GOULDS PUMPS

Installation, Operation and Maintenance Instructions

VMP

ITT

Table of Contents

1 Introduction and Safety

1.1 Important Safety Notice

To: Our Valued Customers:

User safety is a major focus in the design of our products. Following the precautions outlined in this manual will minimize your risk of injury.

ITT Goulds pumps will provide safe, trouble-free service when properly installed, maintained, and operated.

Safe installation, operation, and maintenance of ITT Goulds Pumps equipment are an essential end user responsibility. This Pump Safety Manual identifies specific safety risks that must be considered at all times during product life. Understanding and adhering to these safety warnings is mandatory to ensure personnel, property, and/or the environment will not be harmed. Adherence to these warnings alone, however, is not sufficient — it is anticipated that the end user will also comply with industry and corporate safety standards. Identifying and eliminating unsafe installation, operating and maintenance practices is the responsibility of all individuals involved in the installation, operation, and maintenance of industrial equipment.

Please take the time to review and understand the safe installation, operation, and maintenance guidelines outlined in this Pump Safety Manual and the Instruction, Operation, and Maintenance (IOM) manual. Current manuals are available at https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/ or by contacting your nearest Goulds Pumps sales representative.

These manuals must be read and understood before installation and start-up.

For additional information, contact your nearest Goulds Pumps sales representative or visit our Web site at https://www.gouldspumps.com

1.2 Safety Warnings

Specific to pumping equipment, significant risks bear reinforcement above and beyond normal safety precautions.

WARNING:
A pump is a pressure vessel with rotating parts that can be hazardous. Any pressure vessel can explode, rupture, or discharge its contents if sufficiently over pressurized causing death, personal injury, property damage, and/or damage to the environment. All necessary measures must be taken to ensure over pressurization does not occur.

WARNING:
Operation of any pumping system with a blocked suction and discharge must be avoided in all cases. Operation, even for a brief period under these conditions, can cause superheating of enclosed pumpage and result in a violent explosion. All necessary measures must be taken by the end user to ensure this condition is avoided.

WARNING:
The pump may handle hazardous and/or toxic fluids. Care must be taken to identify the contents of the pump and eliminate the possibility of exposure, particularly if hazardous and/or toxic. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks.

WARNING:
Pumping equipment Instruction, Operation, and Maintenance manuals clearly identify accepted methods for disassembling pumping units. These methods must be adhered to. Specifically, applying heat to impellers and/or impeller retaining devices to aid in their removal is strictly forbidden. Trapped liquid can rapidly expand and result in a violent explosion and injury.

ITT Goulds Pumps will not accept responsibility for physical injury, damage, or delays caused by a failure to observe the instructions for installation, operation, and maintenance contained in this Pump Safety Manual or the current IOM available at http://www.gouldspumps.com/literature.

1.3 Safety

Definitions

Throughout this manual the words Warning, Caution, Electrical are used to indicate where special operator attention is required.

Observe all Cautions and Warnings highlighted in the Pump Safety Manual and the IOM provided with your equipment.

WARNING:
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
Example: Pump shall never be operated without coupling guard installed correctly.

CAUTION:
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
Example: Throttling flow from the suction side may cause cavitation and pump damage.

Electrical Hazard:

WARNING:
Indicates the possibility of electrical risks if directions are not followed.
Example: Lock out driver power to prevent electric shock, accidental start-up, and physical injury.

1.4 General precautions

WARNING:
A pump is a pressure vessel with rotating parts that can be hazardous. Hazardous fluids may be contained by the pump including high temperature, flammable, acidic, caustic, explosive, and other risks. Operators and maintenance personnel must realize this and follow safety measures. Personal injuries will result if procedures outlined in this manual are not followed. ITT Goulds Pumps will not accept responsibility for physical injury, damage or delays caused by a failure to observe the instructions in this manual and the IOM provided with your equipment.

Table 1: General Precautions

WARNING		NEVER APPLY HEAT TO REMOVE IMPELLER. It may explode due to trapped liquid.

WARNING		NEVER use heat to disassemble pump due to risk of explosion from tapped liquid.
WARNING		NEVER operate pump without coupling guard correctly installed.
WARNING		NEVER run pump below recommended minimum flow when dry, or without prime.
WARNING		ALWAYS lock out power to the driver before performing pump maintenance.
WARNING		NEVER operate pump without safety devices installed.
WARNING		NEVER operate pump with discharge valve closed.
WARNING		NEVER operate pump with suction valve closed.
WARNING		DO NOT change service application without approval of an authorized ITT Goulds Pumps representative.
WARNING		Safety Apparel: • Insulated work gloves when handling hot bearings or using bearing heater • Heavy work gloves when handling parts with sharp edges, especially impellers • Safety glasses (with side shields) for eye protection • Steel-toed shoes for foot protection when handling parts, heavy tools, etc. • Other personal protective equipment to protect against hazardous/toxic fluids
WARNING		Receiving: Assembled pumping units and their components are heavy. Failure to properly lift and support equipment can result in serious physical injury and/or equipment damage. Lift equipment only at specifically identified lifting points or as instructed in the current IOM. Current manuals are available at www.gouldspumps.com/literature_ioms.html or from your local ITT Goulds Pumps sales representative. Note: Lifting devices (eyebolts, slings, spreaders, etc.) must be rated, selected, and used for the entire load being lifted.
WARNING		Alignment: Shaft alignment procedures must be followed to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow coupling manufacturer's coupling installation and operation procedures.
WARNING		Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.
CAUTION		Piping: Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.
WARNING		Flanged Connections: Use only fasteners of the proper size and material.
WARNING		Replace all corroded fasteners.
WARNING		Ensure all fasteners are properly tightened and there are no missing fasteners.
WARNING		Startup and Operation:

		When installing in a potentially explosive environment, please ensure that the motor is properly certified.
WARNING		Operating pump in reverse rotation may result in contact of metal parts, heat generation, and breach of containment.
WARNING		Lock out driver power to prevent accidental start-up and physical injury.
WARNING		The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
WARNING		If using a cartridge mechanical seal, the centering clips must be installed and set screws loosened prior to setting impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.
WARNING		Never operate a pump without coupling guard properly installed. Personal injury will occur if pump is run without coupling guard.
WARNING		Make sure to properly lubricate the bearings. Failure to do so may result in excess heat generation, sparks, and / or premature failure.
CAUTION		Never operate the pump without liquid supplied to mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if mechanical seal fails.
WARNING		Never attempt to replace packing until the driver is properly locked out and the coupling spacer is removed.
WARNING		DO NOT operate pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.
WARNING		Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
WARNING		Shutdown, Disassembly, and Reassembly: Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes must be worn at all times.
WARNING		The pump may handle hazardous and/or toxic fluids. Observe proper decontamination procedures. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
WARNING		Operator must be aware of pumpage and safety precautions to prevent physical injury.
WARNING		Lock out driver power to prevent accidental startup and physical injury.
CAUTION		Allow all system and pump components to cool before handling them to prevent physical injury.
CAUTION		If pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107, there may be a risk of static electric discharge from plastic parts that are not properly grounded. If pumped fluid is non-conductive, pump should be drained and flushed with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.
WARNING		Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.

CAUTION		Wear heavy work gloves when handling impellers as sharp edges may cause physical injury.
CAUTION		Wear insulated gloves when using a bearing heater. Bearings will get hot and can cause physical injury.
WARNING		Noise: Sound pressure levels may exceed 80 dbA in operating process plants. Clear visual warnings or other indicators should be available to those entering an area with unsafe noise levels. Personnel should wear appropriate hearing protection when working on or around any equipment, including pumps. Consider limiting personnel's exposure time to noise or, where possible, enclosing equipment to reduce noise. Local law may provide specific guidance regarding exposure of personnel to noise and when noise exposure reduction is required.
WARNING		Temperature: Equipment and piping surfaces may exceed 130ºF (54ºC) in operating process plants. Clear visual warnings or other indicators should alert personnel to surfaces that may reach a potentially unsafe temperature. Do not touch hot surfaces. Allow pumps operating at a high temperature to cool sufficiently before performing maintenance. If touching a hot surface cannot be avoided, personnel should wear appropriate gloves, clothing, and other protective gear as necessary. Local law may provide specific guidance regarding exposure of personnel to unsafe temperatures.

1.5 Parts

The use of genuine Goulds parts will provide the safest and most reliable operation of your pump. ITT Goulds Pumps ISO certification and quality control procedures ensure the parts are manufactured to the highest quality and safety levels.

Please contact your local Goulds representative for details on genuine Goulds parts.

2 Introduction

2.1 Introduction

The design, material, and workmanship incorporated in the construction of Goulds pumps makes them capable of giving long, trouble-free service. The the life and satisfactory service of any mechanical unit, however, is enhanced and extended by correct application, proper installation, periodic inspection and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and the correct methods of installing, operating, and maintaining these pumps.

It is advisable that rotating components of the pump assembly be covered with a suitable rigid guard to prevent injury to personnel.

Study thoroughly Introduction thru Pump Startup and Operation and carefully follow the instructions for installing and operating. Maintenance thru Pump Disassembly are answers to trouble and maintenance questions. Keep this instruction manual handy for reference. Further information can be obtained by contacting the Vertical Pump Division, Goulds Pumps, Inc., City of Industry, California or your local branch office.

WARNING:
Goulds Pumps, Inc. will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual.

2.2 Receiving and checking

The pump shall be carefully supported prior to unloading from the carrier. Handle all components carefully. Inspection for damage of the shipping crate shall be made prior to unpacking the pump. After unpacking, visually inspect the pump, and check the following:

1. Contents of the pump assembly against shipping list.
2. All components against damage.
3. Shafting for straightness and damage. Any shortages or damages should be immediately called to the attention of the local freight
agent of the carrier by which the shipment arrived and proper notation made on the bill. This shall prevent any controversy when claim is made and facilitate prompt and satisfactory adjustment.

2.3 Materials and equipment required

The material and equipment necessary for installation of the pump will vary with the size of the pump and the type of installation.

The following list of standard tools and supplies is offered only as a guide.

1. Bulk material
    - Anti-Galling Lubricant (such as MOLY· KOTE Dow Corning)
    - Thread Compound
    - Lubrication Oil
    - Turbine Oil (refer to 17.1 Recommended lubricants on page 55)
    - Grease (refer to 17.1 Recommended lubricants on page 55)
    - Solvent, petroleum - base (kerosene, distillate or unleaded gasoline)
2. Rigging equipment

- Mobile power hoist, or a traveling crane, or a derrick
- Drag line and blocks
- Elevator clamps
- Clevises- for use with eyebolts
- Timbers - size, length and quantity as required to support long pump parts on the floor
- I-Beams or timbers to support pump over barrel

3. Hand tools
    - Pipe wrenches, clean rags
    - Feeler gages
    - Set of mechanics tools including: fi1es, wire brush, pliers, wire-cutters, pocket knife, and pipe wrenches
4. Optional tools to facilitate pump assembly and disassembly
    - Dial indicator to assist in motor end shaft adjustment (refer to Installing the Driver (VHS) and Installing the Driver (VSS))
    - Collet driver to assist in bowl assembly and disassembly (refer to Pump Disassembly)

3 Storage

3.1 Storage

Goulds Pumps carefully preserves and protects its products for shipment. However, the effective life of the preservatives applied at the factory can vary 3 to 8 months depending on the severity of the environment in which the equipment is stored. This section provides procedures for preparation prior to storage and maintenance during storage of Goulds pumps. These procedures are necessary to protect the precision parts of the pumps. Specific procedures for storing motors, gearheads, and engines, should be obtained from the equipment manufacturer. This section is intended be of general assistance to users of Goulds pumps. It shall not modify, amend and/or otherwise alter the scope of Goulds Pumps warranty responsibilities to the purchaser in any way whatsoever.

3.2 Storage preparation

Goulds vertical pumps require proper preparation for storage and regular maintenance during storage. The pump shall be considered in storage when it has been delivered to the job site and is waiting for installation.

3.3 Recommended storage procedures

1. Controlled storage facilities should be maintained at an even temperature 10ºF or more above the dew point with relative humidity less than 50% and little or no dust. If these requirements cannot be met the pump is to be considered in uncontrolled storage.
2. For uncontrolled storage periods of 6 months or less, the pump is to be inspected periodically lo ensure that all preservatives are intact.
3. All pipe threads and flanged pipe covers are to be sealed with tape.
4. The pump must not be stored closer than 6 inches from the ground.

3.4 Preparations for uncontrolled long term storage

When applicable to the pump, storage periods over 6 months require the preceding uncontrolled storage procedure plus the following:

1. Inspect the lube oil and seal flush piping, and either fill the piping with rust preventative oil, or recoat the piping periodically to prevent corrosion.
2. Place 10 pounds of moisture absorbing desiccant or 5 pounds of vapor phase inhibitor crystals near the center of the pump. If the pump is as assembled, place an additional one pound in the discharge nozzle securely fastened to the discharge elbow.
3. Install a moisture indicator near the perimeter of the pump. Cover the pump with 6 mil minimum thickness black polyethylene or equal and seal it with tape. Provide a small ventilation hole approximately 1/2 inch diameter.
4. Provide a roof or a shed shelter to protect from direct exposure to the elements.

4 General Description

4.1 General description

The Model VMP Autoprime pump is an automatic self priming unit designed for efficient unloading and stripping of product tankers and tank barges, also for ballast, bilge, and fuel oil transfer services. A unique feature of the Autoprime pump is its ability to discharge air or vapors quickly and automatically for fast and complete stripping.

4.2 Drivers

Drivers are supplied in a variety of types and sizes to meet a wide range of operating requirements. Most common are right angle drive units with solid or hollow shafts coupled to internal combustion engines, or steam turbines. In addition, electric motors with solid or hollow shafts are provided. Occasionally a right angle gear drive coupled to a horizontal electric motor is provided to drive the pump.

4.3 Discharge head

The discharge head may be a low or high profile head depending on construction requirements. A Goulds exclusive primacy-clamatic feature may be provided to supply automatic temporary lubrication by the product being handled to the mechanical seal, or stuffing box bushing during the priming or stripping cycle. The discharge head features an automatic venting system which incorporates a vent line from the barrel, or tank to pump discharge, and a check valve that prevents recirculation from pump discharge when pump is in operation. The discharge head also features a bearing in its base to ensure stability of shaft in the stuffing box area.

4.4 Column

The column is fabricated in sections five feet or less to provide vibration free operation below shaft first critical speed. Flanged construction provides positive shaft and bearing alignment. Pumps over 15 feet long are normally equipped with spring loaded sway braces to protect the column from the effects of horizontal movements and twists of the vessel, particularly in a seaway. The lineshalt is supported within the column by use of bearing retainers secured to the column assembly.

4.5 Autoprime valve

An autoprime valve is located near the base of the bottom column. Some larger pumps may have as many as four autoprime valves located at 90 degree intervals around the column. When the pump is not in operation, spring pressure keeps the valve open. On pump startup, discharge pressure closes the valve. When pump loses prime, loss of pressure allows the valve to open. Liquid in column above the valve then flows into barrel and pump suction, repriming pump. Vapor displaced in the barrel is vented to discharge and evacuated from the system through main discharge.

4.6 Bowl assemblies

The bowl assembly is designed to operate when the liquid in the barrel or tank is sufficient to submerge the priming stage. The priming stage normally consists of a mixed flow impeller, suction bell and shaft with the ability to handle air, vapor, and at the same time create vacuum. The stages following the priming stage consist of high efficiency turbine bowls which contribute the largest proportion of head during normal pumping operation.

4.7 Thrust pot

A thrust pot is utilized when the electric motor or gear is not designed to carry the pump down-thrust.

5 Installing the Pump

5.1 Pump installation

Pumps under 6,000 lbs. and 20 feet or less in length are usually shipped completely assembled with the exception of the driver, mechanical seal, and in some cases, the driveshaft when a vertical hollow shaft driver is furnished. When provided, see the Certified Pump Outline Drawing for the applicable bowl configuration.

5.2 Horizontal pump installation

There are two methods of assembling and installing the VMP pump, vertical, and horizon. The vertical method is described in the following pages, but the pump components can be assembled horizontally by following the procedural steps described for the vertical method. The sequence and procedural steps of assembling the pump components are exactly the same, and can be applied either vertical or horizontal for all practical purposes. Observe the following:

1. Support the headshaft, pumpshaft or, lineshaft as applicable, horizontally during assembly at several points to prevent bending or damaging the shafts, Refer to 5.3 Installing a completely assembled pump on page 14, Step 1.
2. Assemble pump components horizontally on blocks. After pump is completely assembled less driver proceed with Step 3, 5.3 Installing a completely assembled pump on page 14, Step 3.

5.3 Installing a completely assembled pump

When a pump is shipped completely assembled (with the exception of the driver) proceed as follows:

1. When a driveshaft or headshaft is shipped separately, check shaft for straightness, average total runout shall not exceed 0.010 T.I.R. for every 10 feet. Shalt must be within tolerance prior to installation.
2. Remove stuffing box and carefully slide shalt through bearing retainer and thread into coupling. Use extreme care not to damage retainer bearing.
3. Install gasket on the barrel opening.
4. Using two cranes the pump may be lifted into position by slinging through the windows (hand holes) on discharge head and around the bowl assembly. Hoist pump horizontally, guiding the lower end to prevent dragging on the floor.
5. Lower the bowl assembly and position over the barrel opening.

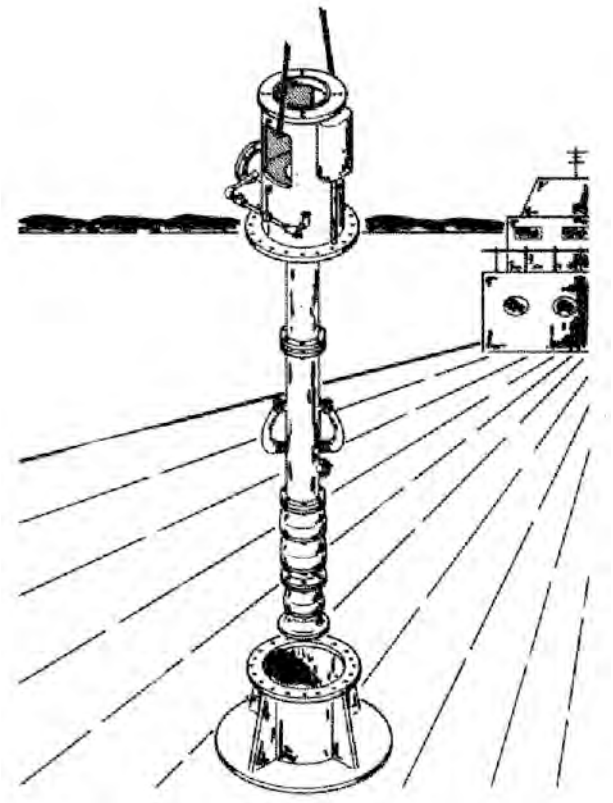


Figure 1: Pump installation

6. Lower pump assembly into the barrel until sway braces engage inside of the barrel. The sway braces are under spring tension and fit snugly in the barrel. Continue to lower the assembly until the discharge head flange engages the barrel flange. Install capscrews and secure discharge head to barrel. Tighten capscrews in diametrically opposite pairs. Install stuffing box, refer to Stuffing Box Installation.
7. Refer to Installing the Driver (VHS) for the installation of hollow shaft gearhead and electric motor driven pumps and also for the adjustment of open and enclosed impellers. Installing the Driver (VSS) covers the installation of solid shaft gearhead and electric motor driven pumps and also the adjustment of open and enclosed impellers. Pump Startup and Operation, covers startup.

6 Installing the Bowl Assembly

6.1 Bowl assembly installation

The following howl installation instructions apply to pumps shipped disassembled.

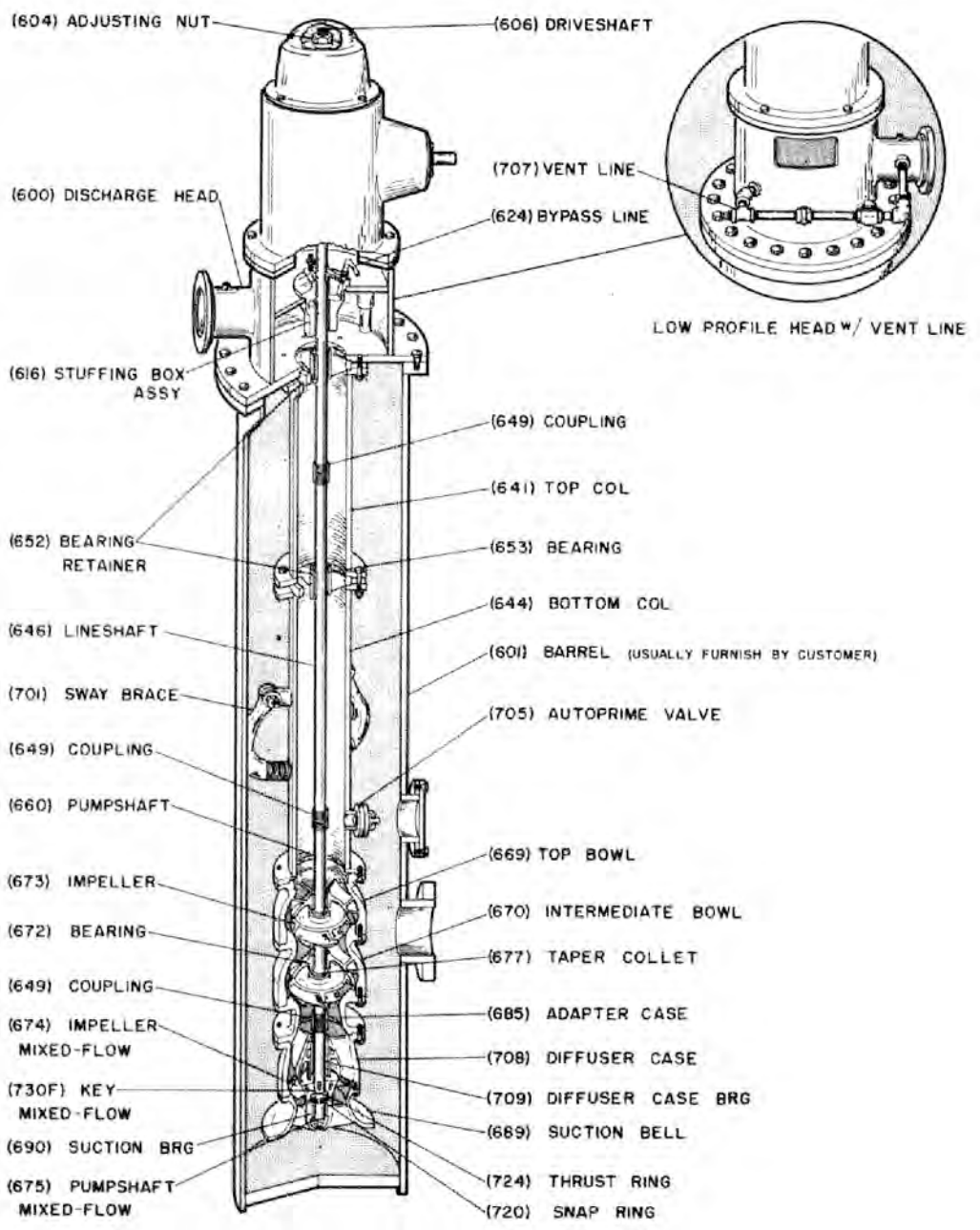


Figure 2: Typical VMP autoprime pump

WARNING:
Do not work under a heavy, suspended objects unless there is a positive support under it, which will protect personnel should a hoist or sling fail.

Prior to installing the bowl assembly, remove all accumulated dust, oil, or other foreign matter from external surfaces of the bowl assembly and proceed as follows:

1. Position a suitable lifting device over the barrel opening. Place two timbers or I-beams across the barrel opening strong enough to safely support the weight of the entire pump assembly.
2. Place an elevator clamp just below the top bowl flange or thread eye-bolts through bolt holes in the flange, and hoist into position over the barrel.

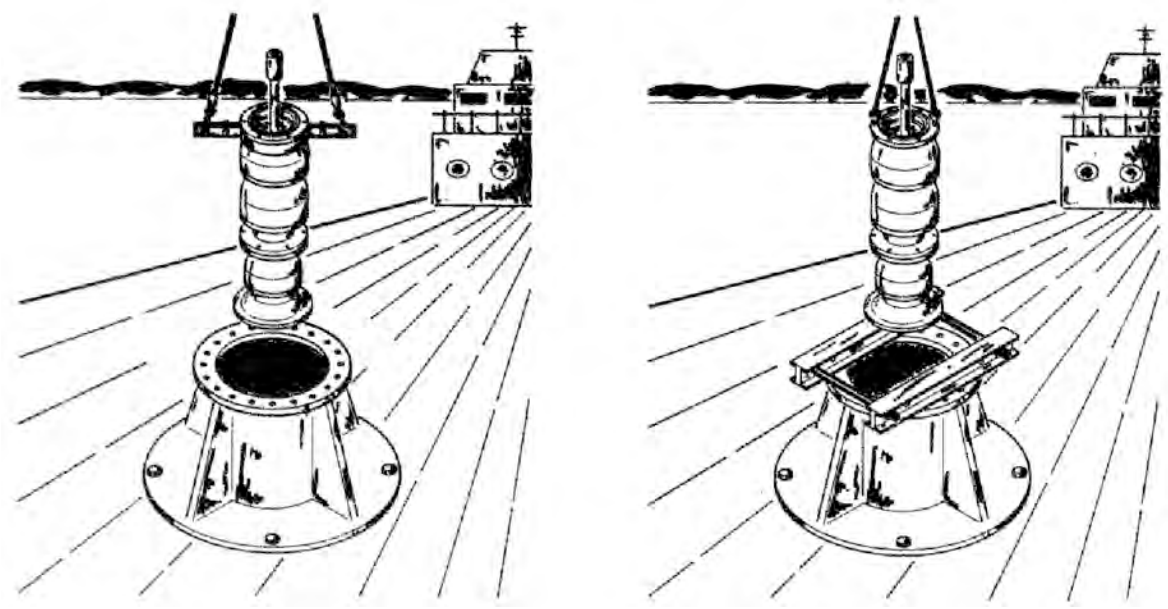


Figure 3: Bowl assembly installation

3. Lower bowl assembly until flanges of elevator clamp, or bowl flange rests firmly on the barrel or supports.
4. Place a cover over bowl assembly to prevent entrance of dirt or other foreign matter.
5. Threaded shaft coupling: When
threaded coupling is not installed on the pump shaft, proceed as follows:

   a) Install threaded coupling onto pumpshaft screwing it on for one-half its length.

   b) A line wire inserted in the drilled hole at the center of the coupling can be used as a gage to determine when the coupling is correctly positioned on the pumpshaft. Remove the wire after installing the coupling.

NOTICE:
Shaft threads are left hand.

6. Keyed shaft coupling: When a pump is equipped with keyed shafts assemble as follows:

   a) Install retainer (650) and insert key (730D) onto shaft.

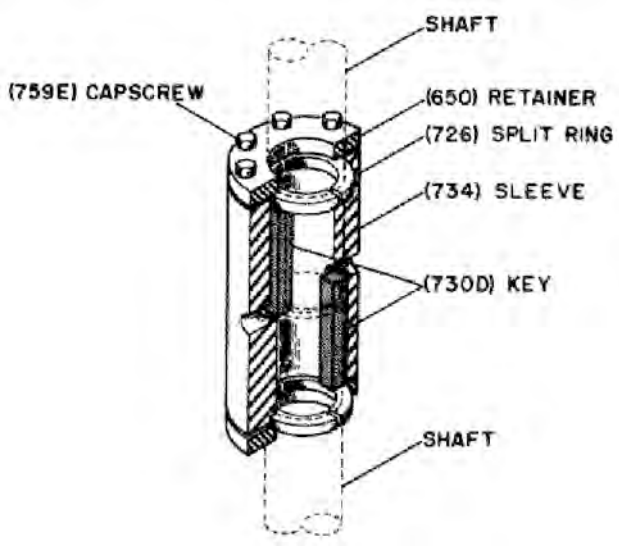


Figure 4: Keyed shaft coupling

b) Lower coupling sleeve (734) onto shaft approximately one inch.

c) Insert split ring (726) and lower coupling sleeve until it bottoms against split ring.

d) Secure re1ainer (650) with capscrews (759E).

e) Install retainer (650), insert key (730D) on lineshaft (646) and carefully lower lineshaft approximately one inch. Install split ring (726) on lineshaft.

f) Lower lineshaft until split ring (726) bottoms in the groove.

g) Secure retainer (650) with capscrews (759E).

CAUTION:
Do not drop any foreign object into the bowl assembly. Such an object can cause serious damage to the pump and any downstream components. Any foreign object dropped into the bowl assembly must be retrieved prior to continuing assembly.

7 Installing the Column

7.1 Installing the column

When provided, see the Certified Pump Outline Drawing for the number of column and shaft sections required.

1. Check lineshaft (646) for straightness, refer to 5.3 Installing a completely assembled pump on page 14, Step 1. Apply a thin
film of oil to lineshaft and coupling (649) threads (if non-galling material). Start thread manually until resistance is felt. Complete the joint utilizing a pair of pipe wrenches, butting the bottom of the lineshaft against the top of the pumpshaft (660). Use care not to apply wrenches on bearing journal surfaces. (See Figure 2: Typical VMP autoprime pump on page 16)

CAUTION:
Use Molykote Dow-Corning or equal for all galling material such as 316 stainless steel.

NOTICE:
Shaft threads are left hand.

2. Keyed shafts - Refer to 6.1 Bowl assembly installation on page 16, Step 6.
3. Install two eyebolts diametrically opposite in the upper flange of column (641) with autoprime valve and sway braces. Attach a sling to the eyebolts and hoist hook. Hoist column section over howl assembly. Lower column over lineshaft until column flange engages the top bowl flange register. Insert as many capscrews through both flanges as possible. Tighten capscrews gradually in diametrically opposite pairs.

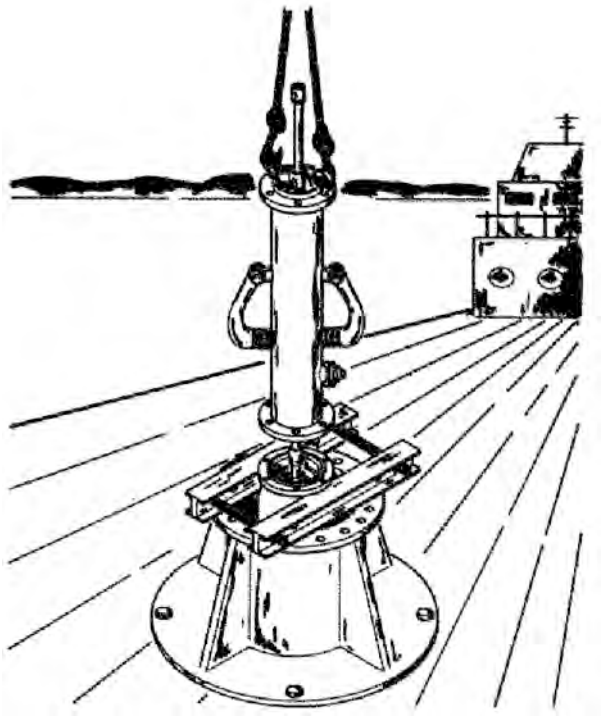


Figure 5: Bottom column installation

4. Lift bowl and column assembly high enough to allow rotation of the elevator clamp or supports. Install and righten remaining capscrews.
5. Lift assembly and remove elevator damps or supports. Slowly lower the bowl and column assembly into the barrel until sway braces engage inside the barrel. The sway braces are under spring tension and fit snugly in the barrel. Place supports on barrel and continue to lower the assembly until the column flange comes to rest on the elevator damp or supports.
6. Place bearing retainer (652) with bearing (653) over lineshaft (646) and locate it in the bottom column (644) flange register.
7. Install threaded coupling (649) on protruding end of lineshaft (646) as required, (see Figure 3: Bowl assembly installation on page 17. Repeat Figure 3: Bowl assembly installation on page 17 Step 5.
8. Keyed shafts - Repeat Step 2, Installing the column.
9. Assemble next column section intermediate, or top column as required, and make certain bearing retainer engages the column register, and secure with capscrews provided until all column and all column and lineshaft sections required for the proper pump setting have been assembled. Tighten capscrews gradually and uniformly.

NOTICE:
Do not over-tighten flange bolts in order to make flange faces meet. Flange faces are designed to be separated by bearing retainer.

8 Installing the Discharge Head

8.1 Installing the discharge head

There are two configurations of discharge heads. The discharge head shown in Figure 2: Typical VMP autoprime pump on page 16, is a low profile head, a high profile head is shown below. The high profile head may be fabricated with a Goulds primacylamatic tank welded on. Install the discharge head as follows:

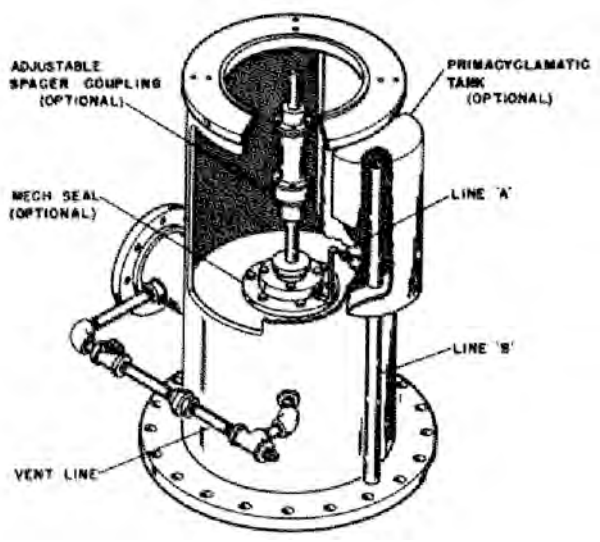


Figure 6: High profile head

1. Remove mesh coupling guard, stuffing box with packing or mechanical seal housing as applicable. When a shaft sleeve is provided, mark position of sleeve on shalt, using a scribe to facilitate reassembly. Attach a sling through windows (hand holes), or thread two eyebolts in the head driver mounting holes diametrically opposite, and hoist discharge head over the protruding headshaft.
2. Install gasket on the barrel flange.

CAUTION:
Do not bump or scrape the shaft protruding above the column. This could result in bending or damaging the shaft.

3. Orient the discharge head in the required position and lower head, aligning the vertical hole with the headshaft protruding above the column until discharge head engages the bearing retainer (652) register. Install capscrews and secure discharge head to bearing retainer. Tighten capscrews gradually in diametrically opposite pairs.

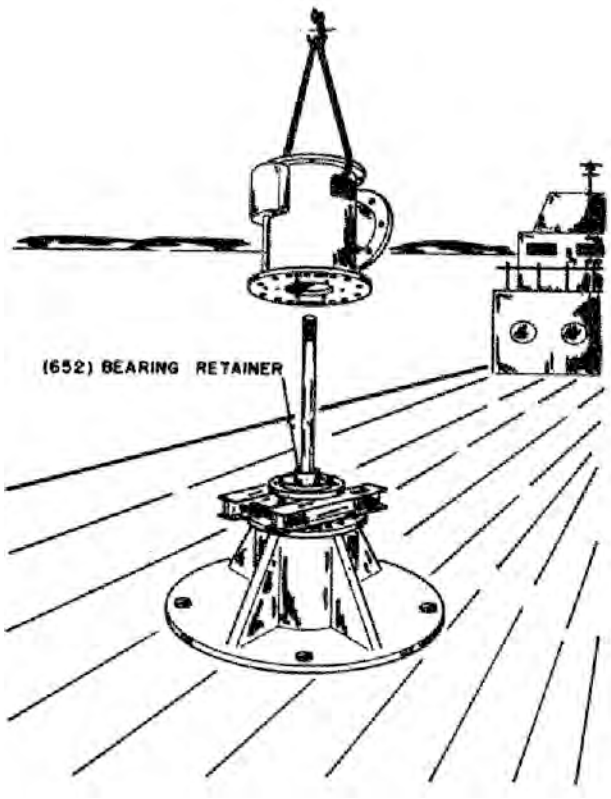


Figure 7: Discharge head installation

4. Lift pump assembly high enough to allow rotation or the elevator damps or supports. Realign and lower assembly. Install and tighten remaining capscrews. Repeat rotation and tightening procedure until all capscrews are uniformly tight.
5. Hoist bowl, column, and head assembly, and remove elevator damp, or supports from barrel opening.
6. Lower bowl, column and head assembly until discharge head flange engages barrel. Install capscrews and secure discharge head to barrel. Tighten capscrews gradually in diametrically opposite pairs.

9 Stuffing Box Installation

9.1 Stuffing box installation

When a shaft sleeve is provided, complete the installation as described in Steps 1 through 3. For stuffing boxes without a shaft sleeve, start with Step 3-a.

1. Lubricate O-ring (in sleeve) and shaft threads.
2. Insert sleeve onto shaft and slowly rotate counter-clockwise, simultaneously pushing inward, gently until O-ring is clear of threads.
3. Locate sleeve on shaft and secure with setscrews.

    a) For pumps with standard stuffing box, position gasket on discharge head. Slide stuffing box (616) down over shaft and into position on gasket. Secure stuffing box with capscrews (758A).

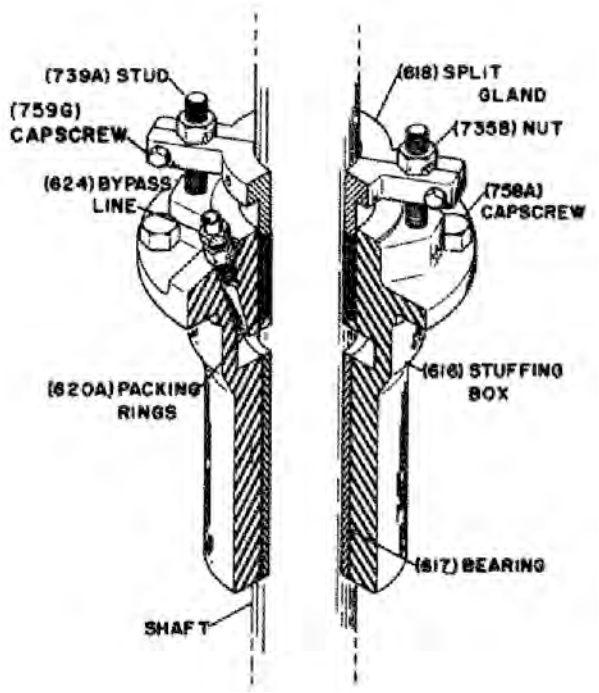


Figure 8: Stuffing box

    b) Insert packing washer (789C) into stuffing box, if provided. (Packing washer not required on shaft sizes 2-3/16 and over.)

    c) Grease the packing rings (620A) for easier installation.

    d) Twist the packing ring sideways to get ring around the shaft and start the first ring into the stuffing box. When the entire ring is worked in using the fingers, tamp it down using a split wooden bushing or equal and push the packing ring hard, it must seal on the shalt and bore. Install the required rings in this manner. Stagger ring joints 90 degrees apart. The split gland (618) may he used as a tamper for the topmost ring.

    e) If a lantern ring is used, be sure it is properly positioned so that it aligns with the lubrication passage in the stuffing box.

    f) Place split gland in the stuffing box. Thread nuts (735B) and tighten with a wrench and then relieve the nuts and take up only finger tight. Thread bypass line (624) into stuffing box.

CAUTION:
Check that the split gland is square in the stuffing box. Cocking can cause uneven compression of the packing and damage to the shaft.

g) Tum shaft manually a few times if possible. A properly parked stuffing box should be loose enough to allow shaft to be turned manually.

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

h) If a lubrication line is being installed, connect tubing from reservoir to stuffing box. Refer to 10.2 Primacyclamatic tank operation on page 25 for primacyclamatic tank operation.

10 Mechanical Seal Installation

10.1 Mechanical seal installation

Instructions for installing mechanical seals are provided by the manufacturer of the seal. Consult the seal manufacturer's instructions (furnished with the seal) for information on the type of mechanical seal used. Prior to installing the seal check the following:

1. That all pans are kept dean, especially the running faces of the seal ring and insert.
2. The seal rotary unit and make sure the drive pins and/or spring pins are free in the pin holes or slots, and that springs compress and expand freely,
3. The setscrews in the rotary unit collar to see that they are free in the threads.

NOTICE:
Setscrews should re replaced after each use.

4. The thickness of all gaskets against the dimensions shown on the assembly drawing. Improper gasket thickness will affect the seal setting and the spring load imposed on the seal.
5. The fit of the gland ring to the equipment. Make sure there is no interference or binding on the studs or bolts or other obstructions. Be sure the gland ring pilot, if any enters the bore with a reasonable guiding fit for proper seal alignment.
6. Make sure all rotary unit parts of the seal fit over the shaft.
7. Both running faces of the seal (seal ring and insert) and be sure there are no nicks or scratches. Imperfections of any kind on either of these faces will cause seal leakage.

When provided, install tubing connecting primacylamatic tank to mechanical seal. (See Figure 6: High profile head on page 21)

10.2 Primacyclamatic tank operation

A primacylamatic tank may be provided m lubricate a mechanical seal or stuffing box. Operation is as follows:

1. Fluid under discharge pressure flows through bearing clearance and lubricates seal face, or stuffing box. Fluid bypasses through tapped hole in seal gland to line "A". (See Figure 6: High profile head on page 21)
2. When reservoir is full, excess fluid returns to barrel through line "B".
3. During reprime cycle (when pump pressure is lost) gravity flow back through line "A" keeps seal or stuffing box bushing constantly lubricated.
4. Reservoir pressure is equalized to barrel pressure through line "B".

11 Installing the Driver (VHS)

11.1 Installation of hollow shaft right angle gear drive

WARNING:
Do not work under a heavy suspended object unless there is a positive support under it which will protect personnel should a hoist or sling fail.

11.2 Low profile discharge head

The low profile discharge head is usually used in conjunction with a hollow shaft driver and stuffing box, and for short setting pumps used on inland waterways barges.

11.3 Driver support

When a driver support is furnished, proceed as follows:

1. Hoist driver support, inspect the mounting surfaces, register and dean these surfaces thoroughly.
2. Install driver support on discharge head and secure with capscrews provided.

11.4 Combination driveshaft

When a pump is furnished with a combination driveshaft (shalt extends above the driver mounting flange) proceed as follows:

1. Remove gearhead covet and drive coupling.
2. Attach a sling to eyebolts on the gearhead. Hoist gearhead, inspect the mounting surfaces, register, and clean these surfaces thoroughly. If any burrs are found, remove burrs with a smooth mill file.
3. Slowly lower the gearhead, aligning the axial hole with the driveshaft, being very careful that the gearhead does not bump or scrape the driveshaft as it enters and passes through the hole.

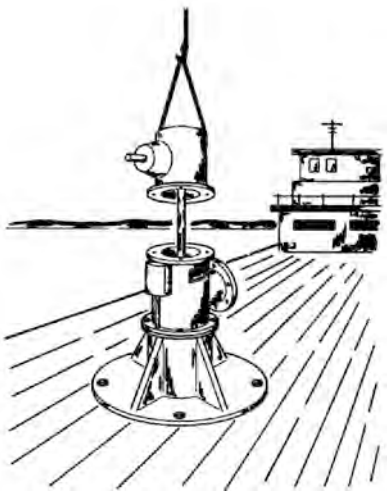


Figure 9: Hollow shaft gearhead installation

4. Orient the gearhead with the input shaft in the required position and align the mounting holes with the mating tapped holes in the discharge head. Continue to lower the gearhead until the registers

engage and the gearhead is set firmly on the discharge head, or driver support, and secure gearhead to discharge head, or driver support with capscrews provided.

5. Check that driveshaft is concentric with the hollow shaft of gearhead by sliding the gearhead coupling over the driveshaft. If the coupling freely engages the drive pins at top of the gearhead, the driveshaft is properly concentric. Eccentricity at this point may be due to a bent shaft or to foreign particles between butting ends or shaft sections. If there is eccentricity, the cause must be found and corrected before proceeding.
6. Slip on drive coupling. Apply a thin film of oil on gib key (730A) and install key. Key shall be a slide fit allowing adjustment of the driveshaft by means of the adjusting nut. Secure drive coupling, ensure that the drive coupling is properly seated. Lubricate bottom of adjusting nut (604) and install.

NOTICE:

Check the rotation of the power unit and pump in relation to that of the drive as shown by arrows on the case. rotate the drive manually before applying power. do not operate in the reverse direction of these arrows.

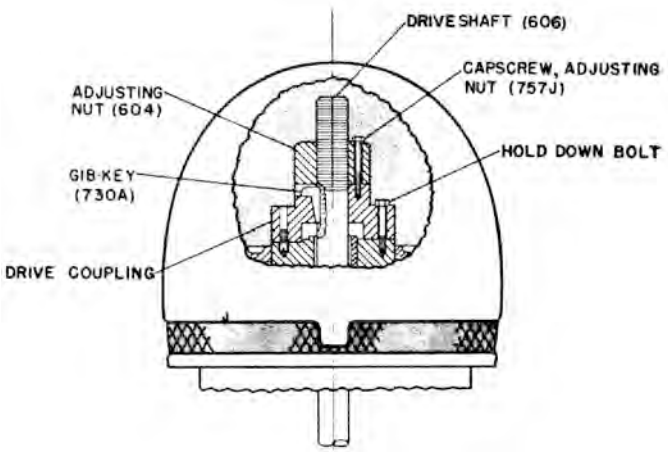


Figure 10: Hollow shaft adjusting nut

7. On gearheads having non-reverse ratchet or pins, manually turn the gearhead shaft clockwise (viewed from above) until the non-reverse ratchet or pins fully engage.
8. Some gearheads are equipped with an oil cooling system which is supplied with cooling fluid from the pump or from an external source. Make cooling connections with tubing or rubber hose. If pump fluid is to be used, connect a length of tubing and a flow regulating valve between the inlet on the gearhead and a pipe tap hole in the discharge head. Attach another tube or a rubber hose to the outlet on the gearhead. This may be used to conduct the fluid hack to the pump or to any convenient drain.

CAUTION:
Do not use rigid pipe for this purpose. rigid pipe is susceptible to leaking at the joints, due to vibration.

9. Fill the gearhead oil reservoir with a high grade of turbine oil. If oil is not furnished with the gearhead, select a suitable grade from the list in 17.1 Recommended lubricants on page 55. Consult the manufacturer's instructions for frequency of oil change and other data on maintenance.

CAUTION:
Do not use automotive oils.

WARNING:
Moving parts of the prime mover, coupling device, and gearhead must be covered with a suitable rigid guard in compliance with local regulations to prevent injury to personnel

10. Assemble the flexible shaft flanges on gearhead driver and engine. The prime mover (engine or steam turbine) must be mounted on a firm foundation in alignment with the gearhead. The driving and driver shafts shall be within plus or minus one degree, parallel. Offset angle shall be one to five degrees for maximum coupling life. Keep the lugs on flange yokes in the same position as shipped from the factory. If slip joint is moved, be sure lugs are realigned or severe unbalance may result. Consult the applicable manufacturer's instruction manual for detailed information for the prime mover (engine or steam turbine) and coupling or driveshaft.
11. Gearhead shaft end-play adjustment. Gearhead shaft end-play shall be checked with a dial indicator prior to connecting pump coupling to hollow shaft motor. Consult the applicable gear manufacturer's instruction manual for detailed information on gearhead shaft end-play.

11.5 High profile discharge head

(See Figure 6: High profile head on page 21) The high profile head may be used in conjunction with a hollow shaft driver, coupling, stuffing box, mechanical seal, or primacyclamatic tank. Primacylamatic tank supplies temporary lubrication to mechanical seal or stuffing box during priming and stripping operations.

11.6 Separate headshaft and driveshaft

When a pump is furnished with a separate headshaft and driveshaft, a flanged rigid coupling is utilized for ease of disassembly. Proceed as follows:

1. Same as Steps 1 and 2, 11.4 Combination driveshaft on page 26.
2. Slowly lower the gearhead onto the driver mounting flange, orient the gearhead with the input shaft in the required position and align the mounting holes with the mating tapped holes in the discharge head. Continue to lower the gear head until the registers engage and the gearhead is set firmly on the discharge head, and secure with capscrews provided.
3. Slide the driveshaft downward through hollow shaft of gearhead.
4. Disassemble the coupling (if assembled) and slide driver hub (610) onto the driveshaft with key (730B) in place. Thread ring (607) onto the driveshaft and slide driver hub over ring.

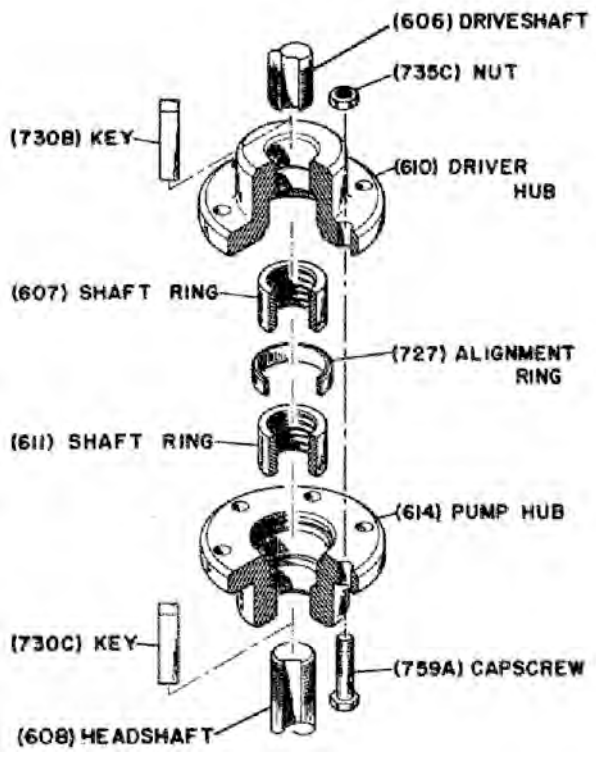


Figure 11: Rigid coupling

5. Thread ring (611) on!o the headshaft (608). Install alignment ring (727) on pump hub (614) groove, slide pump hub over ring and key (730C).
6. Secure driver hub (610) and pump hub (614) together with capscrews and nuts provided.
7. Same as Steps 5 and 6 11.4 Combination driveshaft on page 26.

11.7 Impeller adjustment

(See Figure 10: Hollow shaft adjusting nut on page 27) Adjustment is accomplished by turning adjusting nut (604).

1. For open impellers:
   a) Mechanical seal if provided, must be disengaged prior to impeller adjustment. Shaft must move freely up or down within the seal assembly.
   b) With impellers touching bowl faces, turn adjusting nut (604) counterclockwise until face of adjusting nut makes contact with motor coupling.
   c) Align hole "A" in adjusting nut and hole "C" in motor coupling.

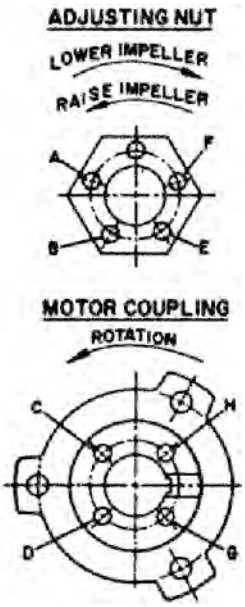


Figure 12: Impeller adjustment

d) Turn adjusting nut counter-clockwise until holes "B" and "D" line up. This gives minimum adjustment 1/20 of one turn of 0.004 inch vertical adjustment, on shafts with 10 threads per inch.

e) Continue to turn adjusting nut (604) and align holes. "E" and "G" impellers are raised 2/20 turn or 0.008 inch. Where holes "F" and "H" align, adjustment is 3/20 turn or 0.012 and so on.

f) For pumps up to 10 feet of column, tum adjusting nut to obtain clearance of 0.015 inch. Add 0.004 inch for each additional 10 feet of column. If pump performance is not satisfactory with the specified clearance, lower impellers as required, but do not allow impellers to drag.

2. For enclosed impellers:

a) For enclosed in impellers obtain 3/ 16 inch clearance.

b) After impeller adjustment (open or enclosed) insert capscrew in corresponding hole in adjusting nut. thread into coupling and tighten securely.

c) Reset seal after impeller adjustment.

11.8 Installation of hollow shaft electric motor

Installation procedures for hollow shaft drivers and gearheads are similar and as follows:

1. Remove motor cover and drive coupling.
2. Attach a sling to lifting lugs on motor. Hoist motor, inspect the mounting surfaces, register, and clean these surfaces thoroughly. If any burrs
are found, remove burrs with a smooth mill file.
3. Slowly lower the motor, aligning hollow shaft with the driveshaft, being careful that the motor does not bump or scrape the driveshaft as it enters and passes through the hole.
4. Orient the motor conduit box in the required position and align the mounting holes with the mating tapped holes in the high or low profile discharge head. Continue to lower the motor until the registers engage and the motor is set firmly on the discharge head, and secure the motor with capscrews provided.
5. Check that driveshaft is concentric with the hollow shaft of motor by sliding the motor coupling over the driveshaft. If the coupling freely engages the drive pins at top of the motor, the driveshaft is properly concentric. Eccentricity at this point may be due to a bent shaft or to foreign particles between butting ends of shaft sections. If there is eccentrically, the cause must be found and corrected before proceeding. Remove driver coupling.

6. On motors having non-reverse ratchet or pins, manually tum the driver shaft clockwise (viewed from above) until the non-reverse ratchet or pins fully engage.
7. Lubricate the motor bearings in accordance with the instructions given on the lubrication plate attached to the motor case.

WARNING:
The motor must not be tested for direction of rotation when coupled to the pump. If pump should rotate in the wrong direction, serious damage to the pump and driver and serious injury to nearby personnel could result.

8. Make temporary electrical connections according to tagged leads or diagram attached to the motor. The motor must rotate counter-clockwise when viewed from above. See arrow on pump nameplate. If motor does not rotate counterclockwise, change motor rotation by interchanging any two leads (for three phase only). For single phase., see motor manufacturer's instructions.
9. Slip on driver coupling. (See Figure 10: Hollow shaft adjusting nut on page 27). Apply a thin film of oil on gib key (730A) and install key. Key shall be a slide fit allowing adjustment of the driveshaft by means of the adjustment nut. Secure drive coupling, see that the drive coupling is properly seated. Lubricate bottom of adjusting nut (604) and install.
10. Motor shaft end-play adjustment. Motor shaft end-play shall be checked with a dial indicator prior to connecting pump coupling to hollow shalt motor. Consult the applicable motor manufacturer's instruction manual for detailed information on motor shaft end-play.

11.9 Separate headshaft and driveshaft

Follow procedural steps in 11.6 Separate headshaft and driveshaft on page 28.

11.10 Impeller adjustment - open or enclosed

Adjustment is accomplished by turning adjusting nut (601). (See Figure 10: Hollow shaft adjusting nut on page 27)

1. Same as steps 12.3 Impeller adjustment on page 34.

12 Installing the Driver (VSS)

12.1 Installation of solid shaft right angle gear drive

WARNING:
Do not work under a heavy suspended object unless there is a positive support under it, which will protect personnel should a hoist or sling fail.

12.2 High profile head

(See Figure 6: High profile head on page 21) The high profile head may be used in conjunct:ion with a solid shaft driver, adjustable or spacer coupling, stuffing box, mechanical seal, or a primacylamatic tank. Primacyclamatic tank supplies temporary lubrication to mechanical seal or stuffing box during priming and stripping operations. The spacer coupling is used on pumps having a mechanical seal to permit repairing or replacing the seal without lifting the gearhead. The coupling between the driveshaft and pumpshaft may be a non-spacer, or a spacer type, . Install the right angle gear driver as follows:

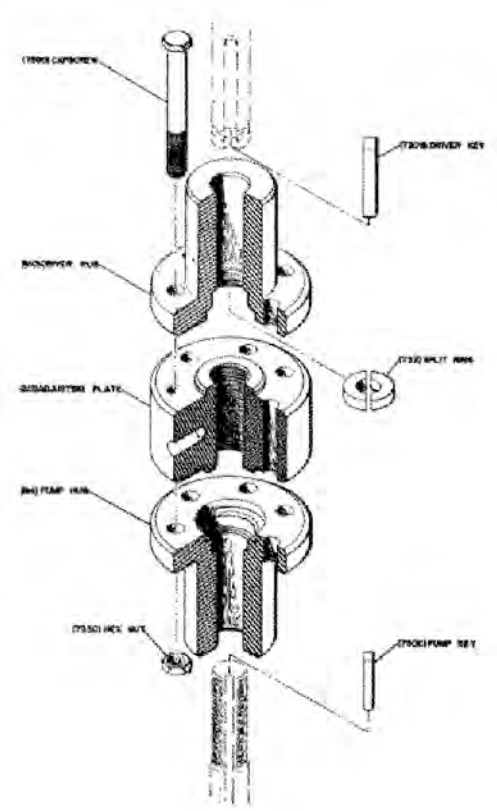


Figure 13: Flanged adjustable coupling

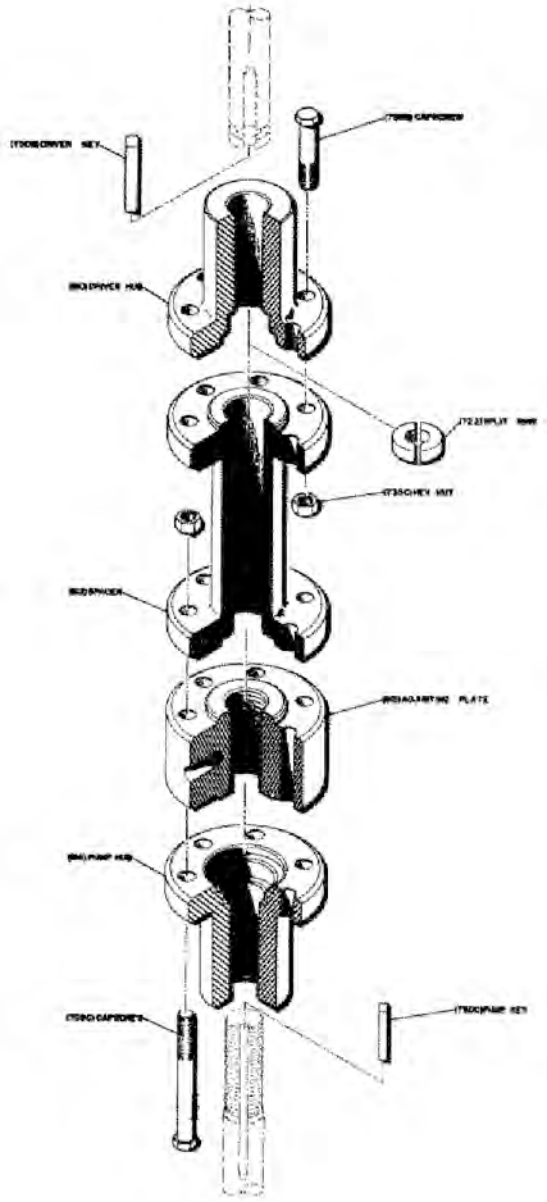


Figure 14: Flanged adjustable coupling with spacer

1. Attach a sling to eyebolts of gearhead. Hoist gearhead, inspect the mounting surface, register, and shaft extension, and dean these surfaces thoroughly. If any burrs are found; remove burrs. with smooth mill file, cleaning thoroughly afterward.
2. Orient the gearhead with the input shaft in the required position and align the mounting holes with the mating tapped holes in the discharge head. Lower the gearhead until the registers engage and gearhead is set firmly on the discharge head and secure gearhead with capscrews provided.
3. On gearheads having non-reverse ratchet or pins, manually tum the gearhead shaft clockwise (viewed from above) until the non-reverse ratchet or pins fully engage.

NOTICE:

Check the rotation or the power unit and pump in relation to that of the drive as shown by arrows on the case. Rotate the drive manually before applying power. Do not operate in the reverse direction of these arrows.

4. Some gearheads are equipped with an oil cooling system which is supplied with cooling fluid from the pump or from an external source. Make cooling connections with tubing or rubber hose. If pump fluid is to be used, connect a length of tubing and a flow-refulating valve between the inlet on the gearhead and a pipe tap hole in the discharge gearhead. This may be used to conduct the fluid back to the sump or to any convenient drain.

CAUTION:
Do not use rigid pipe for this purpose. Rigid pipe is susceptible to leaking at the joints, due to vibration.

5. Fill the gearhead oil reservoir with a high grade of turbine oil. If oil is not furnished with the gearhead, select a suitable grade from the list in 17.1 Recommended lubricants on page 55. Consult the manufacturer's instructions for the frequency of oil change and other data on maintenance.

CAUTION:
Do not use automotive oils.

WARNING:
Moving parts of the prime mover, coupling device, and gearhead must be covered with a suitable rigid guard in compliance with local regulations to prevent injury to personnel.

6. Apply a thin film of oil on headshaft key (730C) and insert key into headshaft keyseat.
7. Gently lower pump hub (614) over headshaft.
8. Thread adjusting plate (613) flush with top of headshaft.
9. Apply a thin film of oil to key (730B) and insert it into the driver shaft keyseat. Place the driver hub (610) over the driveshaft and key sliding it up the shaft until the groove near the end of shaft is exposed. Install split ring (722) in the groove and slide the driver hub down over the split ring to capture it.
10. Install spacer (612) and secure to driver hub (610) with capscrews (759B) and nuts (735C).
11. Assemble the flexible shaft flanges on gearhead drive and engine. The prime mover (engine or steam turbine), must be mounted on a firm foundation in alignment with the gearhead. The driving and driven shafts shall be within plus or minus one degree parallel. Offset angle shall be one to five degrees for maximum coupling life. Keep the lugs on flange yokes in the same position as shipped from the factory. If slip joint is moved, be sure lugs are realigned or severe unbalance may result. Consult the applicable manufacturer's instruction manual for detailed information for the prime mover (engine or steam turbine), and coupling, driveshaft, or hydraulic drive.
12. Gearhead shaft end·play adjustment. Gearhead shaft end play shall be checked with a dial indicator prior to connecting pump coupling to solid shaft gear. Consult the applicable gear manufacturer's instruction manual for detailed information on gearhead shalt end-play.
13. Install spacer (612) and secure to driver hub (6!0) with capscrews (759B) and nuts (735C).

12.3 Impeller adjustment

(See Figure 13: Flanged adjustable coupling on page 33 or Figure 14: Flanged adjustable coupling with spacer on page 33.) Adjustment is accomplished by turning adjusting plate (613).

1. Open impellers:

a) Mechanical seal i£ provided, must be disengaged prior to impeller adjustment (open or enclosed impellers). Shaft must move freely up or down within the seal assembly.

b) 2. With the impellers at the bottom turn adjusting plate (613) towards driver hub (610) or spacer (612). Obtain 0.015 inch clearance between adjusting plate and driver hub or spacer for the first 10 feet of column. Add 0.010 for each additional 10 feet of column.

2. Enclosed impellers:
3. For enclosed impellers obtain 3/16 inch clearance.
4. After impeller adjustment (open or en· dosed), align adjusting plate (613) holes with pump hub (614) holes, insert capscrews (759D) or (759C) and draw pump hub to mate with driver hub. Tighten capscrews gradually and uniformly.
5. Reset seal after impeller adjustment.

12.4 Installation of solid shaft electric motor

Installation procedures for solid shaft drivers and gearheads are similar and as follows:

1. The coupling between the driveshaft and pumpshaft may be a non-spacer, see Figure 13: Flanged adjustable coupling on page 33, or a spacer type, see Figure 14: Flanged adjustable coupling with spacer on page 33.
2. Attach a sling to the lifting lugs of motor. Hoist motor, inspect the mounting surface, register, and shaft extension, and clean these surfaces thoroughly. If any burrs are found, remove burrs with a smooth mill file, deaning thoroughly afterward.

NOTICE:
When pump is provided with a thrust pot, do not secure driver to discharge head until after thrust pot and flexible coupling are installed, refer to 12.6 Thrust pot installation on page 36.

3. Orient the motor conduit box in the required position and align the mounting holes with the mating tapped holes in the discharge head. Lower the motor until the registers engage and motor rests firmly on the discharge head. Secure motor with capscrews provided.
4. On motors having a non-reverse ratchet or pins, manually turn the motor shaft clockwise (viewed from above) until the non-reverse ratchet or pins fully engage.
5. Lubricate motor bearings in accordance with instructions given on the lubrication plate attached to the motor case.

WARNING:
The motor must not be tested for direction of rotation when coupled to the pump. If pump should rotate in the wrong direction, serious damage to the pump and driver and serious injury to nearby personnel could result.

6. Make temporary electrical connections according to tagged leads or diagram attached to the motor. Motor must rotate counterclockwise when viewed from above. See arrow on pump nameplate, If driver does not rotate counterclockwise, change motor rotation by interchanging any two leads (for three phase only). For single phase, see motor manufacturer's instructions.
7. Motor shaft end-play adjustment: Motor shaft end-play shall be checked with a dial indicator prior to connecting pump coupling to solid shalt motor. Consult the applicable motor manufacturer's instruction manual for detailed information on motor shaft end-play.
8. Apply a thin film of oil on headshaft key (730C) and insert key into headshaft keyseat.
9. Gently lower pump hub (614) over headshaft.
10. Thread adjusting plate (613) flush with top of headshaft.
11. Apply a thin film of oil to key (730B) and insert it into the driveshaft keyseat. Place the driver hub (610) over the driveshaft and key, sliding it up the shaft until annular groove on shaft is exposed. Install split ring (722) in the groove and slide driver hub down over the split ring to capture it.
12. Install spacer (612) and secure to driver hub (610) with capscrews (759B) and nuts (735C).

12.5 Impeller adjustment - open or enclosed

(See Figure 13: Flanged adjustable coupling on page 33 or Figure 14: Flanged adjustable coupling with spacer on page 33. Adjustment is accomplished by turning adjusting plate (613).

1. Same as steps in 12.3 Impeller adjustment on page 34.

12.6 Thrust pot installation

Some pumps are equipped with a thrust pot, usually used in conjunction with a solid shaft driver and a flexible coupling. Pumps furnished with a mechanical seal are provided with a spacer coupling located between the mechanical seal and thrust pot. Refer to12.4 Installation of solid shaft electric motor on page 35, Steps 8. through 12. for spacer coupling installation prior to installing thrust pot. When a stuffing box is provided, refer to 9.1 Stuffing box installation on page 23 for installation prior to installing the thrust pot. Refer to 10.1 Mechanical seal installation on page 25 for mechanical seal installation. If a thrust pot is shipped assembled, but not installed on the pump, the thrust pot shall be disassembled prior to installation. Proceed as follows:

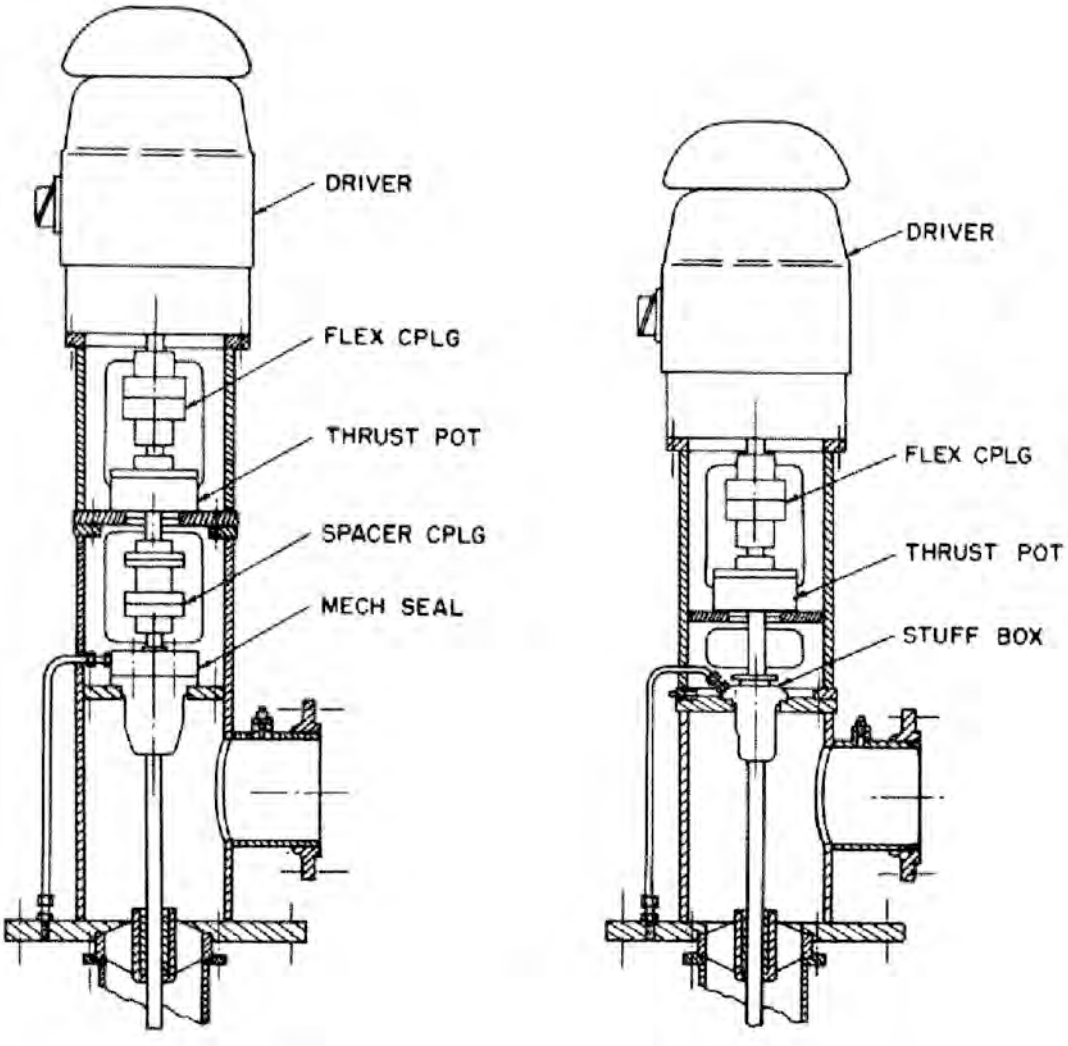


Figure 15: Thrust pot installation

Install housing on center plate of driver support (see Figure 16: Thrust pot bearing arrangement on page 37 dotted lines) and secure with capscrews (760Q).

1. Remove capscrew (757Q).

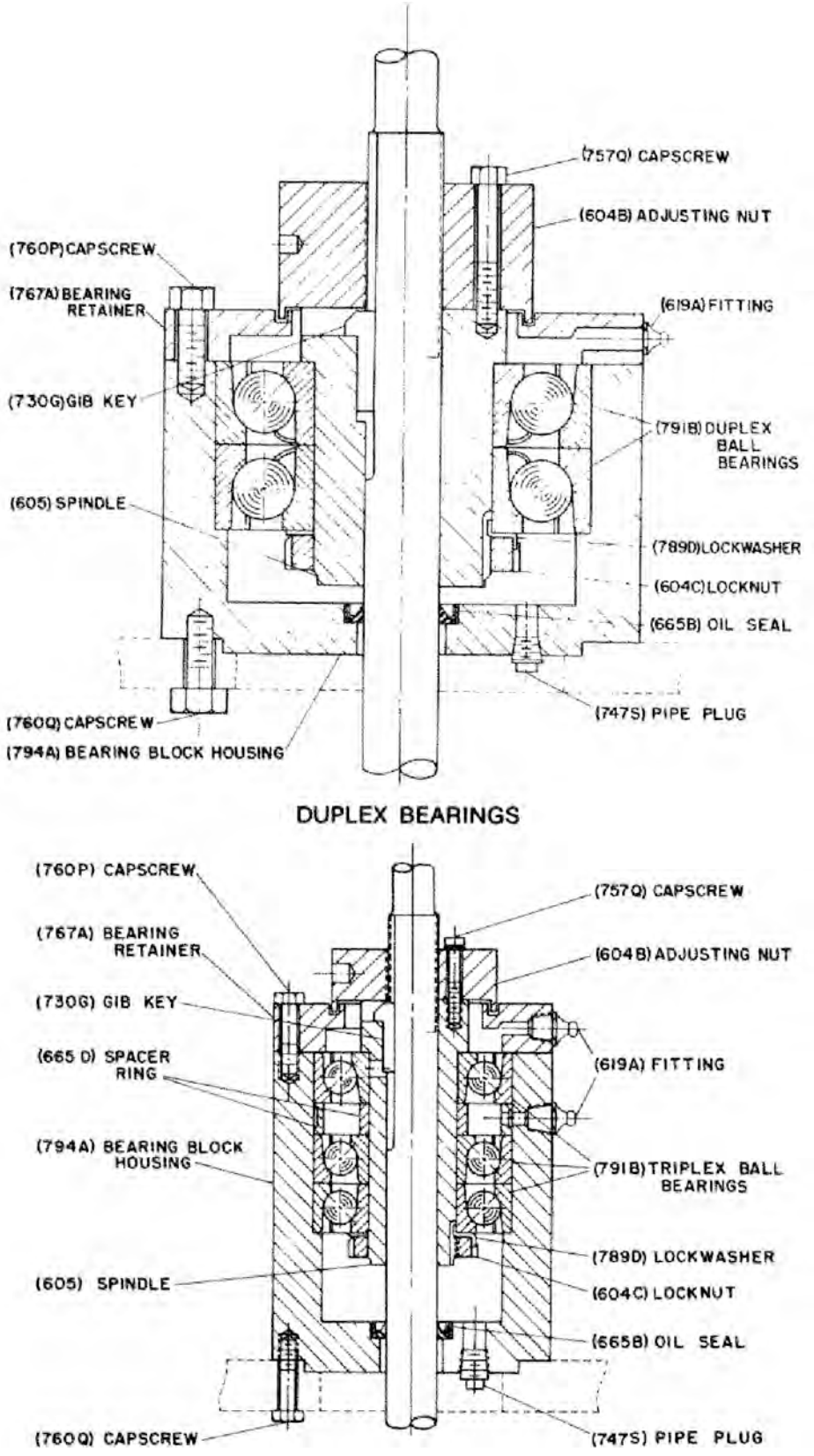


Figure 16: Thrust pot bearing arrangement

2. Unscrew adjusting nut (604B) and remove from shaft.
3. Remove capscrews (760P). See Figure 16: Thrust pot bearing arrangement on page 37.
4. Carefully remove spindle (605) with lockwasher (789D), locknut (604C), spacer rings (665D), (triplex bearings only) and bearings (791B) as a unit from block housing (794A). Do not disassemble. Bearing assemble may be mounted in a duplex or triplex arrangement.
5. Carefully slide block housing (794A). Do not disassemble. Bearing assembly may be mounted in a duplex or triplex arrangement.
6. Carefully slide bearing and spindle (duplex or triplex) assembly over the shaft and into block housing until it bottoms on shoulder of housing. Check that bearings rotate freely. If bearings do not rotate freely, the cause must be found and corrected.

   If driver support is not installed on the discharge head, see 11.3 Driver support on page 26.
7. Insert key (7 0G) into keyway and slide key into spindle (605).
8. Install bearing retainer (767A) on housing and secure with capscrews (760P).
9. Thread adjusting nut (604B) onto shaft until it makes contact with the spindle. Thread capscrew (757Q) into spindle but do not tighten, this is accomplished when impellers are adjusted.
10. Thrust pot lubrication: The recommended type of grease is a Grade 2 lithium or a non-soap type base grease having a viscosity of approximately 400 to 600 SSU at 100ºF such as Chevron SRI or equal.
11. Duplex bearings: Remove plug (747S). (See Figure 16: Thrust pot bearing arrangement on page 37.) Inject grease through fitting (619A), refer to Table 3: Thrust pot lubrication on page 42, for quantity of grease. Quantity of grease depends on the pump speed, starting with the small bearing sizes, down to the larger bearing sizes. Frequency of re-lubrication shown in (hours) is according to bearing size. Example: pump speed 1200 RPM, read down to 2900 (HRS), read across to quantity 5.0 oz. duplex or 4.4 oz, triplex, After pump startup, Pump Startup and Operation, run pump approximately five minutes to relieve
    bearings of excess grease. Replace plug (747S).
12. Triplex bearing: Lubrication is the same asfor duplex bearings except; inject grease through bottom fitting (619A) two-thirds of the amount shown in Table 3: Thrust pot lubrication on page 42. Inject the remaining amount of grease through the top fitting to lubricate the top bearing. Complete lubrication by following Step 10..
13. Flexible coupling: Flexible couplings may be furnished in a variety of types and sizes depending on design requirements. Instructions for installing flexible couplings are provided by the coupling manufacturer. Alignment of the coupling is extremely important for trouble·free operation. The following general instructions may be applied for most common coupling installations.

    a) Install driver key and half-coupling on driver shaft. Install pump key and half-coupling on pump shaft. Secure half-coupling to prevent them from slipping on the shafts. Lower driver and secure to driver support with capscrews provided.

    b) Check alignment by placing a straight edge vertically across coupling hubs at four points 90" apart. When the straight edge rests evenly at all four points, coupling is aligned. Tighten coupling to shalt with setscrews or capscrews provided.
14. Impeller adjustment- open or enclosed: When a thrust pot is provided, impeller adjustment is identical to impeller adjustment in Installing the Driver (VHS), Steps 1 through 4, except that the adjusting nut (604B) is located on the thrust pot, instead of on top of the driver.

13 Pump Startup and Operation

13.1 Pre-start procedure

Consult the applicable manufacturer's instructions for detailed information for the prime mover (engine or steam turbine, coupling, driveshaft, electric driver, gearhead and mechanical seal. When applicable to the pump and prior to startup, check the fol lowing:

1. Make sure mechanical seal is properly lubricated and all piping to seal is connected.
2. Check alignment between pump and driver.
3. Wiring of driver.
4. Driver must rotate counterclockwise when viewed from above.
5. All connections to driver and starting: device with wiring diagram.
6. Voltage, phase, and frequency on motor nameplate with line circuit.
7. Impeller adjustment.
8. Rotating element turns manually.
9. Driver bearings properly lubricated and oil in the in housing.
10. Liquid level in barrel must be up to the suction pipe.
11. Discharge piping and pressure gages for proper operation.
12. Check that thrust pot is lubricated.

13.2 Priming

The first must always be completely submerged. Pump must not run dry, the rotating pans within the pump may gall and seize to the stationary pans. The parts must be lubricated by the liquid being pumped.

13.3 Pump startup

Start the pump. If pump is engine driven, bring it up to speed gradually.

13.4 Stuffing box

With the pump in operation, there shall be some leakage at the stuffing box packing. The correct leakage is a rate which keeps the shaft and stuffing box cool (approximately one drop per second). Check the temperature of the leakage as well as discharge head. If the pump runs hot leakage begins to choke off, stop the pump and allow it to cool down. A few light taps with a hammer on the gland will upset the packing sufficiently, to resume leakage. After pump has cooled, restart
pump and follow the preceding procedure. Run pump 15 minutes, check leakage, if exceeds two drops per second, adjust packing as described in 14.2 Packing adjustment and replacement on page 41.

13.5 Mechanical seal

If seal leaks slightly at startup, allow a reasonable amount of time for seal to adjust itself. Liquids with good lubricating qualities normally take longer to wear in the seal than liquid with lesser quality. When a seal starts out with a slight leak and gets progressively less with running, it is indicative of leakage across the seal faces and that continued running will eliminate leakage. Where leakage occurs immediately and remains constant, unaffected by running, it usually indicates secondary seal (shaft packing) damage, or seal faces are warped out of flat. Refer to Troubleshooting for probable cause.

13.6 Autoprime functional description

When the model VMP Autoprime pump breaks suction in the priming stage or during stripping, the main discharge check valve closes against shore pressure, allowing the Autoprime valve to open and drain part of the contents of the discharge head and column into the pump barrel, at the same time allowing a corresponding volume of air and vapor to pass from the barrel into the discharge head and column through the venting system. When sufficient drain back is achieved to raise fluid level in the barrel to meet the eye of the stripper stage impeller, suction is again established. Pressure built up by the pump will close the Autoprime valve, and trapped air and vapor is expelled through the pump discharge. This cycle will automatically repeat itself as often as necessary to reestablish prime.

The reprime feature of the Goulds Model VMP Autoprime allows one pump to discharge cargo from more than one tank of a vessel by use of a common suction header manifolded to the various compartments or tanks and leading to the pump suction barrel. These suction manifolds are under valve control from the main deck and should be equipped with suction bells or "stroms" of quite a large lip periphery to allow for or a minimum required distance up from the bottom of the lank. This allows the tanks to be pumped out without use of a sump, a feature impossible to obtain with a single skin vessel. The physical size of these main suction stroms. Is such as to prevent their installation very close to the partitions or bulk-heads, making it impossible, as a rule, to remove all product from a tank without the use of secondary or "stripper" lines. The stripper line is a small bypass line around the main suction drop, approximately 3 inches, equipped with its own smaller strom and also under control of a valve from the main deck. This stripper line with strom can be installed in a very small area, and can pick up most product usually un-available to the main suction drop.

13.7 Stripping operation - engine driven pumps

1. Prior to starting the Autoprime, flood the barrel by opening the main suction valve to the manifold and also one or more of the individual suction valves to the tanks.
2. Start the pump slowly by reducing the engine RPM to a minimum before engaging the clutch, and accelerate gradually.
3. When pumping similar cargo from a vessel, pump the tank furthest from the pump first. Just before vortex occurs at the main suction bell,
   open the bypass stripper line, close the main suction drop, and open the main suction of the next full tank.
4. Pump off the next tank, first tank can be stripped clean before reaching the vortex point of the second tank, repeat this operation until the last tank is reached. By following this operation no stripping time is lost, except when the last tank of the series is stripped, then the Autoprime takes over.
5. In stripping the last tank, slow the engine RPM to minimum speed to provide better NPSH characteristics and gradually close the suction drop valve when vortex occurs at the suction bell. Final stripping can be done through the small stripper line mentioned previously.

13.8 Stripping operation-electric motor driven pumps

1. Same as Step 1, 13.7 Stripping operation - engine driven pumps on page 40.
2. Operation of an electric motor driven pump is the same as for variable speed drivers except, more suction valve throttling is required.

14 Maintenance

14.1 Preventive maintenance

Preventative maintenance includes periodic inspection, adjustments, lubrication and tightening procedures in Table 2: Preventive maintenance procedures on page 41. Systematic inspection of the pump shall be made at regular intervals. The frequency required depends upon the operating conditions of the pump and its environment. See 17.1 Recommended lubricants on page 55 for list of recommended lubricants. Consult the applicable manufacturer's instructions for detailed information on maintenance for the prime mover (engine or steam turbine), coupling, driveshaft, electric motor and gearhead.

14.2 Packing adjustment and replacement

Pumps equipped with adjustable packing at top of shaft, shall be adjusted whenever the leakage rate exceeds two drops per second. Adjust the stuffing box as follows:

1. With the pump in operation, tighten the gland nuts one-quarter turn for each adjustment. Allow packing to equalize against the increased pressure and leakage to gradually decrease lo a steady rate, before making another adjustment.

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

2. With the pump shutdown and when packing has been compressed to the point that the gland is about to contact the upper face of stuffing box, remove the split gland, add one extra packing ring, and readjust. If this fails to reduce leakage to one drop per second, remove all packing rings and replace with new rings.
3. Remove the packing with the aid of a packing hook. If a lantern ring is provided, remove it by inserting a wire hook in the slots of the ring and pulling it from the packing box. Thoroughly clean the stuffing box of all foreign matter.
4. If the replacement packing is in the form of a continuous coil or rope, it must be cut into rings before installing. Tightly wrap one end of the packing material around the top shaft like one coil of a coil spring, and cut through the coil with a sharp knife. For repacking sequence, refer to 9.1 Stuffing box installation on page 23.

14.3 Thrust pot lubrication procedure

General lubrication procedures to be performed at intervals (hours) shown in Table 3: Thrust pot lubrication on page 42. The recommended type of grease is a Grade 2
lithium or a non-soap type base grease having a viscosity of approximately 400 to 600 SSU at 100°F, such as Chevron SRI or equal. Refer to 12.6 Thrust pot installation on page 36, Step 10.

Table 2: Preventive maintenance procedures

Procedure	Time interval (operating hours)
Clean dirt, oil, and grease from the driver and discharge head. Clean driver ventilation passages to prevent overheating.	As required. As required.
Change lubricant in gearhead.	2,000 or once a year
Lubricate driveshaft. See manufacturer's instructions for correct lubricant.	200 continuous service or 500 normal service.
Tighten all loose bolts and check for excessive vibration.	As required.

Procedure	Time interval (operating hours)
If packing is supplied with grease, add through fitting on side of stuffing box.	100
Check that there is some leakage through stuffing box while pump is in operation. Do not tighten gland nuts unless necessary, refer to 14.2 Packing adjustment and replacement on page 41 for lightening requirements.	As required.
Maintain a liquid film of lubrication between the seal rubbing faces.	As required.
Regrease motor bearings: • Above 1800 RPM • Below 1800 RPM	1000 2000
Regrease thrust pot	Refer to Table 3: Thrust pot lubrication on page 42

Table 3: Thrust pot lubrication

Bearing arrangement	1800 RPM	1500 RPM	1200 RPM	1000 RPM	900 RPM	750 RPM	Quantity (oz.)
Duplex	2000 (hrs)						1.2
Triplex							3.2
Duplex		2600 (hrs)					2.1
Triplex							3.2
Duplex			2900 (hrs)				3.0
Triplex							4.4
Duplex				2967 (hrs)			4.1
Triplex							6.5
Duplex					3467 (hrs)		4.5
Triplex							6.5
Duplex						3733 (hrs)	5.8
Triplex							8.8

15 Troubleshooting

15.1 Corrective maintenance

Corrective maintenance procedures include troubleshooting for isolating and remedying malfunctions of the pump and its components during operation.

Table 4: Troubleshooting

Trouble	Probable cause	Remedy
1. Pump does not start.	A. Electrical circuit open or not completed.	Check circuit and correct.
	B. Steam turbine not receiving steam pressure.	Make sure that turbine receives full steam pressure.
	C. Impellers binding against bowl.	Reset impeller adjustment Refer to 12.3 Impeller adjustment on page 34.
	D. Low voltage supplied to electric driver.	Check whether driver wiring is correct and receives full voltage.
	E. Defective motor.	Consult factory.
2. No liquid delivered.	A. Insufficient fluid in barrel.	Check for obstruction In piping.
	B. Obstruction in liquid pas sages.	Pull pump, inspect impeller and bowl.
3. Not enough liquid delivered.	A. Speed to low.	Check if driver is directly across the line and receiving voltage.
	B. Wrong rotation.	Check for CCW rotation when viewed from above.
	C. Total pump head too high.	Check engagement of motor coupling.
	D. Partial obstruction in liquid passages.	Check pipe friction losses. Larger piping may correct condition.
	E. Cavitation	Refer to Trouble 2-B.
	F. Impellers adjusted, too high if semi-open construction.	Insufficient NPSH available. Refer to Sections Installing the Driver (VHS) and Installing the Driver (VSS)
4. Not enough pressure.	A. Speed too low.	Refer to Trouble 1-B.
	B. Obstruction in liquid pas sages.	Pull pump and inspect impeller and bowl passages.
	C. Wrong rotation.	Refer to Trouble 3-B.
	D. Same as F In Step 3	Refer to Trouble 3-F.
5.Pump works for a while and quits.	A. Excessive horsepower required.	Use larger driver, consult factory.
	B. Pumping higher viscosity or specific gravity liquid than designed for.	Test liquid for viscosity and specific gravity.
	C. Mechanical failure of critical parts.	Check bearings and Impellers for damage. Any irregularities in these parts will cause a drag on the shaft.
	D. Speed may be too high.	Check voltage on motor.
	E. Misalignment.	Realign pump and driver.
6. Pump takes too much power.	Damaged impeller.	Inspect, replace if damaged.
	Foreign object lodged be tween impeller and bowl.	Remove object as required.
	Specific gravity higher than pump designed for.	Test liquid for viscosity and specific gravity.

Trouble	Probable cause	Remedy
6. Pump takes too much power.	Viscosity too high, partial freezing of pumpage.	Check, both can cause high drag on impeller.
	Defective bearing.	Replace bearing, check shaft or shaft sleeve for scoring.
	Packing too tight.	Release gland pressure. Re-tighten, refer to 14.2 Packing adjustment and replacement on page 41. Keep leakage flowing. If no leakage check packing, sleeve or shaft.
7. Excessive vibrations.	Coupling misalignment, bent shaft, impeller unbalance, worn bearings, cavitation, piping strain, and/ or resonance.	Determine cause utilizing vibration frequency analyzer and/or pump disassembly. Complex problem may require factory service assistance.
	Motor gear drive shaft end play maladjustment.	Refer to Section Installing the Driver (VHS) and Section Installing the Driver (VSS).
8. Pump leaks excessively at stuffing box.	A. Defective packing.	Replace worn packing. Replace packing damaged by lack of lubrication.
	B. Wrong type of packing.	Replace packing not properly installed or run-in. Replace improper packing with correct grade for liquid being pumped.
9. Stuffing box over- heating.	Packing too tight	Release gland pressure.
	Packing not lubricated.	Release gland pressure and replace all packing if burnt or damaged.
	Wrong grade of packing.	Consult factory.
	Stuffing box improperly packed.	Repack.
10. Packing wears too fast	Shaft or shaft sleeve worn or scored.	Pull pump and re-machine, or replace shaft and/or sleeve.
	Insufficient or no lubrication.	Repack and make sure packing is loose enough to allow some leakage.
	Improperly packed.	Repack properly, make sure all old packing is removed and stuffing box is clean.
	Wrong grade of packing.	Consult factory.
11. Mechanical seal leaks steadily.	Faces are not flat.	Gland bolts possibly too tight, causing warpage of gland and insert, remove, check and re-install.
	Shaft packing nicked or chipped during installation.	Replace packing.
	Carbon insert cracked or face of Insert or seal ring chipped during installation.	Remove, inspect and replace as required.
	Seal faces scored from foreign particles between faces.	Install strainer, filter, or cyclone separator as required to filter out foreign particles.
12. Seal squeals during operation.	Inadequate amount of liquid at sealing faces.	Bypass flush line may be necessary. If one is in use it may need to be enlarged to produce more flow.
13. Carbon dust accumulating on outside of gland ring.	Inadequate amount of liquid at sealing faces.	Consult factory.
	Liquid film flashing and evaporating between seal faces and leaving residue which is grinding away the carbon.	Consult factory.
14. Seal leaks, nothing appears to be wrong.	Faces are not flat.	Seal faces should be replaced or re-lapped. Also see Trouble 11-A.

Trouble	Probable cause	Remedy
15. Short seal life.	A. Product is abrasive, causing excessive seal face wear.	Determine source of abrasives and install bypass flushing if required to prevent abrasives from settling out or accumulating in the seal area. Install cyclone separator as required.
	B. When abrasives are forming due to the process liquid cooling and crystallizing or partially solidifying in the seal area.	Install bypass flush line to hold liquid temperature around the seal above crystallization point.
	C. Seal is running too hot.	Check for possible rubbing of some seal component along the shaft. Recirculation or bypass line may be necessary.
	D. Improper choice of seal.	Consult factory.

16 Pump Disassembly

16.1 Pump disassembly

Clear a large area adjacent to the pump as a storage for pump parts as they are disassembled. If the pump has a long column arrange parallel timbers on the ground to support the pump column and shaft sections horizontally. After disassembly for repair or replacement of pump components, reassembly in all cases is the reverse order of disassembly.

WARNING:
Do not attempt to lift the entire pump by the lifting lugs of the driver. These lugs and bolts cannot support the weight of the entire pump.

In the following pump disassembly procedures, references are made to assembly sections of this manual. These sections will aid in the disassembly of the pump (reverse the assembly procedure). Consult. the applicable manufacturer's instructions for detailed information for the prime mover coupling, driveshaft, gearhead, and motor.

1. For a pump which is driven through a gearhead, remove coupling or driveshaft between the gearhead and prime motor. For a pump equipped with an electric motor drive, remove the electrical connection at the conduit box and tag electrical leads at the motor.

WARNING:
Before opening the conduit box of an electrical motor, be sure that the current to the motor is shut off. Severe injury to personnel could result if contact with live motor leads is made.

NOTICE:
Match mark parts in sequence of disassembly to aid in the reassembly procedure.

2. Disconnect discharge and lubrication piping, Remove all external piping, and related hardware attached to the pump.
3. Hollow shaft drivers: Remove cover from top of motor or gearhead and remove adjusting nut capscrew (757J) and adjusting nut (604) from driveshaft, Remove drive coupling. (See Figure 10: Hollow shaft adjusting nut on page 27.)
4. Uncouple driver from driveshaft. The procedure depends upon the type of driver used,

   Refer to Sections Installing the Driver (VHS)Installing the Driver (VSS), 11.1 Installation of hollow shaft right angle gear drive on page 26, 11.1 Installation of hollow shaft right angle gear drive on page 26, and 11.8 Installation of hollow shaft electric motor on page 30. Consult the manufacturer's instructions for complete disassembly of gearhead or motor.
5. Remove capscrews that secure driver to discharge head and lift driver off the discharge head.

WARNING:
Do not work under a heavy suspended object unless there is a positive support under it which will protect personnel should a hoist or sling fail.

16.2 Thrust pot disassembly

1. Remove pump flexible half-coupling.
2. Remove capscrew (757QJ). See Figure 16: Thrust pot bearing arrangement on page 37.
3. Unscrew adjusting nut (604B) and remove from shalt.

4. Remove capscrews (760P) and slide off bearing retainer (767A). Remove key (730G).
5. Take out spindle (605), with lockwasher (789D), locknut (604C), spacer rings (665D), (triplex bearings only) and bearings (791B). Match mark bearings in relation to one another to facilitate reassembly.
6. Pry lockwasher (789D) prong from locknut (604C), remove locknut and lockwasher. Slide out bearings (791B) and spacer rings (665D) from spindle (605).
7. Take out capscrews (760QJ and remove bearing block housing (794A).
8. Remove oil seal (665B) by utilizing an arbor or hydraulic press and a piece of pipe or sleeve with outside diameter slightly smaller than bearing housing bore and press seal off.
9. Clean all parts of the thrust pot and check for excessive wear, stripping or other damage. Examine bearings for wear. Replace all worn or damaged bearings with new bearings.

16.3 Stuffing box disassembly

1. When provided, remove lubrication line connected 10 stuffing box (616).
2. Remove nuts (735B) and slide split gland (618) off the driveshaft (606), or headshaft (608), as applicable. Capscrews (759G) may be loosened to facilitate removal of split gland. Do not remove studs (739A) from stuffing box (616) unless replacement is required. See Figure 8: Stuffing box on page 23.
3. Remove capscrews (758A) and slide stuffing box off the shaft.
4. Remove packing with the aid of a packing hook. If a lantern ring is provided, remove it by inserting a wire hook in the slots of the ring and pulling it from the packing box. Remove packing washer, if provided. Do not remove tube fitting from stuffing box, or bearing (617) unless replacement is required.
5. Remove gasket from discharge head.
6. When a shall sleeve is provided, disassemble as follows:

   a) Mark original position of sleeve on shaft to facilitate reassembly.

   b) Utilizing a sharp scribe, mark position of sleeve on shaft, marking a thin line. Remove any sharp edges by polishing with a fine crocus cloth.

   c) Remove setscrew and gently work sleeve down to expose setscrew seat on shaft.. If area is burred, remove burrs as required to blend with shaft diameter.

   d) Wipe shaft with light oil and gently work sleeve off shaft. If shaft is threaded and/or keyed, use care when passing O-ring over the threaded area. Coat threads with a heavy grease, and screw, or rotate sleeve over the threads, and remove sleeve.

   NOTICE:
   Shaft threads are left hand.

   e) Remove O-ring from sleeve groove.

   f) Check the shall for nicks and score marks, remove if present and clean.
7. If the pump is equipped with a mechanical seal, consult the seal manufacturer's instructions (furnished with the pump) for removal of the seal.
8. Remove capscrews that secure discharge head to barrel.
9. Attach a sling through windows on discharge head and hoist entire pump assembly straight upward to bring the top column flange approximately two feet above the barrel. Place an elevator damp on the barrel flange, lower the pump assembly and allow the top column flange to rest on the elevator clamp.
10. Remove capscrews that secure discharge head (600) to top column (64l). Lift pump assembly and rotate clamps as necessary to remove all capscrews. Hoist discharge head of the top column. Remove bearing retainer (652).

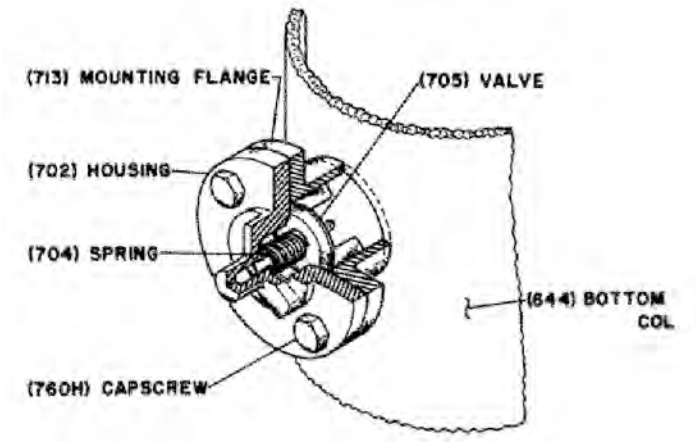


Figure 17: Autoprime valve

CAUTION:
Do not bump or scrape shaft protruding above the column when hoisting the discharge head.

11. Install two eyebolts diametrically opposite in the upper flange of top column (641). Attach a sling to eyebolts and to hoist hook. Remove capscrews that secure top column to intermediate column (642), or to bottom column (644) as applicable, and lift top column.
12. Disconnect driveshaft (606), or headshaft (608) as applicable, from threaded coupling (649), and remove from lineshaft (646). Remove coupling and slide bearing retainer off the lineshaft.

NOTICE:
Shaft threads are left hand.

CAUTION:
If threaded coupling will not readily unscrew, apply heat to coupling (not to shaft), for approximately 30 seconds, at the same time applying torque to the shaft.

13. Keyed shaft coupling: Remove capscrews (759E), slide retainer (650) upward. Raise shaft and remove split ring (726). Raise shaft to clear sleeve (734), remove retainer (650), and sleeve (734) off the shaft. (See Figure 4: Keyed shaft coupling on page 18.)
14. Remove capscrews (760H) that secure autoprime valve (705) to lower column (644) and remove valve. Disassemble valve and inspect for indications of excessive wear, corrosion, broken springs and valve face for damage.
15. Remove capscrews that secure top bowl (669) to bottom column (644), and remove bottom column.
16. Disconnect lineshaft (646) and remove from threaded coupling (649). For keyed shaft, refer to Step 13.
17. Install two eyebolts diametrically opposite in bowl assembly. Attach a sling to eyebolts and to hoist hook. Hoist bowl assembly and place horizontally on blocks.

16.4 Bowl disassembly

There are two types of bowl assemblies, turbine and mixed flow, and several different types of impeller construction.

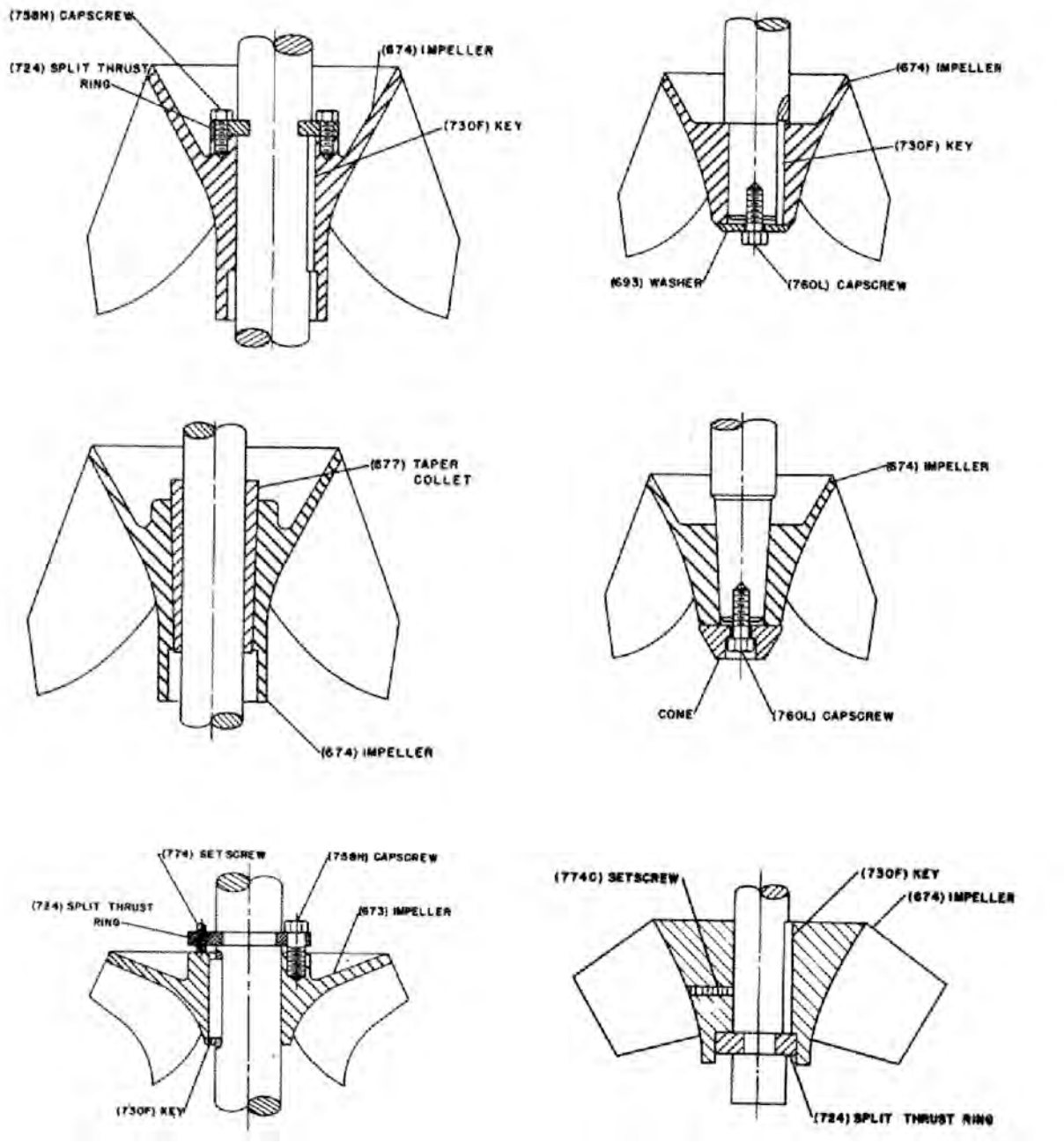


Figure 18: Mixed flow impellers various constructions

The bowl assembly shown in Figure 2: Typical VMP autoprime pump on page 16 is composed of the suction bell, diffuser case, adapter case, intermediate bowl, top bowl, mixed now impeller, with key, thrust and snap rings, turbine impeller with taper collets, bearings and a mixed now pumpshaft with coupling connecting to turbine pumpshaft.

The bowl shown below is the same except there is no adapter case, pumpshaft is one piece and no coupling is required. Also the mixed flow impeller is secured with a left-hand capscrew (760L) and washer (693).

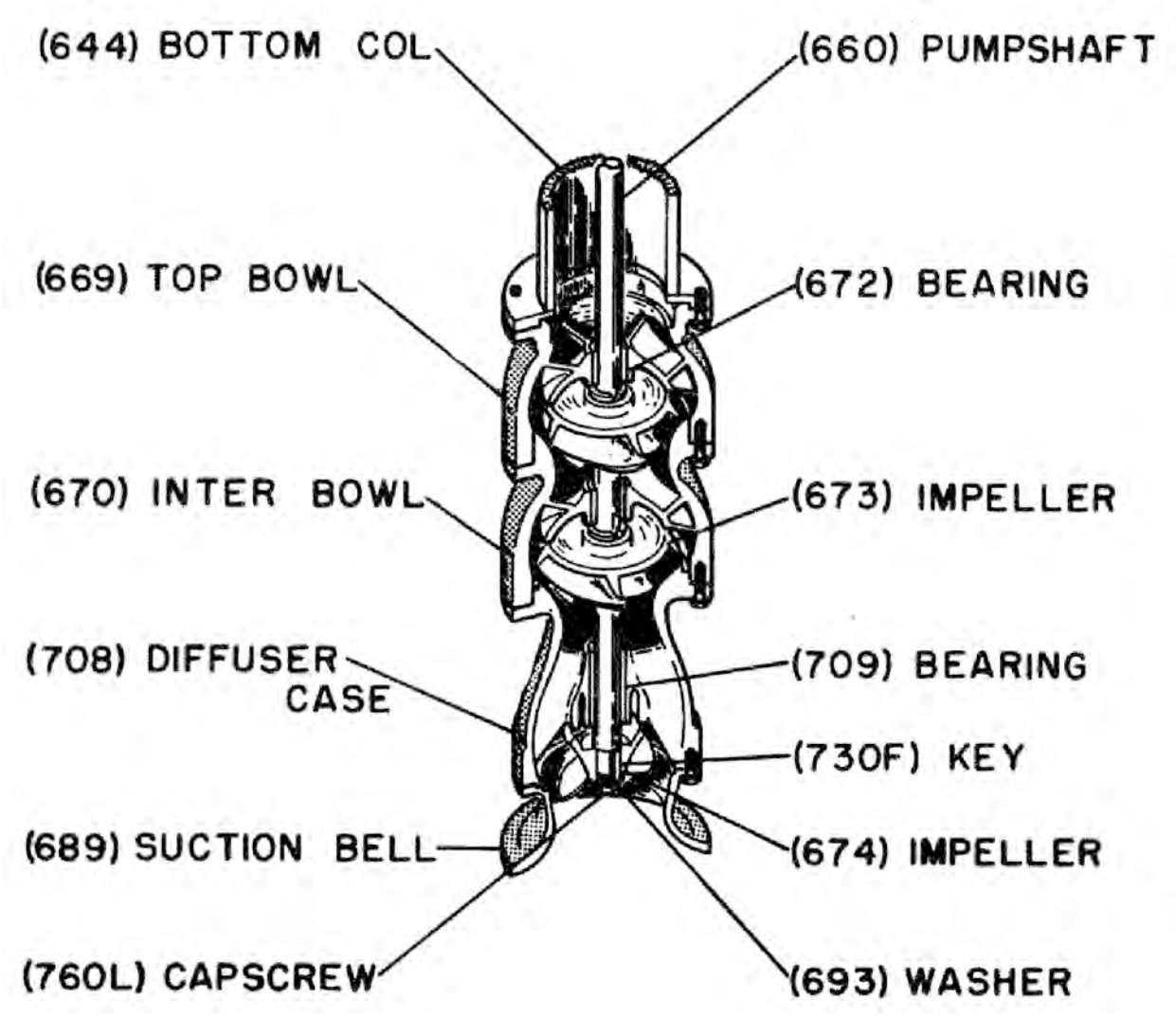


Figure 19: Mixed flow and turbine bowl assembly

NOTICE:
Match mark bowl assembly in sequence of disassembly to aid in the reassembly procedure.

16.5 Turbine bowls

See Figure 2: Typical VMP autoprime pump on page 16.

1. Remove capscrews that secure top bowl (669) to intermediate bowl (670).
2. Slide top bowl off the pumpshaft (660), impeller is now exposed.
3. Pull shaft out as far as possible and strike impeller hub utilizing a collet driver, or equivalent sliding along the pumpshaft to drive the impeller off the taper collet (677).

NOTICE:
Bowl bearings are press fit. do not remove unless replacement is necessary.

4. After impeller is freed, insert a screwdriver into the taper collet to spread it. Slide taper collet and impeller off the pumpshaft.

5. Use the preceding procedure until entire
turbine bowl assembly is completely disassembled.
6. Remove capscrews that secure adapter case (685) to diffuser case (708) and remove adapter case, mixed flow impeller (674) is now exposed.

16.6 Priming stage - mixed flow

See Figure 2: Typical VMP autoprime pump on page 16

1. Remove capscrews that secure suction bell (689) to diffuser case (708) and remove suction bell.
2. Remove threaded or keyed shalt coupling (649), as applicable. Refer to 16.3 Stuffing box disassembly on page 47, Step 13, for removal of keyed shaft coupling.
3. Take off snap ring (720) in hub of impeller (674), slide impeller and remove split thrust ring (724) from pumpshaft (675).
4. Slide impeller to dear pumpshaft and remove impeller. Take off impeller key (730F).

16.7 Priming stage mixed flow standard key construction

(See Figure 18: Mixed flow impellers various constructions on page 49.)

Same as steps in 16.6 Priming stage - mixed flow on page 51 1 and 2.

1. Remove capscrews (758H) and split thrust ring (724) from pumpshaft.

   C Slide impeller (674) off the pumpshaft and remove key (730F). If impeller is seized to shaft, strike impeller with a fiber mallet and drive impeller off the pumpshaft.
2. Remove left-hand capscrew (760L) and washer (693), slide impeller (674) off pumpshaft and remove key (730F).

16.8 Mixed flow - taper collet and shaft construction

See Figure 18: Mixed flow impellers various constructions on page 49.

1. Same as Steps 1 and 2 of 16.6 Priming stage - mixed flow on page 51.
2. Pull shaft out as far as possible, and strike impeller hub utilizing a collet driver, or equivalent sliding along the pumpshaft to drive the impeller off the taper collet (677).
3. After impeller is freed, insert a screwdriver into slot of taper collet to spread it. Slide taper collet and impeller off the pumpshaft.
4. Remove capscrew (760L) and cone, strike impeller hub and remove.

16.9 Mixed flow - optional keyed construction

See Figure 18: Mixed flow impellers various constructions on page 49.

1. Remove setscrews (744) and capscrews (758H). Remove split thrust ring (724).
2. Slide impeller (674) off pumpshaft and remove key (730F).

16.10 Mixed flow – setscrew construction

See Figure 18: Mixed flow impellers various constructions on page 49.

1. Remove setscrew (774C), located at right angle to the shaft between impeller (674) blades.
2. Slide impeller, remove split thrust ring (724), and key (730F) from shaft.

16.11 Turbine bowl – wear rings removal

1. Utilizing a diamond point chisel, cut two "V" shape grooves on the bowl wear ring approximately 180 degrees apart. Use extreme care not to damage the wear ring seat.
2. With a chisel, or equal, knock the end of one half of the ring in, and pry ring out.
3. On special materials such as chrome steel, set up the bowl in a lathe and machine the wear ring off, using extreme care not to machine or damage the ring seat.

16.12 Turbine bowl - impeller wear ring removal

Set up impeller in a lathe and machine the wear ring off, using extreme care not to machine or damage the ring seat or impeller hub.

16.13 Bowl and suction sell bearing removal

Utilizing an arbor press a piece of pipe or sleeve with outside diameter slightly smaller than bowl bearing housing, press the bearing off.

Remove suction bell bearing by setting suction bell on a lathe and machine bearing off.

16.14 Inspection and replacement

1. Clean all pump parts thoroughly with a suitable cleaner.
2. Check bearing retainers for deformation and wear.
3. Check shafts for straightness and excessive wear on bearing surfaces. Check deflection of shafts, average total runout shall not exceed 0.010 T.I.R. for every 10 feet.
4. On pumps equipped with a mechanical seal, check that shaft or sleeve is free of pits, burrs or sharp edges to prevent rutting, or improper sealing of O-rings. Remove burrs and sharp edges by polishing with a fine crocus cloth.
5. Visually check impellers and bowls for cracks and pitting. Check all bowl bearings for excessive wear and corrosion.
6. Replace all badly worn or damaged parts with new parts. In addition, replace all gaskets and packing as required. Refer to 18.3 Return parts on page 56 for spare parts list.

16.15 Turbine bowl and impeller wear rings reassemsly

1. Place chamfered face of bowl or impeller wear ring towards the ring seat and press into seat, use arbor press or equal, making sure ring is flush with edge of wear ring seat.

16.16 Bowl reassembly

See Figure 2: Typical VMP autoprime pump on page 16.

1. Press in new bearings (672), (709), (690) as required utilizing an arbor press or other suitable tool.
2. Install mixed flow impeller (674) on pumpshaft (675), slide impeller until groove is exposed and install thrust ring (724).
3. Slide impeller over thrust ring and secure with setscrew (774C) or install snap ring in impeller hub groove as required. See Figure 18: Mixed flow impellers various constructions on page 49.
4. Assemble suction bell (689) onto pumpshaft.
5. Install diffuser case (708) to suction bell and secure with capscrews provided.
6. If pump shafts (675) and (660) are provided assemble with threaded or keyed coupling (649). For keyed couplings refer to 6.1 Bowl assembly installation on page 16 Step 6, and Figure 4: Keyed shaft coupling on page 18.
7. Assemble adapter case (685) to diffuser case and secure with capscrews provided.

8. Thread a capscrew and washer into tapped hole on bottom of suction bell and into pumpshaft, pulling mixed flow impeller against section bell.

CAUTION:
Remove capscrew prior to pump startup.

9. Slide turbine impeller (673) over pumpshaft, slip taper collet over shaft and into impeller hub and drive into position using a collet driver or equal.
10. Slip an intermediate bowl over end of pumpshaft and secure with capscrews provided.
11. Assemble the next bowl and impeller for the number of stages required. Tighten capscrews gradually and uniformly.
12. Reassemble column, refer to 7.1 Installing the column on page 19, Steps 1 through 9.
13. Reassemble discharge head, refer to 8.1 Installing the discharge head on page 21.

16.17 Stuffing box reassembly

1. When a shaft sleeve is provided, reassemble as follows:
   a) Install O-ring in sleeve groove.
   b) Lubricate O-ring and shaft threads.
   c) Insert sleeve onto shaft and slowly rotate counterclockwise, simultaneously pushing inward gently, until O-ring is dear of threads.
   d) Locate original position of sleeve on shaft and tighten setscrews.
2. Position gasket on discharge head. Slide stuffing box down over shaft and into position on gasket. Secure stuffing box with capscrews.
3. Complete reassembly of stuffing box by referring to 9.1 Stuffing box installation on page 23, Steps b through h.

16.18 Mechanical seal reassembly

1. When a mechanical seal is provided, refer to 10.1 Mechanical seal installation on page 25, for reassembly.

16.19 Thrust pot reassembly

When replacing oil seal (Garlock Klozure) and either duplex or triplex bearings, or other parts, it is imperative that strict cleanliness be observed during reassembly. The bearings shall remain in their original package until immediately before mounting. In case the package has been damaged and bearings become dirty, clean bearings in filtered water-free kerosene and apply new lubricant, Mount the oil seal and bearings as follows:

1. Press oil seal (665B) with sealing lip face-up into bearing block housing (794A) bore, utilizing an arbor or hydraulic press with the ram slightly larger than the oil seal and press seal into bore. Be sure that the pressure exerted by the ram is applied only to the roll-over bead around the outer diameter of the face of the oil seal and not to the adapter or filler ring.
2. Carefully slide block housing (794A) over the shaft to avoid damaging the seal and install block housing on center plate of driver support (see Figure 16: Thrust pot bearing arrangement on page 37) dotted lines and secure with capscrews (760Q).
3. Duplex bearings: Lightly grease first bearing (791B) and slide it on spindle (605) with heavy or wide side of inner race against shoulder of spindle. Use Chevron Grade 2 SRI grease or equal. (See Figure 16: Thrust pot bearing arrangement on page 37).

4. Lightly grease second bearing and slide it on spindle with narrow or light side of inner race against first bearing, mount back-to-back.
5. Place lockwasher (789D) on spindle (605) with inner prong of lockwasher towards the face of bearing and located in the keyway of spindle.
6. Thread locknut (604C) on spindle, chamfered end towards lockwasher and tighten until the outer bearing is driven against the shoulder of the spindle and a tight fit is achieved. Bend prong of lockwasher into one of locknut slots.
7. Slide bearing and spindle assembly over the shaft and into block housing, until it bottoms on shoulder of block housing. Check that bearings rotate freely. If bearings do not turn freely, the cause must be found and corrected.
8. Insert key (730G) into keyway and slide key into spindle (605).
9. Install bearing retainer (767A) on block housing and secure with capscrews (760P).
10. Thread adjusting nut (604B) onto shaft until it makes contact with the spindle. Thread capscrew (757Q) into spindle but do not tighten, this is accomplished when impellers are adjusted.
11. Refer to 12.6 Thrust pot installation on page 36, Step 9 for lubricating procedures.
12. Triplex bearings: Follow Steps 1 and 2.
13. Lightly grease bearing (791B) and slide on spindle (605) with heavy or wide side of inner race of bearing against shoulder of spindle. (See Figure 16: Thrust pot bearing arrangement on page 37).
14. Slide small diameter spacer ring (665D) on spindle and against bearing. Assemble large diameter spacer ring (665D) against bearing. Pack grease between spacers. Use Chevron Grade 2 SRI grease or equal.
15. Lightly grease second bearing and slide it on spindle (605) with heavy or wide side of inner race against small diameter of spacer ring.
16. Lightly grease third bearing and slide it on spindle, with light or narrow side of inner race against second bearing, back-to·back.
17. Follow Steps 5 through 11, for complete triplex bearing installation.

16.20 Pump reassembly

After removal and disassembly for repair or replacement of a pump component, replacement in all cases is the reverse order of removal. Prior to reassembly, apply a thin film of turbine oil to all mating and threaded surfaces. Refer to 17.1 Recommended lubricants on page 55 for
list of recommended lubricants. Reinstall the pump as described in Installing the pump through Installing the Driver (VSS). Refer to Pump Startup and Operation for starting and adjusting procedures for the pump.

17 Recommended Lubricants

17.1 Recommended lubricants

Manufacturer	Greases for line shafts, suction bowl bearings and shaft packings	Turbine oils for line shaft, suction bowl bearings and similar applications		Turbine oils for gear drives vertical pumps	
	Temperature -32°F to 120°F	Temperature Below 32°F	Temperature above 32°F	Temperature Below 32°F	Temperature Above 32°F
American Oil Co.	Amoco Lithium Grease All-Weather	Rykon Industrial Oil No. 11	Rykon Industrial Oil No. 31	Rykon Industrial Oil No. 21	Rykoo Industrial Oil No. 51
Atlantic Richfield Co.	Arco Multipurpose Grease	Duro S-150 LP	Duro S-150 or Duro S150 LP	Duro AWS-315	Duro 500
Cato Oil & Grease	Mystik JT-6	2107 Water Well Turbine Oil or 1872 Antiwear Hyd./Ind. Oil A.5	2107 Water Well Turbine Oil or 1872 Antiwear Hyd./Oil A.5	1875 Antiwear Hyd./Ind Oil C or 1837 R & O Gearhead C	Mystik JT-7 SAE 80/90 Antiwear Ind. Oil F or 1855 R & O Gearhead F
Cities Service Oil Co.	Citgo H-2	Citgo Pacemaker 15	Citgo Pacemaker 15	Citgo Pacemaker 20	Citgo Pace- maker 60
Gulf Oil Co.	Gulfcrown Grease No. 2 or Gulf Supreme Grease No. 2	Paramount 39	Harmony 44	Paramount 45	Harmony 69
Humble Oil & Refining Co.	Lidok No. 2	Nuto 43 or Esstic 42	Teresstic 43 or Nuto 43	Nuto43 or Esstic42	Terresstic 65 or Nuto 63
Mobil Oil Corp.	Mobilux No. 2	DTE 23	DTE BB	DTE 23	DTE Extra Heavy or DTE AA
The Pennzoil Co.	Pennzoil 705 HDW	Pennbell No. I	Pennbell No. 2	Pennbell No. 2	Pennbell No. 5
Shell Oil Co.	Alvania EP Grease 2 or Alvania EP Grease 1 (for prolonged ambient below 0ºF)	Tellus Oil 23	Tellus Oil 27	Tellus Oil 29	Tellus Oil 41
Texaco, Inc.	Novatex. Grease No. 2	Regal Oil A (R&O)	Regal Oil A (R&O)	Regal Oil C (R&O)	Regal Oil F (R&O)
Fiske Bros. Refining Co.	Lubriplate 130M (0° to 120°F)	Lubriplate 3V	Lubriplate 3V	Lubriplate APG 90	Lubriplate APG 90

18 Parts List

18.1 General

The requirement for a stock of spare parts shall vary with the severity of conditions of service, and the extent of field maintenance anticipated, and the number of pumps installed. A minimum of one spare of each rotating part should be stocked, as well as a complete set of bearings and seals.

18.2 Ordering parts

When ordering spare and replacement parts the pump serial number, type and size of pump must be given. Refer to nameplate. This is essential in order that Goulds Pumps may identify the pump and furnish the correct replacement part. Give the name and item number of the part as listed in parts list with the corresponding figure number and pump (See Figure 2: Typical VMP autoprime pump on page 16.) Orders for replacement parts should be sent to Sales Department, Goulds Pumps, Vertical Pump Division. Inc, City of Industry, California.

18.3 Return parts

All materials returned to factory must have a Return Material Order (R.M.0.) tag attached. Consult the nearest factory representative or Sales Office for shipping instructions and an R.M.O. tag. Articles returned should be carefully packed to prevent damage in handling.

VMP - Autoprime pump

See Figure 2: Typical VMP autoprime pump on page 16 and Figure 19: Mixed flow and turbine bowl assembly on page 50.

Table 5: VMP Autoprime parts list

Part Number	Description
600	Head - Discharge
604	Nut - Adjusting
606	Driveshaft
608	Headshaft (as required)
616	Box - Stuffing Assembly (as required)
624	Line-Bypass
641	Column - Top
642	Column - Intermediate (as required)
644	Column - Bottom Assembly W/Sway Braces
646	Lineshaft
649	Coupling - Threaded Lineshaft
652	Retainer - Bearing
653	Bearing - Lineshaft
660	Pumpshaft - Turbine
669	Bowl - Top
670	Bowl - Intermediate
672	Bearing - Intermediate Bowl
673	Impeller - Turbine
674	Impeller- Mixed Flow

Part Number	Description
675	Pumpshaft- Mixed Flow
677	Collet - Taper
680	Ring - Wear Bowl (enclosed impellers only)
681	Ring - Wear Impeller (enclosed impellers only)
685	Case - Adapter
689	Bell- Suction
690	Bearing - Suction
705	Valve-Autoprime
707	Line -Vent Assembly
708	Case - Diffuser
709	Bearing- Diffuser Case
720	Ring-Snap
724	Ring - Thrust Mixed Flow Impeller
730F	Key - Mixed Flow Impeller
758L*	Capscrew - Diffuser Case to Adapter Case
758M*	Capscrew - Adapter Case to Turbine Bowl
759L*	Capscrew - Suction Bell to Diffuser Case
760B*	Capscrew - Column to Column
760E*	Capscrew - Intermediate Bowl to Top Bowl
760C*	Capscrew - Top Bowl to Column
760L	Capscrew-Mixed Flow Impeller
693	Washer-Mixed Flow Impeller Shown, but not called out in Figure 2: Typical VMP autoprime pump on page 16.

Keyed shaft coupling

See Figure 4: Keyed shaft coupling on page 18.

Table 6: Keyed shaft coupling parts list

Part Number	Description
650	Retainer
726	Ring-Split
730D	Key
734	Sleeve
759E	Capscrew

Stuffing box assembly

See Figure 8: Stuffing box on page 23.

Table 7: Stuffing box parts list

Part Number	Description
616	Box-Stuffing
617	Bearing
618	Gland-Split
620A	Rings - Packing
624	Line- Bypass

Part Number	Description
735B	Nut - Gland Stud
739A	Stud
758A	Capscrews
779A	Gasket
789C*	Washer-Packing (as required)
609*	Sleeve-Headshaft
759G	Capscrew-Split Gland * Optional items - not shown in Figure 8: Stuffing box on page 23.

Hollow shaft adjusting nut

See Figure 10: Hollow shaft adjusting nut on page 27.

Table 8: Hollow shaft adjusting nut parts list

Part Number	Description
604	Nut -Adjusting
606	Driveshaft
730A	Key - Gib
757J	Capscrew-Adjusting Nut

Rigid coupling - hollow shaft driver

See Figure 11: Rigid coupling on page 29.

Table 9: Rigid coupling - hollow shaft driver parts list

Part Number	Description
607	Ring - Coupling Drive
610	Hub-Driver
611	Ring-Threaded
614	Hub-Pump
727	Ring-Alignment
730B	Key - Driveshaft
730C	Key - Headshaft
735C	Nuts
759A	Capscrews

Flanged adjustable coupling-solid shaft driver

See Figure 13: Flanged adjustable coupling on page 33 and Figure 14: Flanged adjustable coupling with spacer on page 33.

Table 10: Flanged adjustable coupling-solid shaft driver parts list

Part Number	Description
610	Hub-Driver
612	Spacer
613	Plate-Adjusting
614	Hub-Pump
722	Ring - Split Driver

Part Number	Description
730B	Key - Driveshaft
730C	Key-Pumpshaft
735C	Nut
759B	Capscrew
759D	Capscrew

Thrust pot assembly (Duplex and Triplex Bearings)

See Figure 16: Thrust pot bearing arrangement on page 37.

Table 11: Thrust pot assembly parts list

Part Number	Description
604B	Nut-Adjusting
604C	Locknut
605	Spindle
619A	Fitting - Grease
665 B	Oil Seal
665D	Rings-Spacer
730G	Key-Gib
747S	Plug-Pipe
757Q	Capscrew - Allen Head
760P	Capscrew- Hex Head
760Q	Capscrew- Hex Head
767A	Retainer- Bearing
789 D	Washer-Lock
791B	Bearing- Ball Triplex
791B	Bearing- Ball Duplex
794A	Housing- Bearing Block

Autoprime valve assembly

See Figure 17: Autoprime valve on page 48.

Table 12: Autoprime valve assembly parts list

Part Number	Description
702	Housing
704	Spring
705	Valve
760H	Capscrew

Mixed flow impellers various constructions

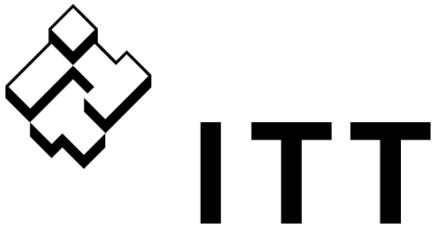
See Figure 18: Mixed flow impellers various constructions on page 49.

Table 13: Mixed flow impellers various constructions parts list

Part Number	Description
674	Impeller- Mixed Flow
677	Collet - Taper
693	Washer

Part Number	Description
724	Ring - Thrust
730F	Key
759H	Capscrew
760L	Capscrew
774C	Setscrew

Visit our website for the latest version of this document and more information:
www.gouldspumps.com



ITT - Goulds Pumps Vertical Products Operation
3951 Capitol Avenue
City of Industry, CA 90601-1734
USA

Form IOM.VMP.en-US.2022-03