



# Installation, Operation, and Maintenance Manual

Model 3171



**ITT**

ENGINEERED FOR LIFE



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# Introduction and Safety

## Introduction

### Purpose of this manual

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

- Installation
- Operation
- Maintenance



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**CAUTION:**

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

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**NOTICE:**

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

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### Requesting other information

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

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

## Safety



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**WARNING:**

- The operator must be aware of safety precautions to prevent physical injury.
  - Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
  - Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
  - This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal unless explicitly stated in this manual.
  - If the pump/motor is damaged or leaking, do not operate as it may cause an electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage. Correct/repair the problem prior to putting back in service.
  - Do not change the service application without the approval of an authorized ITT representative.
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**CAUTION:**

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

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## Safety terminology and symbols

### About safety messages

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

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

### Hazard levels

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

### Hazard categories

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

Electrical hazards are indicated by the following specific symbol:



**Electrical Hazard:**

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

### The Ex symbol

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



## Environmental safety

### The work area

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

## Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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



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**WARNING:**

Do NOT send the product to the ITT manufacturer if it has been contaminated by any nuclear radiation. Inform ITT so that accurate actions can take place.

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## Electrical installation

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

## Recycling guidelines

Always follow local laws and regulations regarding recycling.

## User safety

### General safety rules

These safety rules apply:

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

### Safety equipment

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

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

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**NOTICE:**

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

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## Electrical connections

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

## 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.
- 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.

### **Wash the skin and eyes**

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

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

## **Ex-approved products**

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

### **Personnel requirements**

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

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

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

### **Product and product handling requirements**

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

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.



- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

### **Description of ATEX**

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

### **Guidelines for compliance**

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

### **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

## **Product warranty**

### **Coverage**

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

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

### **Limitations**

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

**Warranty claim**

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

# Transportation and Storage

## 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.

## 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.

## Pump handling



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**WARNING:**

- Make sure that the unit cannot roll or fall over and injure people or damage property.
  - These pumps might use carbon or ceramic silicon carbide components. Do not drop the pump or subject it to shock loads as this can damage the internal ceramic components.
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**NOTICE:**

Use a forklift truck or an overhead crane with sufficient capacity to move the pallet with the pump unit on top. Failure to do so can result in equipment damage.

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## Lifting methods



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**WARNING:**

- All lifting must be done in compliance with all applicable regulations/standards.
  - Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
  - Do not attach sling ropes to shaft ends.
- 

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

## Examples

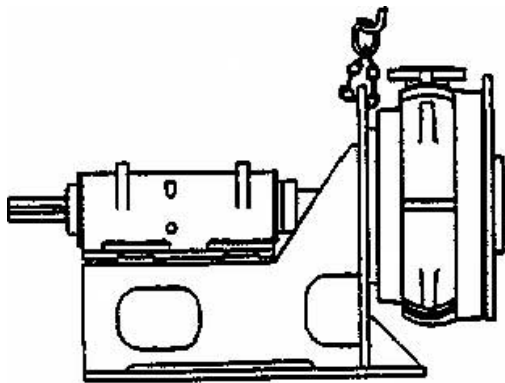


Figure 1: Proper lifting method

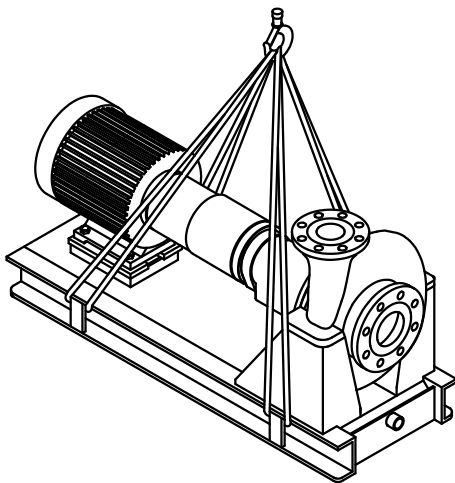


Figure 2: Example of a proper lifting method

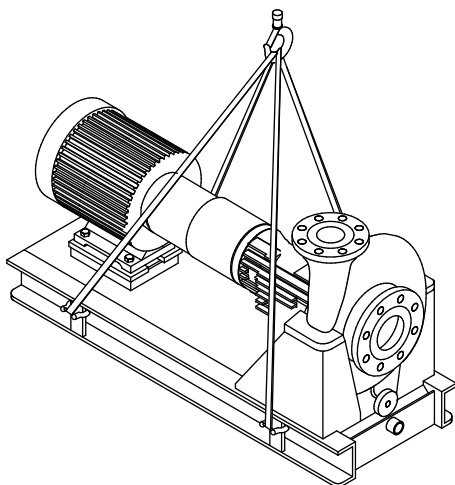
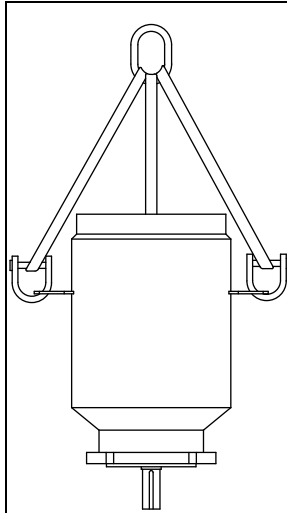
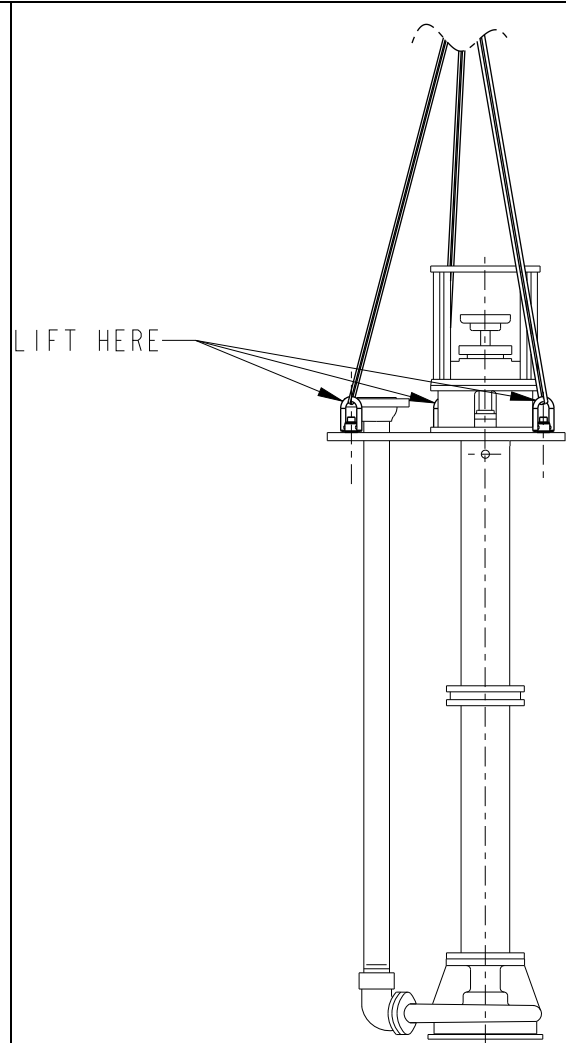


Figure 3: Example of a proper lifting method



**Figure 4: Example of lifting motor properly with lifting lugs**



**Figure 5: Example of lifting pump properly with sling**

## 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, gearheads, and engines, contact the equipment manufacturer.

### Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	<ul style="list-style-type: none"> <li>• Pave the area.</li> <li>• Clean the area.</li> <li>• Drain the area and keep it free from flooding.</li> </ul>

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

### 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, if possible.

## Prepare the pump for long-term storage

For storage periods over six months, you must follow the pump storage requirements and this procedure:

- 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.
- Place 10 lbs (4.5 kg) of moisture-absorbing desiccant or 5.0 lbs (2.3 kg) of vapor-phase inhibitor crystals near the center of the pump.
- If the unit is assembled, place an additional one pound (0.5 kg) in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
- Install a moisture indicator near the perimeter of the unit.
- Cover the unit with black polyethylene with a minimum thickness of 6.0 mil (0.15 mm), and seal it with tape.
- Provide a small ventilation hole approximately 0.5 in. (12.0 mm) in diameter.
- Provide a roof or shed shelter in order to protect the unit from direct exposure to the elements.

# Product Description

## General description

### Product description

The 3171 is a vertical submerged bearing sump and process pump.

This model is based on three bearing frames with 17 hydraulic sizes. The S/ST group has identical bearings with a slightly different shaft on the impeller end for the S and ST. The M/MT group is identical in all aspects for the power end. However, the liquid end of the MT is common with the S group except that the MT is modified to accept a larger shaft. There are two MT sizes that are common with the S/ST group.

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

Drive-unit size group	Number of hydraulic sizes
S/ST	9
M/MT	8
L	2

### Casing

The casing has these features:

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

### Impeller

The impeller is fully open, keyed to the shaft, and held in place by a self-locking capscrew in order to ensure positive locking and prevent damage from reverse rotation. Impellers are spin-balanced (single plane) to ISO G6.3. The impeller is provided with back vanes in order to reduce the axial thrust and prevent the entrance of solids.

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

### Strainer

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

### Discharge elbow

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

### Column pipe

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

### Shaft

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

## Bearings

The thrust bearing is a grease-lubed, double-row, angular contact ball bearing. The bearing is shouldered and locked to the shaft and housing. This enables the bearing to carry all of the thrust loads and some of the radial load. All fits are precision-machined to industry standards. The steady bearings are press fit sleeve bearings. Fits are designed for optimum life under all operating conditions.

## Seals

This pump has three seals:

Seal type	Description
Upper labyrinth seal	This seal is used to exclude dirt and water from the thrust bearing.
Lower grease seal	This seal is used below the thrust bearing in order to contain the grease and exclude any possible contamination.
Carbon Teflon casing collar	This seal is installed immediately behind the impeller in the casing in order to minimize recirculation back to the sump and maximize hydraulic efficiency.

## Motor support

Motor supports are 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

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

# 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

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

## Motor support nameplate

		Goulds Pumps		S/N <input type="text"/>	
MODEL <input type="text"/>	SIZE <input type="text"/>	STD. DIM. <input type="text"/>			
HYDRO PRESS. PSI @ 100°F <input type="text"/>	FLOW GPM <input type="text"/>	R.P.M. <input type="text"/>			
MAX. DES. WORKING PRESS., PSI @°F <input type="text"/>	HEAD FT. <input type="text"/>	MAT'L. <input type="text"/>			
CONT./ITEM NO. <input type="text"/>	IMP. DIA. <input type="text"/>	MAX. DIA. <input type="text"/>			
 <b>WARNING</b> Avoid death or serious injury: Do <b>NOT</b> operate pump against closed valves or blocked lines.					
A09355A					



**Table 1: 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
MAX. DES. WORKING PRESS., PSI°F.	Maximum design working pressure, pounds per square inch at Å°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

**ATEX nameplate**

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
T4	Temperature class

**NOTICE:**

Make sure that the code classifications on the pump are compatible with the specific environment in which you plan to install the equipment. If they are not compatible, do not operate the equipment and contact your ITT representative before you proceed.

**Permissible temperatures**

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

**NOTICE:**

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

# Installation

## Preinstallation

### Precautions



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**WARNING:**

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
  - You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
  - Electrical Connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  -
- 

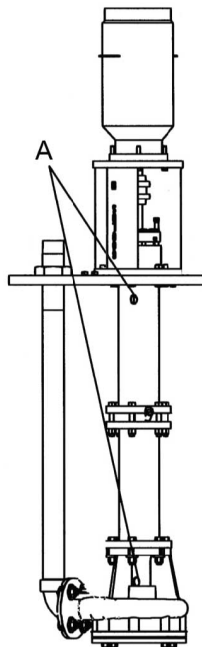
**NOTICE:**

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

---

## 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
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.

## Pump location guidelines



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**WARNING:**

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

---

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

## Concrete foundation requirements

### Requirements

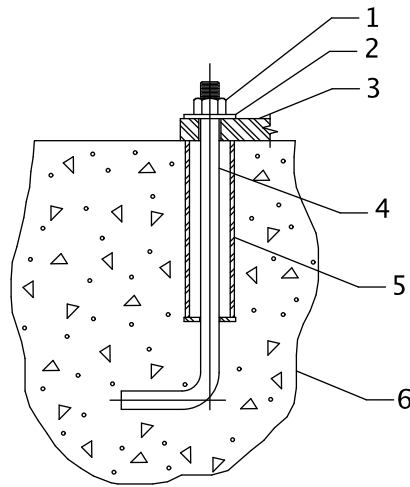
Make sure that you meet these requirements when you prepare the pump foundation:

- 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 0.5 in. (12.7 mm) 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. 0.5 in. (12.5 mm) anchor bolt
5. Anchor bolt sleeve
6. Foundation (by customer)

**Figure 6: Example of a typical installation**

## Support plate installation

### 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.

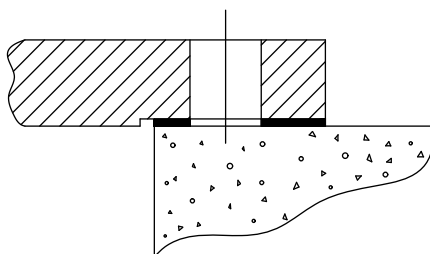
1. Carefully lower the pit cover onto the foundation bolts.
2. Use as long a level as possible in order to level the pit cover in all directions with shims or wedges.
3. Hand tighten the anchor bolts. Check the level and re-shim if necessary.
4. Tighten all anchor bolts in a star pattern in order to 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.

### 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 7: 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.

## Piping checklists

### General piping checklist

#### Precautions



#### CAUTION:

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



#### CAUTION:

#### Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: <ul style="list-style-type: none"> <li>• Strain on the pump</li> <li>• Misalignment between the pump and the drive unit</li> <li>• Wear on the pump bearings and the coupling</li> <li>• Wear on the pump bearings, seal, and shafting</li> </ul>	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: <ul style="list-style-type: none"> <li>• The grout for the baseplate or sub-base becomes hard.</li> <li>• The hold-down bolts for the pump and the driver are tightened.</li> </ul>	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	

Check	Explanation/comment	Checked
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.		
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump 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.	

### Alignment criteria for pump flanges

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

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

### Checklist

Check	Explanation/comment	Checked
Install an elbow at the pump.	Whenever possible, perform these actions: <ul style="list-style-type: none"> <li>• Use long radius elbows.</li> <li>• Move the elbow further from the suction.</li> <li>• Eliminate unneeded elbows.</li> </ul>	
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. 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.	

Check	Explanation/comment	Checked
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. 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.	

## Steam lines

### Checklist

Check	Explanation/comment	Checked
Before you install the pump, become familiar with the location of the steam lines.	There are three connections above the support plate: <ul style="list-style-type: none"> <li>Two steam connections</li> <li>One condensate return connection.</li> </ul> The steam connections are connected to the tops of the column and discharge jackets.	
Determine which method to use in order to connect the steam lines.	There are two methods you can use in order to connect the steam lines: <ul style="list-style-type: none"> <li>You can use both steam lines as input for steam (preferred method).</li> <li>You can use one steam line as input for steam, while the other steam line is used as a feed through to additional pumps.</li> </ul> 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. 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 300°F (149°C).	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.	

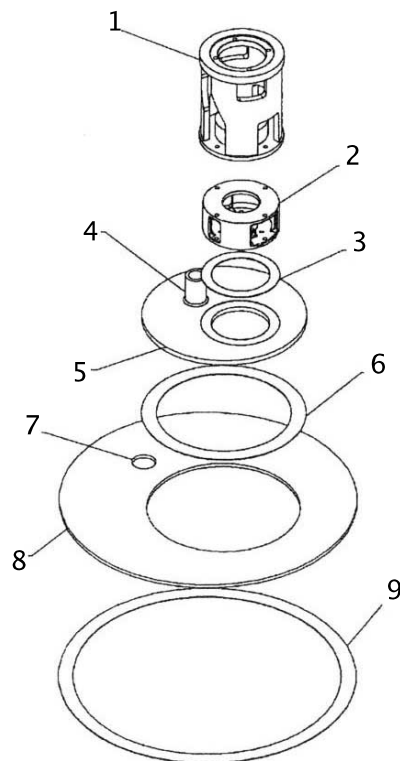
## Final piping checklist

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.	

## Stuffing box installation

This pump is a sealless design. Therefore, when temperatures exceed 180°F (82°C), 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. Gasket
4. Discharge pipe
5. Support plate
6. Gasket
7. 3 in. (76.2 mm) NPT female connection
8. Pit cover
9. Gasket

## Install the packed stuffing box



### **WARNING:**

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

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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.

## Install the pump, driver, and coupling

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



## Motor installation and coupling alignment



### WARNING:

- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
- Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.

### NOTICE:

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

## 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.

## Alignment checks

### When to perform alignment checks

You must perform alignment checks under these circumstances:

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

### Types of alignment checks

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

### Initial alignment (cold alignment) checks

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

### Final alignment (hot alignment) checks

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

### Permitted indicator values for alignment checks

**NOTICE:**

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

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

- The total indicator runout is a maximum of 0.002 in. (0.05 mm) at operating temperature.
- The tolerance of the indicator is 0.0005 in./in. (0.0127 mm/mm) of indicator separation at operating temperature.

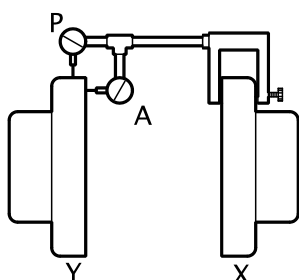
### Alignment measurement guidelines

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

### Attach the dial indicators for alignment

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

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



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

## Align the flexible coupling



### WARNING:

- Disconnect and lock out electrical power before installing or servicing the pump.
- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- The coupling used in an ATEX 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.

## Align the flexible coupling with a straight edge



### WARNING:

- Disconnect and lock out electrical power before installing or servicing the pump.
- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- The coupling used in an ATEX 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. Lay 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.

## 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

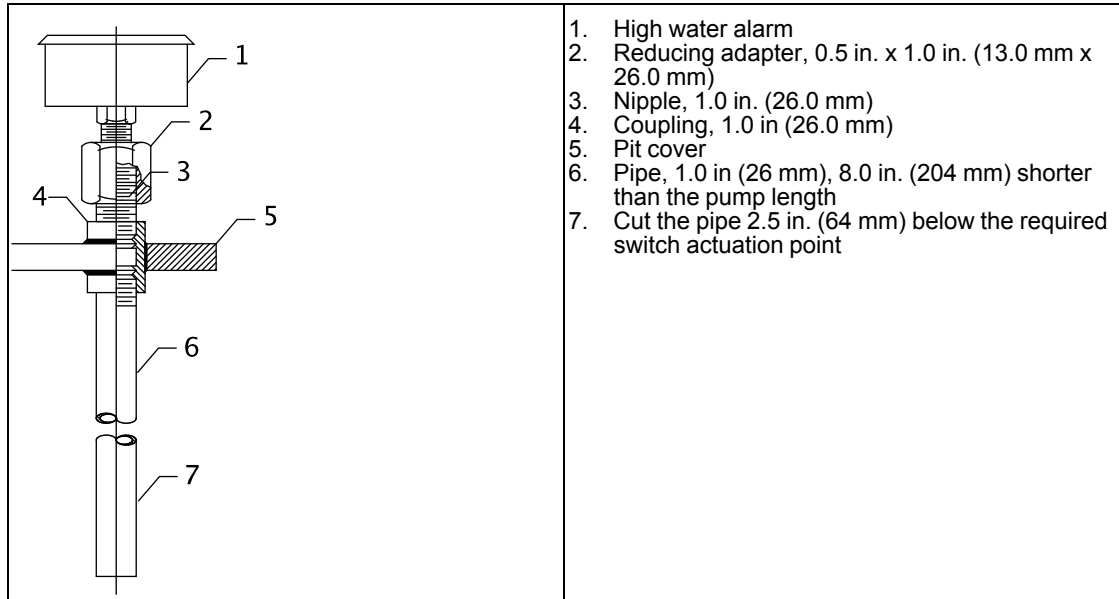
The on and off levels of the Square D 9036 simplex and the Square D 9038 duplex are controlled by adjusting the collars (335). As the liquid level rises, the float rises to contact the upper collar and the upward movement of the float rod causes the mechanical switch inside the control to close. This 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 4 to 6 in. (10 to 15 cm) below the required actuation point. As the liquid level rises in the pipe, trapped air causes bellows inside the switch to inflate and trip a microswitch. The switch can then activate a light, horn, relay, solenoid valve, or other electric device.



### Magnetrol displacer-type liquid level switch

The Magnetrol displacer-type liquid level switch is closed by a magnetic seal inside a sealed tube. Switch operation is controlled by the buoyancy of weighted displacers suspended on a spring. As liquid level rises, the resulting change in buoyancy moves the spring upwards. The spring movement causes a magnetic sleeve to attract a pivoted magnet, closing the actuating switch. Refer to installation guide supplied by the manufacturer for proper installation and configuration.

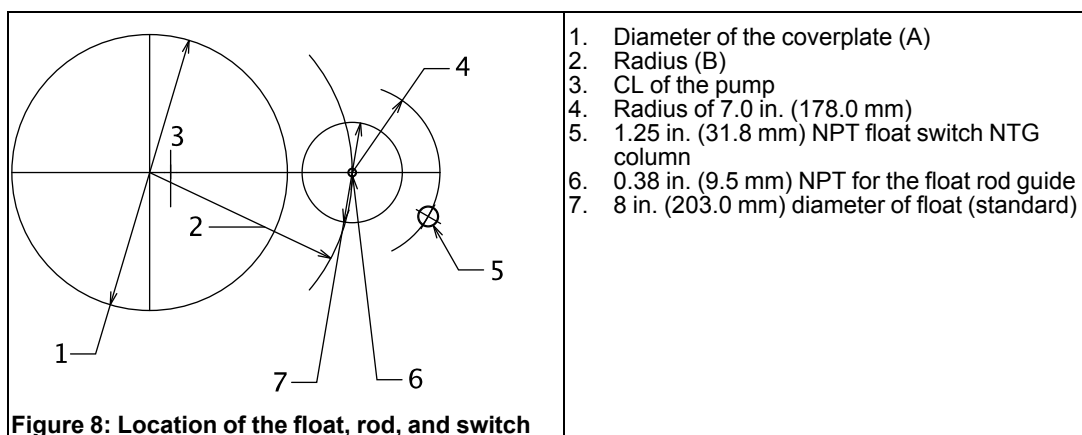
### Float ball switches

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

### 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.

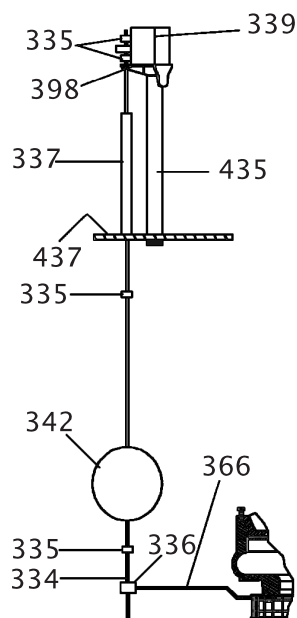
If a pit cover is supplied with the pump, the float switch support pipe (435) and the upper rod guide (337) are installed by the factory. If the pit cover is supplied by others, you must locate, drill, and tap the holes before you install the switch.



**Figure 8: Location of the float, rod, and switch**

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

- 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).
- Thread the float switch support pipe (435) and the upper rod guide (337) into the pit cover.
- 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).
- Install the float rod (334), float (342), and collars (335). You must maintain the radius (4) between the float switch column and the float.



# Commissioning, Startup, Operation, and Shutdown

## Preparation for startup



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**DANGER:**

Avoid death or serious injury. Explosion and/or seizure of pump can cause fire and/or burns. Never operate pump past the pressure and temperature limits shown on the nameplate on the pump.

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**WARNING:**

- Failure to follow these precautions before you start the unit will lead to serious personal injury and equipment failure.
  - Do not operate the pump below the minimum rated flows or with the suction or discharge valves closed. These conditions can create an explosive hazard due to vaporization of pumped fluid and can quickly lead to pump failure and physical injury.
  - Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Operating the pump above maximum rated flow shown on the pump curve leading to an increase in horsepower and vibration along with an increase in NPSHr resulting in mechanical seal and/or shaft failure and/or loss of prime.
  - Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Speed of pump must reach 2000 rpm for 2 pole motors and 1000 rpm for 4 pole motors within 10 seconds or an increase in vibration and rotor deflection and decrease in rotor stability leading to mechanical seal and/or shaft failure and/or pump seizure can occur.
  - Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
    - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
  - Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
  - Avoid death or serious injury. Explosion and/or seizure of pump can cause fire and/or burns. Assure balance line is installed and either piped to the pump suction or back to the suction vessel to avoid vaporization of pumped fluid.
- 



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**DANGER:**

Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Assure all openings are sealed off prior to filling pump.

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## Precautions

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**NOTICE:**

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

You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.

- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 100°F (38°C) of the fluid temperature. 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.

## Check the rotation - Frame Mounted



### **WARNING:**

- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
- Refer to driver/coupling/gear manufacturers 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.

## Thrust bearing lubrication



### **WARNING:**

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

### **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.

### **Pure oil-mist lubrication**

Pure oil-mist lubrication is an option only available on the API 3171.

## Flush the steady bearings

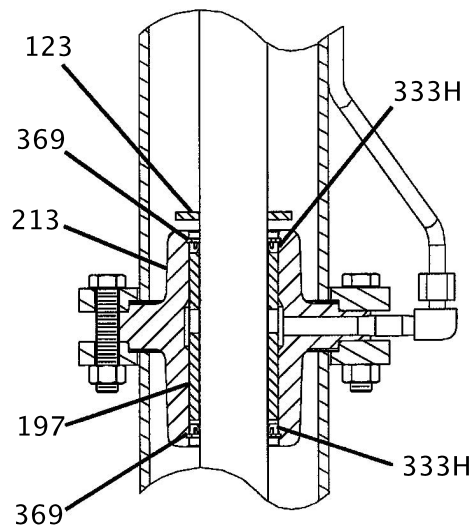
There are five 1/4-in. NPT pipe plugs on the standard support plate that you use to connect the flush lines. Each plug connects with each of the five bearings. Pumps with less than five bearings still have five plugs, but only the required number are connected to bearings.

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.

## 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

## 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 center stem protrudes out of the housing when the cup is full and gradually moves down into the housing as the grease is used. After the wing nut is threaded against the stem zerk fitting and the bottom of the wing nut rests on the cap of the grease cup, then the grease reservoir is empty and you must refill it.

### Fill the housing

1. Turn the wing nut clockwise until the center stem is raised all the way and the wing nut does not turn any further.
2. Fit a pressurized grease gun to the top zerk fitting and pump the grease cup full until a small amount of grease starts to come out of the side vent of the housing.
3. Unthread the wing nut in order to energize the grease cup. Allow the internal spring pressure to push grease into the bearing lube line.
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.

### Adjust the flow (preferred method)

1. Unthread the wing nut completely against the zerk fitting of the center stem.



2. Unlock the hex nut of the throttling screw and turn the slotted screw clockwise approximately one-half turn at a time.
3. Relock the hex nut and monitor the stem movement.

If the grease in the grease cup is completely consumed in 1 to 2 weeks of operation, then the flow is correct and will maintain the proper amount of grease to the bearings.

### **Adjust the flow (alternate method)**

This method provides a more precise amount of grease to the bearings independent of changing operating temperatures and surrounding conditions. However, you must have a more controlled maintenance schedule in order to make sure this is done on a regular basis.

1. Leave the throttling screw locked and open.
2. Back off the wing nut several turns for every 2 to 3 days of operation.

## **Shaft sealing with a mechanical seal**

### **Precautions**



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**WARNING:**

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

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**NOTICE:**

- The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.
  - Cooling systems such as those for bearing lubrication and mechanical-seal systems must be operating properly to prevent excess heat generation, sparks, and premature failure.
  - Sealing systems that are not self-purging or self-venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
- 

### **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 before 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.

## **Shaft sealing with a stuffing box**

This pump is a sealless design. Therefore, when temperatures exceed 180°F (82°C), 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.

## 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.

## 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.
- 

### Set the impeller clearance - dial indicator method



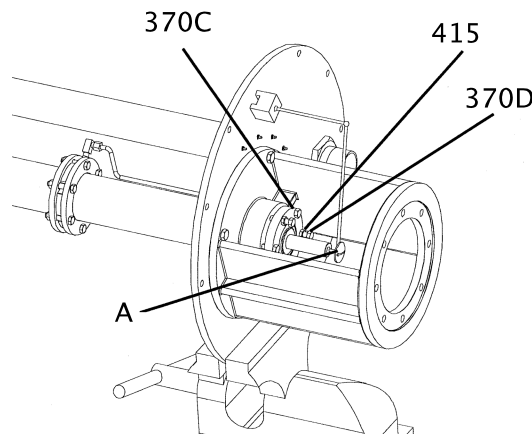
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**WARNING:**

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

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

1. Remove the coupling guard.
2. Set the indicator so that the button contacts either the shaft end or the face of the coupling.



- A—Dial indicator

3. Loosen the jam nuts (415) on the jack bolts (370D), and then back the bolts out about two turns.
4. Tighten the locking bolts evenly (370C), bringing the bearing housing (134A) towards the frame (228) until the impeller contacts the casing.
5. Turn the shaft to ensure that there is contact between the impeller and the casing.
6. Set the indicator to zero and loosen the locking bolt (370C) about one turn.
7. Thread in the jack bolts (370D) until the jack bolts evenly contact the bearing frame.
8. Tighten the jack bolts evenly about one flat at a time, moving the bearing housing (134A) away from the bearing frame until the indicator shows a clearance of 0.015" (0.381 mm).

9. Tighten the bolts evenly in this order:
  - a) Tighten the locking bolts (370C).
  - b) Tighten the jack bolts (370D).
 Make sure to keep the indicator reading at the proper setting.
10. Make sure the shaft turns freely.

## Set the impeller clearance - feeler gauge method

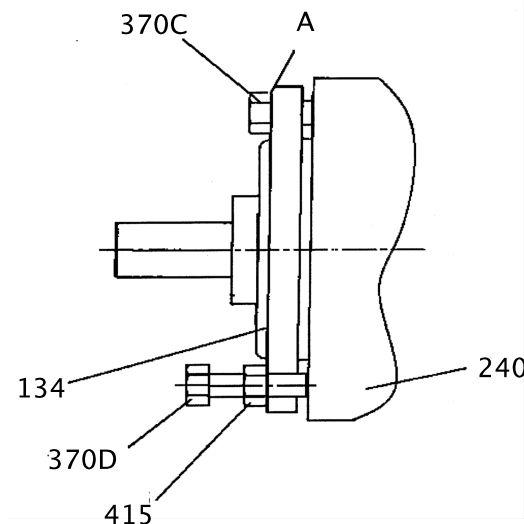


### WARNING:

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

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

1. Lock out the driver power and remove the coupling guard.
2. Remove the coupling, if required.
3. Loosen the jam nuts (415) on the jack bolts (370D), and then back the bolts out about two turns.
4. Evenly tighten the locking bolts (370C) in several turns until the impeller contacts the suction cover (182).
5. Turn the shaft to ensure that there is contact between the impeller and the suction cover.
6. 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

7. Tighten the jack bolts (370D) evenly until the bearing shell (134) is tight against the locking bolts. Make sure all bolts are tight.
8. Evenly tighten the jam nuts (415).
9. Make sure the shaft turns freely.
10. Replace the coupling.
11. Replace the coupling guard.

## Pump priming



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**WARNING:**

These pumps are not self priming and must be fully primed at all times during operation. Loss of prime can lead to excessive heat and severe damage to the pump and seal.

---



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**CAUTION:**

Do not run the pump dry.

---

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

For dry pit/outside tank mount units:

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

## Install the coupling guard



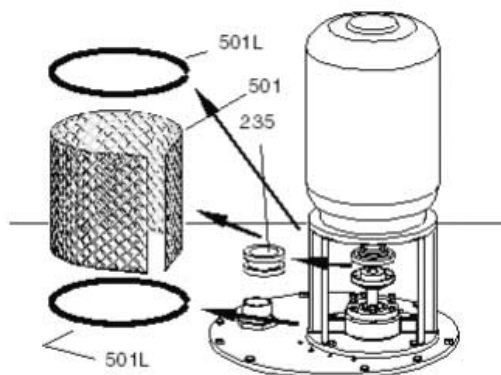
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**WARNING:**

- Never operate the pump without the coupling guard correctly installed.
  - Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
  - The coupling used in an Ex-classified environment must be properly certified and must be constructed from a non-sparking 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).



## Start the pump



**WARNING:** Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.



**CAUTION:**

- Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart the pump.
  - Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.
  - On pure or purge-oil mist-lubricated units, remove the viewing port plugs to verify that oil mist flowing properly. Replace the plugs.
  - On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.
  - Ensure all flush and cooling systems are operating correctly prior to starting pump.
1. Fully close or partially open the discharge valve, depending on system conditions.
  2. Start the driver.
  3. Slowly open the discharge valve until the pump reaches the desired flow.
  4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
  5. If the pump fails to reach the correct pressure, perform these steps:
    - a) Stop the driver.
    - b) Prime the pump again.
    - c) Restart the driver.
  6. Monitor the pump while it is operating:
    - a) Check the pump for bearing temperature, excessive vibration, and noise.
    - b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
  7. Repeat steps 5 and 6 until the pump runs properly.
  8. After the pump is brought to temperature for the first time, shut the unit down temporarily and re-adjust the impeller clearance.

## Pump operation precautions

### General considerations



---

**CAUTION:**

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

### Operation at reduced capacity



---

**WARNING:**

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

---



---

**CAUTION:**

- The pump and system must be free of foreign objects. If pump becomes plugged, shut down and unplug prior to restarting pump.
  - Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
  - Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
  - Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
  - Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.
- 

### Operation under freezing conditions

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**NOTICE:**

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

---

## Shut down the pump



---

**WARNING:**

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

---

1. Slowly close the discharge valve.

2. Shut down and lock the driver to prevent accidental rotation.

## Make the final alignment of the pump and driver



---

**WARNING:**

- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
  - Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
  - Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.
- 

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

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

# Maintenance

## Maintenance schedule

### Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

### Routine maintenance

Perform these tasks whenever you perform routine maintenance:

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

### Routine inspections

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

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

### Three-month inspections

Perform these tasks every three months:

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

### Annual inspections

Perform these inspections one time each year:

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

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

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



## Bearing maintenance

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

### 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 2: 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	—	—

### 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.

## Lubricating-grease requirements

### Precautions

#### NOTICE:

- 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. Doing so may result in decreased performance.
- Remove the bearings and old grease if you need to change the grease type or consistency. Failure to do so may result in equipment damage or decreased performance.

### Bearing temperature

Bearing temperatures are generally about 20Â°F (18Â°C) 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
5°F to 230°F (-15°C to 110°C)	Use a lithium-based mineral-oil grease with a consistency of NLGI 2.
Exceed 350°F (177°C)	Use a high-temperature grease. Mineral-oil greases should have oxidation stabilizers and a consistency of NGLI 3.

### Grease recommendations based on temperature

Most pumps use Sunoco 2EP grease. High temperature units that can pump fluids with a temperature greater than 350°F (177°C) use Mobil SCH32.

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

Brand	When temperature of pumped fluid is less than 350°F (177°C) âM M NLGI consistency 2	When temperature of pumped fluid is greater than 350°F (177°C) âM M NLGI consistency 3
Mobil	Mobilux EP2	SCH32
Exxon	Unirex N2	Unirex N3
Sunoco	Multipurpose 2EP	N/A
SKF	LGMT 2	LGMT 3

## Regrease the thrust bearing

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**NOTICE:**

Make sure that the grease container, the greasing device, and the fittings are clean. Failure to do this can result in impurities entering the bearing housing when you regrease the bearings.

---

1. Wipe dirt from the grease fittings.
2. Remove the two grease-relief plugs from the bottom of the frame.
3. Fill both of the grease cavities through the fittings with a recommended grease until the fresh grease comes out of the relief holes.
4. Make sure that the frame seals are seated in the bearing housing.  
If they are not, press them in place with the drains located at the bottom.
5. Reinstall the grease-relief plugs.
6. Wipe off any excess grease.
7. 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.

## 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.

## Shaft-seal maintenance

### Mechanical-seal maintenance



---

**WARNING:**

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

---



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**CAUTION:**

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

---

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**NOTICE:**

- 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.
  - Cooling systems, such as those for bearing lubrication and mechanical-seal systems, must be operating properly to prevent excess heat generation, sparks, and premature failure.
  - The mechanical seal must have an appropriate seal flush system or excess heat generation and seal failure can occur.
- 

### 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.

## Packed stuffing-box maintenance



---

**WARNING:**

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

### 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:**

Do not over-tighten the stuffing box. Excessive pressure can wear out packing prematurely and seriously damage the shaft.

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### Packing replacement

Replace the packing in this sequence:

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

## Disassembly

### Disassembly precautions



---

**WARNING:**

- This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal unless explicitly stated in this manual.
  - Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
  - Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
  - The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.
  - A small amount of liquid will be present in certain areas like the seal chamber.
- 

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**NOTICE:**

- Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.
  - Make sure that all replacement parts are available before you disassemble the pump for overhaul.
- 

### Tools required

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

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

### Drain the pump



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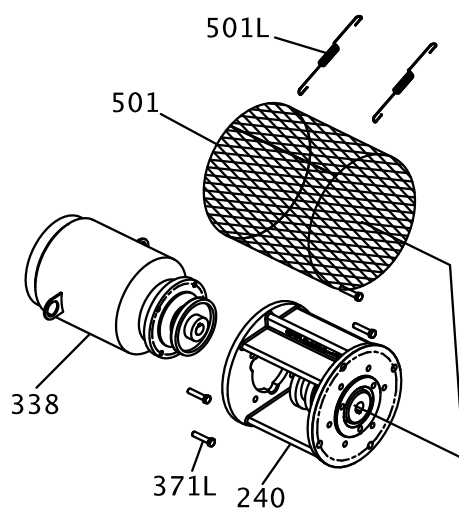
**CAUTION:**

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

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

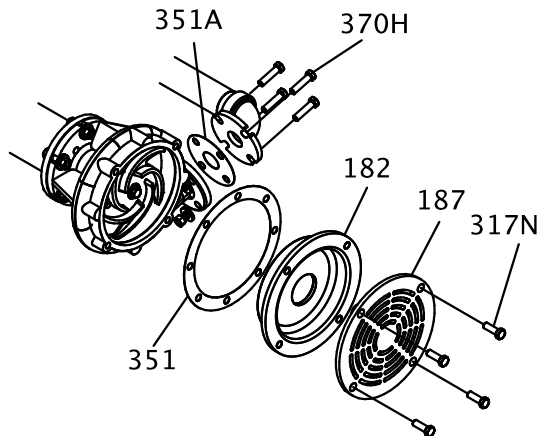
## Remove the pump from the sump

1. Remove the motor bolts (371).



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

7. Remove the bolts (317N) in order to remove the strainer (187).



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

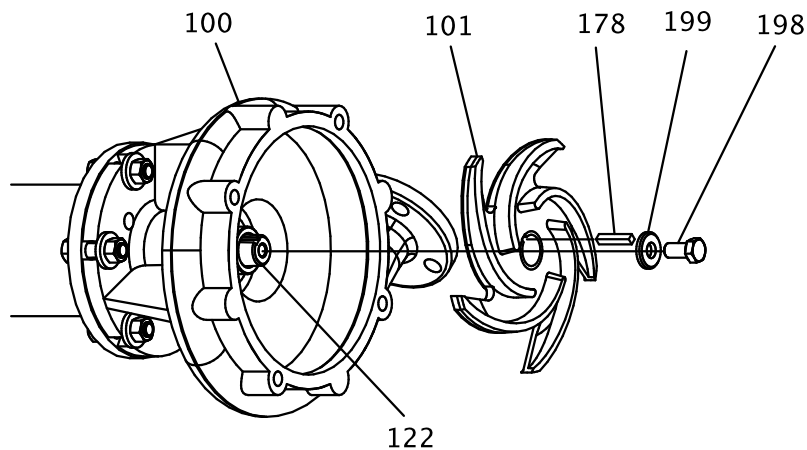
## Remove the impeller



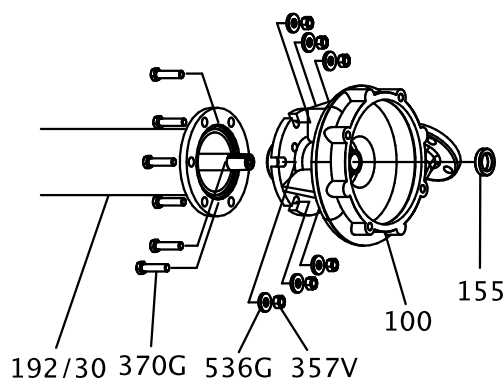
### CAUTION:

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

1. Loosen the set screw at the end of the impeller nut.
2. Loosen and remove the impeller nut.  
The impeller nut has left-hand threads.
3. Pull the impeller from the shaft.  
Use a spanning-type puller if required.

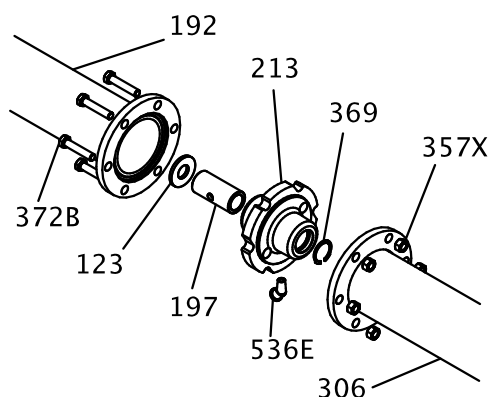


4. Remove the impeller key.  
Save the key for reassembly unless it is damaged.
5. For L group models only, do the following:
  - a) Remove the casing (100) to adapter (108) bolts.
  - b) Remove casing. Do not remove casing collar (155) at this time.
  - c) Remove the adapter (108) to column bolts.
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



## Disassemble the column

1. Remove the column down to the steady bearing housing bolts (372B).  
If your pump has no intermediate steady bearings (only one column section), then skip this step since you do not have any column extension (306) or steady bearing housing (213).
  - a) Start at the casing end of the pump and remove the column extensions (306), steady bearing housings (213), and deflectors (123) one at a time. Support the shaft in order to prevent bending while you remove these sections.  
It is not necessary to remove the head column (192). Do not remove the steady bearings at this time. Refer to inspection procedures prior to removal.

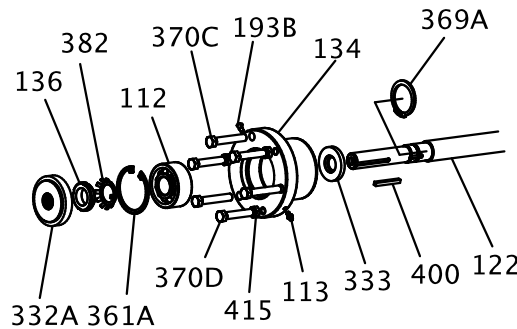


2. Remove the pump half coupling hub (233) and key.
3. Remove the locking bolts (370C) and then slide bearing shell (134) assembly with the shaft out through the motor support (240).

**CAUTION:**

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

M/MT/L Only



4. Use a screwdriver in order to pry the labyrinth seal (332A) from the bearing shell (134).

**NOTICE:**

We recommend that you replace the labyrinth seal every time the pump is inspected.

5. Remove the bearing retaining ring (361A).
6. Slide the bearing shell (134) off the bearing and shaft.
7. Remove the locknut (136) and the lockwasher (382).
8. Use a suitable bearing puller in order to remove the bearing (112).  
Make sure to save the bearing for inspection.
9. Set the shaft on a table where it is adequately supported.  
You do not need to disassemble the pump any further unless you need to replace bad parts.

## Preassembly inspections

### Replacement guidelines

#### Casing check and replacement

**WARNING:**

Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Inspect and assure 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 1/8 in. (3.2 mm) deep
- Pitting that is greater than 1/8 in. (3.2 mm) deep
- Irregularities in the casing-gasket seat surface



## 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:

Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Replace any damaged or worn gaskets/o-rings.

- 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.

## 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.

## 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.

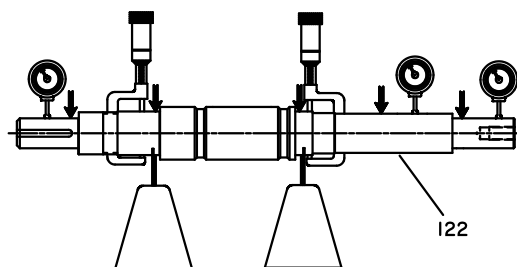
### Shaft straightness check

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 0.001 in. (0.03 mm).

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

### Shaft surface check

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



## 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.

## Bearing fits and tolerances

**Table 3: Steady bearing tolerances**

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

Description S/ST	Bearing ID (pressed into place)			Housing bore			Running clearance (1/2 diametrical clearance)		
	M/MT	L	S/ST	M/MT	L	S/ST	M/MT	L	
Carbon	1.132–1.134 (28.753–28.804)	1.633–1.635 (41.478–41.529)	2.258–2.260 (57.353–57.404)	1.621–1.623 (41.173–41.224)	2.121–2.123 (53.873–53.924)	2.994–2.996 (76.048–76.098)	0.0055–0.0035 (0.140–0.089)	0.006–0.004 (0.152–0.102)	0.0065–0.004 (0.165–0.102)
Bronze	1.129–1.131 (28.677–28.727)	1.629–1.631 (41.377–41.427)	2.256–2.258 (57.302–57.353)	1.621–1.623 (41.173–41.224)	2.121–2.123 (53.873–53.924)	2.994–2.996 (76.048–76.098)	0.004–0.002 (0.102–0.051)	0.004–0.002 (0.102–0.051)	0.0055–0.003 (0.140–0.076)
Fluted elastomer	1.126–1.130 (28.600–28.702)	1.627–1.632 (41.326–41.453)	2.253–2.257 (57.226–57.328)	1.621–1.623 (41.173–41.224)	2.121–2.123 (53.873–53.924)	2.994–2.996 (76.048–76.098)	0.0035–0.0005 (0.089–0.013)	0.0045–0.001 (0.114–0.025)	0.005–0.004 (0.127–0.102)
Rulon	1.132–1.134 (28.753–28.804)	1.633–1.635 (41.478–41.529)	2.258–2.260 (57.353–57.404)	-	-	-	0.0055–0.0035 (0.140–0.089)	0.006–0.004 (0.152–0.102)	0.0065–0.004 (0.165–0.102)
Casing collar	1.183–1.190 (30.048–30.226)	1.678–1.685 (42.621–42.799)	2.299–2.306 (58.395–58.472)	1.811–1.816 (45.999–46.126)	2.243–2.245 (56.972–57.023)	3.243–3.245 (82.372–82.423)	0.0335–0.029 (0.851–0.737)	0.031–0.0265 (0.787–0.673)	0.029–0.0245 (0.737–0.622)

**Table 4: Thrust bearing fits**

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

### Shaft runout tolerances

The following shaft runout tolerances apply to all size groups:

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

## Reassembly

### Assemble the column and support plate

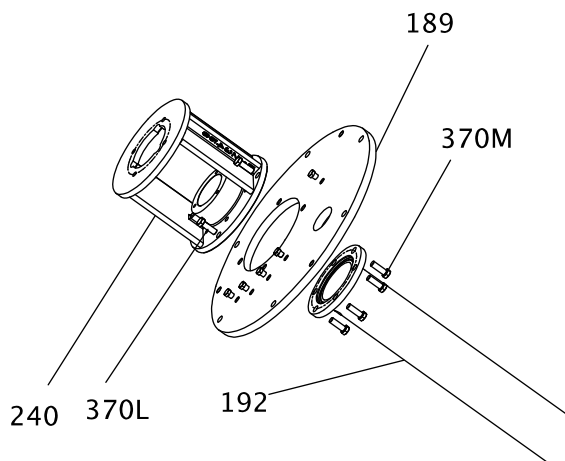
1. If you use the optional stuffing box, then attach the stuffing box (221) to support plate (189) with bolts (370L).
2. Attach the motor support (240):

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

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.

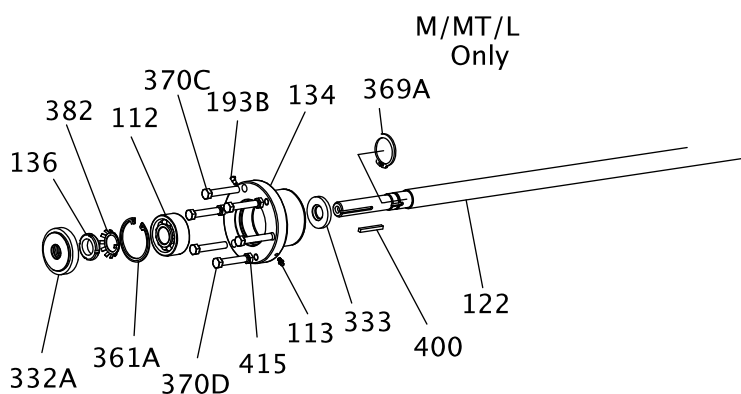


## Assemble the rotating element



**CAUTION:**

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



- For all groups except S/ST, install the retaining ring (369A) on the shaft (122).
- 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:**

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

3. Install the lockwasher (382) on the shaft (122). Make sure that the tang of lockwasher is in the keyway 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).

## Assemble the column

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

1. Prepare the steady bearing housing assemblies, if applicable.  
You do not need to precisely center the steady bearing, and the holes in the bearing do not need to line up with the holes in the housing. A recessed area inside the housing (213) allows lubricants to find the opening in the bearing.
  - a) Remove the snap ring (369), if applicable.
  - b) Use a hydraulic press in order to press out the old steady bearing (197).
  - c) Press in the new steady bearing.  
A snap ring (369) is no longer required due to the fits. If your pump has a snap ring, then it is not necessary to reinstall it. However, the snap ring is still required on sealed bearings.
2. Slide the casing assembly onto the shaft and seat the casing flange against the column flange.  
Make sure the discharge nozzle is aligned with the discharge pipe hole in the support plate.
3. Install the bolts (371G).

## Assemble the impeller, suction cover, and strainer

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

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

4. Install the suction cover gasket (351), suction cover (182), and strainer (187) with bolts (317N).  
Alloy strainers have extra-heavy spacer washers (533) between the strainer and the suction cover. If the unit is supplied with a lower-float control guide arm (366), then use an extra-long bolt in this hole.
5. Check the axial travel of the impeller.  
If the travel is less than 0.030 in. (0.762 mm), then add extra gaskets (351) in order to obtain the minimum travel.
6. Install the discharge elbow gasket (351A) and the discharge elbow (315) using bolts (370H).

Accurate alignment of the elbow is critical in order to make sure that there is no obstruction to the flow through the connection.

7. Install the discharge pipe (195), pipe nuts (242), and flange (195S, if used). Make sure that the pipe nuts are tight and that there is no strain on the pump.
8. Rotate the shaft by hand in order to make sure that there is no binding.
9. Connect all auxiliary piping.
10. Replace the pump half coupling hub (233) and lubricate the pump bearings.

# Troubleshooting

## Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Make sure the pit is filled with liquid above the casing. On dry pit units, the casing and suction pipe must be completely filled.
	The discharge head is too high.	Check the total head, particularly friction loss.
	The motor speed is too low.	Check the motor speed.
	The suction line is clogged.	Remove the obstructions.
	The impeller, discharge pipe, or strainer is clogged.	Remove obstructions or back-flush the pump.
	The shaft is rotating in the wrong direction.	Change the rotation. The rotation must match the arrow on the bearing housing or pump casing.
	The suction lift is too high.	Shorten the suction pipe.
	The amount of available NPSH is not sufficient.	Check the amount of NPSH available and required and adjust accordingly.
The pump is not producing the rated flow or head.	The shaft is rotating in the wrong direction.	Change the rotation. The rotation must match the arrow on the bearing housing or pump casing.
	The discharge head is higher than expected.	Check the total head, particularly friction loss.
	The impeller, discharge pipe, or strainer is clogged.	Remove obstructions or back-flush the pump.
	The motor speed is too low.	Check the motor speed.
	The suction line is clogged.	Remove the obstructions.
	The suction lift is too high.	Shorten the suction pipe.
	The impeller is worn or broken.	Inspect and replace the impeller if necessary.
	The suction line has air or vapor pockets.	Rearrange the piping in order to eliminate air pockets.
The pump starts and then stops pumping.	The amount of available NPSH is not sufficient.	Check the amount of NPSH available and required and adjust accordingly.
	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 bearings are running hot.	The suction line has an air leak.	Repair the leak.
	The pump and driver are not aligned properly.	Realign the pump and driver.
	There is not sufficient lubrication.	Check the lubricant for suitability and level.
	The lubrication was not cooled properly.	Check the cooling system.
The pump is noisy or vibrates.	The pump and driver are not aligned properly.	Realign the pump and driver.
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
	The impeller or shaft is broken or bent.	Replace the impeller or shaft as necessary.
	The foundation is not rigid.	Tighten the hold-down bolts of the pump and motor. Make sure 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.

Symptom	Cause	Remedy
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.

## Assembly troubleshooting

**Table 5: 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.	Remove the individual shims to obtain the proper thickness.
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. (not applicable on 3700LF)	The shaft is bent.	Replace the shaft.
	The wear ring was machined improperly.	Replace or re-machine the impeller.

# Parts Listings and Cross-Sectionals

## Dimensional drawings

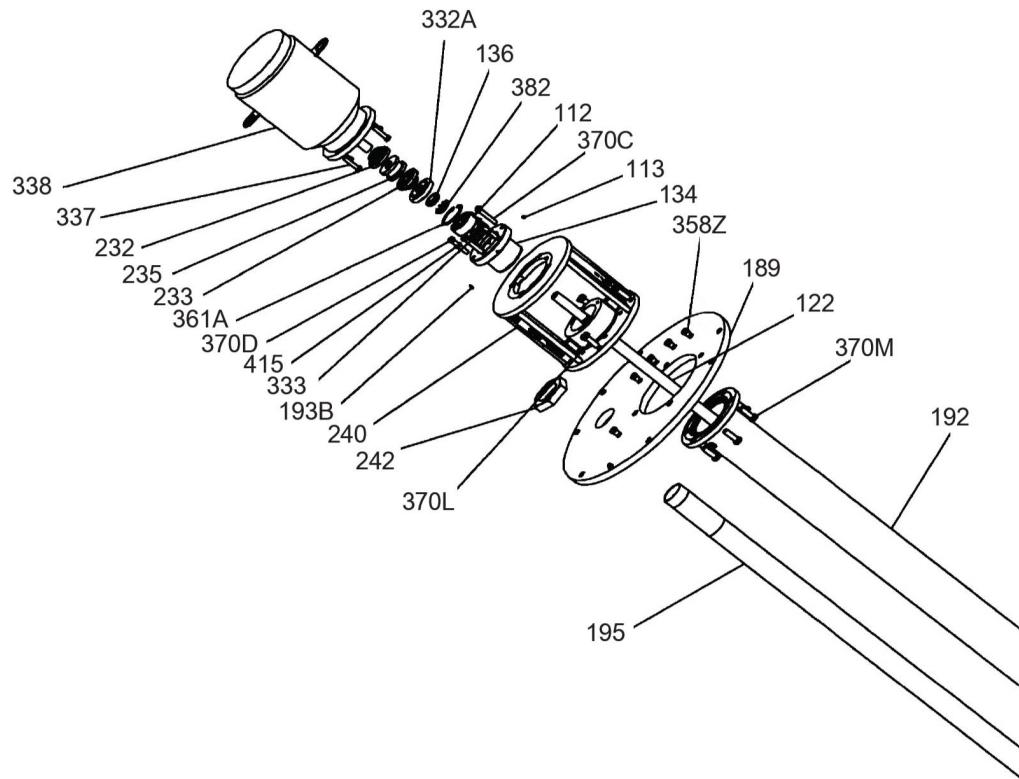


Figure 9: 3171 exploded view (part 1 of 2)



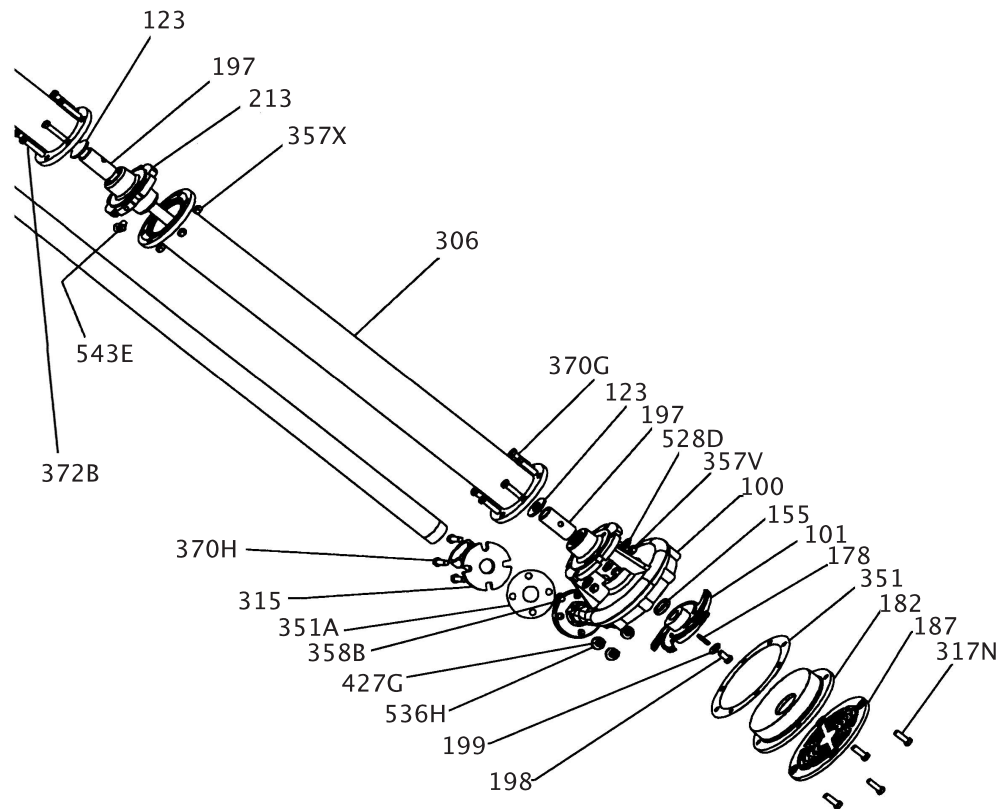


Figure 10: 3171 exploded view (part 2 of 2)

## Parts list

Table 6: Parts list with materials of construction

Item	Quantity	Part name	All iron	Bronze-fitted	Carbon steel	CD4-fitted	316SS	Alloy 20	Hast. B	Hast. C
100	1	Casing	1000	1000	1212	1216	1203	1204	1217	1215
101	1	Impeller	1018	1101	1212	1216	1203	1204	1217	1215
112	1	Thrust bearing	Double row angular contact							
122	1	Shaft	2205				2216	2221	2263	2264
123		Deflector	EPDM							
134	1	Bearing shell	1000							
136	1	Bearing locknut	Steel							
155	1	Casing bushing	Carbon-filled PTFE (Teflon)							
178	1	Impeller key	2229					2230	2247	2248
182	1	Suction cover	1000		1212	1216	1203	1204	1217	1215
187	1	Strainer	1000		3211			1204	1217	1215
189	1	Support plate	3201							
190		<sup>1</sup> Flush tubing	As specified							
192	1	Head column	6501			6545		6506	6519	6548
193B	1	Grease fitting	Carbon or as specified							
195	1	Discharge pipe	6501			-	-	6506	6519	6548
197	<sup>1</sup>	Steady bearings	Carbon or as specified							
198	1	Impeller screw	2229					2230	2247	6548
199	1	Impeller washer	2229					2230	-	-
213	<sup>1</sup>	Steady bearing housing	1000			1203		1204	1217	1215
240	1	Motor support	1000							
242	2	Pipe nut	1000				1203	1204	1217	1215

<sup>1</sup> The quantity depends on pump length and speed. Nuts and washers are omitted for clarity.

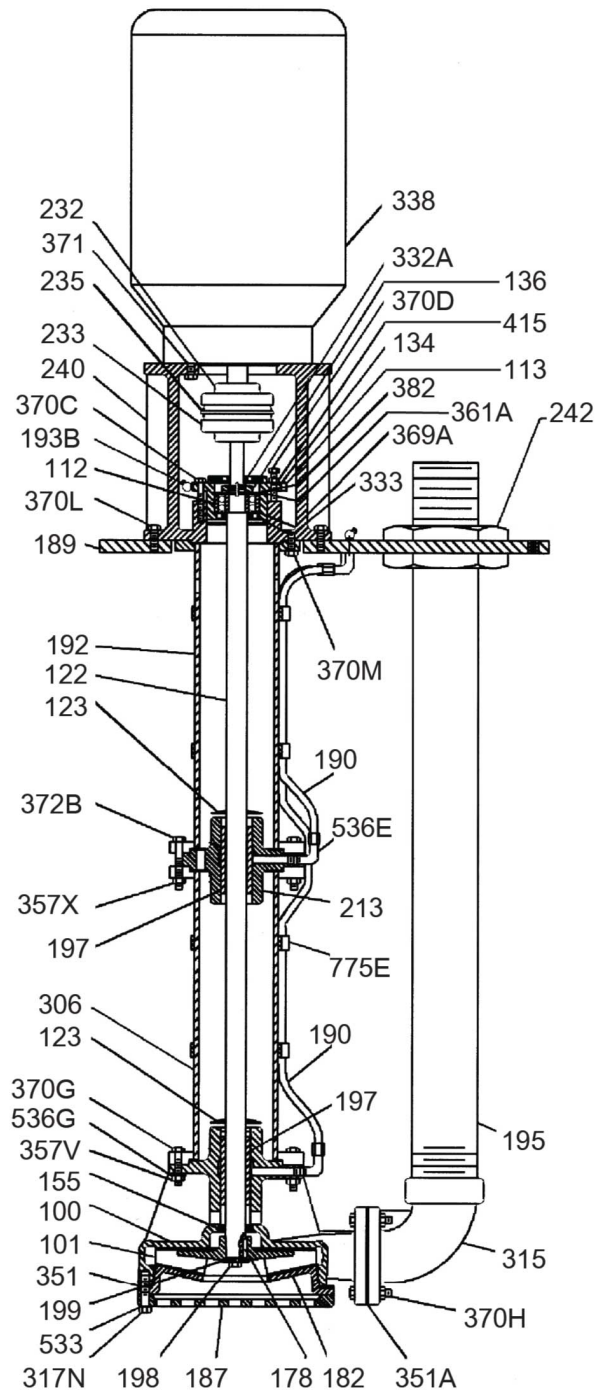
Item	Quantity	Part name	All iron	Bronze -fitted	Carbon steel	CD4- fitted	316SS	Alloy 20	Hast. B	Hast. C
306	1	Column extension	6501			6545		6506	-	-
315	1	Discharge elbow	1000		1212	1216	1203	1204	1217	1215
332A	1	Labyrinth seal	Carbon Teflon							
333	1	Lip seal	Nitrile lip seal							
333H	2/Brg	Lip seal	Nitrile				Viton			
351	1	Gasket (suction cover to casing)	Nitrile acrylic							
351A	1	Gasket (discharge elbow to casing)	Nitrile acrylic							
361A	1	Retaining ring (thrust bearing)	Steel							
369	1	Retaining ring (steady bearing)	PH15-7MO Stainless					C-20	Hastelloy	
369A	1	Retaining ring (shaft)	M/MT, L Groups Only. Steel							
370C	3	Clamp bolt (bearing shell)	2210							
370D	3	Jack bolt (bearing shell)	2210							
370G	6	Bolt (column to casing)				2229		2230	2247	2248
370H	4	Bolt (elbow to casing)				2229		2230	2247	2248
370L	4	Bolt (motor adapter to support plate)	2210							
370M	4	Bolt (head column to motor support)				2229		2230	2247	2248
371	4	Bolt (motor to motor support)	2210							
501	1	Coupling guard	3122							
501L	2	Guard springs	Steel							

Table 7: Material code cross reference

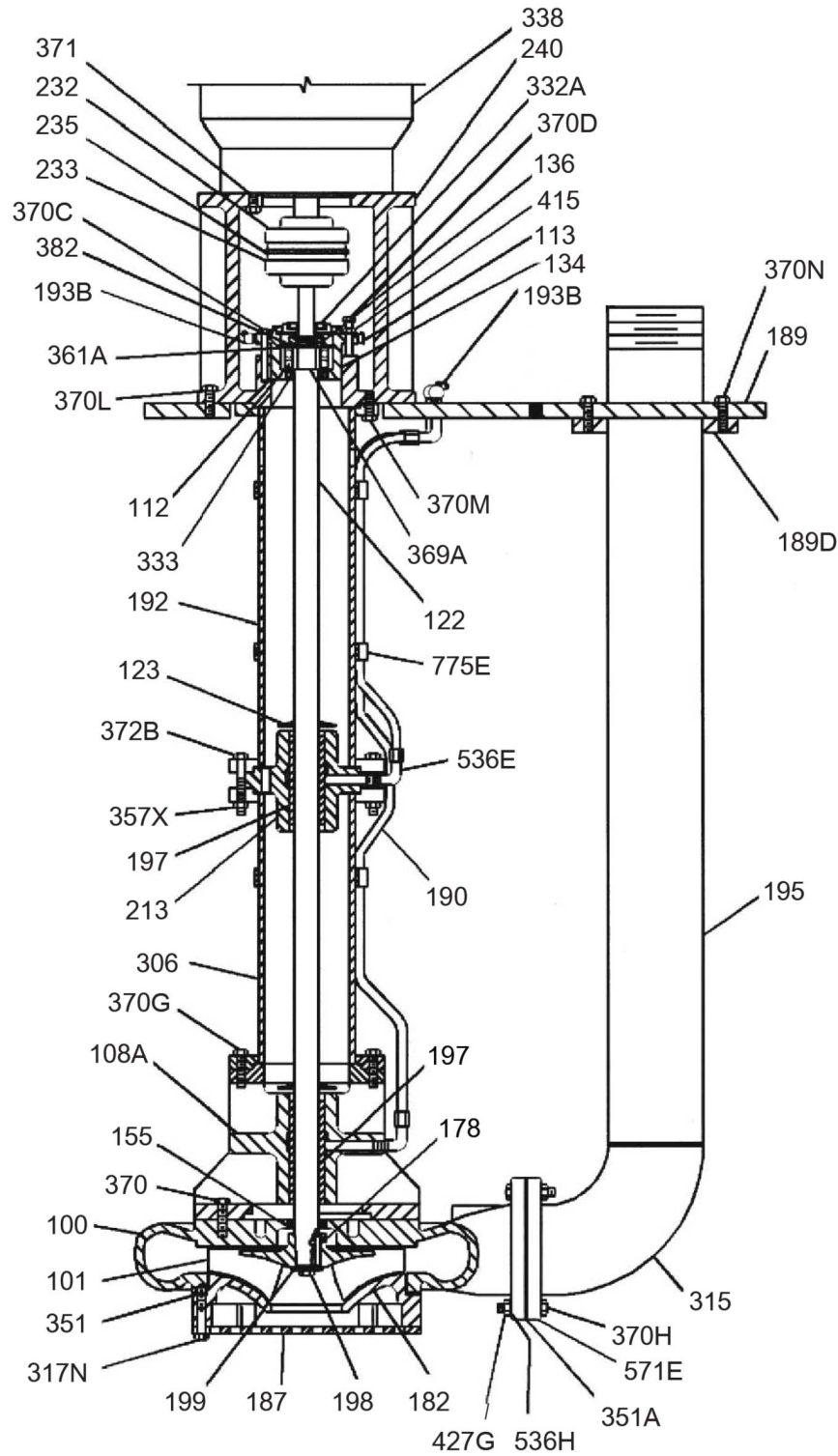
Goulds code	ASTM number
1000	A48 CL25B Cast Iron
1018	A536-84 60-42-10 Ductile Iron
1101	B584 Silicon Brass
1203	A743 CF8M 316 Stainless
1204	A743 CN7M Alloy 20
1212	A216 WCB Carbon Steel
1215	A494-90 CW6M C1,1 Hastelloy C
1216	A890 1A CD4MCuN
1217	A494 N-7M Hastelloy B
2205	C1045 Carbon Steel Ground and Polished
2210	A108 Gr1211 Carbon Steel
2216	A276 316 Stainless Ground and Polished
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

## Cross-sectional diagrams

### S/ST and M/MT groups



**L group**



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Middle East and Africa	ITT - Goulds Pumps Achileos Kyrrou 4 Neo Psychiko 115 25 Athens Greece	+30 210-677-0770	+30 210-677-5642





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