

# Installation, Operation and Maintenance Instructions

VRS



**ITT**

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# Introduction

## Purpose of this manual

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

- Installation
- Operation
- Maintenance



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**CAUTION:**

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

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**NOTICE:**

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

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## Requesting other information

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

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

# Safety



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**WARNING:**

- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
  - Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.
  - Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.
  - Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
  - Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
  - Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.
  - Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
  - Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
  - If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.
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**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.

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## Safety terminology and symbols

### About safety messages

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

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

## Hazard levels

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

## Hazard categories

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

Electrical hazards are indicated by the following specific symbol:



### Electrical Hazard:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

## The Ex symbol

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



## Environmental safety

### The work area

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

### Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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



**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 unless it has been properly decontaminated.

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**Electrical installation**

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

**Recycling guidelines**

Always follow local laws and regulations regarding recycling.

## User safety

**General safety rules**

These safety rules apply:

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

**Safety equipment**

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

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

**Electrical connections**

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

## Precautions before work

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

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Recognize the site emergency exits, eye wash stations, emergency showers and toilets.
- Allow all system and pump components to cool before you handle them.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.



- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

### Wash the skin and eyes

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

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

## Ex-approved products

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

### Personnel requirements

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

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

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

### Product and product handling requirements

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

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

### Description of ATEX

The ATEX directives are a specification enforced in Europe for electrical and non-electrical equipment installed in Europe. ATEX deals with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmos-

pheres. The relevance of the ATEX requirements is not limited to Europe. You can apply these guidelines to equipment installed in any potentially explosive atmosphere.

### **Guidelines for compliance**

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

## **Monitoring equipment**

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

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

# Product warranty

## Coverage

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

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

## Limitations

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

## Warranty claim

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

# Transportation and Storage

## Receive the unit

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

## 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.

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# Pump handling

**WARNING:**

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

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**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.

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## Lifting methods

**WARNING:**

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
  - Safe lifting points are specifically identified in this manual. It is critical to lift the equipment only at these points. Integral lifting eyes or eye bolts on pump and motor components are intended for use in lifting the individual components only.
  - Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.
  - Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as swivel hoist rings, shackles, slings and spreaders must be rated, selected, and used for the entire load being lifted.
-

# Pump storage requirements

## Requirements

require proper preparation for storage and regular maintenance during storage. The is considered in storage when it has been delivered to the job site and is awaiting installation. For specific requirements for storing motors, gearheads, and engines, contact the equipment manufacturer.

## Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	<ul style="list-style-type: none"> <li>• Pave the area.</li> <li>• Clean the area.</li> <li>• Drain the area and keep it free from flooding.</li> </ul>
Outdoor storage area (when indoor storage is not available)	<ul style="list-style-type: none"> <li>• Observe all indoor storage requirements.</li> <li>• Use weather-proof coverings such as flame-resistant sheeting or tarpaulins.</li> <li>• Place coverings in a manner that maximizes drainage and air circulation.</li> <li>• Tie coverings down in order to protect the pump from wind damage.</li> </ul>
Placement of pumps and component parts	<ul style="list-style-type: none"> <li>• Place the unit on skids, pallets, or shoring higher than 15 cm   6 in. from the ground for good air circulation.</li> <li>• Sort the parts in order to permit easy access for inspection and/or maintenance without excessive handling.</li> </ul>
Stacking of units or component parts	<ul style="list-style-type: none"> <li>• Make sure that racks, containers, or crates bear the full weight of units or parts in order to prevent distortion.</li> <li>• Keep identification markings readily visible.</li> <li>• Immediately replace any cover you remove for internal access.</li> </ul>
Rotation of the pump	<ul style="list-style-type: none"> <li>• Make sure that the shaft rotates freely.</li> </ul>
Controlled storage facilities	<ul style="list-style-type: none"> <li>• Maintain an even temperature of 6°C   10°F or higher above the dew point.</li> <li>• Keep the relative humidity to less than 50%.</li> <li>• Make sure that there is little or no dust.</li> </ul>
Uncontrolled storage facilities that have uneven temperatures, higher humidity, and/or dusty conditions)	<ul style="list-style-type: none"> <li>• Inspect the unit periodically to make sure that all preservatives are intact.</li> <li>• Seal all pipe threads and flanged pipe covers with tape.</li> </ul>

## When pump is not in regular operation

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

## Prepare the pump for long-term storage

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

1. Inspect the lube-oil and seal-flush piping and either fill the piping with rust-preventative oil, or recoat the piping periodically in order to prevent corrosion.
2. Place 4.5 kg | 10 lbs of moisture-absorbing desiccant or 2.3 kg | 5.0 lbs of vapor-phase inhibitor crystals near the center of the pump.
3. If the unit is assembled, place an additional 0.5 kg | 1 lb in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
4. Install a moisture indicator near the perimeter of the unit.

5. Cover the unit with black polyethylene with a minimum thickness of 6.0 mil (0.15 mm), and seal it with tape.
6. Provide a small ventilation hole approximately 12.0 mm | 0.5 in. diameter.
7. Provide a roof or shed shelter in order to protect the unit from direct exposure to the elements.

# General Information

## General



**WARNING:**

Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure that the code classifications on the pump are compatible with the specific environment in which the equipment is to be installed. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

Keep this instruction manual handy for reference. Further information can be obtained by contacting Goulds Pumps, Ashland Operations, 500 East Centre St., Ashland, PA 17921 or your local representative.

Goulds Pumps will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures, nor used on liquids other than stated in the original order acknowledgment without written permission of Goulds Pumps.

## Pump description

The Model VRS pump is a rubber lined vertical cantilever centrifugal pump. The wet end of the pump contains the same casing halves, liners, and impeller as a similar size Model SRL pump. The impeller is threaded onto the shaft. It is axially adjustable by means of jacking bolts in the thrust housing to renew and maintain proper leakage path clearances.

The heavy duty bearing frame is made of cast iron and contains a deep groove ball bearing on the inboard side and an angular contact ball bearing on the outboard side. All bearings are grease lubricated through fittings on the bearing frame. The direction of rotation is clockwise when viewed from the power end to the wet end.

## Nameplate information

Every pump has a nameplate that provides information about the pump. The nameplate is located on the bearing frame and provides information about the pump's hydraulic characteristics.

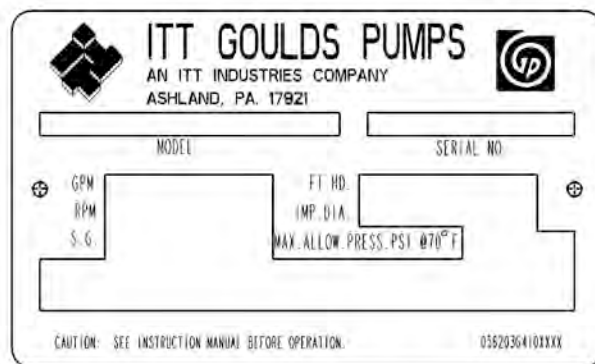


Figure 1: Goulds Pumps nameplate



# Installation



## Pre-installation

### Precautions



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**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.
- 

## Site/foundation

A pump should be located near the supply of liquid in a clean dry area free from flooding. The area should provide adequate space for operation, maintenance, and inspection, considering complete disassembly and handling of equipment.

The pump support must be sufficiently substantial and level to give rigid support to the pump and absorb vibration.

The location and size of the mounting holes are shown on the outline assembly drawing supplied with the pump order. The bolts which secure the pump to the foundation should be 1/8" less in diameter than the hole size.

## Sump

The sump must be screened to prevent any foreign objects from falling into the sump and damaging the pump. The openings in the screening should be smaller than the openings in the pump impeller. Guidelines for sump design can be found in the Hydraulic Institute Standards for sump design.

## Level the pump

Leveling the pump is best performed without the drive and motor installed. Loosen the (4) bearing frame hold down bolts. Level the bearing housing to within 0.25 mm | 0.010 in.

Place shims between bearing housing and support so that a gap of no more than 0.05 mm | 0.002 in exists at any of the (4) anchor bolts when the bolts are loose. Tighten the anchor bolts. If a floorplate is used, shim each anchor bolt location so that a gap of no more than 0.05mm | 0.002 in exists at any of the anchor bolt locations when the bolts are loose.

## Alignment procedure



**WARNING:**

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

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

Check the alignment twice:

- Initial Alignment is done prior to operation when the pump and driver are at ambient temperature.
- Final Alignment is done just after operation when the pump and driver are at operating temperature.

**NOTICE:** Proper alignment is the responsibility of the installer and user of the unit.

Accurate alignment of the equipment must be attained. Trouble free operation can be accomplished by following these procedures.

## Alignment checks

### Initial Alignment (Cold Alignment)

- Before Connecting Piping - To be sure alignment can be obtained.
- After Connecting Piping - To ensure pipe strains have not altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

### Final Alignment (Hot Alignment)

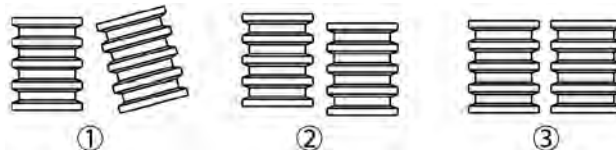
After First Run - To obtain correct alignment when both pump and driver are at operating temperature. Thereafter, alignment should be checked periodically in accordance with plant operating procedures.

## V-belt drive pumps



**WARNING:** Before beginning any alignment procedure, make sure driver power is locked out.

1. Place a straight edge across the top of the motor and pump sheaves to measure the angular and parallel misalignment. Measure the gap between the straight edge and the sheaves with feeler gauges. If the gap exceeds 0.25 mm | 0.010 in., adjust the sheaves along the shafts to correct parallel misalignment and shim the motor to correct angular misalignment.



1. Angular misalignment

2. Parallel misalignment

3. Perfect alignment

**Figure 2: V-belt drive alignment**

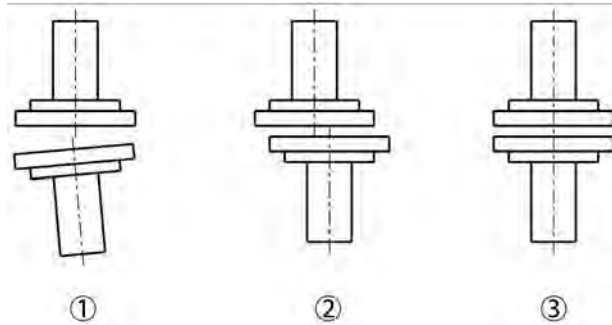
2. A dial indicator can be used to check runout on the periphery and face of each sheave.

## Direct connect pumps

### Alignment criteria

Disconnect coupling halves before proceeding with the alignment. Check for parallel and angular alignment with either the Dial Indicator Method or the Straight Edge Method outlined below.

The faces and outside diameters of the coupling halves must be square and concentric with the bores. Good alignment is achieved when the dial indicator readings for both parallel and angular misalignment are 0.076 mm | 0.003 in. total indicator reading (TIR) or less when the pump and driver are at operating temperature (refer to [Final alignment](#) (page 24)). The Direct connect alignment image, below, provides a representation of what to look for.



1. Angular misalignment
2. Parallel misalignment
3. Perfect alignment

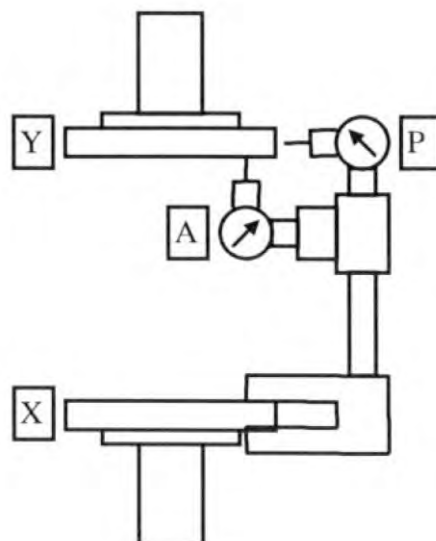
**Figure 3: Direct connect alignment**

### Set up



**WARNING:** Before beginning any alignment procedure, make sure driver power is locked out.

1. Mount two dial indicators on one of the coupling halves (X) so that they contact the other coupling half (Y) as shown in [Figure 4: Dial indicator setup](#) (page 17).



**Figure 4: Dial indicator setup**

2. Check setting of indicators by rotating coupling half X to ensure indicators stay in contact with coupling half Y but do not bottom out. Adjust indicators accordingly.

### Measurement techniques

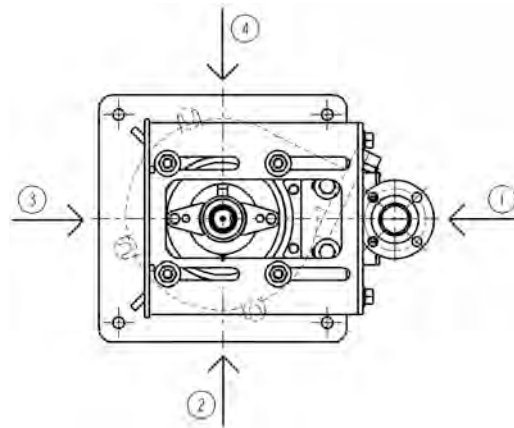
1. To ensure accuracy of indicator readings, always rotate both coupling halves together so indicators contact the same point on coupling half Y. This will eliminate any measurement problems due to runout on coupling half Y.
2. Take indicator measurements with driver hold down bolts tightened. Loosen hold down bolts prior to making alignment corrections.
3. Take care not to damage indicators when moving driver during alignment corrections.

### Angular alignment

A unit is in angular alignment when indicator A (Angular Indicator), [Figure 3: Direct connect alignment](#) (page 17), does not vary by more than 0.076 mm | 0.003 in. as measured at four points on the coupling periphery 90 degrees apart at operating temperature. There are two methods outlined below which are acceptable to achieve alignment.

#### Method 1 - Dial indicator method

For the following steps, refer to [Figure 5: Directions of viewing coupling from top of pump](#) (page 18).



**Figure 5: Directions of viewing coupling from top of pump**

1. Zero indicator A at position 1 of coupling half Y. Mark this position on both flanges.
2. Rotate both flanges 180 degrees to position 3. Observe needle and record reading.
3. Negative Reading - The coupling halves are further apart at position 3 than position 1.  
Positive Reading - The coupling halves are closer at position 3 than position 1.
4. The angular alignment should not be a problem. If, however, 0.076 mm | 0.003 in. TIR or less is not attainable, check the motor and motor mount for perpendicularity to their respective centerlines.
5. Repeat steps 1 through 4 substituting position 2 for position 1 and position 4 for position 3. Use the same marks made on the coupling from position 1 and be sure to turn the coupling halves together.

#### Method 2 - Feeler gauge method

For the following steps refer to [Figure 5: Directions of viewing coupling from top of pump](#) (page 18).

1. Insert a feeler gauge at position 1 at the periphery of the couplings. Mark this position on both flanges.
2. Record the largest gauge size which fits snugly between the two flanges.
3. Rotate both flanges 180 degrees to position 3.
4. Insert a feeler gauge at position 3 at the periphery of the couplings.
5. Record the largest gauge size which fits snugly between the two flanges.
6. Calculate the difference between the readings at positions 1 and 3. The difference should not be greater than 0.076 mm | 0.003 in. If, however, 0.076 mm | 0.003 in. TIR or less is not

attainable, check the motor and motor mount for perpendicularity to their respective centerlines.

- Repeat steps 1 through 6 substituting position 2 for position 1 and position 4 for position 3. Use the same marks made on the coupling from position 1 and be sure to turn the coupling halves together.

## Parallel alignment

The unit is in parallel alignment when indicator P (Parallel Indicator, see Figure 4) does not vary by more than 0.003 in (0.076 mm) as measured at four points on the coupling periphery 90 degrees apart at operating temperature. There are two methods outlined below which are acceptable to achieve alignment.

### Method 1 - Dial indicator method

For the following steps, refer to [Figure 5: Directions of viewing coupling from top of pump](#) (page 18).

- Zero indicator P at position 1 of coupling half Y. Mark this position on both flanges.
- Rotate both flanges 100 degrees to position 3. Observe the needle and record the reading.
- Negative reading* - The coupling half Y is shifted toward position 1. If the value is greater than 0.076 mm | 0.003 in., shift the motor accordingly.  
*Positive reading* - The coupling half Y is shifted toward position 3. If the value is greater than 0.076 mm | 0.003 in., shift the motor accordingly.
- Repeat steps 1 through 3 until indicator P reads 0.076 mm | 0.003 in. or less.
- Once ideal alignment is reached, repeat steps 1 through 4 substituting position 2 for position 1, and position 4 for position 3. **Method 2 - Straight edge method**

For the following steps, refer to [Figure 5: Directions of viewing coupling from top of pump](#) (page 18).

- Place a straight edge across the two coupling flanges at position 1 and mark this position on both flanges.
- Adjust the motor so that the straight edge rests evenly on both flanges within 0.076 mm | 0.003 in.
- Rotate both flanges to position 2 and repeat steps 1 and 2.
- The unit will be in parallel alignment when the straight edge rests evenly within 0.076 mm | 0.003 in. on the coupling periphery at both positions along the periphery.

---

**NOTICE:** Care must be taken to have the straight edge parallel to the axis of the shafts.

---



---

**NOTICE:** Since the coupling halves are disconnected, this would be a good time to check the direction of motor rotation.

---

## Factors that may affect alignment




---

### CAUTION:

The unit should be checked periodically for alignment.

---

If the unit does not stay aligned after being properly installed, it may be due to any of the following causes:

- Non-rigid foundation
- Foundation settling
- Bearing wear
- Distortion due to piping loads/strain
- Distortion of support due to an adjacent heat source
- Structural changes due to variable loading or other causes
- Loose nuts/bolts on the pump and/or drive assembly

## Piping

### General

Review the guidelines for piping in the 'Hydraulic Institute Standards' prior to pump installation.

---



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



**CAUTION:**

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

---

**NOTICE:**

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

---

1. All piping must be supported independently of, and line up naturally with, the pump flanges.
- 



**CAUTION:** Never draw piping into place by forcing the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely affect the reliability of the pump.

---

2. Piping runs should be as short as possible to minimize friction losses.
  3. Arrangements should be made to keep the pump from back spinning severely during shutdown. In situations where this occurs, a non-slam check valve should be installed.
- 



**CAUTION:** Do not start the pump while the impeller is in reverse rotation.

---

## Final piping check

After Connecting the Piping to Pump:

1. Turn the shaft several times by hand to confirm free rotation.
2. Check alignment per the procedure outlined earlier. If pipe strain is affecting alignment, it must be corrected prior to startup.

# Operation

## 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.
  - Avoid mechanical seal failure or pump seizure by:
    - increasing speed at startup to at least 65% of rated speed within 5 seconds and
    - decreasing speed at shutdown from 65% of rated speed to 0 within 5 seconds
- 




---

**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.
  - 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

---

**NOTICE:**

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

You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- 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.

## Pump support

Before starting a newly installed pump, check the pump supports and piping to be certain that they conform to the specifications in the [Installation](#) (page 14) section of this manual.

## Bearing lubrication

The bearings must have adequate lubrication. The bearings were properly filled with grease prior to shipment. Regrease bearings if pump was disassembled. Refer to [Maintenance of bearings](#) (page 25).

## Shaft rotation

The pump shaft must turn without any binding or rubbing - only the uniform frictional drag of the bearings should be felt. If the pump does not turn freely by hand, check to determine the cause of the binding.

## Correct driver rotation



---

**CAUTION:** Incorrect rotation could result in considerable damage to the pump. Check the motor rotation when motor is not connected to the pump shaft.

---

The direction of rotation of the driver must be checked before it can be coupled to the pump. The correct direction of rotation of the pump is indicated on the bearing frame. Since the impeller is threaded on, reverse rotation could cause the impeller to unscrew from the shaft.



---

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

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

- 
1. Lock out power to driver.
  2. Disconnect coupling from the driver or the belts from the drive. Make sure no parts are loose.
  3. Unlock driver power.
  4. Make sure everyone is clear of driver. Jog the driver just long enough to determine the direction of rotation. Rotation must correspond to the arrow on the pump.
  5. Lockout power to driver and reinstall coupling or belts.
  6. Reinstall coupling or belt drive guard.

## Priming

The liquid level must be above that shown on the dimensional drawing supplied with the order.



---

## Start the pump



---

**WARNING:** This unit must never be used without proper installation of the safety guards for rotating parts.

---



---

**CAUTION:** Immediately observe the discharge gauge after starting pump. If discharge pressure is not quickly obtained, stop the driver, check the liquid level and discharge valve, and attempt to restart.

---

1. Make sure the liquid level is at or above the minimum.
2. Slightly open the discharge valve.
3. Start driver.
4. Slowly open the discharge valve.

## Running pump

### General considerations

Driver may overload if the pumpage specific gravity (density) is greater than originally assumed or the rated flow rate is exceeded.

Always operate the pump at or near the rated conditions to prevent damage resulting from cavitation or recirculation.

New bearing housing seals may generate some heat until broken in. Oil should be applied to them if heat becomes excessive.

### Operating at reduced capacity



---

**WARNING:** Do NOT operate pump below minimum rated flows or with the discharge valve closed. These conditions can quickly lead to pump failure and a possible explosion.

---

Damage caused by reduced flow operations includes:

1. Increased Vibration Levels - Affects bearings.
2. Increased Radial Thrust - Stresses on shaft and bearings.
3. Heat Build Up - Vaporization causing rotating parts to score or seize or possible explosion.

## Final alignment

---



**WARNING:**

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
  - Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.
    - Follow the coupling installation and operation procedures from the coupling manufacturer.
  - Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.
- 
1. Run the pump under actual conditions for a sufficient length of time to bring the pump and driver up to operating temperature.
  2. Check the alignment per alignment procedure outlined earlier.

# Preventive maintenance

## General comments

A routine maintenance program can extend the life of your pump. Well maintained equipment will last longer and require fewer repairs. A maintenance record will help identify the potential causes of problems.

## Maintenance schedule

### Routine Maintenance

- Bearing Lubrication
- Vibration Analysis

### Routine Inspections

- Check for unusual noise, vibration and bearing temperature
- Inspect pump and piping for leaks
- Check temperature of bearings
- Observe discharge pressure

### Quarterly Inspections

- Check hold down bolts for tightness

### Yearly Inspections

- Check pump capacity, pressure, and power. If the pump performance does not satisfy your process requirements, the pump should be disassembled and inspected. Worn parts should be replaced.

## Maintenance of bearings

The bearings have been adequately greased prior to shipment. Under normal operating conditions, add grease monthly or after 500 operating hours, whichever occurs first. Add approximately (4) pumps to the inboard fitting and outboard fitting. Use a lithium based NLGI 2 grease to match the type used when the pump was initially built.

### NOTICE:

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

### Acceptable Greases:

Shell Alvania No. 2  
 Mobil Mobilux EP No. 2  
 Texaco Multifak No. 2  
 Sun Oil Co. Prestige No. 42 American Oil Co.  
 Amolith Grease No. 2



**CAUTION:** Never mix greases of different consistency (NLGI 1 or 3 with NLGI 2) or different thickener soaps (sodium or calcium with lithium). The consistency usually becomes softer and will not provide adequate lubrication to the bearings.

## Maintenance of seals

When it becomes necessary to replace the bearing housing seals, the housing and the bearings should be flushed clean with a solvent and repacked with new grease. Overpacking results in excessive bearing temperature.

## Maintenance of drive

Well designed and properly installed V-belt drives are capable of running for years without maintenance. There are a few points that should be checked periodically.

- Sheave Alignment - Alignment must be maintained for full power transmission, minimum vibration, and long drive life.
- Belt Installation - When installing new belts, shorten the center distance between sheaves so that the belts can be placed on the sheave without the use of force. Never 'roll' or 'pry' the belts into place, as this could damage the belt cords.
- Check Belt Fit - Regardless of the belt section used, the belt should never be allowed to bottom in the groove. This will cause the belts to lose their wedging action and allow slippage. Replace such sheaves or belts.
- Maintain Proper Belt Tension - Tension is essential for long belt life. Improper tension could cause belt fatigue and/or hot bearings. Methods of determining proper belt tension can be obtained from the drive manufacturer.
- Use Belt Guards - Belt guards protect personnel from danger and the drive from contamination. Inspect periodically to assure that belts do not rub against guard.
- Keep Belts Clean - Dirt and grease reduce belt life. Belt dressing affects performance only temporarily and is never recommended. Maintaining a clean drive is a better idea.

If any questions arise pertaining to the drive limitations, consult the manufacturer.

## Impeller clearance setting

A change in pump performance may be noted over time by a drop in head or flow or an increase in power required.

Performance can usually be restored by adjusting the impeller clearance. Each application is different and hence it is necessary to monitor the amount of wear over a certain period of time in order to set up an adjustment schedule.

Other factors which may indicate that impeller adjustment is required are:

- High thrust bearing temperatures resulting from uneven adjustment of impeller adjusting bolts
- Noise and vibration resulting from the impeller rubbing the suction liner

Adjust the impeller clearance with the pump in the vertical position.

**WARNING:**

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

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
1. Lockout power to driver.
  2. Remove the coupling guard (direct drive) or belt guard (belt drive).
  3. *Break* the coupling (direct drive) or remove tension from belts (belt drive).

---

**NOTICE:** Lubricate the adjusting bolts and nuts for easy turning.

---

4. Loosen the thrust housing adjusting bolt nuts (415A) and locking capscrews (356B).
  5. Turn thrust housing adjusting bolts (9956) counterclockwise to lower the thrust housing (134A) until the impeller (101) touches the suction liner (600R).
  6. Turn the thrust housing adjusting bolts (9956) clockwise to raise the thrust housing (134A) 0.76 mm | 0.030 in., which is the recommended operating clearance. This adjustment is best measured with a dial indicator. Adjust each bolt slightly each time around so that the thrust housing rises evenly and is not cocked in the bearing frame (228). Make sure the rotating assembly turns freely throughout the entire rotation.
  7. Tighten the thrust housing adjusting bolt nuts (415A) and locking capscrews (356B), carefully noting that the dial indicator does not change during final tightening.
  8. Make sure the rotating assembly turns freely throughout the entire rotation.
  9. Align the coupling (direct drive) or sheaves (belt drive) as outlined in the installation section.
  10. Replace the coupling guard (direct drive) or belt guard (belt drive).
- 

## Pump washdown

The pump is designed to prevent liquid from entering the bearing frame. Care should be taken, however, to avoid spraying a high pressure stream directly at the bearing frame seals.

## Troubleshooting guide

### Insufficient capacity

- Pump not primed, check the sump liquid level
- Speed too low
- Total head higher than pump rating
- Insufficient NPSH
- Impeller passages partially blocked.
- Wrong direction of rotation
- Mechanical defects: impeller worn or damaged, defective gasket causing leakage

### Insufficient pressure

- Speed too low
- Air in liquid
- Wrong direction of rotation
- Mechanical defects: impeller worn or damaged, defective gasket causing leakage

### Motor overload

- Speed too high
- Total head lower than pump rating resulting in increased flow
- Liquid being pumped has higher specific gravity than that for which it is rated

- Mechanical defects: bent shaft, worn bearings, worn impeller or other wet end parts
- Solids locked in and around impeller
- Rubbing or binding of rotating elements

## **Pump vibration**

- Foundation not sufficiently rigid
- Impeller partially blocked causing imbalance
- Misalignment of thrust housing - housing cocked
- Mechanical defects: bent shaft, worn bearings, worn impeller

## **Water hammer**

Water hammer is a high pressure surge within a closed pipe system, created by a rapid change in the flowrate. The most common is the sudden opening or closing of a valve or other flow control device. Rapid changes in flowrate can also occur when there is a sudden change in pump speed. Extensive damage to the pump and pipeline can result from water hammer.

# Disassembly and reassembly

Refer to figures at end of manual for disassembly and reassembly.

## 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.
- 

## Pump disassembly

### Disassembly of wet end



---

**WARNING:** Lockout driver power to prevent accidental startup.

---

1. Lockout power supply to motor.
2. Close discharge valve. Drain the pump.



**WARNING:**

- The pump may handle hazardous and/or toxic fluids.
- Hazardous fluids may be under pressure and may erupt when pump is opened, particularly if pump is hot.
- Allow pump to cool and open cautiously. Skin and eye protection may be required. Precautions must be taken to prevent injury or environmental damage. Always know the contents of the pump prior to opening it.
- Failure to do so can result in death, personal injury or property or environmental damage.

3. Remove piping from pump.
4. Remove coupling guard (direct connect) or belt guard and belts (belt drive). Remove motor.
5. Remove pump from sump and lay on horizontal surface.
6. Wash down pump and inside column pipe and casing with appropriate cleaner.
7. Remove motor mount and coupling (direct drive) or sheave (belt drive) from the pump.
8. Remove strainer, and/or tailpipe from suction half casing (100A), if supplied.
9. Remove the discharge pipe assembly (195) from bearing frame (228) and casing (100A/D), if applicable.



**WARNING:**

Suction casing (100A) must be supported before removing tiebolts.

10. Remove the suction half casing (100A). The suction liner (600R) will be attached to the casing.
11. Remove the suction liner (600R) from the suction half casing (100A).



**WARNING:** Do NOT apply heat to the hub or nose of the impeller due to the danger of explosion.

12. Unscrew the impeller (101) from the shaft (122) by clamping the shaft and turning the impeller in the direction for a normal right hand thread (counter-clockwise when viewing eye of impeller). After removing impeller, wrap tape around shaft threads to avoid damage. Remove impeller washer (199).
13. Mark the orientation of the gland half casing (100D) to the column pipe (192). Disassemble the gland half casing from the column pipe by removing capscrews (371W). The gland liner (600T) will be attached to the casing.
14. Remove the gland liner (600T) from the gland half casing (100D).
15. Mark orientation of column pipe (192) to bearing frame (228). Disassemble column pipe from bearing frame by removing capscrews (371M).

## Disassembly of power end

1. Remove the inboard bearing deflector (123A) by sliding it down the shaft.
2. Remove the inboard seal plate (119B) with O-ring (412) and seal (333) from the bearing housing (228).
3. Remove thrust housing locking capscrews (356B).
4. Draw thrust housing (134A) and shaft (122) from bearing frame (228).
5. Check inboard bearing (168C) to see if it is worn, loose, or rough and noisy when rotated. Press the inboard bearing (168C) off the shaft (122) if replacement is required. It is recommended that a new bearing be installed after pressing off old bearing, regardless of condition. The thrust bearing must be removed from the shaft to replace the inboard bearing (refer to step 7 (page 30)).
6. Remove the outboard deflector (123) by sliding up the shaft.
7. Remove the thrust bearing locking clip (361) from the thrust housing (134A).



8. Slide thrust housing (134A) up the shaft to remove from the thrust bearing (112C).
9. Check outboard thrust bearing (112C) to see if they are worn, loose, or rough and noisy when rotated. Remove the outboard bearing locknut (136) and lockwasher (382). Press the outboard bearing (112C) off the shaft if replacement is required. It is recommended that a new bearing be installed after pressing off old bearing, regardless of condition.
10. Check the condition of the inboard seal (333). Remove the inboard seal from the inboard seal plate (119B) if replacement is required. It is recommended that a new seal be installed after pressing out old seal, regardless of condition.
11. Check the condition of the outboard seal (332). Press the outboard seal from the thrust housing (134A) if replacement is required. It is recommended that a new seal be installed after pressing out old seal, regardless of condition.

## Inspections

### Impeller

Replace if excessive erosion, extreme wear, or vane breakage is evident. Reduction in hydraulic performance may be caused by excessive wear, especially along the suction wear ring surface.

### Suction/gland liners

Replace if excessive erosion or extreme wear is evident.

### Casing




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**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.

---

Replace if excessive erosion, corrosion, or extreme wear is evident.

### Shaft

Check for runout (0.015 mm | 0.006 in. maximum) to ensure that the shaft is not bent. Bearing seats and seal areas must be smooth and free of scratches and grooves. Shaft threads must be in good condition. Replace if necessary.

### Column pipe

Replace if worn or excessively corroded.

### Bearings

Replace if worn, loose, or rough and noisy when rotated.

### Seals, o-rings, gaskets




---

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

Replace during reassembly.

## Fastening



---

**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.
- 

## Reassembly

### Reassembly of power end

1. Clean shaft (122) thoroughly, checking for nicks or worn areas.
2. Press the outboard seal (332) into the thrust housing (134A), positioning the seal so that the lip points upward when installed in the pump. Press the inboard seal (333) into the inboard seal plate (119B), positioning the seal so that the lip points downward when installed in the pump. Lubricate both seals with a thin coat of grease.
3. Heat the inboard bearing (168C) evenly using an oven, bearing heater, or hot clean oil bath. The use of a torch is not recommended. Heat the bearing to 110°C to 121°C | 230°F to 250°F. Slide the bearing onto the shaft from the drive end until the bearing shoulder is firmly against the shaft shoulder. Hold in place until bearing cools and grips the shaft.
4. Heat the outboard bearing (112C) evenly using an oven, bearing heater, or hot clean oil bath. The use of a torch is not recommended. Heat the bearing to 110°C to 121°C | 230°F to 250°F. Slide the bearing onto the shaft until the bearing shoulder is firmly against the shaft shoulder. Hold in place until bearing cools and grips the shaft.
5. Position bearing lockwasher (382) and locknut (136) against the bearing shoulder and tighten firmly. Bend *tang* of lockwasher into locknut slot after the locknut has been tightened.
6. Hand pack the inboard (168C) and outboard bearings (112C) with recommended grease (see Maintenance section). Mound a small amount of grease above the bearing to ensure sufficient lubrication.
7. Insert thrust housing (134A) over the outboard bearing (112C).
8. Insert bearing locking clip (361) in thrust housing (134A).
9. Install O-ring (496A) on thrust housing (134A) and lubricate.
10. Install outboard deflector (123) by sliding it down the shaft until it is approximately 1.5 mm | 0.06 in. from the thrust housing (134A).
11. Insert thrust housing and shaft assembly into bearing frame (228). Install thrust housing locking capscrews (356B), thrust housing adjusting capscrews (9956) and nuts (415A). Adjust all hardware so that the thrust housing (134A) bottoms out in bearing frame (228).
12. Install O-ring (412) on inboard seal plate (119B). Slide inboard seal plate and seal up shaft and mount to bearing housing (228).
13. Install inboard deflector (123A) by sliding it up the shaft until it is approximately 1.5 mm | 0.06 in. from the inboard seal plate (119B).

### Reassembly of wet end

1. Slide column pipe (192) up shaft (122) and attach to bearing frame (228) with capscrews (371M) using the orientation marks made during disassembly.
2. Attach gland liner (600T) into gland half casing (100D).

3. Attach gland half casing (100D) to column pipe (192) using the orientation marks made during disassembly.
4. Remove protective tape from shaft (122) threads. Install impeller washer (199) on shaft (122). Thread the impeller (101) onto the shaft until it is snug against the shaft washer (199). Hold the drive end of the shaft and firmly tighten the impeller.
5. Move the impeller (101) by means of the thrust housing adjusting capscrews (9956) toward the drive end as far as possible.
6. Install the suction liner (600R) into the suction half casing (100A).
7. Attach the suction half casing (100A) and liner to the gland half casing (100D).
8. Adjust the impeller using the thrust housing adjusting screws (9956) so that the impeller turns freely.
9. Assemble the discharge pipe assembly (195) to the casing discharge (100A/D) and bearing frame, if supplied.
10. Install strainer and/or tailpipe onto suction half casing (100A), if supplied.
11. Install unit into sump, being careful not to damage the strainer, if supplied.
12. Connect piping to pump following procedures in the [Installation](#) (page 14) section.
13. Use [Impeller clearance setting](#) (page 26) to set proper impeller clearance.

## Reassembly of drive

1. Mount drive onto pump.
2. Align the coupling (direct drive) or sheaves (belt drive) as outlined previously.
3. Replace the coupling guard (direct drive) or belt guard (belt drive).

# Spare and repair parts

## Replacement parts procedure

To ensure against possible long and costly down time periods, especially on critical services, it is advisable to have spare parts on hand.

Repair orders will be handled with a minimum of delay if the following directions are followed:

1. Give model number, size of pump, and serial number. These can be obtained from the nameplate on the pump.
2. Write plainly the name and part number of each part required. These names and numbers should agree with those on the bill of material.
3. Give the number of parts required.
4. Give complete shipping instructions.

## Recommended spare parts

### Light Duty - Random mildly abrasive particles

- (1) Seal/Gasket Set

### Medium Duty - Light slurries up to 1.2 SG with moderately abrasive materials

- (1) Impeller
- (1) Gland Liner
- (1) Suction Liner
- (1) Seal/Gasket Set
- (1) Set Bearings

### Heavy Duty - Slurries over 1.2 SG with highly abrasive materials

- (1) Impeller
- (1) Gland Liner
- (1) Suction Liner
- (1) Shaft/Bearing Assembly
- (3) Seal/Gasket Set

### Severe Duty - Key process equipment and/or heavy slurries over 1.2 SG with high heads and highly abrasive particles

- (2) Impeller
- (2) Gland Liner
- (2) Suction Liner
- (3) Seal/Gasket Set
- (1) Spare Pump



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