GOULDS PUMPS

# Installation, Operation, and Maintenance Manual

Model CV3171 and LF3171

ITT

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# 1 Introduction and Safety

## 1.1 Introduction

**Purpose of this manual**

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

- Installation
- Operation
- Maintenance

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

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

### 1.1.1 Requesting other information

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

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

## 1.2 Safety

**WARNING:**

- 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.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.

- 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.
- 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.
- 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.
- 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.

**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:** | • A potential situation which, if not avoided, could result in undesirable conditions<br>• 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 130ºF (54ºC) 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 | 1. Hold your eyelids apart forcibly with your fingers.<br>2. Rinse the eyes with eyewash or running water for at least 15 minutes.<br>3. Seek medical attention. |
| Chemicals or hazardous fluids on skin | 1. Remove contaminated clothing.<br>2. Wash the skin with soap and water for at least 1 minute.<br>3. Seek medical attention, if necessary. |

### 1.2.3.3 Precautions during work

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

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

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.

## 1.2.4  Ex-approved products

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

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

**Personnel requirements**

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

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, EN 60079-17).

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

**Product and product handling requirements**

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

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

**Description of Ex-Directives**

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

**Guidelines for compliance**

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

1. Monitoring the liquid end temperature.
2. Maintaining proper bearing lubrication.

3. Ensuring that the pump is operated in the intended hydraulic range.

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

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

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

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

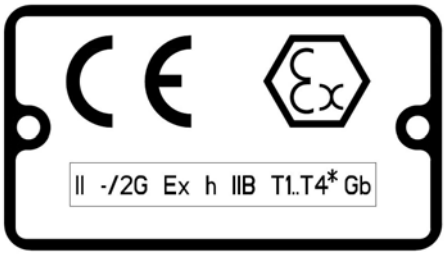



**Figure 1: Typical Ex nameplate**


**Figure 2: Typical UKCA Ex nameplate**

**Table 1: Temperature class definitions**

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

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

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

### Equipment for monitoring

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

**WARNING:**

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

- Pumps that are not self-priming must be fully primed at all times during operation. The only model lines that are self-priming is the 3796 and SP3298.
- Pumps must be fully primed at all times during operation.
- The preventive maintenance section must be adhered to in order to keep the applicable Ex classification of the equipment. Failure to follow these procedures will void the Ex classification for the equipment. Bearing replacement intervals are given in the specific pump model IOM.
- Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.
- Throughout this section on bearing lubrication, different pumpage temperatures are listed. If the equipment is Ex certified and the listed temperature exceeds the applicable value shown in Table 1 under SAFETY, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goulds representative.
- Cooling systems, such as those for bearing lubrication, mechanical seal systems, etc., where provided, must be operating properly to prevent excess heat generation, sparks and premature failure.
- Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation, sparks and premature failure.
- Flange loads from the piping system, including those from thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts which can result in excess heat generation, sparks and premature failure.
- Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.
- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check for magnetism on the pump shaft and demagnetize the shaft if there is any detectable magnetism. Magnetism will attract ferritic objects to the impeller, seals and bearings which can result in excess heat generation, sparks and premature failure.
- Leakage of process liquid may result in creation of an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid.
- Leakage of process liquid may result in creation of an explosive atmosphere. Follow all pump and seal assembly procedures.
- A buildup of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.
- Sealing systems that are not self purging or self venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
- Do not apply additional paint or coatings to the pump when in an Ex environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
- Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
- Stray electrical currents may ignite explosive atmospheres. Ensure drives are certified for variable frequency drive operation by the manufacturer.
- User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.

- For variable speed motor applications, the electric motor must be specified with shaft grounding and used with a conductive type coupling suitable for the area classification.
- In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.

### 1.2.5 Monitoring equipment

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Pressure gauges
- Flow meters
- Level indicators
- Motor load readings
- Temperature detectors
- Bearing monitors
- Leak detectors
- PumpSmart control system
- Filter

## 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 Receive the unit

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.

## 2.2 Unpack the unit

1. Remove packing materials from the unit.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the unit to determine if any parts have been damaged or are missing.
3. Contact your ITT representative if anything is out of order.

## 2.3 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.

### 2.3.1 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 swivel hoist rings 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**

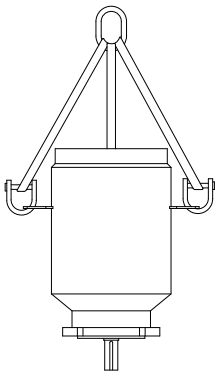


**Figure 3: Example of lifting motor properly with lifting lugs**

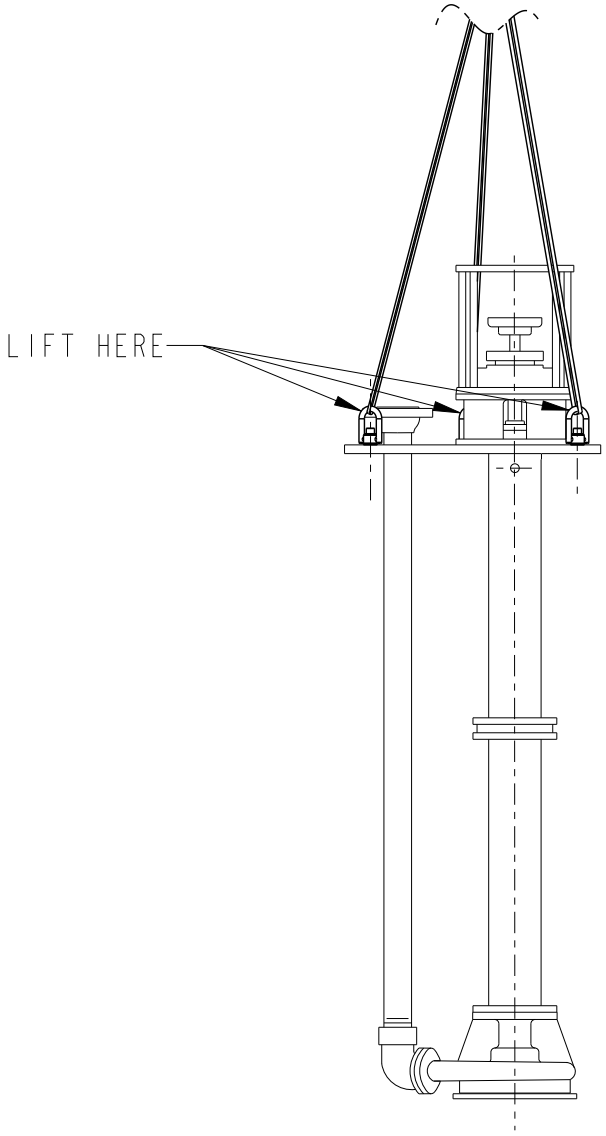



**Figure 4: Example of lifting pump properly with sling**

# 2.4 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) | • Pave the area.<br>• Clean the area.<br>• Drain the area and keep it free from flooding. |
| Outdoor storage area (when indoor storage is not available) | • Observe all indoor storage requirements.<br>• Use weather-proof coverings such as flame-resistant sheeting or tarpaulins.<br>• Place coverings in a manner that maximizes drainage and air circulation.<br>• Tie coverings down in order to protect the pump from wind damage. |
| Placement of pumps and component parts | • Place the unit on skids, pallets, or shoring higher than 15 cm \| 6 in. from the ground for good air circulation.<br>• Sort the parts in order to permit easy access for inspection and/or maintenance without excessive handling. |
| Stacking of units or component parts | • Make sure that racks, containers, or crates bear the full weight of units or parts in order to prevent distortion.<br>• Keep identification markings readily visible.<br>• Immediately replace any cover you remove for internal access. |
| Rotation of the pump shaft | • Rotate the shaft clockwise once a month, at a minimum.<br>• Make sure that the shaft rotates freely. |
| Controlled storage facilities | • Maintain an even temperature of 6°C \| 10°F or higher above the dew point.<br>• Keep the relative humidity to less than 50%.<br>• Make sure that there is little or no dust. |
| Uncontrolled storage facilities that have uneven temperatures, higher humidity, and/or dusty conditions) | • Inspect the unit periodically to make sure that all preservatives are intact.<br>• 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.

## 2.4.1 Prepare the pump for long-term storage

For storage periods over six months, you must follow the 2.4 Pump storage requirements on page 16 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.

# 3 Product Description

## 3.1 General description

**Product description**

The model CV3171 is a vertical vortex, recessed open impeller pump that generates pressure head by creating a vortex in the casing. Use of a recessed impeller allows for solids, entrained air, or shear sensitive liquid handling.

The model CV3171 is based on 1 power end and 5 hydraulic pump sizes:

| | | |
|---|---|---|
| CV 2x2-8 | CV 2x2-10 | CV 3x3-10 |
| CV 2x3-13 | CV 3x4-13 | |

The model LF3171 is a vertical radial vane impeller pump. Use of this pump allows for generation of high heads at low flows in clean services.

The model LF3171 is based on 3 sizes currently with 5 hydraulic sizes:

| | | |
|---|---|---|
| LF 1x1.5-8 | LF 1x2-10 | LF 1.5x3-13 |
| LF 1x2-10F | LF 1.5x3-13G | |

**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 CV3171 is a concentric volute.

The LF3171 casing is a concentric casting with machined volute and tight clearances design specifically for low flow and high heads.

**Impeller**

The CV impeller is fully open, has curved vanes, and is threaded to the shaft. The LF sizes have straight radial vanes and are threaded to the shaft. The threads are sealed from the pumpage by a PTFE O-ring.

**Strainer**

The strainer is a basket type. Openings are sized to prevent the entrance of large solids that are commonly found in open sumps.

**Power End**

The power ends of the CV3171 and LF3171 are identical to the 3171 power end. It consists of the motor, coupling, motor mount, support plate, double-row ball thrust bearing, shaft, column pipe header, steady bearings, and column pipe extension.

**Discharge elbow**

The discharge elbow is a short radius elbow that provides compact size and minimum profile.

### 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 a grease or oil-mist lubricated double row angular contact ball bearing. It is shouldered and locked to the shaft and the housing enabling it 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.

### Seals

This pump has three seals:

| Seal type | Description |
|---|---|
| The CV and LF use the same Upper labyrinth seal | This seal is used to exclude dirt and water from the thrust bearing. |
| The CV and LF use the same 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. |
| Lower grease seal | The CV3171 steady bearing housing as standard utilizes an upper and lower lip seal to exclude contaminates and to retain the grease lubrication. Steady bearing are grease lubricated from the support plate. |

### Motor support

Motor supports are cast construction and precision-machined in order to maintain proper alignment between the motor and pump shaft with minimal shimming. Motor supports are designed for vertical C-face motors as standard. P-base supports and IEC adapters are available upon request.

### Direction of rotation

Clockwise (right hand) as viewed from the driver, looking at the pump shaft.

### Maximum solids size

The maximum solids size is 47.6 mm |1.875 in. for 2" discharge and 73 mm | 2.875 in. for 3" discharge. For the LF3171 please refer to the current pump curve for maximum solids capabilities.

### Steady bearings

1. **Carbon and carbon filled PTFE** These bearings are chemically inert in most liquids and can be used in liquids up to the temperature limits of the pump. They should not be used in liquids containing abrasive solids. Grease or clear liquid flush is required.
2. **Fluted rubber or Viton** These bearings consist of fluted rubber or Viton contained within a metal shell. Clear water from an outside source, 1 to 2 GPM, is required to each bearing housing. They are ideally suited for liquids containing abrasive solids but are limited to 71°C | 160°F temperature liquid. Corrosion resistant shafting is required.
3. **Metallic bearing** Bronze steady bearings are available and must be grease lubricated. Lack of lubrication can lead to galling and eventual seizing. It becomes extremely difficult to keep enough

grease in the housing when handling hot liquids, caustic solutions or solvents. Unless an adequate maintenance program exists, it is recommended that a self-lubricating bearing such as carbon be used in place of the metallic bearing.

4. **Sealed bearings** Recommended for abrasive liquids where no outside flush is available. The carbon bearing is sealed within the housing by two lip seals and filled by grease via pressure lubricator located above the support plate. The pressure cup must be kept full of grease. The control screw on the pressure cup should be wide open to start and then controlled by usage.

# 3.2 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.

### Motor support nameplate

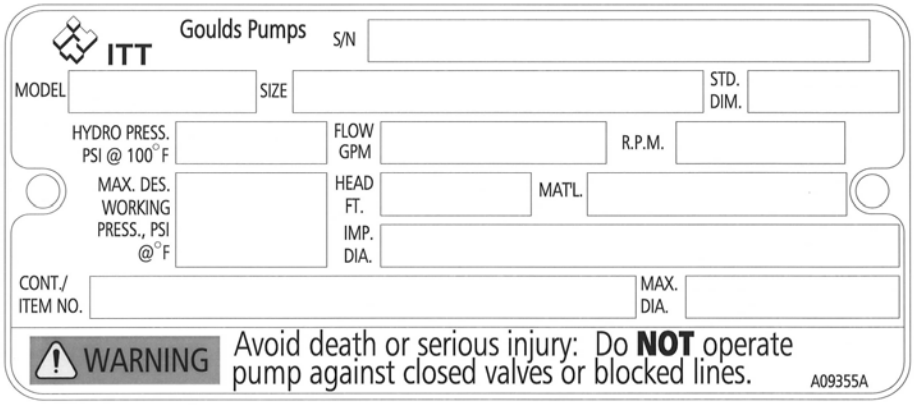



**Figure 5: Motor support nameplate**

**Table 2: Explanation of the nameplate**

| Nameplate field | Explanation |
|---|---|
| MODEL | Pump model |
| SIZE | Size of the pump |
| S/N | Serial number of the pump |
| STD. DIM. | Standard dimension |
| HYDRO PRESS. PSI @ 100°F | Hydrotest pressure in pounds per square inch at 100°F |
| FLOW GPM | Rated pump flow, in gallons per minute |
| R.P.M. | Rated pump speed, revolutions per minute |

| Nameplate field | Explanation |
|---|---|
| MAX. .DES. WORKING PRESS., PSI°F. | Maximum design working pressure, pounds per square inch at Â°F |
| HEAD FT. | Rated pump head, in feet |
| MAT'L. | Material of construction |
| IMP. DIA. | Diameter of the impeller |
| CONT./ ITEM NO. | Contract/item number |
| MAX. DIA. | Maximum impeller diameter |

### Ex nameplate

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

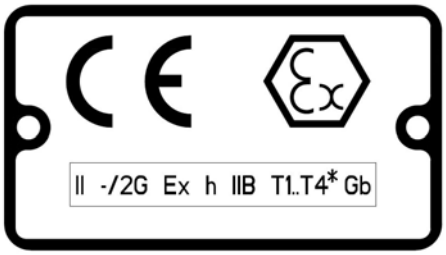



**Figure 6: Typical Ex nameplate**


**Figure 7: Typical UKCA Ex nameplate**

Refer to Table 1 for pumpage temperature restrictions.

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. 3.2 Nameplate information on page 20 is for the purpose of determining T'x' code for Ex applications with liquid temperatures exceeding 107ºC | 225ºF.

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

# 4 Installation

## 4.1 Pre-installation

**Precautions**

**WARNING:**

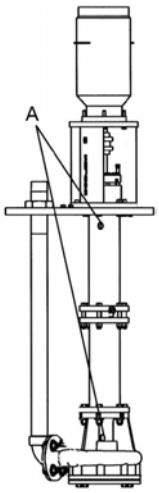
- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to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

**NOTICE:**

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

### 4.1.1 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 8: 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.

## 4.1.2 Pump location guidelines

| 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:<br>• Pressure relief valves<br>• Compression tanks<br>• Pressure controls<br>• Temperature controls<br>• Flow controls<br>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. |

## 4.1.3 Concrete foundation requirements

### Requirements

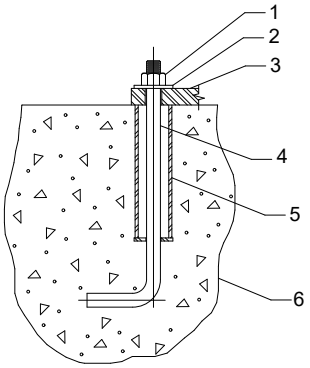
Make sure that you meet these requirements when you prepare the pump foundation:

- 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 9: Example of a typical installation**

# 4.2 Support plate installation

## 4.2.1 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.

## 4.2.2 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. |

| Support plate type | Action |
|---|---|
| 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. |

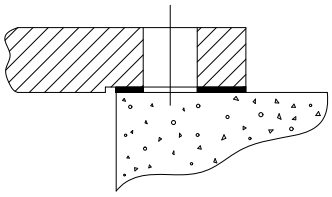


**Figure 10: Layout for a standard support plate with the vapor-proof option**

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.

# 4.3 Piping checklists

## 4.3.1 General piping checklist

**Precautions**

**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.

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

**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. | • Strain on the pump<br>• Misalignment between the pump and the drive unit<br>• 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 | This helps to minimize friction losses. | |

| Check | Explanation/comment | Checked |
|---|---|---|
| 45° or long radius 90° fittings where necessary. | | |
| 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:<br>• The grout for the baseplate or sub-base becomes hard.<br>• The grout for the pit cover becomes hard. | — | |
| 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 |
| Concentric | You can easily install the flange bolts by hand. |

## 4.3.2 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:<br>• Use long radius elbows.<br>• Move the elbow further from the suction.<br>• Eliminate unneeded elbows. | |
| Make sure the suction piping is a larger diameter than the pump suction. | — | |
| Install separate suction lines when more than one pump is operating from the same source of supply. | — | |
| Make sure that the suction piping contains no air pockets. | — | |
| Make sure that the suction piping slopes upwards toward the pump. | — | |
| 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.<br>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 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 connection at the top of the column back to the tank.<br>Connect the pipe at the top of the pump column back to the source tank in order to prevent fluid from entering the thrust bearing. | |

## 4.3.3 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:<br>• Two steam connections<br>• One condensate return connection.<br>The steam connections are connected to the tops of the column and discharge jackets. | |

| Check | Explanation/comment | Checked |
|---|---|---|
| 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:<br>• You can use both steam lines as input for steam (preferred method).<br>• You can use one steam line as input for steam, while the other steam line is used as a feed through to additional pumps.<br>Only use this method if absolutely necessary, because it is difficult to control the steam at subsequent pumps. | |
| Before you install the pump, check the fittings for leaks. Use plant air or high pressure water. | The jackets are hydrotested by the factory at 100 psi before shipment. However, the tube fittings can become loose during transit.<br>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. | |

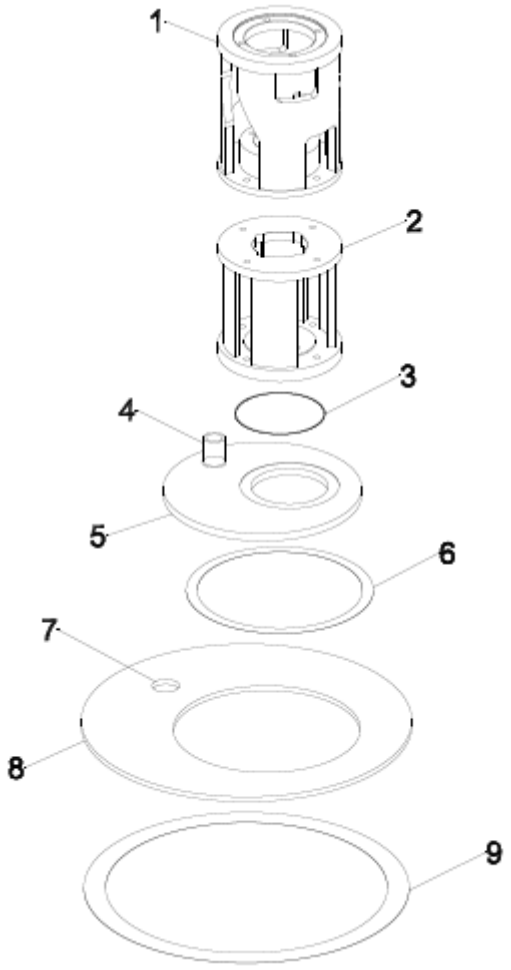
### 4.3.4 Final piping checklist

| 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. | |

## 4.4 Stuffing box installation

This pump is a sealless design. Therefore, when temperatures exceed 82°C | 180°F , you must move the thrust bearing away from the heat source in the pump by adding the upper stuffing box. Air can then circulate around the bearing in order to keep it cool.

The upper stuffing box is also used to minimize vapor emissions when the pump handles controlled substances.




1. Motor support
2. Upper stuffing box
3. O-ring
4. Discharge pipe
5. Support plate
6. Gasket
7. 76.2 mm | 3 in. NPT female connection
8. Pit cover
9. Gasket

**Figure 11: Suffing box installation**

## 4.4.1 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.

# 4.5 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.

## 4.5.1 Install the motor

Use NEMA Vertical C-face motors with this pump. P-base motor adapters and IEC motor adapters are available as options.

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.

## 4.5.2 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 bolt the support plate | This ensures that alignment can be accomplished. |
| After you bolt the support plate | This ensures that no changes have occurred during the bolting of the support plate. |
| 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. |

## 4.5.3 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.

## 4.5.4 Alignment measurement guidelines

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

## 4.5.5 Attach the dial indicators for alignment

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

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

b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.

This indicator is used to measure angular misalignment.

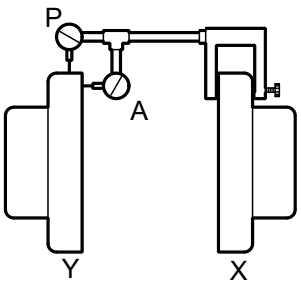



**Figure 12: Dial indicator attachment**

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

## 4.5.6 Align the flexible coupling

**WARNING:**
Disconnect and lock out electrical power before installing or servicing the pump.

**WARNING:**

- 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 proves adequate for most installations. Use dial indicators for disc couplings and applications where alignment to tighter tolerances is desirable. Standard dial indicator procedures would apply.

## 4.5.7 Align the flexible coupling with a straight edge

**WARNING:**
Disconnect and lock out electrical power before installing or servicing the pump.

**WARNING:**

- 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. Place a straight edge across both coupling rims at four points 90° apart.
2. Move the motor until a straight edge rests evenly at each position.
3. Repeat these steps until you achieve the correct alignment.
4. Install a flexible sleeve between the hubs per the manufacturer's directions included with the pump data package.
5. Tighten all motor bolts.

# 4.6 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.

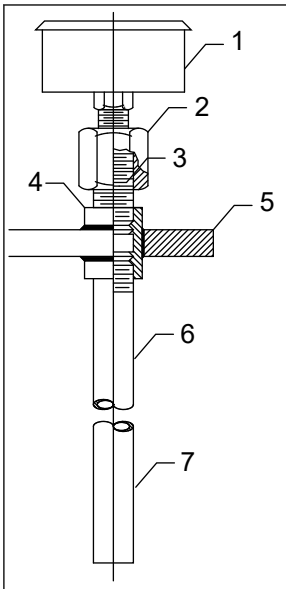



**Figure 13: High water alarm**

1. High water alarm
2. Reducing adapter, 13.0 mm x 26.0 mm | 0.5 in. x 1.0 in.
3. Nipple, 26.0 mm | 1.0 in.
4. Coupling, 26.0 mm | 1.0 in
5. Pit cover
6. Pipe, 26 mm | 1.0 in, 204 mm | 8.0 in. shorter than the pump length
7. Cut the pipe 64 mm | 2.5 in. below the required switch actuation point

### 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.

## 4.6.1 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.

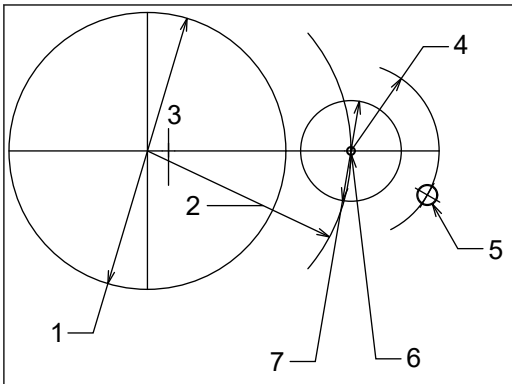



**Figure 14: Location of the float, rod, and switch**

1. Diameter of the coverplate (A)
2. Radius (B)
3. CL of the pump
4. Radius of 178.0 mm | 7.0 in.
5. 1.25 in. NPT float switch NTG column
6. 0.38 in. NPT for the float rod guide
7. 203.0 mm | 8 in. diameter of float (standard)

| 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.

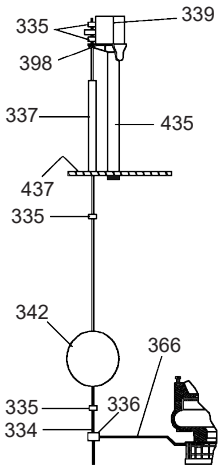



**Figure 15: Radius between float switch column and float**

# 5 Commissioning, Startup, Operation, and Shutdown

## 5.1 Preparation for startup

**WARNING:**

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

**WARNING:**

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

**Precautions**

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

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

**NOTICE:**

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

**NOTICE:**
You must follow these precautions before you start the pump:

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

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

# 5.2 Check the rotation - Frame Mounted

**WARNING:**

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

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

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

# 5.3 Thrust bearing lubrication

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

**Grease lubrication**

This pump comes with a grease-lubricated duplex thrust bearing. The bearing is pre-lubricated at the factory with a lithium-based grease. Regrease the bearing according to the schedule in the Maintenance chapter.

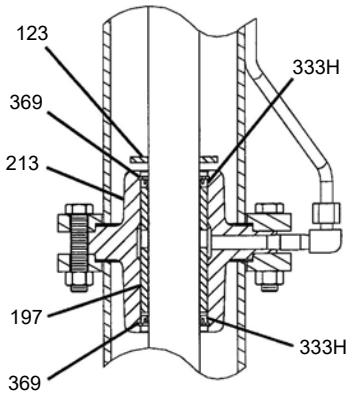
## 5.3.1 Flush the steady bearings

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.

## 5.3.2 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**

## 5.3.3 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.

## 5.3.3.1 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.

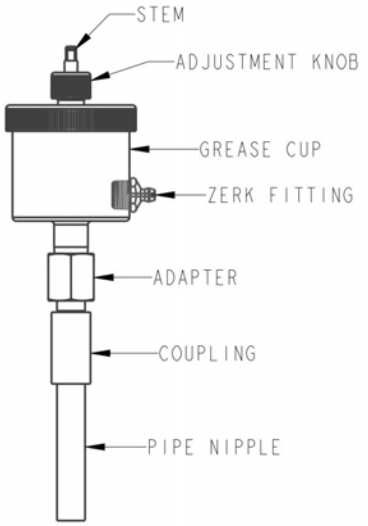
If all the grease is found on the reverse (or back side) of the plunger, then it is defective and must be replaced.

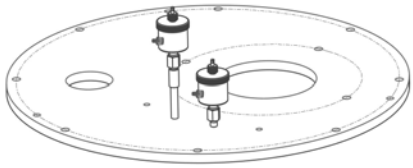
## 5.3.3.2 Adjust the flow

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.



# 5.4 Shaft sealing with a mechanical seal

**Precautions**

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

**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.

# 5.5 Shaft sealing with a stuffing box

This pump is a sealless design. Therefore, when temperatures exceed 82°C | 180°F, you must move the thrust bearing away from the heat source in the pump by adding the upper stuffing box. Air can then circulate around the bearing in order to keep it cool.

The upper stuffing box is also used to minimize vapor emissions when the pump handles controlled substances.

# 5.6 Install the shaft guard - if provided

**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.

Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.

# 5.7 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.

# 5.8 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.

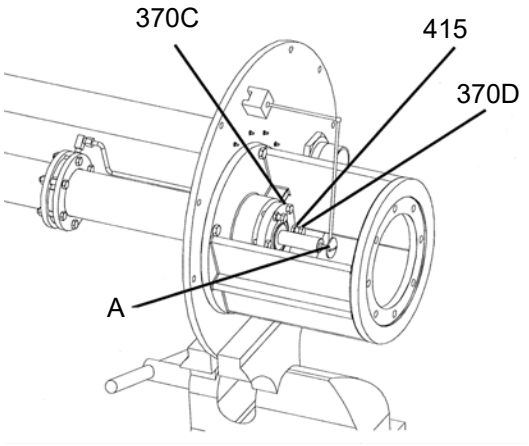
## 5.8.1 Set the impeller clearance - dial indicator method - CV 3171 Sizes: 2 x 2-8; 2 x 2-10; 3 x 3-10; 2 x 3-13; 3 x 4-13

Before you can begin this procedure, you must lock out the driver power and then remove the coupling guard according to the instructions in this manual.

**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. Remove coupling guard.
2. Remove coupling if required.
3. Set indicator so that the indicator button contacts either the shaft end or the face of the coupling.




A - Dial indicator

**Figure 17: Dial indicator method**

4. Loosen each locking bolt (370C) several turns.
5. Loosen the jam nuts (415) on the jack bolts (370D).
6. Tighten the bolts in several turns until the impeller contacts the casing adapter. Turn the shaft to ensure that there is contact between the impeller and the casing adapter.
7. Set the dial indicator to zero.
8. Alternately back off the jacking bolts (370D).
9. Tighten the locking bolts (370C) to move the impeller away from the adapter cover until the dial indicator shows 0.060 in. (1.52 mm) of clearance.
10. Tighten all bolts and the jam nuts (415) evenly.
11. Check shaft for free turning.
12. Replace coupling.
13. Replace coupling guard.

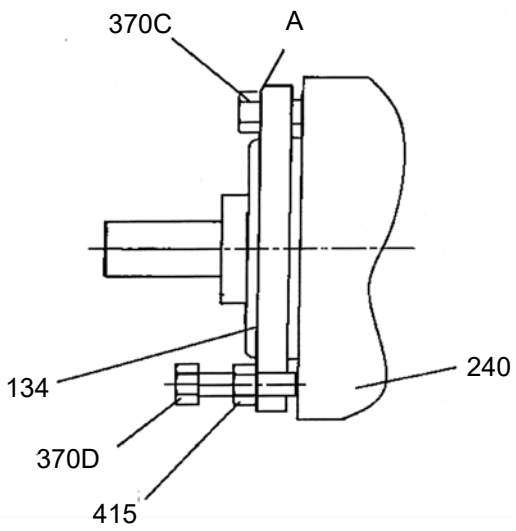
## 5.8.2 Set the impeller clearance - feeler gauge method - CV 3171 Sizes: 2 x 2-8; 2 x 2-10; 3 x 3-10; 2 x 3-13; 3 x 4-13

Before you can begin this procedure, you must lock out the driver power and then remove the coupling guard according to the instructions in this manual.

**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. Remove the coupling guard.
2. Remove coupling if required.
3. Loosen each locking bolt (370C) several turns.
4. Loosen the jam nuts (415) on the jack bolts (370D).
5. Tighten the bolts in several turns until impeller contacts the adapter cover. Turn shaft to ensure contact is made.
6. Turn in locking bolts (370C) until they are snug against the shell. Loosen jack bolts (370D) until a 0.060" feeler gauge can be inserted between the underside of the locking bolt head (370C) and the bearing shell (134).
7. Tighten locking bolts (370C) evenly until they are tight against the bearing shell (134). Make sure all bolts are tight. Tighten jam nuts (415).




A - Feeler gauge

**Figure 18: Feeler gauge method**

8. Check the shaft for free rotation.
9. Replace coupling.
10. Replace coupling guard.

Both of the above methods set the impeller 0.060" away from the adapter, giving the required clearance for ambient temperatures. For high temperatures, it is recommended that this procedure be repeated after the pump reaches operating temperature.

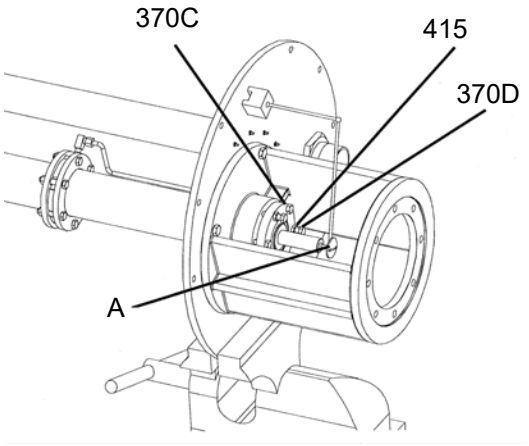
## 5.8.3 Set the impeller clearance - dial indicator method - LF3171 sizes 1 x 1.5-8; 1 x 2-10; 1.5 x 3-13; 1 x 2-10F; 1.5 x 3-13G

Before you can begin this procedure, you must lock out the driver power and then remove the coupling guard according to the instructions in this manual.

**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. Remove coupling guard.
2. Remove coupling if required.
3. Set indicator so that the indicator button contacts either the shaft end or the face of the pump coupling hub.




A - Dial indicator

**Figure 19: Dial indicator method**

4. Loosen the jam nuts (415) on the jack bolts (370D). Back off jack bolts several turns.
5. Turn all locking bolts (370C) in several turns until impeller contacts the casing (100). Turn shaft to ensure contact has been made.
6. Set the dial indicator at zero.
7. Loosen the locking bolts (370D) and tighten the jacking bolts (370D) to move the impeller away from the casing until the dial indicator shows that a 0.015" clearance has been obtained.
8. Tighten all bolts and the jam nuts (415) evenly.
9. Check the shaft for free rotation.
10. Replace coupling.
11. Replace coupling guard.

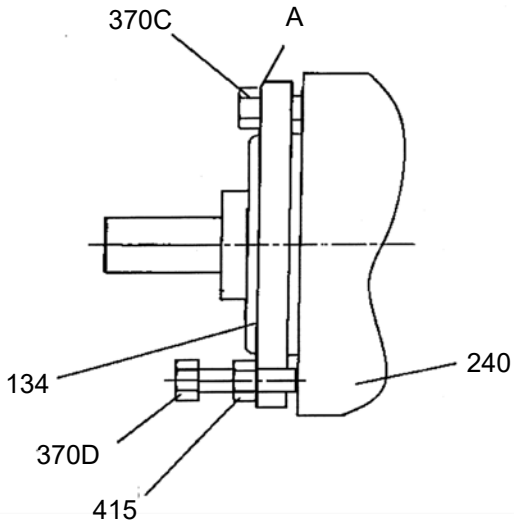
## 5.8.4 Set the impeller clearance - feeler gauge method - LF3171 Sizes: 1 x 1.5-8; 1 x 2-10; 1.5 x 3-13; 1 x 2-10F; 1.5 x 3-13G

Before you can begin this procedure, you must lock out the driver power and then remove the coupling guard according to the instructions in this manual.

**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. Remove the coupling guard.
2. Remove coupling if required.
3. Loosen the jam nuts (415) on the jack bolts (370D). Back off jack bolts several turns.
4. Turn all locking bolts (370C) in several turns until impeller contacts the casing (100). Turn shaft to ensure contact has been made.
5. Loosen the locking bolts (370C) until a 0.015" feeler gauge can be inserted between the underside of the bolt head and the bearing shell (134).




A - Feeler gauge

**Figure 20: Feeler gauge method**

6. Tighten jack bolts (370D) evenly until the bearing shell (134) is tight against the locking bolts (370C). Make sure all bolts are tight. Tighten jam nuts (415).
7. Check the shaft for free rotation.
8. Replace coupling.
9. Replace coupling guard.
   Both of the above methods set the impeller 0.015" away from the adapter, giving the required clearance for ambient temperatures. For high temperatures, it is recommended that this procedure be repeated after the pump reaches operating temperature.

## 5.9 Pump priming

**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:

# 5.10 Install the coupling guard

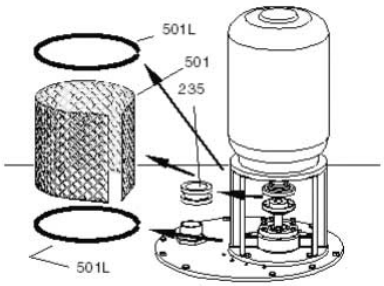
**WARNING:**

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

**WARNING:**
The coupling used in an Ex-classified environment must be properly certified and must be 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. Wrap the expanded metal shield (501) around the motor support.
2. Install the two guard springs (501L).




# 5.11 Start the pump

**WARNING:**

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

**NOTICE:**

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

**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.

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.
8. After the pump is brought to temperature for the first time, shut the unit down temporarily and readjust the impeller clearance.

## 5.12 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.

**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 ($NPSH_3$) 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.

# 5.13 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.

## 5.14 Make the final alignment of the pump and driver

**WARNING:**

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

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

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

# 6 Maintenance

## 6.1 Maintenance schedule

### Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

### Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the thrust bearings.
- Inspect the seal or packing, if present.

### Routine inspections

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

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.*
- Inspect the discharge pressure.
- Inspect the temperature.*
- Check the seal chamber and stuffing box for leaks.
    - Ensure that there are no leaks from the mechanical seal.
    - Adjust or replace the packing in the stuffing box if you notice excessive leaking.

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

### Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- Check the shaft alignment, and realign as required.
- Check the pump and motor hold down bolts for proper tightness.

### Annual inspections

Perform these inspections one time each year:

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

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

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

# 6.2 Bearing maintenance

These bearing lubrication sections list different temperatures of 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.

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

## 6.2.1 Thrust bearings

The pump comes with a grease-lubricated duplex thrust bearing. The bearing is pre-lubricated at the factory. Regrease the bearing according to the schedule in the following table.

**Table 3: Lubricating intervals in operating hours**

| Drive-unit size group | Below 1800 RPM | 1800 RPM | 3000 RPM | 3600 RPM |
|---|---|---|---|---|
| S/ST | 2,000 | 2,000 | 1,200 | 750 |
| M/MT | 2,000 | 1,800 | 800 | 450 |
| L | 2,000 | 1,200 | — | — |

## 6.2.2 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 greasing procedure.

## 6.2.3 Lubricating-grease requirements

**Precautions**

**NOTICE:**

- Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the

grease type or consistency, remove the rotor and old grease from the housing before re-greasing.

**Bearing temperature**

Bearing temperatures are generally about greater than bearing-housing outer surface temperatures.

This table shows the type of grease required for the operating temperature of the pump.

| Bearing temperature | Type of grease |
|---|---|
| -15°C to 110°C \| 5°F to 230°F | Use a lithium-based mineral-oil grease with a consistency of NLGI 2. |
| Exceed 177°C \| 350°F | Use a high-temperature grease. Mineral-oil greases should have oxidation stabilizers and a consistency of NGLI 3. |

**Grease recommendations based on temperature**

This table shows which brand of grease to use when lubricating the pump.

| Brand | When temperature of pumped fluid is less than 177°C \| 350°F NLGI consistency 2 | When temperature of pumped fluid is greater than NLGI consistency 3 |
|---|---|---|
| Mobil | Mobilux EP2 | |
| Exxon | Unirex N2 | Unirex N3 |
| Sunoco | Mutipurpose 2EP | N/A |
| SKF | LGMT 2 | LGMT 3 |

Recommended bearing replacement interval = 17,500 hours of operation.

## 6.2.3.1 Regrease the thrust bearing

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

1. Wipe dirt from the grease fittings.
2. Fill grease cavity through grease fitting (193B) on bearing shell (134). Use recommended grease and fill until fresh grease comes out of the relief fitting (113) on the opposite side of the bearing shell.

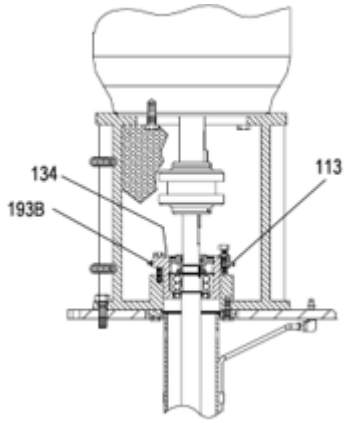



**Figure 21: Thrust bearings**

3. Wipe off any excess grease.
4. Recheck the alignment.

The bearing temperature usually rises after you regrease due to an excess supply of grease. Temperatures return to normal in about two to four operating hours as the pump runs and purges the excess grease from the bearings.

For most operating conditions a lithium complex soap based grease of NLGI consistency No. 2 is recommended. This grease is acceptable for bearing temperatures of -15°C to 110°C | 5°F to 230°F. Bearing temperatures are generally about 20°F | 11°C higher than bearing housing outer surface temperature.

The original grease from the factory is a lithium based NLGI. See Lubricating Grease Requirements Table.

**NOTICE:**
If it is necessary to change the grease type or consistency, the bearing must be removed and all the old grease eliminated from the housing and bearing.

### 6.2.4 Steady bearings

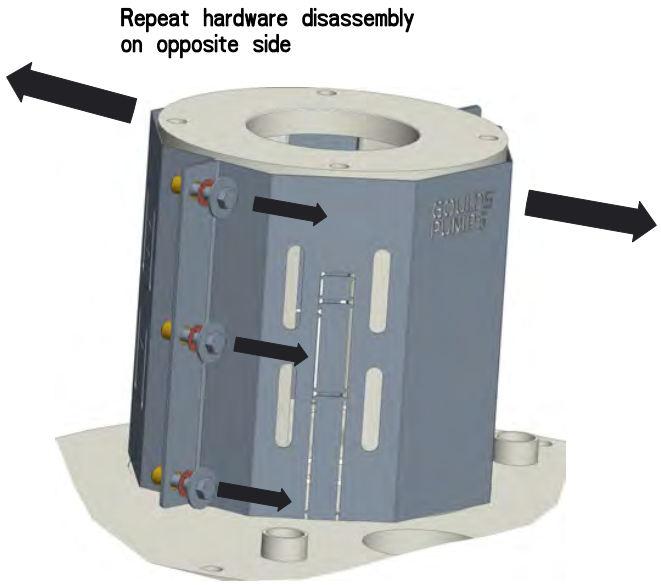
Check the ID of the casing collar (155) and steady bearing (197) per the dimensions in the Bearing fits and tolerances table. If the ID is greater than what is allowed, remove the snap ring (369) and use a suitable hydraulic press in order to remove these items for replacement. If sealed bearings are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

## 6.3 Shaft-seal maintenance

### 6.3.1 Remove the shaft guard

1. Remove the bolt for each shaft guard half that mounts the halves to each side of the frame.
2. Do not remove the clip that retains the bolt on the guard to maintain a captive fastener.
3. Retain each guard half with fasteners for reinstallation.




## 6.3.2 Mechanical-seal maintenance

**WARNING:**

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

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

**Cartridge-type mechanical seals**

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

**Other mechanical seal types**

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

**Reference drawing**

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

**Before you start the pump**

Check the seal and all flush piping.

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

## 6.3.3 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:

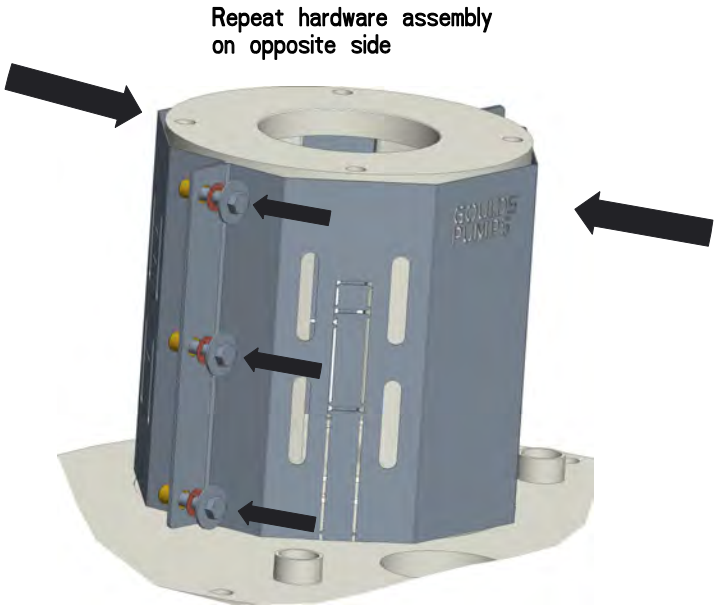
1. Three rings of packing
2. Lantern ring
3. Two rings of packing
4. Gland

## 6.3.4 Install the shaft 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.

Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.




1. Ensure that the mounting bolt for each shaft guard half is inserted with the bolt retainer in place for captive hardware.
2. Assemble a guard half from each side of the pump and fasten to the bearing frame.
3. Ensure that adequate coverage is maintained for rotating components.

# 6.4 Disassembly

## 6.4.1 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.

**NOTICE:**
Images may not accurately match all scopes of supply but the directions and instructions remain the same.

## 6.4.2 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
- Micrometer
- Rubber mallet
- Screwdriver
- Snap-ring pliers
- Torque wrench with sockets
- Wrenches
- Lifting eyebolt (dependent on pump / motor size)

## 6.4.3 Drain the pump

**CAUTION:**

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

1. Leave the drain valve open.

Do not close the drain valve until the reassembly is complete.

2. Remove the coupling guard springs (501L) then unwrap the coupling guard (501) from the motor mount (240).

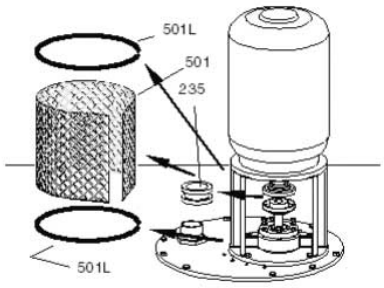



**Figure 22: Coupling Guard Removal**

3. Disconnect the coupling.

## 6.4.4 Remove the pump from the sump

1. Remove the motor bolts (371).

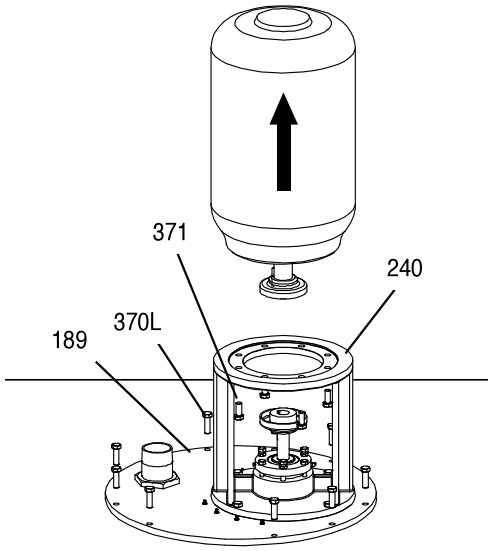



**Figure 23: Motor Bolts Removal**

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. Dismantle flow controls from pump and pit cover, if required (when furnished).
6. Use properly-sized slings in order to lift the pump from the sump.
   Refer to the Installation chapter for the proper handling procedure.
7. Lay the pump horizontally on proper supports where there is sufficient clearance to disassemble the pump.

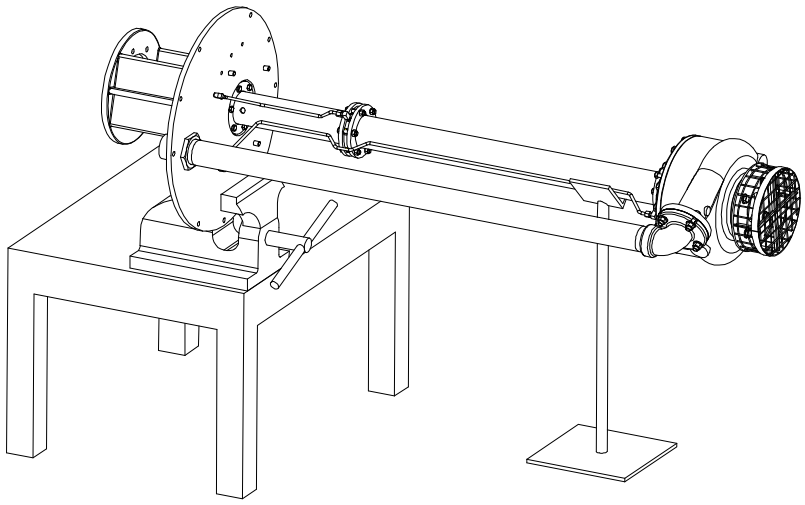


**Figure 24: Lay Pump Horizontally on Proper Supports**

8. Remove the strainer (187) from the pump.

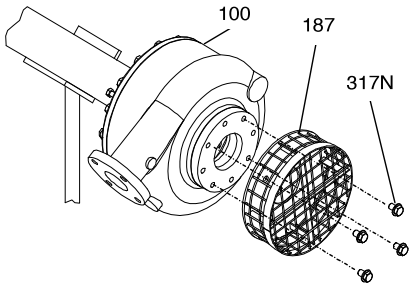



**Figure 25: Strainer removal**

9. Disassemble the discharge pipe (195) by removing the upper nut (242) and elbow fasteners (370H). Pull the discharge pipe from the support plate and pump flange.
10. Disconnect any steady bearing flush tubing (190).
11. Remove pump half-coupling hub (233) and key.

## 6.4.5 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.

1. Disassemble the pump casing (100) by removing the casing to adapter bolts (370). Leave the jacking bolts (418) in place. When removing the casing, be careful not to mar the inside casing walls.

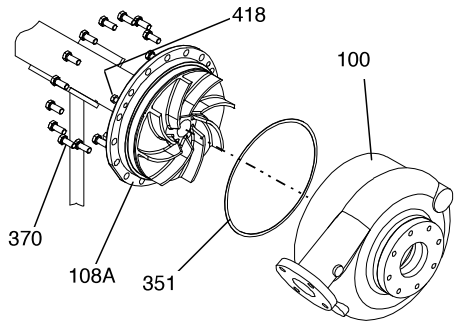



**Figure 26: Casing Removal**

## NOTICE:

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

2. Remove the impeller (101) from the shaft (122). One method is to use a locking bar to break the thread grip on the impeller.
3. Attach the locking bar onto the power end of the pump shaft.

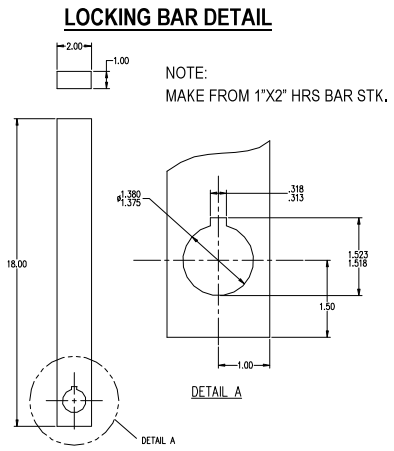



**Figure 27: Locking Bar Detail**

4. Quickly turn impeller counter clockwise as viewed from the impeller end of the shaft (right hand thread) impacting the locking bar handle on the motor support. Repeat this process until the impeller breaks free.

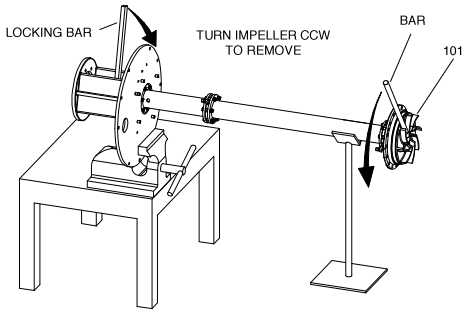



**Figure 28: Impeller Removal**

5. Remove the impeller (101) and O-ring (412A).

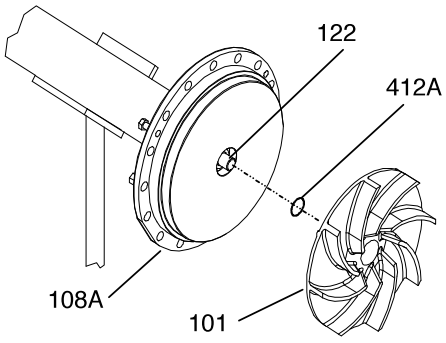



**Figure 29: Impeller Removal**

6. Using a scribe, put a small mark on each of the column pipes, steady bearings, adapter, and motor support to match mark the pieces. This will help in identifying and aligning during reassembly.

## 6.4.6 Disassemble the column

1. Loosen the bolts (370G) that hold the adapter (108A) to the column pipe. Slide the adapter from the shaft (122).
   If adapter is difficult to remove, shaft end may be corroded. Remove any rough spots or corrosion using an emery cloth.

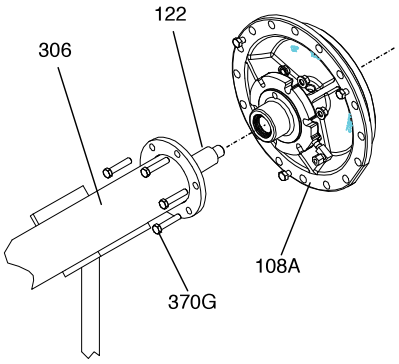



**Figure 30: Adapter Removal**

2. If your pump has no intermediate steady bearings (only one column section), you will not have any column extension (306) or steady bearing housing (213). Go to *Bearing Shell and Shaft Removal* step.
3. Starting at the casing end of the pump, remove column to steady bearing housing bolts (372B) and remove column extensions (306), steady bearing housings (213), and deflectors (123) one at a time.

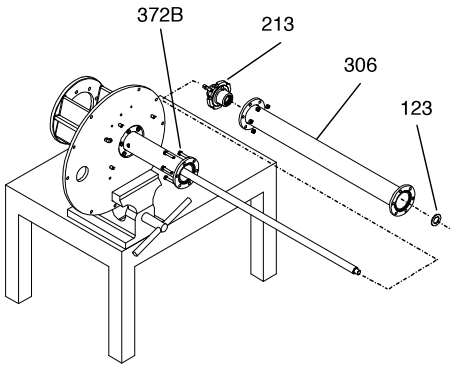



**Figure 31: Column Removal**

4. While removing column sections, support the shaft to prevent bending. There is usually no need to remove the head column (192). Do not remove steady bearings at this time. Refer to the inspection procedures prior to removal.

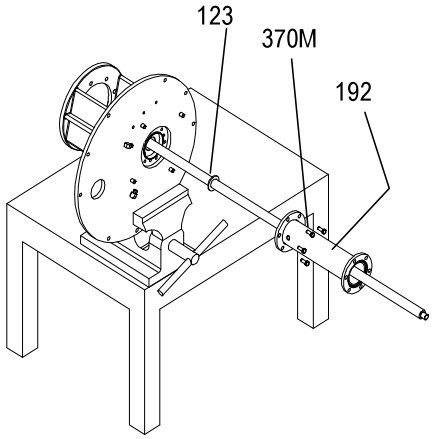



**Figure 32: Head Column Removal**

5. Remove locking bolts (370C) and slide bearing shell (134) assembly with shaft out through the motor support (240).

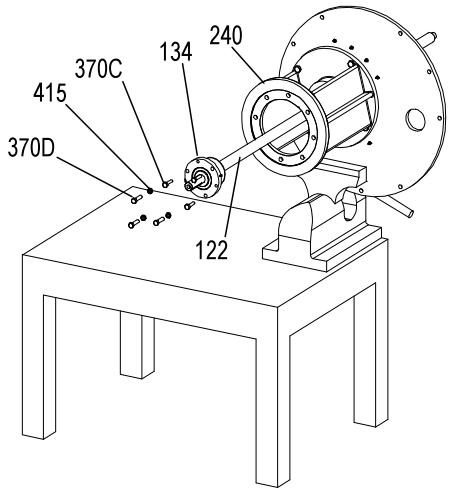



**Figure 33: Bearing Shell and Shaft Removal**

6. Remove labyrinth seal (332A). A screwdriver is required to pry the seal from the bearing shell (134).

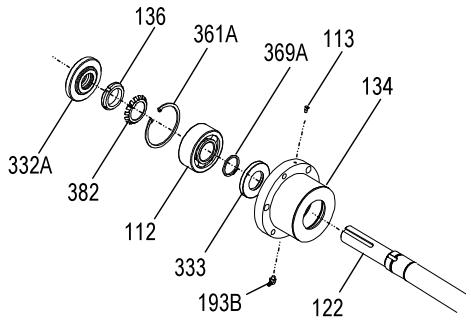



**Figure 34: Labyrinth Seal Removal**

7. Remove bearing retaining ring (361A). Slide bearing shell (134) off the bearing and shaft.
8. Remove locknut (136) and lockwasher (382).
9. Using a suitable bearing puller, remove bearing (112).
10. Set the shaft on a table where it is adequately supported.
11. There is usually no need to tear the pump down any further unless parts are known to be bad.

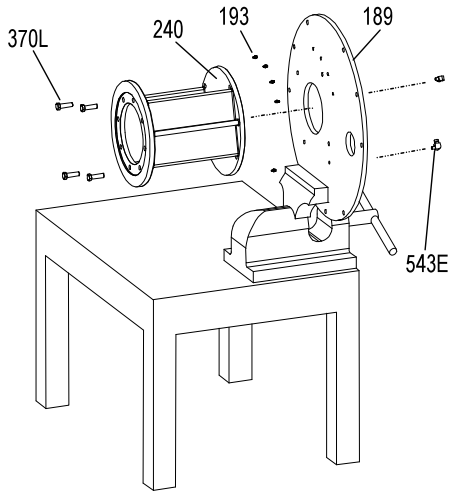



**Figure 35: Motor Adapter Removal**

# 6.5 Preassembly inspections

## 6.5.1 Replacement guidelines

**Casing check and replacement**

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

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

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

- Localized wear or grooving that is greater than 3.2 mm | 1/8 in. deep
- Pitting that is greater than 3.2 mm | 1/8 in. deep

- Irregularities in the casing-gasket seat surface

**Impeller replacement**

This table shows the criteria for replacing the impeller:

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

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

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

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

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

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

**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.

## 6.5.2 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 inspection

Check the shaft surface for damage, especially in areas indicated by the arrows in the following figure. Replace the shaft if it is damaged beyond reasonable repair.

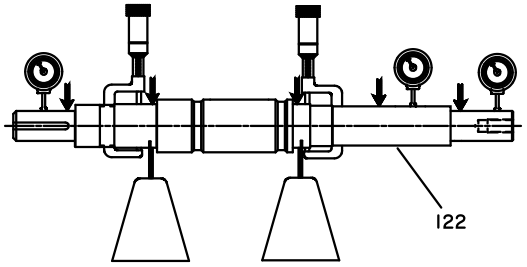



**Figure 36: Shaft inspection**

## 6.5.3 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.

## 6.5.4 Bearing fits and tolerances

### Table 4: Steady bearing tolerances

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

| Description | 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 \| 1.132–1.134 | 41.478–41.529 \| 1.633–1.635 | 57.353–57.404 \| 2.258–2.260 | 41.173–41.224 \| 1.621–1.623 | 53.873–53.924 \| 2.121–2.123 | 76.048–76.098 \| 2.994–2.996 | 0.140–0.089 \| 0.0055–0.0035 | 0.152–0.102 \| 0.006–0.004 | 0.165–0.102 \| 0.0065–0.004 |
| Bronze | 28.677–28.727 \| 1.129–1.131 | 41.377–41.427 \| 1.629–1.631 | 57.302–57.353 \| 2.256–2.258 | 41.173–41.224 \| 1.621–1.623 | 53.873–53.924 \| 2.121–2.123 | 76.048–76.098 \| 2.994–2.996 | 0.102–1.051 \| 0.004–0.002 | 0.102–1.051 \| 0.004–0.002 | 0.140–0.076 \| 0.0055–0.003 |
| Fluted elastomer | 28.600–28.702 \| 1.126–1.130 | 41.326–41.453 \| 1.627–1.632 | 57.226–57.328 \| 2.253–2.257 | 41.173–41.224 \| 1.621–1.623 | 53.873–53.924 \| 2.121–2.123 | 76.048–76.098 \| 2.994–2.996 | 0.089–0.013 \| 0.0035–0.0005 | 0.114–0.025 \| 0.0045–0.001 | 0.127–0.102 \| 0.005–0.004 |

| Description | 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 |
| Rulon | 28.753–28.804 \| 1.132–1.134 | 41.478–41.529 \| 1.633–1.635 | 57.353–57.404 \| 2.258–2.260 | - | - | - | 0.140–0.089 \| 0.0055–0.0035 | 0.152–0.102 \| 0.006–0.004 | 0.165–0.102 \| 0.0065–0.004 |
| Casing collar | 30.048–30.226 \| 1.183–1.190 | 42.621–42.799 \| 1.678–1.685 | 58.395–58.472 \| 2.299–2.306 | 45.999–46.126 \| 1.811–1.816 | 56.972–57.023 \| 2.243–2.245 | 82.372–82.423 \| 3.243–3.245 | 0.851–0.737 \| 0.0335–0.029 | 0.787–0.673 \| 0.031–0.0265 | 0.737–0.622 \| 0.029–0.0245 |

**Table 5: Thrust bearing fits**

| Group | Shaft OD | Shell ID |
|---|---|---|
| S/ST | 25.0139/25.0038) \| 0.9848/0.9844 | 62.0166/61.9989 \| 2.4416/2.4409 |
| M/MT | 40.0177/40.0025 \| 1.5755/1.5749 | 90.0227/89.9998 \| 3.5442/3.5433 |
| L | 55.0164/55.0037 \| 2.1660/2.1655 | 120.0226/119.9896 \| 4.7253/4.7240 |

### 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.

## 6.5.5 Casing and adapter inspection

The casing (100) and adapter (108A) should be inspected for excessive wearing or pitting. They should be replaced if they exceed:

- Localized wear or grooving greater the 3.2mm | 1/8" deep.
- Pitting greater than 3.2mm | 1/8" deep.

1. Inspect casing gasket seat surface for irregularities.
2. Check ID of casing collar (155) per the dimensions in *Steady Bearing Tolerances* table. If ID is greater than allowable, pry or pull the casing collar from its seat on the backside of the adapter.

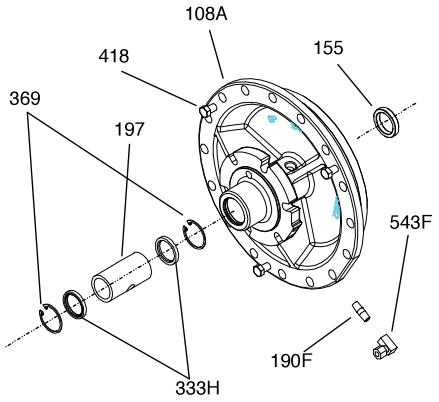



**Figure 37: Casing Collar Inspection**

3. Check ID of the steady bearing (197) per the dimensions in the *Steady Bearing Tolerances* table. If ID is greater than allowable, remove the inner and outer retaining rings (369) and seals (333H) (if applicable), then press out the steady bearing (197) using a small press.
4. Check bore adapter (108A) per *Steady Bearing Tolerances* table. If bore is excessive, replace.
5. Inspect casing-to-column connection area for any cracks or excessive corrosion damage. Replace if any of these conditions exist.

## 6.5.6 Inspect the column sections

1. Inspect column section(s) (306,192) for any cracks or excessive corrosion damage. Replace if any of these conditions exist.

## 6.5.7 Inspect the impeller

1. Inspect impeller (101) vanes for damage. Replace if grooved deeper than 1/16" (1.6 mm) or if worn evenly more than 1/32" (0.8 mm).
2. Inspect back pumpout vanes for damage. Replace if if worn more than 1/32" (0.8 mm).
3. Inspect leading and trailing edges of the vanes for pitting, erosion, or corrosion damage.

## 6.5.8 Inspect the steady bearing housings

1. Check the ID of steady bearings (197) per the dimensions in the *Steady Bearing Tolerance* table. If ID is greater than allowable, remove the inner and outer retaining rings (369) and seals (333H) (if applicable), then press out the steady bearing (197) using a small press.
2. Check bore of steady bearing housing (213) per *Steady Bearing Tolerance* table. If bore is excessive, replace.

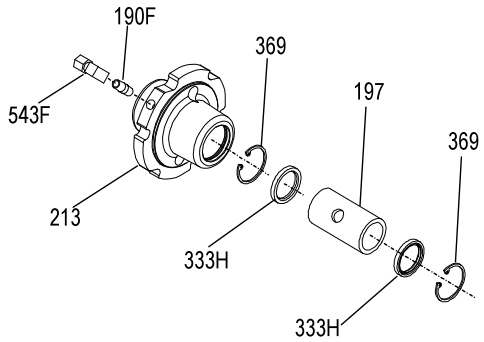



**Figure 38: Steady Bearing Inspection**

# 6.6 Reassembly

## 6.6.1 Assemble the column and support plate

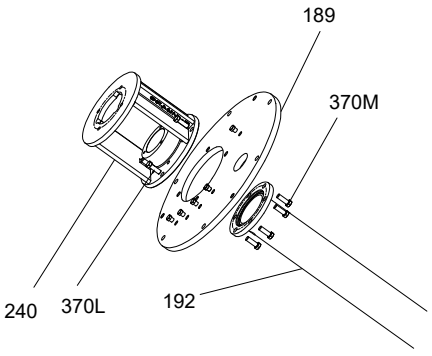
1. If you use the optional stuffing box, then attach the stuffing box (221) to support plate (189) with bolts (370L).
2. Attach the motor support (240):

| If ... | Then... |
|---|---|
| You use the stuffing box | Attach the motor support (240) to the stuffing box with bolts (370L). |
| You do not use the stuffing box | Attach the motor support (240) to the support plate (189) with bolts (370L). |

3. Attach the head column (192):

| If... | Then... |
|---|---|
| You use the stuffing box | Attach the head column (192) to the stuffing box with bolts (370M). |
| You do not use the stuffing box | Attach the head column (192) to the motor support with bolts (370M). |

Make sure that the vent holes are closer to the motor support.




## 6.6.2 Assemble the rotating element

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

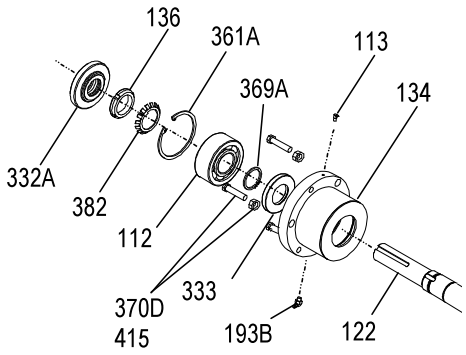



**Figure 39: Retainer ring reassembly**

1. For all groups except S/ST, install the retaining ring (369A) on the shaft (122).
2. Install the thrust bearing (112) on the shaft.

   There are several methods that you can use in order to install bearings. The recommended method is to use an induction heater that heats as well as demagnetizes the bearing.

**CAUTION:**

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

3. Install the lockwasher (382) on the shaft (122). Make sure that the tang of lockwasher is in the key-way of the shaft.
4. Thread the locknut (136) onto the shaft and tighten the locknut until it is snug.
5. Bend any tang of the lockwasher into one of the slots on the locknut. Tighten the locknut if necessary to align a lockwasher tab with a locknut slot.
6. Press the grease seal (333) into the bearing shell (134).
7. Slide the bearing shell onto the pump-end of the shaft and over the bearing.
8. Insert the retaining ring (361A) in the bearing shell groove. Make sure to keep the flat side against the bearing.
9. Slide the labyrinth seal (332A) over the coupling-end of the shaft into the bearing shell until it is flush.
10. With the support plate in a vertical position, slide the shaft horizontally through the motor support. Support the shaft and column with suitable stands.
11. Install the hold-down bolts (370C) and jacking bolts (370D) with jam nuts (415).

## 6.6.3 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.

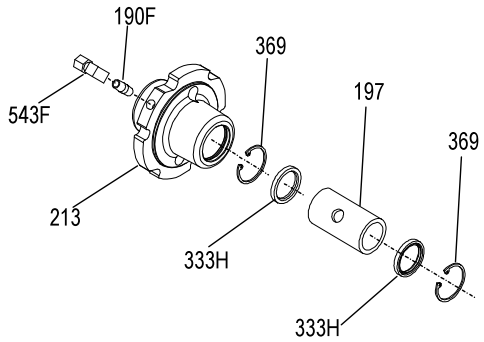



**Figure 40: Steady bearing housing**

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.

## 6.6.4 Assemble the liquid end

1. Press casing collar (155) into adapter (108A) using a suitable press.
2. Prepare the adapter (108A) if required. Press in new steady bearing. Install snap ring and seals on sealed bearings.

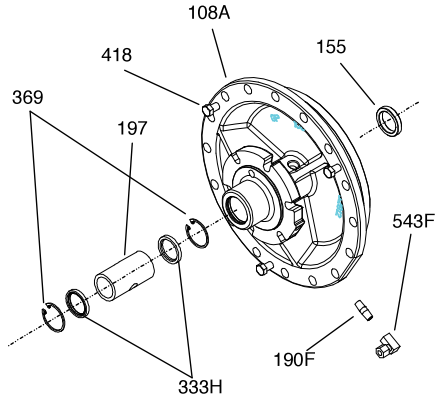



**Figure 41: Steady bearing reassembly**

The seals are mounted with lips out, facing away from the steady bearing.

**NOTICE:**

The steady bearing does not have to be centered exactly nor do the holes in the bearing have to line up with the holes in the housing. There is a recessed area on the inside of the adapter (108A) that allows lubricants to find the opening in the bearing.

3. Slide the adapter onto shaft. Seat adapter flange against column flange. Make sure match marks scribed during disassembly line up. Install bolts (371G).

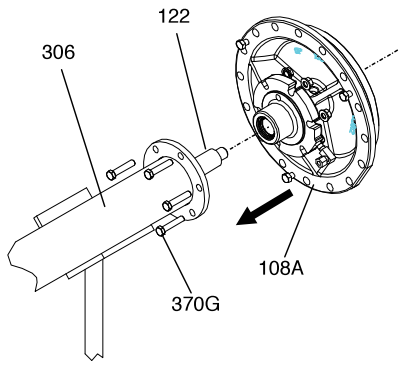



**Figure 42: Adapter reassembly**

4. Insert O-ring into impeller groove. A small amount of grease can be used to hold the O-ring in place. Install impeller on shaft and tighten.
   If impeller rubs adapter during tightening, adjust impeller at thrust housing away from adapter. Ensure shaft rotates freely after tightening the impeller.

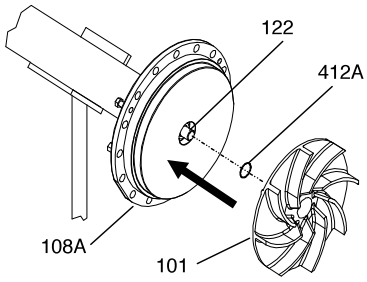



**Figure 43: Shaft rotation**

5. Adjust impeller (101) towards adapter using jacking bolts (370D) until impeller just touches adapter (108A). Place casing gasket (351) on seal in casing (100). Install casing against adapter. Make sure match marks scribed during disassembly line up. Install casing to adapter bolts (370) and tighten. Back off jacking bolts (370D) until shaft rotates freely.

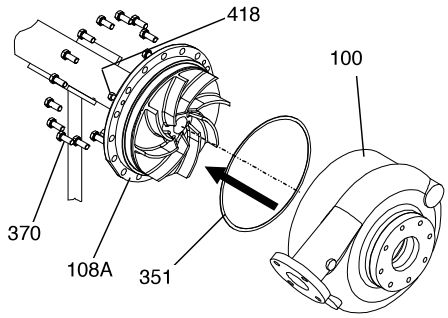



**Figure 44: Impeller adjustment**

6. Turn discharge pipe (195) into elbow (315) with thread sealant and tighten. Turn lower pipe nut (242) onto discharge pipe all the way down thread.
7. Install discharge pipe/elbow assembly through support plate (189). Install elbow gasket (#51A) and connect elbow to casing with bolts (370H) and tighten.

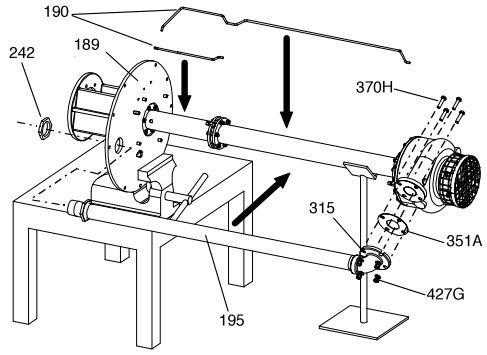



**Figure 45: Discharge pipe reassembly**

8. Install upper pipe nut (242). Tighten pipe nuts against support plate. Make sure that the pipe nuts are tight and that no strain has been placed on the pump. Rotate shaft by hand to assure there is no rubbing.
9. Install strainer (187) with bolts.

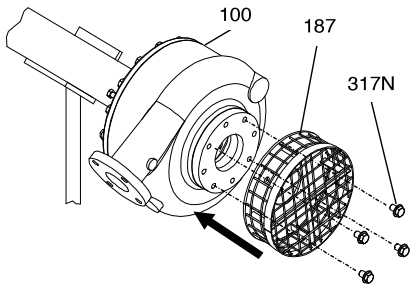



**Figure 46: Strainer reassembly**

10. Connect all auxiliary piping.
11. Replace the pump half-coupling hub (233).
12. Install motor and attach coupling.

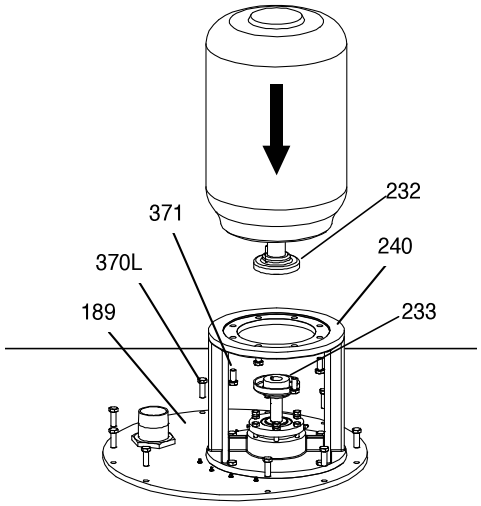



**Figure 47: Motor and coupling reassembly**

13. Adjust impeller clearance following the impeller clearance setting procedure.
14. Install coupling guard (501).

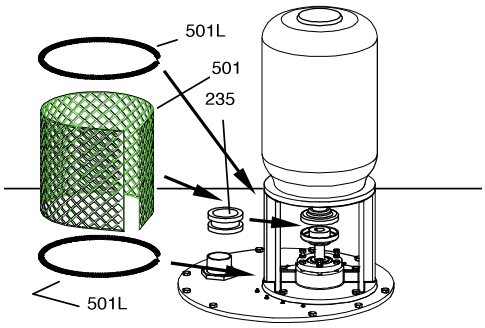



**Figure 48: Coupling guard reassembly**

15. Lubricate the pump bearings.

# 7 Troubleshooting

## 7.1 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 it 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. |
| The pump is noisy or vibrates. | The pump and driver are not aligned properly. | Realign the pump and driver. |

| Symptom | Cause | Remedy |
|---|---|---|
| | 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. |

# 7.2 Assembly troubleshooting

**Table 6: 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. |
| | There are too many shims under the thrust bearing end cover. | |
| 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 List and Cross-Sectionals

## 8.1 Cross-sectional diagrams

**CV3171**

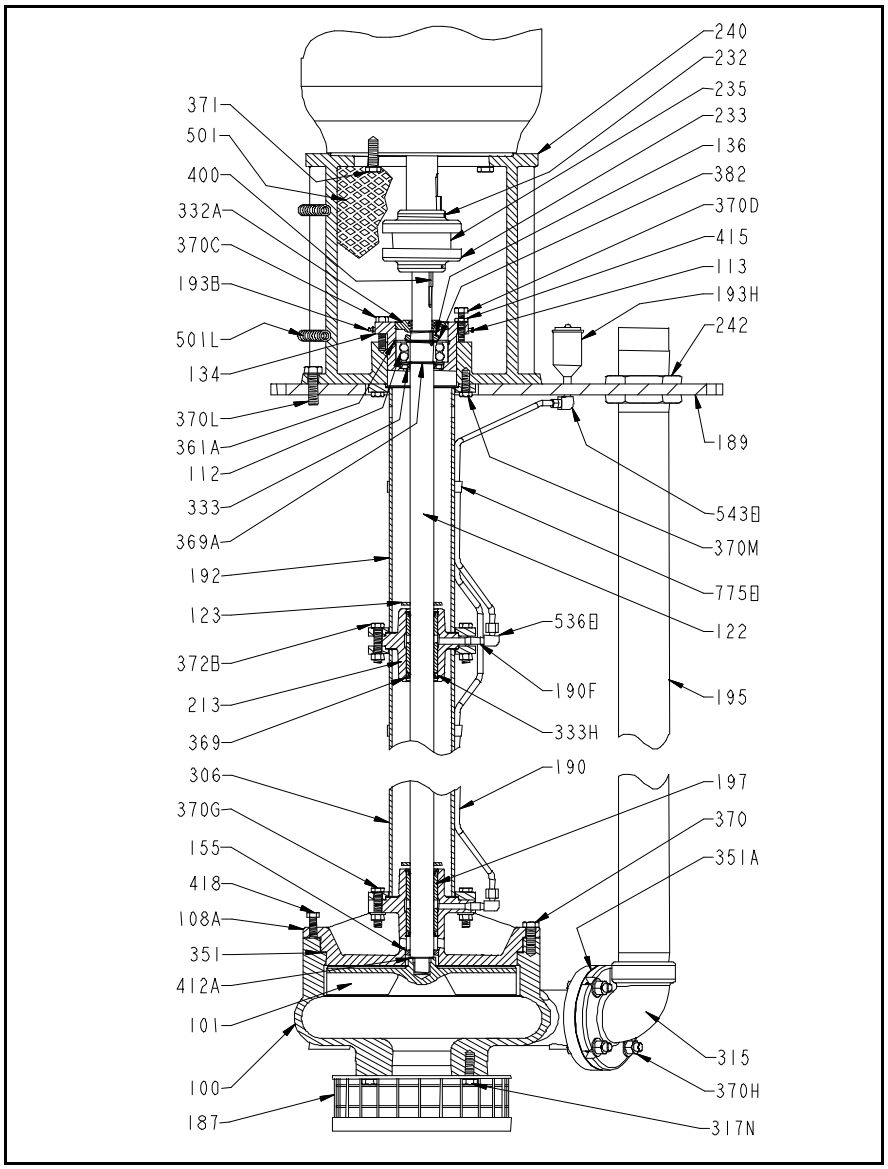



**Figure 49: Sizes: 2 x 2-8; 2 x 2-10; 3 x 3-10; 2 x 3-13; 3 x 4-13**

**LF3171**

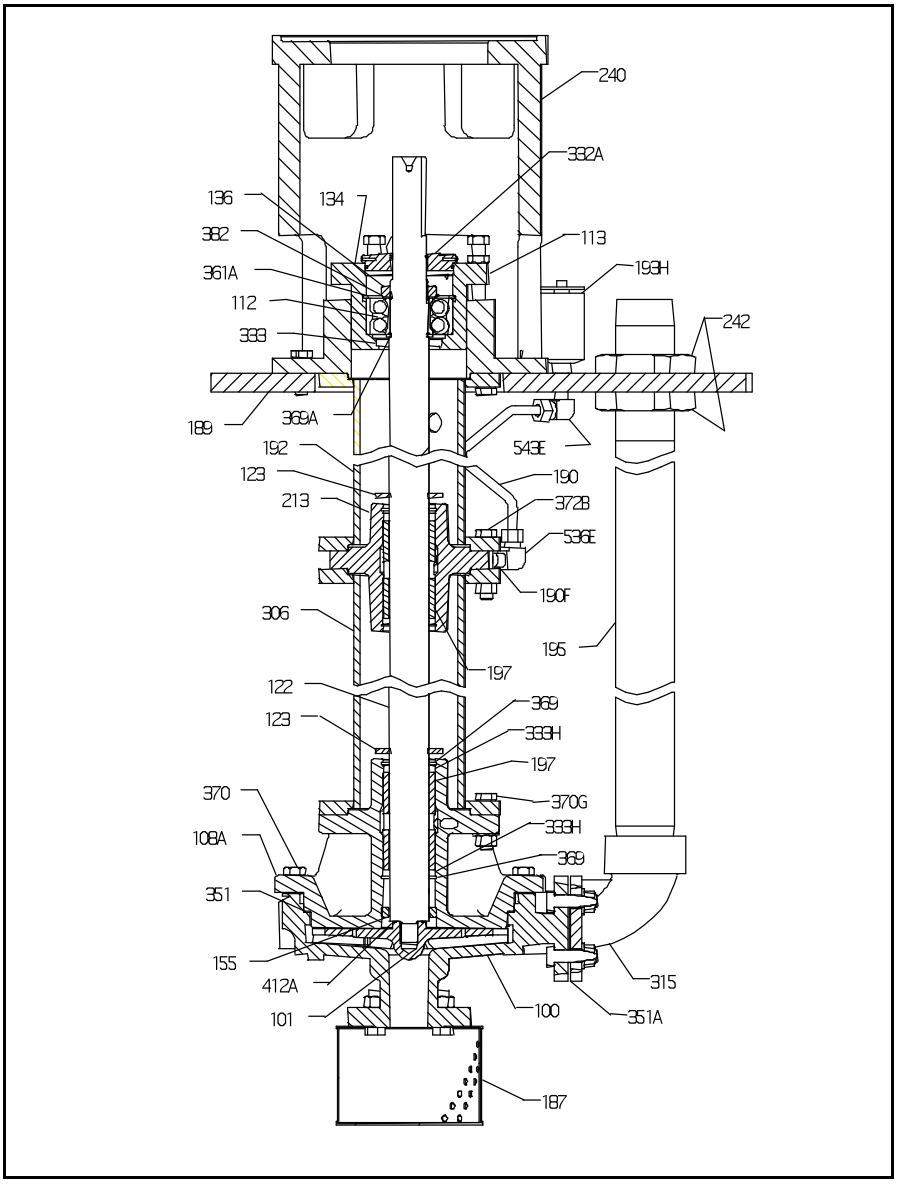



**Figure 50: 1x 1.5-8; 1 x 2-10; 1.5 x 3-13; 1 x 2-10F; 1.5 x 3-13G**

# 8.2 Parts list

- Impeller (101)
- Impeller O-ring (412A)
- Shaft (122)
- Ball bearing (112)
- Casing gasket (351)
- Ball bearing retaining ring (shell) (361A)
- Ball bearing retaining ring (shell) (369A)
- Bearing lockwasher (382)
- Bearing shell grease seal (333)
- Bearing shell labyrinth seal (332A)
- Steady bearing (197)
- Steady bearing seals (333H) (optional)
- Steady bearing retaining rings (369)
- Lantern ring half (105) (optional)
- Stuffing box packing (106) (optional)
- Packing gland (107) (optional)

- Bearing locknut (136)

**Table 7: Material Code Cross Reference**

| Goulds code | ASTM number |
|---|---|
| 1000 | A48 CL25B Cast Iron |
| 1018 | A536-84 60-42-10 Ductile Iron |
| 1101 | B584 Silicon Brass |
| 1203 | A743 CF8M 316 Stainless |
| 1204 | A743 CN7M Alloy 20 |
| 1215 | A494-90 CW6M C1,1 Hastelloy C |
| 1216 | A890 1A CD4MCuN |
| 1217 | A494 N-7M Hastelloy B |
| 2205 | C1045 Carbon Steel Ground and Polished |
| 2210 | A108 Gr1211 Carbon Steel |
| 2216 | A276 316 Stainless Ground and Polished |
| 2221 | ASTM 8473 C-20 Ground and Polished |
| 2229 | A276-91A Stainless |
| 2230 | B743 20CB3 Carpenter 20 |
| 2247 | B335 Type B-2 Hastelloy B |
| 2248 | B574 C-276 Hastelloy C |
| 2263 | B335 B-2 Hastelloy B Ground and Polished |
| 2264 | B574 C-276 Hastelloy C Ground and Polished |
| 3122 | Aluminum |
| 3201 | A283 Grade D Carbon Steel Plate |
| 3211 | A240 316 Steel Plate |
| 6501 | A53 Type F Carbon Steel Schedule 40 Pipe |
| 6506 | B464 C20CB3 Carpenter 20 Schedule 40 Pipe |
| 6511 | Red Brass Pipe SPS |
| 6519 | B622 Hastelloy B Schedule 40 Pipe |
| 6545 | A312 316L Stainless Steel Schedule 40 Pipe |
| 6548 | Hastelloy C C-276 Schedule 40 Pipe |

**Table 8: Parts List and Materials of Construction**

| Item | Qty | Part Name | Standard Materials of Construction | | |
|---|---|---|---|---|---|
| | | | Iron/CD4 | CD4 | GA-20 |
| 100 | 1 | Casing | D.I. | CD4 | GA-20 |
| 101 | 1 | Impeller | CD4 | CD4 | GA-20 |
| 105 | 1 | Lantern Ring | PTFE | | |
| 106 | 1 set | Packing | Acrylic yarn | | |
| 107 | 1 | Gland | 316SS or as specified | | |
| 108A | 1 | Casing adapter | C.I. | CD4 | GA-20 |
| 112 | 1 | Ball bearing | Steel | | |
| 113 | 1 | Relief fitting | Steel | | |
| 122 | 1 | Shaft | Steel | 316SS | C-20 |
| 123 | 1+N | Deflector | Epdm | | |
| 134 | 1 | Bearing shell | C.I. | | |
| 136 | 1 | Bearing locknut | Steel | | |

| Item | Qty | Part Name | Standard Materials of Construction | | |
|---|---|---|---|---|---|
| | | | Iron/CD4 | CD4 | GA-20 |
| 155 | 1 | Bushing (Casing) | Carbon/PTFE | | |
| 178 | 1 | Impeller key | | | |
| 187 | 1 | Strainer | Steel | 316SS | C-20 |
| 189 | 1 | Support plate | Steel or as specified | | |
| 190 | "L" | Lube line tubing | Steel | 316SS | C-20 |
| 190F | 1+N | Pipe nipple | Steel | 316SS | C-20 |
| 190G | 1 | Pipe nipple | Steel | | |
| 192 | 1 | Head column | Steel | 316SS | C-20 |
| 193 | 1+N | Ftng. Gr. 1/4" NPT | Steel | | |
| 193B | 1 | Ftng. Gr. 3/416" NPT | Steel | | |
| 193I | 1 | Cup, Gr. Up. St. Bx | Steel | | |
| 195 | 1 | Discharge pipe | Steel | 316SS | C-20 |
| 197 | 1+N | Steady bearing | See notes | | |
| 213 | N | Steady brg. housing | C.I. | CD4 | GA-20 |
| 221 | 1 | Upper stuffing box | Cast iron or as specified | | |
| 232 | 1 | Coupling half | Steel | | |
| 233 | 1 | Coupling half | Steel | | |
| 235 | 1 | Coupling sleeve | EPDM | | |
| 240 | 1 | Support, motor | C.I. | | |
| 242 | 2 | Pipe nut | Steel | 316SS | GA-20 |
| 306 | N | Column extension | Steel | 316SS | C-20 |
| 315 | 1 | Discharge elbow | C.I. | CD4 | GA-20 |
| 317N | 4 | Screw, HHC Strcase | Steel | 316SS | C-20 |
| 332A | 1 | Labyrinth seal | PTFE/Viton | | |
| 333 | 1 | Housing seal | Steel/Nitrile | | |
| 333H | (2xN)+2 | Lip seal | Nitrile | Viton | |
| 351 | 1 | Casing gasket | Nitrile/Acrylic | | |
| 351A | 1 | Elbow gasket | Nitrile/Acrylic | | |
| 361A | 1 | Retaining ring, ball brg | Steel | | |
| 364A | 1 | Insert, upper st. box | 316SS or as specified | | |
| 367B | 1 | Gasket, insert | Nitrile/Acrylic | | |
| 369 | (2xN)+2 | Retaining ring, steady bearing | 316SS | | C-20 |
| 369A | 1 | Retaining ring, shaft | Steel | | |
| 370 | 8 | Screw, HHC | Steel | 316SS | C-20 |
| 370C | 3 | Screw, HHC | Steel | | |
| 370D | 3 | Screw, HHC | Steel | | |
| 370H | 4 | Screw, HHC | Steel | 316SS | C-20 |
| 370G | 6 | Screw, HHC | Steel | 316SS | C-20 |
| 370L | 4 | Screw, HHC | Steel | 316SS | C-20 |

| Item | Qty | Part Name | Standard Materials of Construction | | |
|---|---|---|---|---|---|
| | | | Iron/CD4 | CD4 | GA-20 |
| 370M | 6 | Screw, HHC | Steel | 316SS | C-20 |
| 371 | 4 | Screw, HHC | Steel | | |
| 372B | 6xN | Screw, HHC | Steel | 316SS | C-20 |
| 382 | 1 | Lockwasher | Steel | | |
| 399 | 1 | Coupling key | 316SS | | |
| 412A | 1 | O-ring, Impeller | PTFE | | |
| 415 | 3 | Jam nut | Steel | | |
| 418 | 2 | Screw, HHC | Steel | 316SS | C-20 |
| 494V | 1 | Elbow, 45 degree | Steel | | |
| 501 | 1 | Coupling guard | Steel | | |
| 501L | 2 | Guard springs | Steel | | |
| 540M | 1 | O-ring, upper st. box | Buna-n | | |
| 543E | 1+N | Elbow, comp. male | Steel | 316SS | C-20 |
| 543F | 1+N | Elbow, comp. fem. | Steel | 316SS | C-20 |
| 775E | (2xN)+2 | Tubing strap | 304L | | |

**Table 9: Float Controls Parts List and Materials of Construction**

| Item | Qty | Part Name | Standard Materials of Construction | | |
|---|---|---|---|---|---|
| | | | Class A | Class B | Class C |
| 334 | 1 | Float rod | Steel or brass | 316SS | 316SS |
| 335 | 4 | Float rod collar | Steel | | |
| 336 | 1 | Lower fl. rod guide | Steel or brass | | 316SS |
| 337 | 1 | Upper fl. rod guide pipe | Steel | | |
| 339 | 1 | Float switch or alternator | ---- | | |
| 342 | 1 | Float | Steel or copper | 316SS | 316SS |
| 366 | 1 | Lower fl. rod guide arm | Steel or brass | | 316SS |
| 398 | 1 | Float switch bracket | Cast iron | | |
| 435 | 1 | Float switch supp. pipe | Steel | | |
| 437 | 1 | Pit cover | Steel | | |

# 9 Local ITT Contacts

## 9.1 Regional offices

| Region | Address | Telephone | Fax |
|---|---|---|---|
| North America<br>(Headquarters) | ITT - Goulds Pumps<br>240 Fall Street<br>Seneca Falls, NY 13148<br>USA | +1 315-568-2811 | +1 315-568-2418 |
| Houston office | 12510 Sugar Ridge Boulevard<br>Stafford, TX 77477<br>USA | +1 281-504-6300 | +1 281-504-6399 |
| Los Angeles | Vertical Products Operation<br>3951 Capitol Avenue<br>City of Industry, CA 90601-1734<br>USA | +1 562-949-2113 | +1 562-695-8523 |
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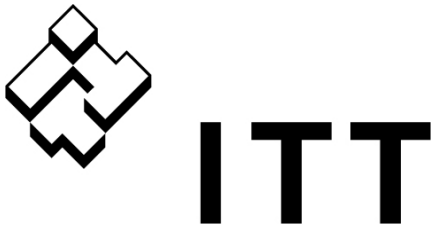

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