

 **GOULDS PUMPS**

Installation, Operation, and Maintenance Manual

Model NM 3171



ITT

Table of Contents

1 Introduction and Safety	4
1.1 Introduction.....	4
1.1.1 Requesting other information	4
1.2 Safety	4
1.2.1 Safety terminology and symbols	5
1.2.2 Environmental safety.....	6
1.2.3 User safety	6
1.2.4 Ex-approved products	9
1.3 Product approval standards	10
1.4 Product warranty	10
2 Transportation and Storage.....	11
2.1 Receive the unit.....	11
2.2 Unpack the unit	11
2.3 Pump handling	11
2.3.1 Lifting methods.....	11
2.4 Pump storage requirements	12
2.4.1 Prepare the pump for long-term storage	13
3.2 General description	14
3.3 Nameplate information	15
3.4 Permissible temperatures.....	16
4 Installation.....	18
4.1 Pre-installation.....	18
4.1.1 Inspect the pump.....	18
4.1.2 Pump location guidelines	18
4.1.3 Concrete foundation requirements.....	19
4.2 Support plate installation	19
4.2.1 Install the support plate with a pit cover	19
4.2.2 Install the support plate without a pit cover	19
4.3 Piping checklists.....	20
4.3.1 General piping checklist	20
4.3.2 Suction piping for optional dry pit, outside tank mount, and tailpipe applications	20
4.3.3 Steam lines	21
4.3.4 Final piping checklist.....	21
4.4 Stuffing box installation	21
4.4.1 Install the packed stuffing box.....	22
4.5 Install the pump, driver, and coupling.....	23
4.6 Motor installation and coupling alignment	23
4.6.1 Install the motor.....	23
4.6.2 Alignment checks	23
4.6.3 Permitted indicator values for alignment checks.....	24
4.6.4 Alignment measurement guidelines	24
4.6.5 Attach the dial indicators for alignment	24
4.6.6 Align the flexible coupling.....	25
4.6.7 Align the flexible coupling with a straight edge	25
4.7 Float control installation.....	25
4.7.1 Install the Square D 9036 simplex and 9038 duplex float controls	27

5 Commissioning, Startup, Operation, and Shutdown	28
5.1 Preparation for startup.....	28
5.2 Check the rotation	29
5.3 Thrust bearing lubrication.....	30
5.3.1 Flush the steady bearings	30
5.3.2 Sealed bearings	30
5.3.3 Lubricate the sealed bearings with grease cups	31
5.3.4 Fill the housing	31
5.3.5 Adjust the flow.....	31
5.4 Shaft sealing with a mechanical seal	32
5.5 Install the shaft guard - if provided	33
5.6 Steam jacket pumps (molten sulfur construction)	33
5.7 Impeller-clearance setting	33
5.7.1 Set the impeller clearance - dial indicator method	33
5.7.2 Set the impeller clearance - feeler gauge method	34
5.8 Install the coupling guard	35
5.9 Start the pump.....	36
5.10 Pump operation precautions	36
5.11 Shut down the pump.....	37
5.12 Make the final alignment of the pump and driver	37
6 Maintenance	39
6.1 Bearing maintenance	39
6.1.1 Thrust bearings	39
6.1.2 Lubricate the bearings after a shutdown period	39
6.1.3 Lubricating-grease requirements	39
6.1.4 Regrease the thrust bearing.....	40
6.1.5 Steady bearings	40
6.2 Shaft-seal maintenance.....	40
6.2.1 Mechanical-seal maintenance.....	40
6.3 Disassembly	41
6.3.1 Disassembly precautions	41
6.3.2 Tools required.....	42
6.3.3 Drain the pump.....	42
6.3.4 Remove the pump from the sump.....	42
6.3.5 Remove the impeller	43
6.3.6 Remove the shaft guard	44
6.3.7 Disassemble the column.....	45
6.4 Preassembly inspections.....	46
6.4.1 Replacement guidelines.....	46
6.4.2 Shaft replacement guidelines.....	47
6.4.3 Bearings inspection.....	47
6.4.4 Bearing fits and tolerances.....	48
6.5 Reassembly.....	48
6.5.1 Assemble the column and support plate	49
6.5.2 Assemble the rotating element.....	49
6.5.3 Assemble the column.....	50
6.5.4 Assemble the impeller, suction cover, and strainer	50
6.5.5 Install the shaft guard.....	51

7 Troubleshooting	52
7.1 Operation troubleshooting	52
7.2 Assembly troubleshooting	53
8 Parts List and Cross-Sectionals	54
8.1 Cross-sectional drawing	54
8.2 Parts list.....	55
Appendix A Appendix	57
A.1 Appendix	57
A.1.1 Sealed bearing design	57

1 Introduction and Safety

1.1 Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance



CAUTION:

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

NOTICE:

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

1.1.1 Requesting other information

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

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

1.2 Safety



WARNING:

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

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



CAUTION:

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




1.2.1 Safety terminology and symbols

About safety messages

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

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

Hazard levels

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

Hazard categories

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

Electrical hazards are indicated by the following specific symbol:



ELECTRICAL HAZARD:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

1.2.1.1 The Ex symbol

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



1.2.2 Environmental safety

The work area

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

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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



WARNING:

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

Electrical installation

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

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 User safety

General safety rules

These safety rules apply:

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

Safety equipment

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

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

Electrical connections

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

Noise



WARNING:

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

Temperature



WARNING:

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

1.2.3.1 Precautions before work

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

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

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

1.2.3.2 Precautions during work

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



CAUTION:

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

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

1.2.3.3 Hazardous liquids

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

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

1.2.3.4 Wash the skin and eyes

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

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

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

1.2.4 Ex-approved products

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

Personnel requirements

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

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

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



Product and product handling requirements

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

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

1.3 Product approval standards

Regular standards



WARNING:

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

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

1.4 Product warranty

Coverage

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

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

Limitations

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

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

2 Transportation and Storage

2.1 Receive the unit

1. Inspect the package for damaged or missing items upon delivery.

2.2 Unpack the unit

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

2.3 Pump handling



WARNING:

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



CAUTION:

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

2.3.1 Lifting methods



WARNING:

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

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

Examples

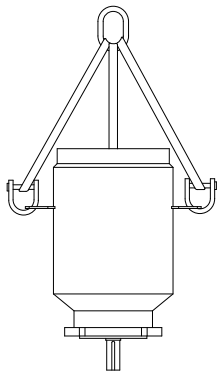


Figure 1: Example of lifting motor properly with lifting lugs

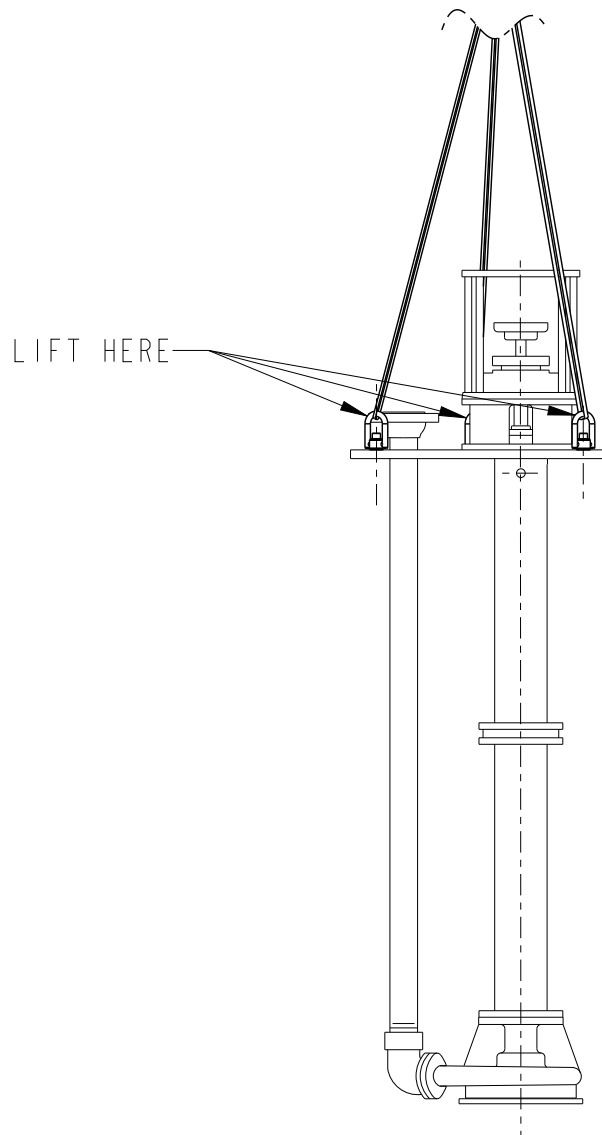


Figure 2: Example of lifting pump properly with sling

2.4 Pump storage requirements

Requirements

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

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

Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	<ul style="list-style-type: none"> Pave the area.

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

When pump is not in regular operation

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

2.4.1 Prepare the pump for long-term storage

For storage periods over six months, you must follow the [2.4 Pump storage requirements on page 12](#) above 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 4.5 kg | 10 lbs of moisture-absorbing desiccant or 2.3 kg | 5.0 lbs of vapor-phase inhibitor crystals near the center of the pump.
- If the unit is assembled, place an additional 0.5 kg | 1 lb in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
- Install a moisture indicator near the perimeter of the unit.
- Cover the unit with black polyethylene with a minimum thickness of 0.15 mm | 6.0 mil, and seal it with tape.
- Provide a small ventilation hole approximately 12.0 mm | 0.5 in. diameter.
- Provide a roof or shed shelter in order to protect the unit from direct exposure to the elements.

3.2 General description

Product description

The model NM 3171 is a vertical centrifugal submerged or wet pit type pump intended for installation directly into a sump or vessel vented to atmospheric pressure.

All pump parts in contact with the pumpage are constructed of glass reinforced vinylester or polyester resin, except for the shaft and hardware, which are of an alloy selected for compatibility with the pumpage.

The design of the NM 3171 incorporates one or more non-metallic column (steady) bearings which require a source of clean liquid for cooling and lubrication.

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



WARNING:

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

Casing

The casing has these features:

Impeller

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 NM 3171 incorporates one or more non-metallic column (steady) bearings which require a source of clean liquid for cooling and lubrication.

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.
Carbon PTFE [®] casing collar	This seal is installed immediately behind the impeller in the casing in order to minimize recirculation back to the sump and maximize hydraulic efficiency.

Motor support

Motor supports are 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

Steady bearings

1. **Carbon and carbon filled PTFE** These bearings are chemically inert in most liquids and can be used in liquids up to the temperature limits of the pump. They should not be used in liquids containing abrasive solids. Clear flush from the support plate is required.
2. **Fluted rubber or Viton** These bearings consist of fluted rubber or Viton contained within a metal shell. Clear water from an outside source, 1 to 2 GPM, is required to each bearing housing. They are ideally suited for liquids containing abrasive solids but are limited to 71°C | 160°F temperature liquid. Corrosion resistant shafting is required.
3. **Metallic bearing** Bronze steady bearings are available and must be grease lubricated. Lack of lubrication can lead to galling and eventual seizing. It becomes extremely difficult to keep enough grease in the housing when handling hot liquids, caustic solutions or solvents. Unless an adequate maintenance program exists, it is recommended that a self-lubricating bearing such as carbon be used in place of the metallic bearing.
4. **Sealed bearings** Recommended for abrasive liquids where no outside flush is available. The carbon bearing is sealed within the housing by two lip seals and filled by grease via pressure lubricator located above the support plate. The pressure cup must be kept full of grease. The control screw on the pressure cup should be wide open to start and then controlled by usage.

3.3 Nameplate information

Important information for ordering

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

When you order spare parts, identify this pump information:

3.4 Permissible temperatures

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

Item numbers can be found in the spare parts list.

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

Motor support nameplate

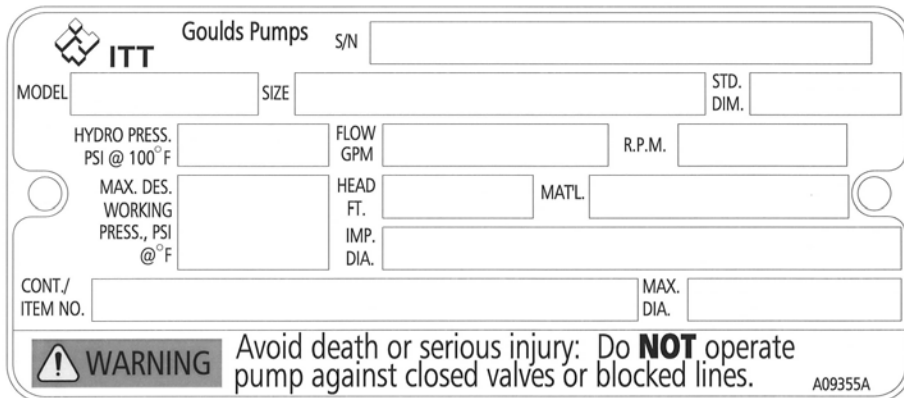


Figure 3: Motor support nameplate

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 Â°F
HEAD FT.	Rated pump head, in feet
MAT'L.	Material of construction
IMP. DIA.	Diameter of the impeller
CONT./ ITEM NO.	Contract/item number
MAX. DIA.	Maximum impeller diameter

3.4 Permissible temperatures

Code	Maximum permissible surface temperature	Maximum permissible liquid temperature
T1	450°C 842°F	372°C 700°F
T2	300°C 572°F	277°C 530°F
T3	200°C 392°F	177°C 350°F
T4	135°C 275°F	113°C 235°F

Code	Maximum permissible surface temperature	Maximum permissible liquid temperature
T5	100°C 212°F	Option not available
T6	85°C 185°F	Option not available

NOTICE:

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

4 Installation

4.1 Pre-installation

Precautions



WARNING:

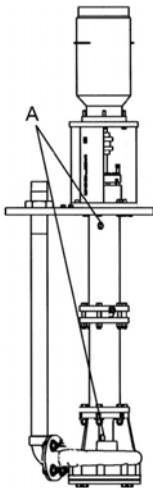
- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to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

NOTICE:

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

4.1.1 Inspect the pump

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



"A" represents the location of the plugs

Figure 4: Pump plug locations

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

4.1.2 Pump location guidelines

4.1.3 Concrete foundation requirements

Requirements

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

- The foundation must be able to absorb any vibration.
- The foundation must be able to form a permanent and rigid support for the pumping unit.
- The foundation must be of adequate strength in order to support the complete weight of the pump and driver, plus the weight of the liquid that passes through it.

4.2 Support plate installation

4.2.1 Install the support plate with a pit cover

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

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

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

4.2.2 Install the support plate without a pit cover

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

Support plate type	Action
Standard	Insert the supplied gasket between the two flanges. Bolt the support plate to a metal sole plate that has a machined surface.
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.

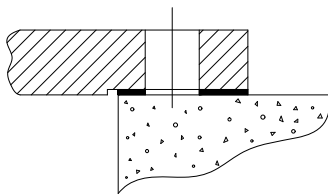


Figure 5: Layout for a standard support plate with the vapor-proof option

4. Hand tighten the anchor bolts. Check the level and re-shim if necessary.

5. Tighten all anchor bolts in a star pattern in order to avoid distorting the support plate.

4.3 Piping checklists

4.3.1 General piping checklist

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

Checklist

Check	Explanation/comment	Checked
Install an elbow at the pump.	Whenever possible, perform these actions: <ul style="list-style-type: none"> • Use long radius elbows. • Move the elbow further from the suction. • Eliminate unneeded elbows. 	
Make sure the suction piping is a larger diameter than the pump suction.	—	
Install separate suction lines when more than one pump is operating from the same source of supply.	—	
Make sure that the suction piping contains no air pockets.	—	
Make sure that the suction piping slopes upwards toward the pump.	—	
Make sure that all joints are air tight.	—	
Provide a method to prime the pump.	For outside tank mount and dry pit applications, allow the fluid level inside the tank or pit to rise above the casing level. In tailpipe applications, submerge the casing before you start the pump.	
For outside tank mount and dry pit applications, install an isolation valve in the suction line at least two pipe diameters from the suction.	This allows the line to be closed for pump inspection and maintenance. The isolation valve must be kept fully open during operation.	
Make sure that the entrance to the suction pipe is kept adequately submerged below the free liquid surface.	This prevents vortices and air entrainment.	
For an outside tank mount application, make sure that a column assembly is installed.	The column assembly allows the fluid that comes through the lower bushings to flow up through the column and back through the connection at the top of the column back to the tank. Connect the pipe at the top of the pump column back to the source tank in order to prevent fluid from entering the thrust bearing.	

4.3.3 Steam lines

Checklist

Check	Explanation/comment	Checked
Before you install the pump, become familiar with the location of the steam lines.	<p>There are three connections above the support plate:</p> <ul style="list-style-type: none"> • Two steam connections • One condensate return connection. <p>The steam connections are connected to the tops of the column and discharge jackets.</p>	
Determine which method to use in order to connect the steam lines.	<p>There are two methods you can use in order to connect the steam lines:</p> <ul style="list-style-type: none"> • You can use both steam lines as input for steam (preferred method). • You can use one steam line as input for steam, while the other steam line is used as a feed through to additional pumps. <p>Only use this method if absolutely necessary, because it is difficult to control the steam at subsequent pumps.</p>	
Before you install the pump, check the fittings for leaks. Use plant air or high pressure water.	<p>The jackets are hydrotested by the factory at 100 psi before shipment. However, the tube fittings can become loose during transit.</p> <p>If you use air to check for leaks, use a soap solution at each joint in order to check for air bubbles.</p>	
Provide source of steam at 35 psi and 149°C 300°F.	Less than ideal conditions require higher pressure steam in order to keep the correct temperature.	
After the pump is brought to temperature for the first time, shut down the unit temporarily and readjust the impeller clearance.	Refer to Impeller clearance setting in the Operations chapter.	

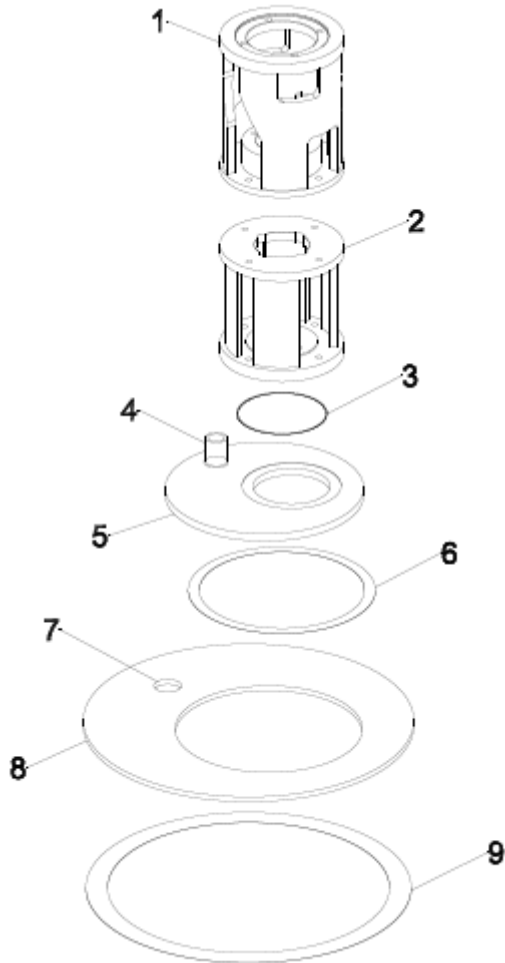
4.3.4 Final piping checklist

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

4.4 Stuffing box installation

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

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



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

Figure 6: Suffing box installation

4.4.1 Install the packed stuffing box



WARNING:

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

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

1. Fill the grease cup with any lithium-based #2 grease.

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

4.5 Install the pump, driver, and coupling

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

4.6 Motor installation and coupling alignment



WARNING:

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

4.6.1 Install the motor

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

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

4.6.2 Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

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

Types of alignment checks

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

Initial alignment (cold alignment) checks

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

Final alignment (hot alignment) checks

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

4.6.3 Permitted indicator values for alignment checks

4.6.4 Alignment measurement guidelines

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

4.6.5 Attach the dial indicators for alignment

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

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

Figure 7: Dial indicator attachment

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

3. Adjust the indicators if necessary.

4.6.6 Align the flexible coupling



WARNING:

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



WARNING:

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
 - The coupling used in an Ex classified environment must be properly certified.
-

Alignment of the pump and motor is of extreme importance for trouble-free mechanical operation. Straight-edge alignment by an experienced installer proves adequate for most installations. Use dial indicators for disc couplings and applications where alignment to tighter tolerances is desirable. Standard dial indicator procedures would apply.

4.6.7 Align the flexible coupling with a straight edge



WARNING:

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



WARNING:

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
 - The coupling used in an Ex classified environment must be properly certified.
-

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

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

4.7 Float control installation

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

How float controls work

The on and off levels of the Square D 9036 simplex and the Square D 9038 duplex are controlled by adjusting the collars (335). As the liquid level rises, the float rises to contact the upper collar and the

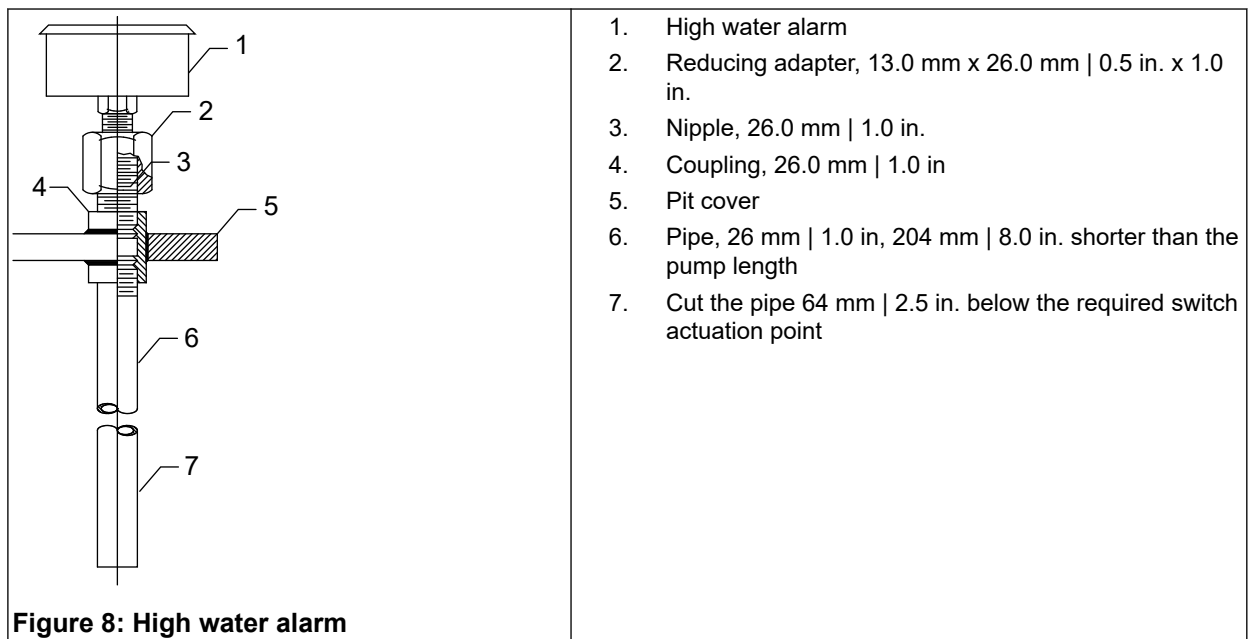
upward movement of the float rod causes the mechanical switch inside the control to close. This completes the circuit to the starter. Operation continues until the liquid level drops low enough for the float to contact the lower collar. This pulls the rod down, opening the switch and turning off the pump.

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

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

APEX high level alarm

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



Magnetrol displacer-type liquid level switch

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

Float ball switches

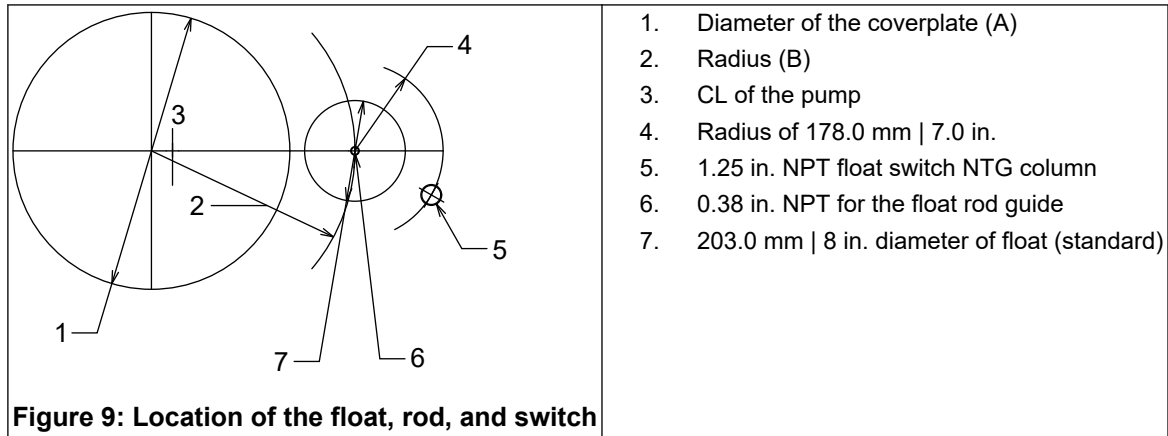
Float balls are individual switches that are used in multiple configurations to control the pump circuit. The float balls are suspended in the sump to the desired control level. When the fluid level rises to the float ball, the switch begins to float. The float is either anchored to a pipe or weighted. This allows the switch

to tilt when the fluid continues to rise. When the float tilts, a switch closes that you can use in order to turn the pump on, activate a high-level alarm, or control any other electrical device.

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

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

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



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

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

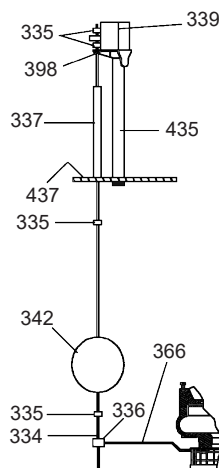


Figure 10: Radius between float switch column and float

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup



WARNING:

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



WARNING:

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

Precautions

WARNING:

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

**CAUTION:**

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

NOTICE:

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

NOTICE:

You must follow these precautions before you start the pump:

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

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

5.2 Check the rotation

**WARNING:**

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

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

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

5.3 Thrust bearing lubrication



WARNING:

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

Grease lubrication

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

Pure oil-mist lubrication

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

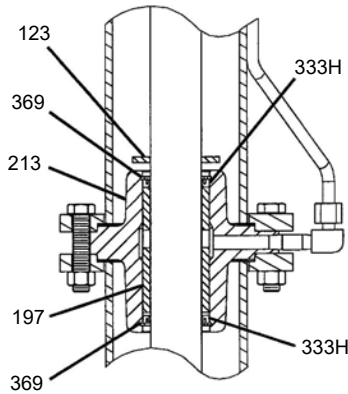
5.3.1 Flush the steady bearings

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

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

5.3.2 Sealed bearings

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



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

Figure 11: Sealed bearings

5.3.3 Lubricate the sealed bearings with grease cups

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

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

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

5.3.4 Fill the housing

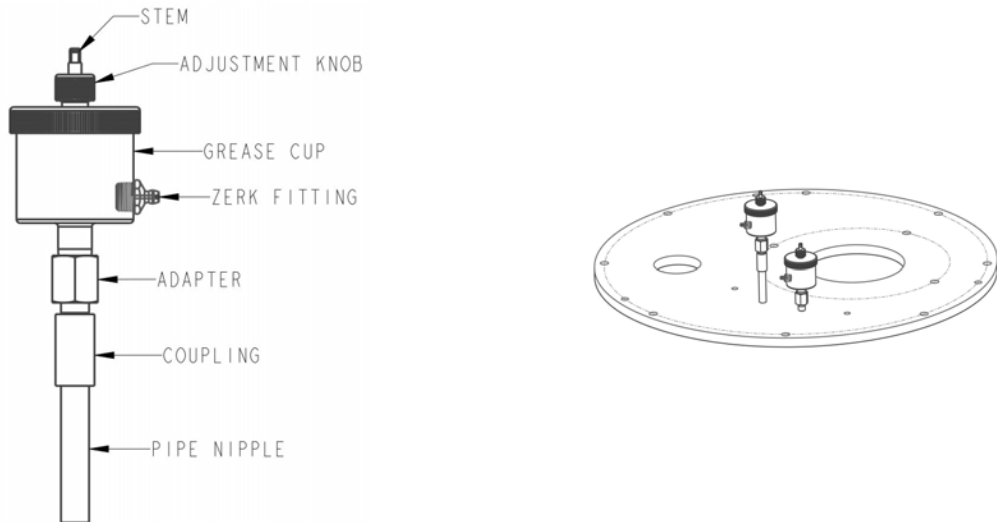
1. Tighten both the top stem (by turning the flat) and the colored stem adjustment knob – closing off the cups flow.
2. Fit a pressurized grease gun to the side zerk fitting and pump the grease cup full until the stem is fully protruding from the cup and/or a small amount of grease starts to come out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

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

5.3.5 Adjust the flow

1. Loosen the adjustment knob and turn the flat of the stem counter clockwise – opening the cups flow as much as possible.

2. Retighten the colored adjustment knob a few turns.
3. If your grease cup has a 1.75 oz capacity and the grease is completely consumed in 1 to 2 weeks operation, then the flow is correct and will maintain the proper amount of grease to the bearings.
If the flow was less than 1 week, the adjustment knob can be tightened more, closing the stem off more and reducing the rate of flow.
4. If your cup is a 3.5 oz capacity – then cup should be completely consumed over 3 to 4 weeks.



5.4 Shaft sealing with a mechanical seal

Precautions



WARNING:

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

NOTICE:

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

Shipping

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

Cartridge-type mechanical seals

Cartridge-type mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require disengagement of the holding clips prior to operation, allowing the seal to slide into place.

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

Other mechanical seal types

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

5.5 Install the shaft guard - if provided



WARNING:

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

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

5.6 Steam jacket pumps (molten sulfur construction)

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

5.7 Impeller-clearance setting

Importance of a proper impeller clearance

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



WARNING:

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

5.7.1 Set the impeller clearance - dial indicator method

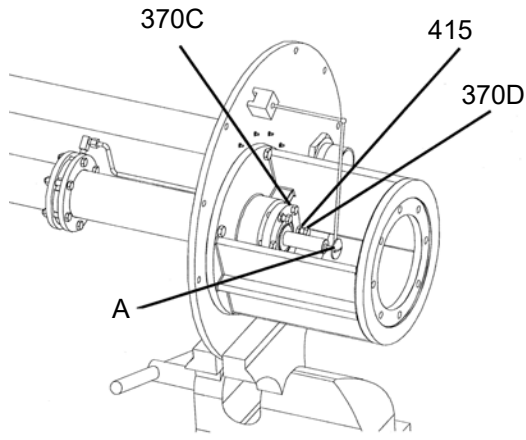


WARNING:

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

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
- Refer to driver/coupling/gear manufacturer's 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

Figure 12: Dial indicator setting

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 0.381 mm | 0.015".
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.

5.7.2 Set the impeller clearance - feeler gauge method



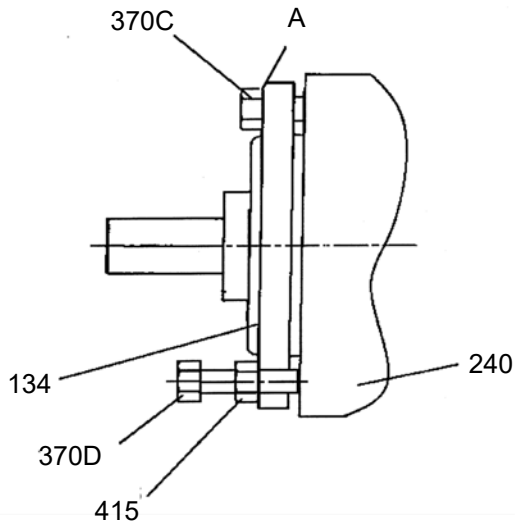
WARNING:

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

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

1. Lock out the driver power and remove the coupling guard.
2. Remove the coupling, if required.
3. Loosen the jam nuts 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

Figure 13: Loosen locking bolts

7. Make sure the shaft turns freely.
8. Replace the coupling.
9. Replace the coupling guard.

5.8 Install the coupling guard



WARNING:

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

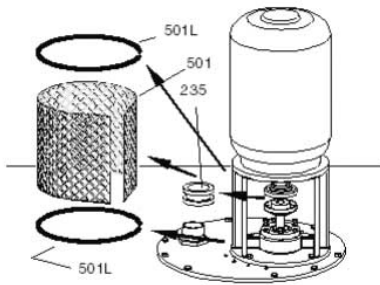


WARNING:

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

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

1. Wrap the expanded metal shield (501) around the motor support.
2. Install the two guard springs (501L).



5.9 Start the pump



WARNING:

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

NOTICE:

- Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.
-

1. Fully close the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
5. If the pump fails to reach the correct pressure, perform these steps:
 - a) Stop the driver.
 - b) 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.
7. Repeat steps 5 and 6 until the pump runs properly.

5.10 Pump operation precautions

General considerations

Operation at reduced capacity



WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe

pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.

- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.

NOTICE:

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

Operation under freezing conditions

NOTICE:

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

5.11 Shut down the pump



WARNING:

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

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

5.12 Make the final alignment of the pump and driver



WARNING:

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

5.12 Make the final alignment of the pump and driver

- Follow the coupling installation and operation procedures from the coupling manufacturer.
-

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

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

6 Maintenance

6.1 Bearing maintenance



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

6.1.1 Thrust bearings

6.1.2 Lubricate the bearings after a shutdown period

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

6.1.3 Lubricating-grease requirements

Precautions

NOTICE:

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

Bearing temperature

Bearing temperatures are generally about 18°C | 20°F greater than bearing-housing outer surface temperatures.

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

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

Grease recommendations based on temperature

Most pumps use Sunoco 2EP grease. High temperature units that can pump fluids with a temperature greater than 177°C | 350°F 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 177°C 350°F NLGI consistency 2	When temperature of pumped fluid is greater than NLGI consistency 3
Mobil	Mobilux EP2	

Brand	When temperature of pumped fluid is less than 177°C 350°F NLGI consistency 2	When temperature of pumped fluid is greater than NLGI consistency 3
Exxon	Unirex N2	Unirex N3
Sunoco	Multipurpose 2EP	N/A
SKF	LGMT 2	LGMT 3

6.1.4 Regrease the thrust bearing

NOTICE:

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

1. Wipe dirt from the grease fittings.
2. Remove the two grease-relief plugs from the bottom of the frame.
3. 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.
4. Reinstall the grease-relief plugs.
5. Wipe off any excess grease.
6. 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.

6.1.5 Steady bearings

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

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

6.2 Shaft-seal maintenance

6.2.1 Mechanical-seal maintenance



WARNING:

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



CAUTION:

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

Cartridge-type mechanical seals

Cartridge-type mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require disengagement of the

holding clips prior to operation, allowing the seal to slide into place. If the seal has been installed in the pump by ITT, these clips have already been disengaged.

Other mechanical seal types

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

Reference drawing

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

Before you start the pump

Check the seal and all flush piping.

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

6.3 Disassembly

6.3.1 Disassembly precautions



WARNING:

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

**CAUTION:**

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

6.3.2 Tools required

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

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

6.3.3 Drain the pump

**WARNING:**

Risk of serious injury or death in Ex-classified environments. If the pump is a Model NM3171, NM3196, 3198, CV3198, 3298, V3298, SP3298, 4150, 4550, or 3107, ignition due to static electric discharge is possible from plastic parts that are not properly grounded. If the pumped fluid is non-conductive, drain and flush the pump with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.

**CAUTION:**

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

1. Leave the drain valve open.
Do not close the drain valve until the reassembly is complete.

6.3.4 Remove the pump from the sump

1. Remove the motor bolts (371).

Figure 14: Motor bolts removal

2. Place the sling on the motor lifting lugs and remove the motor.
3. Remove the support plate anchor bolts.
4. Attach the eyebolts to the support plate.

5. Use properly-sized slings in order to lift the pump from the sump. Refer to the Installation chapter for the proper handling procedure.
6. Lay the pump horizontally on proper supports where there is sufficient clearance to disassemble the pump.
7. Remove the bolts (317N) in order to remove the strainer (187).

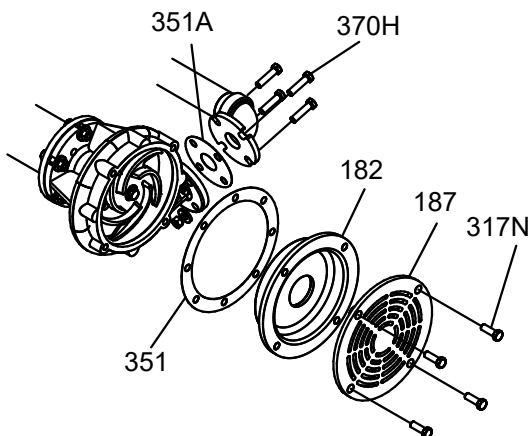


Figure 15: Remove bolts to remove strainer

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

6.3.5 Remove the impeller



WARNING:

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



CAUTION:

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

1. Loosen 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 (101) from the shaft. Use a spanning-type puller if required.

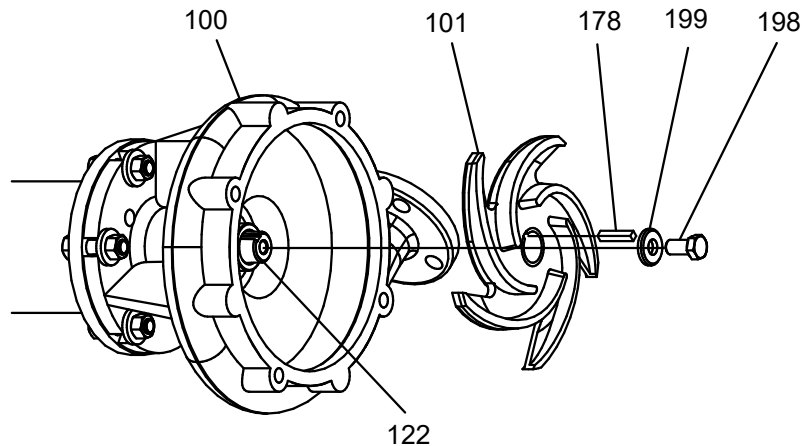


Figure 16: Remove impeller

4. Remove the impeller key (178).
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.

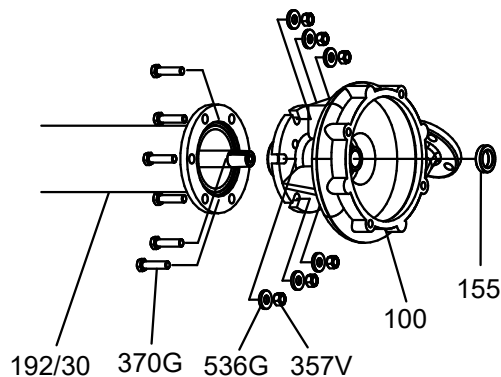


Figure 17: Remove adapter



CAUTION:

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

6.3.6 Remove the shaft guard

1. Do not remove the clip that retains the bolt on the guard to maintain a captive fastener.

2. Retain each guard half for reinstallation.

6.3.7 Disassemble the column

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

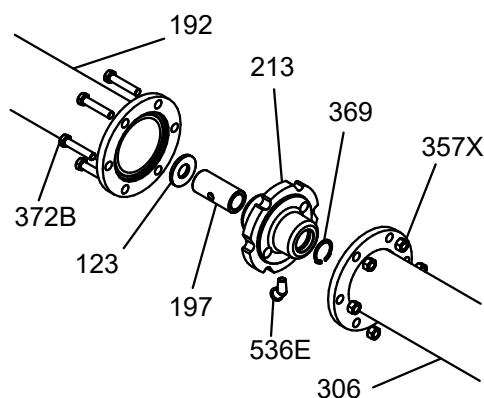


Figure 18: Disassemble the column

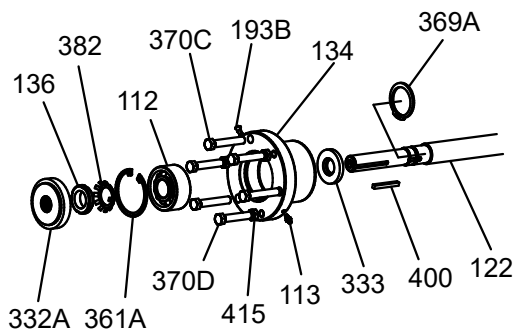
2. Remove the pump half coupling hub (233) and key.
3. Remove the locking bolts (370C) and then slide bearing shell (134) assembly with the shaft out through the motor support (240).



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.

6.4 Preassembly inspections

6.4.1 Replacement guidelines

Casing check and replacement



WARNING:

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

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

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

Impeller replacement

This table shows the criteria for replacing the impeller:

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

Gaskets, O-rings, and seats replacement

**WARNING:**

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

**WARNING:**

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

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

Column sections

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

Motor support

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

6.4.2 Shaft replacement guidelines

6.4.3 Bearings inspection

Condition of bearings

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

Checklist

Perform these checks when you inspect the bearings:

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

6.4.4 Bearing fits and tolerances

Table 2: Steady bearing tolerances

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

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

Table 3: Thrust bearing fits

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

Shaft runout tolerances

The following shaft runout tolerances apply to all size groups:

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

6.5 Reassembly

6.5.1 Assemble the column and support plate

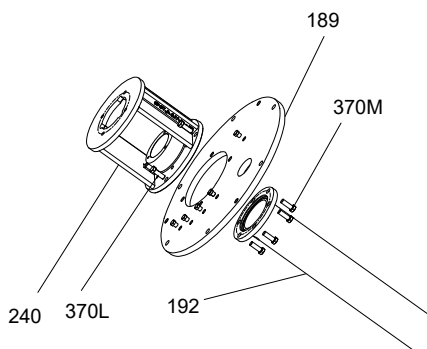
1. If you use the optional stuffing box, then attach the stuffing box (221) to support plate (189) with bolts (370L).
2. Attach the motor support (240):

If ...	Then...
You use the stuffing box	Attach the motor support (240) to the stuffing box with bolts (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.

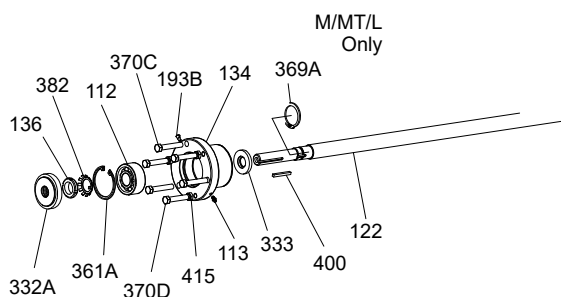


6.5.2 Assemble the rotating element



CAUTION:

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



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

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

**CAUTION:**

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

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

6.5.3 Assemble the column

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

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

6.5.4 Assemble the impeller, suction cover, and strainer

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

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

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

If the travel is less than 0.762 mm | 0.030 in., then add extra gaskets (351) in order to obtain the minimum travel.

6. 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.

6.5.5 Install the shaft guard



WARNING:

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

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

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

7 Troubleshooting

7.1 Operation troubleshooting

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

Symptom	Cause	Remedy
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
	The impeller or shaft is broken or bent.	Replace the impeller or shaft as necessary.
	The foundation is not rigid.	Tighten the hold-down bolts of the pump and motor. Make sure that the base plate is properly grouted without voids or air pockets.
	The bearings are worn.	Replace the bearings.
	Rotating parts are loose, broken, or rubbing against each other.	Replace parts as necessary.
	The suction or discharge piping is not anchored or properly supported.	Anchor the suction or discharge piping as necessary according to recommendations in the Hydraulic Institute Standards Manual.
	The pump is cavitating.	Locate and correct the system problem.
The motor requires excessive power.	The discharge head has dropped below the rated point and is pumping too much liquid.	Install a throttle valve. If this does not help, then trim the impeller diameter. If this does not help, then contact your ITT representative.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	Rotating parts are rubbing against each other.	Check the parts that are wearing for proper clearances.
	The motor speed is too high.	Check the motor speed.
	The impeller clearance is too tight.	Adjust the impeller clearance.

7.2 Assembly troubleshooting

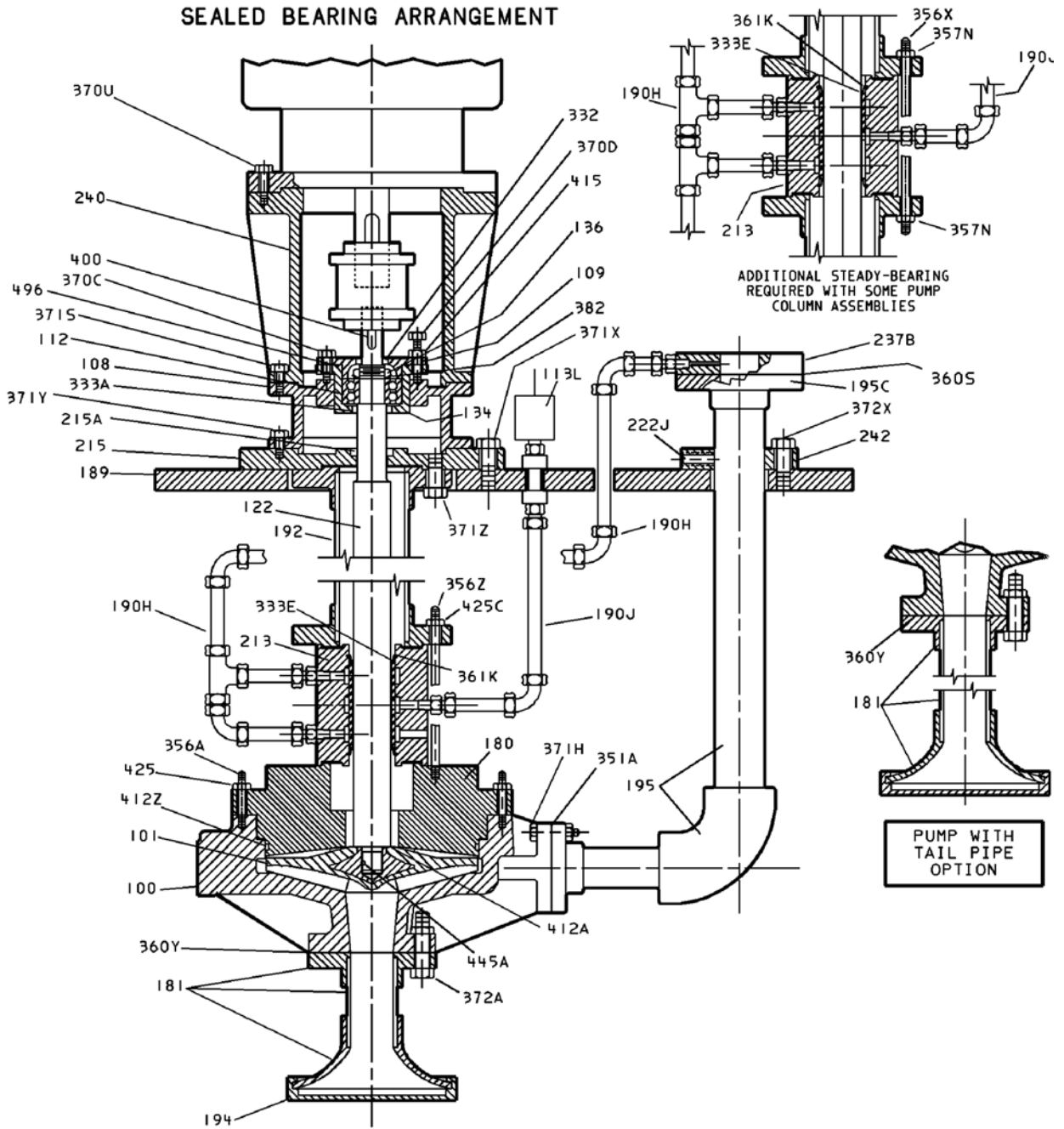
Table 4: Troubleshooting procedure

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.	The shaft is bent.	Replace the shaft.
	The wear ring was machined improperly.	Replace or re-machine the impeller.

8 Parts List and Cross-Sectionals

8.1 Cross-sectional drawing

NM 3171



8.2 Parts list

Table 5: Parts list with materials of construction

Item	Quantity	Part name	Material
100	1	Casing	GMP 2000
101	1	Impeller with insert	GMP2000/Hastelloy C
108	1	Adapter	Cast iron
109	1	Bearing end cover	Cast iron
112	1	Ball bearing (greased for life)	Steel
113L	1	Grease cup	Steel
122	1	Shaft	316 SS
134	1	Bearing housing	Cast iron
136	1	Bearing locknut	Steel
180	1	Pump cover	Polyester
181	1	Suction tail pipe assembly	Polyester
189	1	Mounting plate	Polyester
190H	1	Tube assembly, internal angular flush	Polypropylene
190J	1	Tube assembly, grease line	Polypropylene
192	4	Column pipe assembly	Vinyl ester
194	1	Suction strainer	Valox
195	1	Discharge pipe assembly	Vinyl ester
195C	1	Flange, discharge pipe	Vinly ester
213	4	Column bearing assembly	Polyester/carbon
215	1	Protector plate	Polyester
215A	1	Vapor seal	PTFE
222J	3	Set screw, pipe collar/discharge assembly	304 SS
237B	1	Flush spacer	Polyester
240	1	Motor support	Cast iron
242	1	Pipe collar	Polyester
332	1	Lip seal, upper bearing housing	Steel/BUNA
333A	1	Lip seal, lower bearing housing	Steel/BUNA
333E	1	Lip seal, steady bearing housing	Gpaphite/PTFE
351A	1	Gasket, casing/discharge pipe assembly	Non-asbestos
356A	12	Stud, casing/pump cover	316 SS
356X	4	Stud, Column/column	316 SS
356Z	4	Stud, column/pump cover	316 SS
357N	8	Hex nut, column/column	316 SS
360S	1	Gasket, discharge pipe flange/flush spacer	Non-asbestos
360Y	1	Gasket, casing/tail pipe assembly	Non-asbestos
361K	1	Retaining ring, steady bearing assembly	316 SS
370C	3	Cap screw, bearing end cover/bearing housing	304 SS
370D	3	Tap bolt, impeller adjustment	304 SS
370U	4	Cap screw, motor/motor support	304 SS
371H	4	Cap scres, casing/discharge pipe assembly	316 SS
371S	4	Cap screw, motor support/adpater	304 SS
371X	3	Cap screw, protector plate/mounting plate	304 SS

8.2 Parts list

Item	Quantity	Part name	Material
371Y	4	Cap screw, adapter/protector plate	304 SS
371Z	4	Cap screw, column pipe assembly/protector plate	316 SS
372A	4	Cap screw, casing/suction tailpipe assembly	316 SS
372X	3	Cap screw, pipe collar/mounting plate	304 SS
382	1	Bearing lockwasher	Steel
400	1	Key, coupling	Steel
412A	1	O-ring, impeller	Acid-resistant viton
412Z	1	O-ring, pump cover	Acid-resistant viton
415	3	Locknut, impeller adjustment	304 SS
425	12	Hex nut, casing/pump cover stud	316 SS
425C	4	Hex nut, column/pump cover stud	316 SS
445A	1	Pin, anti-rotation	Nylon
496	1	O-ring, bearing housing	BUNA

Appendix A Appendix

A.1 Appendix

A.1.1 Sealed bearing design

This supplement addresses the grease lubricated/sealed bearing design that uses the pumpage to externally cool the bearing cavity. The standard bearing configuration is product lubricated, and is addressed in the IOM. The bearing housing will be provided fully assembled. This will include the bearing housing, bearing, lip seals and snap rings.

Assembly steps to immediately follow the attachment of the first column pipe assembly to the protector plate, refer to the installation section.

1. Squeeze the top lip seal of the bearing assembly so that it will go over the pump shaft.
2. Slide the bearing assembly onto the shaft and lock it into place on the lock collar of the column shaft.

NOTICE:

Care must be taken to align the cooling connections on the bearing housing with the cooling piping. The same care must be taken to align the grease connection with the grease line. All fittings should line up with the appropriate supply lines as originally installed by the factory.

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3. Repeat steps 1-3 until all column shafts and bearing assemblies are in place.
 4. Grease the bearing with NLGI#2 grade lithium 12 hydroxysterate EP grease or equivalent before assembling grease lines.
 5. Assemble all grease lines, fittings and connectors together but do not connect to bearing housing.
 6. Charge all grease lines from the grease cup down to the connector of the bearing assembly.
 7. Confirm that grease comes out the mail connector of the bearing housing, and then connect to the bearing housing.
 8. Continue with instructions in IOM at point of placing pump cover against last column bearing.

NOTICE:

- Keep the grease cup reservoir full at all times.
 - It is important to ensure that all air is out of grease lines and grease lines are charged before pump startup.
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