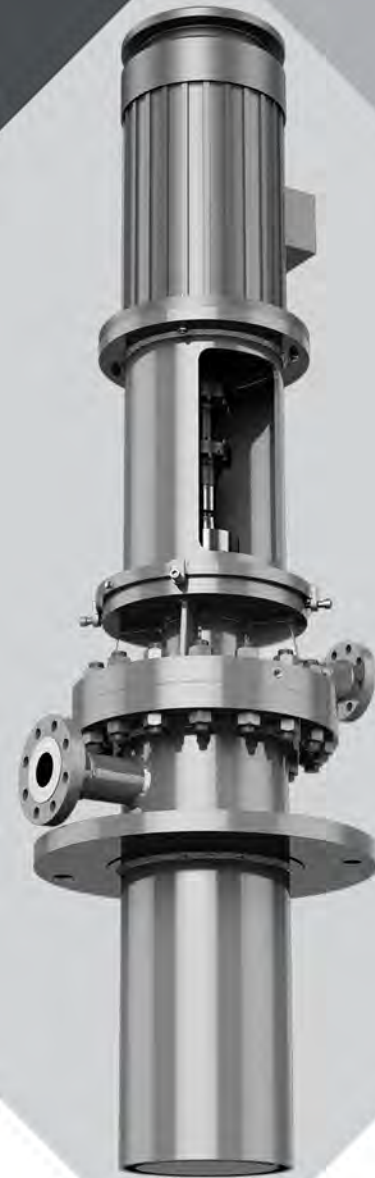


 **GOULDS PUMPS**

# Installation, Operation, and Maintenance

Model VICR



**ITT**



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# 1 Introduction and Safety

## 1.1 Introduction

### Purpose of this manual

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

- Installation
- Operation
- Maintenance



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**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.

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**NOTICE:**

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

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### 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.

Specifications such as weights, dimensions or centers of gravity of the pump, pump unit or subassemblies are described in the supplier's applicable documentation.

## 1.2 Safety



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**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.
- Pumps are provided specifically for an application. User should contact the OEM to use the pump for a different application.
- 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.
- Before proceeding, after alignment is complete, make sure that the coupling guard provided by the manufacturer is properly reinstalled. Guards must not be removed while the pump is operational. Always follow lock out - tag out procedures.
- Never operate the pump if a strainer is clogged.



**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.
- When the pump is handling hazardous liquids, care must be taken to avoid exposure to the liquid by following proper safety precautions, limiting personnel access, and by operator training. If the liquid is flammable and/or explosive, strict safety procedures must be applied.
- Gland packing must not be used when wetted with hazardous liquids.



### 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
 <p><b>DANGER:</b></p>	<p>A hazardous situation which, if not avoided, will result in death or serious injury</p>
 <p><b>WARNING:</b></p>	<p>A hazardous situation which, if not avoided, could result in death or serious injury</p>

Hazard level	Indication	
	<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

#### 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.



#### WARNING:

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

#### 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.

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**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.

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## 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:



- Electrostatic charging: Never earth (ground) an electric welding machine on pump equipment or base.
- 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"> <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>

### 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 Noise level data

Personnel exposed to noise levels exceeding 80 dBA (or less if specified by local regulations) shall wear hearing protection.

## 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.



Special care must be taken in potentially explosive environments to ensure that the equipment is properly operated and maintained. Compliance with the essential safety and health requirements has been assured by compliance with the following standards, method of protection Constructional Safety (C): ISO 80079-36 ISO 80079-37

### Description of Ex-Directives

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

### Guidelines for compliance

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

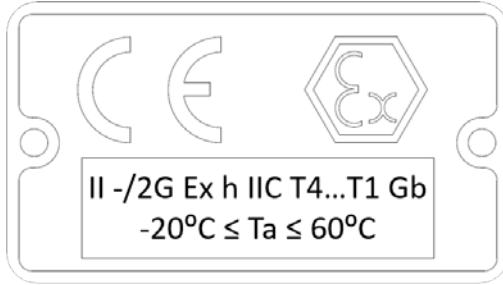
1. Monitoring the thrust bearing and liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

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

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

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

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



**Figure 1: Typical Ex nameplate**



**Figure 2: Typical UKCA Ex nameplate**

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

### **Equipment for monitoring**

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

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

## 2 Transportation and Storage

### 2.1 Receive the unit

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.

---

**NOTICE:**

Mechanical seals and related parts are shipped loose in a proper box.

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### 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, rigging and lifting



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**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.

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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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#### 2.3.1 Lifting methods



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**WARNING:**

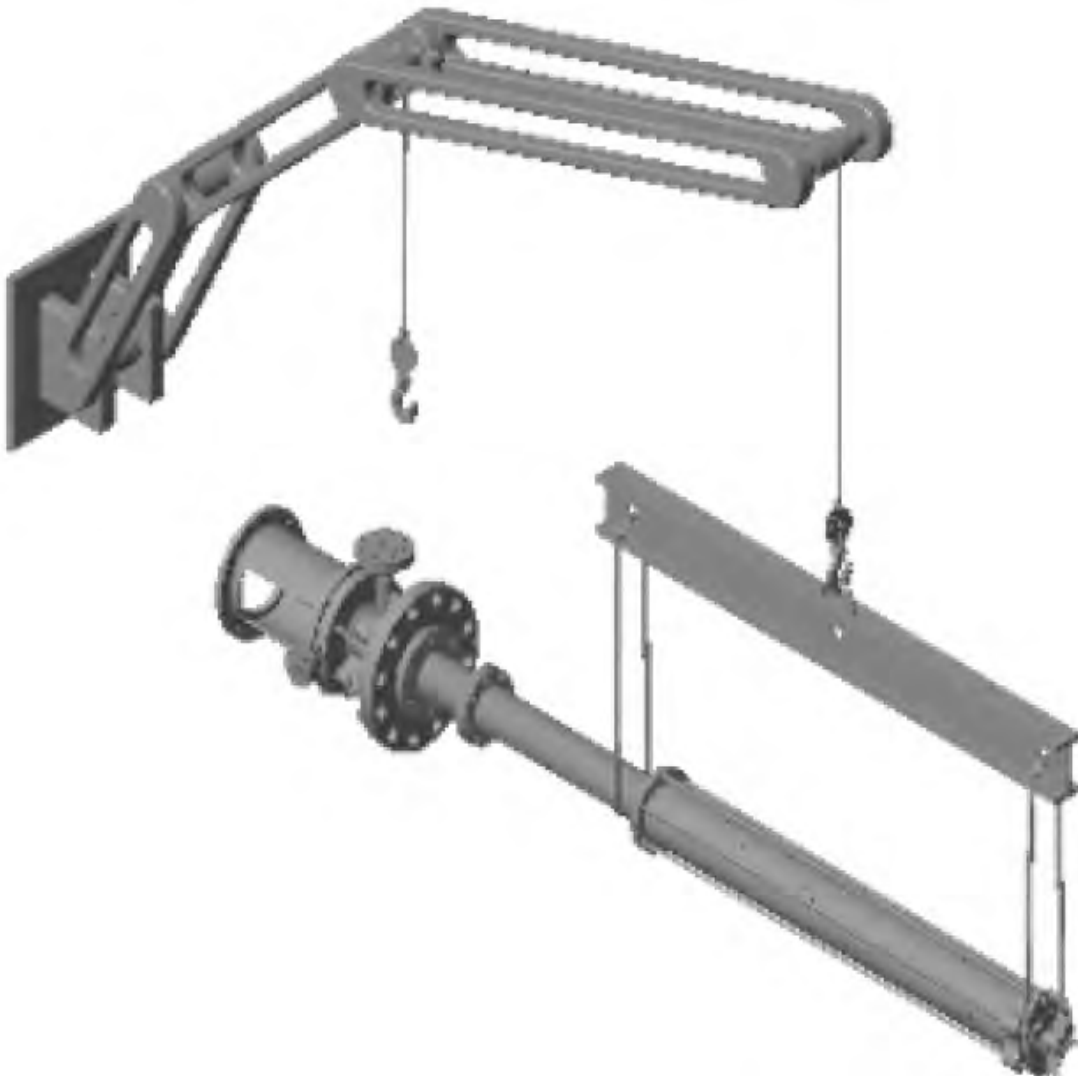
- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
  - Safe lifting points are specifically identified in this manual. It is critical 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.
-

**Table 1: Methods**

Pump type	Lifting method
A fully-assembled pump	Use suitable lifting devices attached to the lifting lugs on the discharge head or hoist rings on the discharge head base flange.
A partially-assembled pump	Use suitable lifting devices attached to the component or sub-assembly lifting lugs or suitable swivel hoist rings through the component flanges, bolt holes.
A disassembled pump	Use suitable lifting devices attached to the component lifting lugs or suitable swivel hoist rings through the component flanges, bolt holes.

**NOTICE:**

Rig the bowl assembly from the discharge head or column adapter and from the suction bell.  
Never rig the bowl assembly from the tie-rods.

**Example: VICR lifted from horizontal to vertical****Figure 3: VICR horizontal position**



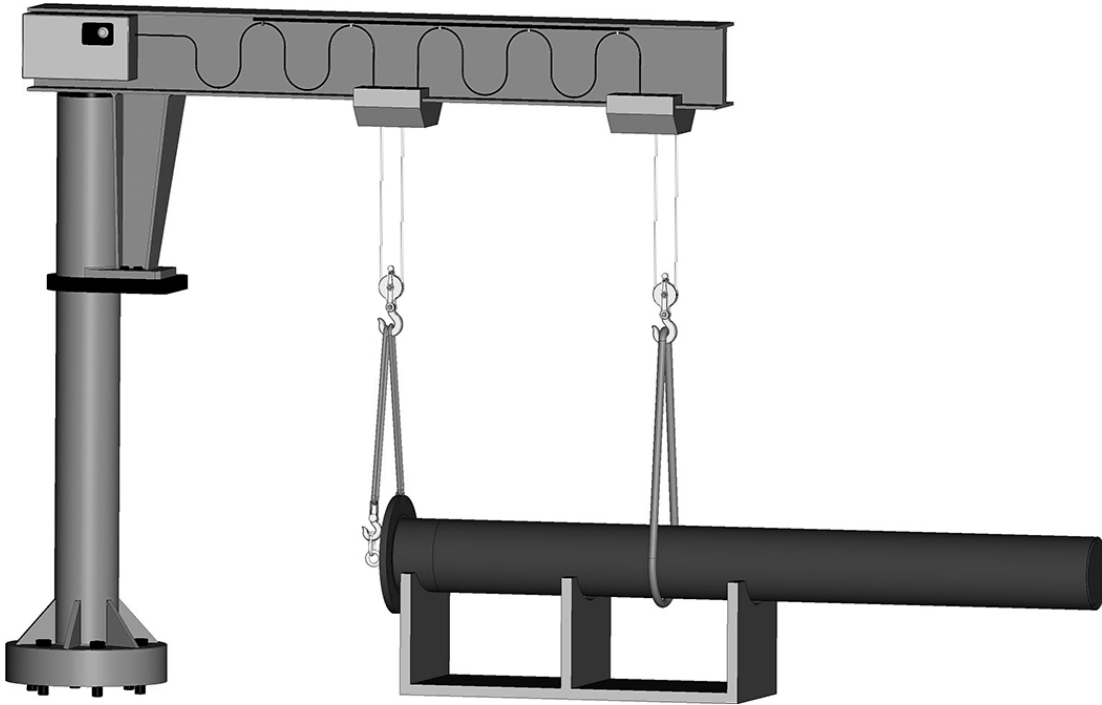
**Figure 4: VICR intermediate position**



**Figure 5: VICR vertical position**



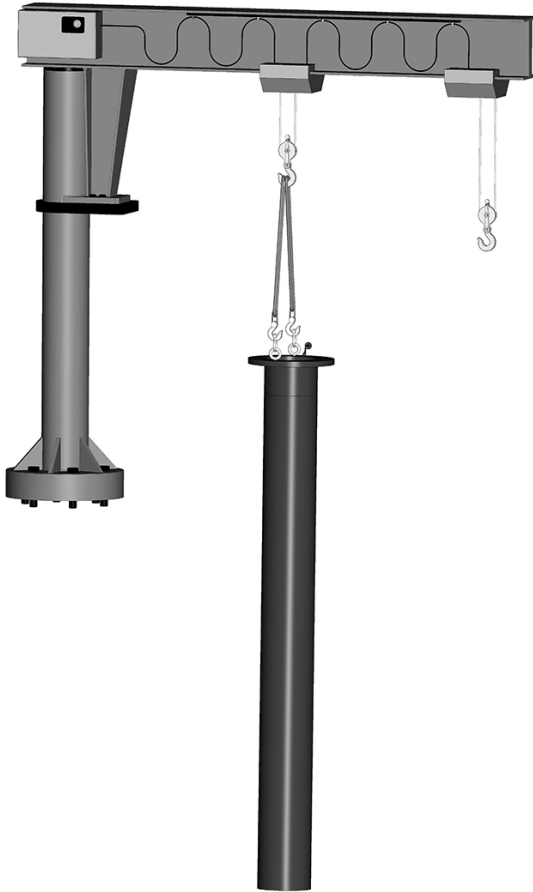
**Example: Barrel lifting**



**Figure 6: Barrel - horizontal position**



**Figure 7: Barrel - intermediate position**



**Figure 8: Barrel - vertical position**

## 2.4 Pump and bowl assembly storage requirements

### Requirements

Vertical units require proper preparation for storage and regular maintenance during storage. The pumpunit 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"> <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>• Place moisture absorbing material in the quantity to prevent condensation</li> </ul>

Condition	Proper preparation
	<ul style="list-style-type: none"> <li>• Tie coverings down in order to protect the pump from wind damage.</li> </ul>
Placement of units 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 and bowl assembly shaft	<ul style="list-style-type: none"> <li>• Rotate the shaft and bowl assembly shaft clockwise at least 3 turns once a month, at a minimum.</li> <li>• Never leave the shaft in a previous position or in the extreme raised or lowered lateral position.</li> <li>• Make sure that the shaft rotates freely.</li> </ul>
<p style="text-align: center;"><b>NOTICE:</b></p> <p style="text-align: center;">This activity is fundamental and requires a special boxing that should be ordered.</p>	
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.

## 2.4.1 Prepare the pump for long-term storage

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

1. It is recommended to disassemble the pump for storage, with the bowl assembly, columns, and discharge head resting vertically on wooden pallets. The line shaft should be stored in a horizontal position on wooden blocks. Weight of individual components has to be evenly distributed in a minimum of three points evenly spread according to the geometry of the component, same dimensions between resting points.
2. Apply rust-preventative to any exposed machine surfaces, disregarding the shaft. The shaft should be wrapped in plastic.
3. 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.
4. Place 13.5 kg | 30 lbs of moisture-absorbing desiccant near the center of the pump.
5. If the pump is assembled, place an additional 0.5 kg | 1 lb in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
6. Install a moisture indicator near the perimeter of the pump.
7. Wrap each component with black polyethylene with a minimum thickness of 0.15 mm | 6.0 mil, and seal it with tape.
8. Provide a small ventilation hole approximately 12.0 mm | 0.5 inch in diameter.

## 2.4 Pump and bowl assembly storage requirements

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9. Provide a roof or shed shelter to protect the pump from direct exposure to the elements.
10. For pumps equipped with thrust pots: remove driver support with thrust pot from pump assembly, store support with thrust pot vertically and fill thrust pot with suitable oil to the top oil sight gage.

---

# 3 Product Description

## 3.1 General description

The Model VICR pump is vertical, industrial, can, radial-type pump designed to meet a wide range of applications.

This pump has these capabilities:

- Capacities up to 636 m<sup>3</sup>/h | 2,800 gpm
- Heads up to 1372 m | 4500 ft.
- Power up to 2685 kW | 3,600 hp

### Bowl assembly

The bowl assembly construction is ring-section diffusers fastened together with tie rods. Bowls are assembled to each other with register fit. Impellers are always keyed to the shaft.

### Column

Flanged column construction with rabbeted fits provides positive shaft and bearing alignment, and also eases assembly and disassembly. The line shaft is supported within the column with the use of bearing retainers that are spaced in order to provide vibration-free operation and ensure long bearing and shaft wear.

### Discharge head

The discharge head is designed to support the pump and to align the driver to the pump. Driver support windows provide access to seal piping and allow for easy adjustment of seals and couplings.

### Suction barrel (can)

The suction barrel flange, or separate mounting flange, is designed to support the weight of the pump and driver when it is full of liquid. You can install the suction barrel in a sleeve or open steel structure with thermal insulation around the suction barrel below its mounting flange.

### Thrust pot

A thrust pot is an option that is used when the driver is not designed to carry the axial pump thrust.

### Drivers

Solid shaft drivers are used in all VICR applications. The rigidity of the rotor enhances vibration-free operation when mechanical seals are used.

### Balance drum and thrust producing device

Depending on service, balance drum or thrust producing device can be added to the product.

## 3.2 Nameplate information

### Important information for ordering

Every unit has a nameplate that provides information about it.

When you order spare parts, identify this pump information:

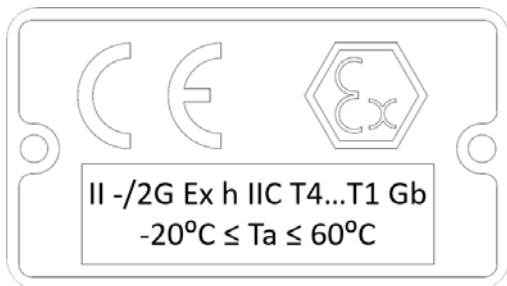
- Model

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

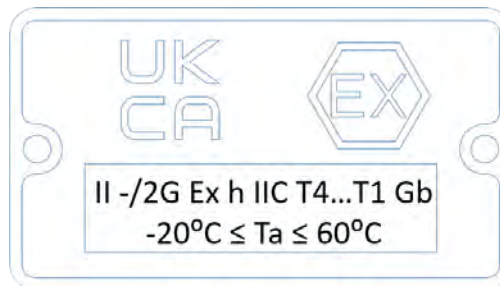
Item numbers can be found in the spare parts list.

**Ex nameplate**

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



**Figure 9: Typical Ex nameplate**



**Figure 10: Typical UKCA Ex nameplate**

The CE and the Ex designate the Ex compliance. The code directly below these symbols reads as follows:

Nameplate field	Explanation
II	Group 2
-/2	Category "inside/outside"
G	Gas present
h	Mechanical product
IIB	Gas group
T*	Temperature class, can be T1 to T4
Gb	Atmosphere and Equipment Protection Level

**Table 2: Temperature class definitions**

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

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

\* Maximum liquid temperature may be limited by the pump model and order specific options. [Table 2: Temperature class definitions on page 20](#) is for the purpose of determining T'x' code for Ex applications with liquid temperatures exceeding 107°C | 225°F.

**WARNING:**

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

---

# 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.
- When pumping fluids with conductivity less than 1000 ps/m follow IEC TS 60079 32-1 guidelines.
- Stray electrical currents may ignite explosive atmospheres. Ensure drives are certified for variable frequency drive operation by the manufacturer.
- In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.

---

**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 sole plate

1. A sole plate is furnished. Remove the sole plate from the suction barrel as it is shipped assembled.
2. Completely clean the underside of the sole plate.

### 4.1.2 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 suction barrel.
- 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.

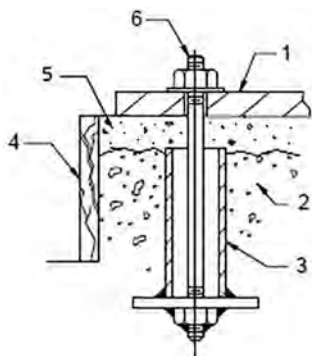
#### Typical installation

A typical installation has these characteristics:

- Bolts with a pipe sleeve that is two and a half times the size of the bolt diameter embedded in the concrete
- Properly sized



- Located in accordance with the dimensions given in the example drawing
- Enough space inside the pipe sleeves to allow the final position of the foundation bolts to align with the holes in the sub-base flange



- |                            |                |
|----------------------------|----------------|
| 1. Barrel flange, sub-base | 4. Dam         |
| 2. Foundation              | 5. Grout       |
| 3. Sleeve                  | 6. Anchor bolt |

**Figure 11: Example of a typical installation**

#### 4.1.2.1 Installing the sub-base on a concrete foundation



User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.

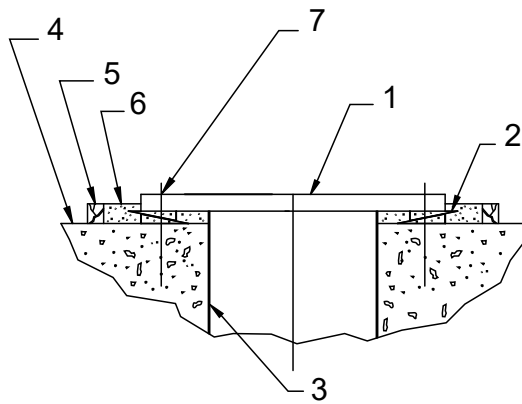
1. Remove water and debris from the anchor bolt holes and sleeves before you start the grout.
2. For sleeve-type bolts, fill the sleeves with packing or rags in order to prevent grout from entering the sleeves.
3. Carefully lower the barrel or sub-base onto the foundation bolts and hand-tighten the bolt nuts.
4. Use a machinist's level in order to level the barrel flange or sub-base or the machine surface of the sole plate using metal plates and leveling screws.

In order to ensure an accurate reading, check that the surface being leveled is free from all contaminants, such as dust.

5. Level the barrel or sub-base sole plate in two directions at 90° on the machined surface to achieve levelness condition indicated in this table.

**Table 3: Levelness tolerances**

<b>API</b>
42 micrometer per meter   0.0005 inch/ft



- |                              |                        |
|------------------------------|------------------------|
| 1. Barrel flange or Sub-base | Dam                    |
| Leveling wedges              | Grout                  |
| Floor sleeve (optional)      | Centerline anchor bolt |
| Foundation                   |                        |

**Figure 12: Example of a foundation**

#### 4.1.2.2 Grout the barrel or sub-base

Non-shrink grout is recommended for this procedure.



**WARNING:**

Follow grout manufacturers SDS sheets for recommended PPE.

1. Inspect the foundation for dust, dirt, oil, chips, and water.
2. Remove any contaminants.  
Do not use oil-based cleaners since they do not bond well with grout. Refer to the instructions from the grout manufacturer.
3. Build a dam around the foundation.
4. Pour grout to a minimum thickness of 9.520 mm | 0.375 in. between the barrel flange or sub-base and concrete foundation, up to the level of the dam.
5. Remove any air bubbles from the grout as it is poured by either puddling, using a vibrator, or pumping the grout into place.
6. Allow the grout to set at least 48 hours.
7. Remove the leveling wedges or leveling screws.
8. Tighten the foundation bolts to the torque value provided on the pump general arrangement drawing.

#### 4.1.3 Installing the pump on a structural-steel foundation

1. Locate the barrel and pump directly over, or as near as possible, to the main building support members, beams, or walls.
2. Bolt the barrel or sub-base to the support in order to avoid distortion, prevent vibration, and retain proper alignment.
3. Level the barrel or sub-base using solid shims.

### 4.1.4 Install the suction barrel (if applicable)

1. Remove all shipping covers.
2. Install suction barrel onto sole plate, and position drain connections according to piping arrangement.
3. Tighten suction barrel hold down bolts in accordance with the order-specific Pump Sectional Assembly drawing.

### 4.1.5 Install the pump

1. Remove all shipping covers.
2. Install the pump into the suction barrel and position suction and discharge connections according to piping arrangement.
3. Tighten all pressure vessel bolts in accordance with order-specific Pump Sectional Assembly drawing.

### 4.1.6 Piping checklists

#### 4.1.6.1 General piping checklist

##### Precautions



##### **WARNING:**

- Risk of premature failure. Casing deformation can result in misalignment and contact with rotating parts, causing excess heat generation and sparks. Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump as defined on the Certified Outline Drawing.
- Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
  - Use fasteners of the proper size and material only.
  - Replace all corroded fasteners.
  - Ensure that all fasteners are properly tightened and that there are no missing fasteners.



##### **CAUTION:**

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

##### **NOTICE:**

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

##### Piping guidelines

Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

**Checklist**

<b>Check</b>	<b>Explanation/comment</b>	<b>Checked</b>
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: <ul style="list-style-type: none"> <li>• Strain on the pump</li> <li>• Misalignment between the pump and the drive unit</li> <li>• Wear on the pump bearings, seal, and shafting</li> </ul>	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Keep the piping as straight as possible. Avoid unnecessary bends. Use 45° or long radius 90° fittings where necessary.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Make sure that the inside diameters match properly when you use flange joints.	—	
Do not connect the piping to the pump until: <ul style="list-style-type: none"> <li>• The grout for the foundation and sole plate has hardened for at least 48 hours.</li> <li>• The grout for the barrel or sub-base has hardened.</li> <li>• The anchor bolts for the sub-base to the foundation have been tightened.</li> <li>• Hold-down bolts for the suction barrel to the sub-base have been tightened.</li> <li>• Hold-down bolts for the pump to the suction barrel have been tightened.</li> <li>• Remove flange covers from the pump</li> </ul>	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
If the pump handles liquids at low or elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to thermal expansion or contraction of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	

Check	Explanation/comment	Checked
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

#### 4.1.6.2 Suction and discharge piping checklist

Check	Explanation/comment	Checked
Check that isolation valves are installed in the suction and discharge line.	Isolation valves are required for: <ul style="list-style-type: none"> <li>• Priming</li> <li>• Regulation of flow</li> <li>• Inspection and maintenance of the pump</li> </ul>	
For multiple pump installations, provide a check valve in the discharge line, between the isolation valve and the pump discharge connection.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow.	
If increasers are used, check that they are installed between the pump and the check valve.	—	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	
If increasers are used, they must be of the eccentric type.	This prevents air from collecting at the top of the discharge pipe.	

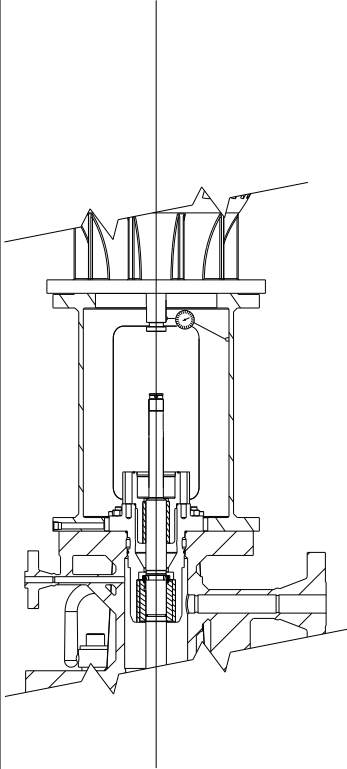
#### 4.1.6.3 Balance line piping checklist (if applicable, refer to pump general arrangement drawing)

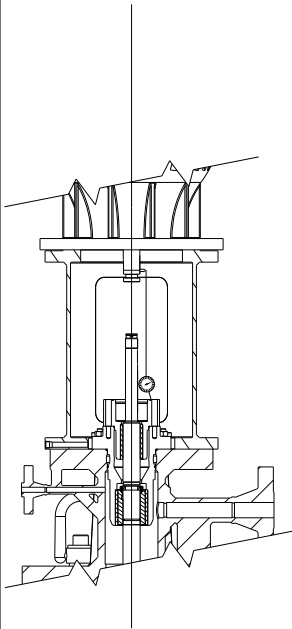
Table 4:

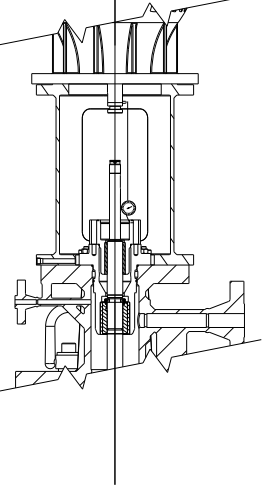
Check	Explanation/comment	Checked
Balance line piping diameter equal to or larger than the size of the balance line connection on the pump.		
Balance line piping pressure rating equal to or greater than the rating of balance line connection on the pump.		
Balance line piping free of obstructions and unnecessary turns and fittings (e.g., check valves).		
Balance line piping with manual valve to isolate suction source from pump during maintenance. This valve must be locked/tagged open whenever the pump is operating.		
Balance line piping with controlled backpressure to prevent flashing. See GA drawing for special instructions.		
Balance line piping sumps continually upwards towards the source of suction.	Special requirement for light hydrocarbons, condensate, or feed water applications	
Monitor pump discharge flow rate by measuring temperature of balance line flow and calculating temperature rise from suction flow to balance line	Optional for monitoring purposes	

Check	Explanation/comment	Checked
flow. Goulds Pumps will provide temperature rise alarm points upon request.		
Monitor balance line flow rate by measuring pressure of balance line flow and calculating pressure rise from suction flow to balance line flow. Goulds Pumps provide pressure rise alarm point upon request.	Optional for monitoring purposes	

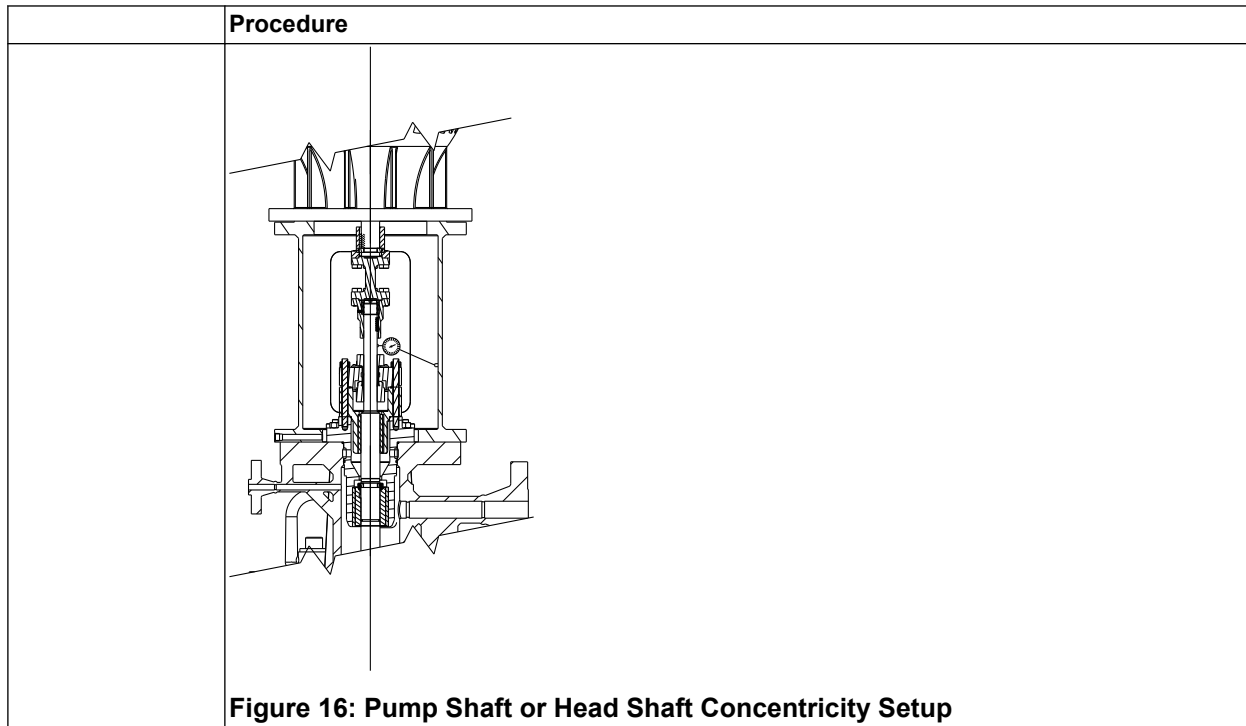
### 4.1.7 Alignment Procedure

	Procedure
Runout of driver shaft	<ol style="list-style-type: none"> <li>1. Install the dial indicator as shown in <a href="#">Figure 13: Drive Shaft Concentricity Setup on page 28</a>Figure 4, with the base attached to the motor support.</li> <li>2. Rotate the driver shaft by hand while you read the dial. Make sure that the runout does not exceed NEMA standards, 0.05 mm   0.002 in. maximum TIR.</li> <li>3. If the indicator reads higher than 0.05 mm   0.002 in. TIR, loosen the driver support's hold-down bolts and relocate the driver support and driver with use of alignment screws on driver support.</li> <li>4. Obtain the desired position.</li> <li>5. Tighten the hold-down bolts and repeat the indicator reading.</li> </ol>  <p><b>Figure 13: Drive Shaft Concentricity Setup</b></p>
Flatness and angularity of the seal housing face	<p>For this measurement, remove the mechanical seal if the dial indicator stylus cannot rotate 360° on the top surface of the seal gland.</p> <ol style="list-style-type: none"> <li>1. Remove the lower coupling components and attach the base of the dial indicator to the driver shaft.</li> <li>2. Place the stylus at the top surface of the seal gland, or at the top of the surface of the seal housing.</li> <li>3. Slowly rotate the driver shaft 360°.</li> </ol>

<b>Procedure</b>	
	<p>4. Check that the face of the seal housing is square with the shaft to within 0.5 micrometers TIR per millimeter of indicated diameter   0.0005 inches TIR per inch of indicated diameter.</p>  <p><b>Figure 14: Seal Chamber Flatness and Angularity Setup</b></p>
Runout of the seal housing bore	<p>This measurement requires that you remove the mechanical seal.</p> <ol style="list-style-type: none"> <li>1. Install the dial indicator as shown.</li> <li>2. Rotate the driver shaft by hand and run the indicator in the inside-machined surface of the seal housing in order to determine the concentricity.</li> <li>3. If the indicator reads higher than 0.05 mm   0.002 in. TIR, loosen the driver hold-down bolts and relocate the driver on the motor base register.</li> <li>4. Obtain the desired position.</li> <li>5. Tighten the hold-down bolts and repeat the indicator reading.</li> </ol>

	Procedure
	 <p data-bbox="462 871 1023 903"><b>Figure 15: Seal Housing Concentricity Setup</b></p>
<p>Concentricity of the pump shaft or head shaft</p>	<ol style="list-style-type: none"> <li>1. Reinstall the mechanical seal if it was removed for the flatness or concentricity measurement.</li> <li>2. Install the coupling assembly and adjust the impeller.</li> <li>3. Attach the base of the dial indicator on the discharge head or driver support.</li> <li>4. Place the stylus on the shaft between the top of the seal and the bottom of the pump coupling.</li> <li>5. Rotate the driver shaft slowly 360°.</li> <li>6. Check that the shaft runout is within 0.07 mm   0.003 in. TIR, or as required by specification.</li> <li>7. Position and install the drive collar of the seal by tightening the setscrews using the instructions from the mechanical seal manufacturer.</li> <li>8. Save the seal spacer or eccentric washer. You can use these in order to hold correct seal spacing in the event that you have to remove the seal. You must loosen the seal setscrews to re-adjust the impellers.</li> <li>9. Seals that use half-dog-point setscrews might require that the shaft be spot faced or drilled in order to provide a secure placement:             <ol style="list-style-type: none"> <li>1. Cover the seal and seal housing.</li> <li>2. Remove the setscrews one at a time from the collar and spot face or drill the shaft and then tighten the setscrews into position.</li> <li>3. Remove any metal chips in order to avoid damage to the seal.</li> </ol> </li> </ol>





## 4.2 Mechanical seal options

Pumps are shipped without mechanical seals installed. Refer to the mechanical seal manufacturer's installation instructions.

These are the mechanical seal options for this pump:

- Cartridge mechanical seal
- High-pressure seal
- Dual mechanical seal

### 4.2.1 Install the mechanical seal




---

#### CAUTION:

Sparsingly lubricate the shaft and sleeve ID with the lubricant included with the mechanical seal or recommended by the mechanical seal manufacturer.

---

#### NOTICE:

- Do not bump carbon inserts against the shaft as they can chip, crack, or break.
  - Do not over tighten the cap screws on the gland. This can distort the seal seat and cause seal failure.
  - Do not remove the seal spacer or eccentric washer, adjust the seal, or tighten the set-screws until after you adjust the impellers.
  - Reset the seal after you adjust the impeller.
- 

1. Install the O-ring or gasket between the seal housing and seal:
  - a) Install the seal over the shaft and ease it into position against the face of the seal box.

- b) Take care when you pass the sleeve and O-ring over the keyways or threads in order avoid damage to the O-ring.
2. Position the seal gland on the discharge-head seal housing and secure it with cap screws.
3. Tighten the cap screws gradually and uniformly in a crisscross pattern, taking two or three passes.
4. Install all seal piping as required.
5. Before you make the final connections of the sealing-liquid pressurizing lines, make sure the seal housing and all sealing-liquid lines are flushed free of dirt, scale, and other particles using barrier fluid only.
6. Install the driver and coupling.
7. Take flatness and concentricity measurements once the seal is installed.

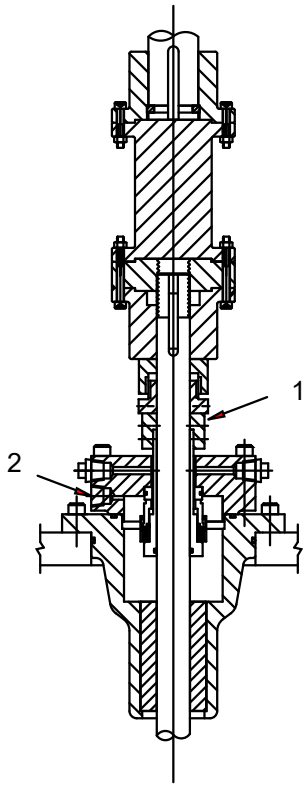
### 4.2.2 Installing the high-pressure seal

High-pressure seals have these characteristics:

- Usually cartridge seals
- Shipped assembled and ready for installation
- Are either single or dual seals

Mechanical seals on pumps with over 50 kg/cm<sup>2</sup> | 700 psi gauge discharge pressure, or a pressure level specified by the seal manufacturer, are normally fitted with backup rings. These rings are installed after the seal installation, between the drive collar of the seal and the bottom of the flanged-pump coupling.

1. Check the TIR on the headshaft above the mechanical seal.
2. Install the backup ring:
  - a) Thread the bottom backup ring into the top backup ring until it bottoms out.
  - b) Slide the backup ring assembly over the shaft and position it on the seal.
3. Install the spacer coupling and the driver.
4. Set the seal into position.
5. Adjust the backup ring assembly.



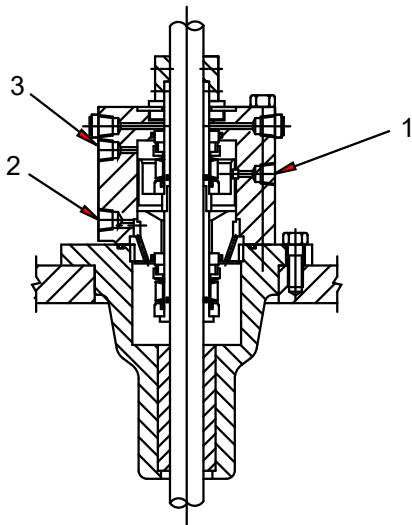
1. Back-up rings
2. Bypass to suction

**Figure 17: Mechanical Seal in Housing**

### 4.2.3 Installing dual mechanical seals

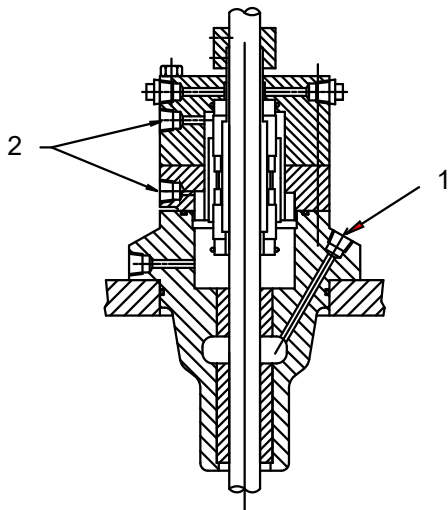
Dual seals are:

- Cartridge seals
- Shipped assembled and ready for installation
- Design has two options as shown below.



1. Connection to external seal lubrication
2. Bypass to suction
3. Connection to external seal lubrication

**Figure 18: Tandem-mounted seal (dual unpressurized)**



1. Bypass to suction
2. Connection to external seal lubrication

**Figure 19: Double-mounted seal (dual pressurized)**

### 4.3 Install a solid-shaft driver



**WARNING:**

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.

---

**WARNING:**

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- Do not test the motor for direction of rotation when it is coupled to the pump. If the pump is driven in the wrong direction, serious damage to the pump, motor, and personnel could result.
- Avoid working under suspended loads. If necessary to do so, follow the more stringent of local, state or federal safety regulations.

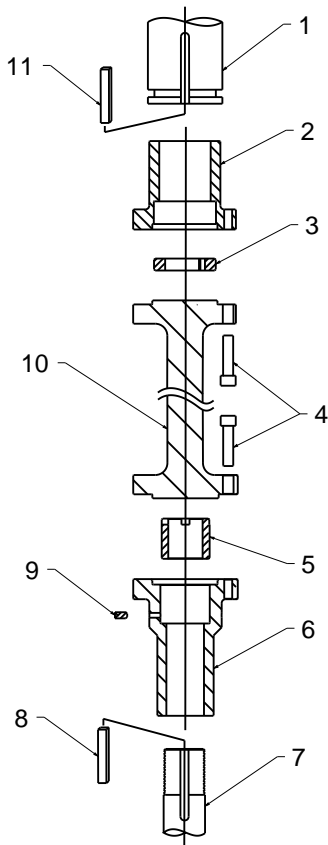
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**NOTICE:**

- Refer to the separate IOM supplement for thrust pots.
- Read and follow the motor manufacturer's instructions before lubricating the motor bearings. Excessive lubrication can cause the bearings to overheat and fail prematurely.

---

The spacer type adjustable rigid coupling is used on pumps furnished with a mechanical seal to permit servicing of the seal without the removal of the driver.



1. Driveshaft
2. Driver hubs
3. Split ring
4. Capscrew
5. Adjusting nut
6. Pump hub
7. Pump rotor
8. Pump key
9. Setscrew
10. Spacer
11. Driver key

**Figure 20: Spacer-type adjustable rigid coupling**

1. If a driver support is furnished and not installed, perform these steps:
  - a) Hoist the driver support and inspect the mounting surfaces and register.
  - b) Clean these surfaces thoroughly.
  - c) Install the driver support on the discharge head and secure it with capscrews.
2. Attach a sling to the lifting lugs of the driver and hoist the motor.
3. Inspect the mounting surface, register, and shaft extension, and then clean these surfaces thoroughly.  
If any burrs are found, remove them with a smooth mill file.
4. Orient the motor-conduit box in the required position:
  - a) Align the motor-mounting holes with the mating-tapped holes on the discharge head.
  - b) Lower the motor until the registers engage and the motor rests on the discharge head.

- c) Secure the motor with capscrews.
5. On drivers with a non-reverse ratchet or pins, manually turn the driver shaft clockwise when viewed from the top, until the non-reverse ratchet or pins fully engage.
6. Lubricate the motor bearings according to the instructions on the lubrication plate attached to the motor frame.
7. Make temporary electrical connections according to the tagged leads or the diagram attached to the motor.

The motor must rotate clockwise when viewed from the top. See the arrow on the pump nameplate. If the motor does not rotate clockwise, change the rotation by interchanging any two leads (for three phase only). For single-phase motors, see the instructions from the motor manufacturer.

If motor shaft-end-play adjustment is required, check it using a dial indicator before you connect the pump coupling to the solid-shaft motor. Consult the applicable motor manufacturer instruction manual for detailed information on motor shaft end play.

### 4.3.1 Install the coupling hub and make pump rotor adjustment

---

#### NOTICE:

- Ensure motor alignment is performed prior to coupling installation.
  - Impeller adjustment is identical for all driver types.
  - The impeller lift is measured from height required for the rotor to turn freely (i.e. as the rotor is lifted up from its resting position, the point at which the rotor spins freely is the lift datum,  $A=0$ ).
  - Adjust the pump rotor lift by turning adjusting nut. Ensure backup ring (if supplied) is placed and bottomed out prior to coupling installation.
- 

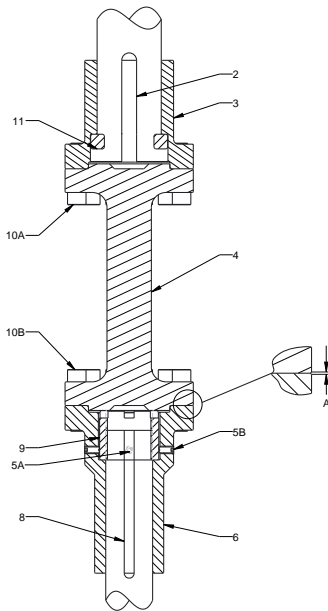
1. Apply a thin film of oil on the pump key (8) and insert the key into the pump rotor (7) keyway seat.
2. Gently lower the pump hub (6) onto the pump rotor (7).
3. Thread the adjusting nut (9) onto the pump rotor (7) until it is flush with the top of the pump rotor (7).
4. Apply a thin film of oil to the driver key (2) and insert the key into the driver shaft keyway seat.
5. Place the driver hub (3) onto the driver shaft (1) with the key (2) and slide it up the driver shaft (1) until the split ring groove is exposed. Ensure the driver hub is in contact with the split ring.
6. Install the split ring (11) in the groove and slide the driver hub (3) down over the split ring (11) to capture it.
7. Install spacer (4) securely to driver hub (3) with cap screws (10A) with torque to specified value on General Arrangement drawing.
8. Obtain pump rotor lift setting (A) from the order-specific General Arrangement drawing.
9. Turn the adjusting nut (9) until the gap between the adjusting nut and the coupling spacer (4) is equal to A.
10. Hand tighten two cap screws (10B) between coupling spacer (4) and pump hub (6) until pump rotor can just be rotated by hand.
11. Measure the gap between coupling spacer (4) and pump hub (6). If this gap is equal to A, proceed to step 12. If not, remove two cap screws, lower pump hub, and readjust adjusting nut.
12. When the specified lift, measured between pump rotor hub (6) flange and spacer (4) flange, is achieved, secure the spacer to the pump hub with cap screws (10B) and torque to specified value on General Arrangement drawing.
13. Install and securely tighten locking set screw (5A) in line to keyway on the pump hub.
14. Install two set screws (5B) located  $90^\circ$  to keyway, gradually tightening on each side until both are securely installed.
15. Check that all set screws are securely installed.

### 4.3.2 Impeller adjustment

**NOTICE:**

- When a mechanical seal is provided, make sure it is not secured to the shaft during impeller adjustment. The shaft must move up or down within the seal assembly.
- For pumps that handle liquids between -45°C to 93°C | -50°F to 200°F, you can make impeller adjustments under ambient conditions. For liquids in excess of this range, make any impeller adjustments after the pump reaches the temperature of the liquid. In situations where this is not feasible due to safety considerations, or impossible due to external ice buildup in cryogenic applications, refer to the factory for specific instructions.
- Improper impeller adjustment can cause contact between the rotating and stationary parts. This may result in sparks and heat generation.

**Example figures**



1. Driveshaft
2. Driver key, supplied by motor vendor
3. Driver hub
4. Spacer
5. Setscrews
6. Pump hub
7. Pump rotor
8. Pump key
9. Adjusting nut
10. Capscrew
11. Split ring

**Figure 21: Spacer coupling (Type AS)**



## 4.4 Installation and startup checklist

Use this checklist in conjunction with the standard instruction manual furnished with the equipment. Initial each completed item or write N/A if the item is not applicable. After you complete this checklist, forward a copy to the VPO field service for entry into the quality assurance records. Use a separate checklist for each individual pump.

### Part 1: System and installation inspections

Check	Checked
Check that the pump foundation is level according to <a href="#">4.1.2.1 Installing the sub-base on a concrete foundation on page 23</a> .	
Check that the foundation can handle the weight and loading of the pump.	
Check that the foundation is properly grouted using a high quality non-shrink 2 part epoxy grout.	
Check that all the anchor bolts are tight.	
Check that the suction and discharge piping is properly supported and that there is no excess nozzle loading on the discharge flange.	
On units with flexible or expansion joints attached to the pump suction or discharge, check that tie rods are in place and properly installed.	
Check that the suction valve is fully open.	
Check these items for all valves: <ul style="list-style-type: none"> <li>• Operate freely</li> <li>• Properly installed for the direction of flow</li> <li>• Have the proper pressure</li> </ul>	
Check where the pumped fluid is going and that the system is properly lined up for the test.	
Check that the pumped fluid supply will be continuously available for the duration of the test. It is very important that the initial run is at least ten minutes in duration in order to completely flush the pump.	
If possible, check the cleanliness of the pumped fluid and piping. If you are present during the installation, check that the sump, barrel, and piping are clean.	
Check that electrical conduit and boxes aren't obstructing of the windows of the discharge head.	
Check that electrical conduit and boxes are sized to manufacturers' recommendations along with all appropriate standards and local statutes.	
Check that all control and alarm systems, which may be electrical, hydraulic, or pneumatic, are corrected installed and functioning in accordance with the manufacturer's instructions. All alarm point settings should be verified.	

### Part 2: Pump assembly pre-start inspections

Check	Checked
Verify that the drivers are properly lubricated before start-up. On drives with grease-lubricated motor bearings, insist that the motor vendor grease them on-site. Lubrication information is located on special motor tags or in the motor manuals. Verify that the rolling element in the seal is being properly lubricated.	
Determine the allowable number of cold/hot starts with the motor vendor. The general rule of thumb is two cold or one hot start per hour. Exceeding the recommended starts breaks down the motor insulation and can cause failure. Megger the motor if possible.	
Before you couple the driver to the pump, verify the proper rotation of the driver by bumping it. The proper rotation for vertical pumps is clockwise when viewed from above.	
Run the pump uncoupled in order to check that the driver runs smooth and sounds normal.	

#### 4.4 Installation and startup checklist

Check	Checked
<ul style="list-style-type: none"> <li>On drivers with NRRs, remove the ratchet pins, if possible. Otherwise, rotate the drive coupling clockwise until the pin stops tight against the ratchet plate.</li> </ul> <p>On drivers with non-reverse ratchets, remove the ratchet pins, if possible. Otherwise, rotate the drive coupling clockwise until the pin stops tight against the ratchet plate.</p> <p>If a customer refuses to allow you to check the rotation, have the customer sign and date this checklist before you proceed.</p>	
<p>After you verify the proper rotation of the driver, you can couple the pump to the driver.</p> <ul style="list-style-type: none"> <li>On VSS units with a flanged coupling set the impeller lift.</li> </ul> <p>See either the pump nameplate or the order-specific General Arrangement drawing for pump rotor lift required for an individual pump.</p>	
<p>Check the alignment on pumps that are equipped with jacking bolts since they require that the motor be physically aligned to the pump.</p> <p>Special alignment of the pump to the motor is not usually required since all components are equipped with register fits.</p>	
<p>Use a dial indicator in order to check that the shaft runout above the sealing element is not excessive:</p> <ul style="list-style-type: none"> <li>Mechanical seal limit is a maximum of 0.10 mm   0.004 in.</li> </ul>	
<p>On units with seals, check these items:</p> <ul style="list-style-type: none"> <li>Check that the seal rotates freely.</li> <li>Check that the seal spacers are removed.</li> <li>Check that the seal piping is properly installed and leak-free.</li> <li>Check that the barrier fluid is filled and completely vented.</li> </ul>	

### Part 3: Unit startup

Check	Checked
After you complete all of the checks in Parts 1 and 2, conduct a start-up meeting with customer in order to discuss the actual procedures they might require during start-up and commissioning. Also, verify with the customer that their system is ready for pumped fluid.	
When the system is ready, push the start button and adjust the discharge valve in order to meet the design point, if required.	
Watch for signs of trouble. The unit must run at least ten minutes in order to flush out the pump and system.	
Verify that the unit runs smoothly with no unusual noise, vibration, or over heating.	
Run the unit for one hour in order to test the system.	

### Measurements

Reading	Value
Impeller lift	
Driver shaft runout	
Pump head shaft runout	
Seal housing face runout	
Seal housing bore runout	
Megger	
Vibration	

# 5 Commissioning, Startup, Operation, and Shutdown

## 5.1 Preparation for startup



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**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.



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**WARNING:**

- Failure to use or incorrect use of auxiliary connections provided (e.g. barrier fluid, flushing liquid, etc.) may result in injury from escaping fluid, burns, and malfunction of the pump. Refer to the general arrangement drawing, piping layout, mechanical seal drawing and seal system drawing for the quantity, dimensions and locations of auxiliary connections.
- 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.
- Prior to startup, make sure that all areas, such as threaded openings, vent and drain valves, and flanged openings, that could leak pumped fluid to the work environment are closed.
- 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.



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**WARNING:**

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

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**NOTICE:**

Avoid mechanical seal failure or pump seizure by:

- never running the pump at a speed below 65% of full speed unless operating range for this pump has specifically been approved by the manufacturer at a lower speed.
  - never running the pump at a speed lower than the speed required to overcome the static lift.
- 

**Precautions**



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**WARNING:**

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

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**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.

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**NOTICE:**

- Avoid running a pump at critical speeds.
  - 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.
  - Make sure that the cool-down rate does not exceed 2.8°C | 5°F per minute.
  - Prior to startup, make sure that all areas, such as threaded openings, vent and drain valves, and flanged openings, that could leak pumped fluid to the work environment are closed.
- 

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**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 seal-housing bearing.
  - Using appropriate precaution and personal protection equipment, check that the pump rotor still rotates freely.
  - 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.

- Rubber bearings must be wet prior to startup if the non-submerged (dry column) length is greater than 15 m | 50 ft. You can only use clean water or clean sea water.

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

### 5.1.1 Prepare for startup



#### WARNING:

- For the VSS motor, do not check the motor rotation unless the motor is bolted to the pump and the driver hub is disconnected from the pump hub.
- Do not test the motor for direction of rotation when it is coupled to the pump. If the pump is driven in the wrong direction, serious damage to the pump, motor, and personnel could result.

Consult the applicable manufacturer instructions for detailed information for the prime mover (electric motor, engine, or steam turbine), coupling, drive shaft, gear-head, or mechanical seal.

1. Confirm that you have completed these procedures:
  - a) Connected the driver to a power supply.
  - b) Verified that the driver rotates clockwise when viewed from above.
  - c) Checked the alignment between the pump and driver.
  - d) Adjusted the pump rotor.
  - e) Attached the mechanical-seal lock collar to the shaft if applicable.
2. Verify that the mechanical seal is properly lubricated and that all piping to the seal is connected.
3. Verify that all cooling, heating, and flushing lines are operating and regulated.
4. Verify that all connections to the driver and starting device match the wiring diagram.
5. Verify that the voltage, phase, and frequency on the motor nameplate agree with the line current.
6. Rotate the shaft manually to make sure that the impellers are not binding.
7. Verify that the driver bearings are properly lubricated and check the oil level in the housing.
8. Verify that the auxiliary seal components are properly connected.
9. Verify that the auxiliary seal components are properly vented.
10. Inspect the suction and discharge-piping connection and pressure gauges for proper operation.

## 5.2 Pump priming



#### CAUTION:

The pump must be properly vented through the discharge head connections. This is important for liquids with suction pressures close to their vapor pressures. Vent piping must continuously rise back to the suction source so that liquid cannot collect in the vent line.

#### NOTICE:

Net positive suction head available (NPSH<sub>A</sub>) must always exceed NPSH required (NPSH<sub>R</sub>) as shown on the published performance curve of the pump.

### Requirements

- The minimum submergence must always be as indicated on the Certified Pump Outline Drawing.
- Never run the pump dry as this can cause the rotating parts within the pump to gall and seize to the stationary parts.
- The parts are lubricated by the liquid being pumped unless the enclosed lineshaft option is purchased to lubricate the lineshaft bearings with a clean fluid.

## 5.3 Start the pump



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### WARNING:

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

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

- Open the suction valve.
  - Open any recirculation.
1. Fully close the discharge valve and fully open minimum flow bypass line or partially open the discharge valve, depending on system conditions.
  2. Start the driver.
  3. Slowly open the discharge valve until the pump reaches the desired flow.
  4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
  5. If the pump fails to reach the correct pressure, perform these steps:
    - a) Stop the driver.
    - b) Confirm adequate suction conditions.
    - c) Restart the driver.
  6. Monitor the pump while it is operating:
    - a) Check the pump for bearing temperature, excessive vibration, and noise.
    - b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
  7. Repeat steps 5 and 6 until the pump runs properly.

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## 5.4 Pump operation precautions

### General considerations

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**WARNING:**

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

**NOTICE:**

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.
  - Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
    - The specific gravity or viscosity of the fluid is greater than expected
    - The pumped fluid exceeds the rated flow rate.
  - Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.
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### Operation at reduced capacity

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**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 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.
- 

**CAUTION:**

- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
  - Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
  - 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.
- 

**NOTICE:**

- Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available (NPSH<sub>A</sub>) always exceeds NPSH required (NPSH<sub>R</sub>) as shown on the published performance curve of the pump.
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### Operation under freezing conditions

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#### **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.

---

## 5.5 Mechanical seal leaks

### Occasional leaks

If the seal leaks slightly at start-up, allow a reasonable amount of time for the seal to adjust itself. Fluids with good lubricating qualities normally take longer to adjust than fluids with lesser lubricating qualities. When a seal starts out with a slight leak and the leak decreases while running, it indicates leaks across the seal faces. Run the pump continuously in order to eliminate this issue.

### Continuous leaks

When immediate leaks occur and remain constant, even during operation, it usually indicates either secondary seal damage, or seal faces that are warped or cracked. See Troubleshooting for probable causes.

## 5.6 Shut down the pump



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#### **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.

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1. Slowly close the discharge valve.
2. Shut down and lock out the driver to prevent accidental rotation.
3. If the driver is not equipped with a non-reverse ratchet (NRR), be certain that the unit is completely stopped before you restart the pump.
4. On pump sets with double mechanical seal, apply the required pressure specified in the mechanical seal documentation to the mechanical seal chamber also during standstill.
5. Ensure quench liquid supply is on during pump standstill.

## 5.7 Lubricate the thrust pot during a shutdown period

1. Completely immerse the bearings in oil.  
This helps to avoid oxidation of the anti-friction bearings during shutdown periods lasting longer than one week.
2. Fill the oil reservoir until the oil runs over the oil retainer tube and down the shaft.

Before startup, drain the oil to its required level.



# 6 Maintenance

## 6.1 Maintenance schedule

### Maintenance inspections

A maintenance schedule includes these types of inspections:

- Routine inspections
- Three-month inspections
- Annual inspections

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

### Routine inspections

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



#### **WARNING:**

Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

- Check for unusual noise vibration, and bearings temperatures of thrust pot or electric motor.



- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check the pump and piping for leaks.
- Analyze the vibration.\*

#### **NOTICE:**

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

### Three-month inspections

Perform these tasks every three months:

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

### Annual inspections

Perform these inspections one time each year:

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

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

1. Disassemble the pump.

2. Inspect it.
3. Replace worn parts.

## 6.2 Thrust pot lubrication guidelines

### Flushing the oil reservoir

Flush the oil reservoir in order to remove all grit particles in the oil reservoir sump. Use the same type of oil to flush the reservoir as specified for lubrication.

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#### NOTICE:

- Pumps are shipped without oil. Oil-lubricated bearings must be lubricated at the job site.
  - Refer to Thrust Pot IOM for lubrication requirements.
- 

### Oil levels

Pump status	Oil level
Not operating	At or lower than 0.635 to 0.3175 mm   1/8 in. to 1/4 in. from the top of the oil sight gauge. Never operate the pump when the oil in the sight gauge is not at the required level.
Operating	Lower than the required level as indicated on the oil sight gauge. Prior to startup, the oil level should be below the oil sight gauge such that during operation the oil can be seen splashing in the sight gauge.

### Changing the oil

Observe the instructions in the Thrust Pot IOM.

## 6.3 Disassembly

### 6.3.1 Disassembly precautions




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#### 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.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids, which may cause injury and/or illness. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations. The pump must also be decontaminated if it will return to ITT. Refer to the ITT return goods policy.

**CAUTION:**

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

### 6.3.2 Disassemble the head and column

**WARNING:**

Safe lifting points are specifically identified in the general arrangement drawing. It is critical to lift the equipment only at these points. Integral lifting eyes or swivel hoist rings on pump and motor components are intended for use in lifting the individual components only. Never try to lift the entire pump assembly by the lifting points furnished for the driver only.

1. Loosen the setscrews that fasten the mechanical seal to the pump shaft. Disconnect the seal and seal housing from all auxiliary piping.
2. Remove the necessary components:

If the pump is...	Then remove...
Gear-driven	The driveshaft between the gear and the prime mover.
Electric-motor driven	The electrical connections at the conduit box and label the electrical leads so they can be reassembled correctly.

3. Uncouple the driver, or gear box, from the pump shaft and mounting flanges, and then lift off by the lifting lugs or swivel hoist rings as furnished.
4. Remove all hold-down bolts and integral piping.
5. Remove the coupling, mechanical seal and seal housing.
6. Continue with disassembly down to the bowls as described in the next section.

### 6.3.3 Bowl disassembly

The bowl assembly is composed of these parts:

- Suction bell
- Intermediate bowls
- Top bowl
- Impellers and securing hardware

- Bearings
- Tie rods
- Pump shaft

Impellers are secured to the shaft by a key and split-thrust ring and/or retaining ring. Follow only the procedures that apply to your particular construction.

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**NOTICE:**

Match mark the components in sequence in order to aid the reassembly.

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### 6.3.3.1 Disassemble the bowl

1. Bowl assembly must be vertical when disassembling. Secure bowl assembly at suction bell.
2. Loosen the Tie Rods holding together bowl assembly.
3. Lift discharge head or the adapter plate off of bowl assembly.
4. Lift the top bowl off the pump shaft. Remove the retaining ring(s) as applicable.
5. Lift the impeller off the pump shaft and remove the key, retaining ring(s), and split-thrust ring as applicable.

---

**NOTICE:**

If the impeller is seized to the shaft, then strike the impeller with a fiber mallet and drive the impeller off the pump shaft.

Impellers should not require heat to be removed, as they are clearance fit to the shaft.

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6. Remove the intermediate bowl.
7. Repeat steps 5 through 7 until the bowl assembly is completely disassembled.

### 6.3.3.2 Remove the bowl and impeller wear rings

1. Remove the setscrews if the rings are furnished with this locking method.
2. Use a diamond-point chisel in order to cut two V-shaped grooves on the bowl or impeller wear ring approximately 180° apart.  
Use extreme care not to damage the wear ring seat.
3. With a chisel or drift punch, knock the end of one half of the ring in, and pry the ring out.
4. On high-alloy materials such as chrome steel, set up the bowl or the impeller in a lathe and machine the wear ring off, using extreme care not to machine or damage the ring seat.

### 6.3.4 Remove the bowl, suction bell, and lineshaft bearings

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**NOTICE:**

Bowl bearings are press fit. Do not remove the bowl bearings unless replacement is necessary.

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1. Press the bearing out of bearing housing or bowl.  
Use an arbor press and a piece of pipe or sleeve with an outside diameter that is slightly smaller than the diameter of the bowl or lineshaft bearing housing bore.
2. Remove the suction bell bearing by setting the suction bell in a lathe and machining the bearing off.  
The suction bell bearing can also be removed using bearing pullers to pull the bearings out.

## 6.4 Pre-assembly inspections

### Guidelines

Before you assemble the pump parts, make sure you follow these guidelines:

- Inspect the pump parts according to the information in these pre-assembly topics before you reassemble your pump. Replace any part that does not meet the required criteria.
- Make sure that the parts are clean. Clean the pump parts in solvent in order to remove oil, grease, and dirt.

---

### NOTICE:

Protect machined surfaces while cleaning the parts. Failure to do so may result in equipment damage.

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### 6.4.1 Replacement guidelines

#### Casting check and replacement

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

#### Impeller replacement

This table shows the criteria for replacing the impeller parts.

Impeller parts	When to replace
Impeller vanes	<ul style="list-style-type: none"> <li>• When grooved deeper than 1.6 mm   1/16 in., or</li> <li>• When worn evenly more than 0.8 mm   1/32 in.</li> </ul>
Vane edges	When you see cracks, pitting, or corrosion damage
Keyway and bores	When you see damages

#### Gaskets, O-rings, shims, and seal replacements

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

#### Bearing retainer check

Check the bearing retainer for deformation and wear.

#### Mechanical seal check

On pumps equipped with a mechanical seal, check that the shaft or sleeve is free of pits, burrs, or sharp edges to prevent cutting or improper sealing of the seal O-rings. Remove any burrs and sharp edges by polishing with a fine emery cloth.

#### Impeller and bowl check

Visually check impellers and bowls for cracks and pitting. Check all bowl bearings for excessive wear and corrosion.

### Shaft check

Inspect shaft straightness using precision V-block or roller and dial indicator. Replace shafts with total indicated runout greater than 0.0005 inches per foot of shaft length.

## 6.5 Reassembly

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### NOTICE:

Bowl Assembly shall be done only by ITT Goulds Pumps authorized service centers.

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### 6.5.1 Guidelines

Before you reassemble the pump parts, make sure you follow these guidelines:

- Use only new gaskets, o-rings and lip seals.
  - Tighten tie-rod nuts to torque values shown on the pump general arrangement drawing.
- 



### WARNING:

- Do not use any rust inhibitors.
  - Protect machined surfaces while you clean the parts. Failure to do so may result in equipment damage.
  - Do not use any anti-seize on running clearances.
  - Wear protective gloves and use appropriate eye protection to prevent injury when handling parts.
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### NOTICE:

Bowl Assembly shall be done only ITT Goulds Pumps authorized service centers.

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# 7 Troubleshooting

## 7.1 Operation troubleshooting

Symptom	Cause	Remedy
Pump does not start.	The electrical circuit is open or not complete.	Check the circuit and make any necessary corrections.
	Rotor resists turning due to freezing.	Drain pump and dry internal surfaces with dry air.
	The impellers are binding against the bowls.	Reset the impeller adjustment. See Installation for details.
	The electric driver is not receiving enough voltage.	Make sure that the driver is wired correctly and receiving full voltage.
	The motor is defective.	Consult an ITT representative.
The pump is not delivering liquid.	The bowl assembly is not submerged enough.	Adjust the liquid level in the suction barrel as necessary.
	There is an obstruction in the liquid passage.	Pull the pump and inspect the impeller and bowl.
	The discharge head is not properly vented.	Open the vent.
	The suction or discharge valves are closed.	Open the valves. For more information, see <a href="#">5 Commissioning, Startup, Operation, and Shutdown on page 41</a>
The pump is not producing the rated flow or head.	The impellers are not rotating fast enough.	Make sure that the driver is wired correctly and receiving full voltage.
	The impellers are rotating the wrong direction.	Make sure the impellers are spinning when viewed from above. Check the engagement of the motor coupling.
	The total pump head is too high.	Check the pipe friction losses. Use larger discharge piping.
	The liquid passages are partially obstructed.	Inspect the impellers and bowls and remove any obstructions.
	There is cavitation.	Insufficient NPSH. Check for and remove any obstructions in pump suction inlet.
	The impellers are too high	Reset the impeller adjustment. See Installation for details.
There is not enough pressure.	The impellers are not rotating fast enough.	Make sure that the variable frequency drive is set properly.
	The liquid passage is obstructed.	Inspect the impellers and bowls and remove any obstructions.
	The impellers are rotating in the wrong direction.	Make sure the impellers are spinning when viewed from above. Check the engagement of the motor coupling.
	The impellers are too high (semi-open construction only).	Reset the impeller adjustment. See Installation for details.
The pump starts and then stops pumping.	Excessive power is required.	Use a larger driver. Consult an ITT representative.
	The pump is pumping a higher viscosity or different specific gravity liquid than it was designed to handle.	Test the liquid for viscosity and specific gravity. Consult an ITT representative.
	Critical parts have experienced mechanical failure.	Check the bearings, wear rings, and impellers for damage. Any irregularities in

Symptom	Cause	Remedy
		these parts will cause a drag on the shaft. Replace any damaged parts as necessary.
	The impellers are rotating too fast.	Check the frequency on the motor.
	The pump and driver are misaligned.	Realign the pump and driver.
	The discharge head is not properly vented.	Open the vent.
The pump requires excessive power.	The impellers are damaged.	Inspect the impellers for damage and replace them if necessary.
	A foreign object is lodged between the impeller and the bowl.	Remove the object and check suction piping.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The liquid viscosity is too high or the pumped fluid is partially freezing.	Check for both conditions. They can cause drag on the impeller. Consult an ITT representative.
	The bearings are defective.	Replace the bearings and check the shaft or shaft sleeve for scoring.
The pump is noisy.	The pump is cavitating.	Increase the liquid level in the sump.
	The shaft is bent.	Replace the shaft.
	Rotating parts are binding, loose, or broken.	Replace parts as necessary.
	The bearings are worn.	Replace the bearings.
	The discharge head is not properly vented.	Open the vent.
The pump is vibrating excessively.	One of these conditions might exist: <ul style="list-style-type: none"> <li>The coupling is misaligned.</li> <li>The shaft is bent.</li> <li>The impellers are not balanced.</li> <li>The bearings are worn.</li> <li>There is cavitation.</li> <li>There is strain on the discharge piping.</li> <li>There is resonance.</li> </ul>	Determine the cause by using a vibration frequency analyzer or by disassembling the pump. A complex problem might require the assistance of an ITT representative.
	The driver shaft is not adjusted properly.	Readjust the driver. See Installation for details.
The mechanical seal leaks.	The seal faces are not flat because the gland bolts are too tight. This causes the gland and insert to warp.	Remove the gland bolts and then reinstall them properly.
	The gasket has been chipped during installation.	Replace the gasket.
	One of these conditions exists: <ul style="list-style-type: none"> <li>The carbon insert is cracked.</li> <li>The insert face or seal ring was chipped during installation.</li> <li>The rotary shaft seal does not work properly.</li> </ul>	Remove the mechanical seal, inspect, and replace as necessary.
	The seal faces are scored from foreign particles between the faces.	Install a strainer, and then filter or cyclone the separator as required in order to filter out any foreign particles.



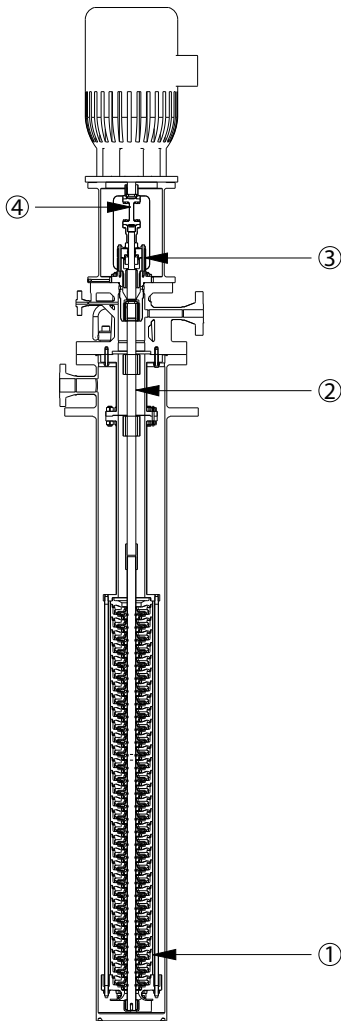
Symptom	Cause	Remedy
The seal squeals during operation.	The self-aligning bearing lacks lubrication.	Grease the self-aligning ball bearing.
Carbon dust is accumulating on the outside of the gland ring.	There is an inadequate amount of liquid at the seal faces.	Bypass the flush line. If a bypass line is already in use, then enlarge it to produce more flow.
		Consult an ITT representative.
The seal leaks but nothing appears to be wrong.	The seal faces are not flat.	Relap or replace the seal faces.
The seal is wearing out too quickly.	This product is abrasive. This causes excessive seal face wear.	Determine the source of the abrasives and install a bypass flushing in order to prevent abrasives from accumulating in the seal area. Install a cyclone separator as necessary.
	Abrasives are forming due to the process liquid cooling and crystallizing or partially solidifying in the seal area.	Install a bypass flush line in order to hold the liquid temperature around the seal above the crystallization point.
	The seal is running too hot.	Check for possible rubbing of the seal components. Recirculation or a bypass line may be necessary.
	The wrong kind of seal was used.	Consult an ITT representative.

# 8 Parts Listing and Cross-sectional Drawings

## 8.1 VICR Cross-Sectional Drawings and Parts List

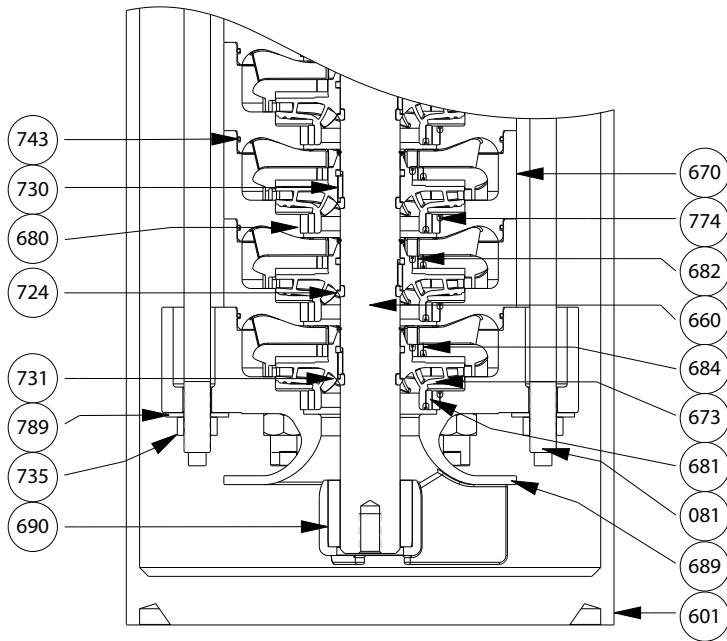
**NOTICE:**

Provided cross-sectional drawing and part list are for reference only. Consider to follow job specific Cross-sectional drawing.



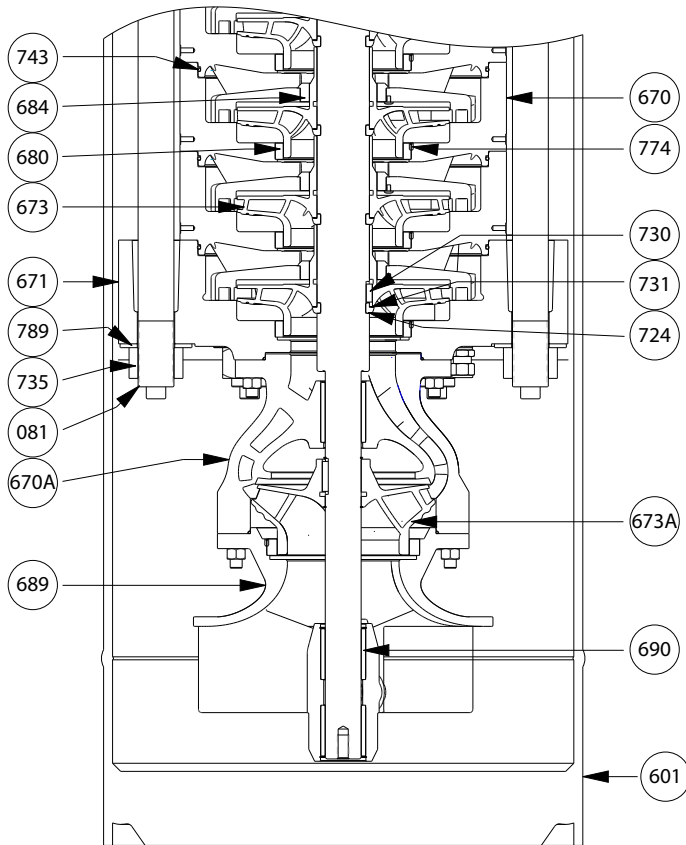
Item Number	Description
1	see Detail A
2	see Detail B
3	see Detail C
4	see Detail D

**Figure 22: Typical VICR**



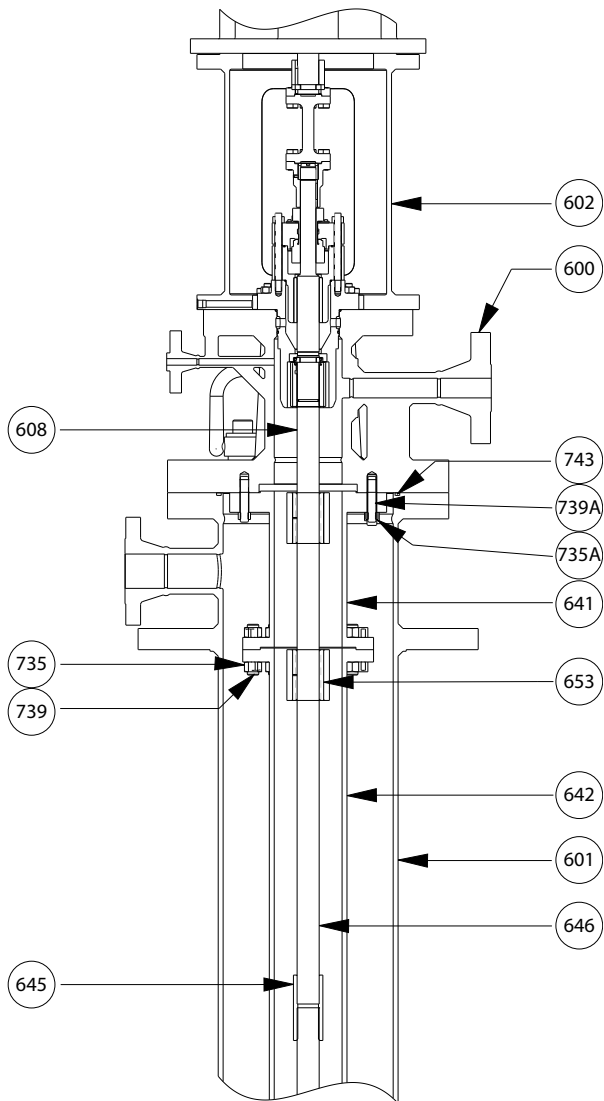
Item Number	Part Name
601	Barrel, suction can
689	Suction bell
690	Bearing, suction bell
081	Tie rod
735	Hex nut, tie rod
789	Washer, tie rod
670	Intermediate bowl
660	Pump shaft
673	Impeller
681	Ring, wear, impeller, suction
682	Ring, wear, impeller, balance
680	Ring, wear, bowl, suction
684	Ring, wear, bowl, balance
774	Setscrew, wear ring
731	Ring, split (thrust ring), impeller
724	Retaining ring
730	Key, impeller
743	O-ring

**Figure 23: Bowl Assembly, Detail A - Option 1**



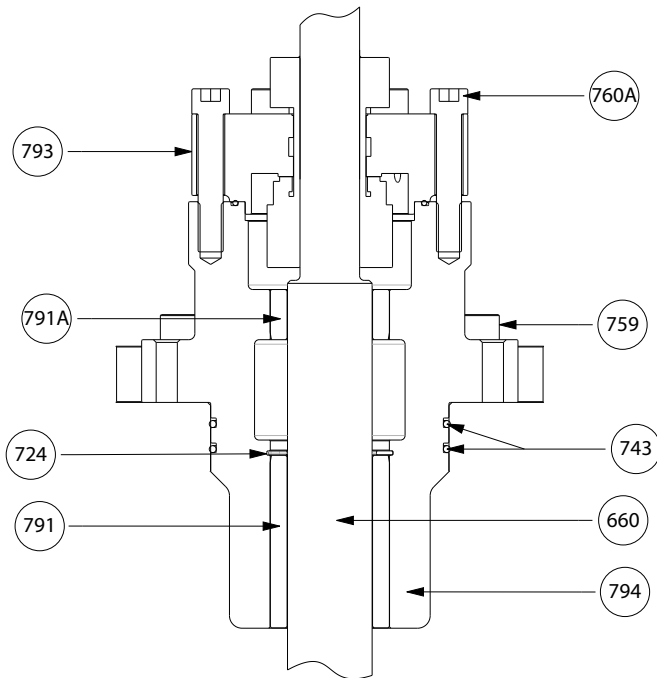
Item Number	Part Name
601	Barrel, suction can
689	Suction bell
690	Bearing, suction bell
673A	Impeller, 1st stage
670A	Intermediate bowl, 1st stage
081	Tie rod
735	Hex nut, tie rod
789	Washer, tie rod
671	Adapter bowl
670	Intermediate bowl
673	Impeller, additional bowl
731	Ring, split (thrust ring), impeller
730	Key, impeller
680	Ring, wear, bowl, suction
684	Ring, wear, bowl, balance
774	Setscrew, wear ring
743	O-ring

**Figure 24: Bowl Assembly, Detail A - Option 2**



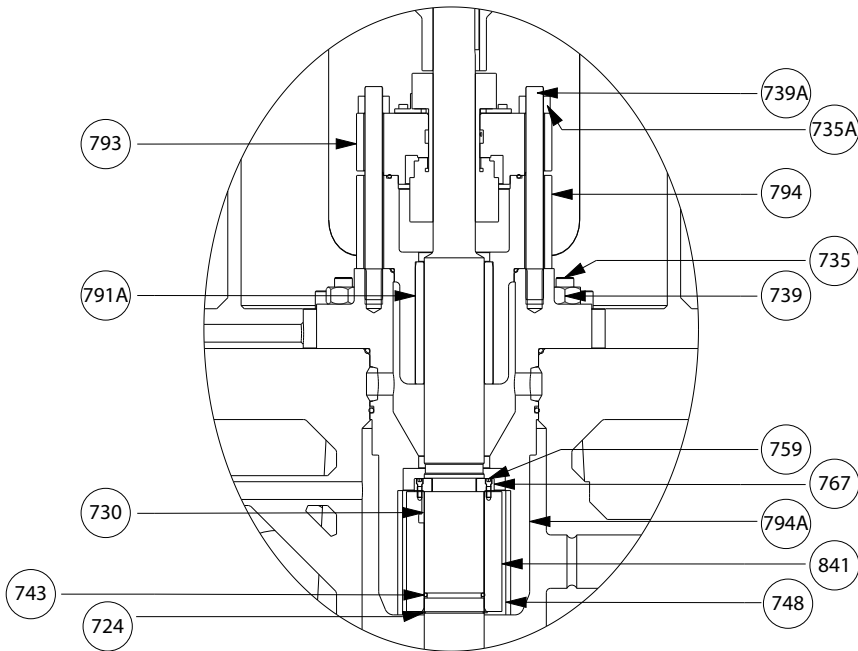
Item Number	Part Name
600	Discharge head
601	Barrel, suction can
602	Driver support
642	Column, intermediate
641	Column, top
646	Lineshaft
645	Coupling, lineshaft
653	Bearing, lineshaft
735	Hex nut, column/column
739	Stud, column/column
735A	Hex nut, column/head
739A	Stud, column/head
608	Headshaft
743	O-ring, Head/suction can

**Figure 25: Column Assembly and Head Assembly, Detail B**



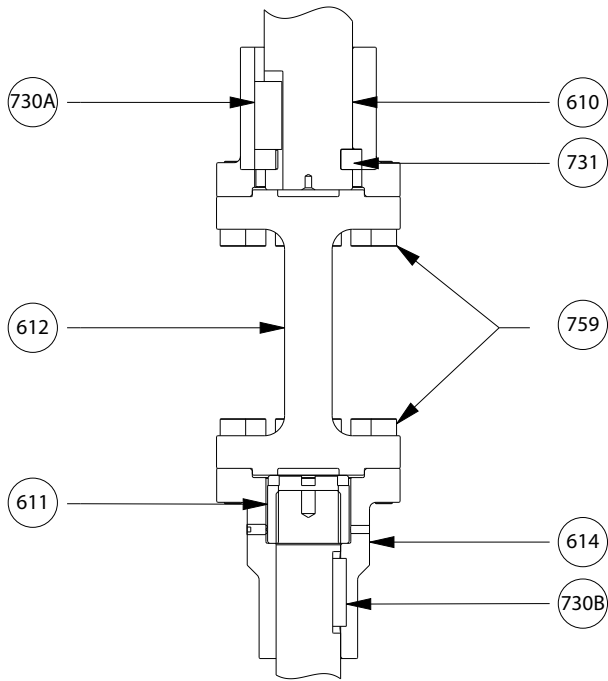
Item Number	Part Name
794	Seal housing, mechanical
660	Pump shaft
791	Lower bearing, seal housing
791A	Upper bearing, seal housing
724	Retaining ring
759	Socket head cap screw, split ring/balance drum
743	O-ring
793	Mechanical seal
760A	Socket head cap screw, mechanical seal/seal housing

**Figure 26: Seal Housing Assembly, Detail C - Option 1**



Item Number	Part Name
794	Seal housing, mechanical
794A	Lower seal housing, mechanical
660	Pump shaft
841	Balance drum, straight
748	Bushing, balance drum
731	Ring split, balance drum
760	Socket head cap screw, seal housing/head
730	Key, balance drum
743	O-ring, shaft/balance drum
724	Retaining ring, balance drum
791	Bearing, upper seal housing
735	Hex nut, lower seal housing/head
739	Stud, lower seal housing/head
793	Mechanical seal
793A	Stud, mechanical seal/upper seal housing
735A	Hex nut, mechanical seal/upper seal housing

**Figure 27: Seal Housing Assembly with Straight Balance Drum, Detail C Option 2**



Item Number	Part Name
610	Driver hub
614	Pump hub
612	Spacer, flange coupling
611	Adjusting nut, flange coupling
731	Ring split
730A	Key, driver shaft/driver hub
730B	Key, pump shaft/pump hub
759	Socket head capscrew

**Figure 28: Adjustable Rigid Spacer Coupling, Detail D**



# 9 Local ITT Contacts

## 9.1 Regional offices

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North America (Headquarters)	ITT - Goulds Pumps 240 Fall Street Seneca Falls, NY 13148 USA	+1 315-568-2811	+1 315-568-2418
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Asia Pacific	ITT Goulds Pumps Ltd 35, Oksansandan-ro Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do 28101, Rep. of KOREA	+82 234444202	
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