the column

6.2.8 Guidelines for i-ALERT[®] Equipment Health Monitor disposal

Precautions



WARNING:

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

Guidelines

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

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

6.3 Preassembly inspections

6.3.1 Replacement guidelines

Casing check and replacement



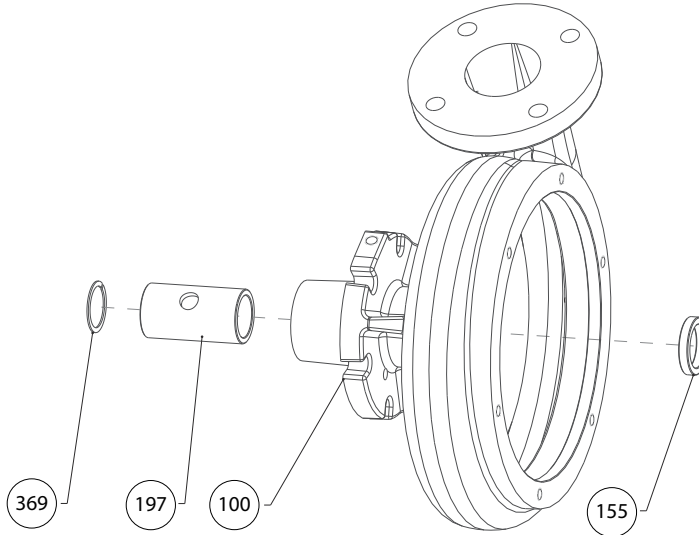
WARNING:

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



- Check the I.D. of the casing collar (155) and steady bearing (197) per the dimensions in [6.3.6 Bearing fits and tolerances on page 70](#). If the I.D. is greater than what is allowed, remove the snap ring (369) and use a suitable hydraulic press to remove these items for replacement. If sealed bearings have been provided, you must also remove the lip seals (333H).
- Inspect the casing-to-column connection area for any cracks or excessive corrosion damage. Replace if any of these conditions exist.
- Irregularities in the casing-gasket seat surface

Impeller replacement

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.
Vane edges	When you see cracks, pitting, or corrosion damage
Pumpout vanes	When worn or bent more than 0.8 mm 1/32 in.

Gaskets, O-rings, and seats replacement



WARNING:

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



WARNING:

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

- Use fasteners of the proper size and material only.
- Replace all corroded fasteners.

- Ensure that all fasteners are properly tightened and that there are no missing fasteners.
-

Column sections

Inspect the column section(s) (306, 192) for any cracks or excessive corrosion damage. Replace if necessary.

Motor support

Inspect the motor support (240) for any cracks or excessive corrosion damage. Replace if necessary.

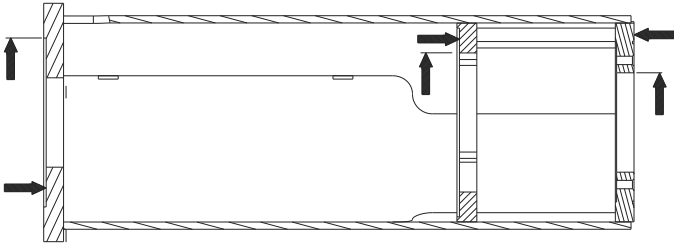


Figure 33: Motor support

6.3.2 Shaft replacement guidelines

Shaft measurement check

Check the bearing fits of the shaft. If any are outside the tolerances shown in the Bearing fits and tolerances table, then replace the shaft.

Shaft inspection

Check the shaft straightness. Use "V" blocks or balance rollers to support the shaft on the bearing fit areas. Replace the shaft if runout exceeds 0.03 mm | 0.001 in.

NOTICE:

Do not use shaft centers for the runout check as they may have been damaged during the removal of the bearings or impeller.

Shaft surface check

Check the shaft surface for damage. Replace the shaft if it is damaged beyond reasonable repair.

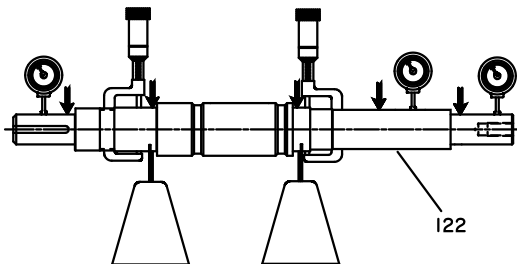


Figure 34: Shaft surface check

6.3.3 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.

6.3.4 Bearing Frame inspection

Disassembly

1. Loosen and remove the inside Rating Plate holding screws (371B) and Rating plate (549T).
2. Use a screwdriver in order to pry the labyrinth seal (332A) from the bearing frame (228).

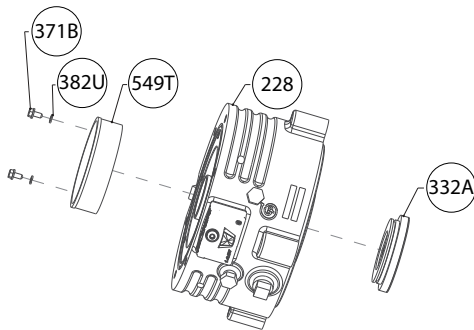


Figure 35: Bearing frame disassembly

Checklist

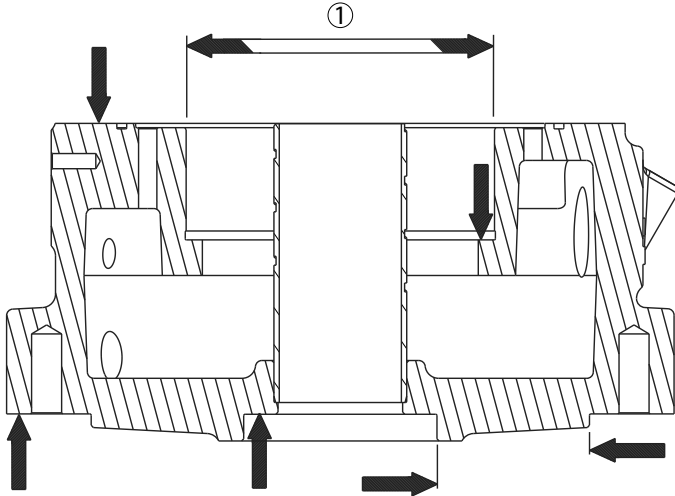
Check the bearing frame for these conditions:

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

If the bore is outside the measurements in the Bearing fits and tolerances table, replace the bearing frame.

Surface inspection locations

This figure shows the areas to inspect for wear on the bearing carrier surfaces.



1. See thrust bearing fit

Figure 36: Inspect for wear on bearing carrier surfaces

6.3.5 Bearing carrier inspection

Disassembly

1. Place the spindle assembly upside down on a clean flat surface. Bend down any tabs which hold the Locknut Washer (382) to the Locknut (136).

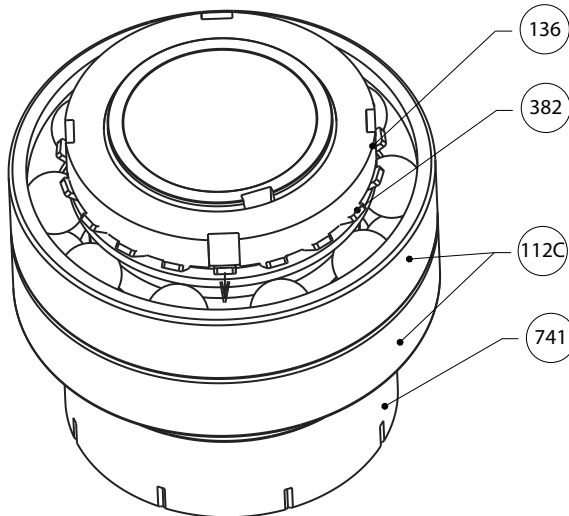


Figure 37: Spindle assembly

2. Hold the spindle securely so that it does not turn

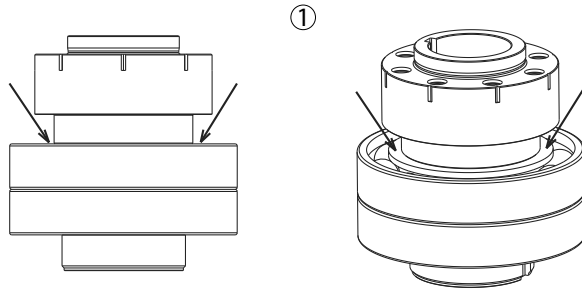


CAUTION:

Do not damage the spindle in the process of securing it to a solid surface. The Laby Seal needs to be installed over the outside of the spindle.

3. Using a torque wrench or spanner wrench (supplied by others), loosen the Locknut (136), and remove the Locknut Washer (382).
4. With the Locknut (136) and Locknut Washer (382) removed, the bearings can now be pressed from the Bearing carrier (741). You will need a mechanical or hydraulic press to perform this step.

Place the spindle on a round die which will allow clearance for the Angular Contact Bearing (112) to be removed. Using blocks and/or tooling (supplied by others) press the inner race (only) of the angular contact bearings until they are free from the spindle.



1. Press inner race only

Figure 38: Press bearings from bearing carrier

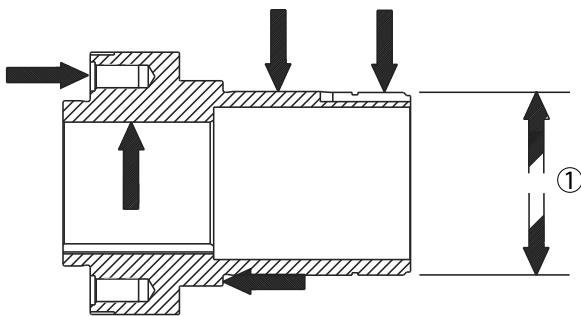
Checklist

Check the bearing carrier for these conditions:

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

If the bearing mounting surface is outside the measurements in the Bearing fits and tolerances table, replace the bearing carrier.

Surface inspection locations



1. See thrust bearing fit

Figure 39: Areas to inspect for wear on the bearing carrier surfaces

6.3.6 Bearing fits and tolerances

Table 11: Steady bearing tolerances

This table references the bearing fits and tolerances according to ISO 286 (ANSI/ABMA Standard 7) in millimeters | inches.

De-scrip-tion	Bearing ID (pressed into place)			Housing bore			Running clearance (1/2 diametrical clearance)		
	S/ST	M/MT	L	S/ST	M/MT	L	S/ST	M/MT	L
Carbon	28.753– 28.804	41.478– 41.529	57.353– 57.404	41.173– 41.224	53.873– 53.924	76.048– 76.098	0.140– 0.089	0.152– 0.102	0.165– 0.102
	1.132– 1.134	1.633– 1.635	2.258– 2.260	1.621– 1.623	2.121– 2.123	2.994– 2.996	0.0055– 0.0035	0.006– 0.004	0.0065– 0.004
Bronze	28.677– 28.727	41.377– 41.427	57.302– 57.353	41.173– 41.224	53.873– 53.924	76.048– 76.098	0.102– 1.051	0.102– 1.051	0.140– 0.076
	1.129– 1.131	1.629– 1.631	2.256– 2.258	1.621– 1.623	2.121– 2.123	2.994– 2.996	0.004– 0.002	0.004– 0.002	0.0055– 0.003
Fluted elastomer	28.600– 28.702	41.326– 41.453	57.226– 57.328	41.173– 41.224	53.873– 53.924	76.048– 76.098	0.089– 0.013	0.114– 0.025	0.127– 0.102
	1.126– 1.130	1.627– 1.632	2.253– 2.257	1.621– 1.623	2.121– 2.123	2.994– 2.996	0.0035– 0.0005	0.0045– 0.001	0.005– 0.004
Rulon	28.753– 28.804	41.478– 41.529	57.353– 57.404	-	-	-	0.140– 0.089	0.152– 0.102	0.165– 0.102
	1.132– 1.134	1.633– 1.635	2.258– 2.260				0.0055– 0.0035	0.006– 0.004	0.0065– 0.004
Casing collar	30.048– 30.226	42.621– 42.799	58.395– 58.472	45.999– 46.126	56.972– 57.023	82.372– 82.423	0.851– 0.737	0.787– 0.673	0.737– 0.622
	1.183– 1.190	1.678– 1.685	2.299– 2.306	1.811– 1.816	2.243– 2.245	3.243– 3.245	0.0335– 0.029	0.031– 0.0265	0.029– 0.0245

Table 12: Thrust bearing fits

Group	Carrier OD	Shell ID
S	45.012/45.002	85.023/85.001
	1.7722/1.7717	3.3474/3.3465
M	60.014/60.002	110.022/110.000
	2.3628/2.3623	4.3316/4.3307
L	85.019/85.004	145.025/145.000
	3.3472/3.3466	5.9065/5.9055

Shaft runout tolerances

The following shaft runout tolerances apply to all size groups:

- Coupling end: 0.051 mm | 0.002 in.
- Shaft body: 0.0005 in./ft.
- Impeller end: 0.127 mm | 0.005 in.

6.4 Reassembly

6.4.1 Assembly of Motor Support to Mounting Plate

6.4.1.1 Assemble Seal cover in Motor support

1. Install Seal cover (184) and O-ring (412P) inside Motor support (240) using mounting screws (371E).
2. Attach the Motor support (240) to support plate (189) with bolts (370L).

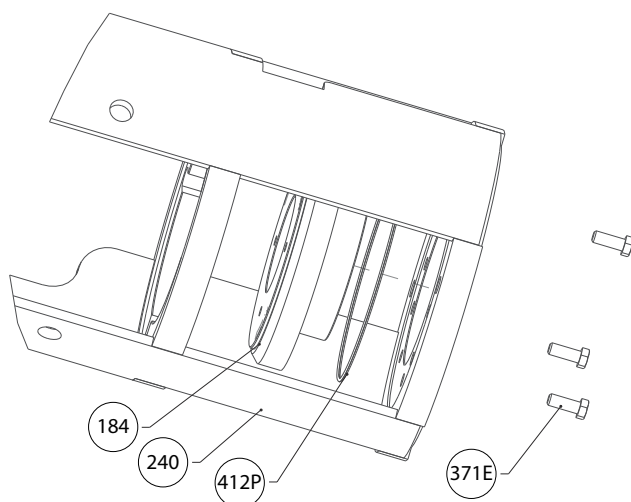


Figure 40: Install seal cover and O-ring

3. Attach the head column (192) to the motor support with bolts (370M). Make sure that the vent holes are closer to the motor support.
4. With the support plate in a vertical position, slide the shaft horizontally through the motor support. Support the shaft and column with suitable stands.

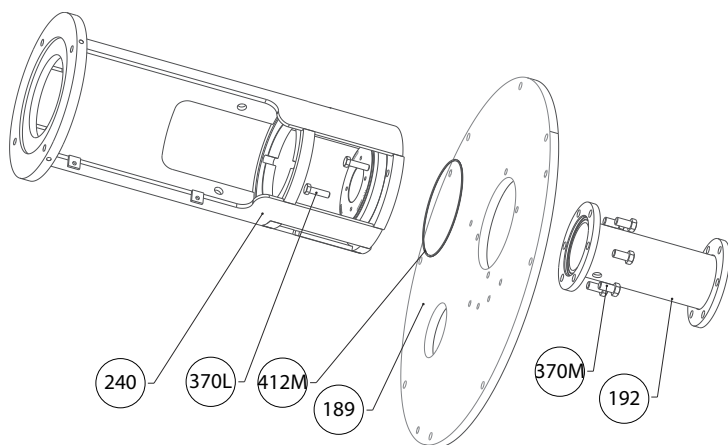


Figure 41: Slide shaft horizontally through motor support

6.4.2 Assemble the column

If intermediate steady bearings are required, then you need additional column extensions (306) and steady bearing housings (213).

1. Prepare the steady bearing housing assemblies, if applicable.
You do not need to precisely center the steady bearing, and the holes in the bearing do not need to line up with the holes in the housing. A recessed area inside the housing (213) allows lubricants to find the opening in the bearing.

- a) Remove the snap ring (369), if applicable.
- b) Use a hydraulic press in order to press out the old steady bearing (197).
- c) Press in the new steady bearing.
A snap ring (369) is no longer required due to the fits. If your pump has a snap ring, then it is not necessary to reinstall it. However, the snap ring is still required on sealed bearings.
2. Slide the casing assembly onto the shaft and seat the casing flange against the column flange. Make sure the discharge nozzle is aligned with the discharge pipe hole in the support plate.
3. Install the bolts (371G).

6.4.3 Assemble the impeller, suction cover, and strainer

1. Add a film of oil to the shaft and place the impeller key (178) and impeller (101) on the shaft.
2. Check that all of the bearing shell bolts (370C and 370D) are completely backed off.
3. Install the impeller washer (199) and impeller screw (198).
When you tighten the impeller screw, the impeller will be seated on the shaft. The impeller screw has a nylon insert to lock it in place. Do not exceed these torque values when you tighten the impeller screw:

Group	Torque value
S/ST	56 Nm 500 in-lbs
M/MT and L	102 Nm 900 in-lbs

4. Install the suction cover gasket (351), suction cover (182), and strainer (187) with bolts (317N). Alloy strainers have extra-heavy spacer washers (533) between the strainer and the suction cover. If the unit is supplied with a lower-float control guide arm (366), then use an extra-long bolt in this hole.

6.4.4 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.

Methods for sealing the shaft

These sections discuss the methods that you can use to seal the shaft.

- Seal the shaft with a labyrinth seal.
- Seal the shaft with a cartridge-mechanical seal.
- Seal the shaft with a packed stuffing box.

6.4.4.1 Seal the shaft with a Labyrinth seal

1. 1. Install Labyrinth Seal (383A) in seal cover (184).

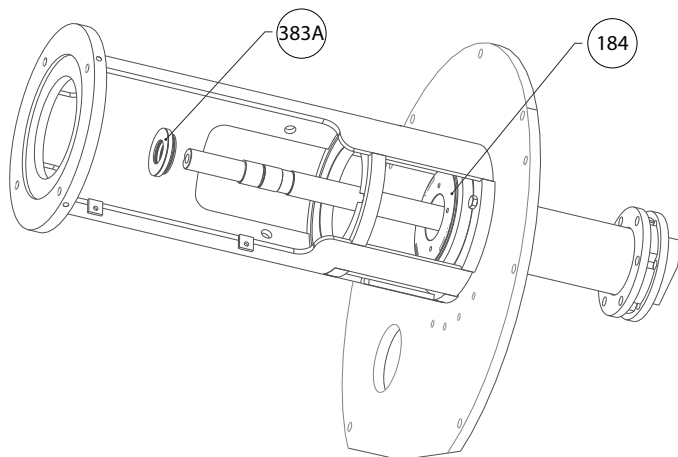


Figure 42: Labyrinth seal

6.4.4.2 Seal the shaft with a packed stuffing box



WARNING:

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



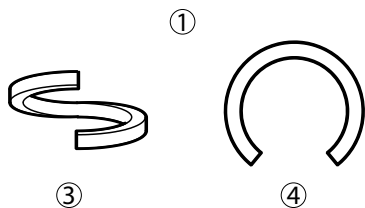
WARNING:

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

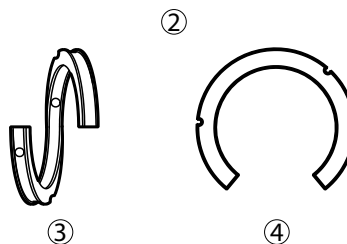
Pumps are shipped without the packing, lantern ring, or split gland installed. These parts are included with the box of fittings shipped with each pump and must be installed before startup.

1. Carefully clean the stuffing-box bore (364A).
2. Install stuffing box insert (364A) and two mounting studs (353) in seal cover (184).
3. Twist the packing (106) enough to get it around the shaft.

Packing rings



Lantern rings



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

Figure 43: Packing rings and lantern rings

4. Insert the packing and stagger the joints in each ring by 90°. Install the stuffing box parts in this order:
 - a) Three packing rings (106)

- b) One lantern ring (105)
 - c) Two packing rings (106)
5. Install the gland halves (107) and evenly hand-tighten the nuts (355).

NOTICE:

Do not overtighten gland nuts. Overtightened packing causes excessive friction between packing and sleeve and will result in damaged components.

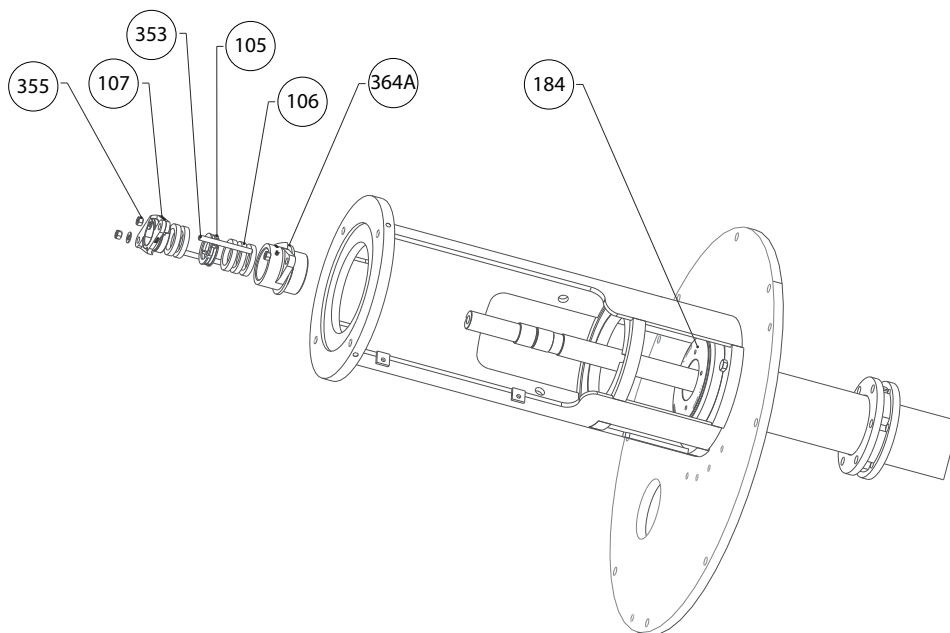


Figure 44: Install gland halves

6.4.4.3 Seal the shaft with a cartridge mechanical seal

**WARNING:**

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

Prior to startup, make sure that all areas, such as threaded openings, vent and drain valves, and flanged openings, that could leak pumped fluid to the work environment are closed.

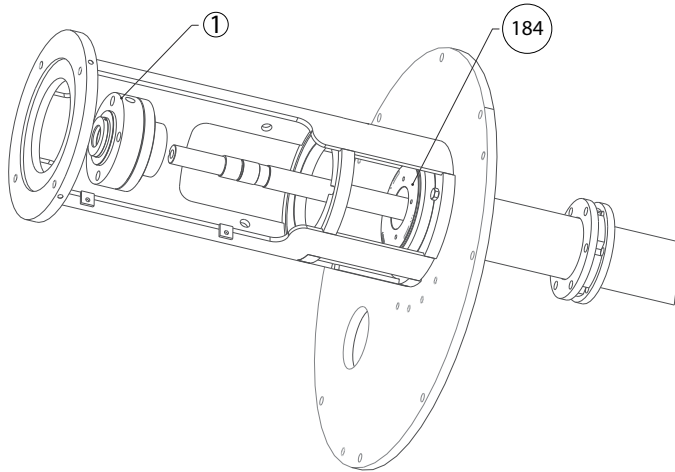
NOTICE:

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

1. Slide the cartridge seal into the seal chamber and secure using the four studs and nuts.
2. Continue with the pump reassembly.
3. Set the impeller clearance.

Refer to the Impeller clearance setting topic for more information.

4. Tighten the setscrews in the seal locking ring in order to secure the seal to the shaft.
5. Remove the centering clips from the seal.



1. Mechanical seal

Figure 45: Cartridge mechanical seal

6.4.5 Assemble bearing frame

NOTICE:

Make sure that the pipe threads are clean, and that you apply thread sealant to the plugs and fittings.

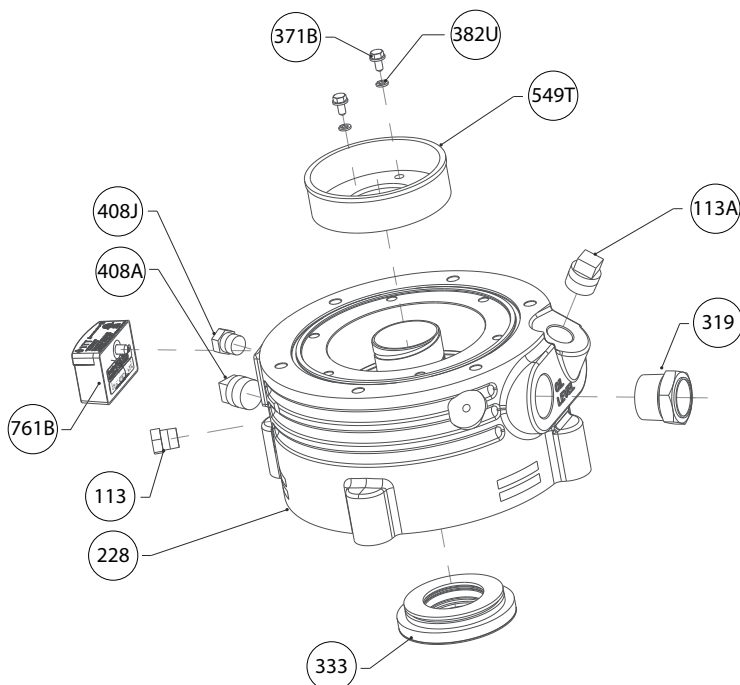


Figure 46: Bearing frame assembly

Prepare the bearing frame (228) as follows (see the illustration):

1. Install Rating Plate (549T) using mounting screw (371B) with lockwasher (382U) in bearing frame (228).
2. Install Labyrinth Seal (333) in the bearing frame (228).
3. Install the oil-fill plug (113A).
4. Install the oil-drain plug (408A).
5. Install the sight glass (319).
6. Install the sight oiler plug (408J).
7. Install the plug for Greased lube option (113).

6.4.6 Assemble Bearings on carrier



CAUTION:

- Mount the bearing in a clean environment. The Carrier (741) and other components of the bearing arrangement should be checked to see that they are clean. The bearings should be left in their original packages until immediately before mounting so that they do not become dirty.
 - Risk of physical injury from hot bearings. Wear insulated gloves when using a bearing heater.
-

1. Clean the carrier (741). Remove any residual grease or contaminants. Secure the Spindle upside down in the vertical position
2. Heat the Angular Contact Bearings (112C) using an induction heater to about 80 to 90 °C | 160°F to 170°F. Refer to [Figure 47: Bearing heater on page 76](#) for a typical bearing induction heater.



Figure 47: Bearing heater



WARNING:

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.



Figure 48: Do not use torch to heat bearings

3. Install the Angular Contact Bearings (112C) onto the carrier (741). It is critical that the Angular Contact Bearings be installed in the correct orientation.

Angular Contact Bearing need to be installed in what is considered the down thrust orientation. This means that the larger outer races together (back-to-back).

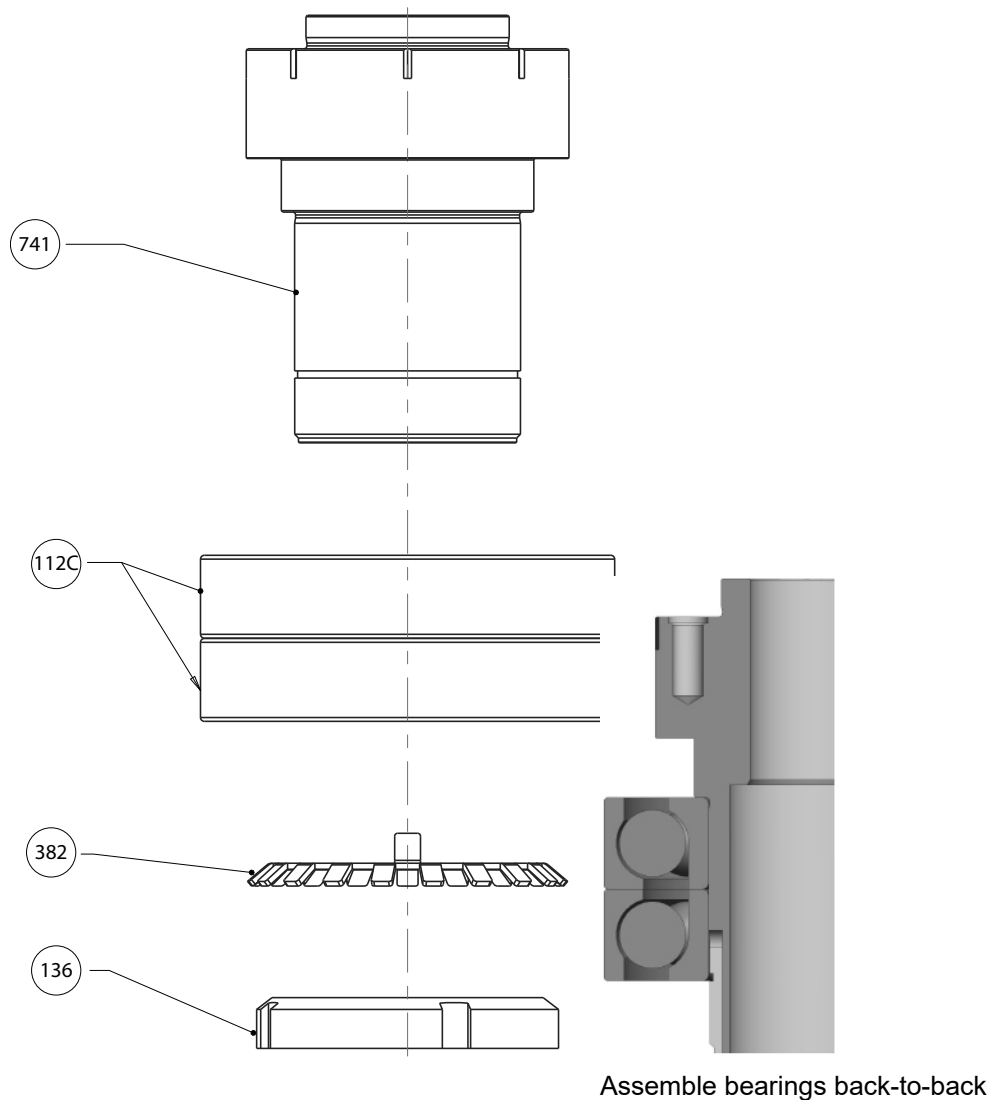


Figure 49: Bearing assembly

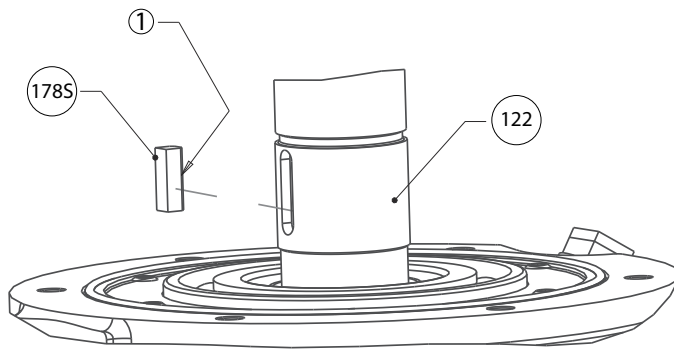
4. Position the bearings (112C) on the carrier (741) against the shoulder and snug the locknut (136) against the bearings until they are cool.

The locknut prevents the bearings from moving away from the shaft shoulder as they cool. Rotate the outer bearing rings relative to each other as they are placed on the shaft to assure good alignment.

5. Remove the bearing locknut (136) after the carrier (741) are cool.
6. Put the lockwasher (382) onto the carrier (741) Make sure that the tang of lockwasher is in the keyway of the carrier.
7. Thread the locknut (136) onto the carrier (741) and tighten it until it is snug.
8. Bend the tangs of the lockwasher into the slots of the locknut.

6.4.7 Assemble the bearing frame, bearing carrier and end cover

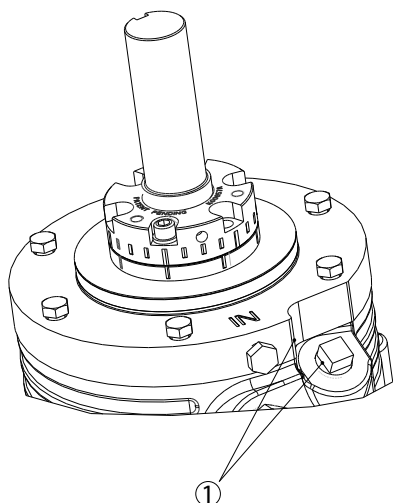
1. Slide the bearing frame (228) onto the shaft and mount to motor support (240) using mounting hardware (352D).
2. Install the Key (178S) onto the Shaft (122). Goulds recommends putting a small amount of adhesive on the Key, and securing to the Shaft. This will make installing the Bearing Carrier (741) assembly much easier.



1. Adhesive

Figure 50: Install key on shaft

3. Slide the Bearing Carrier Assembly (741) onto the shaft. Align the internal keyway in the Carrier to the Key (178S) and lower into the Bearing Frame (228) until the Carrier Bearings bottom out in the Bearing Frame.
4. Install the O-ring (412) into the Bearing Frame O-Ring groove (228).
5. Install the Endcover (109) using the mounting bolts (370W). When installing the cover, make sure to align the notch in the cover over the Oil fill connection.



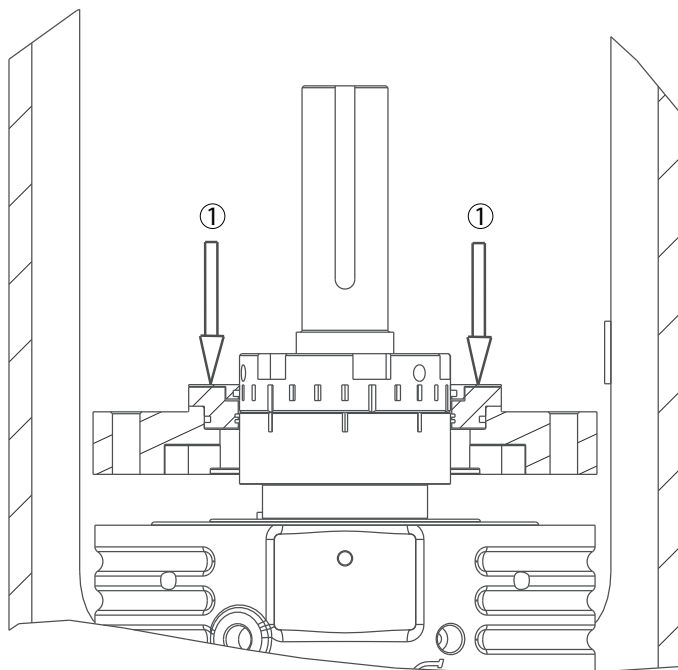
1. Align notch in cover

Figure 51: Align notch in cover

6. Install the outboard labyrinth oil-seal (332A) over the Bearing Carrier OD (741) and into the end cover (109). Press into cover referencing the figure below.

NOTICE:

If labyrinth oil-seal (332A) is preassembled in end cover (109), do not press on end cover to install, refer to figure below for acceptable force application. Labyrinth oil-seal (332A) seal may be damaged if force is applied to end cover (109).



1. Press here

Figure 52: Acceptable force application

7. Slide the EZ adjust nut (283A) on to the shaft (122) and thread onto shaft until it contacts the Bearing Carrier.

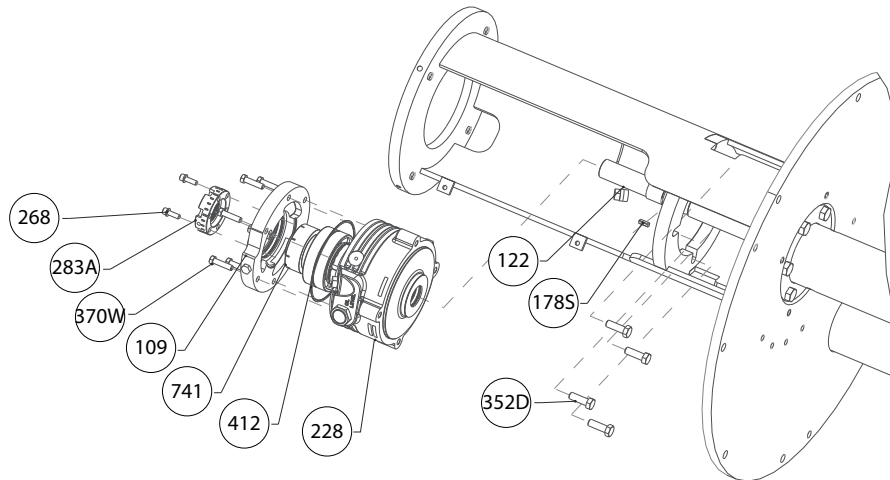


Figure 53: Slide EZ adjust nut onto shaft

8. Using the EZ adjust nut (283A), check the axial travel of the impeller. (Refer to the Impeller-clearance setting section in “Commissioning, Startup, Operation and Shutdown for the procedure).
If the travel is less than 0.762 mm | 0.030 in., then add extra gaskets (351) in order to obtain the minimum travel.

6.4.8 Assemble the discharge elbow, pipe and auxiliary piping

1. Install the discharge elbow gasket (351A) and the discharge elbow (315) using bolts (370H).
Accurate alignment of the elbow is critical in order to make sure that there is no obstruction to the flow through the connection.
2. Install the discharge pipe (195), pipe nuts (242), and flange (195S, if used). Make sure that the pipe nuts are tight and that there is no strain on the pump.
3. Rotate the shaft by hand in order to make sure that there is no binding.
4. Connect all auxiliary piping.
5. Replace the pump half coupling hub (233) and lubricate the pump bearings.

7 Troubleshooting

7.1 Troubleshooting

7.1.1 Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Make sure the pit is filled with liquid above the casing. On dry pit units, the casing and suction pipe must be completely filled.
	The discharge head is too high.	Check the total head, particularly friction loss.
	The motor speed is too low.	Check the motor speed.
	The suction line is clogged.	Remove the obstructions.
	The impeller, discharge pipe, or strainer is clogged.	Remove obstructions or back-flush the pump.
	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 suction lift is too high.	Shorten the suction pipe.
	The amount of available NPSH is not sufficient.	Check the amount of NPSH available and required and adjust accordingly.
The pump is not producing the rated flow or head.	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 discharge head is higher than expected.	Check the total head, particularly friction loss.
	The impeller, discharge pipe, or strainer is clogged.	Remove obstructions or back-flush the pump.
	The motor speed is too low.	Check the motor speed.
	The suction line is clogged.	Remove the obstructions.
	The suction lift is too high.	Shorten the suction pipe.
	The impeller is worn or broken.	Inspect and replace the impeller if necessary.
	The suction line has air or vapor pockets.	Rearrange the piping in order to eliminate air pockets.
The amount of available NPSH is not sufficient.	Check the amount of NPSH available and required and adjust accordingly.	
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 float controls are not adjusted properly.	Check the float controls.
	The strainer is clogged.	Check the sump for large items that the pump may be picking up. Check if the bearings are running hot.
	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.

Symptom	Cause	Remedy
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 that the base plate is properly grouted without voids or air pockets.
	The bearings are worn.	Replace the bearings.
	Rotating parts are loose, broken, or rubbing against each other.	Replace parts as necessary.
	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 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.
	Rotating parts are rubbing against each other.	Check the parts that are wearing for proper clearances.
	The motor speed is too high.	Check the motor speed.
	The impeller clearance is too tight.	Adjust the impeller clearance.

7.1.2 Assembly troubleshooting

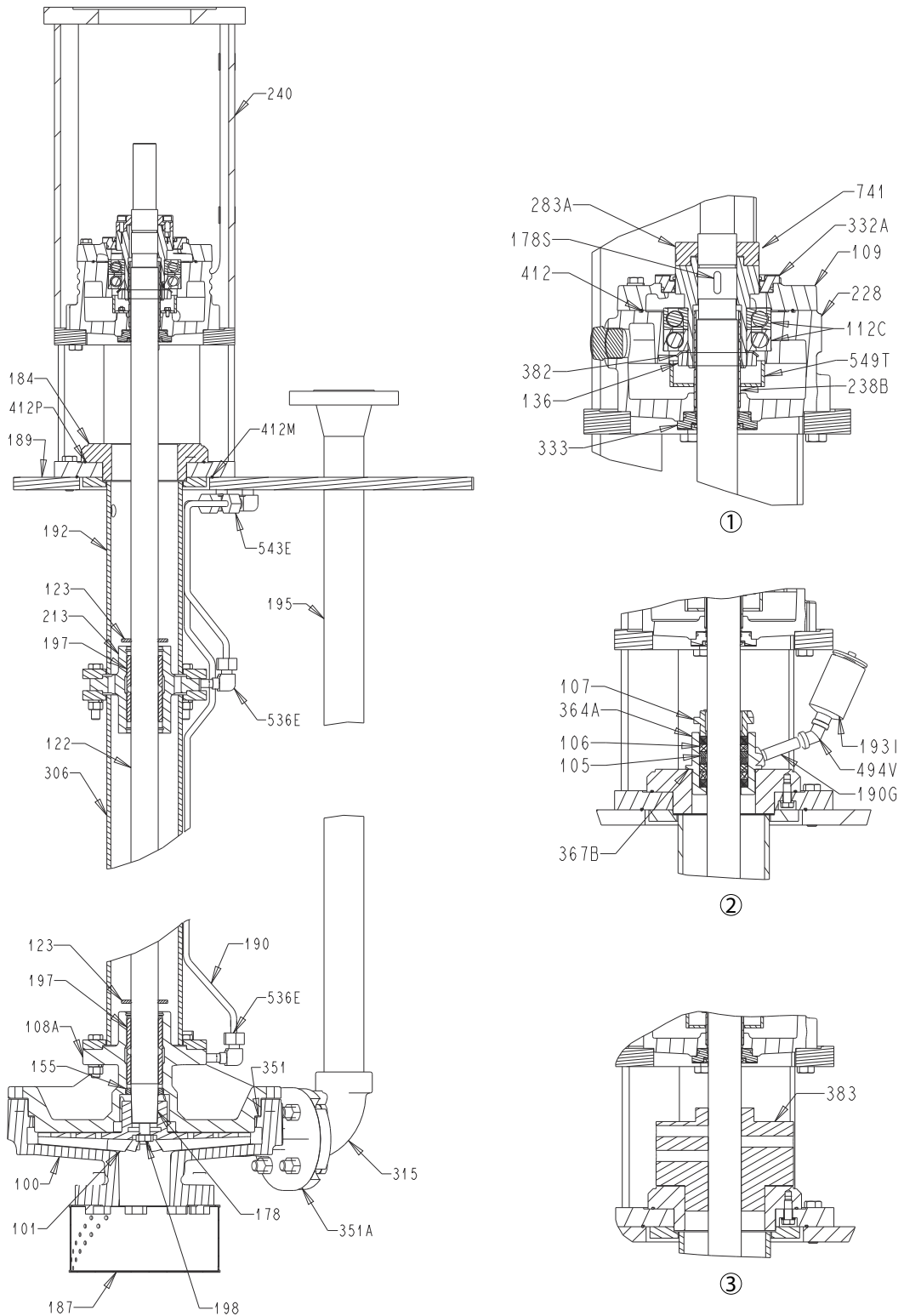
Table 13: Troubleshooting procedure

Symptom	Cause	Remedy
There is excessive shaft end play.	The internal clearance of the bearings is excessive.	Replace the bearings with a bearing of the correct type.
	The thrust-bearing end cover is loose.	Tighten the screws.
The runout for the shaft is excessive.	The shaft is bent.	Replace the shaft.
The runout for the bearing-frame flange is excessive.	The shaft is bent.	Replace the shaft.
	The flange of the bearing frame is distorted.	Replace the bearing-frame flange.
The runout for the seal-chamber cover is excessive.	The seal-chamber cover is improperly seated on the frame.	Replace or re-machine the seal-chamber cover.
	There is corrosion or wear on the seal-chamber cover.	Replace the seal-chamber cover.
The runout for the impeller wear ring is excessive.	The shaft is bent.	Replace the shaft.
	The wear ring was machined improperly.	Replace or re-machine the impeller.

8 Parts Listings and Cross-Sectional Drawings

8.1 Cross-sectional diagram

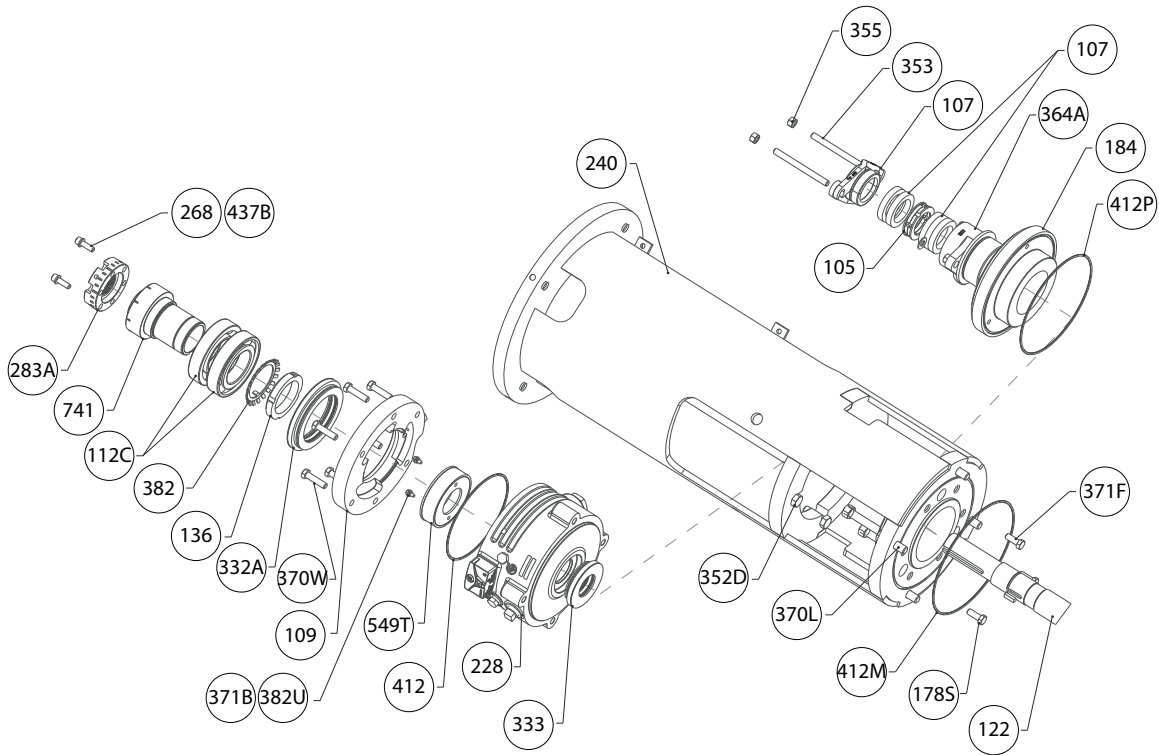
8.1 Cross-sectional diagram



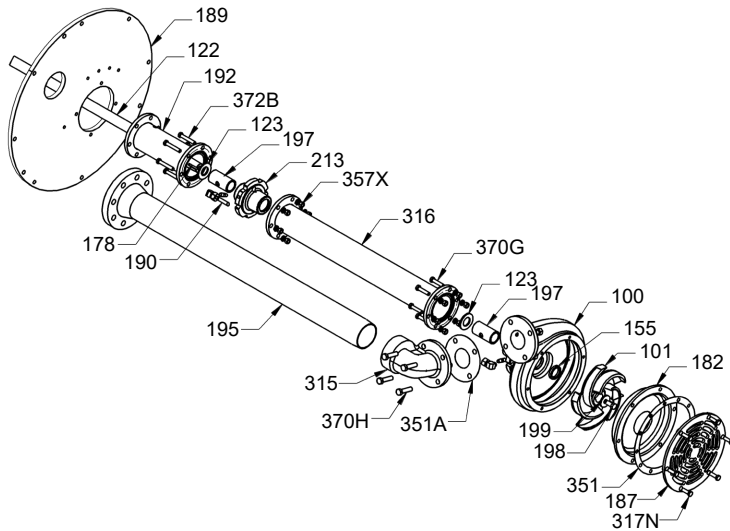
1. Enlarged frame section
2. Stuffing box with packing option
3. Mechanical seal option

8.2 Dimensional drawings

Exploded view A



Exploded view B



8.3 Parts list

Table 14: Parts list with materials of construction

Item	Quantity	Part name	S-1/S-4	S-3	S-5	S-6	S-8	A-8	D-1	D-2	
100	1	Casing	A216 WCB (1212)					A743 CF8M (1203)	A890 Grade 4A (1360)	A890 Grade 5A (1361)	
101	1	Impeller	A536 65-45-1 2 (1018)	A436 Type 2 (1007)	A216 WCB (1212)	A487 CA6NM (1234)	A743 CF8M (1203)	A743 CF8M (1203)	A890 Grade 4A (1360)	A890 Grade 5A (1361)	
105	1	Lantern ring	As specified								
106	Set	Packing	As specified								
107	1	Gland	1000 or 1203								
108	1	Casing from adapter (L group only)	A216 WCB (1212)					A743 CF8M (1203)	A890 Grade 4A (1360)	A890 Grade 5A (1361)	
109	1	End cover	2201								
112C	2	Thrust bearing	Angular contact with machined brass cage								
122	1	Shaft	A582 S41600 (2218)					A276 S3160 0 (2216)	A276 S31803 (2478)	A479 S3275 0 (3273)	
123	1	Deflector	Neoprene								
136	1	Bearing locknut	Steel								
155	1	Casing bushing	Carbon-filled PTFE (PTFE)								
178	1	Impeller key	2229						2248		
178S	1	Bearing carrier key	2213								
182	1	Suction cover	A216 WCB (1212)					A743 CF8M (1203)	A890 Grade 4A (1360)	A890 Grade 5A (1361)	
184	1	Seal cover	2201								
187	1	Strainer	3211					A890 Grade 4A (1360)		A890 Grade 5A (1361)	
189	1	Support plate	3201								
190	1	Flush tubing	As specified								
190G	1	Pipe nipple	Steel								
192	1	Head column	A53 Grade F (6501)					A312 316L (6545)	A790 S31803 (6762)	A790 S3275 0 (6682)	
193I	1	Grease cup	Steel								
195	1	Discharge pipe	A53 Grade F (6501)					A312 316L (6545)	A790 S31803 (6762)	A790 S3275 0 (6682)	
197	1	Steady bearings	Carbon or as specified								

Item	Quantity	Part name	S-1/S-4	S-3	S-5	S-6	S-8	A-8	D-1	D-2	
198	1	Impeller screw	2229							2248	
199	1	Impeller washer	2229							2248	
213	1	Steady bearing housing	A216 WCB (1212)							A890 Grade 4A (1360)	A890 Grade 5A (1361)
228	1	Bearing frame	1212								
240	1	Motor support	1000								
283A	1	Adjustment nut	2201								
306	1	Column extension	A53 Grade F (6501)						A312 316L (6545)	A790 S31803 (6762)	A790 S3275 0 (6682)
315	1	Discharge elbow	A216 WCB (1212)						A351 CF3M (1296)	A890 Grade 4A (1360)	A890 Grade 5A (1361)
332A	1	Labyrinth seal, upper	Bronze INPRO								
333	1	Labyrinth seal, lower	Bronze INPRO								
351	1	Gasket, suction cover to casing	Nitrile acrylic								
351A	1	Gasket, discharge elbow to casing	Nitrile acrylic								
364A	1	Stuffing box	1203								
367B	1	Gasket, stuffing box insert	Nitrile acrylic								
369A	1	Bearing collar	Steel								
370G	6	Bolt, column-to-casing	A193 B8M (2272)							2248	
370H	4	Bolt, elbow-to-casing	A193 B8M (2272)							2248	
370M	6	Bolt, head column-to-motor support	A193 B8M (2272)								
372B	6	Bolt, head column-to-column extension	As specified								
382	1	Bearing lockwasher	Steel								
383	1	Mechanical seal	As specified								
412	1	O-Ring, end cover	Nitrile								
412M	1	O-Ring, motor support	Nitrile								
412P	1	O-Ring, seal cover	Nitrile								
494V	1	Pipe elbow	1000								
536E	1	Tube fitting, steady bearing	As specified								
543E	1	Tube fitting, support plate	As specified								
549T	1	Rating plate	Steel								
571E	1	Discharge elbow flange (L group only)	A216 WCB (1212)						A351 CF3M (1296)	A890 Grade 4A (1360)	
741	1	Bearing carrier	2201								

¹The quantity depends on pump length.

Table 15: Material code cross reference

Goulds code	ASTM number
1000	A48 CL25B cast iron
1007	A436 Type 2 Ni-Resist
1018	A536-84 60-42-10 ductile iron
1203	A743 CF8M 316 stainless
1212	A216 WCB carbon steel
1234	A487 GR CA-6NM Class A
1296	A351 GR CF-3M
1360	A890 Grade 4A 22Cr-5Ni-Mo-N
1361	A890 Grade 5A 25Cr-7Ni-Mo-N
2210	A108 Gr1211 carbon steel
2216	A276 316 stainless ground and polished
2218	A582 Type 416 stainless steel
2229	A276-91A stainless
2248	B574 C-276 Hastelloy C
2272	A193 B8M AISI Grade 316 alloy steel
2478	A479 Type S 31083
3201	A283 Grade D carbon steel plate
3211	A240 316 steel plate
3273	A479 Alloy 2507 (annealed) turned, ground, and polished
6501	A53 Type F carbon steel schedule 40 pipe
6545	A312 316L stainless steel schedule 40 pipe
6682	A790 Alloy 2507 schedule 40 pipe
6762	A790 GR S 31803 stainless steel welded pipe

9 Other Relevant Documentation or Manuals

9.1 Other Relevant Documentation or Manuals

9.1.1 For additional documentation

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

10 Contacts

10.1 Local ITT Contacts

10.1.1 Regional offices

Region	Address	Telephone	Fax
North America (Headquarters)	ITT - Goulds Pumps 240 Fall Street Seneca Falls, NY 13148 USA	+1 315-568-2811	+1 315-568-2418
Houston office	12510 Sugar Ridge Boulevard Stafford, TX 77477 USA	+1 281-504-6300	+1 281-504-6399
Los Angeles	Vertical Products Operation 3951 Capitol Avenue City of Industry, CA 90601-1734 USA	+1 562-949-2113	+1 562-695-8523
Asia Pacific	ITT Fluid Technology Asia Pte Ltd 1 Jalan Kilang Timor #04-06 Singapore 159303	+65 627-63693	+65 627-63685
Asia Pacific	ITT Goulds Pumps Ltd 35, Oksansandan-ro Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do 28101, Rep. of KOREA	+82 234444202	
Europe	ITT - Goulds Pumps Millwey Rise Industrial Estate Axminster, Devon, England EX13 5HU	+44 1297-639100	+44 1297-630476
Latin America	ITT - Goulds Pumps Camino La Colina # 1448 Condominio Industrial El Rosal Huechuraba Santiago 8580000 Chile	+562 544-7000	+562 544-7001
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