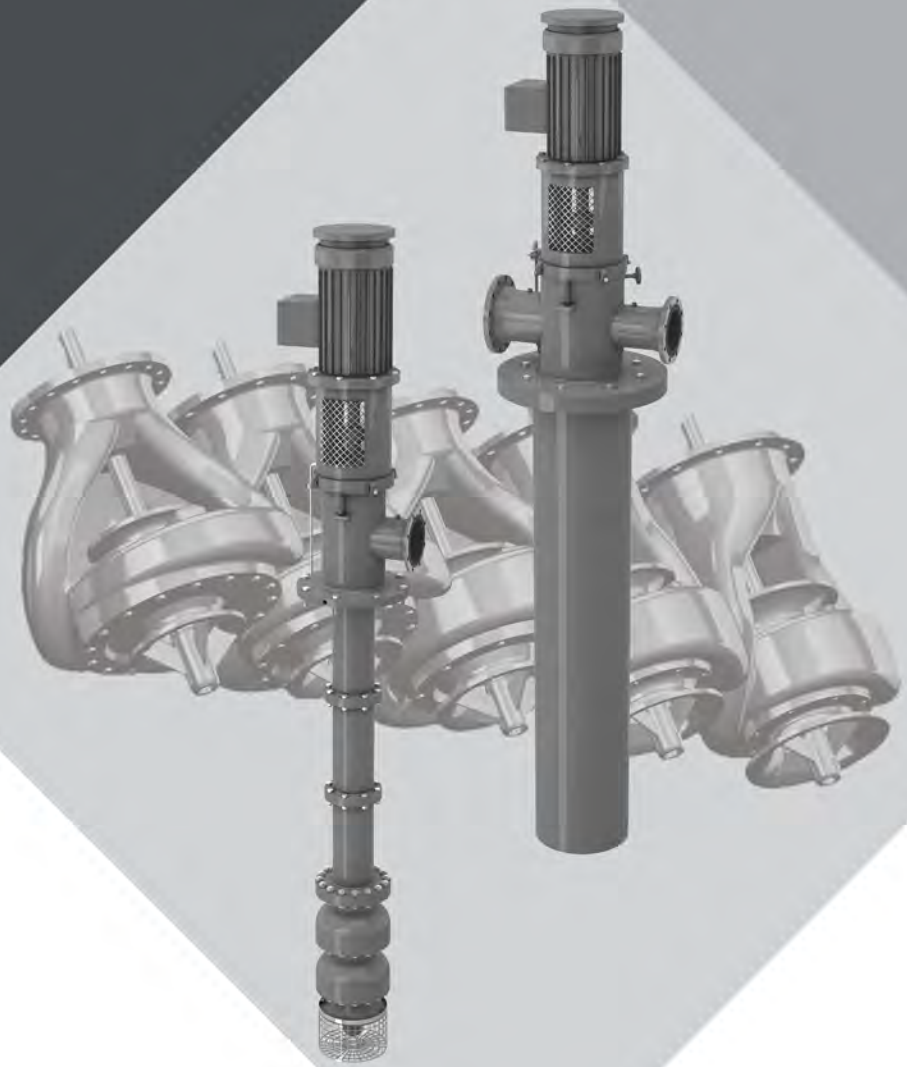
GOULDS PUMPS

Installation, Operation, and Maintenance Manual

Model VIT, VIC and VIDS



ITT

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1 Introduction and Safety

1.1 Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance

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

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

1.1.1 Requesting other information

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

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

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

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
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury

Hazard level	Indication
CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

Hazard categories

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

Electrical hazards are indicated by the following specific symbol:

ELECTRICAL HAZARD:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

1.2.1.1 The Ex symbol

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

1.2.2 Environmental safety

The work area

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

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.

Electrical installation

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

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 User safety

General safety rules

These safety rules apply:

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

Safety equipment

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

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

Electrical connections

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

Noise

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

Temperature

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

1.2.3.1 Precautions before work

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

- 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	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.2.4 Ex-approved products

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

Personnel requirements

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

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

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

Product and product handling requirements

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

- Only use the product in accordance with the approved motor data.

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

1.3 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.

1.5 

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.

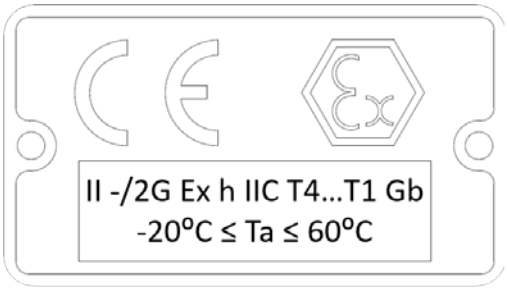


Figure 1: Typical Ex nameplate

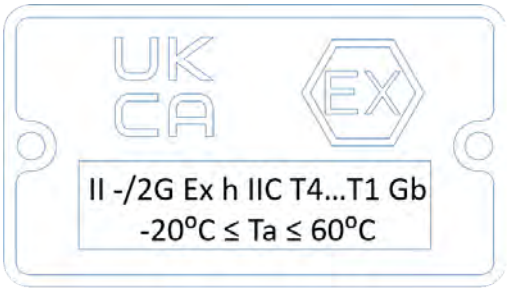


Figure 2: Typical UKCA Ex nameplate

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.

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 or bowl assembly handling, rigging and lifting

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

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

2.3.1 Lifting methods

WARNING:

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
- Safe lifting points are specifically identified in 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.
- 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 suitable swivel hoist rings through the barrel flange or 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.
A disassembled pump	Use suitable lifting devices attached to the component lifting lugs or suitable swivel hoist rings through the component flanges.
Bowl assembly (partly completed machinery)	Use suitable swivel hoist rings attached to the component flanges.

NOTICE:
For VIC-T pumps, use lifting straps as illustrated in Figure 6: VIC-T horizontal position on page 16, Figure 7: VIC-T intermediate position on page 16, and Figure 8: VIC-T vertical position on page 17 to lift pump off the skid. Lifting lugs on head maybe used once pump has been removed off shipping skid.

Example: VIT lifted from horizontal to vertical

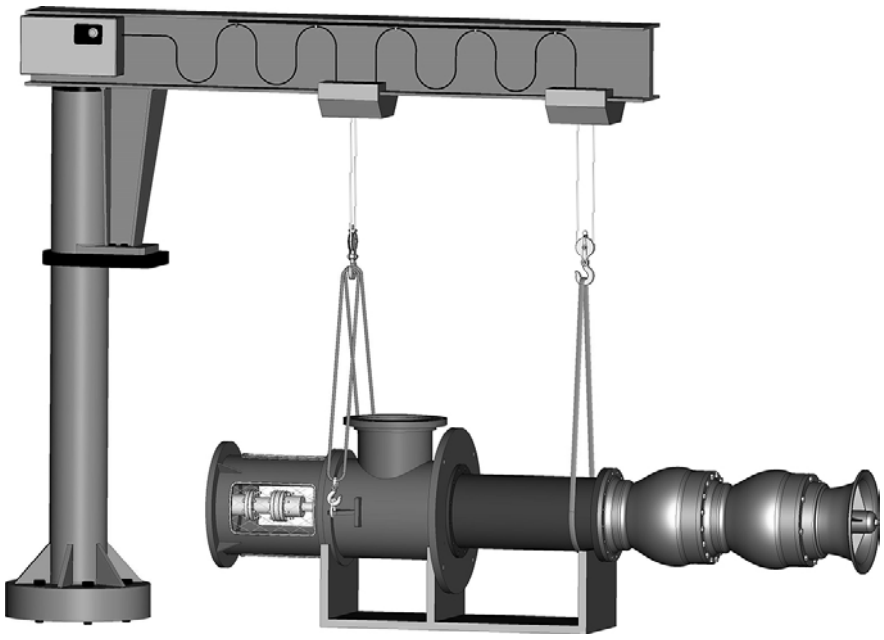


Figure 3: VIT horizontal position

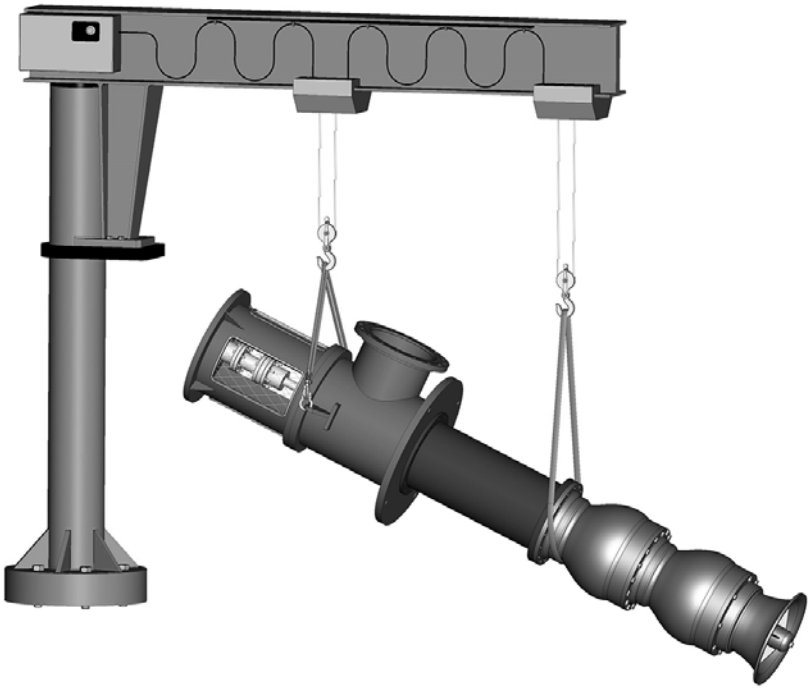


Figure 4: VIT intermediate position

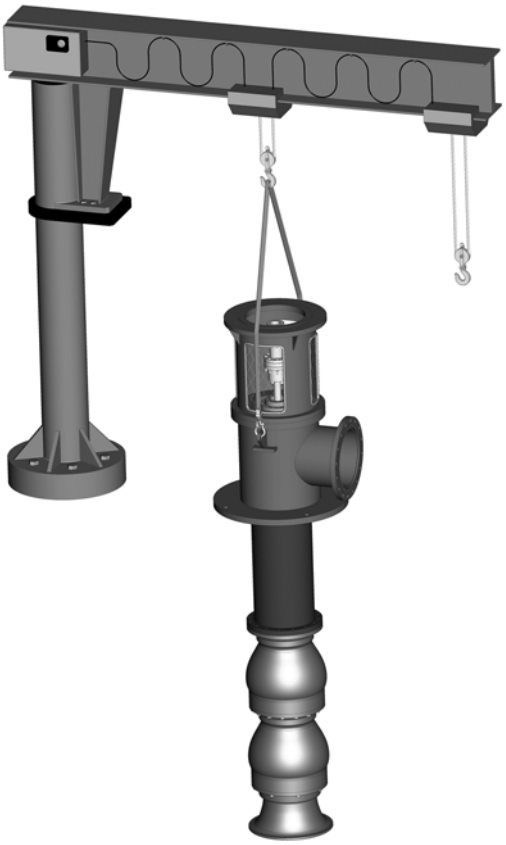


Figure 5: VIT vertical position

Example: VIC-T lifted from horizontal to vertical

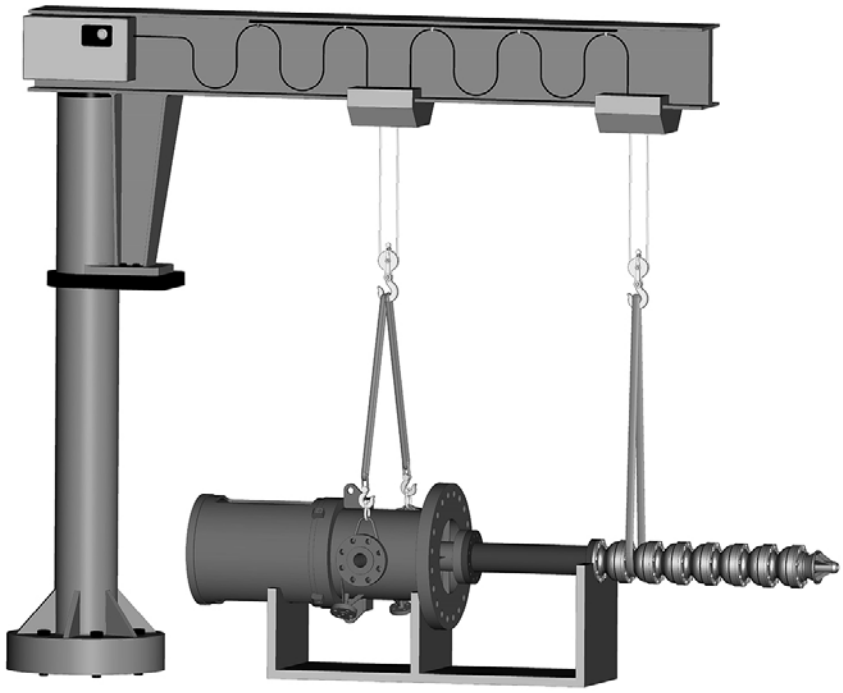


Figure 6: VIC-T horizontal position

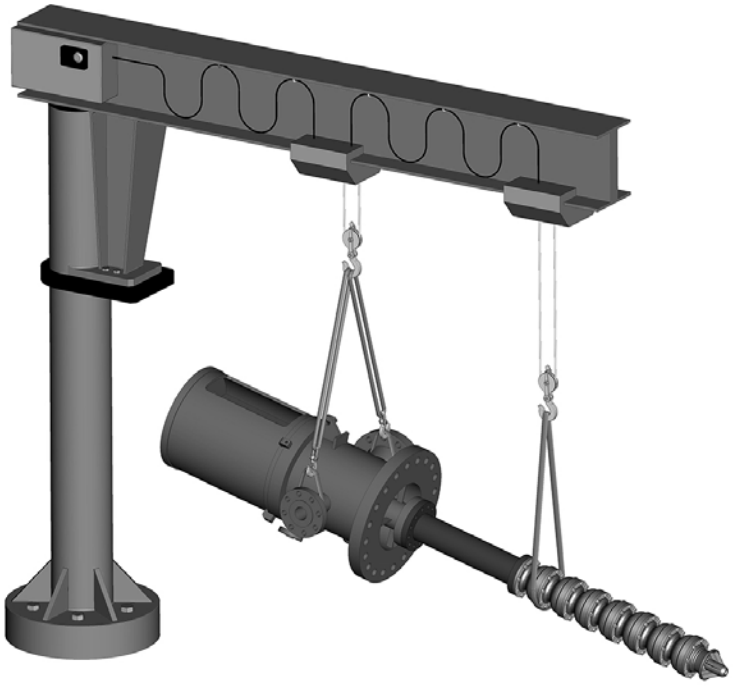


Figure 7: VIC-T intermediate position

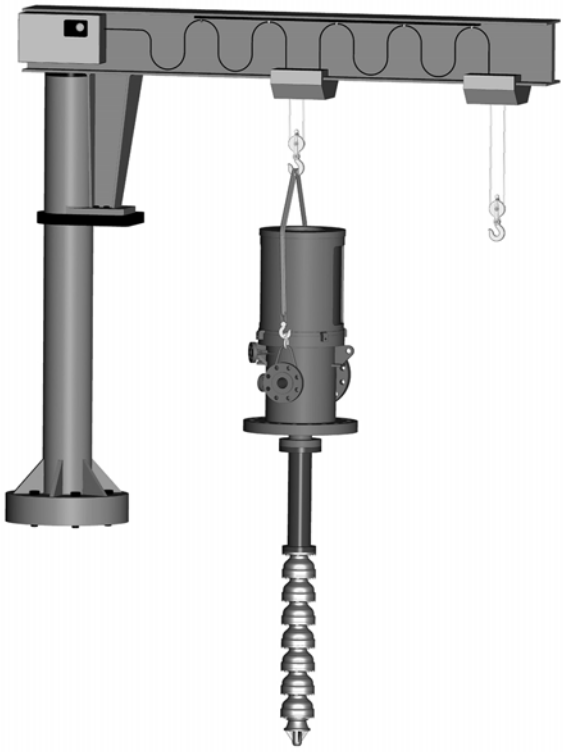


Figure 8: VIC-T vertical position

Example: Partially-assembled machinery (bowl assembly)

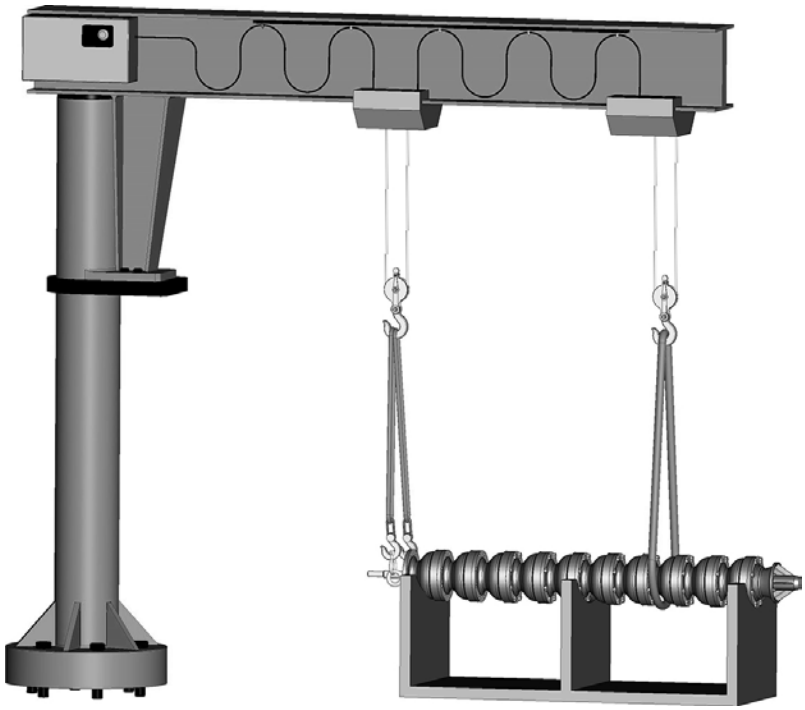


Figure 9: Bowl - horizontal position

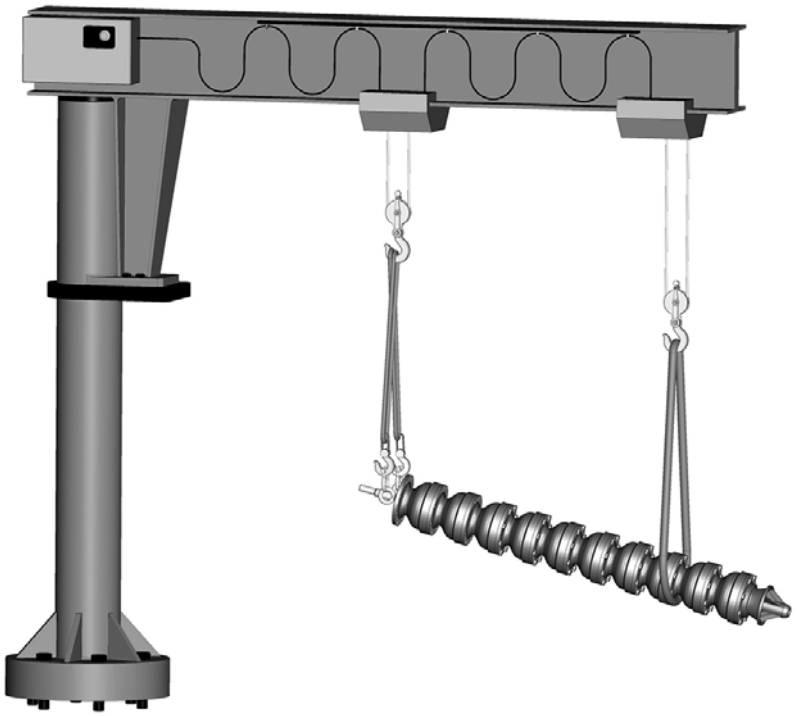


Figure 10: Bowl - intermediate position

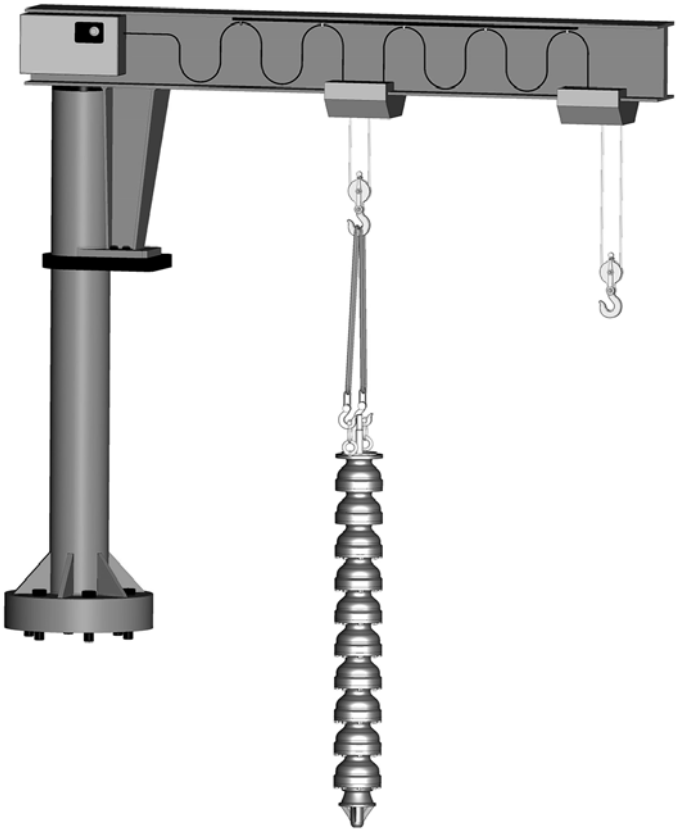


Figure 11: Bowl - vertical position

Example: Barrel lifting

Figure 12: Barrel - horizontal position

Figure 13: Barrel - intermediate position

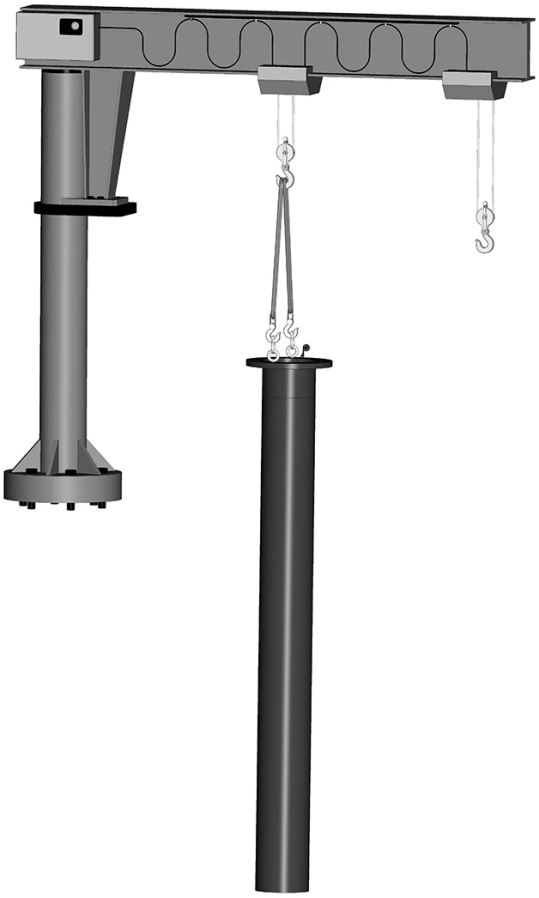


Figure 14: Barrel - vertical position

2.4 Pump and bowl assembly storage requirements

Requirements

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

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

Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	• Pave the area. • Clean the area. • Drain the area and keep it free from flooding.
Outdoor storage area (when indoor storage is not available)	• Observe all indoor storage requirements. • Use weather-proof coverings such as flame-resistant sheeting or tarpaulins. • Place coverings in a manner that maximizes drainage and air circulation. • Tie coverings down in order to protect the pump from wind damage.

Condition	Proper preparation
Placement of units and component parts	• Place the unit on skids, pallets, or shoring higher than 15 cm | 6 in. from the ground for good air circulation. • Sort the parts in order to permit easy access for inspection and/or maintenance without excessive handling.
Stacking of units or component parts	• Make sure that racks, containers, or crates bear the full weight of units or parts in order to prevent distortion. • Keep identification markings readily visible. • Immediately replace any cover you remove for internal access.
Rotation of the pump and bowl assembly shaft **NOTICE:** This activity is fundamental and requires a special boxing that should be ordered.	• Rotate the shaft and bowl assembly shaft counterclockwise at least 3 turns once a month, at a minimum. • Never leave the shaft in a previous position or in the extreme raised or lowered lateral position. • Make sure that the shaft rotates freely.
Controlled storage facilities	• Maintain an even temperature of 6°C | 10°F or higher above the dew point. • Keep the relative humidity to less than 50%. • Make sure that there is little or no dust.
Uncontrolled storage facilities that have uneven temperatures, higher humidity, and/or dusty conditions)	• Inspect the unit periodically to make sure that all preservatives are intact. • Seal all pipe threads and flanged pipe covers with tape.

When pump is not in regular operation

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

2.4.1 Prepare the unit for long-term storage

For storage periods over six months, you must follow the 2.4 Pump and bowl assembly storage requirements on page 20 above this procedure:

1. Inspect the lube-oil and seal-flush piping and either fill the piping with rust-preventative oil, or recoat the piping periodically in order to prevent corrosion.
2. Place 4.5 kg | 10 lbs of moisture-absorbing desiccant or 2.3 kg | 5.0 lbs of vapor-phase inhibitor crystals near the center of the pump.
3. If the unit is assembled, place an additional 0.5 kg | 1 lb in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
4. Install a moisture indicator near the perimeter of the unit.
5. Cover the unit with black polyethylene with a minimum thickness of 0.15 mm | 6.0 mil, and seal it with tape.
6. Provide a small ventilation hole approximately 12.0 mm | 0.5 in. diameter.
7. Provide a roof or shed shelter in order to protect the unit from direct exposure to the elements.
8. For units with Thrust Pot see the instructions 5.8 Lubricate the thrust pot during a shutdown period on page 69.

3 Product Description

3.1 General description

Pumps VIT, VIC and VIDS have few differences.

The Model VIT pump is a vertical, industrial, turbine-type pump designed to meet a wide range of applications.

The Model VIC is pump VIT inside a barrel with a different discharge head.

The model VIDS has a double suction bowl and impeller.

These pumps have these capabilities:

- Capacities up to 15,900 m3/h | 70,000 gpm
- Heads up to 1,372 m | 4,500 ft.
- Power up to 3,730 kW | 5,000 hp

Axial thrust force generated by the suction pressure, dynamic forces, rotor weight can be supported by the Thrust Pot or driver. In any case rolling bearings are designed for a bearing life L10h as per ISO 281 at least 17,500 hours at rated condition.

Bowl assembly (partly completed machinery)

The bowl construction is flanged for accurate alignment and ease of assembly and disassembly. Impellers are either open or enclosed, depending on the design requirements. For temperatures over 82°C | 180°F and in the larger size bowls, impellers are keyed to the shaft. Low NPSH first-stage impellers are available for special applications.

Column

Flanged column construction 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 fan cooled 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 with most industrial applications. The rigidity of the rotor enhances vibration-free operation when mechanical seals are used.

You can use hollow shaft drivers in applications that specify packing or an enclosed lineshaft.

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:

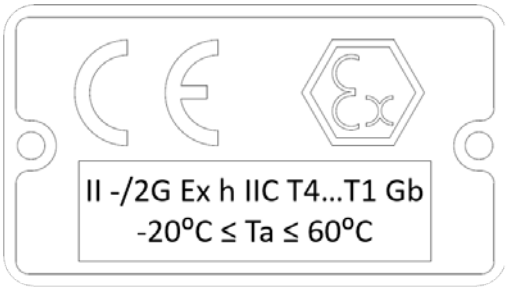


Figure 15: Typical Ex nameplate

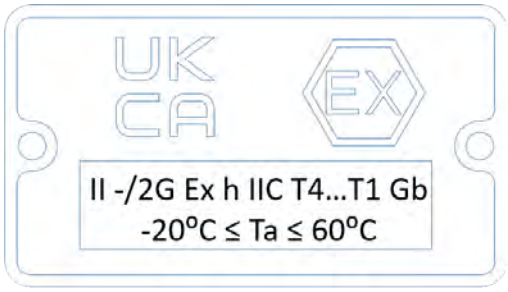


Figure 16: Typical UKCA Ex nameplate

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 23 is for the purpose of determining T'x' code for Ex applications with liquid temperatures exceeding 107ºC | 225ºF.

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

4 Installation

4.1 Installation of a partly completed machinery

A partly completed machinery is a bowl assembly, refer to 4.4.1 Installing the bowl assembly on page 32 and subsequent items.

4.2 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.

4.2.1 Location

Do not apply additional paint or coatings to the pump when in an Ex environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.

Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.

For pumps that require assembly on site, a clean dry area should be provided next to the point of installation, of adequate size for placing the pump components and driver in the sequence in which they will be installed. Protective covers should be left on all pump openings until the time of actual installation to prevent dirt and foreign objects from entering the pump. Protective coatings should likewise be left on

machined surfaces to prevent rusting. Pump accessories such as controls instrumentation or intermediate junction boxes must be protected from damage and moisture. For outdoor installations, the components should be covered with rainproof tarps during the period of installation for protection against the elements. This is particularly important during freezing conditions to prevent water from collecting in the pump cavities and perhaps causing freezing damage.

All pumps require regular maintenance. It is therefore important to locate pump outlet piping (and inlet piping when applicable) as well as auxiliary equipment and control and starting panels in such a manner the adequate access is provided for maintenance. Adequate floor space and working room should also be provided for repair, including parts placement.

To minimize frictional head loss, locate the pump so that it can be installed with a short and direct inlet piping and with the least number of elbows and fittings.

4.2.2 Inspect the sub-base

1. If an optional sub-base is furnished, remove it from the pump discharge head or barrel when it is shipped assembled.
2. Completely clean the underside of the sub-base.
   You might need to coat the underside of the sub-base with an epoxy primer which you can purchase as an option.
3. Remove the rust-preventative solution from the machined topside of the barrel flange with an appropriate solution.

4.2.3 Concrete foundation requirements

Requirements

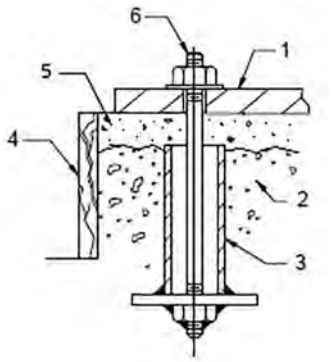
Make sure that you meet these requirements when you prepare the pump foundation:

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

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 or discharge head
2. Foundation
3. Sleeve
4. Dam
5. Grout
6. Anchor bolt

Figure 17: Example of a typical installation

4.2.3.1 Installing the barrel or sub-base on a concrete foundation

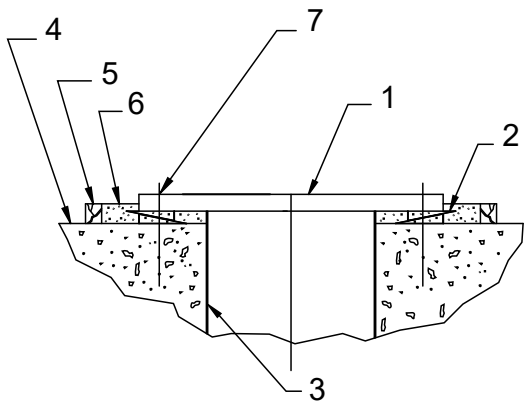
User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.

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 discharge head using leveling wedges or 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 in two directions at 90° on the machined surface to achieve levelness condition indicated in this table.

Table 3: Levelness tolerances

Commercial	API
0.4 mm/m | 0.005 inch/ft	0.2 mm/m | 0.002 inch/ft



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

Figure 18: Example of a foundation

4.2.3.2 Installing the VIC-L barrel

VIC-L barrel design has a suction nozzle below the ground and its installation can require specific instructions if it is fixed and encased to the foundation.

9.1 Example of VIC-L barrel installation on page 96 shows an example of this kind of installation.

Please observe 9.1 Example of VIC-L barrel installation on page 96 carefully before starting your works and ask additional help to ITT any time that a VIC-L barrel is ordered.

4.2.3.3 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. Tighten the foundation bolts to the torque value provided on the pump general arrangement drawing.

4.2.4 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 discharge head mounting, barrel or sub-base to the support in order to avoid distortion, prevent vibration, and retain proper alignment.
3. Level the discharge head mounting, barrel or sub-base using shims.

4.2.5 Seismic analysis

When pumps are located in seismically active areas and for certain critical installations, such as nuclear power plants, the pumps, supports, and accessories should be earthquake-resistant. The design specifications to achieve earthquake resistance vary, depending on geographical area, class of equipment (defining how critical the survival of the equipment is), and the characteristics (acceleration response) of the structure or foundation supporting the pump.

Complete specifications for earthquake-resistance requirements should be supplied by the customer. These include:

- The seismic criteria, such as acceleration, magnitudes, frequency spectrum, location, and direction relative to pump
- The qualification procedure required, i.e., analysis, testing, or a combination of these requirements for operability during and/or after test

4.2.6 Piping checklists

4.2.6.1 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

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: • Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings, seal, and shafting	
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: • The grout for the pit cover becomes hard. • The grout for the barrel or subbase has hardened. • The hold-down bolts for the pump are tightened. • Remove flange covers from the pump	—	
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 elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to thermal expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	

Check	Explanation/comment	Checked
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

4.2.6.2 ischarge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	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.	

4.2.7 Pump installation

Depending on the length and size pumps are shipped in *Bare shaft* condition or in *Disassembled* condition.

Bare shaft pump means a pump composed of bowl assembly + column (and shafts) + discharge head + shaft sealing + driver support all mounted together as a single unit.

Other components, mechanical seals, couplings, coupling spacers, thrust pot, motor are shipped loose.

Disassembled pump means a pump composed of only bowl assembly mounted as a single unit. All remaining components, column (and shafts), discharge head, seal housing, mechanical seals, couplings, coupling spacers, driver support, thrust pot and motor are shipped loose.

Sub bases and cans, as applicable are always shipped loose.

Below items describe how to install a *Bare shaft pump* and *Disassembled pump* in detail.

4.3 Installing a bare shaft pump

Pumps 12 meters | 40 feet or less in length are usually shipped partially assembled, with the exception of these parts:

- Driver - for installation instructions refer to 4.4.9 Installing a solid-shaft driver on page 51 and 4.4.10 Installing a hollow-shaft driver on page 54.
- Packing - for assembly instructions refer to 4.4.5 Stuffing box installation on page 37.
- Mechanical seal with piping - for assembly instructions refer to 4.4.7 Mechanical seal options on page 42.
- Coupling assembly, spacer or non-spacer type

Refer to the Certified Pump Outline Drawing for the location of the anchor-bolt holes.

1. Clean the barrel flange and the bottom of the discharge head base.
2. Attach shackles to the discharge head lifting lugs or thread two swivel hoist rings through the bolt holes in the mounting flange.
3. Hoist the unit into position over the foundation.
   Make sure that the shackles, swivel hoist rings, and sling are rated to handle in excess of the pump weight. See the outline drawing.
4. Carefully guide the unit so that it does not strike the sides of the sub-base or foundation.
5. Lower the unit until the discharge-head flange engages and rests firmly on the barrel flange or sub-base, then secure it with the capscrews provided.

4.4 Installing a disassembled pump

4.4.1 Installing the bowl assembly

WARNING:
Avoid working under suspended loads. If necessary to do so, follow the more stringent of local, state or federal safety regulations.

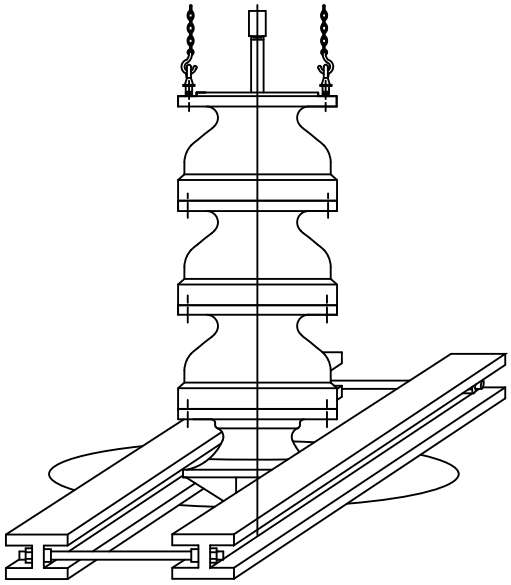
CAUTION:
Refer to 2.3.1 Lifting methods on page 13.

1. Check that all fasteners are tight and turn the pump shaft by hand to make sure it turns freely.
2. Remove all accumulated dust, oil, or other foreign material from the external surfaces.
3. Place two I-beam supports across the sub base or barrel opening that are strong enough to safely support the weight of the entire pump assembly.

NOTICE:

I-beams and lifting clamps can be provided by ITT upon request. If I-beams and lifting clamps are supplied by ITT the "Pump Installation Instructions (w/ Lifting Clamps)" IOM should be used.

Connect these I-beams with threaded rods and nuts so you can clamp them firmly together for the portion to be supported.



4. Place a suitable hoist or derrick over the barrel opening with the hook in the center.
5. Install two threaded swivel hoist rings through the discharge bowl bolt holes 180º apart.
6. Attach a sling to the swivel hoist rings and hoist it into position over the foundation opening.
7. Carefully lower the bowl assembly, guiding the unit so it does not strike the sides of the opening, until the discharge bowl flange rests firmly on the I-beam supports.
8. Place a cover over the discharge bowl opening to prevent the entrance of dirt or other foreign matter until you are ready to install the column assembly.

4.4.2 Column installation

This section describes how to install the two lineshaft options available for the column assembly:

- Open lineshaft
- Enclosed lineshaft

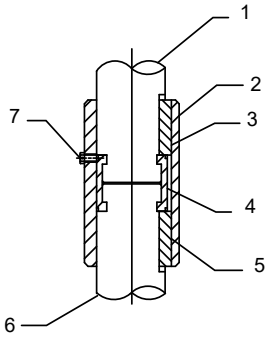
4.4.2.1 Installing the column - open lineshaft

NOTICE:
Use Molykote Dow-Corning anti-galling compound or an equivalent for all galling material such as 316 stainless steel.

The bearing retainer is integral with the column. The top flange of the column has a male register and the bottom flange of the column has a female register.

1. Before starting the shafts installation, check the headshaft and lineshaft for straightness. The average TIR should be less than 0.013 mm | 0.0005 in. per 0.305 m | foot and not exceed 0.127 mm | 0.005 in. for every 3 m | 10 ft.
2. Apply a thin film of oil to the lineshaft.
3. Install the coupling per Table 4: Lineshaft coupling on page 34.

Table 4: Lineshaft coupling

If your lineshaft coupling is...	Then...
Threaded	1. Apply a thin film of oil to the coupling threads if it is a non-galling material. Use a suitable anti-seize if the coupling is a galling material. 2. Manually start the thread until you feel resistance. Use a fine wire inserted in the drill hole at the center of the coupling as a gauge to determine when the coupling is correctly positioned on the shaft. 3. Remove the wire after you install the coupling. 4. Complete the joint using a pair of pipe wrenches, one on top of the pump shaft and the other on the coupling. 5. Run the upper lineshaft into the coupling and hand-tighten. Do not apply wrenches on the bearing journal surfaces.
Keyed	1. Insert the key into the pump shaft. 2. Lower the sleeve over the pump shaft, to approximately 25.4 mm | 1.0 in. below the top of the shaft. 3. Lower the lineshaft until it touches the pump shaft. 4. Insert the split ring into the grooves of the pump shaft and lineshaft. 5. Raise the sleeve until it covers the split ring. 6. Insert the key into the lineshaft. 7. Raise the sleeve to the top of the key. 8. Secure the sleeve to the split ring with a lock screw and lock wire.  1. Lineshaft 2. Sleeve 3. Key 4. Split ring 5. Key 6. Pump shaft 7. Lock screw/lock wire

4. Attach the column to the bowl assembly:
   a) Attach a sling to the swivel hoist rings and to the hoist hook.
   b) Hoist the column section over the bowl assembly.
   c) Lower the column over the lineshaft until the column flange engages the discharge-bowl flange register.
   d) Insert as many capscrews through both flanges as possible and gradually tighten them in diametrically-opposite pairs.

5. Lift the bowl and column assembly high enough to allow for the removal of the I-beam supports.
6. Install and tighten the remaining capscrews.
7. Place the bowl and column assembly in the sump or barrel:
   a) Lift the entire assembly by the column pipe swivel hoist rings and remove the I-beam supports.
   b) Slowly lower the bowl and column assembly.
   c) Place the supports on the sub base or barrel flange and continue to lower the assembly until the upper column flange comes to rest on the supports.
8. If required, install the coupling and lineshaft to the protruding end of the lineshaft.
9. Assemble the next column section, or top column:
   a) Make sure that the bottom-column register engages the top-column register.
   b) Secure the columns with capscrews and hex nuts until all column and lineshaft sections required for the proper pump setting are assembled.
   c) Tighten the capscrews into the hex nuts gradually and uniformly.

4.4.2.2 Installing the column - enclosed lineshaft

Pump lineshafts are connected with either threaded or keyed couplings. This section describes both procedures.

See the Certified Pump Outline Drawing for the number of column and shaft sections required.

1. Before starting the shafts installation, check the headshaft and lineshaft for straightness.
   The average TIR should be less than 0.013 mm | 0.0005 in. per 0.305 m | foot and not exceed 0.127 mm | 0.005 in. for every 3 m | 10 ft.
2. Install the coupling per Table 4: Lineshaft coupling on page 34.
3. Attach a small, adjustable, pipe-vise type of lifting device to a section of enclosing tube.
   If such a device is not available, use a piece of light manila line, fastened to the tubing by a clove hitch or a double-half hitch.
4. Raise up and then lower the enclosing tube over the first length of shaft attached to the bowl.
5. Apply an anti-sieze compound to the matching threads of the pump-top screw bearing and securely tighten.
6. Repeat the process for additional enclosing tubes before installing column.
   Typically the stacked enclosing tubes should equal the length of the column section.
7. Install the first length of column pipe over the tube:
   a) Install two swivel hoist rings diametrically opposite each other in the upper flange of the bottom column.
   b) Attach a sling to the swivel hoist rings and to the hoist hook.
   c) Hoist the column section over the bowl assembly.
   d) Lower the column over the enclosing tube until the column flange engages the discharge-bowl flange register.
   e) Insert as many capscrews through both flanges as possible and gradually tighten them in diametrically-opposite pairs.
8. Lift the entire assembly by the column pipe swivel hoist rings and remove the I-beam supports.
9. Slowly lower the bowl and column assembly.
10. Place the supports on the foundation and continue to lower the assembly until the upper column flange comes to rest on the supports.
11. Pour one quart of synthetic turbine oil ISO VG 32 into the top tubing section and screw the tube bearing into the top length until it bottoms, ready to receive the next length of tubing assembly.

NOTICE:

Do not use automotive oils.

12. Install the lineshaft coupling onto the projecting end of the shaft.

If your lineshaft coupling is...	Then...
Threaded	1. Install it on the projecting end of the lineshaft for half the length of the coupling. 2. Repeat this step until all joints are installed.
Keyed	1. Install it onto the projecting end of the shaft as described in step 2. 2. Repeat this step until all joints are installed.

4.4.3 Installing the discharge head

CAUTION:

- Do not bump or scrape the shaft protruding above the column. This could result in a bent or damaged shaft, which could affect the performance of the pump.

CAUTION:

- Packed stuffing boxes are not allowed in an Ex-classified environment.
- The mechanical seal used in an Ex-classified environment must be properly certified.

NOTICE:

Make sure that all rigging devices are rated to handle more than the pump weight.

Mechanical seals are shipped separately. If the seal housing is assembled to the discharge head, remove it before you begin this procedure.

1. Remove the coupling guard:
   a) Attach shackles to the discharge head lifting lugs.
   b) Hoist the discharge head over the protruding headshaft.
2. Orient the discharge head in the required position:
   a) Lower the head while you center the vertical hole with the headshaft that protrudes above the column.
   Stop when the discharge head engages the column.
   b) Install the capscrews and secure the discharge head to the column.
   c) Tighten the capscrews gradually in diametrically-opposite pairs.
3. Lift the pump assembly high enough to allow for the removal of the supports.
4. Install and tighten the remaining capscrews until all capscrews are uniformly tight.
5. Hoist the bowl, column, and head assembly and remove the supports.
6. Lower the bowl, column, and head assembly until the discharge-head mounting flange engages the sub base or barrel flange.
7. Secure the discharge head to the sub base or barrel flange.

4.4.4 Shaft sealing installation and alignment summary

Shaft sealing have 2 different options: packing or mechanical seal.

Packing shaft sealing is shipped completely mounted on the discharge head with its stuffing box, packing rings, packing gland. Nuts threaded to the gland studs are hand tightened, therefore end customer should do the proper adjustment during pump start-up.

Shaft sealing uses a mechanical seal with respective seal housing shipped pre mounted on the discharge head while the mechanical seal is shipped loose.

Detailed instructions of stuffing box/packing and mechanical seal installations are informed on next items. Mechanical seal requires shafts alignment and other checks also detailed in next items.

More details will be presented in next chapters.

4.4.4.1 Alignment summary

Vertical solid shaft drivers

1. Before mounting the driver on the discharge head/driver support, check the register fit and the mounting face of the driver for acceptable tolerance on runout and perperdicularity, respectively, using a dial indicator mounted on the driver shaft.
2. With the driver bolted to the discharge head, mount a dial indicator on the driver support and check the runout of the driver shaft.
3. If the shaft sealing has a mechanical seal then additional checks of flatness and concentricity of seal housing are necessary.
4. Next, mount the driver and pump half couplings, adjusting plate, spacer if applicable and raise the impeller. Then secure the coupling bolts.
5. Make a final check of the pump head shaft runout below the pump half coupling with a dial indicator mounted on the driver support or any other convenient stationary surface and slowly rotate the pump's shaft. If the runout is within the acceptable tolerances, check the tightness of the driver hold-down bolts.

Vertical hollow shaft drivers

1. Remove the clutch or coupling from the top of the hollow shaft shaft motor, and mount the driver on top of the discharge head/driver support. For designs requiring the pump head shaft to be installed prior to mounting the driver, lower the hollow shaft driver with care over the head shaft to be sure the latter is not damaged.
2. Install the head shaft, if not already done, and check it for centering in the hollow shaft. If off-center, check for runout in the head shaft, misalignment from the discharge head to driver, or out-of-plumb of the suspended pump.
3. The head shaft is centered within the motor hollow shaft by using a close-fitting steady bushing supplied by the motor manufacturer.
4. Install the driver coupling or clutch, and check the anti-reverse rotation device for operability, if furnished. Install the coupling gib key and the adjusting nut, and raise the shaft assembly with the impeller(s) to the correct running position. Secure the adjusting nut and double-check the driver hold-down bolts for tightness.

4.4.5 Stuffing box installation

CAUTION:

- Make sure the split gland fits squarely in the stuffing box. A split gland that is not properly seated can cause uneven compression of the packing and damage to the shaft or sleeve.

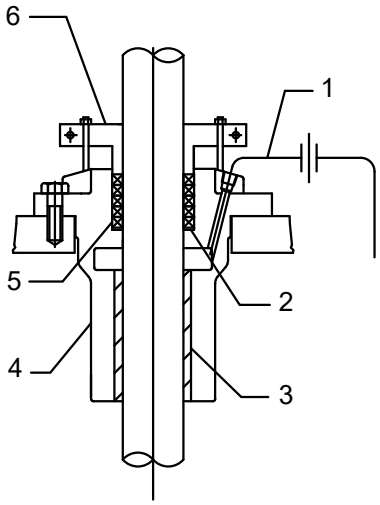
CAUTION:
Packed stuffing boxes are not allowed in an Ex-classified environment.

NOTICE:
Below instructions are to be used in case the stuffing box and packing are not mounted on shipped pump.

Stuffing box types

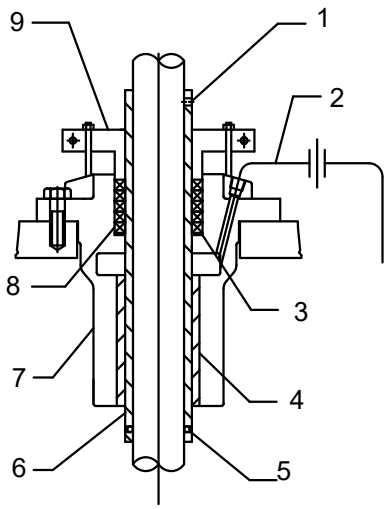
The stuffing box installation has three types:

- Type A (standard version)
- Type B (shaft sleeved version)
- Type C (shaft sleeved version grease lubricated for longer column length)



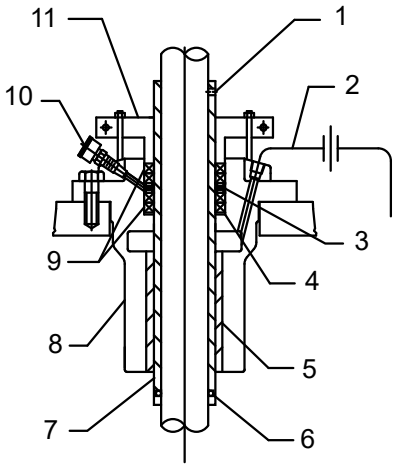
1. Bypass line
2. Packing washer
3. Bearing
4. Packing box
5. Packing rings
6. Split gland

Figure 19: Type A stuffing box



1, Setscrew
2. Bypass line
3. Packing washer
4. Bearing
5. O-ring
6. Sleeve
7. Packing box
8. Packing rings
9. Split gland

Figure 20: Type B stuffing box



1. Setscrew
2. Bypass line
3. Lantern ring
4. Packing washer
5. Bearing
6. O-ring
7. Sleeve
8. Packing box
9. Packing rings
10. Grease cup
11. Split gland

Figure 21: Type C stuffing box

4.4.5.1 Installing the type A and B stuffing boxes

The type B stuffing box is the same as the type A with the exception that it has a shaft sleeve with an O-ring.

1. Lubricate the O-ring and the shaft threads.
2. Slip the sleeve onto the shaft and carefully rotate it counterclockwise while you gently push down until the O-ring is clear of the shaft threads.
3. Locate the sleeve on the shaft and secure it with setscrews.
4. Position the gasket on the discharge head.
5. Slide the stuffing box down over the shaft and into position on the gasket.
6. Secure the stuffing box with capscrews.
7. If the packing washer is provided, insert it into the stuffing box.
   The packing washer is not required on shaft sizes 55.63 mm | 2.19 in. and larger.
8. Grease the packing rings for easier installation.
9. Install the packing rings:

   a) Twist each of the five packing rings sideways in order to easily get them around the shaft.

You can set the sixth ring aside until the packing is adjusted for leakage after the first startup.

   b) Start the first ring into the stuffing box.

   c) Use your fingers to position the entire ring in the stuffing box.

   d) Tap each ring down using a split wooden bushing and push the packing ring down firmly until it seals on the shaft and bore of the stuffing box.

   e) Stagger the ring joints 90° apart.

   You can use the split gland as a tamper for the top ring.
10. Install the split gland and thread the nuts on the split gland studs.
11. Hand-tighten the nuts.
12. If an optional bypass line is furnished, attach it to the tube fitting in the stuffing box.

Final adjustment of the stuffing box must be made at pump start up. This final adjustment applies to all stuffing box styles. A properly packed stuffing box needs to be loose enough to allow you to manually turn the shaft.

4.4.5.2 Installing the type C stuffing box

The type C stuffing box is provided with a shaft sleeve, O-ring, lantern ring, and grease cup.

1. Lubricate the O-ring and the shaft threads.
2. Slip the sleeve onto the shaft and carefully rotate counterclockwise while you gently push down until the O-ring is clear of the shaft threads.
3. Locate the sleeve on the shaft and secure it with setscrews.
4. If the packing washer is provided, insert it into the stuffing box.
   The packing washer is not required on shaft sizes 55.63 mm | 2.19 in. and larger.
5. Grease the packing rings for easier installation.
6. Install the packing rings:

   a) Twist each of the four packing rings sideways in order to get them around the shaft easily.

You can set the fifth ring aside until the packing is adjusted for leakage after the first startup.

   b) Start the first ring into the stuffing box.

   c) Use your fingers to position the entire ring in the stuffing box.

   d) Tap each ring down using a split wooden bushing and push the packing ring down firmly until it seals on the shaft and bore of the stuffing box.

   e) Stagger the ring joints 90° apart.

   You can use the split gland as a tamper for the top ring.

f) Insert the lantern ring into the stuffing box so that it aligns with the lubrication passage in the stuffing box.

g) Install two packing rings and stagger the ring joints 90° apart.

7. Install the split gland and thread the nuts on the split gland studs.
8. Hand-tighten the nuts.
9. Attach a bypass line to the tube fitting in the stuffing box.
10. Grease the stuffing box:

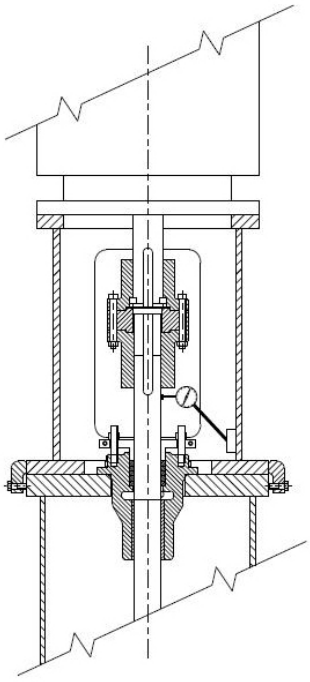
    a) Thread a grease cup into the stuffing box.

    b) Fill the grease cup with a high grade of grease.

    c) After the stuffing box is completely assembled, apply grease to the lantern ring by turning the grease-cup cap several turns.

Final adjustment of the stuffing box must be made at pump start up. This final adjustment applies to all stuffing box styles. A properly packed stuffing box needs to be loose enough to allow you to manually turn the shaft.

4.4.6 Stuffing box installation – alignment check

Runout of driver shaft	**Runout of driver shaft**
Concentricity of the head shaft	1. Install the coupling assembly following the instructions of 4.4.9.1 Installing the coupling hub on page 52 and adjust the impeller per 4.4.9.2 Rotor lift setting adjustment on page 53. 2. Attach the base of the dial indicator on the discharge head or driver support. 3. Place the stylus on the shaft between the top of the packing gland and the bottom of the pump coupling. 4. Check that the shaft runout is within 0.20 mm | 0.008 in. TIR, or as requested by specification. Relocate the driver support using the four alignment lugs when applied.
	

4.4.7 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:

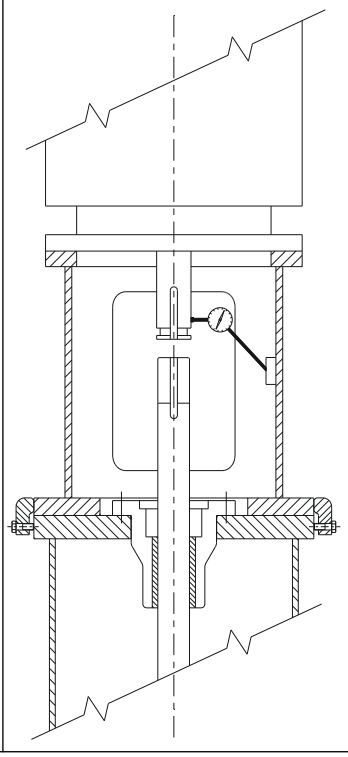
- Cartridge mechanical seal
- High-pressure seal

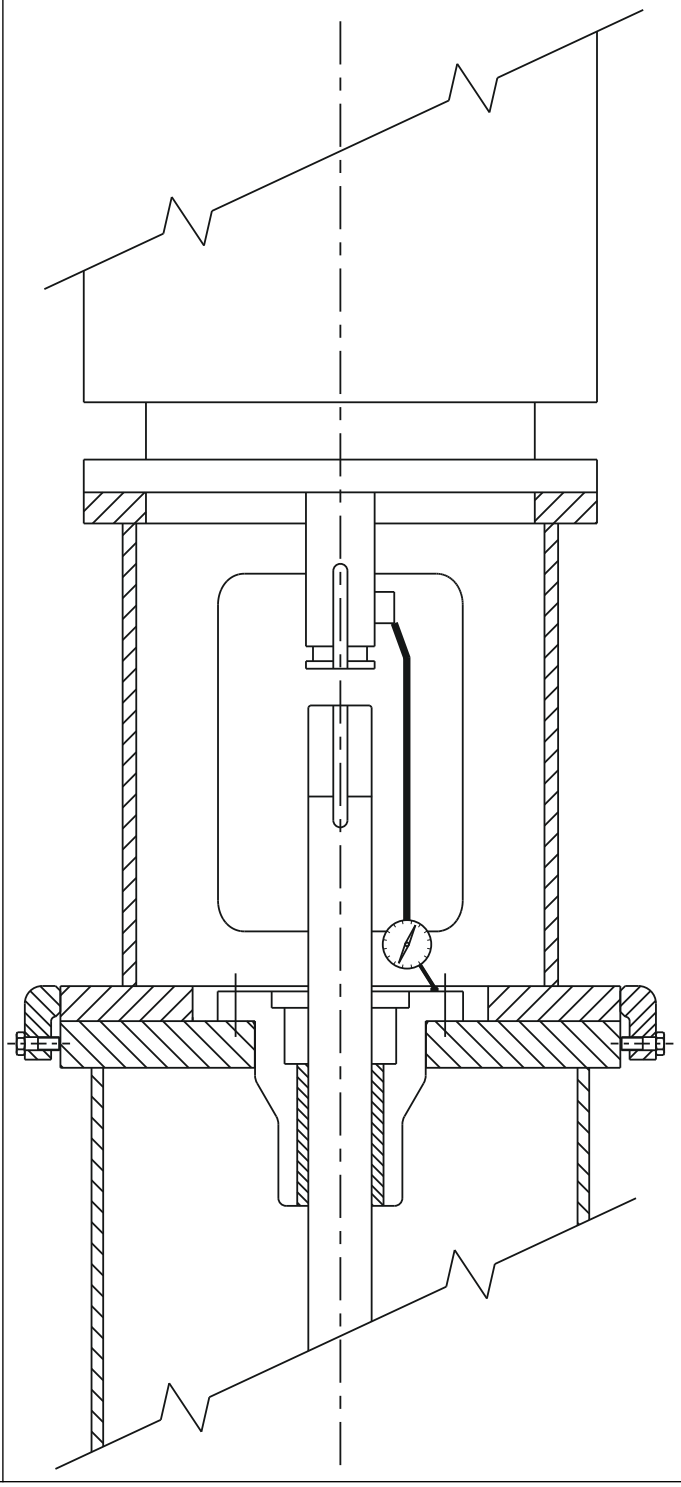
4.4.7.1 Installing the mechanical seal

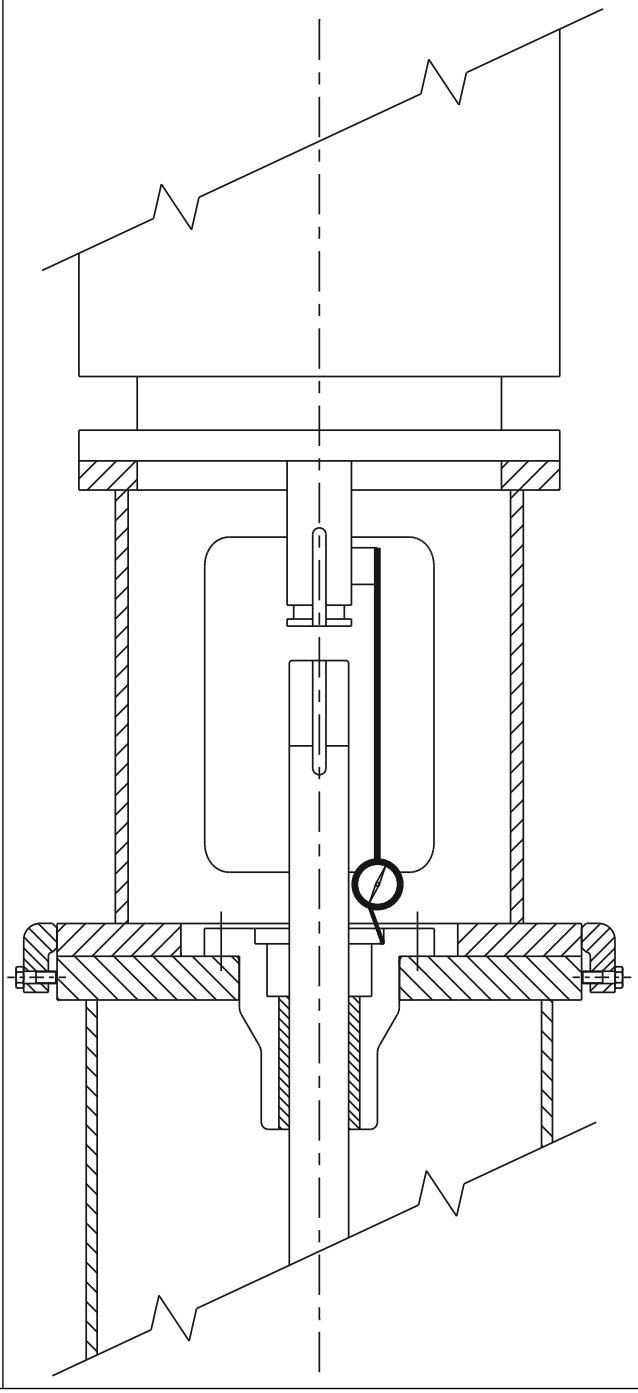
Mechanical seal is shipped loose and for its proper installation driver shaft and seal housing concentricities should be priorly checked.

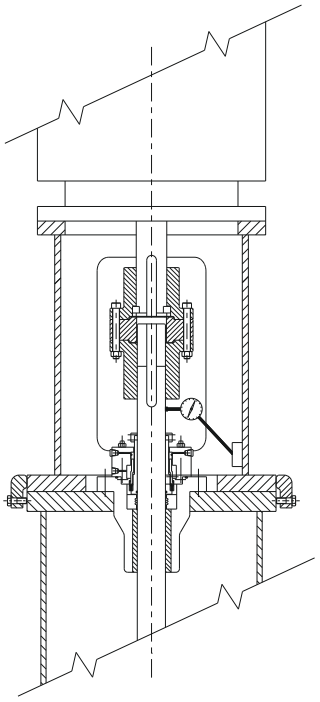
Below instructions are applicable for solid-shaft driver with or without thrust pot.

In case of an enclosed line shaft pump observe topic 4.4.8 Installing the enclosing tube tension plate on page 48 before following below instructions.

Runout of driver shaft	Procedure
Concentricity of driver shaft	1. Install the dial indicator as shown, with the base attached to the motor support. 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. 3. If the indicator reads higher than 0.05 mm | 0.002 in. TIR, loosen the head/driver support hold-down bolts and relocate the driver support using the four alignment lugs when supplied. 4. Obtain the desired position. 5. Tighten the hold-down bolts and repeat the indicator reading. When precision alignment couplings are supplied maximum TIR is 0.025 mm | 0.001 in. 

Runout of driver shaft	Procedure
Flatness of seal housing	1. Remove the lower coupling components and attach the base of the dial indicator to the driver shaft. 2. Place the stylus at the top surface of the seal gland, or at the top surface of the seal housing. 3. Slowly rotate the driver shaft 360°. 4. Check that the face of the seal housing is square with the shaft to within 0.0005" per inch of seal chamber TIR. 

Runout of driver shaft	Procedure
Concentricity of seal housing	1. Install the dial indicator as shown. 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. 3. If the indicator reads higher than 0.125mm | 0.005 in. TIR, loosen the head/motor base hold-down bolts and relocate the driver on the motor base using the four aligning lugs when supplied. 4. Obtain the desired position. 5. Tighten the hold-down bolts and repeat the indicator reading. For seal glands that don't have a register fit this check isn't necessary. 

Runout of driver shaft	Procedure
Concentricity of the head shaft	1. Install the coupling assembly following the instructions of 4.4.9.1 Installing the coupling hub on page 52 and adjust the impeller as per 4.4.9.2 Rotor lift setting adjustment on page 53. 2. Attach the base of the dial indicator on the discharge head or driver support. 3. Place the stylus on the shaft between the top of the seal and the bottom of the pump coupling. 4. Slowly rotate the driver shaft 360°. 5. Check that the shaft runout is within 0.10 mm | 0.004 in. TIR, or as required by specification. When precision alignment couplings are supplied maximum TIR is 0.05 mm | 0.002 in. 

NOTICE:
Be careful with the mechanical seal. Carbon or ceramic components are brittle and easily broken.

NOTICE:

- Do not over tighten the capscrews 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 setscrews until after you adjust the rotor lift setting.
- Reset the seal after you adjust the rotor lift setting.

1. Install the O-ring or gasket between the seal housing and seal:
    1. Install the seal over the shaft and ease it into position against the face of the seal box.
    2. Take care when you pass the sleeve and O-ring over the keyways or threads in order to avoid damage to the O-ring.

2. Position the seal gland on the discharge-head seal housing and secure it with capscrews.
3. Tighten the capscrews gradually and uniformly in a criss-cross 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.
6. Install the driver and coupling.
7. Take flatness and concentricity measurements as recommended in previous instructions.
8. Position and install the drive collar of the seal by tightening the setscrews using the instructions from the mechanical seal manufacturer.
9. Save the seal spacer or eccentric washer. You can use these in order to hold the correct seal spacing in the event that you have to remove the seal. You must loosen the seal setscrews in order to re-adjust the impeller lift.

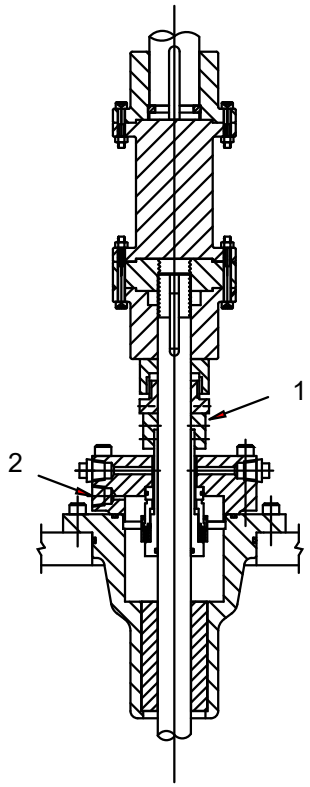
4.4.7.2 Installing the high-pressure seal

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^2 | 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.

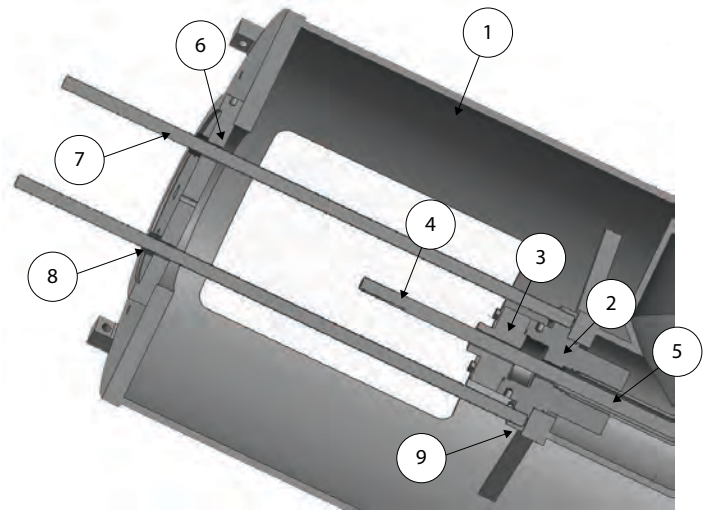
1. Check the TIR on the headshaft above the mechanical seal.
2. Install the backup ring:
   a) Thread the bottom backup ring into the top backup ring until it bottoms out.
   b) Slide the backup ring assembly over the shaft and position it on the seal.
3. Install the spacer coupling and the driver.
4.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



1. Back-up rings
2. Bypass to suction

Figure 22: Mechanical Seal in Housing

4.4.8 Installing the enclosing tube tension plate



1. Discharge head
2. Tension plate or (stuffing box)
3. Mechanical seal (if required)
4. Headshaft
5. Enclosing tube nipple
6. Tension plate tool
7. Studs
8. Nuts
9. Shims

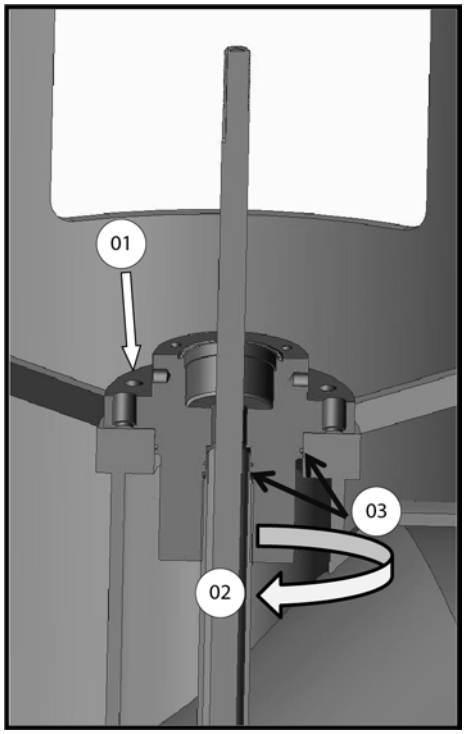
Figure 23: Tube tension plate

1. Inspect the discharge head (1) for any major defects.

   If any major defects are present, immediately report them to your supervisor. Do not proceed until any major defects are resolved.
2. Mount the discharge head (1) into place.
3. Inspect the tension plate (2). Ensure the tension plate bearing is pressed prior to proceeding.
4. Once the bearing is pressed, slide the tension plate (2) onto the discharge head (1). Thread the tension plate (2) onto the enclosing tube nipple (5) as seen in Figure: 2. Thread until enclosing tube nipple (5) feels taught and alignment of the bolt holes of the discharge head (1) to the bolt holes of the tension plate (2) is still achievable.

NOTICE:

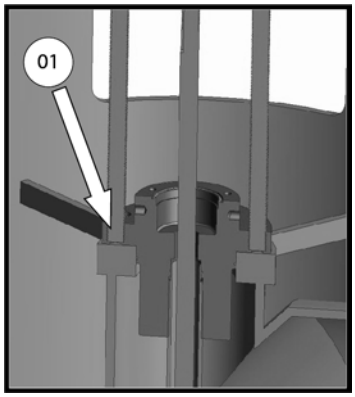
Be sure all O-rings maintain a good seal on the headshaft (4) as well as the discharge head (1).



1. Align bolt holes
2. Thread
3. O-rings

Figure 24: Thread tension plate

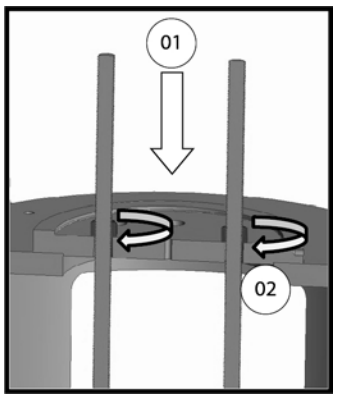
5. Now take the studs (7) and thread them into the tension plate (2). This can be seen below in Figure 25: Thread studs on page 49.



1. Thread

Figure 25: Thread studs

6. Take the tension plate tool (6), slip over studs and fit into place on the discharge head (1) top plate. Secure the tension plate tool (6) by threading on the nuts (8). Do not overtighten the nuts (8) at this time. This is depicted in Figure 26: Tension plate tool on page 50.



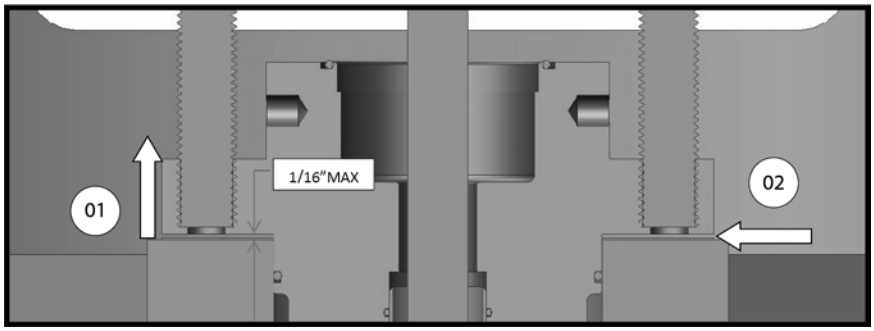
1. Slip on
2. Secure

Figure 26: Tension plate tool

NOTICE:

If the discharge head (1) has a male register, use female register side of tension plate tool (6) and slip onto male register of discharge head (1) top plate. If the discharge head (1) has no register, use male register side of tension plate tool (6) and slip onto the discharge head (1) top plate bore. (No register design is shown in Figure 26: Tension plate tool on page 50)

7. Slowly turn the nuts (8) until the tension plate tool (6) lifts just enough to slide the shims (9) into place. This is depicted bellow in Figure 27: Tension plate lifts on page 50.



1. Lift
2. Slide in

Figure 27: Tension plate lifts

8. The shim (7) is now in place. From this position, lower down the tension plate (2) by unthreading the nuts (8). Once the tension plate is set in position, remove the nuts (8), studs (7), and tension plate tool (6). Bolt the tension plate (2) to the discharge head (1). Do the checks for installation of the packing or mechanical seal (3) as per previous chapters. Set the mechanical seal (3) into position and fasten to the tension plate (2) if a mechanical seal (3) is required. The finished assembly should resemble Figure 28: Tube Tension plate completed on page 51 below.

NOTICE:

This shim (7) has been sized to maintain adequate tension in the enclosing tube assembly.

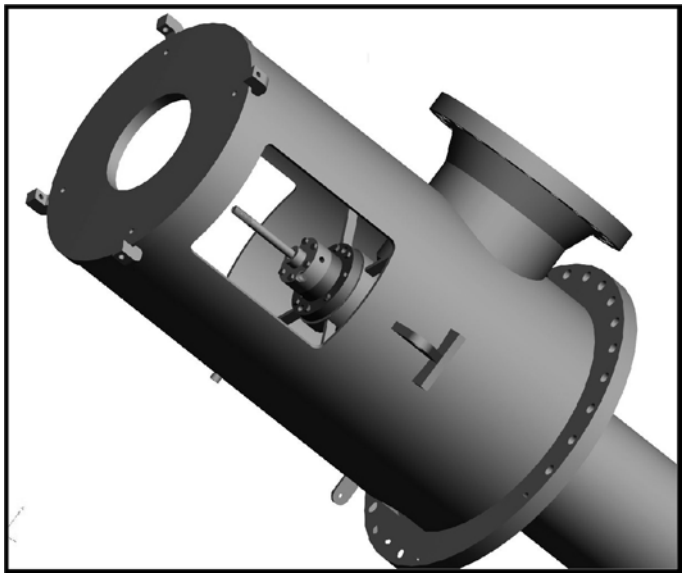


Figure 28: Tube Tension plate completed

This completes the enclosing tube tension plate assembly procedure. The user can now continue to finish assembling the rest of the pump.

4.4.9 Installing 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.

WARNING:

- 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.

NOTICE:

- Refer to the separate IOM supplement for thrust pots.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.

- Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

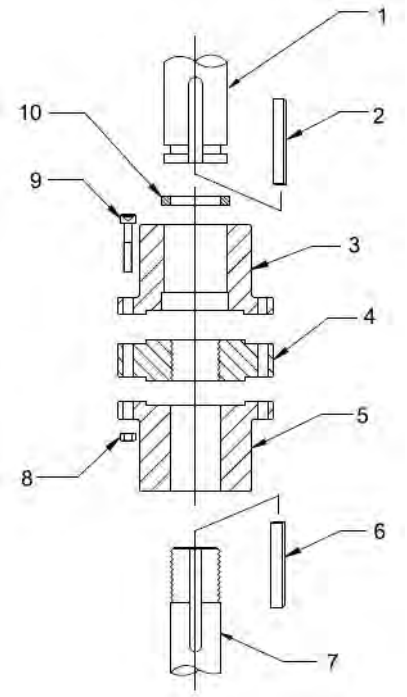
1. If a driver support is furnished and not installed, perform these steps:
   a) Hoist the driver support and inspect the mounting surfaces and register.
   b) Clean these surfaces thoroughly.
   c) Install the driver support on the discharge head and secure it with capscrews.
2. Attach a sling to the 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 counterclockwise 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 counterclockwise when viewed from the top. See the arrow on the pump nameplate. If the motor does not rotate counterclockwise, 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 end play.

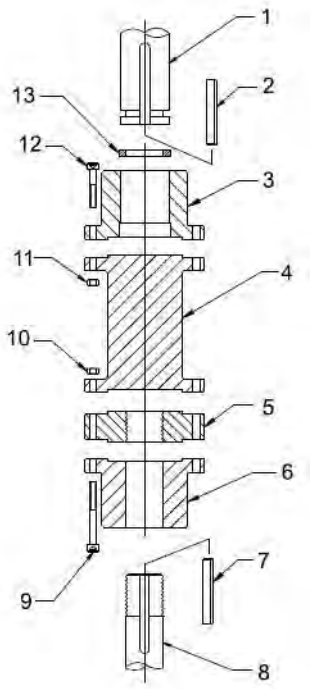
4.4.9.1 Installing the coupling hub

1. Apply a thin film of oil on the pump key and insert the key into the headshaft keyway seat.
2. Gently lower the pump half of the coupling hub onto the headshaft.
3. Thread the adjusting plate onto the headshaft until it is flush with the top of the headshaft.
4. Apply a thin film of oil to the driver key and insert the key into the drive-shaft keyway seat.
5. Place the driver half of the coupling hub onto the drive shaft with the key and slide it up the drive shaft until the annual groove is exposed.
6. Install the split ring in the groove and slide the driver half of the coupling hub down over the split ring to capture it.
7. If the pump is supplied with an adjustable spacer coupling, install the spacer between the headshaft and the drive shaft hubs.
8. Secure with capscrews and hex nuts.



1. Driveshaft
2. Drive key, supplied by motor vendor
3. Driver hub
4. Adjusting plate
5. Pump hub
6. Pump key
7. Headshaft
8. Hex nut
9. Capscrew
10. Split ring

Figure 29: Non-spacer type coupling



1. Driveshaft
2. Drive key, supplied by motor vendor
3. Driver hub
4. Spacer
5. Adjusting plate
6. Pump hub
7. Pump key
8. Headshaft
9. Capscrew
10. Hex nut
11. Hex nut
12. Capscrew
13. Split ring

Figure 30: Spacer type coupling

4.4.9.2 Rotor lift setting adjustment

NOTICE:

- When a mechanical seal is provided, make sure it is not secured to the shaft during rotor lift setting adjustment. The shaft must move up or down within the seal assembly.
- Refer to the general arrangement drawing for the rotor lift setting value.
- Improper rotor lift adjustment can cause contact between the rotating and stationary parts. This results in sparks and heat generation.

4.4.9.3 Adjust the impeller for a solid-shaft driver

IMPORTANT: The determination of the driver-shaft end-play can be critical and should be added to the impeller setting noted in this topic. Refer to the pump outline drawing for details.

When impellers are reset, you must also reset the seal.

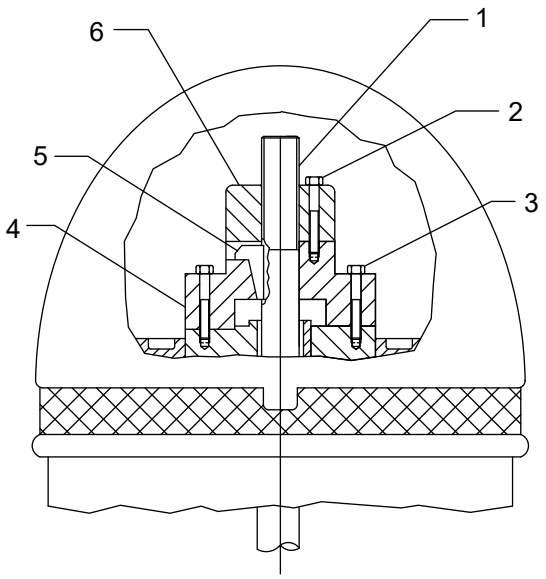
1. Obtain the impeller setting from the Certified Pump Outline Drawing.
2. Align the adjusting plate with the pump hub, and tightly draw the coupling flanges together with capscrews and nuts.
3. Set the seal:
   a) Securely tighten all setscrews in the collar.
   b) Remove the spacer between the gland plate and the collar.
   c) Retain the spacer for future resetting of the seal.

4.4.10 Installing a hollow-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:
Avoid working under suspended loads. If necessary to do so, follow the more stringent of local, state or federal safety regulations.

This figure shows the driving mechanism of all hollow-shaft drives. The drive shaft extends up through the quill or hollow shaft of the motor (or gear drive) and is held in place by an adjusting nut. This adjusting nut carries all the static and hydraulic thrust of the impellers and shaft, and also provides the adjustment for the impeller clearances:

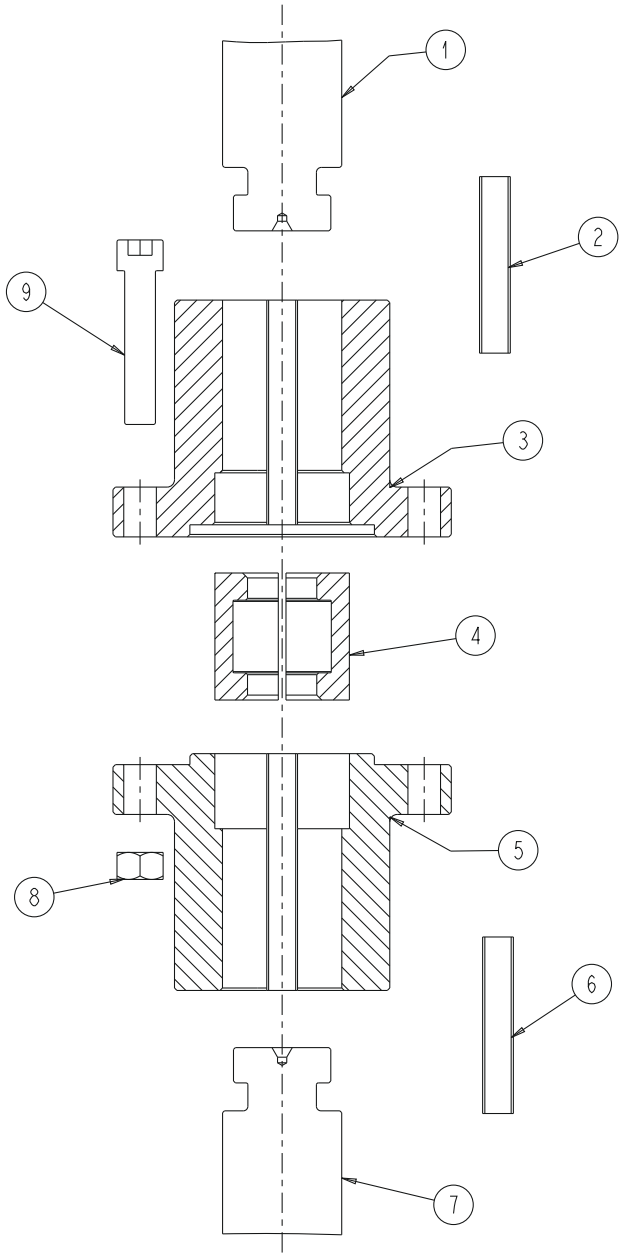


1. Drive shaft
2. Capscrew adjusting nut
3. Hold-down bolt
4. Drive coupling
5. Gib key
6. Adjusting nut

This procedure refers to either a VHS-type electric motor or hollow-shaft type gear drive.

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. Install the stuffing box and packing or seal housing and mechanical seal on the discharge head as per the instructions given on previous chapters.
3. Inspect the driver:
   a) Attach a sling to the lifting lugs of the driver and hoist the motor.
   b) Inspect the mounting surface, register, and shaft extension.
   c) Clean these surfaces thoroughly.
   d) If any burrs are found, remove these burrs with a smooth mill file and then thoroughly clean the driver.
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. Lubricate the motor bearings according to the manufacturer instructions.
6. Remove the drive coupling and hold-down bolts.
7. Screw the adjusting nut loosely onto the end of the drive shaft.
8. Clean the drive shaft thoroughly and attach the nut.
9. Lower the drive shaft through the motor-quill shaft and examine closely for dirt or burrs between the shaft ends.
10. Raise the drive shaft and adjusting nut assembly to allow room to install the rigid-flanged coupling.

4.4.10.1 Assemble the type AR rigid-flanged coupling



1. Drive shaft
2. Driver key
3. Driver hub
4. Split ring
5. Pump hub
6. Pump key
7. Head shaft
8. Hex nut
9. Capscrew

1. Disassemble the coupling:

a) Check that all components are clean and no foreign matter is lodged in any of the machined recesses or registers.

b) Insert the driver key into the drive shaft keyway and slide the driver hub onto the drive shaft.

c) Position the hub so that the shaft end is exposed enough to allow for the mounting of split ring on the shaft end.

In order to ease the assembly, you can temporarily secure the hub in this position using tape or a rope.

2. Insert the pump key into the pumpshaft keyway and slide the pump hub onto the pumpshaft. Position the hub so that the headshaft end is exposed.
3. Insert the split ring into the groove of the pump head shaft.
4. Slide the pump hub towards the split ring until the split ring is fully seated in its register in the hub. Hold the hub in this position.
5. Slide the driver and pump hubs towards each other until the split ring is fully captured.
6. Insert all the coupling hub capscrews and hex nuts and tighten them.

4.4.10.2 Complete the hollow-shaft driver installation

NOTICE:
Never check the motor rotation with the drive coupling in place. The bore clearance between the drive coupling and the pump shaft OD is close enough that if the motor spins while this shaft is stationary, then galling and locking together is likely to occur.

1. Remove the sling and see if the drive shaft centers inside the driver quill within 0.25 mm | 0.010 in. If it does not, this indicates misalignment. Perform these steps:

   a) Check to see if you have a bent drive shaft, burrs, or foreign matter between the shaft ends or any of the mounting flanges:

   - Driver-to-driver support
   - Driver support to discharge head
   - Discharge head to sub-base or foundation

   b) Check to see if the sub-base and discharge head are level.

   If it is not, shim between the sub-base and the discharge head in order to correct the problem.

   c) Check the concentricity of the motor-to-motor stand to discharge head.
2. Connect the electricity and check that the motor rotation is counterclockwise when viewed from the top.
   See the arrow on the pump nameplate. If the motor does not rotate counterclockwise and you have a three-phase motor, change the rotation by interchanging any two leads. For single-phase motors, refer to the instructions from the motor manufacturer.
3. Install the motor-drive coupling:

   a) Insert ratchet pins if you are using a non-reverse ratchet.

   b) Match the coupling lugs with the corresponding holes in the motor.

   c) Pull down the hold-down bolts evenly.

   d) Make sure that the drive coupling is properly seated in the register fit.
4. Fit the gib key into the keyway so that there is a snug, but sliding, fit.
   Make sure that you can remove the key with gentle leverage using a screwdriver.
5. Make sure that the gib key is not so high that it prevents the adjusting nut from seating on the drive coupling.
6. Install the adjusting nut and hand-tighten.

4.4.10.3 Adjust the impeller for a hollow-shaft driver

NOTICE:

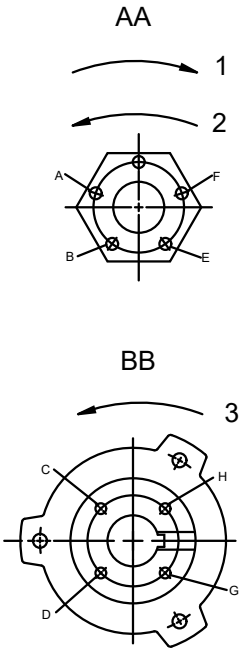
- If your hollow-shaft driver has a mechanical seal, you must disengage the mechanical seal prior to impeller adjustment.
- Improper impeller adjustment can cause contact between the rotating and stationary parts. This may result in sparks and heat generation.

This procedure applies to the open and enclosed impeller:

1. Make sure that the shafting is all the way down and that the impellers are resting on their seats.
2. Turn the adjusting nut in a counterclockwise direction in order to lift the shaft until the impellers just clear their seats and the shaft turns freely by hand.
   This removes all deflection from the shaft.
3. Align hole A in the adjusting nut and hole C in the motor coupling.

   If you are careful, you can reach an initial impeller clearance between 0.02 mm to 0.07 mm | 0.001 in. to 0.003 in. depending on the shaft size and thread data shown in this table:

Shaft size	Thread	Vertical movement in 1/20th turns - adjusting nut
19 mm | ¾ in.	¾-16 LH	0.076 mm | 0.003 in.
25 mm | 1 in.	1-12 LH	0.10 mm | 0.004 in.
30 mm | 1 3/16 in.	1-12 LH	0.12 mm | 0.005 in.
38 mm | 1½ in.	1-10 LH	0.12 mm | 0.005 in.
42 mm | 1 11/16 in.	1-10 LH	0.12 mm | 0.005 in.
49 mm | 1 15/16 in.	1-10 LH	0.12 mm | 0.005 in.
55 mm | 2 3/16 in.	1-10 LH	0.12 mm | 0.005 in.
62 mm | 2 7/16 in.	1-10 LH	0.12 mm | 0.005 in.
68 mm | 2 11/16 in.	1-8 LH	0.15 mm | 0.006 in.



1. Lower impeller
2. Raise impeller
3. Correct impeller rotation

4. Obtain the impeller setting from the Certified Pump Outline Drawing.
5. Insert a capscrew into hole B provided that these are the nearest-matching holes for counterclockwise rotation of the adjusting nut.
6. Turn the adjusting nut counterclockwise until holes B and D line up.
7. Tighten the capscrew of hole B to D.

4.4.11 Set up the lubrication system

1. Observe instructions on the submittal document.
2. Connect the solenoid valve, if provided, and the oil lines.
3. Fill the oil reservoir with oil.
4. Check the lubricator feed and make sure that the oil reservoir is flowing freely.
   In the case of a solenoid valve, temporary power connections are required.
5. Set the proper drops per minute on the regulator as this table shows:
   The shaft is the headshaft (OD). The adjustment is a manual adjustment on the regulator valve.

Shaft size in inches	Shaft size in millimeters	Drops per minute per 100 feet (30.48 meters) of shaft
0.75 to 1.00	19 to 25 mm	8
1.19 to 1.94	30 to 50 mm	16
2.19 and larger	55 mm and larger	20

NOTICE:

In general applications, ITT recommends synthetic turbine oil ISO VG 32. For more specific data consult ITT.

4.4.12 Flush water system setup

Please refer to General Arrangement Drawing to get the flush water parameters.

4.4.13 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 VPD 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 Table 3: Levelness tolerances on page 27.	
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 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: • Operate freely • Properly installed for the direction of flow • Have the proper pressure	
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.	
For other drivers than electric motors, verify the specific assembly and installation instructions concerning to exhaust gas collection, noise, temperature protection and others.	
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 counterclockwise when viewed from above.	

Check	Checked
Run the pump uncoupled in order to check that the driver runs smooth and sounds normal. • For VHS motors, remove the driveshaft if a coupling is provided. If a coupling is not provided, then remove the steady bushing and driver coupling. • On drivers with NRRs. remove the rachet pins, if possible. Otherwise, rotate the drive coupling clockwise until the pin stops tight against the rachet plate. If a customer refuses to allow you to check the rotation, have the customer sign and date this check-list before you proceed.	
After you verify the proper rotation of the driver, you can couple the pump to the driver. • On VSS units with a flanged coupling , except for the AR type, set the impeller lift. • On VHS units, set the impeller lift using the adjusting nut on top of the motor after you make up the threaded or AR coupling. See either the pump nameplate or the outline drawing for the specific impeller lift required for an individual pump.	
Check the alignment on pumps that are equipped with jacking bolts since they require that the motor be physically aligned to the pump. Special alignment of the pump to the motor is not usually required since all components are equipped with register fits.	
Use a dial indicator in order to check that the shaft runout above the sealing element is not excessive: • Packing limit is a maximum of 0.2 mm | 0.008 in. • Mechanical seal limit is a maximum of 0.13 mm | 0.005 in.	
On units with seals, check these items: • Check that the seal rotates freely. • Check that the seal spacers are removed. • Check that the seal piping is properly installed and leak-free.	
On water-lubricated, enclosed lineshaft units, check these items: • Check the water PSI and flow rate. • Check the solenoid valve and its connection for proper operation.	
On oil-lubricated, enclosed lineshaft units, check these items: • Check that the oil tank is completely full and allow the oil to drip overnight prior to start-up. • Check the solenoid valve and its connection for proper operation. • Check the oil tank and refill.	

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

WARNING:

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

WARNING:

- 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.

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

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

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

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

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

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

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.

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

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

- 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.
- For a VHS motor, do not check the motor rotation unless the motor is bolted to the pump and the drive coupling is removed.
- 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 counterclockwise when viewed from above.
   c) Checked the alignment between the pump and driver.
   d) Adjusted the impeller.
   e) Attached the mechanical-seal lock collar to the shaft.
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 vented.
9. Inspect the discharge-piping connection and pressure gauges for proper operation.
10. For the enclosed lineshaft construction, turn on the oil drip or water flush for a minimum of five minutes.
11. For oil-lubricated lineshafts, set the sight feed dripper for the number of drops per minute as directed in 4.4.11 Set up the lubrication system on page 59.
12. For flush water lubricated lineshafts, see the instructions on General Arrangement Drawing.

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 ($NPSH_A$) must always exceed NPSH required ($NPSH_R$) 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

WARNING:

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

NOTICE:

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

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

- Open the suction valve.
- Open any recirculation or cooling lines.

1. Fully close or partially open the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
5. If the pump fails to reach the correct pressure, perform these steps:
   a) Stop the driver.
   b) Confirm the minimum submergence.
   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.

5.4 Pump operation precautions

General considerations

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.

Operation at reduced capacity

WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.
- Risk of 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 ($NPSH_A$) always exceeds NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.
-

Operation under freezing conditions

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

5.5 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 Stuffing box leaks

Normal leaks

With the pump in operation, there should be some leaking at the stuffing box packing. The correct leak rate is a rate which keeps the shaft and stuffing box cool. This rate is approximately one drop per second. Check the temperature of the leaked fluid as well as the discharge head.

Decreased leaks

If the pump runs hot and the leaks begin to decrease, stop the pump and allow it to cool down. Loosen the packing gland in order to allow the packing to resume leaking. After the pump has cooled, restart the pump and run it for 15 minutes. Then check the leaks. If the leaks exceed two drops per second, adjust the packing.

5.7 Shut down the pump

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

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

5.8 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 Adjust and replace the packing

NOTICE:
Never over-tighten packing to the point where less than one drop per second is observed. Over-tightening can cause excessive wear and power consumption during operation.

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

Adjust the packing when one of the following conditions occurs:

- The leakage rate exceeds two drops per second.
- There is overheating or no leakage.

If you cannot tighten the packing to obtain less than the specified leakage rate, then replace the packing.

6.2.1 Adjust the packing when leaking is excessive

Perform this procedure if leaks exceed two drops per second.

1. With the pump in operation, tighten the gland nuts one-quarter turn.
2. Before you make any more adjustments, check to see if the packing has equalized against the increased pressure by making sure the leaks have decreased to a steady state.

If the leaks decrease to two drops per second, then you are finished. If the leaks continue to exceed two drops per second, continue to the next step.

3. Shut down the pump.
4. Allow the packing to compress enough so that the gland is about to contact the upper face of the stuffing box.
5. Remove the split gland, add one extra packing ring, and readjust.
6. If this fails to reduce the leak to two drops per second, then remove all packing rings and replace them with new rings:

   a) Remove the packing with the aid of a packing hook.

   b) If a lantern ring is provided, remove it by inserting a wire hook in the slots of the ring and pull it from the stuffing box.

   c) Thoroughly clean the stuffing box of all foreign matter.
7. If the replacement packing is in the form of a continuous coil or rope, cut it into rings before installing:

   a) Tightly wrap one end of the packing material around the top shaft like one coil spring.

   b) Cut through the coil with a sharp knife.

   See Installation for details about how to properly reinstall the stuffing box.

6.2.2 Adjust the packing when there is overheating or no leaks

CAUTION:
If there are no leaks or the stuffing box overheats, do not back off the gland nuts while the pump is running. This causes the entire set of packing rings to move away from the bottom of the box without relieving pressure of the packing on the shaft.

A small amount of leaking is required in order to prevent overheating.

1. Stop the pump and allow the packing to cool.
2. Restart the pump.
3. Repeat these steps until two drops of liquid per second comes through.
4. If this fails to fix the problem, then you must replace the packing.

6.3 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.

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.

Changing the oil

Observe the instructions in the Thrust Pot IOM.

6.4 Disassembly

6.4.1 Disassembly precautions

WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This

manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.

- Handling heavy equipment poses a crush hazard. Use caution during handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.
- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
- Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
- Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.
- 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.

6.4.2 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. 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.

2. 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.
3. Remove all hold-down bolts and integral piping.
4. Remove the coupling, mechanical seal.
5. Continue with disassembly down to the bowls as described in the next section.

6.4.3 Bowl disassembly

The bowl assembly is composed of these parts:

- Suction bell
- Intermediate bowls
- Top bowl
- Impellers and securing hardware
- Bearings
- Pump shaft

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

6.4.3.1 Disassemble the taper collet impeller

1. Remove the capscrews that secure the top bowl to the intermediate bowl.
2. Slide the top bowl off the pump shaft.
3. Pull the shaft out as far as possible and strike the impeller hub using a collet driver or equivalent, sliding along the pump shaft to drive the impeller off the taper collet.
4. After the impeller is freed, insert a screwdriver into the slot in the taper collet, spread it, and remove the taper collet.
5. Slide the impeller off the pump shaft.
6. Repeat these steps until the bowl assembly is completely disassembled.

6.4.3.2 Disassemble the keyed impeller

1. Remove the capscrews that secure the top bowl to the intermediate bowl.
2. Slide the top bowl off the pump shaft.
3. Remove the capscrews and the split-thrust ring from the pump shaft.
4. Slide the impeller off the pump shaft and remove the key.

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.

5. Repeat these steps until the bowl assembly is completely disassembled.

6.4.4 Remove the bowl and impeller wear rings

1. Remove the setscrews or grind off the tack weld if the rings are furnished with those locking methods.
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.

6.4.5 Remove the bowl, suction bell, and lineshaft bearings

NOTICE:
Do not remove any bowl bearings unless replacement is necessary.

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.

6.5 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.

6.5.1 Replacement guidelines

Casing check and replacement

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

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

Impeller replacement

This table shows the criteria for replacing the impeller:

Impeller parts	When to replace
Impeller vanes	• When grooved deeper than 1.6 mm | 1/16 in., or • When worn evenly more than 0.8 mm | 1/32 in.
Vane edges	When you see cracks, pitting, or corrosion damage
Keyway and bores	When you see damage

Gaskets, O-rings, and seats replacement

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

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

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

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

Bearing retainer check

Check the bearing retainer for deformation and wear.

Shaft check

- Check the shafts for straightness and excessive wear on the bearing surfaces.
- Check the deflection of shafts. The average total runout should not exceed 0.25 mm | 0.010 in. TIR for every 3 m | 10 ft. of shaft length.
- 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.

Mechanical seal checks

On pumps equipped with a mechanical seal, check that the shaft or sleeve is free of pits, burrs, or sharp edges in order 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 checks

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

6.6 Reassembly

6.6.1 Installing the turbine bowl and impeller wear ring

1. Place the chamfered face of the bowl or impeller wear ring towards the ring seat and press the ring into the seat.
2. Use an arbor press or equivalent and make sure the ring is flush with the edge or the wear ring seat.

6.6.2 Installing the bowl, suction bell, and lineshaft bearings

Make sure you have an arbor press or equivalent for pressing the bearings.

1. Press the bearing into the retainer.
2. Press the bearing into the suction bell.
   The top of the bearing should protrude above the suction hub equal to the depth of the counter bore in the sand collar.
3. Press the bearings into the intermediate bowl and the top bowl.
4. Place the bowl with the flange downward and press the bearing through the chamfered side of the bowl hub until the bearing is flush with the hub.

6.6.3 Installing the taper collet bowl assembly

WARNING:
Wear heat resistant gloves and use the appropriate eye protection in order to prevent injury when you handle hot parts.

1. Apply a thin film of turbine oil to all mating and threaded parts.
2. If the pump utilizes a sand collar, then perform these steps:

   a) If the sand collar is not assembled to the shaft, then heat the sand collar until it slips over the shaft and quickly position it so that the top of the sand collar is even with the locating groove before it cools.

   The sand collar is attached to the shaft with a shrink fit. The shaft is machined with a 0.25 mm | 0.01 in. groove to locate the sand collar. The large diameter of the counterbore of the sand collar goes toward the suction bell bearing.

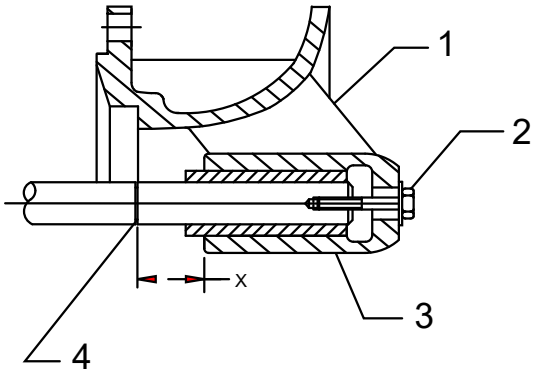
   b) Slide the end of the pump shaft with the sand collar into the suction bell bearing until the sand collar rests against the suction bell.

   c) Skip the next step and proceed to installing the impellers.
3. If the pump is not equipped with a sand collar, then locate the pump shaft with respect to the suction bell:

   a) Insert the pump shaft into the suction bell bearing until it bottoms out.

   b) Pull the shaft out until the distance between the groove on the shaft and the top of the suction bell hub, and not the top of the bearing, is correct for the particular pump.

   Use the X dimension in the Pump shaft dimensions table in the Maintenance chapter.



1. Suction bell
2. Capscrew screwed into the tapped hole in the shaft with washers, as required
3. Suction bell hub
4. 0.25 mm | 0.01 in. groove

4. Hold the shaft in this position by inserting a capscrew with a washer into the hole in the end of the suction bell and then into the threaded hole in the end of the shaft.
5. Install the impeller:

   a) Slide the first impeller over the shaft until it seats on the suction bell.

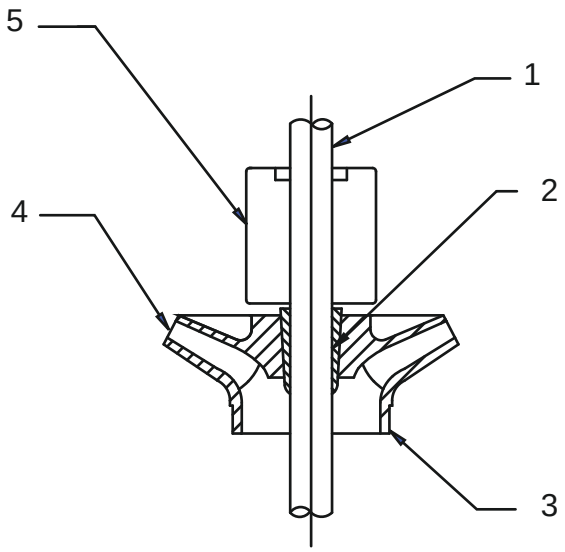
   b) Insert a screwdriver into the slot in the taper collet, spread the slot, and slide the collet over the pump shaft.

   c) Hold the impeller against the bowl and slide the collet into the impeller hub.

d) Hold the shaft with a capscrew and washer against the suction bell and drive the taper collet into place with a collet driver.

NOTICE:

Collet driver should slide on the shaft and knock firmly the taper collet.



1. Shaft
2. Collet
3. Impeller
4. Location to hold impeller against the bowl and drive collet into impeller hub
5. Collet driver assembly position

6. After the collet is in place, recheck the X dimension, if possible.
7. Slide the intermediate bowl onto the shaft and secure it with the capscrews provided.
8. Repeat this procedure for the number of stages required.
9. Remove the capscrew and washer from the shaft at the suction bell and perform these checks:
   - Check that the shaft rotates freely without dragging or binding.
   - Check that there is adequate lateral end play.

6.6.4 Installing the keyed bowl assembly

1. Install the key into the keyway of the pump shaft, slide the impeller over the shaft, and position the impeller on the key.
2. Install a split-thrust ring on the pump shaft groove and secure it to the impeller with capscrews.
3. Slide an intermediate bowl over the pump shaft and secure it to the suction bell with capscrews.
4. Repeat these steps for the number of stages required.

6.6.5 Pump shaft setup dimensions

The size of the pump is stated on the nameplate and on the Certified Pump Outline Drawing.

Pump size	X dimension (inches)	X dimension (millimeters)
4D	1.31	33.27
6A	1.37	34.80

Pump size	X dimension (inches)	X dimension (millimeters)
6D	1.37	34.80
6J	1.37	34.80
7A	1.37	34.80
8A	1.37	34.80
8D	1.37	34.80
8J	1.37	34.80
9A	1.37	34.80
10A	1.75	44.45
10D	1.75	44.45
10J	1.75	44.45
10L	2.12	53.85
11A	2.12	53.85
12D	2.25	57.15
12J	2.12	53.85
14D	2.75	69.85
14H	2.75	69.85
14J	2.75	69.85
16D - Bell	1.75	44.45
16D - Bowl	2.75	69.85
18H	2.75	69.85
20H	0.87	22.10
28T	4.50	114.30
36T	6.25	158.75

6.6.6 Tightening torques

Refer to Tightening torque table for tie-rods for bowl assembly and 10.1 Tightening torque tables for studs, capscrews and nuts on page 101.

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 sump as necessary.
	The suction strainer is clogged.	Remove the obstructions.
	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 5 Commissioning, Startup, Operation, and Shutdown on page 63
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 counterclockwise 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 driver is running at the proper speed. Make sure that the turbine is receiving full steam pressure.
	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 counterclockwise 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.

Symptom	Cause	Remedy
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 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.
	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 stuffing-box packing is too tight.	Release the gland pressure and retighten. Keep the leaking fluid flowing. If there are no leaks, then check the packing, sleeve, or shaft. See Maintenance for details.
The pump is noisy.	The pump is cavitating.	Increase the liquid level in the sump.
	The shaft is bent.	Straighten as necessary.
	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: • The coupling is misaligned. • The shaft is bent. • The impellers are not balanced. • The bearings are worn. • There is cavitation. • There is strain on the discharge piping. • There is resonance.	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.
There is excessive leakage from the stuffing box.	The packing is defective.	Replace any packing that is worn or damaged.
	The wrong kind of packing was used.	Consult an ITT representative.

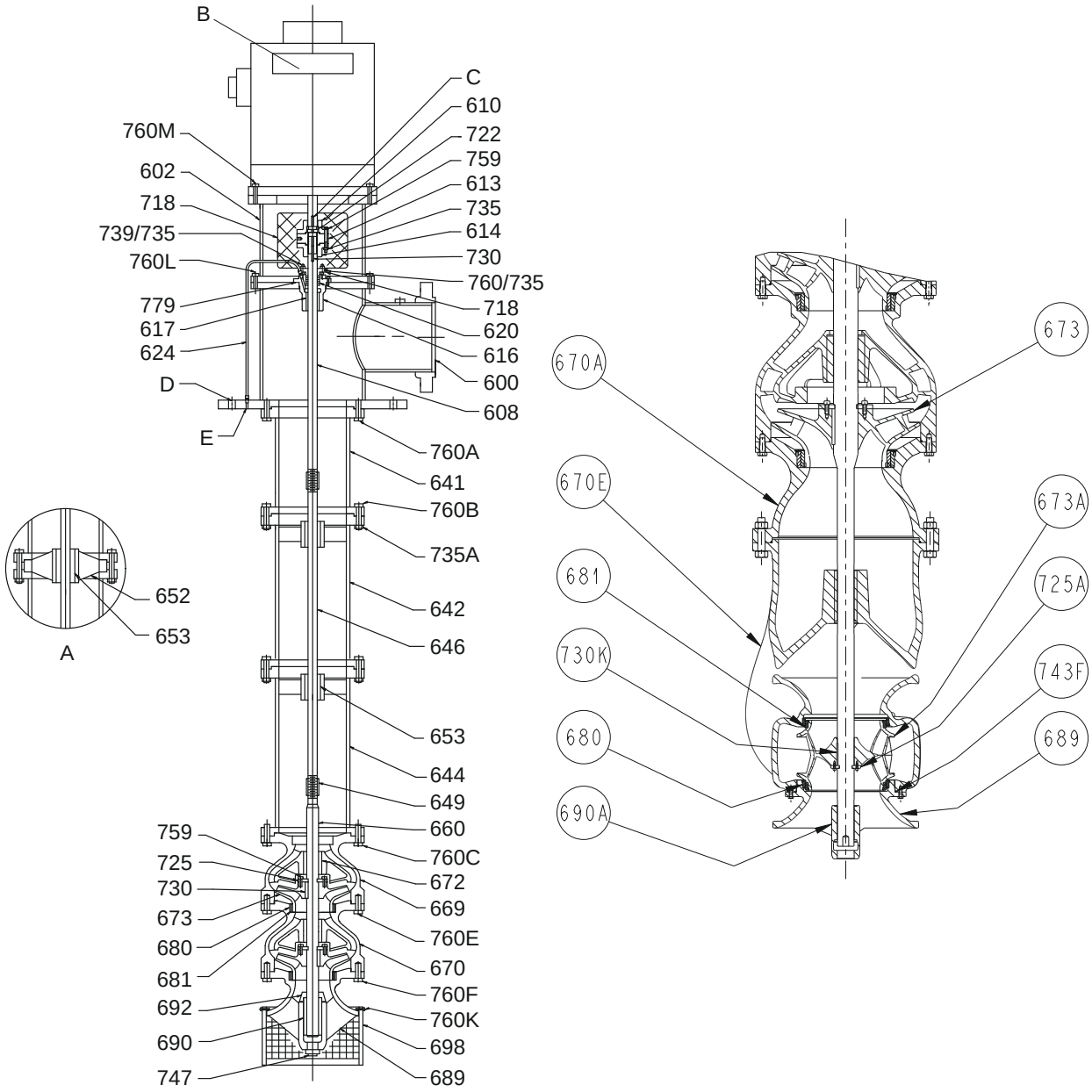
Symptom	Cause	Remedy
The stuffing box is overheating.	The packing is too tight.	Release the gland pressure and retighten. Keep the leakage flowing. If there is no leakage, then check the packing, sleeve, or shaft. See Maintenance for details.
	The packing is not lubricated.	Release the gland pressure and replace any packing that is burned or damaged. Regrease the packing as necessary.
	The wrong grade of packing was used.	Consult an ITT representative.
	The stuffing box was improperly packed.	Repack the stuffing box.
The packing wears out too fast.	The shaft or shaft sleeve is worn or scored.	Remachine or replace any parts as necessary.
	There is insufficient leakage across the packing.	Repack the stuffing box and make sure that the packing is loose enough to allow some leakage.
	The stuffing box was improperly packed.	Repack the stuffing box properly, making sure that all old packing is removed and the stuffing box is clean.
	The wrong grade of packing was used.	Consult an ITT representative.
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: • The carbon insert is cracked. • The insert face or seal ring was chipped during installation.	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.
The seal squeals during operation.	There is an inadequate amount of liquid at the seal faces.	A bypass flush line is necessary. If a bypass line is already in use, then enlarge it in order to produce more flow.
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.
	Liquid film is flashing and evaporating between the seal faces and leaving residue, which is grinding away the carbon.	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.

Symptom	Cause	Remedy
	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 List and Cross-Sectionals

8.1 VIT product lube (includes VIDS detail)

This image shows the VIT with motor support (two-piece head construction):



This pump has these features:

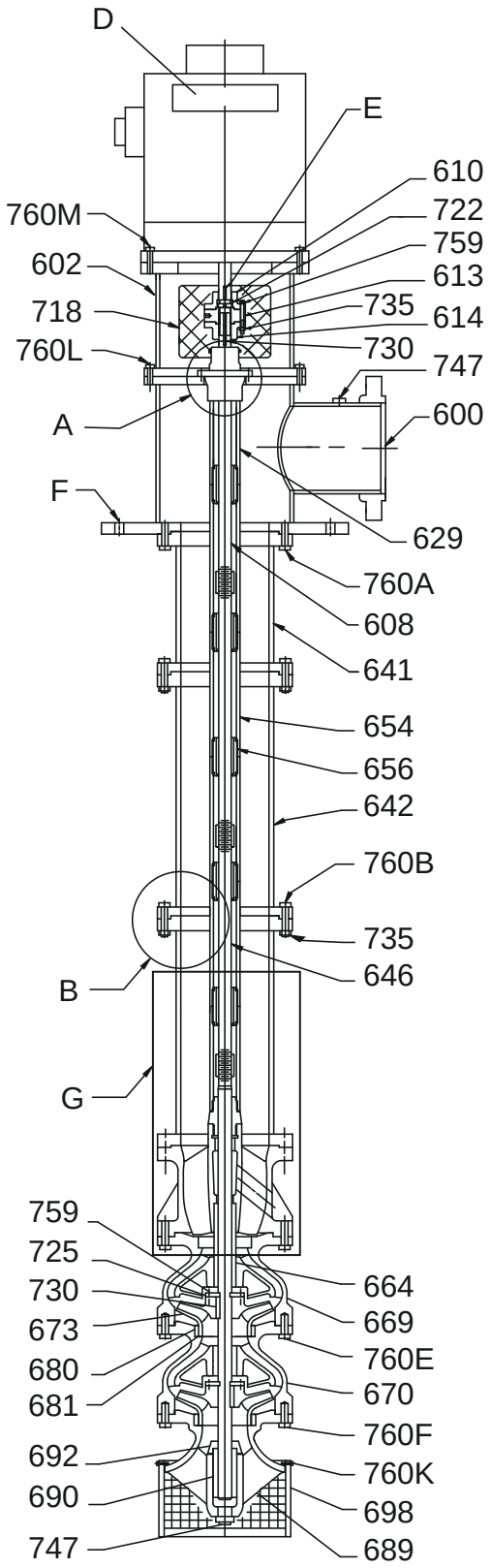
- Flanged adjustable coupling
- Standard stuffing box
- Flanged column with integral bearing retainer and lineshaft bearing

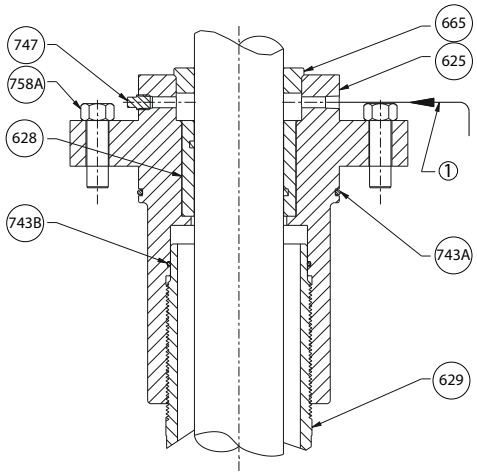
- Bowl assembly:
  - Keyed impellers
  - Bowl and impeller wear rings
  - Strainer (basket type)

Label	Part name	Label	Part name
A	Optional, on duplicate pumps	747	Pipe plug
B	VSS motor	759	Socket head capscrew
C	Motor key, supplied by the motor vendor	760	Capscrew
D	Mounting holes	760A	Column/head capscrew
E	Bypass, return to sump	760B	Column/column capscrew
600	Head	760C	Column/bowl capscrew
602	Motor support	760E	Bowl/bowl capscrew
608	Headshaft	760F	Bowl/bell capscrew
610	Hub motor	760K	Strainer capscrew
613	Adjusting plate	760L	Support head capscrew
614	Pump hub	779	Gasket
616	Stuffing box	670A	Bowl adapter
617	Bearing	670E*1	Casing
620	Packing	673E*1	Impeller double suction
624	Bypass line assembly, tube and fitting	725A*1	Thrust ring
641	Top column	730K*1	Key
642	Intermediate column	743F*1	O-ring
644	Bottom column		
646	Lineshaft		
649	Lineshaft coupling		
652	Bearing retainer		
653	Lineshaft bearing		
660	Pump shaft		
669	Top bowl		
670	Intermediate bowl		
672	Bowl bearing		
673	Impeller		
680	Bowl wear ring		
681	Impeller wear ring		
689	Suction bell		
690	Suction bearing		
692	Sand collar		
698	Basket type strainer		
718	Coupling guard		
722	Retaining ring		
725	Thrust ring		
730	Key		
735	Hex nut		
739	Stud		

*1 VIDS specific parts

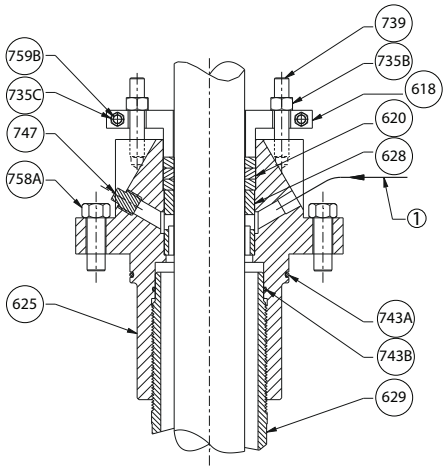
8.2 VIT enclosed lineshaft





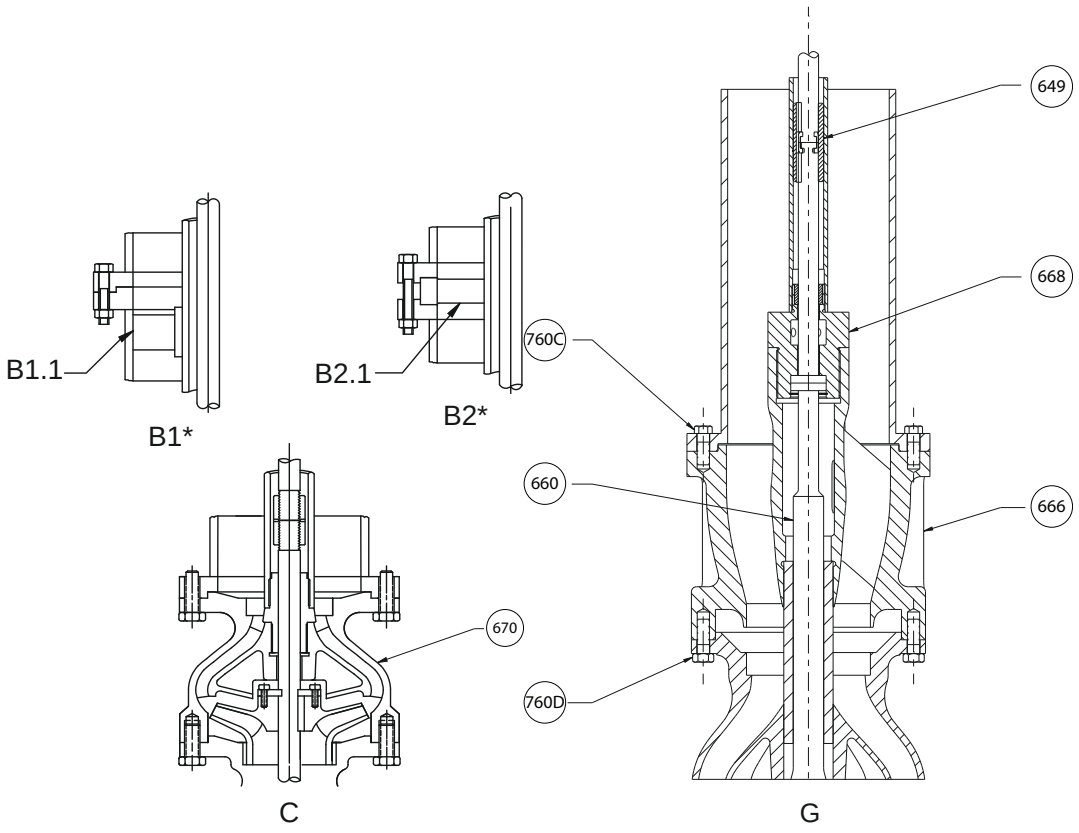
A1

1. Oil lube line



A2

1. Water flush line

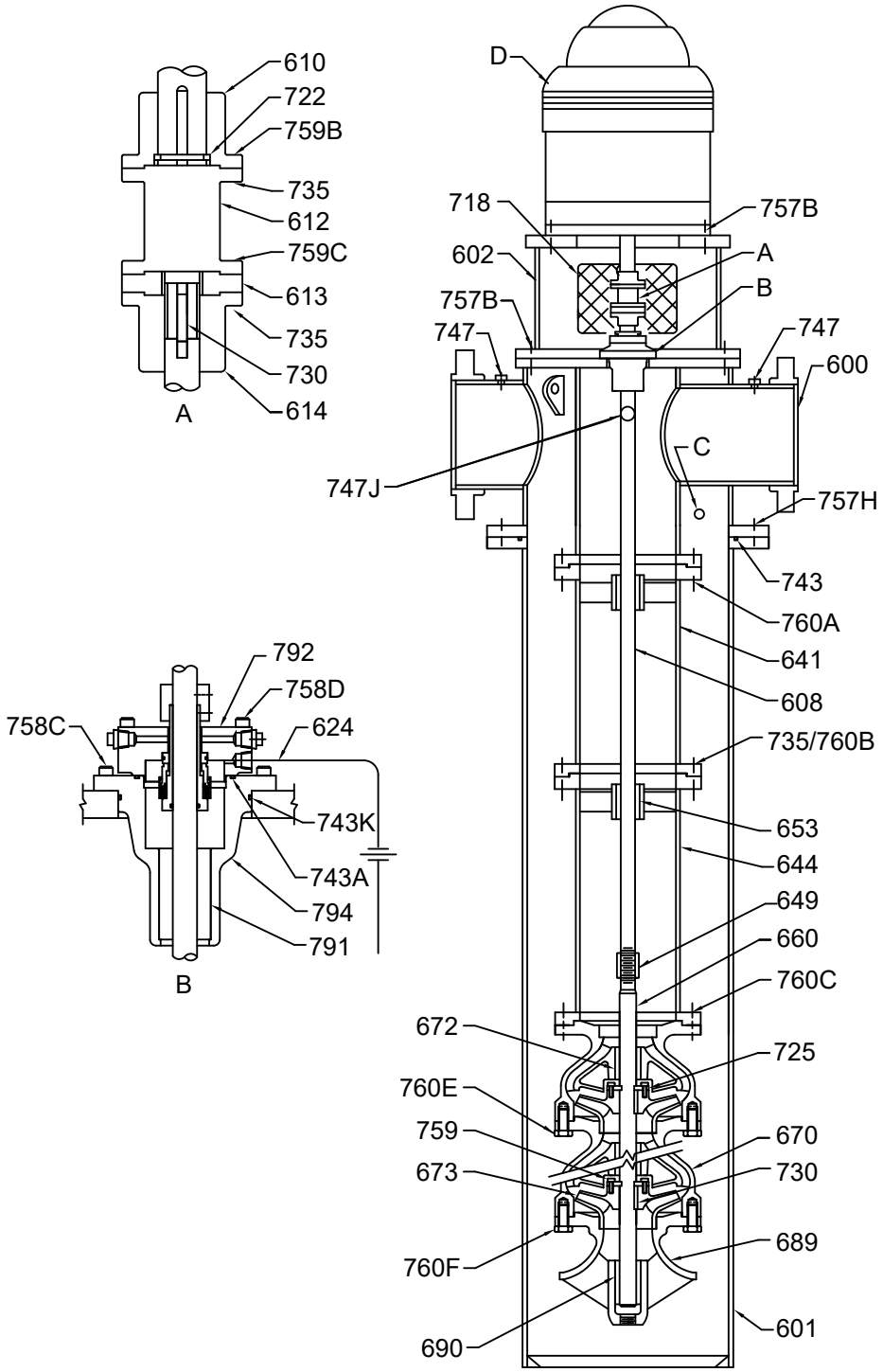


Label	Part name
A	Tension plate, oil lube and water flush
A1	Tension plate – oil lubricated
A2	Tension plate – water flushed
B	Tube stabilizer
B1	Tube stabilizer
B1.1	Integral tube stabilizer (welded to column)
B2	Tube stabilizer
B2.1	Tube stabilizer (optional on duplicate pumps)
C	32 in. (81 cm) and larger bowl assembly (with flush only) Note: No discharge bowl required.
D	VSS motor
E	Motor key, supplied by motor vendor
F	Mounting holes
G	Discharge bowl required for all lube oil lube and water flush lines with bowl sizes 30" and smaller
600	Head
602	Motor support
608	Headshaft
610	Hub motor
613	Adjusting plate
614	Pump hub
618	Gland
620	Packing

Label	Part name
625	Tension plate
628	Bearing
629	Tube nipple
641	Top column
642	Intermediate column
644	Bottom column
646	Lineshaft
649	Lineshaft coupling
654	Enclosed tube
656	Bearing tube
660	Pump shaft
664	Bearing throttle
665	Inpro seal
666	Discharge bowl
668	Bearing adapter
669	Top bowl
670	Intermediate bowl
673	Impeller
680	Bowl wear ring
681	Impeller wear ring
689	Suction bell
690	Suction bearing
692	Sand collar
698	Basket type strainer
718	Coupling guard
722	Retaining ring
725	Thrust ring
730	Key
735	Hex nut
735B	Hex nut
735C	Hex nut
739	Stud
743A	O-ring
743B	O-ring (tension plate/tube nipple)
747	Pipe plug
758A	Capscrew
759	Socket head capscrew
759B	Capscrew
760	Capscrew
760A	Column/head capscrew
760B	Column/column capscrew
760C	Column/bowl capscrew
760D	Bowl/discharge bowl capscrew
760E	Bowl/bowl capscrew
760F	Bowl/bell capscrew
760K	Strainer capscrew

Label	Part name
760L	Support head capscrew
760M	Motor/support capscrew
818	Lubricator assembly
Stabilizers provided: • Every 3 m | 10 ft. up to 12 m | 40 ft. of column • Every 12 m | 40 ft. over 12 m | 40 ft. of column	

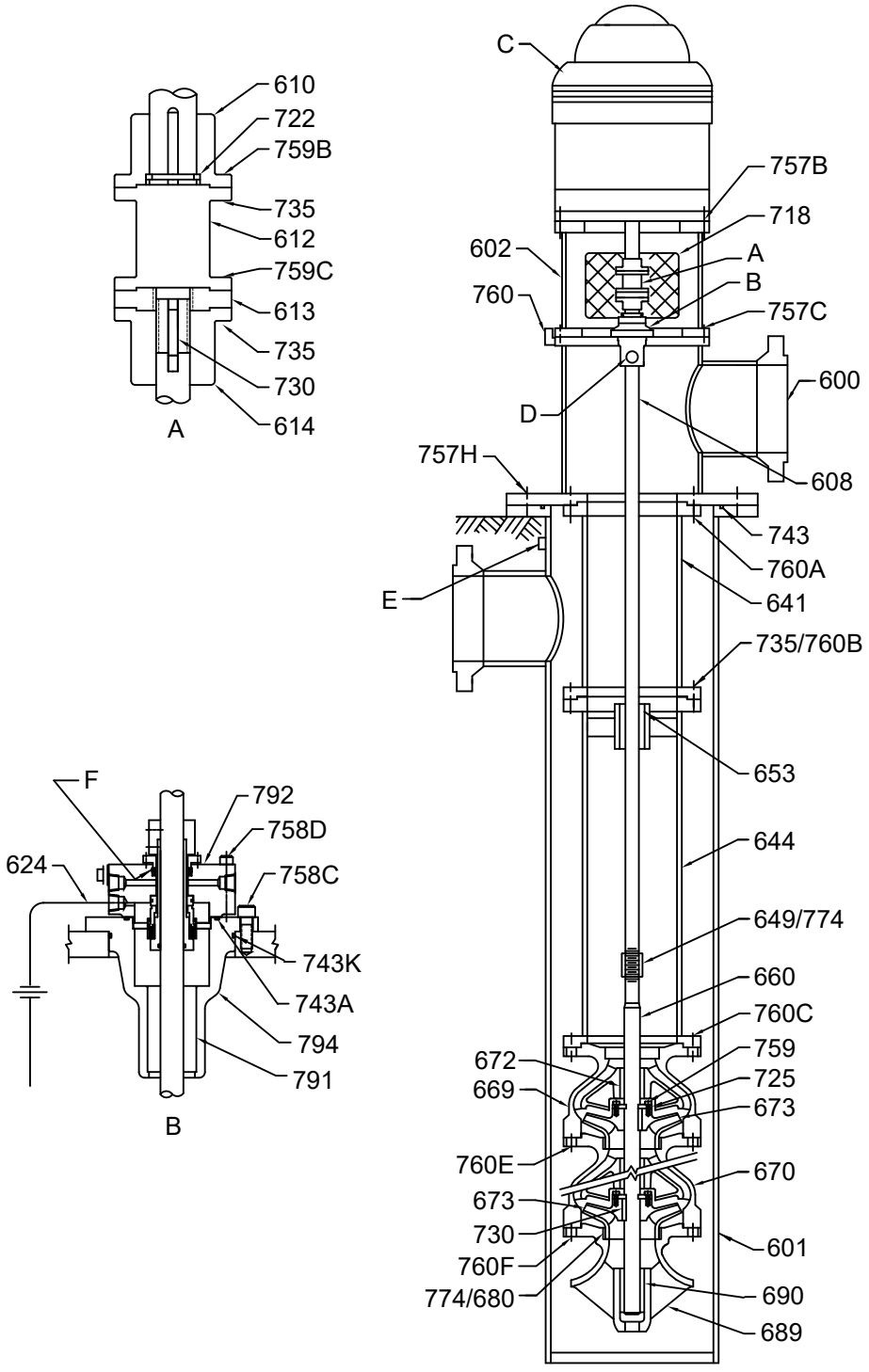
8.3 VIC-T



Label	Part name
A	Spacer coupling
B	Mechanical seal
C	Seal, by-pass return
D	VSS motor
600	Head

Label	Part name
601	Barrel
602	Motor support
608	Headshaft
610	Hub motor
613	Adjusting plate
614	Pump hub
624	Flush plan API 31
641	Top column
644	Bottom column
649	Lineshaft coupling
652	Bearing retainer
653	Bearing lineshaft
660	Pump shaft
670	Top bowl
672	Bowl bearing
673	Impeller
680	Bowl wear ring
681	Impeller wear ring
689	Suction bell
690	Suction bearing
718	Coupling guard
722	Retaining ring
725	Thrust ring
730	Key
735	Hex nut
739	Stud
743	O-ring
747	Pipe plug
747J	Barrel vent
757B	Motor/support capscrew
757C	Support/head capscrew
757H	Head/bowl bearing capscrew
759	Socket head capscrew
759B	Driver hub socket capscrew
759C	Pump hub socket capscrew
760	Capscrew
760A	Column/head capscrew
760C	Column/bowl capscrew
760E	Bowl/bowl capscrew
760F	Bowl/bell capscrew
774	Setscrew with ring
791	Seal housing bearing
792	Seal gland
794	Seal housing

8.4 VIC-L



Label	Part name
A	Spacer coupling
B	Mechanical seal
C	VSS motor
D	Vent connection
E	Barrel vent

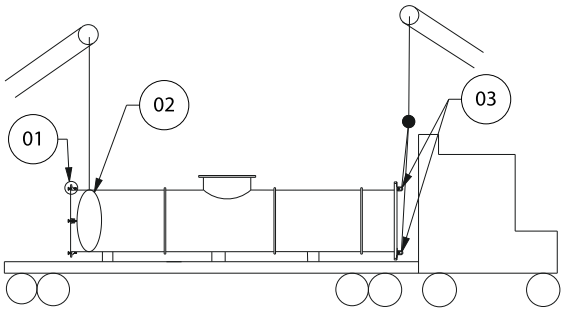
Label	Part name
F	Auxiliary packing
600	Head
601	Barrel
602	Motor support
608	Headshaft
610	Hub motor
612	Spacer
613	Adjusting plate
614	Pump hub
624	Bypass assembly API 13
641	Top column
644	Bottom column
649	Lineshaft coupling
653	Bearing lineshaft
660	Pump shaft
669	Top bowl
670	Bottom and intermediate bowl
672	Bowl bearing
673	Impeller (H and X)
680	Bowl wear ring
689	Suction bell
690	Suction bearing
718	Coupling guard
722	Retaining ring
725	Thrust ring
730	Impeller key
730C	Pump key
735	Hex nut
743	O-ring
743A	Gland/seal housing O-ring
743K	Seal housing/head O-ring
757B	Motor/support capscrew
757C	Support/head capscrew
757H	Head/bowl bearing capscrew
758C	Seal housing/head capscrew
758D	Gland/seal housing capscrew
759	Impeller capscrew
759B	Driver hub socket capscrew
759C	Pump hub socket capscrew
760	Align lug capscrew
760A	Column/head capscrew
760B	Column/column capscrew
760C	Column/bowl capscrew
760E	Bowl/bowl capscrew
760F	Bowl/bell capscrew
774	Setscrew with ring

Label	Part name
791	Seal housing bearing
792	Seal gland
794	Seal housing

9 Annex I

9.1 Example of VIC-L barrel installation

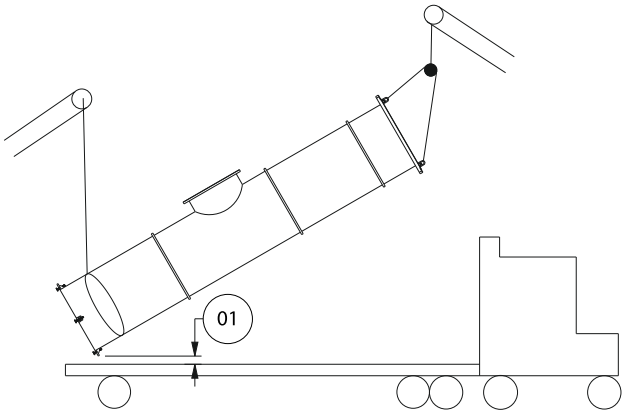
Step 1



1. Install leveling screws
2. Lifting strap chocking barrel outside diameter
3. Lifting cables attached to four hoist rings

Figure 31: Barrel initial hoisting

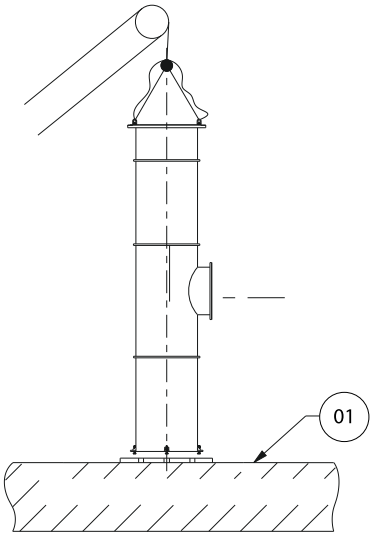
Step 2



1. Maintain clearance here during lift

Figure 32: Barrel intermediate hoisting

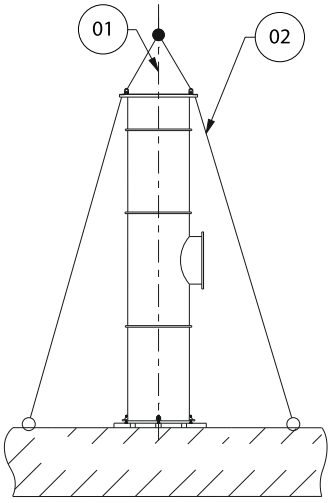
Step 3



1. Bottom foundation

Figure 33: Barrel vertical hoisting

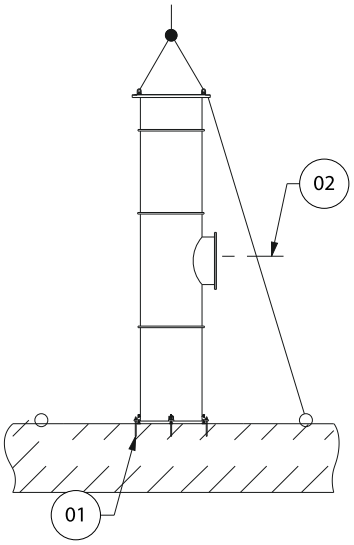
Step 4



1. Locate suction barrel centerline on desired coordinates
2. Install binding chains from barrel top plate to four anchor points in base concrete pad. Use chain binders to tighten chains. Using the crane, jack screws and binders level the barrel top plate and maintain elevation.

Figure 34: Anchoring of the barrel on the floor for initial works

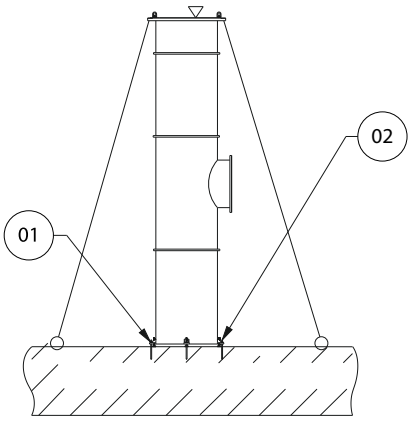
Step 5



1. Anchor bolts simultaneously to achieve required level and elevation conditions
2. Adjust leveling screws and chain binding such that suction nozzle centerline is in line

Figure 35: Barrel initial leveling

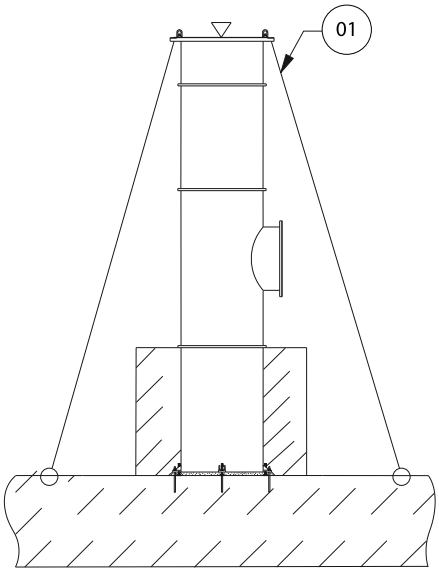
Step 6



1. Adjust anchor bolt nuts
2. Adjust leveling screws and anchor bolts simultaneously to achieve required level and elevation conditions

Figure 36: Barrel in-process leveling

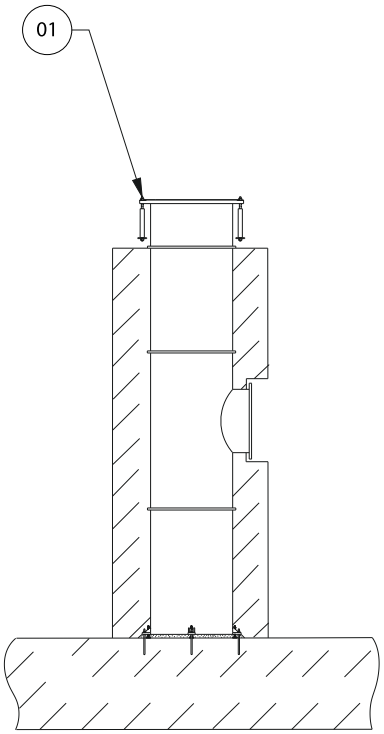
Step 7



1. Use chain binders to maintain top plate level during concrete pouring

Figure 37: Concrete pouring

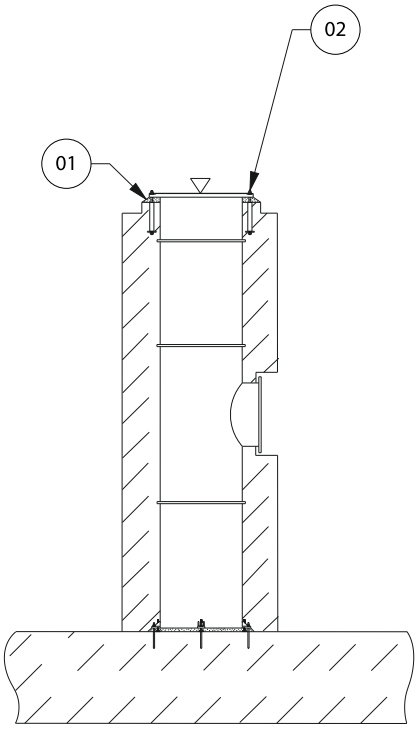
Step 8



1. Install anchor bolts prior to final concrete pour

Figure 38: Final concrete pouring

Step 9



1. Pour grout
2. Wait until concrete reaches full design strength, then torque anchor bolts

Figure 39: Top plate grouting and final leveling check

10 Annex II

10.1 Tightening torque tables for studs, capscrews and nuts

Thread Data		303, 304SS SAE F593 Group 1 316SS SAE F593 Group 2	A193 B8 A193 B8M Cl 1 A276 Tp 304 A582 Tp 303	A193 Class 2, B8M	A193 Class 2B B8M2
Nominal Dia. mm | In.	Threads per 25 mm/1in.	*1Recommended Torque Nm | lb*ft			
6 | 1/4	20	7 | 5	3 | 2	9 | 7	7 | 5
8 | 5/16	18	12 | 9	5 | 4	19 | 14	15 | 11
10 | 3/8	16	23 | 17	11 | 8	33 | 24	26 | 19
11 | 7/16	14	35 | 26	16 | 12	53 | 39	42 | 31
13 | 1/2	13	54 | 40	26 | 19	80 | 59	64 | 47
14 | 9/16	12	79 | 58	37 | 27	115 | 85	91 | 67
16 | 5/8	11	108 | 80	50 | 37	159 | 117	126 | 93
19 | 3/4	10	134 | 99	89 | 66	283 | 209	224 | 165
22 | 7/8	9	210 | 155	140 | 103	442 | 326	350 | 258
25 | 1	8	324 | 239	216 | 159	683 | 504	540 | 398
29 | 1-1/8	7	458 | 338	305 | 225	968 | 714	765 | 564
29 | 1-1/8	8	475 | 350	316 | 233	1002 | 739	792 | 584
32 | 1-1/4	7	647 | 477	431 | 318	1365 | 1007	1078 | 795
32 | 1-1/4	8	667 | 492	445 | 328	1409 | 1039	1112 | 820
35 | 1-3/8	6	848 | 625	565 | 417	1224 | 903	1413 | 1042
35 | 1-3/8	8	906 | 668	603 | 445	1309 | 965	1509 | 1113
38 | 1-1/2	6	1125 | 830	750 | 553	1626 | 1199	1875 | 1383
38 | 1-1/2	8	1195 | 881	796 | 587	1726 | 1273	1992 | 1469
38 | 1-1/2	12	1267 | 934	845 | 623	1829 | 1349	2110 | 1556
41 | 1-5/8	8	1540 | 1136	1026 | 757	Not available	2570 | 1895
44 | 1-3/4	5	1775 | 1309	1182 | 872		2957 | 2181
44 | 1-3/4	8	1946 | 1435	1296 | 956		3242 | 2391
48 | 1-7/8	8	2416 | 1782	1611 | 1188		4027 | 2970
51 | 2	4.5	2667 | 1967	1778 | 1311		4446 | 3279
51 | 2	8	2959 | 2182	1973 | 1455		4932 | 3637
54 | 2-1/8	8	3576 | 2637	2384 | 1758		5174 | 3816
57 | 2-1/4	4.5	3903 | 2878	2601 | 1918		5636 | 4156
57 | 2-1/4	8	4273 | 3151	2849 | 2101		6173 | 4552
60 | 2-3/8	8	5055 | 3728	3371 | 2486		7303 | 5386
64 | 2-1/2	4	5339 | 3937	3558 | 2624		7710 | 5856
64 | 2-1/2	8	5930 | 4373	3953 | 2915		8564 | 6316
67 | 2-5/8	8	6897 | 5086	4598 | 3391		9963 | 7347
70 | 2-3/4	4	7245 | 5343	4830 | 3562		8855 | 6530
95 | 3-3/4	8	7965 | 5874	5310 | 3916		9736 | 7180
73 | 2-7/8	8	9138 | 6739	6093 | 4493		11169 | 8237

Thread Data		303, 304SS SAE F593 Group 1 316SS SAE F593 Group 2	A193 B8 A193 B8M Cl 1 A276 Tp 304 A582 Tp 303	A193 Class 2, B8M	A193 Class 2B B8M2
Nominal Dia. mm | In.	**Threads per 25 mm/1in.**	***1Recommended Torque Nm | lb*ft**			
76 | 3	4	9558 | 7049	6372 | 4699	Not available	11682 | 8615
76 | 3	8	10421 | 7685	6947 | 5123		12737 | 9393

*1 Torque values provided assume fastener lubricant applied, k-factor = 0.15

Thread Data		A479 Grade XM19 SAE Gr. 5 A193 Gr. B7	A276 S31803	A276 Type S32760	A479/479M Alloy 2507
Nominal Dia. mm | In.	**Threads per 25 mm/1in.**	***1Recommended Torque Nm | lb*ft**			
6 | 1/4	20	9 | 7	7 | 5	8 | 6	8 | 6
8 | 5/16	18	20 | 15	12 | 9	15 | 11	15 | 11
10 | 3/8	16	37 | 27	23 | 17	27 | 20	27 | 20
11 | 7/16	14	58 | 43	35 | 26	45 | 33	45 | 33
13 | 1/2	13	88 | 65	54 | 40	68 | 50	68 | 50
14 | 9/16	12	127 | 94	79 | 58	98 | 72	98 | 72
16 | 5/8	11	176 | 130	108 | 80	134 | 99	134 | 99
19 | 3/4	10	312 | 230	194 | 143	239 | 176	239 | 176
22 | 7/8	9	490 | 361	302 | 223	373 | 275	373 | 275
25 | 1	8	755 | 557	468 | 345	575 | 424	575 | 424
29 | 1-1/8	7	1070 | 789	662 |488	815 | 601	815 | 601
29 | 1-1/8	8	1108 | 817	686 | 506	843 | 622	843 | 622
32 | 1-1/4	7	1509 | 1113	934 | 689	1150 | 848	1150 | 848
32 | 1-1/4	8	1557 | 1148	964 | 711	1187 | 875	1187 | 875
35 | 1-3/8	6	1978 | 1459	1224 | 903	1508 | 1112	1508 | 1112
35 | 1-3/8	8	2114 | 1559	1309 | 965	1611 | 1188	1611 | 1188
38 | 1-1/2	6	2625 | 1936	1626 | 1199	2000 | 1475	2000 | 1475
38 | 1-1/2	8	2788 | 2056	1726 | 1273	2125 | 1567	2125 | 1567
38 | 1-1/2	12	2955| 2179	1829 | 1349	2251 | 1660	2251 | 1660
41 | 1-5/8	8	9963 | 7347	2227 | 1642	2740 | 2021	2740 | 2021
44 | 1-3/4	5	4140 | 3053	2563 | 1890	3154 | 2326	3154 | 2326
44 | 1-3/4	8	4539 | 3347	2810 | 2072	3458 | 2550	3458 | 2550
48 | 1-7/8	8	5638 | 4158	3490 | 2574	4296 | 3168	4296 | 3168
51 | 2	4.5	6224 | 4590	3852 | 2841	4742 | 3497	4742 | 3497
51 | 2	8	6905 | 5092	4274 | 3152	5260 | 3879	5260 | 3879
54 | 2-1/8	8	5961 | 4396	5165 | 3809	6358 | 4689	5961 | 4396
57 | 2-1/4	4.5	6503 | 4796	5636 | 4156	6937 | 5116	6503 | 4796
57 | 2-1/4	8	7122 | 5252	6173| 4552	7596 | 5602	7122 | 5252
60 | 2-3/8	8	8426 | 6214	7303 | 5386	8988 | 6628	8426 | 6214
64 | 2-1/2	4	8897 | 6561	7710 | 5686	9489 | 6998	8897 | 6561
64 | 2-1/2	8	9883 | 7288	8564 | 6316	10542 | 7774	9883 | 7288

Thread Data		A479 Grade XM19 SAE Gr. 5 A193 Gr. B7	A276 S31803	A276 Type S32760	A479/479M Alloy 2507
Nominal Dia. mm | In.	Threads per 25 mm/1in.	*1Recommended Torque Nm | lb*ft			
67 | 2-5/8	8	11495 | 8477	9963 | 7347	12261 | 9042	11495 | 8477
70 | 2-3/4	4	12074 | 8904	10464 | 7717	12879 | 9498	12074 | 8904
95 | 3-3/4	8	13275 | 9790	11506 | 8485	14161 | 10443	13275 |9790
73 | 2-7/8	8	15231 11232|	13199 | 9734	16245 | 11980	15231 | 11232
76 | 3	4	15930 | 11748	13805 | 10181	16992 | 12531	15930 | 11748
76 | 3	8	17369 | 12809	15053 | 11101	18527 | 13663	17369 | 12809

*1 Torque values provided assume fastener lubricant applied, k-factor = 0.15

Thread Data		ASTM A354 BD, SAE Gr. 5	A320 L7	A 193 B7M	ASTM A574	F468 N05500
Nominal Dia. mm | In.	Threads per 25 mm/1in.	*1Recommended Torque Nm | lb*ft				
6 | 1/4	20	12 | 9	20 | 15	8 | 6	15 | 11	8 | 6
8 | 5/16	18	26 | 19	37 | 27	15 | 11	30 | 22	18 | 13
10 | 3/8	16	45 | 33	58 | 43	27 | 20	53 | 39	31 | 23
11 | 7/16	14	72 | 53	88 | 65	45 | 33	84 |62	50 | 37
13 | 1/2	13	110 | 81	127 | 94	68 | 50	129 | 95	76 | 56
14 | 9/16	12	157 | 116	176 | 130	98 | 72	186 | 137	110 | 81
16 | 5/8	11	218 | 161	312 | 230	134 | 99	256 | 189	151 | 111
19 | 3/4	10	386 | 285	503 | 371	239 | 176	456 | 336	268 | 198
22 | 7/8	9	624 | 460	755 | 557	384 | 283	734 | 541	431 | 318
25 | 1	8	934 | 689	1070 | 789	575 | 424	1100 | 811	612 | 451
29 | 1-1/8	7	1325 | 977	1108 | 817	815 | 601	1559 | 1150	866 | 639
29 | 1-1/8	8	1371 | 1011	1509 | 1113	843 | 622	2269 | 1673	896 | 661
32 | 1-1/4	7	1869 | 1378	1557 | 1148	1150 | 848	2199 | 1622	1222 | 901
32 | 1-1/4	8	1928| 1422	1978 | 1459	1187 | 875	2269 | 1673	1261 | 930
35 | 1-3/8	6	2449 | 1806	2114 | 1559	1508 | 1112	2883 | 2126	1601 | 1181
41 | 1-3/8	8	2617 | 1930	2625 | 1936	1611 | 1188	3079 | 2271	1711 | 1262
38 | 1-1/2	6	3250 | 2397	2788 | 2056	2000 | 1475	3827 | 2822	2125 | 1567
38 | 1-1/2	8	3452 | 2546	2955 | 2179	2125 | 1567	4063 | 2996	2262 | 1668
38 | 1-1/2	12	3658 | 2698	3593 | 2650	2251 | 1660	4305 | 3175	2392 | 1764
41 | 1-5/8	8	4449 | 3281	4140 | 3053	2738 | 2019	5236 | 3861	Not available
44 | 1-3/4	5	5126 | 3780	4539 | 3347	3154 | 2326	6034 | 4450	
44 | 1-3/4	8	5619 | 4144	5638 | 4158	3458 | 2550	6615 | 4878	
48 | 1-7/8	8	6982 | 5149	6224 | 4590	4296 | 3168	8217 | 6060	
51 | 2	4.5	7706 | 5683	6905 | 5092	4742 | 3497	9070 | 6689	
51 | 2	8	8548 | 6304	8345 | 6154	5260 | 3879	10059 | 7418	
54 | 2-1/8	8	10331| 7619	9104 | 6714	6358 |4689	12158 | 8966	
57 | 2-1/4	4.5	11272 | 8313	9971 | 7353	6937 | 5116	13266 | 9783	
57 | 2-1/4	8	12345 | 9104	11797 | 8700	7596 | 5602	14530| 10715	
60 | 2-3/8	8	14605 | 10771	12455 | 9185	8988 | 6628	17191 | 12678	

Thread Data		ASTM A354 BD, SAE Gr. 5	A320 L7	A 193 B7M	ASTM A574	F468 N05500
Nominal Dia. mm | In.	**Threads per 25 mm/1in.**	**[*1]Recommended Torque Nm | lb*ft**				
64 | 2-1/2	4	15420 | 11372	13835 | 10203	9489 | 6998	18149 | 13384	Not available
64 | 2-1/2	8	17129 | 12632	Not available	10542 | 7774	20160 | 14867	
67 | 2-5/8	8	19925 | 14694		12261 | 9042	23452 | 17295	
70 | 2-3/4	4	20929 | 15434		12879 | 9498	24632 | 18165	
95 | 3-3/4	8	23011 | 16970		14161 | 10443	27083 | 19973	
73 | 2-7/8	8	26399 | 19468		16245 | 11980	31071 | 22914	
76 | 3	4	27611 | 20362		16992 | 12531	32498 | 23966	
76 | 3	8	30106 | 22202		18527 | 13663	35434 | 26131	

*1 Torque values provided assume fastener lubricant applied, k-factor = 0.15

11 CE Declaration of Conformity

11.1 CE Declaration of Conformity

EC DIRECTIVES – HEALTH & SAFETY (MACHINERY)

ITT

CE DECLARATION OF CONFORMITY

We,

Manufacturer
ITT Goulds Pumps

Person Authorized To Compile Technical File
Maik Spannuth – Quality Manager
ITT Bornemann GmbH
Industruestrasse 2
31683 Obernkirchen, Germany
Tel: +49 5724 390 190
Email: Maik.Spannuth@itt.com

Declare under our sole responsibility that the product

Model/Type _____

Serial Number(s): **Pump Size:**

comply with all applicable Directives and Regulations set out by the directives and standards listed below as well as with all the essential health and safety requirements applying to it.

Machinery Directive 2006/42/EC - (Subordinates to EN 809)
ISO 12100
EN 809:1998+A1:2009

.....
Place & Date of Issue

.....
Authorized Name (Print)

.....
Function (Print)

.....
Authorized Name (Signature)

EC DIRECTIVES – HEALTH & SAFETY (MACHINERY)

ITT

CE DECLARATION OF INCORPORATION of PARTLY COMPLETED MACHINERY

We,

Manufacturer
ITT Goulds Pumps

Person Authorized To Compile Technical File
Maik Spannuth – Quality Manager
ITT Bornemann GmbH
Industruestrasse 2
31683 Obernkirchen, Germany
Tel: +49 5724 390 190
Email: Maik.Spannuth@itt.com

Declare under our sole responsibility that the following partly completed machinery

Bowl Assembly _____

Serial Number(s):

comply with all applicable Directives and Regulations set out by the directives and standards listed below as well as with all the essential health and safety requirements applying to it.

Machinery Directive 2006/42/EC - (Subordinates to EN 809)
ISO 12100
EN 809:1998+A1:2009

.....
Place & Date of Issue

.....
Authorized Name (Print)

.....
Function (Print)

.....
Authorized Name (Signature)

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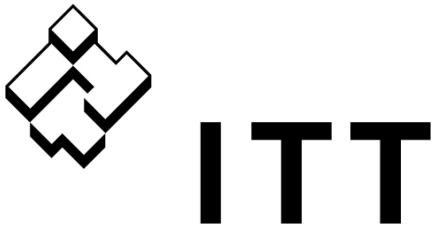

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