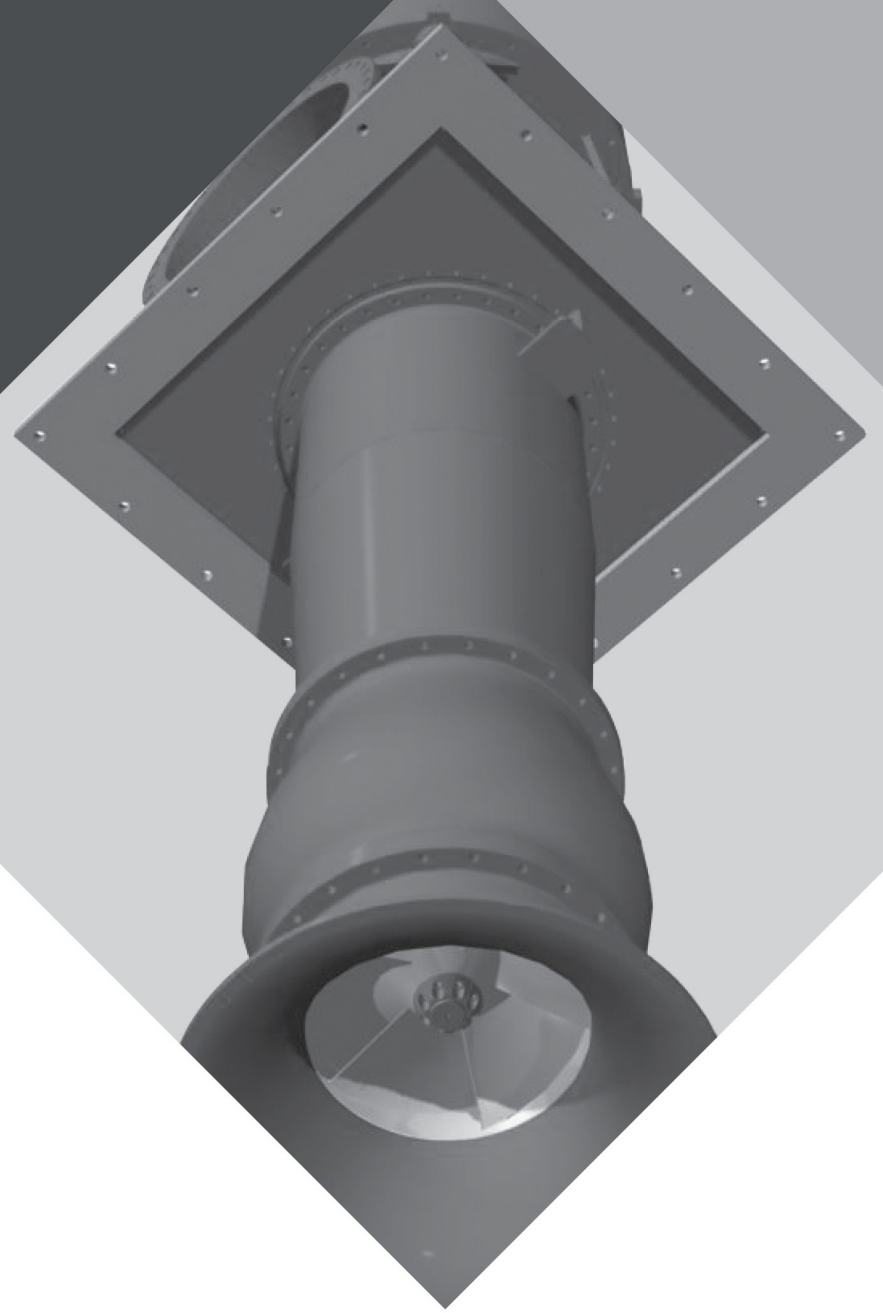
GOULDS PUMPS

Installation, Operation, and Maintenance

Model VCW



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Introduction and Safety

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- ⟨Ex⟩ This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal unless explicitly stated in this manual.
- Do not change the service application without the approval of an authorized ITT representative.
- Never operate the pump below the minimum rated flow, when dry, or without adequate submergence.
- Never operate the pump without safety devices installed.
- Never operate the pump with the discharge valve closed.
- Never operate the pump when the strainer is clogged.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

Safety terminology and symbols

About safety messages

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

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

Hazard levels

Hazard level	Indication
DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury

Hazard level	Indication
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

Environmental safety

The work area

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

Recycling guidelines

Always recycle according to these guidelines:

1. If the unit or parts are accepted by an authorized recycling company, then follow local recycling laws and regulations.
2. If the unit or parts are not accepted by an authorized recycling company, then return them to the nearest ITT representative.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Dispose appropriately of all waste.
- Handle and dispose of the pumped fluid 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.

Reference for electrical installation

For electrical installation requirements, consult your local electric utility.

User health and safety

Safety equipment

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

- Helmet
- Safety goggles (with side shields)
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection

The work area

Observe these regulations and warnings in the work area:

- 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.

Product and product positioning requirements

Observe these requirements for the product and the product positioning:

- Never operate a pump unless safety devices are installed.
- Never start a pump without the proper submergence.
- Never run a pump below the minimum rated flow or with the discharge valve closed.

Electrical connections regulations

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations.

Observe these guidelines and warnings for electrical connections:

- Make sure that the product is isolated from the power supply and cannot be energized by mistake. This guideline also applies to the control circuit.
- Make sure that the thermal contacts are connected to a protection circuit according to the product approvals, and that they are in use.

Earthing (grounding)

Precautions before work

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

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Allow all system and pump components to cool before you handle them.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.
- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

Precautions during work

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

Clean chemicals from the eyes

1. Hold your eyelids apart forcibly with your fingers.

2. Rinse the eyes for at least 15 minutes.
   Use an eyewash or running water.
3. Seek medical attention.

Clean chemicals from the body

1. Remove contaminated clothing.
2. Wash the skin with soap and water for at least one minute.
3. Seek medical attention, if required.

Safety regulations for Ex-approved products in potentially explosive atmospheres

Description of ATEX

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

Every installation has to be properly analyzed and classified by professional certified personnel that set the areas, zones and any other space to a corresponding hazardous area classification. Classification normally includes the form of the hazardous material the potential exposure, the potential level, the frequency of potential exposure. All equipment installed within such are must be certified accordingly, all activities related to such equipment have to be handled to preserve its certification and the site specification.

Guidelines for compliance

WARNING:

This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal unless explicitly stated in this manual.

If there are any questions regarding these requirements, the intended use, or if the equipment requires modification, contact an ITT representative before you proceed.

Personnel requirements

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

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 and/or vapor present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example IEC/EN 60079-17).

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 stated on the nameplates.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Never start a pump with a closed suction valve or blocked suction line.

- Before you start working with 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.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Make sure that the equipment is properly maintained:
  - Monitor the pump components and the end temperature of the liquid.
  - Maintain proper bearing lubrication.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that have been provided by an authorized ITT representative.

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

Product warranty

Coverage

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

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

Limitations

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries

- Material damages
- Economic losses

Warranty claim

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

Transportation and Storage

Receive the unit

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

Unpack the unit

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

Pump handling

WARNING:

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

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

Lifting methods

WARNING:

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

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 eyebolts 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 eyebolts through the component flanges.
A disassembled pump	Use suitable lifting devices attached to the component lifting lugs or suitable eyebolts through the component flanges.

Examples

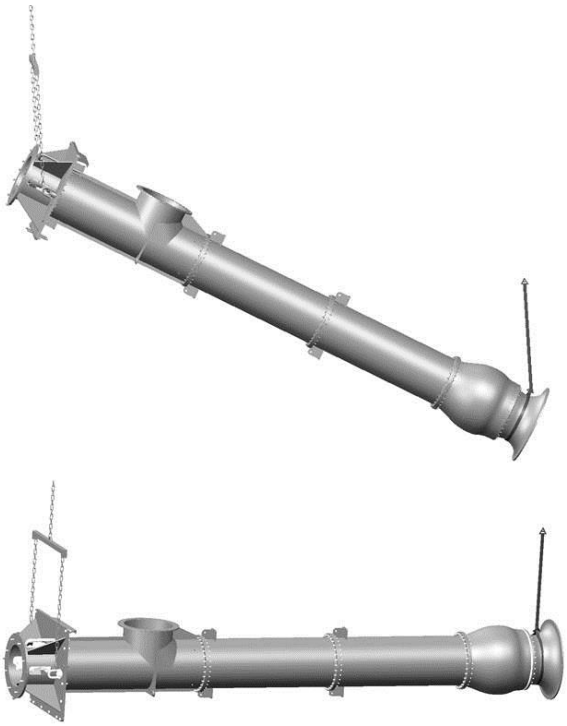


Figure 1: VCW lifted from horizontal to vertical (for pumps up to 15 feet (4.6 meters) in length))

NOTICE:
Actual number of lifting points may vary for specific pump design and installation circumstances. Refer to order-specific drawings for details.

Pump storage requirements

Requirements

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

For specific requirements for storing motors, gearheads, and engines, contact the equipment manufacturer.

Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	• 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. • Place moisture absorbing material in the quantity to prevent condensation • Tie coverings down in order to protect the pump from wind damage.

Condition	Proper preparation
Placement of pumps and component parts	• Place the unit on skids, pallets, or shoring higher than 6 in. (15 cm) 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	• Rotate the pump a half turn (180°) and bowl assembly shaft conterclockwise 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 10°F (6°C) 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, if possible.

Prepare the pump for long-term storage

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

1. Disassemble pump to enable proper long-term storage of sub-assemblies and individual components: Discharge head sub-assembly, individual column pipes, individual shafts and couplings, and bowl sub-assembly.
2. Store bowl sub-assembly indoors in vertical orientation. Store bowl sub-assembly with its suction bell mounted on a flat and level floor with soft wood to protect suction bell material.
3. Store individual column pipes in horizontal orientation. Mount column pipes on the outside diameters of both flanges with soft wood to protect flange material.
4. Store individual shafts indoors in vertical orientation. Hang shafts from horizontal beam with fixtures connected to eye bolts threaded into ends of shafts. Do not stand shaft on floor.
5. Store discharge head sub-assembly in vertical orientation. Store discharge head sub-assembly with its mounting flange mounted on a flat and level floor with soft wood to protect the discharge head material.
6. Store loose parts and hardware from pump assembly in wooden boxes.

Product Description

General description

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

This pump has these capabilities:

- Capacities up to 400,000 gpm (90850 m3/h)
- Heads up to 600 ft. (183 m)
- Power up to 10,000 hp (7,457 kW)

Bowl assembly

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. Impellers are keyed to the shaft.

Column

Flanged column construction with rabbeted fits provides positive shaft and bearing alignment, and also eases assembly and disassembly. The lineshaft 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 packing or seal piping and allow for easy adjustment of seals and couplings. In the case of an underground discharge, these features are part of a separate motor stand above ground.

Thrust pot

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

Drivers

Solid shaft drivers are used with most industrial applications. The rigidity of the rotor enhances vibration-free operation when mechanical seals are used.

Nameplate information

Important information for ordering

Every pump has a nameplate that provides information about the pump. The nameplate is located on the discharge head.

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.

Bowl assembly

Nameplate types

Nameplate	Description
Pump	Provides information about the hydraulic characteristics of the pump.

Nameplate	Description
ATEX	If applicable, your pump unit might have an ATEX nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the ATEX specifications of this pump.

Discharge head nameplate

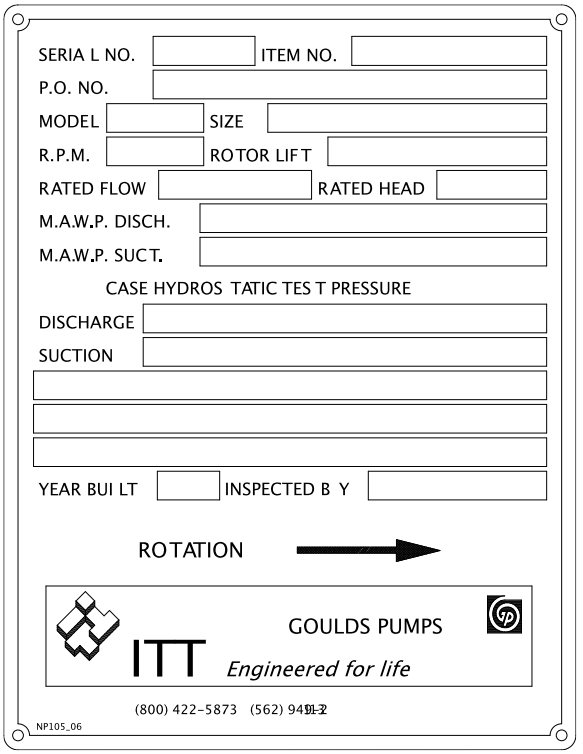


Table 2: Explanation of discharge head nameplate

Nameplate field	Explanation
SERIAL NO.	Serial number of the pump
ITEM NO.	Pump item number of the customer
P.O. NO.	Purchase order number of the customer
MODEL	Pump model
SIZE	Size of the pump
R.P.M.	Rated pump speed, revolutions per minute
ROTOR LIFT	Axial lift of the pump shaft and impellers
RATED FLOW	Rated pump flow, gpm (m^3/hr)
RATED HEAD	Rated pump head, ft (m)
M.A.W.P. DISCH.	Maximum allowable working discharge pressure, psi (kg/cm^2)
M.A.W.P. SUCT.	Maximum allowable working suction pressure, psi (kg/cm^2)
DISCHARGE	Discharge region hydrostatic test pressure, psi (kg/cm^2)
SUCTION	Suction region hydrostatic test pressure, psi (kg/cm^2)
YEAR BUILT	Year the pump was built
INSPECTED BY	Quality control identification stamp

ATEX nameplate

Nameplate field	Explanation
II	Group 2

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

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

Preinstallation

Inspect the sub-base

1. If an optional sub-base is furnished, remove it from the pump discharge head 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.

Concrete foundation requirements

Requirements

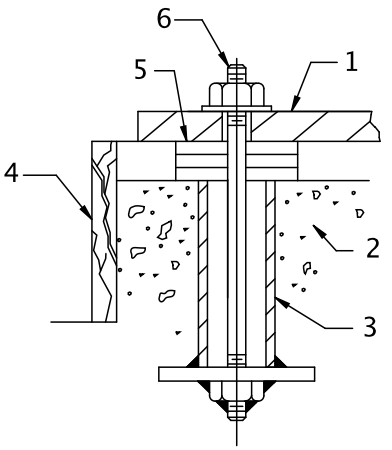
Make sure that you meet these requirements when you prepare the pump foundation:

- 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 or sub-base
2. Foundation
3. Sleeve
4. Dam
5. Shims
6. Anchor bolt

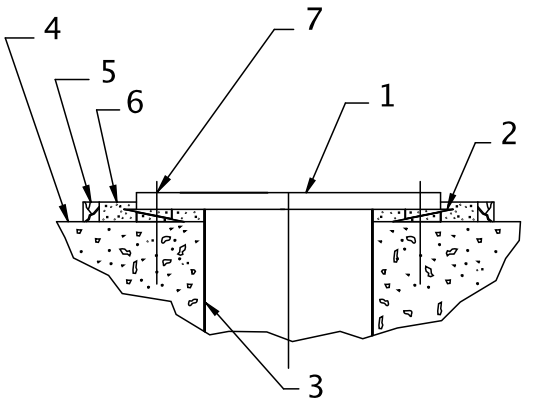
Figure 2: Example of a typical installation

Install the sub-base on a concrete foundation

CAUTION:
You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.

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 sub-base onto the foundation bolts and hand-tighten the bolt nuts.
4. Use a machinist's level in order to level sub-base or a machine surface of the discharge head using metal plates and leveling screws.

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



1. Sub-base
2. Leveling wedges
3. Floor sleeve (optional)
4. Foundation
5. Dam
6. Grout
7. Centerline anchor bolt

Figure 3: Example of a foundation

5. Level the sub-base in two directions at 90° on the machined surface to achieve levelness condition equal to or less than 0.001 inches per foot (0.08mm per meter).

Grout the sub-base

Non-shrink grout is recommended for this procedure.

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. Thoroughly wet the foundation.
5. Pour grout to a minimum thickness of 0.375 in. (9.520 mm) between the sub-base and concrete foundation, up to the level of the dam.
6. Remove any air bubbles from the grout as it is poured by either puddling, using a vibrator, or pumping the grout into place.
7. Allow the grout to set at least 48 hours.
8. Tighten the foundation bolts to the torque value provided on the pump general arrangement drawing.

Piping checklists

General piping checklist

Install the pump on a structural-steel foundation

1. Locate the pump directly over—or as near as possible to—the main building members, beams, or walls.
2. Bolt the discharge-head mounting flange, or sub-base to the support in order to avoid distortion, prevent vibration, and retain proper alignment.

3. Level the sub-base or discharge head using shims.

Precautions

CAUTION:

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

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	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: • The grout for the sub-base has hardened.	—	
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. Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.		

Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line. Minimize distance from pump discharge.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump	
Check that a air-release/vacuum-break 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 air to evacuate pump assembly during starting and water to release from pump after stopping.	
If increasers are used, they must be of the eccentric type.	This prevents air from collecting at the top of the discharge pipe.	
Isolation valve opening after pump start-up and closing prior to pump shutdown are controlled to prevent system surge and water hammer.	Customer's engineer analyzes hydraulic system transients to determine valve opening timing and closing timing to protect system and pump.	

Install a partially-assembled pump

Pumps 20 feet (6 meters) or less in length are usually shipped partially assembled, with the exception of these parts:

- Driver
- Packing
- Mechanical seal with piping
- Coupling assembly, spacer or non-spacer type

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

1. If a sub-base is supplied, install it.
2. Clean the sub-base and the bottom of the discharge head base.
3. Attach suitable lifting devices to the discharge head lifting lugs or the hoist rings in the mounting flange. Make sure that the shackles, eye bolts, and sling are rated to handle in excess of the pump weight. Attach suitable lifting sling around suction bell. Lift pump assembly from horizontal position with two separate crane hooks. See the outline drawing.
4. Hoist the unit into position over the foundation.
5. Carefully guide the unit so that it does not strike the sides of the sub-base or foundation.
6. Lower the unit until the discharge-head flange engages and rests firmly on the sub-base surface, then secure it with the capscrews provided.

Install the bowl assembly, Install unassembled pump elements

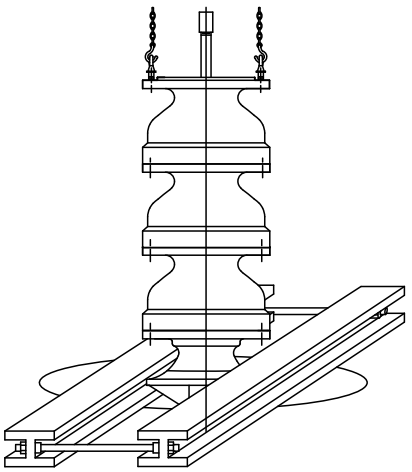
WARNING:
Do not work under a heavy and suspended object unless there is a positive support and safeguards that will protect you if a hoist or sling fails.

CAUTION:

- Do not attempt to lift the bowl assembly by the pump shaft. This can result in damage to the pump shaft.
- Do not drop any foreign object into the bowl assembly. This can cause serious damage to the pump and any downstream components. Any foreign object dropped into the bowl assembly must be retrieved before you continue with assembly.

Pump may need to be assembled in a horizontal or vertical position depending on site conditions. Refer to assembly and erection drawing in appendix for specific instructions.

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 barrel opening that are strong enough to safely support the weight of the entire pump assembly.
   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. Attach a sling to the bowl assembly and hoist it into position over the foundation opening.
6. 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.
7. 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.

Column installation

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

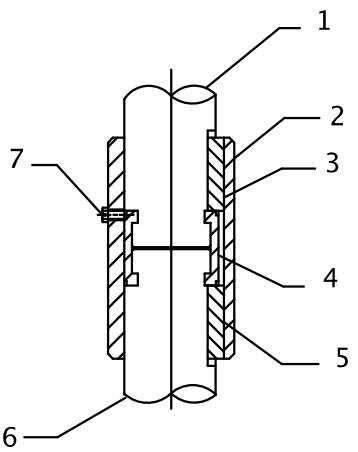
- Open lineshaft
- Enclosed lineshaft

Install the open lineshaft

CAUTION:
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. Check the headshaft and lineshaft for straightness.
   The average TIR should be less than 0.0005 in. (0.013 mm) per ft. (0.305 m) and not exceed 0.005 in. (0.127 mm) for every 10 ft. (3 m).
2. Apply a thin film of oil to the lineshaft.
3. Install the coupling:

If your lineshaft coupling is...	Then...
Keyed	1. Insert the key into the pump shaft. 2. Lower the sleeve over the pump shaft, to approximately 1.0 in. (25.4 mm) 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) Lower the column over the lineshaft, taking care as the shaft passes through the lineshaft bearing, until the column flange engages the top-bowl flange register.
b) Attach a sling to the eyebolts and to the hoist hook.
c) Hoist the column section over the bowl assembly.
d) Lower the column over the lineshaft 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.

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 on the I-beams across sub base surface:
   a) Lift the entire assembly by the column pipe eyebolts and remove the supports.
   b) Slowly lower the bowl and column assembly.
   c) Place the supports on the 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.

Install the threaded coupling

If you have a keyed coupling, see the Install the column section of this manual.

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

Shaft threads are left hand.

1. Coat the threads with a light coat of oil for a non-galling material, or Molykote for galling material.
2. Install the threaded coupling onto the pump shaft by threading it on for one-half of its length.
   You can insert a fine wire in the drill hole at the center of the coupling that serves as a gauge in order to determine when the coupling is correctly positioned on the pump shaft.
3. Remove the wire.

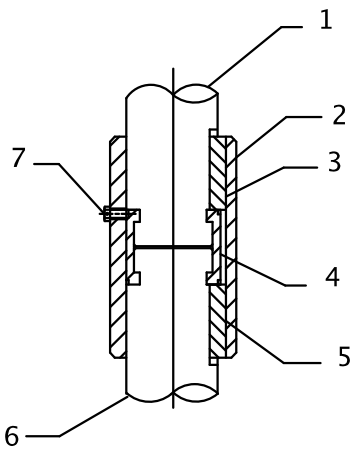
Install the enclosed lineshaft

CAUTION:
Do not use automotive oils.

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

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

1. Check the headshaft and lineshaft for straightness.
   The average TIR should be less than 0.0005 in. (0.013 mm) per ft. (0.305 m) and not exceed 0.005 in. (0.127 mm) for every 10 ft. (3 m).
2. Install the coupling:

If your lineshaft coupling is...	Then...
Keyed	1. Insert the key into the pump shaft. 2. Lower the sleeve over the pump shaft, to approximately 1.0 in. (25.4 mm) 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. Pumpshaft 7. Lock screw/lock wire

3. If the enclosing tube is threaded, attach the threaded lifting device to a section of enclosing tube. If the enclosing tube is threaded, attached eyebolts to two holes in the flange.
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. Install the first length of column pipe over the tube:
   a) Install two eyebolts diametrically opposite each other in the upper flange of the bottom column.
   b) Attach a sling to the eyebolts 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.
7. Lift the entire assembly by the column pipe eyebolts and remove the supports.
8. Slowly lower the bowl and column assembly.
9. Place the supports on the foundation and continue to lower the assembly until the upper column flange comes to rest on the supports.
10. Pour one quart of light turbine oil 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.
11. Install the lineshaft coupling onto the projecting end of the shaft.

If your lineshaft coupling is...	Then...
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.

Install the discharge head

CAUTION:

- Do not bump or scrape the shaft protruding above the column. This could result in a bent or damaged shaft.
- Ⓔx Packed stuffing boxes are not allowed in an ATEX-classified environment.
- The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

NOTICE:
Make sure that the eyebolts or slings 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 the seal before you begin this procedure.

For the enclosed lineshaft option, only perform steps 3 and 4 in this procedure:

1. If the stuffing box is assembled to the head, remove it and all attached piping.
2. Remove the coupling guard:
   a) Attach shackles to the discharge head lifting lugs, or thread two eyebolts in the head driver-support mounting holes diametrically opposite each other.
   b) Hoist the discharge head over the protruding headshaft.
3. 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.
4. Lift the pump assembly high enough to allow for the removal of the supports.
5. Install and tighten the remaining capscrews until all capscrews are uniformly tight.
6. Hoist the bowl, column, and head assembly and remove the supports.
7. Lower the bowl, column, and head assembly until the discharge-head mounting flange engages the sub-base.
8. Secure the discharge head to the sub-base.

Stuffing box installation

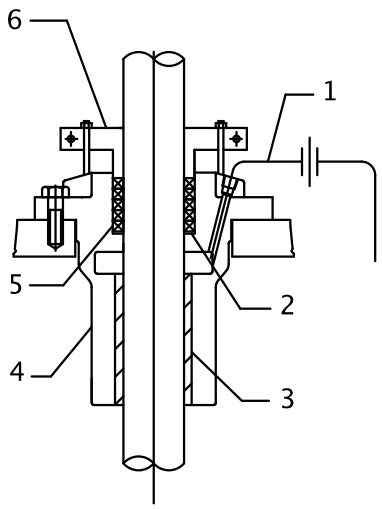
CAUTION:

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

Stuffing box types

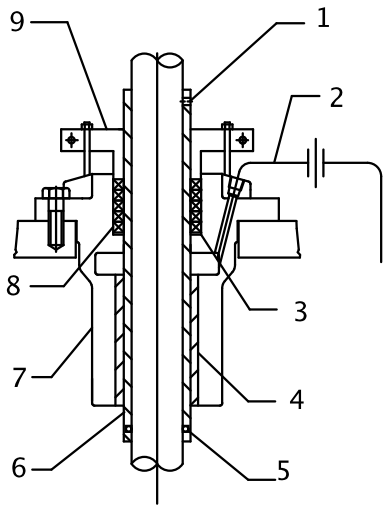
The stuffing box installation has three types:

- Type A
- Type B



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

Figure 4: 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 5: Type B stuffing box

Install 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 2.19 in. (55.63 mm) 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.

Mechanical seal options

Pumps are shipped without mechanical seals installed. If they are not, then refer to the mechanical seal manufacturer's installation instructions.

These are the mechanical seal options for this pump:

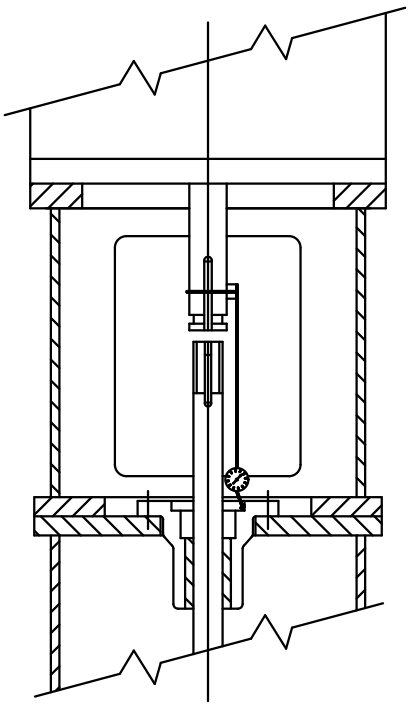
- Cartridge mechanical seal
- Conventional inside component mechanical seal
- Conventional outside component mechanical seal
- High-pressure seal
- Dual mechanical seal

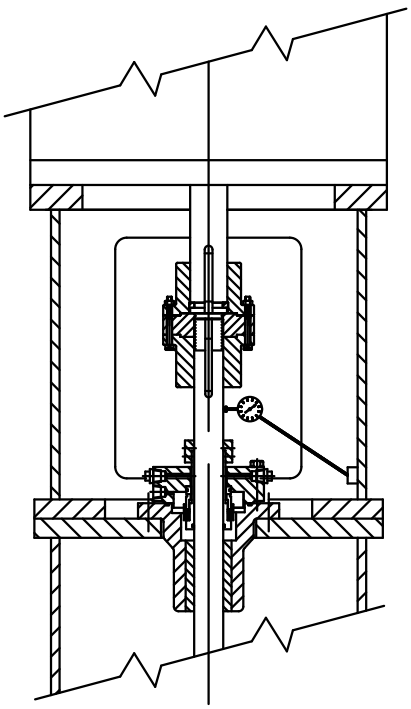
Install the mechanical seal

NOTICE:

- Do not bump carbon inserts against the shaft as they can chip, crack, or break.
- Do not overtighten 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 impellers.
- Reset the seal after you adjust the impeller.

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

Motor shaft to pump assembly alignment	Procedure
Concentricity of the seal housing	This measurement requires that you remove the mechanical seal. 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 0.004 in. (0.10 mm) TIR, loosen the driver hold-down bolts and relocate the driver on the motor base register. 4. Obtain the desired position. 5. Tighten the hold-down bolts and repeat the indicator reading. 

Motor shaft to pump assembly alignment	Procedure
Concentricity of the head shaft	1. Reinstall the mechanical seal if it was removed for the concentricity measurement. 2. Install the coupling assembly and adjust the impeller. 3. Attach the base of the dial indicator on the discharge head or driver support. 4. Place the stylus on the shaft between the top of the seal and the bottom of the pump coupling. 5. Slowly rotate the driver shaft 360°. 6. Check that the shaft runout is within 0.004 in. (0.10 mm) TIR, or as required by specification. 7. Drill and dowel the pin in three places in order to secure the driver to the motor base after you obtain the required runouts. 

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.
10. Seals that use half-dog-point setscrews might require that the shaft be spot faced or drilled in order to provide a secure placement:
    a) Cover the seal and seal housing.
    b) Remove the setscrews one at a time from the collar and spot face or drill the shaft and then tighten the setscrews into position.
    c) Remove any metal chips in order to avoid damage to the seal.

Assemble a single inside-mounted mechanical seal

Single inside-mounted mechanical seals have these characteristics:

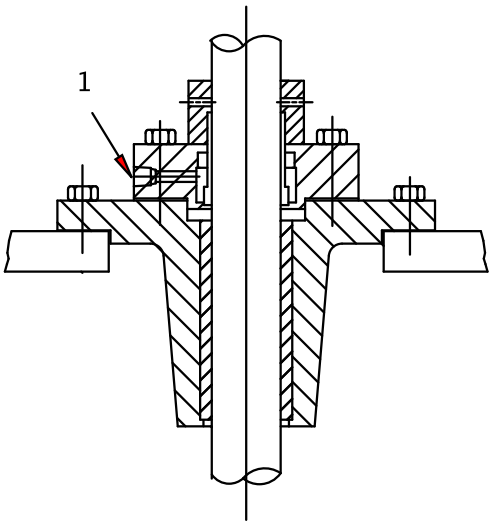
- They are cartridge seals.
- They have glands and sleeves.

- They are assembled as a unit by the seal manufacturer.

Follow the special instructions from the seal manufacturer in the event that non-cartridge seals are installed.

1. Assemble the seal:

If the seal is...	Then...
An O-ring type	Assemble the complete unit over the shaft. Use care when you pass the sleeve and O-ring over the keyways or threads to avoid damaging the O-ring.
A Teflon wedge- ring type	1. Remove the sleeve collar and Teflon wedge ring. 2. Assemble them separately after the sleeve is in position. 3. Tighten the collar on the threads to seal the Teflon wedge around the shaft.



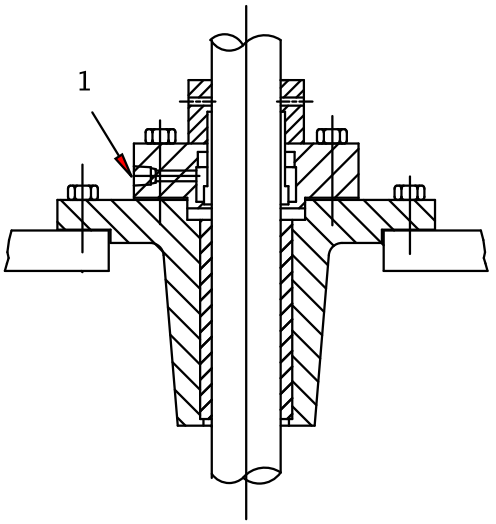
1. Bypass to suction

Assemble a single outside-mounted mechanical seal

These seals are provided in two sub-assemblies:

- Stationary unit
- Rotary unit

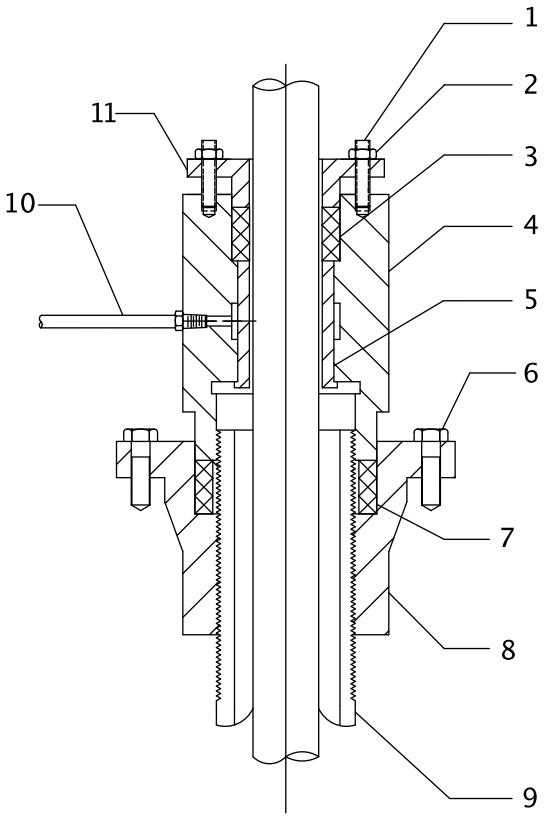
1. Install the stationary unit, which is the seal-gland assembly.
   The stationary unit will face up.
2. Install the rotary unit and take care not to disengage the rotary parts.
   Installation becomes difficult when the rotary unit parts become disengaged.
   IMPORTANT: Do not tighten the setscrews or adjust the seal until the impellers are adjusted.
3. Adjust the seal:
   a) Refer to the spring gap which is stamped on the collar and shown on the seal assembly drawing.
   b) Tighten the setscrews so that the compression ring is maintained at the same distance from the collar at all points.
   c) Before you start the pump, make sure that the spring gap and the distance from the face of the stuffing box to the collar are the same as shown on the seal assembly drawing.



1. Bypass to suction

Install the tube tension plate

1. Lubricate the tube threads and the underside of the tension-plate flange with a thread compound.
2. Thread the tension plate onto the enclosing tube nipple manually until its shoulder rests on the discharge head.



1. Stud
2. Hex nut
3. Packing
4. Tension nut
5. Bearing
6. Capscrew
7. Packing rings
8. Tension plate
9. Tube nipple
10. Line assembly water flush
11. Gland

Figure 6: Tension plate - water flush

Tension the enclosing tube

The enclosing tube sags from its own weight as it is installed and must be pulled tight (tensioned) to make it straight. This section describes two methods you can use to tension the tube:

- Direct pull method is more precise and is preferred.
- Wrenching method is given as an alternate.

The correct tension is equal to the weight of the enclosing tube plus 10%. Weights per unit length for each tube size are given in this table. Multiply by the total length of the tube to determine the total weight.

Table 3: Tube weight

Tube diameter in inches (millimeters)	Weight in pounds (kilograms) per foot of length
4.00 (101.60)	14.98 (6.80)
5.00 (127.00)	20.78 (9.43)
6.00 (152.40)	28.57 (12.96)
7.00 (177.80)	35.98 (13.32)
8.00 (203.2)	43.39 (19.68)
9.00 (228.6)	53.86 (24.43)
10.00 (254.00)	64.33 (29.18)
11.00 (279.40)	76.42 (34.66)
12.00 (304.80)	88.51 (40.15)

Tension the enclosing tube using the direct pull method

This method requires the use of a dynamometer scale and an adapter fitting to grip the tube. A tube tension adapter is available through the factory.

1. Use a hoist to pull the upper end of the tube in order to obtain the predetermined tension value.
2. With the tension plate installed manually but not tightened, thread the special fitting onto the top of the tube to full engagement.
3. Attach the dynamometer scale to the fitting, and connect the upper end of the scale to the hoist hook.
4. Operate the hoist hook to apply the required tension.
   This pulls the tension plate off the discharge head.
5. Manually thread the tension plate in order to reset it.
6. Release the tension from the hoist.
7. Remove the dynamometer scale and special fitting.

Tension the enclosing tube using the wrenching method

If a dynamometer scale is not available, you can tension the tube by wrenching the tube-tension plate.

1. Make up a spanner wrench to straddle the projecting threaded tube end and engage the tube-tension plate capscrew holes by two lugs.
2. Torque the tension plate to take all the slack out of the shaft tubing and induce a reasonable amount of tension by turning the tension plate counterclockwise.
   For tubing 2.50 in. (63.50 mm) and larger, a man's full strength on a 3 ft. (0.9 m) lever arm is sufficient. For smaller sizes, you must utilize less pull.

   Do not turn the tension plate clockwise to align the holes in the tension plate and discharge head.

Install the tension nut

CAUTION:
Be sure that the top of the enclosing tube does not interfere with the tension nut.

1. Install the capscrews in the tension plate.
2. Pour one pint of oil down the oil tube.
3. Install the packing in the tension plate.
4. Thread the tension nut and tighten it firmly against the packing.
5. Perform these steps if a packed-type tension nut is used for water flush:
   a) Install the packing and packing gland.
   b) Secure the packing and the packing gland with a stud and nut and finger tighten.
   c) Install the line assembly and connect it to the flush liquid supply.

6. If the top of the tube interferes with the tension nut, determine the distance:

If the tube is...	**Then...**
Too short	Replace the tube with a longer tube of the correct length.
Too long	Cut the tube to the correct length and re-thread it.

7. Reinstall and re-level the pump.

Install a solid-shaft driver

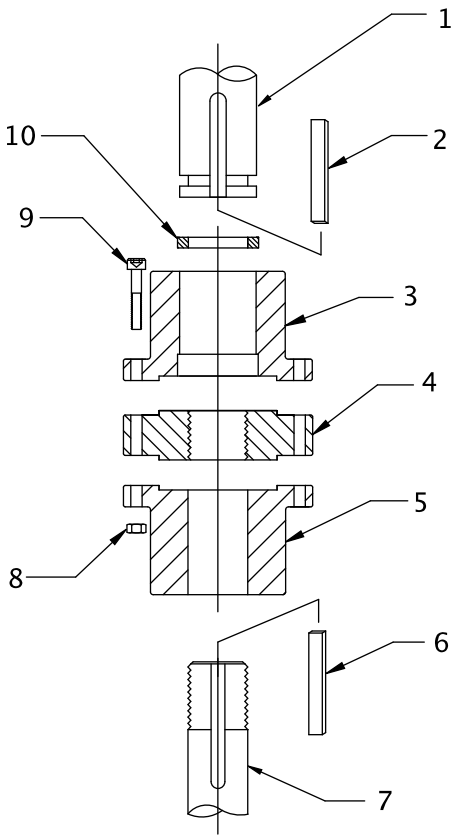
WARNING:

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- Do not test the motor for direction of rotation when it is coupled to the pump. If the pump rotates in the wrong direction, serious damage to the pump, motor, and personnel will result.
- Do not work under a heavy and suspended object unless there is a positive support and safeguards that will protect you if a hoist or sling fails.

NOTICE:

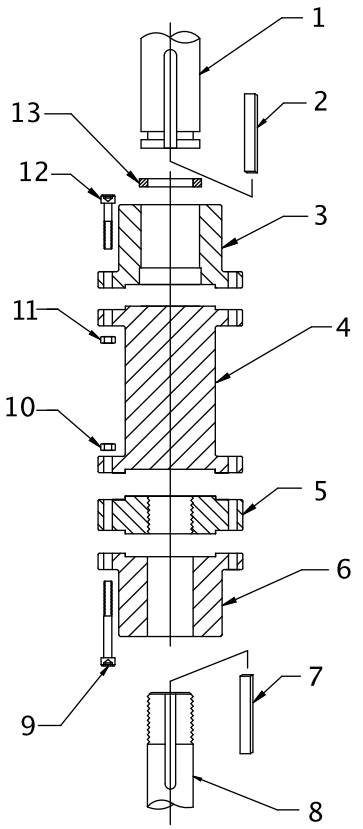
- When the pump is supplied with a thrust pot, do not secure the driver to the discharge head until after the thrust pot and flexible coupling are installed. A separate supplement for thrust pots will be furnished as required.
- Read and follow the motor manufacturer's instructions before lubricating the motor bearings. Excessive lubrication can cause the bearings to overheat and fail prematurely.

The coupling between the driveshaft and the discharge-head shaft can either be a non-spacer type or a spacer type. The spacer type is used on pumps furnished with a mechanical seal to permit servicing of the seal without the removal of the driver.



1. Driveshaft
2. Driver 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 7: Non-spacer type coupling



1. Driveshaft
2. Driver 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 8: Spacer-type coupling

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

6. Lubricate the motor bearings according to the instructions on the lubrication plate attached to the motor frame.
7. Make temporary electrical connections according to the tagged leads or the diagram attached to the motor.
   The motor must rotate 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 shaft end play.

Install 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 annular 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.

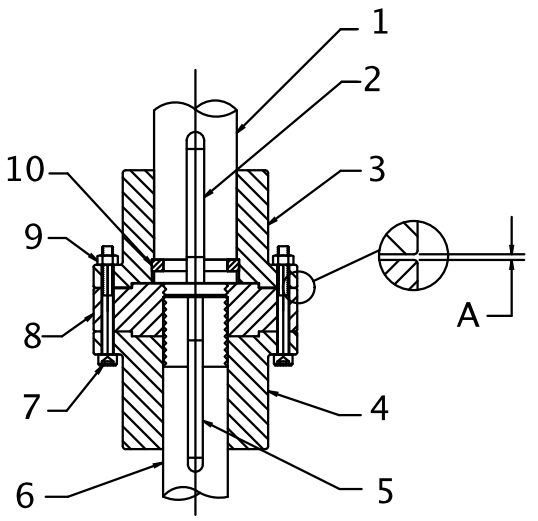
Impeller adjustment

NOTICE:

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

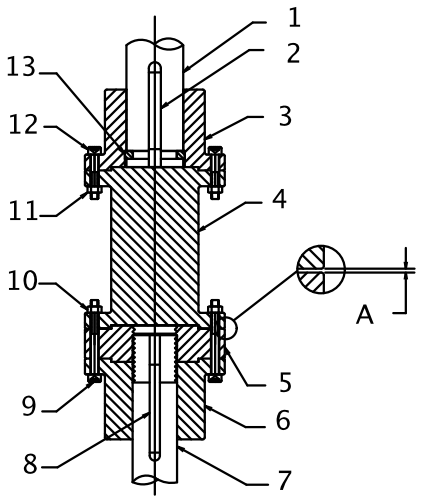
Example figures

Impeller adjustment is identical for all drivers. Adjust the impeller by turning the adjusting plate. At location A in these two figures, measure the impeller adjustment before you tighten the coupling capscrews:



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

Figure 9: Adjustable coupling (Type A)



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

Figure 10: Spacer coupling (Type AS)

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. For larger pumps over 8.00 in. (20.32 cm), this amount might not be sufficient. Refer to the pump outline drawing for details.

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

1. Complete these steps based on your impeller type:

If your impeller is an...	Then...
Open impeller	1. With the impeller resting on the bottom of the bowl assembly, turn the adjusting plate down until it reaches the bottom of the shaft thread. 2. Install the coupling bolts through the driver hub, adjusting plate, and pump hub, and hand tighten the bolts evenly. Measure and record the gap between the adjust plate and the driver hub flange faces. 3. Tighten the coupling bolting evenly in a star pattern and in small increments until the pump rotor begins to turn free. This indicates that the impeller is just lifted off from the bowl assembly. Measure and record the gap between the adjust plate and the driver hub flange faces. 4. Calculate the difference between the two gaps recorded above. To this difference add the specified impeller lift value from the pump general arrangement drawing or from the pump nameplate. Record the calculated sum. 5. Loosen and remove the coupling bolting. Turn the adjusting plate until the measured gap between the flange faces of the adjusting plate and the driver hub is equal to the calculated sum above. 6. Install the coupling bolts and tighten in a star pattern to draw the flanges together. Prestress the bolts in three stages to the final torque value provided on the pump assembly drawing. 7. Set the shaft packing or the mechanical seal.
Enclosed impeller	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: 1. Securely tighten all setscrews in the collar. 2. Remove the spacer between the gland plate and the collar. 3. Retain the spacer for future resetting of the seal.

Adjust the impeller for a hollow-shaft driver

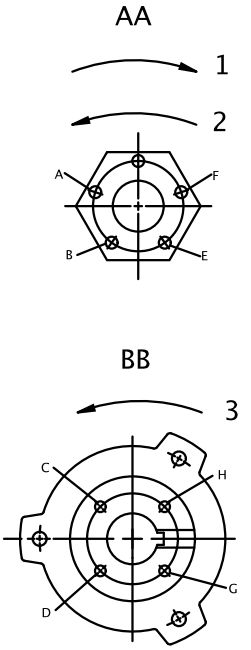
NOTICE:

- If your hollow-shaft driver has a mechanical seal, you must disengage it prior to impeller adjustment.
- Improper impeller adjustment can cause contact between the rotating and stationary parts. This results 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 0.001 in. to 0.003 in. (0.02 mm to 0.07 mm) depending on the shaft size and thread data shown in this table:



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

4. Insert a capscrew into hole B provided that these are the nearest-matching holes for counterclockwise rotation of the adjusting nut.

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 to within 0.005 in. per ft. (0.0123 cm per m) of diameter. For API units, the level requirement is 0.001 in. per ft. (0.003 cm per m) of diameter.	
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.	

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.	
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. 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 checklist 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.	
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 0.008 in. (0.020 cm) • Mechanical seal limit is a maximum of 0.005 in. (0.0123 cm)	
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.	

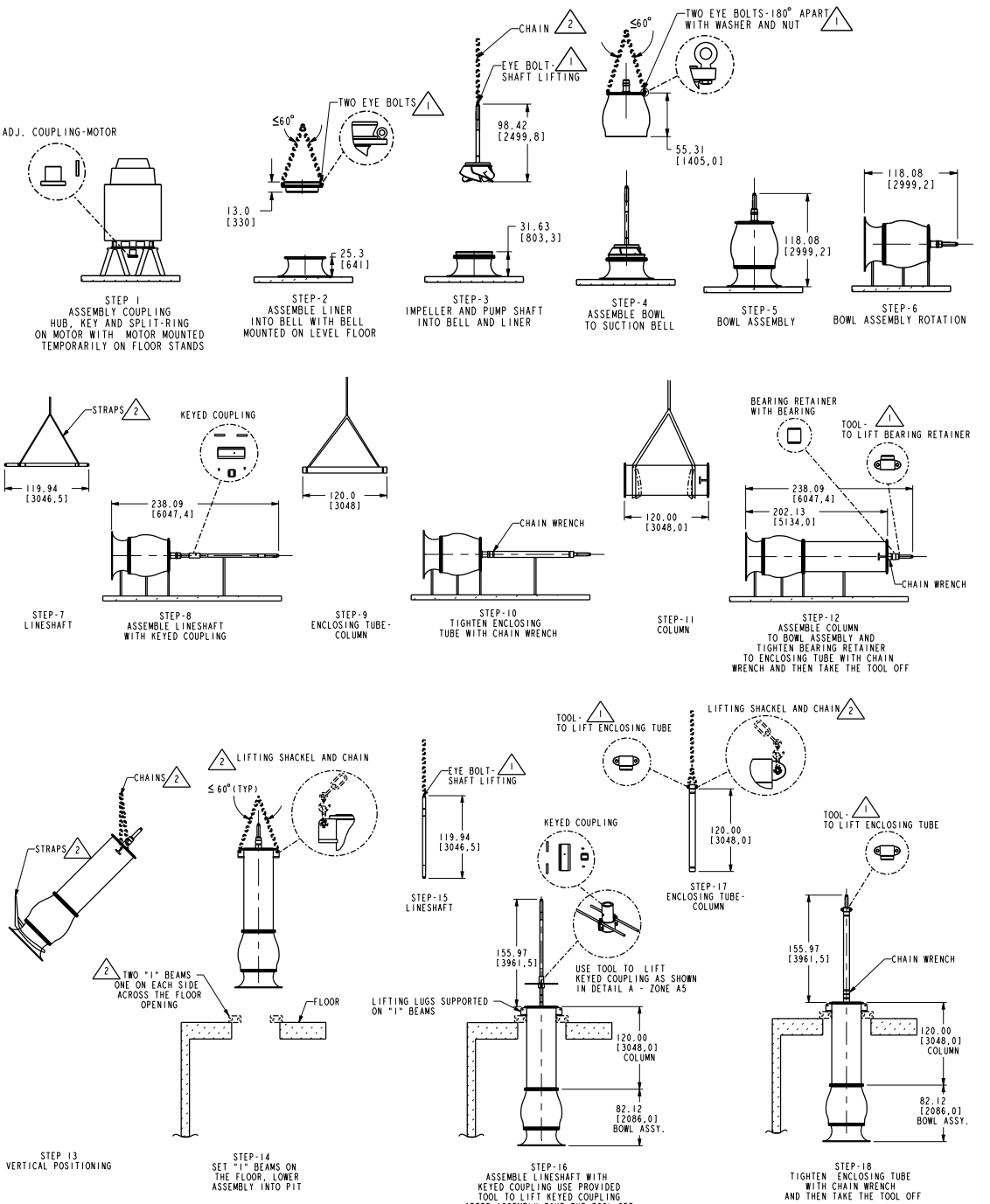
Part 3: Unit startup

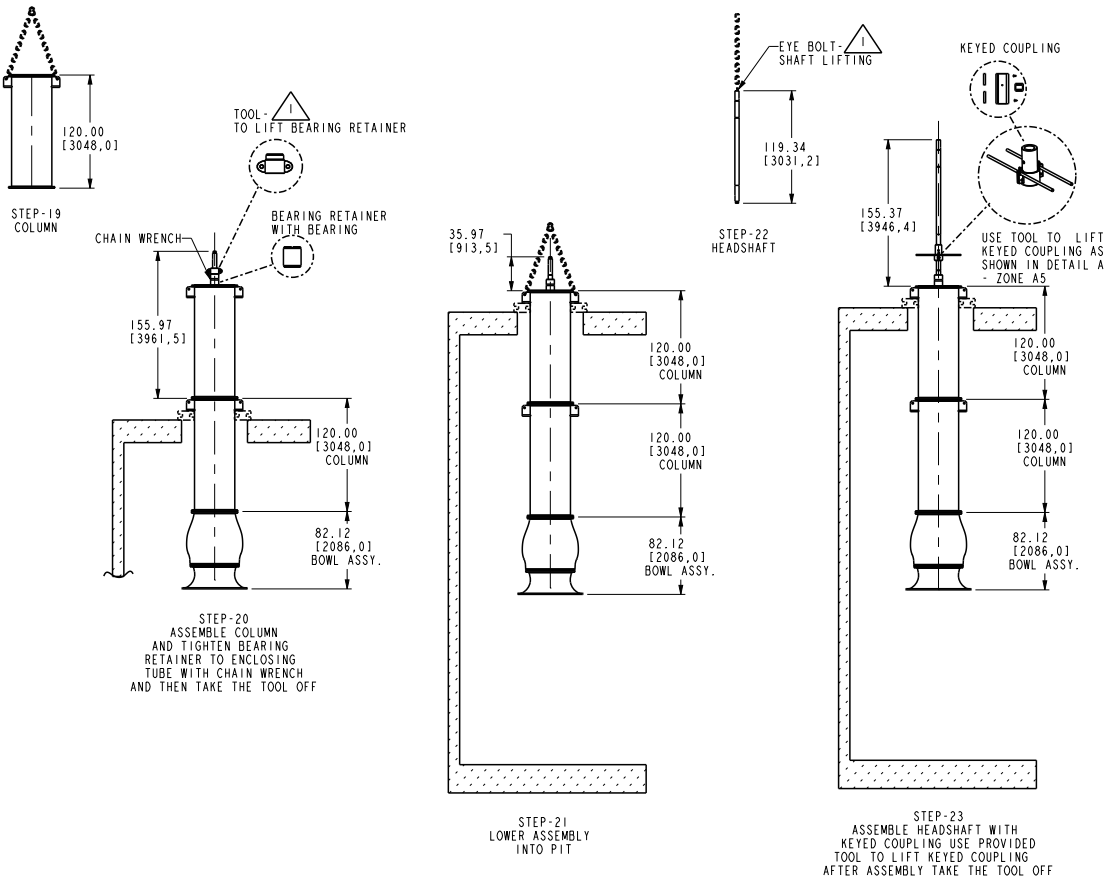
Check	Complete
After you complete all of the checks in Parts 1 and 2, conduct a start-up meeting with customer in order to discuss the actual procedures they might require during start-up and commissioning. Also, verify with the customer that their system is ready for pumped fluid.	
When the system is 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.	

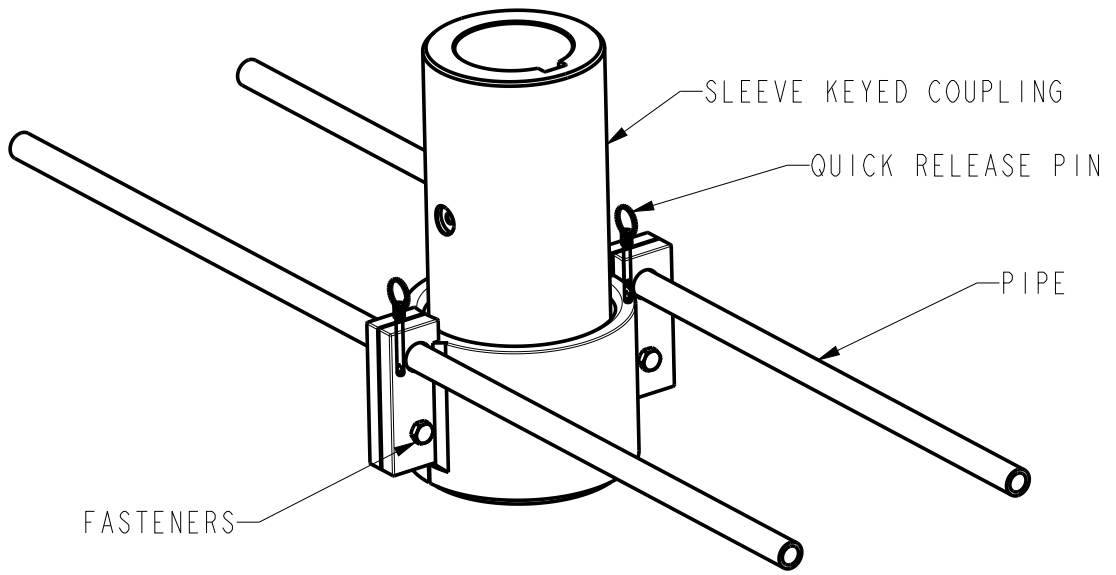
Measurements

Reading	Value
Impeller lift	
Shaft runout	
Megger	
Vibration	

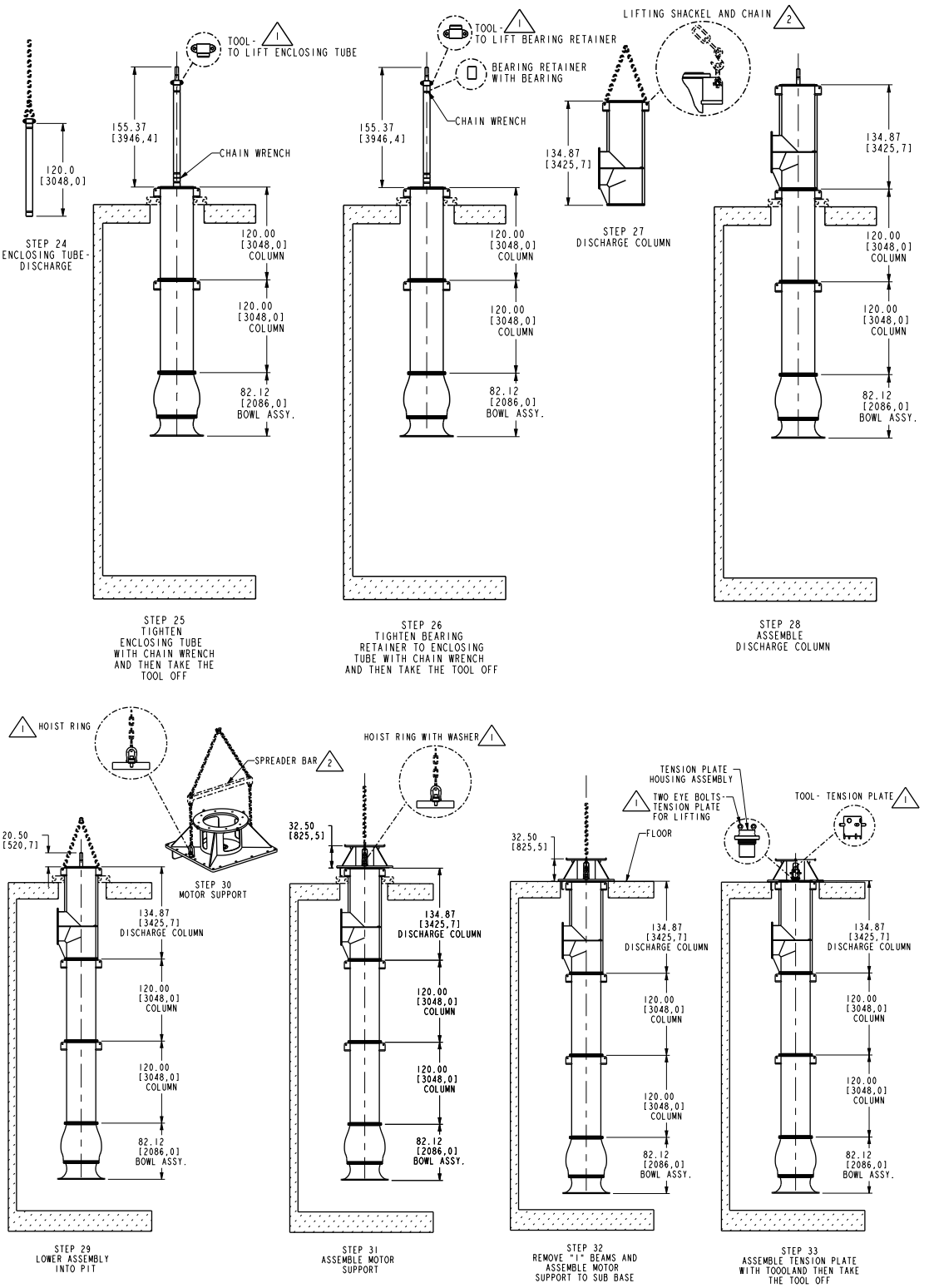
Optional Erection and Rigging of Individual Components

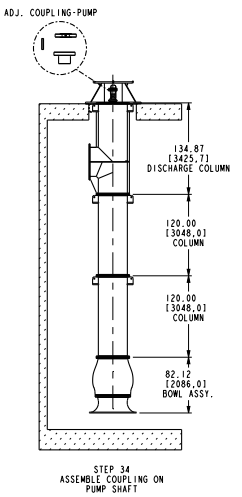


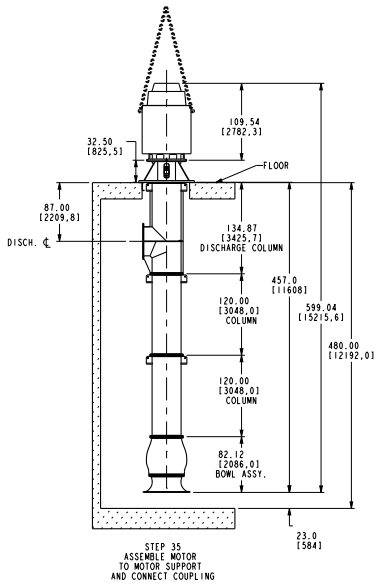


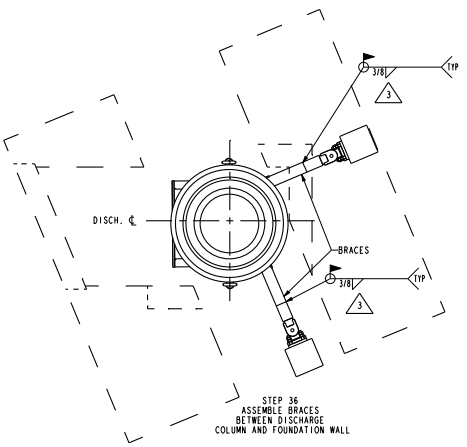


DETAIL A
ASSEMBLY TOOL TO LIFT SLEEVE KEYED COUPLING


TOOL- 1 TO LIFT ENCLOSING TUBE
155.37 [3946,4]
CHAIN WRENCH
120.0 [3048,0]
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 24 ENCLOSING TUBE- DISCHARGE
STEP 25 TIGHTEN ENCLOSING TUBE WITH CHAIN WRENCH AND THEN TAKE THE TOOL OFF
TOOL- 1 TO LIFT BEARING RETAINER
BEARING RETAINER WITH BEARING
CHAIN WRENCH
155.37 [3946,4]
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 26 TIGHTEN BEARING RETAINER TO ENCLOSING TUBE WITH CHAIN WRENCH AND THEN TAKE THE TOOL OFF
LIFTING SHACKEL AND CHAIN 2
134.87 [3425,7]
STEP 27 DISCHARGE COLUMN
134.87 [3425,7]
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 28 ASSEMBLE DISCHARGE COLUMN
1 HOIST RING
SPREADER BAR 2
20.50 [520,7]
STEP 30 MOTOR SUPPORT
134.87 [3425,7] DISCHARGE COLUMN
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 29 LOWER ASSEMBLY INTO PIT
HOIST RING WITH WASHER 1
32.50 [825,5]
134.87 [3425,7] DISCHARGE COLUMN
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 31 ASSEMBLE MOTOR SUPPORT
TENSION PLATE HOUSING ASSEMBLY
1 TWO EYE BOLTS- TENSION PLATE FOR LIFTING
32.50 [825,5]
FLOOR
134.87 [3425,7] DISCHARGE COLUMN
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 32 REMOVE "I" BEAMS AND ASSEMBLE MOTOR SUPPORT TO SUB BASE
TOOL- TENSION PLATE 1
134.87 [3425,7] DISCHARGE COLUMN
120.00 [3048,0] COLUMN
120.00 [3048,0] COLUMN
82.12 [2086,0] BOWL ASSY.
STEP 33 ASSEMBLE TENSION PLATE WITH TOOOLAND THEN TAKE THE TOOL OFF


ADJ. COUPLING-PUMP
134.87
[3425.7]
DISCHARGE COLUMN
120.00
[3048.0]
COLUMN
120.00
[3048.0]
COLUMN
82.12
[2086.0]
BOWL ASSY.
STEP 34
ASSEMBLE COUPLING ON
PUMP SHAFT


109.54
[2782.3]
32.50
[825.5]
FLOOR
87.00
[2209.8]
DISCH. ℄
134.87
[3425.7]
DISCHARGE COLUMN
457.0
[11608]
599.04
[15215.6]
480.00
[12192.0]
120.00
[3048.0]
COLUMN
120.00
[3048.0]
COLUMN
82.12
[2086.0]
BOWL ASSY.
23.0
[584]
STEP 35
ASSEMBLE MOTOR
TO MOTOR SUPPORT
AND CONNECT COUPLING


3/8
TYP
3
DISCH. ℄
BRACES
3/8
TYP
3
STEP 36
ASSEMBLE BRACES
BETWEEN DISCHARGE
COLUMN AND FOUNDATION WALL

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

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

WARNING:

- Failure to follow these precautions before you start the unit will lead to serious personal injury and equipment failure.
- Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Operating the pump above maximum rated flow shown on the pump curve leading to an increase in horsepower and vibration along with an increase in NPSHr resulting in mechanical seal and/or shaft failure and/or loss of prime.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- Avoid death or serious injury. Explosion and/or seizure of pump can cause fire and/or burns. Assure balance line is installed and either piped to the pump suction or back to the suction vessel to avoid vaporization of pumped fluid.

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

Precautions

NOTICE:

- Verify the driver settings before you start any pump.

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.

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 rotates in the wrong direction, serious damage to the pump, motor, and personnel will 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.

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 source so that liquid cannot collect in the vent line.
- 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.

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 pump must always be flooded with the suction valve fully open.
- 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 linshaft option is purchased to lubricate the lineshaft bearings with a clean fluid.

Start the pump

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

CAUTION:

- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.
- On pure or purge-oil mist-lubricated units, remove the viewing port plugs to verify that oil mist flowing properly. Replace the plugs.
- On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.
- Ensure all flush and cooling systems are operating correctly prior to starting pump.

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

Pump operation precautions

General considerations

CAUTION:

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

Operation at reduced capacity

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

CAUTION:

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

Operation under freezing conditions

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

Mechanical seal leaks

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

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 (shaft packing) damage, or seal faces that are warped or cracked. See Troubleshooting for probable causes.

Stuffing box leaks

CAUTION:
Ⓔx Packed stuffing boxes are not allowed in an ATEX-classified environment.

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.

Shut down the pump

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

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.

Maintenance

Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

Routine inspections

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

- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.

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.

Adjust and replace the packing

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

NOTICE:
Ⓔx Packed stuffing boxes are not allowed in an ATEX-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.

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.

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.

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. Always keep a supply of turbine oil on-hand.

NOTICE:
Pumps are shipped without oil. Oil-lubricated anti-friction bearings must be lubricated at the job site.

Oil levels

Pump status	Oil level
Not operating	At or lower than 1/8 in. to 1/4 in. (0.635 to 0.3175 mm) 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.

Pump status	Oil level
Operating	Lower than the required level as indicated on the oil sight gauge.

Changing the oil

The frequency with which you change the oil depends on the severity of the environment. When the oil in the sight gauge is a dark brown color, it is time for an oil change. However, for a longer bearing life, it is recommended that you change the oil every six months. Be sure to flush the oil reservoir with each oil change.

Disassembly

Disassembly precautions

WARNING:

- This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal unless explicitly stated in this manual.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- A small amount of liquid will be present in certain areas like the seal chamber.

NOTICE:

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

Disassemble the head and column

WARNING:
Never try to lift the entire pump assembly by the lifting lugs or eyebolts furnished for the driver only. Always lift the pump with shackles through the lifting lugs or with eyebolts inserted through the flanges.

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

Bowl disassembly

The bowl assembly is composed of these parts:

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

NOTICE:
Mark the components in sequence in order to aid the reassembly.

Disassemble the keyed bowl

1. Remove the capscrews that secure the top bowl to the intermediate bowl.
2. Slide the top bowl off the pump shaft.
3. For singe-stage pumps, lift pump shaft and impeller from suction bell as an assembly. Dismantle split ring from impeller and remove shaft from impeller.

Remove the bowl and impeller wear rings

1. 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.
2. With a chisel or drift punch, knock the end of one half of the ring in, and pry the ring out.
3. 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.

Remove the bowl, suction bell, and lineshaft bearings

NOTICE:
Bowl bearings are press fit. Do not remove the 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.

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 you clean the parts. Failure to do so may result in equipment damage.

Replacement guidelines

Gaskets, O-rings, and seats replacement

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

- Replace all gaskets and O-rings at each overhaul and disassembly.
- Inspect the seats. They must be smooth and free of physical defects.
- Replace parts if the seats are defective.

Reassembly

Install the 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.

Install the bowl, suction bell, and lineshaft bearings

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

1. Press bowl bearings into bearing housings until bearing is flush with seat.
2. Press line shaft bearings into retainers in column pipes.

Install 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.

Troubleshooting

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.
	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 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 (semi-open construction only).	Reset the impeller adjustment. See Installation for details.
There is not enough pressure.	The impellers are not rotating fast enough.	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.
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.

Symptom	Cause	Remedy
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.
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 shaft 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 shaft packing has been chipped during installation.	Replace the packing.
	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.

Symptom	Cause	Remedy
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.
	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.

Parts Listings and Cross-Sectionals

Typical Parts List and Cross Sectionals

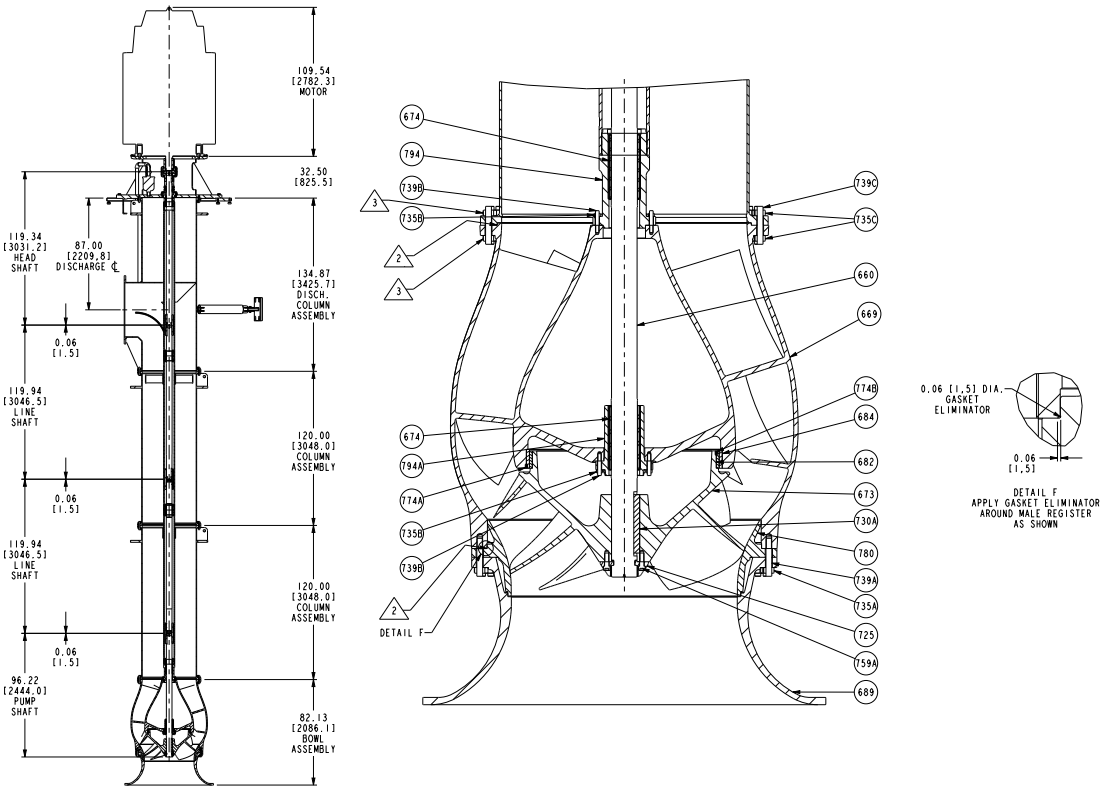


Figure 11: Cross Sectional

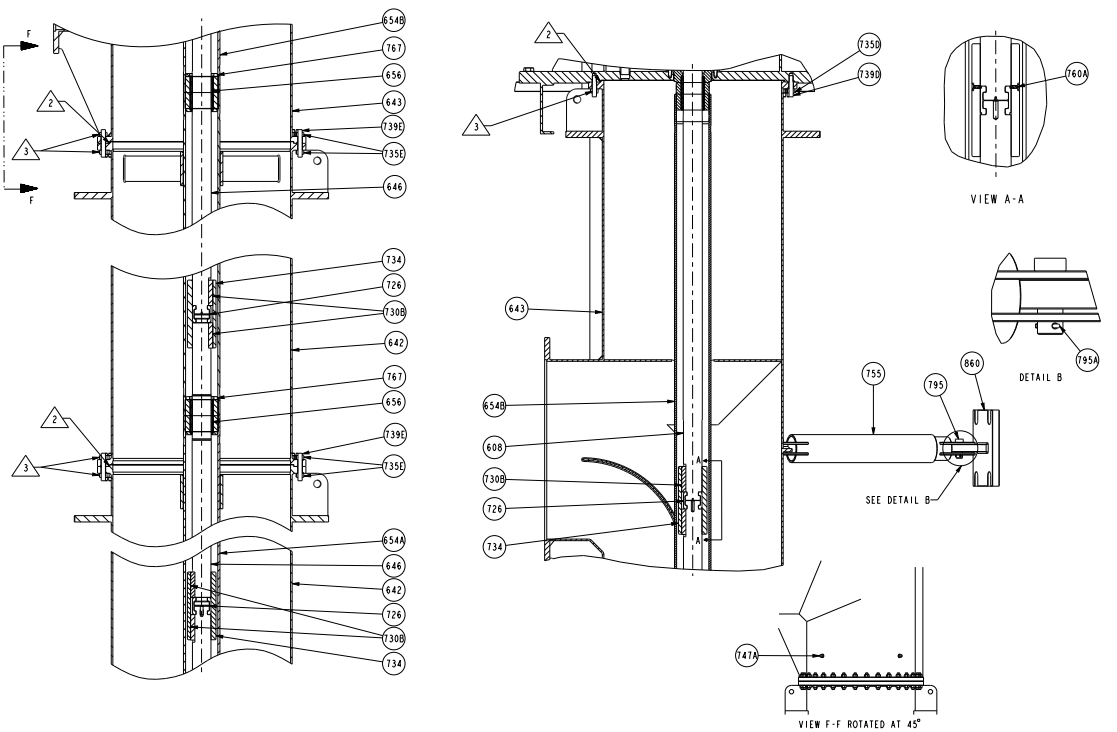


Figure 12: Cross Sectional

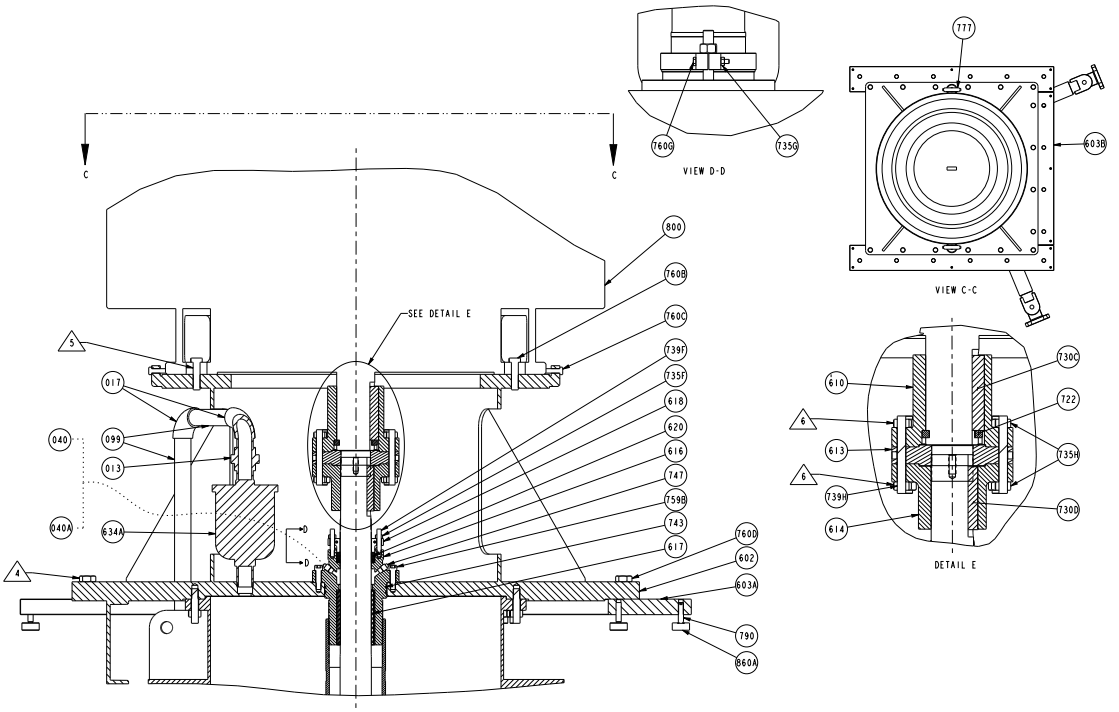


Figure 13: Cross Sectional

Table 4: Sub Assembly - Bowl Assembly Parts List

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
689	1	Bell, Suction	ASTM A48 Class 30B with SCOTCHKOTE 134	5853
780	1	Liner	ASTM A744 GR CF3-M, 316L SS	1219
673	1	Impeller	ASTM A744 GR CF3-M, 316L SS	1219
730A	1	Key, Impeller	ASTM A276 Type 316	2229
725	1	Thrust Ring, Impeller	ASTM A276 Type 316	2229
759A	8	SKT HD Screw, Imeller/Thrust Ring	ASTM A276 Type 316	2229
739A	32	Studs, Bell/Liner/bowl	ASTM A193 GR B8M Class 2	2287
735A	32	Hex Nut, Bell/Liner/Bowl	ASTM A194 GR 8M	2291
669	1	Bowl	ASTM A48 Class 30B with SCOTH-KOTE 134	5853
682	1	Wear Ring, Impeller	ASTM B148/B505 Alloy 954	1128
684	1	Wear Ring, Bowl	ASTM B148/B505 Alloy 954	1128
774A	3	Set Screw, Bowl/Wear Ring	ASTM A276 Type 316	2229
774B	3	Set Screw, Impeller/Wear Ring	ASTM A276 Type 316	2229
794A	1	Housing, Lower Bearing, Bowl	ASTM A108 GR 1018	2242
794	1	Housing, Bearing, Bowl/Enclosing Tube	ASTM A108 GR 1018	2242
674	2	Bearing, Bowl	Hard Shell Rubber Bearing (Nitrile & Brass)	6106
739B	32	Studs, Bearing Housing	ASTM A193 GR B8M Class 2	2287
735B	32	Hex Nut, Bearing Housing	ASTM A194 GR 8M	2291
660	1	Pump Shaft	ASTM A479-Type 410 Cond. 2 with PT1-25	0000
739C	32	Studs, Bowl, Column	ASTM A193 GR B8M Class 2	2287
735C	32	Hex Nut, Bowl/Column	ASTM A194 GR 8	2291

Table 5: Sub Assembly - Column and Discharge Assembly Parts List

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
642	2	Column	ASTM A36, Carbon Steel	9616
643	1	Column, Discharge	ASTM A36, Carbon Steel	9616
739E	64	Studs, Column/Column	ASTM A193 GR B8M Class 2	2287
735E	64	Hex Nut, Column/Column	ASTM A194 GR 8M	2291

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
646	2	Lineshaft	ASTM A479-Type 410 Cond 2 with PTI-25	0000
608	1	Headshaft	ASTM A479-Type 410 Cond 2 with PTI-25	0000
734	3	Sleeve, Key Coupling	ASTM A564, Type 630	2255
726	3	Splitting, Key Coupling	ASTM A564, Type 630	2255
730B	6	Key, Coupling	ASTM A564, Type 630	2255
760A	6	Hex Hd Screw, Key Coupling	ASTM A564, Type 630	2253
654A	2	Enclosing Tube, Column	ASTM A53, Grade B, Type E	6531
654B	1	Enclosing Tube, Discharge Column	ASTM A53, Grade B, Type E	6531
767	2	Bearing Retainer, Enclosing Tube	ASTM A108 GR 1018	2242
656	2	Bearing, Enclosed Shaft	Hard Shell Rubber Bearing (Nitrile & Brass)	6106
755	2	Brace	ASTM A36, Carbon Steel	9616
860	2	Plate	ASTM A36, Carbon Steel	9616
795	4	Pin	ASTM A564 Type 630	2255
795A	4	Pin	316 SS	0000
739D	32	Studs, Discharge Column/Motor Support	ASTM A193 GR B8M Class 2	2287
735D	32	Hex Nut, Discharge Column/Motor Support	ASTM A194 GR 8M	2291
747A	4	Pipe Plug, Tension Plate	ASTM A276 Type 316	2229

Table 6: Sub Assembly - Seal Assembly Parts List

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
616	1	Housing, Tension Plate	ASTM A108 GR 1018 UNS G10180	2242
617	1	Bearing, Tension Plate	Hard Shell Rubber Bearing (Nitrile & Brass)	6106
759B	8	SKT HD Screw, Tension Plate/Motor Mount	ASTM A276 Type 316	2229
743	2	O-Ring, Tension Plate	Nitrile BUNA-N	5302
747	2	Pipe Plug, Tension Plate	ASTM A276 Type 316	2229
620	3	Packing Ring	JOHN CRANE Packing Style 1340	5017
618	1	Gland, Split	ASTM B148/B505 Alloy 954	1128
739F	2	Studs, Split Gland/Tension Plate	ASTM A276 Type 316	2229
735F	2	Hex Nut, Split Gland/Tension Plate	ASTM A276 Type 316	2229
760G	2	Hex Hd Screw, Split Gland	ASTM A276 Type 316	2229
735G	2	Hex Nut, Split Gland	ASTM A276 Type 316	2229

Table 7: Sub Assembly - Adj. Coupling Assembly Parts List

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
610	1	Hub, Driver	ASTM A108 GR 1018 with Zinc Phosphate Coating	5933
722	1	Ring, Retaining	ASTM A434 Grade 4140/4142 Class BC	2467
730C	1	Key, Hub Driver	ASTM A564, Type 630	2255
613	1	Plate, Adjusting	ASTM A108 GR 1018 with Zinc Phosphate Coating	5933
614	1	Hub, Pump	ASTM A108 GR 1018 with Zinc Phosphate Coating	5933
730D	1	Key, Hub Pump	ASTM A564, Type 630	2255
739H	12	Studs, Adj Coupling	ASTM A193 GR B7	2239
735H	24	Hex Nut, Adj Coupling	SAE J995 Grade 8	2318

Table 8: Sub Assembly - Motor Support Assembly Parts List

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
602	1	Support	ASTM A36, Carbon Steel	9616
603A	2	Sub Base	ASTM A36, Carbon Steel	3236
603B	1	Sub Base	ASTM A36, Carbon Steel	3236
760D	16	Hex Hd Screw, Motor Support/Sub Base	ASTM A354 Grade BD or SAE 5429 GR8	2298
790	18	Jacking Bolt, Sub Base	ASTM A582 Type 303	2226

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
860A	18	Plate, Jacking Bolt	ASTM A108 GR 1018	2242
777	2	Lifting Lug, Motor Support	Alloy Steel Generic	0000
760B	8	Hex Hd Screw, Motor Support/Motor	ASTM A354 Grade BD or SAE S429 GR 8	2298
760C	4	Hex Hd Screw, Alignment, Motor Support/Motor	ASTM A354 Grade BD or SAE S429 GR 8	2298

Table 9: Accessories

Item No	Qty	Sub Assembly - Bowl Assembly	Material	GP MATL
800	1	Driver - Motor	Vendor: GE	0000
634A	1	Air Release Valve - APCO	Cast Iron Brass Fitted	0000
099	1	Pipe - cut to length	ASTM A53, Grade B, Type E	6531
017	2	Elbow, Pipe	MAL Iron	7201
013	1	Union, Pipe	Mal Iron	7611
040	1	Flow Switch	Vendor: IFM EFECTOR, Model: SI5002	0000
040A	1	Pressure Switch	Vendor: IFM EFECTOR, Model: PA3226	0000

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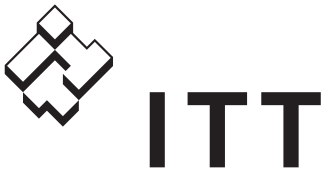

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