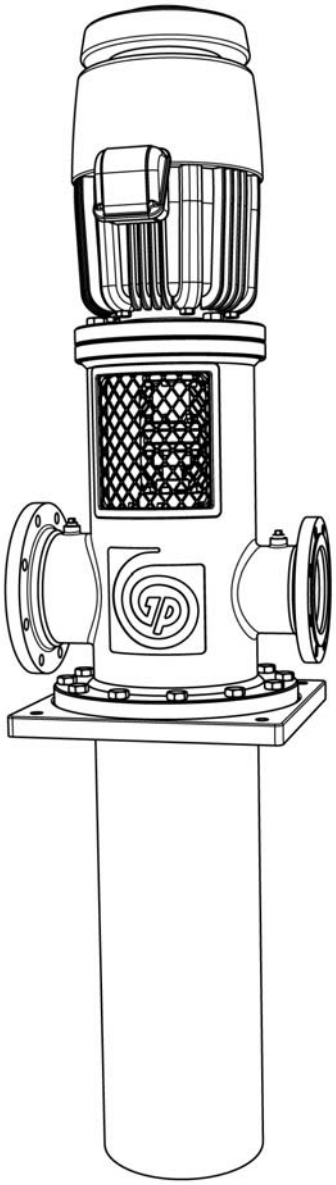
GOULDS PUMPS

Installation, Operation, and Maintenance Instructions



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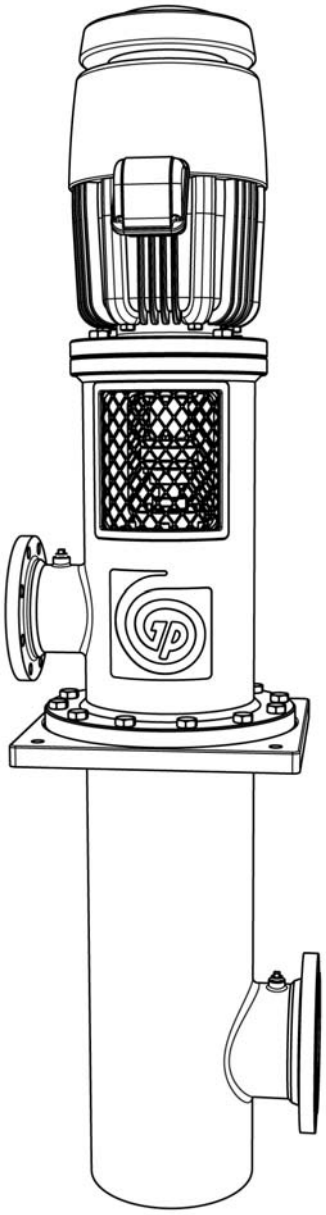


L Type Alternate - Suction in Barrel

Model VIC

ITT

FOREWORD

This manual provides instructions for the Installation, Operation, and Maintenance of the ITT Goulds Vertical Model Pumps. This manual covers the standard product plus common options that are available. For special options, supplemental instructions are supplied. **This manual must be read and understood before installation and start-up.**

This instruction manual covers several different pump configurations. Most assembly, disassembly, and inspection procedures are the same for all the pumps. However, where there are differences, they are called out separately within the manual. The design, materials, and workmanship incorporated in the construction of ITT Goulds pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by correct application, proper installation, periodic inspection, condition monitoring 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.

ITT Goulds shall not be liable for physical injury, damage, or delays caused by a failure to observe the instructions for installation, operation, and maintenance contained in this manual.

Warranty is valid only when genuine ITT Goulds parts are used.

Use of the equipment on a service other than stated in the order will nullify the warranty, unless written approval is obtained in advance from ITT Goulds Pumps.

Supervision by an authorized ITT Goulds representative is recommended to assure proper installation.
Additional manuals can be obtained by contacting your local ITT Goulds representative or by calling 1-800-446-8537.

THIS MANUAL EXPLAINS

- **Proper Installation**
- **Start-Up Procedures**
- **Operation Procedures**
- **Routine Maintenance**
- **Pump Overhaul**
- **Troubleshooting**
- **Ordering Spare or Repair Parts**

TABLE OF CONTENTS

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 www.gouldspumps.com/literature_ioms.html 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 www.gouldspumps.com.

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 www.gouldspumps.com/literature.

SAFETY

DEFINITIONS

Throughout this manual the words **WARNING**, **CAUTION**, **ELECTRICAL, and ATEX** are used to indicate where special operator attention is required.

Observe all Cautions and Warnings highlighted in this 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

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.

When installed in potentially explosive atmospheres, the instructions that follow the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact an ITT Goulds Pumps representative before proceeding.

Example: Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

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.

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.

General Precautions		
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		The coupling used in an ATEX classified environment must be properly certified and must be constructed from a non-sparking material.
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		The mechanical seal used in an ATEX classified environment must be properly certified. Prior to start up, ensure all points of potential leakage of process fluid to the work environment are closed.
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		Dynamic seals are not allowed in an ATEX classified environment.
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.

General Precautions		
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.

ATEX CONSIDERATIONS and INTENDED USE

Special care must be taken in potentially explosive environments to ensure that the equipment is properly maintained. This includes but is not limited to:

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

The ATEX conformance is only applicable when the pump unit is operated within its intended use. Operating, installing or maintaining the pump unit in any way that is not covered in the Instruction, Operation, and Maintenance manual (IOM) can cause serious personal injury or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT Goulds Pumps. If there is any question regarding the intended use of the equipment, please contact an ITT Goulds representative before proceeding. Current IOMs are available at www.gouldspumps.com/literature_ioms.html or from your local ITT Goulds Pumps Sales representative.

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

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

II = Group 2
2 = Category 2
G/D = Gas and Dust present
T4 = Temperature class, can be T1 to T6 (see Table 1)

Table 1

Code	Max permissible surface temperature °F (°C)	Max permissible liquid temperature °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

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

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.

GENERAL INFORMATION

INTRODUCTION

CAUTION

The information in this manual is intended to be used as a guide only. If you are in doubt, consult the factory at 562-949-2113 for specific information about your pump. See the pump nameplate and / or your pump outline drawing for the correct impeller lift setting.

The design, material, and workmanship incorporated in the construction of ITT Goulds pumps makes them capable of giving long, troubl- free service. 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.

WARNING

Rotating components of the pump assembly must be covered with a suitable rigid guard to prevent injury to personnel.

Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

Study thoroughly Sections 1 through 6 and carefully follow the instructions for installing and operating. Section 5 contains answers to troubleshooting and maintenance questions. Keep this instruction manual handy for reference. Further information can be obtained by contacting the Vertical Pump Operations, ITT Goulds Pumps, City of Industry, California (562) 949-2113 or your local branch office.

WARNING

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

RECEIVING AND CHECKING

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

1. Contents of the pump assembly against the packing list.
2. All components against damage.
3. Shafting for straightness and damage should the crate be broken or show careless handling.

Any shortages or damage 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 will prevent any controversy when claim is made and facilitate prompt and satisfactory adjustment.

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.

BULK MATERIAL

- Anti-Galling lubricant
- Thread Compound
- Lubrication Oil
- Turbine Oil
- Grease
- Solvent, petroleum based (kerosene, distillate or unleaded gasoline)

RIGGING EQUIPMENT

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

HAND TOOLS

- Pipe wrenches
- Feeler gauges
- Set of mechanics tools including: files, wire brush, pliers, wire cutters and pocket knife
- Clean rags

OPTIONAL TOOLS TO FACILITATE PUMP ASSEMBLY AND DISASSEMBLY

- Dial indicator to assist in motor and pump alignment.
- Collet driver to assist in bowl assembly and disassembly (for pumps with taper lock impellers only)

STORAGE

ITT Goulds Pumps carefully preserves and protects its products for shipment. However, the effective life of the preservatives applied at the factory can vary from 3 to 18 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 ITT 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 to be of general assistance to users of ITT Goulds pumps. It shall not modify, amend and/or otherwise alter the scope of ITT Goulds Pumps warranty responsibilities to the purchaser in any way whatsoever.

STORAGE PREPARATION

ITT 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 awaiting installation.

Preferably, the storage area shall be paved, well drained and free from flooding, and be indoors whenever possible.

Weather-proof coverings used for outdoor storage shall be flame resistant type sheeting or tarpaulins. They shall be placed so as to provide good drainage and air circulation and shall be tied down to protect from wind damage.

Storage area shall be maintained in a clean condition at all times.

Pumps and/or component parts shall be placed on skids, pallets, or shoring to permit good air circulation.

Pumps and/or component parts shall be sorted so as to permit ready access for inspection and/or maintenance without excessive handling.

Pumps and/or components parts stacked during storage shall be arranged so that the racks, containers, or crates bear full weight without distortion of pumps or parts. Identification markings must be readily visible. Any cover removed for internal access shall be replaced immediately.

Pump and bowl assembly shafting shall be rotated counter clockwise, as a minimum, once a month. Shaft shall not be left in the same previous position, nor in the extreme raised or lowered lateral position. Shaft should rotate freely.

NOTE: For further information on these procedures contact your ITT Goulds Pumps representative.

RECOMMENDED STORAGE PROCEDURES

Controlled storage facilities should be maintained at an even temperature 10° F (6° C) 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.)

For uncontrolled storage periods of 6 months or less, the pump is to be inspected periodically to insure that all preservatives are intact.

All pipe threads and flanged pipe covers are to be sealed with tape.

The pump must not be stored closer than six inches (15 cm) from the ground.

UNCONTROLLED LONG TERM STORAGE PREPARATIONS

When applicable to the pump, storage periods over six months require the preceding storage procedure and storage preparation plus the following:

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.

Place 10 pounds (4.5 kg) of moisture absorbing desiccant or 5 pounds (2.3 kg) of vapor phase inhibitor crystals near the center of the pump. If the pump is assembled, place an additional one pound (0.5 kg) in the discharge nozzle securely fastened to the discharge elbow.

Install a moisture indicator near the perimeter of the pump. Cover the pump with 6 mil (0.15 mm) minimum thickness black polyethylene or equal and seal it with tape. Provide a small ventilation hole approximately 1/2 inch (12 mm) diameter.

Provide a roof or shed shelter to protect from direct exposure to the elements.

GENERAL DESCRIPTION

The Model VIC pump is a vertical industrial turbine type pump which is designed to meet many wide ranges of service. The VIC pump features capacities to 60,000 GPM (13,630 m3/h), heads to 4500 feet (1372 m), and pressures to 3000 PSIG (210 kg/cm2).

DRIVERS

Where mechanical seals are required, the most common type of drivers supplied are solid shaft electric motors with adjustable spacer type couplings. Solid shaft drivers are recommended when mechanical seals are used. This will permit the replacement of the mechanical seal without disturbing the driver. Solid shaft right angle gear drives are also used occasionally. When packed stuffing boxes are used with open lineshaft pumps, or if the pump unit is of the enclosed lineshaft / oil lubricated type, hollow shaft motors or right angle gear drives are often used with a separate driveshaft through the driver and connected to the pump by a rigid flanged coupling.

DISCHARGE HEAD

The discharge head is a fabricated “T” or "L" type head. Ports are provided for connecting the discharge gauge, stuffing box or mechanical seal bypass return. The driver support portion of the discharge head is designed with large hand holes for easy mechanical seal or stuffing box adjustment.

COLUMN

Flanged column construction provides positive shaft and bearing alignment, and also ease of assembly and disassembly. Bearings are spaced to provide vibration-free operation below the shaft first critical speed in order to insure long bearing and shaft wear. The lineshaft is supported within the column by use of bearing retainers within the column assembly. These retainers are usually integrally fabricated for all diameters.

BOWL ASSEMBLY

The bowls are generally of flanged construction for accurate alignment and ease of assembly and disassembly. Impellers may be either open or enclosed, depending on the design requirements. For temperatures over 180° F (82° C) and in the larger size bowls, impellers are keyed to the shaft.
A special first stage low NPSH impeller may be provided in certain applications.

THRUST POT

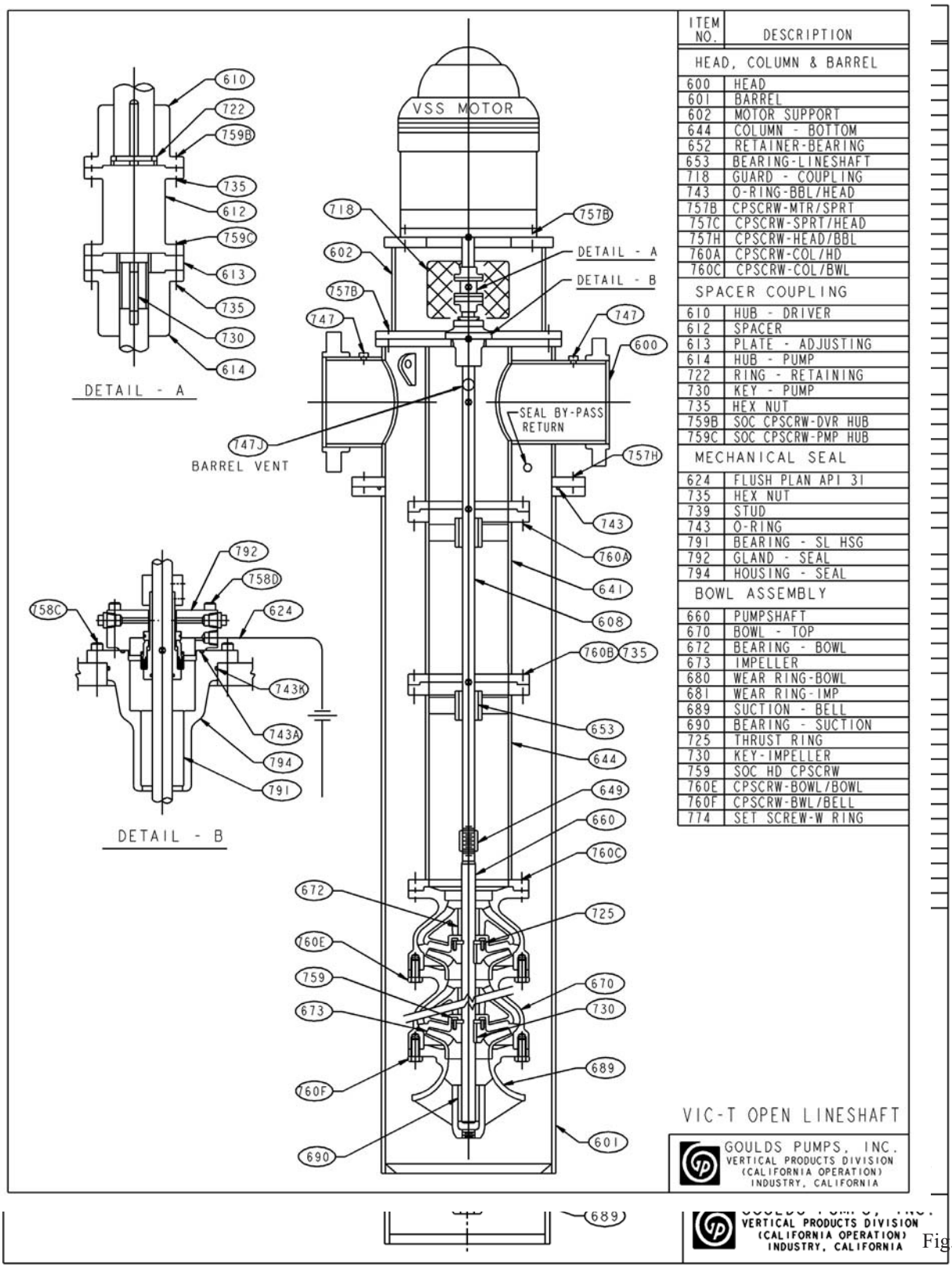
A thrust pot is utilized when the driver is not designed to carry the pump thrust.

BARREL (OR CAN)

The barrel is flanged to support the weight of the pump and driver when full of liquid. The barrel may be installed in a sleeve or open steel structure.

The suction flange may be installed in the side of the barrel as in the VIC-L model.

TYPICAL CROSS SECTIONAL - VIC-T — PRODUCT LUBE



ITEM NO.	DESCRIPTION
	HEAD, COLUMN & BARREL
600	HEAD
601	BARREL
602	MOTOR SUPPORT
644	COLUMN - BOTTOM
652	RETAINER-BEARING
653	BEARING-LINESHAFT
718	GUARD - COUPLING
743	O-RING-BBL/HEAD
757B	CPSCRW-MTR/SPRT
757C	CPSCRW-SPRT/HEAD
757H	CPSCRW-HEAD/BBL
760A	CPSCRW-COL/HD
760C	CPSCRW-COL/BWL
	SPACER COUPLING
610	HUB - DRIVER
612	SPACER
613	PLATE - ADJUSTING
614	HUB - PUMP
722	RING - RETAINING
730	KEY - PUMP
735	HEX NUT
759B	SOC CPSCRW-DVR HUB
759C	SOC CPSCRW-PMP HUB
	MECHANICAL SEAL
624	FLUSH PLAN API 31
735	HEX NUT
739	STUD
743	O-RING
791	BEARING - SL HSG
792	GLAND - SEAL
794	HOUSING - SEAL
	BOWL ASSEMBLY
660	PUMPSHAFT
670	BOWL - TOP
672	BEARING - BOWL
673	IMPELLER
680	WEAR RING-BOWL
681	WEAR RING-IMP
689	SUCTION - BELL
690	BEARING - SUCTION
725	THRUST RING
730	KEY-IMPELLER
759	SOC HD CPSCRW
760E	CPSCRW-BOWL/BOWL
760F	CPSCRW-BWL/BELL
774	SET SCREW-W RING

Fig. 1

Fig. 2

TYPICAL CROSS SECTIONAL - VIC-L — PRODUCT LUBE

INSTALLATION

When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a ITT Goulds representative before proceeding.

FOUNDATION/PIPING

SUB BASE OR BARREL FLANGE INSPECTION

Sub Base and Sole Plate are terms in common use to describe a general class of solid steel plates mounted in grout (or bolted to steel structures) at the pump-foundation interface.

1. Remove the Sub Base from the Pump Discharge Head, or Barrel Flange when shipped assembled.
2. Completely clean the underside of the Sub Base. It is sometimes necessary to coat the underside of the Sub Base with an epoxy primer. This may have been purchased as an option.
3. Remove the rust preventative solution from the machined topside with an appropriate solution.

SITE WITH CONCRETE FOUNDATION

1. A pump should have adequate space for operation, maintenance, and inspection.
2. Sub Base mounted pumps are normally grouted on a concrete foundation which has been poured on a solid footing. The foundation must be able to absorb any vibration and to form a permanent rigid support for the pumping unit.
3. The foundation must be of adequate strength to support the complete weight of the pump plus the weight of the liquid passing through it. A typical installation will have bolts with a pipe sleeve 2 1/2 times the bolt diameter embedded in the concrete, sized and located in accordance with the dimensions given on the Pump Certified Outline Drawing. The pipe sleeve allows movement for final positioning of the foundation bolts to conform to the holes in the Sub Base flange. Fig. 3 shows a typical installation.

All equipment being installed must be properly grounded to prevent unexpected static electrical discharge. If not, a static electric discharge may occur when the pump is drained and disassembled for maintenance purposes.

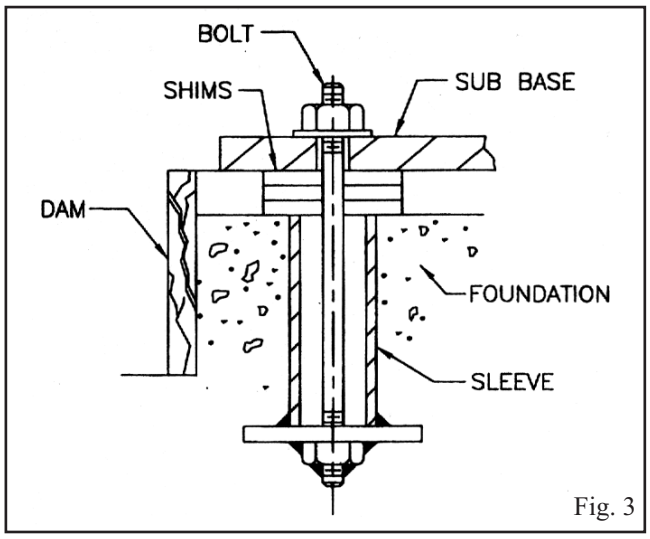


Fig. 3

4. Remove water and/or debris from anchor bolt holes/sleeves prior to grouting. If the sleeve type bolts are being used, fill the sleeves with packing or rags to prevent grout from entering.

5. Carefully lower the Sub Base or Barrel Flange onto the foundation bolts. Hand tighten the bolt nuts.

6. Leveling the Sub Base or Barrel Flange may be done by several methods. Two common methods are:

   A. Leveling wedges. This is shown in Fig. 4.

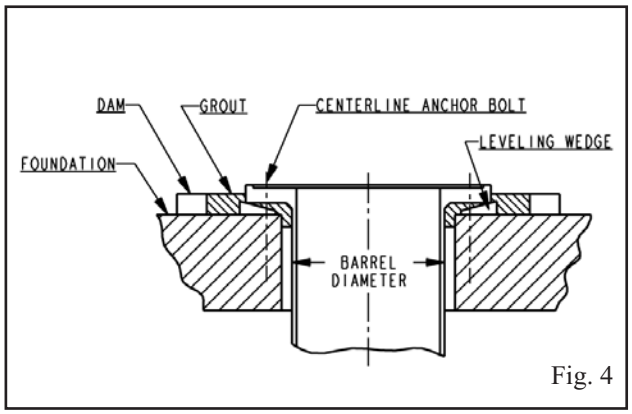


Fig. 4

   B. Leveling nuts on the anchor bolts (Fig. 3).

   Regardless of the method, a machinist level must be used for leveling.

NOTE: When using a machinist level, it is important that the surface being leveled is free of all contaminants, such as dust, to ensure an accurate reading.

7. Level the Sub Base or Barrel Flange in two directions at 90° on the machined surface. The levelness tolerance is 0.005 inches per foot for commercial, and 0.001 inches per foot for API.

SUB BASE OR BARREL FLANGE GROUTING

1. Inspect foundation for dust, dirt, oil, chips, water, etc. and remove any contaminants. Do not use oil-based cleaners as grout will not bond to it. Refer to grout manufacturer's instructions.

2. Build dam around foundation. Thoroughly wet foundation.

3. Pour grout between Sub Base or Barrel Flange and concrete foundation, up to level of dam. Remove air bubbles from grout as it is poured by puddling, using a vibrator, or pumping the grout into place. Non-shrink grout is recommended.

4. Allow grout to set at least 48 hours.

5. Tighten foundation bolts.

SITE WITH STRUCTURAL STEEL FOUNDATION

1. When the pump is mounted directly on a structural steel frame, pumps shall be located directly over, or as near as possible to, the main building members, beams, or walls. The Barrel, Discharge Head mounting flange, or Sub Base, shall be bolted to the support to avoid distortion, prevent vibration, and retain proper alignment.

2. If a Sub Base or Barrel Flange is being bolted to a structural steel foundation, or the Sub Base or Barrel Flange is not grouted to the concrete foundation, use shims for leveling the plate.

PIPING

Guidelines for piping are given in the "Hydraulic Institute Standards" available from: Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054-3802 and must be reviewed prior to pump installation.

⚠ WARNING

Never draw piping into place by forcing at the flange connections of the pump. Pipe strain will adversely affect the operation of the pump resulting in physical injury and damage to the equipment.

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

2. DO NOT connect piping to pump until grout has hardened and pump hold down bolts have been tightened.

3. It is suggested that expansion loops or joints, if used, be properly installed in discharge line when handling liquids at elevated temperatures, so linear expansion of piping will not draw pump out of alignment.

4. Carefully clean all pipe parts, valves and fittings, and pump branches prior to assembly.

5. Isolation and check valves should be installed in discharge line. Locate the check valve between isolation valve and pump, this will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.

6. Cushioning devices should be used to protect the pump from surges and water hammer if quick-closing valves are installed in the system.

FINAL PUMP CHECK

1. Rotate shaft several times by hand to be sure that there is no binding and all parts are free.

2. Check alignment, per the alignment procedure outlined in *Operation* section to determine absence of pipe strain. If pipe strain exists, correct piping.

PUMP INSTALLATION

When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a ITT Goulds representative before proceeding.

Pumps 20 feet (6m) or less in length are usually shipped partially assembled, with the exception of the driver, packing, mechanical seal with tubing and coupling assembly, spacer or non spacer type. When provided, refer to the Certified Pump Outline for the applicable baseplate plan for location of anchor bolt holes.

INSTALLING A PARTIALLY ASSEMBLED PUMP

1. If a baseplate was supplied, install as described in Foundation/Piping Section (Figs. 3 & 4).

2. Clean the plate mounting flange and clean bottom surface of discharge head or barrel mounting flange.

3. Check that all fasteners on the pump are tight as it is recognized that transportation and handling may result in bolt relaxation.

4. Install the barrel (can) to discharge head O-ring (743).

5. Sling through discharge hand holes or thread two eyebolts through bolt holes in mounting flange and hoist unit into position over the barrel.

NOTE: Eyebolts or sling should be rated to handle in excess of the pump weight (see Outline Drawing).

6. Lower the unit and carefully guide it so that unit does not strike the sides of the baseplate or barrel. Continue to lower unit until the discharge head flange engages and rests firmly on the plate or barrel, then secure with capscrews provided.

7. When a lineshaft is shipped separately, check shaft for straightness; average total runout should not exceed 0.005" T.I.R. (0.127mm) for every 10 feet (3m). Shaft must be within tolerance prior to installation.

8. Remove stuffing box (if installed) and carefully slide shaft through top column bearing retainer and thread into coupling after replacing stuffing box or seal housing. Use extreme care not to damage bearing retainer.

9. Refer to the remainder of this manual for complete assembly, start-up, maintenance, disassembly and recommended lubricants for the pump.

INSTALLING THE BOWL ASSEMBLY

The following bowl installation instructions apply to pumps shipped disassembled.

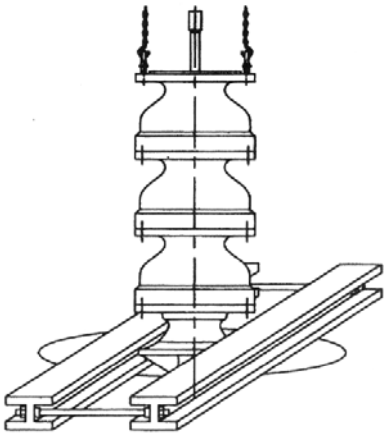
⚠ WARNING

Do not work under a heavy suspended object unless there is positive support and safe guards which will protect personnel should a hoist or sling fail.

! CAUTION

Do not attempt to lift bowl assembly by the pumpshaft. This can result in damaging the pumpshaft.

1. Prior to installing the bowl assembly, check that all capscrews are tight and any integral piping is installed. Remove all accumulated dust, oil, or other foreign material from the external surfaces.
2. Place two I-beam supports across the baseplate opening, strong enough to safely support the weight of the entire pump assembly. These I-beams should be connected by threaded rods and nuts so as to clamp them firmly together for the portion to be supported (See Fig. 5).
3. Put in place a suitable hoist or derrick over baseplate opening. Place the elevator clamps just below the discharge bowl flange or install two threaded eye bolts through bolt holes in flange 180° apart.
4. Attach sling to elevator clamps or eye bolts and hoist into position over foundation opening (See Fig. 5).



INSTALLING THE BOWL ASSEMBLY Fig. 5

5. Carefully lower bowl assembly, guiding the unit so it does not strike the sides of the opening. Continue to lower bowl assembly until the elevator clamps or discharge bowl flange rests firmly on the I-beam supports.
6. Place a cover over the discharge bowl opening to prevent entrance of dirt or other foreign matter.

! 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.

THREADED COUPLING INSTALLATION

! CAUTION

Use "MOLYKOTE" Dow-Corning or equal for all galling material such as 316 stainless steel.

NOTE: Shaft threads are left hand.

When the threaded coupling is not installed on the pumpshaft, install as follows:

1. Coat the threads with a light coat of oil for a non-galling material, or Molykote for galling material.
2. Install threaded coupling onto pumpshaft by threading it on for one-half its length. A fine wire inserted in the drill hole at the center of the coupling can be used as a gauge to determine when the coupling is correctly positioned on the pumpshaft. Remove the wire after installing the coupling.

KEYED COUPLING INSTALLATION

For a pump with keyed shaft coupling, proceed to *INSTALLING THE COLUMN*.

INSTALLING THE COLUMN

OPEN LINESHAFT

Pump lineshafts are connected with either threaded or keyed couplings. Follow only those procedures appropriate for the type of lineshaft coupling supplied.

THREADED LINESHAFT COUPLINGS

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

1. Check the headshaft (608) and lineshaft (646) for straightness. Average total runout should be less than 0.0005" TIR (0.013 mm) per foot (0.305 m), not to exceed 0.005" T.I.R. (0.127 mm) for every 10 feet (3 m) of shafting.

2. Apply a thin film of oil to lineshaft (646) and coupling (649) threads (if non-galling material, or a suitable anti-seize if galling material). Start thread manually until resistance is felt. A fine wire inserted in the drill hole at the center of the coupling can be used as a gauge to determine when the coupling is correctly positioned on the shaft. Remove the wire after installing the coupling. Complete the joint using a pair of pipe wrenches, one on the top of pumpshaft (660) and the other on coupling (649). Run the upper lineshaft into the coupling until it is hand tight. Use care not to apply wrenches on bearing journal surfaces.

! CAUTION

Use "MOLYKOTE" Dow-Corning or equal for all galling material such as 316 stainless steel.

NOTE: Shaft threads are left hand.

3. Install two eyebolts diametrically opposite in the upper flange of bottom column (644). Attach a sling to the eyebolts and to the hoist hook. Hoist column section over bowl assembly. Lower column over lineshaft until column flange engages the discharge bowl flange register. Insert as many capscrews (760C) through both flanges as possible. Tighten capscrews gradually in diametrically opposite pairs.

4. Lift bowl and column assembly high enough to allow rotation of the I-beam supports. Install and tighten remaining capscrews.

5. Lift assembly and remove supports. Slowly lower the bowl and column assembly. Place supports on the baseplate and continue to lower the assembly until the column flange comes to rest on the supports.

NOTE: Normally, the bearing retainer will be integral with the column. The top flange of the column will have a male register and the bottom flange of the column will have a female register. If you have separate bearing retainers, there will be a female register in the flanges at both ends of the column. Follow step 6 below.

6. Place bearing retainer (653) with bearing (652) over lineshaft (646) and locate it in the bottom column (644) flange register.

7. Install threaded coupling (649) on protruding end of lineshaft (646), if required.

8. Assemble next column (642) section, or top column (641) as required, and make certain bottom column register [or bearing retainer (643)] engages the top column register, and secure with capscrews (760B) and hex nuts (735A) provided until all column and lineshaft sections required for the proper pump setting have been assembled. Tighten capscrews into hex nuts gradually and uniformly.

NOTE: Where separate bearing retainers are used, do not overtighten flange bolts in order to make flange faces meet. Flange faces are designed to be separated by bearing retainer (653).

KEYED LINESHAFT COUPLINGS

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

1. Check the headshaft (608) and lineshaft (646) for straightness. Average total runout should not exceed 0.005" T.I.R. (0.12 mm) for every 10 feet (3 m).

2. Apply a thin film of oil to lineshaft.

3. See Fig. 6.

Fig. 6

4. Insert key (730) onto pumpshaft (660).

5. Lower sleeve (734) over pumpshaft, to approximately one inch below top of shaft.

6. Lower lineshaft until it touches pump shaft. Insert split ring (726) into grooves in pumpshaft and lineshaft. Raise sleeve (734) until it covers split ring (726).

7. Insert key (730) onto lineshaft (646). Raise sleeve (734) to top of key (730).

8. Secure sleeve (734) to split ring (726) with lock screw (760) and lock wire (788).

9. Install two eyebolts diametrically opposite in the upper flange of column (644). Attach a sling to the eyebolts and to the hoist hook. Hoist column section over bowl assembly. Lower column over lineshaft until column flange engages the discharge bowl flange register. Insert as many capscrews through both flanges as possible. Tighten capscrews gradually in diametrically opposite pairs.

10. Lift bowl and column assembly high enough to allow rotation of the I-beam supports. Install and tighten remaining capscrews.

11. Lift assembly and remove supports. Slowly lower the bowl and column assembly. Place supports on the baseplate and continue to lower the assembly until the column flange comes to rest on the supports.

NOTE: Normally, the bearing retainer will be integral with the column. The top flange of the column will have a male register and the bottom flange of the column will have a female register. If you have separate bearing retainers, there will be a female register in the flanges at both ends of the column. Follow step 12 below.

12. Place bearing retainer (653) with bearing (652) over lineshaft (646) and locate it in the bottom column (644) flange register.

13. Install next lineshaft coupling assembly on protruding end of lineshaft (646), if required, per steps 4-8 above.

14. Assemble next column (642) section, or top column (641) as required, and make certain bottom column register [or bearing retainer (653)] engages the top column register, and secure with capscrews provided until all column and lineshaft sections required for the proper pump setting have been assembled. Tighten capscrews gradually and uniformly.

NOTE: Where separate bearing retainers are used, do not overtighten flange bolts in order to make flange faces meet. Flange faces are designed to be separated by bearing retainer (653).

INSTALLING THE DISCHARGE HEAD

OPEN LINESHAFT

1. ITT Goulds VIC pumps are provided with "T" type or "L" type heads. Install the discharge head as follows.

2. If the stuffing box is assembled to the head, remove it and all attached piping. See Fig. 7 for the applicable stuffing box provided for the pump being assembled. Remove coupling guard if provided.

3. When a mechanical seal is provided it is usually shipped separately. In case the seal is assembled to the discharge head, remove the seal prior to installing the head. See Dissassembly / Reassembly section for removal of the seal.

4. Remove coupling guard if provided. Attach a sling through windows (hand holes) or thread two eyebolts in the head driver support mounting holes diametrically opposite and hoist discharge head over the protruding headshaft.

NOTE: Eyebolts or sling should be rated to handle in excess of the pump weight (see Outline Drawing).

! CAUTION

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

5. Orient the discharge head in the required position and lower the head centering the vertical hole with the headshaft protruding above the column until the discharge head engages the column. Install capscrews and secure discharge head to column. Tighten capscrews gradually in diametrically opposite pairs.

6. Lift pump assembly high enough to allow rotation of the supports. Realign and lower assembly. Install and tighten remaining capscrews. Repeat rotation and tightening procedure until all capscrews are uniformly tight.

7. Using a device with the capacity to support the weight of the entire pump assembly, hoist bowl, column, and head assembly and remove supports.

NOTE: Eyebolts or sling should be rated to handle in excess of the pump weight (see Outline Drawing).

8. Lower bowl, column and head assembly until discharge head mounting flange engages baseplate. Secure discharge head to mounting plate.

STUFFING BOX INSTALLATION

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

Assemble stuffing box in accordance with the style provided, A, B or C (Fig. 7).

Caution notes apply to each individual stuffing box.

STYLE "A" STANDARD CONSTRUCTION

1. Position gasket on discharge head. Slide stuffing box (616) down over shaft and into position on the gasket. Secure stuffing box with capscrews.
2. Insert packing washer (789) into stuffing box if provided. Packing washer not required on shaft sizes 2.19" (55mm) and larger.
3. Grease the packing rings (620) for easier installation.
4. Twist the packing ring sideways to get it around the shaft easily. 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 down firmly. It must seal on the shaft and bore of the stuffing box. Install all 5 rings in this manner (the 6th ring may be set aside until the packing is adjusted for leakage after the first startup). Stagger ring joints 90°apart. The split gland (618) may be used as a tamper for the top ring.
5. Install the split gland (618) and thread nuts on split gland studs. Tighten nuts then relieve the nuts and tighten finger tight. Attach bypass line (624) to tube fitting in the stuffing box.
6. Final adjustment of the stuffing box must be made at pump start up. This final adjustment applies to all stuffing box styles.

CAUTION

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

7. A properly packed stuffing box should be loose enough to allow the shaft to be turned manually.

CAUTION

Do not over tighten packing or excessive wear can occur on the shaft or sleeve.

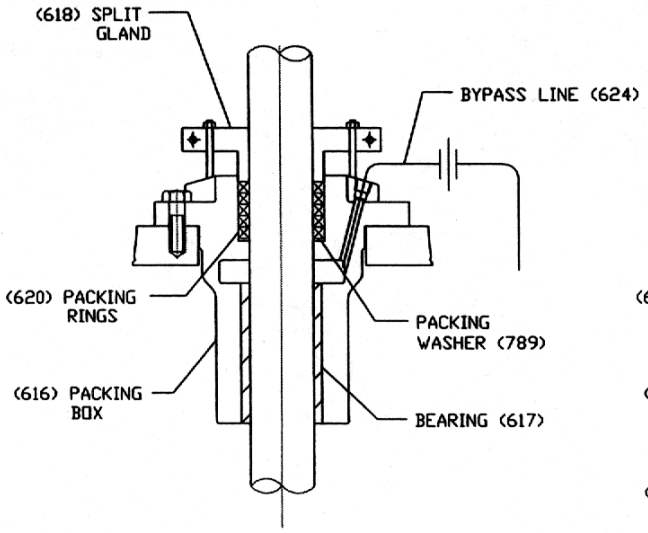
STYLE "B" STANDARD CONSTRUCTION WITH SHAFT SLEEVE

1. Style "B" stuffing box is the same as style "A" with the exception that it has a shaft sleeve with an O-ring.
2. Lubricate the O-ring (743) in the sleeve (609) and also lubricate the shaft threads.
3. Slip sleeve onto shaft, carefully rotate counter clockwise, simultaneously pushing downward gently until O-ring is clear of shaft threads.
4. Locate sleeve on shaft (scribe mark on shaft or setscrew scar) and secure with setscrews (774).
5. Follow steps 1 through 7 of *STYLE "A" STANDARD CONSTRUCTION*, for complete style "B" installation.

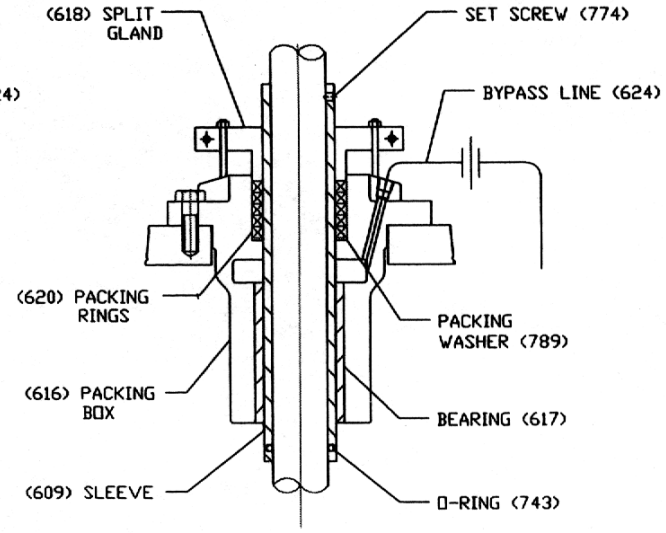
STYLE "C"

1. The style "C" stuffing box is provided with a shaft sleeve, O-ring, lantern ring, and a grease cup.
2. Follow steps 2 through 4 of *STYLE "B" STANDARD CONSTRUCTION* when provided with a shaft sleeve and O-ring.
3. Insert packing washer (789) into stuffing box and install two packing rings (620) in accordance with steps 3 and 4 of *STYLE "A" STANDARD CONSTRUCTION*.
4. Insert lantern ring (621) into stuffing box. Be sure it is properly positioned so that it aligns with the lubrication passage in the stuffing box.
5. Install two packing rings, stagger ring joints 90° apart.
6. Install split gland (618) and thread nuts on split gland studs. Tighten nuts with a wrench, then relieve the nuts and tighten finger tight. Attach by-pass line (624) to tube fitting in stuffing box. Thread grease cup (619) into stuffing box.
7. Fill grease cup with a high grade of grease.
8. After stuffing box is completely assembled, apply grease to the lantern ring by turning the grease cup cap a couple of turns.

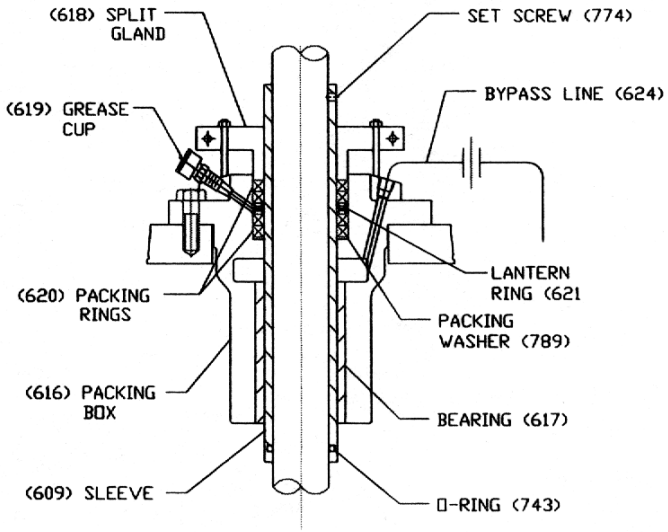
STUFFING BOX ARRANGEMENTS



STYLE A



STYLE B



STYLE C

Fig. 7

MECHANICAL SEAL INSTALLATION

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

Instructions for installing mechanical seals are provided by the seal manufacturer. Consult the seal manufacturer's instructions (furnished with the seal) for information on the type of seal used. Additionally, refer to factory furnished outline drawing and seal piping schematic on complex seal piping arrangements.

GENERAL REQUIREMENTS FOR ALL SEALS

The vertical turbine pumps are usually supplied with cartridge type mechanical seals, shipped assembled - ready for installation, when mechanical seals are supplied. The exceptions are the Outside Mounted Seals (Fig. 12) and the Split Seals (not shown).

1. Check surfaces at the face of the seal housing and at the bottom of the seal housing to insure that they are clean, flat and free of burrs. The face surface must be smooth to form a good sealing surface for a gasket or O-ring.

2. Check that shaft is smooth, and free of burrs, nicks and sharp corners that could ruin the O-ring or shaft packing. When further clean up is required, protect by covering the inside of the pump seal housing. Remove burrs, nicks, and sharp corners by using a strip of emery cloth "shoeshine fashion" over the shaft threads. File threads around the keyway with a smooth mill file or emery cloth. Sharp edges must be rounded.

3. Remove all chips and dust from the shaft area.

4. Check that all rotary unit parts of the seal fit over the shaft. A pre-check may be made by removing the O-ring(s) from the cartridge sleeve Inside Diameter (ID) and then installing the seal on the shaft. Further shaft clean up will be necessary when the seal will not pass all the way into the seal housing.

5. Remove the seal after the pre-check, and re-install the sleeve O-ring(s).

CAUTION

Sparingly lubricate the shaft and sleeve ID with the lubricant included with the mechanical seal or recommended by the mechanical seal manufacturer. The following lubricants may be used for water service when no lubricant is supplied or recommended by the mechanical seal manufacturer.

- Light Oil (SAE #10 or 20)
- Dow Corning #4 Grease
- Silicone Lubricant
- Wax or Clay
- Soapy Water

Oil based lubricants will damage EPR / EPDM elastomer O-rings. Silicone lube and soapy water are safe for EPR / EPDM elastomer O-rings.

6. Install the O-ring or gasket, between the seal housing and seal. Install the seal over the shaft and ease it into position against the face of the seal box. Take care when passing the sleeve and O-ring over keyways or threads to avoid damaging the O-ring.

CAUTION

Do not bump carbon members against the shaft as they may chip, crack, or break.

7. Position seal gland on discharge head seal housing and secure with capscrews (or nuts for studs) provided. Tighten capscrews gradually and uniformly in a criss-cross pattern, taking 2 or 3 passes.

CAUTION

Do not overtighten capscrews on gland. This can distort seal seat and cause seal failure.

8. Install all seal piping as required. Prior to making final connections of sealing liquid pressurizing lines, make sure the seal housing and all sealing liquid lines are flushed free of dirt, scale, and other particles that would be abrasive to the sealing faces.

9. The driver and coupling must now be installed before the mechanical seal installation can proceed. See *INSTALLATION OF A SOLID SHAFT DRIVER* or *INSTALLATION OF A HOLLOW SHAFT DRIVER* as appropriate.

10. The following flatness and concentricity measurements may be taken at this time.

    A. **Concentricity of Driver Shaft** (See Fig. 8). Install dial indicator as shown, with the base attached to the motor support. Rotate driver shaft by hand while checking dial for reading. Runout should not exceed NEMA standards, 0.002 in. (0.05mm) maximum Total Indicated Runout

(TIR). If indicator reads above 0.002 in. (0.05mm) TIR, loosen the four driver tie down bolts and relocate driver on motor base register. Obtain desired position. Tighten tie down bolts. Repeat indicator reading.

B. **Flatness of Seal Housing** (See Fig. 9). This measurement may require that the mechanical seal be removed in the event that the dial indicator stylus cannot rotate 360° on the top surface of the seal gland. With the lower coupling components removed, attach the base of the dial indicator to driver shaft. Place the stylus at the top surface of the seal gland, or at the top surface of the seal housing. Rotate the driver shaft slowly 360°. Check that the face of the seal housing is square with the shaft, to within 0.002 in. (0.05mm) TIR.

C. **Concentricity of Seal Housing** (See Fig. 10). This measurement will require that the mechanical seal be removed. Install dial indicator as shown. By rotating driver shaft by hand, run indicator in the inside machined surface of the seal housing to determine concentricity. If indicator reads above 0.004 in. (0.10mm) TIR, loosen the four driver tie down bolts and relocate driver on motor base register. Obtain desired position. Tighten tie down bolts. Repeat indicator reading.

D. **Concentricity of Head Shaft** (See Fig. 11). Re-install the mechanical seal if it was removed for the Flatness or Concentricity measurement. Install the coupling assembly and make the impeller adjustment as described in *Installation* section. Attach the base of the dial indicator on the discharge head or driver support. Place the stylus on the shaft between the top of the seal and the bottom of the pump coupling. Rotate the driver shaft slowly 360°. Check that the shaft runout is within 0.004 in. (0.10mm) TIR, or as required by specification.

11. The drive collar of the seal may now be positioned and installed by tightening the set screws using the mechanical seal manufacturer's instructions.

CAUTION

Do not remove seal spacer or eccentric washer, adjust seal, or tighten setscrews until after impellers are adjusted.

12. Save the seal spacer or eccentric washer as they may be used to hold the correct seal spacing in the event that the seal must be removed. The seal setscrews must be loosened to re-adjust the impeller(s).

CAUTION

Reset the seal after impellers are adjusted.

13. Seals using half dog setscrews may require that the shaft be spot faced/drilled, to provide a secure placement. Cover the seal and seal housing. Remove the setscrews, one at a time from the collar and spot face/drill the shaft. Then tighten the setscrews into position. Remove any metal chips to avoid damaging seal.

SINGLE INSIDE MOUNTED SEALS (See Fig. 12)

These seals will be cartridge seals, complete with glands and sleeves, assembled as a unit by the seal manufacturer. The seal manufacturer's special instructions must be followed in the event that non-cartridge seals are to be installed.

1. When the seal is an O-ring type, assemble the complete unit over the shaft. Take care when passing the sleeve and O-ring over keyways or threads to avoid damaging the O-ring.

2. If the seal is the teflon wedge ring type, remove the sleeve collar and teflon wedge ring and assemble them separately after the sleeve is in position. Tighten the collar on the threads to seal teflon wedge around the shaft.

SINGLE OUTSIDE MOUNTED SEALS (See Fig. 12)

These seals will be provided in two sub-assemblies, the stationary unit and the rotary unit.

1. Install the stationary unit, which is the seal gland assembly as instructed in *GENERAL REQUIREMENTS FOR ALL SEALS*. The stationary face will face up.

2. Install rotary unit taking care not to disengage rotary parts. If rotary unit parts become disengaged, installation becomes difficult.

3. Do not tighten setscrews or adjust seal at this time until impellers are adjusted.

4. To adjust seal, refer to the spring gap which is stamped on the collar and shown on the assembly drawing. Tighten setscrews so that the compression ring is maintained at the same distance from the collar at all points. Before starting the pump, check to insure that the spring gap and the distance from the face of the stuffing box to the collar are the same as shown on the seal assembly drawing.

HIGH PRESSURE SEALS (See Fig. 12)

High Pressure seals are usually cartridge seals, shipped assembled, ready for installation. High Pressure seals may be either Single or Dual seals.

1. Mechanical seals on pumps with over 1200 PSI (85 kg/cm2) gauge discharge pressure, or as specified by the seal manufacturer, are normally fitted with "backup rings." These rings are installed following seal installation, between the drive collar of the seal and the bottom of the flanged pump coupling, (See Fig. 12). Install backup ring as follows:
   A. Screw the bottom backup ring into the top backup ring until it bottoms out.
   B. Slide backup ring assembly over the shaft and position it on the seal.
2. Adjustment of the backup ring assembly shall be completed after the spacer coupling and driver are installed, after the seal is set in position, and after checking total indicated runout on the headshaft above the mechanical seal as stated in *GENERAL REQUIREMENTS FOR ALL SEALS."*

DUAL SEALS (Tandem and Double) (See Fig. 13)

Dual seals are cartridge seals, shipped assembled. The following instructions would only apply if a non-cartridge type seal is furnished, and there are no instructions provided by the seal manufacturer.

1. Scribe a mark on the shaft or sleeve exactly flush with the face of the seal housing. This is the "reference mark" for setting the seal to the seal assembly.
2. Lubricate the stuffing box bore and O.D. of inner (or lower) stationary insert with lubricants described in *GENERAL REQUIREMENTS FOR ALL SEALS*," Paragraph 6. Protect inner inset face with soft clean material, such as gasketing or sheet rubber and install into the bottom of the seal housing with hand pressure only. If the insert includes a holding pin, be sure the pin is aligned with the slot or hole in the bottom of the seal housing.
3. Carefully place gland ring and outer (or upper) stationary insert over the shaft.
4. Lubricate shaft or sleeve before installing any of the rotary unit parts.
5. Install seal collar or collars on the shaft or sleeve and locate collar or collars in the relation to established "reference mark" and to setting dimension given on the seal assembly drawing. Lock the collar to shaft or sleeve by tightening setscrews.
6. Install the remaining rotary unit parts on the shaft or sleeve in the proper sequence and complete the assembly of equipment.
7. Shaft packing (if provided, depending on seal type) shall be installed on the shaft or sleeve individually and with care to avoid nicks or damage that would cause seal to leak.
8. Seat the gland ring and gland gasket to the face of the seal housing by tightening the nuts or bolts evenly and firmly. Be sure the gland ring is not cocked. Tighten nuts or bolts just enough to seal at the gland ring gasket.

SEAL FLUSH PLANS

1. See Fig. 14 for generic schematic drawing of seal flush plan provided with your pump.

The mechanical seal piping must always stay connected. Failure to do so will result in excess heat generation and seal failure.

CONCENTRICITY OF DRIVER SHAFT

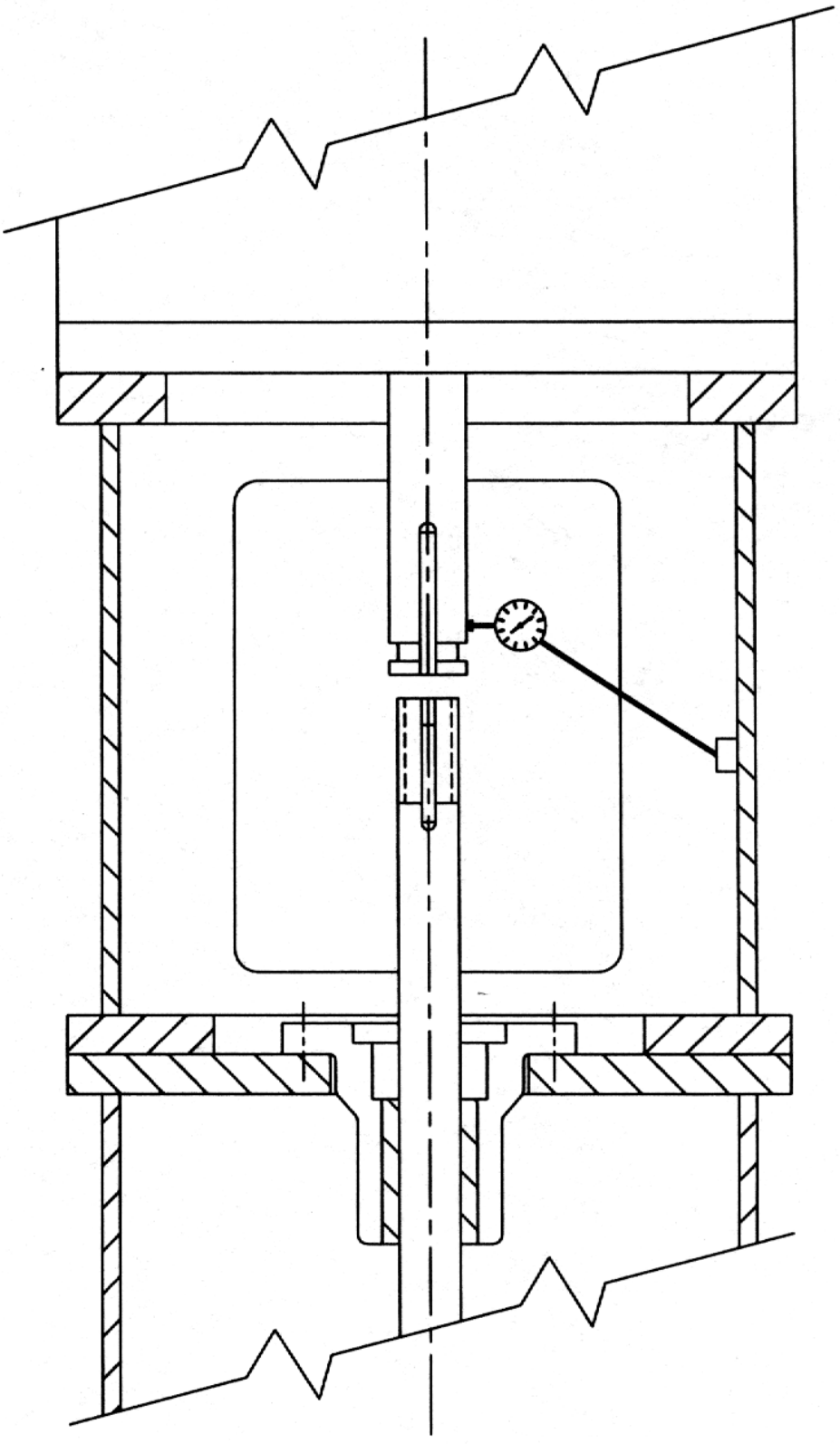


Fig. 8

FLATNESS OF SEAL HOUSING

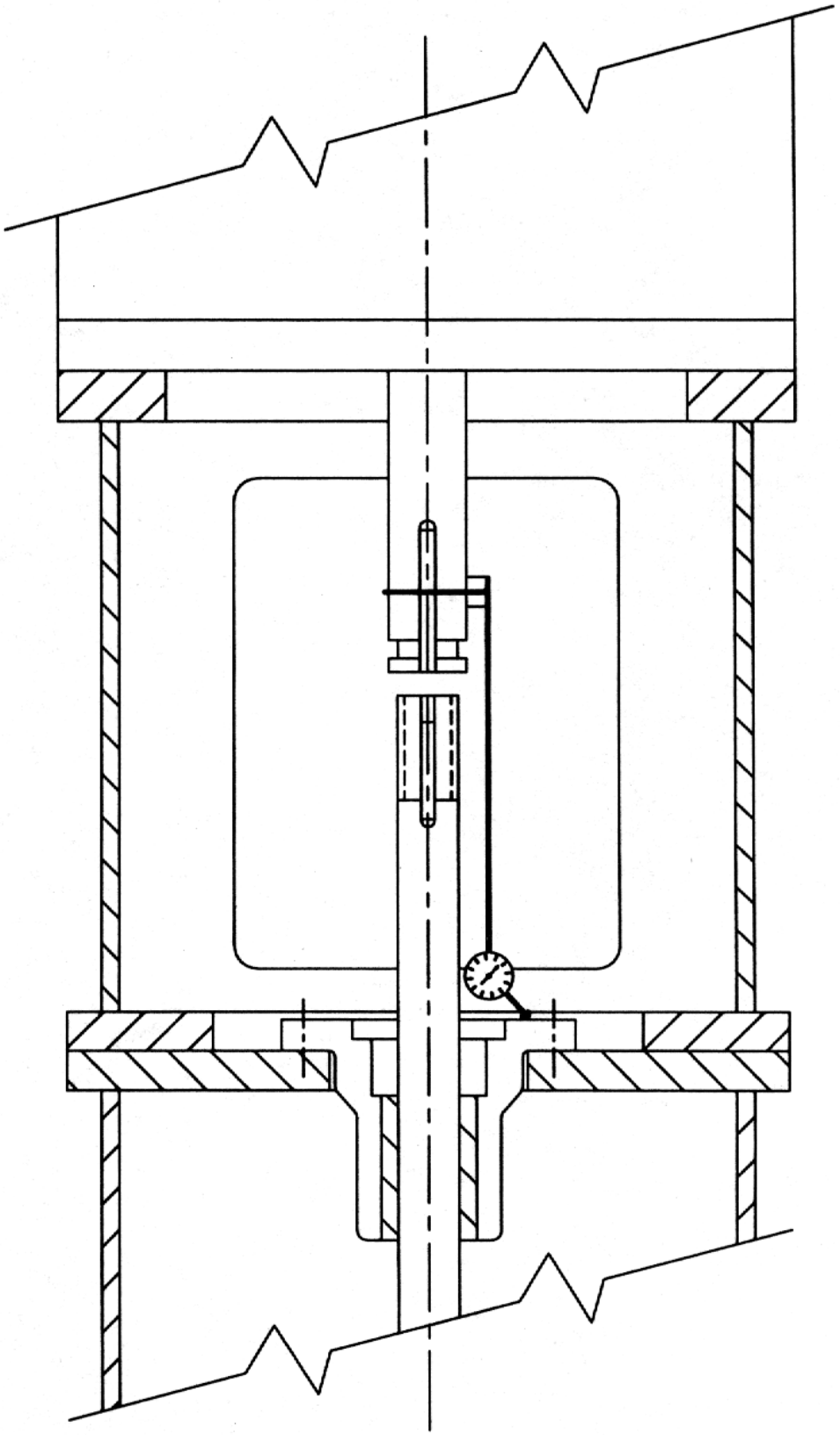


Fig. 9

CONCENTRICITY OF SEAL HOUSING

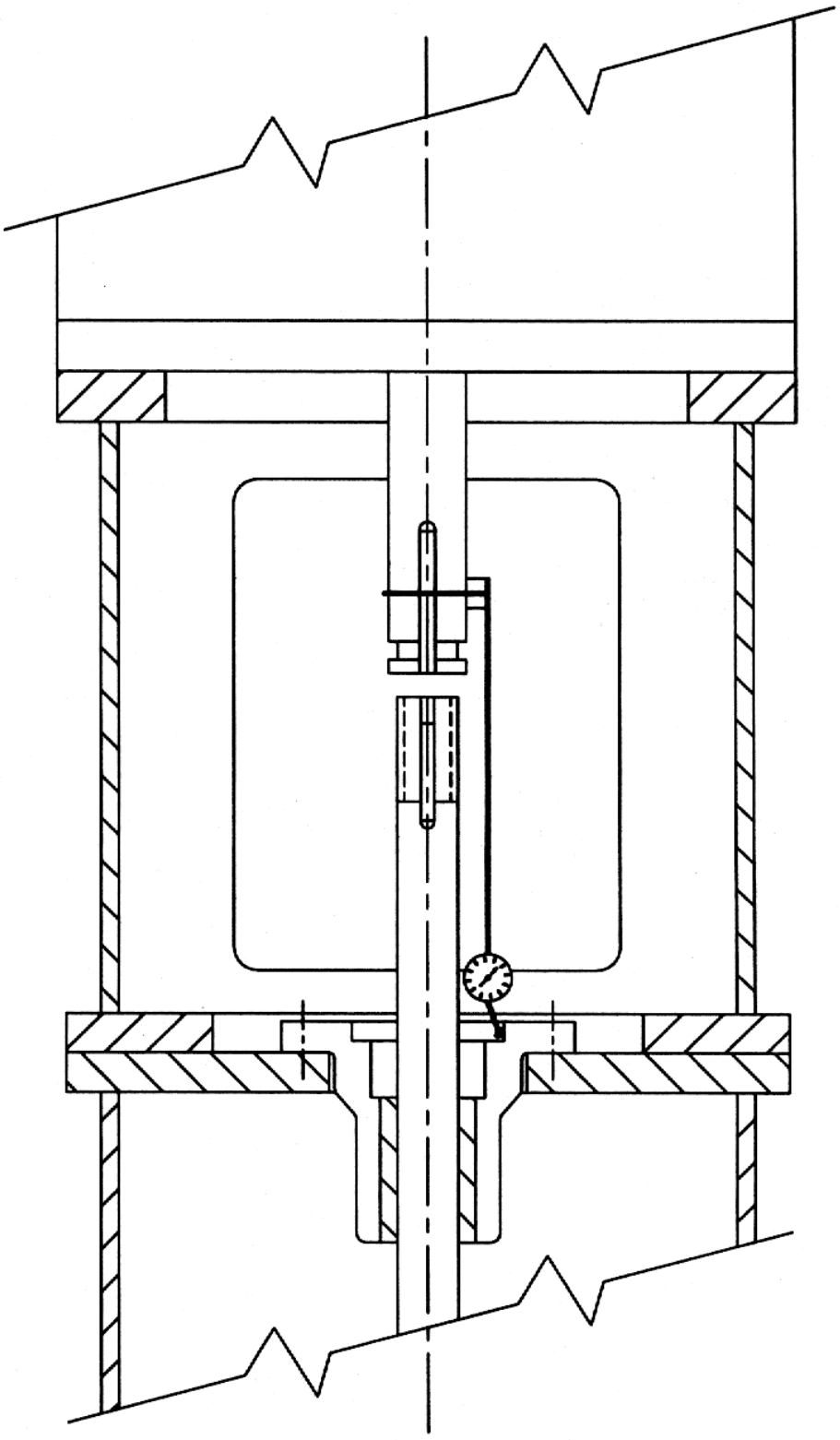


Fig. 10

CONCENTRICITY OF HEAD SHAFT

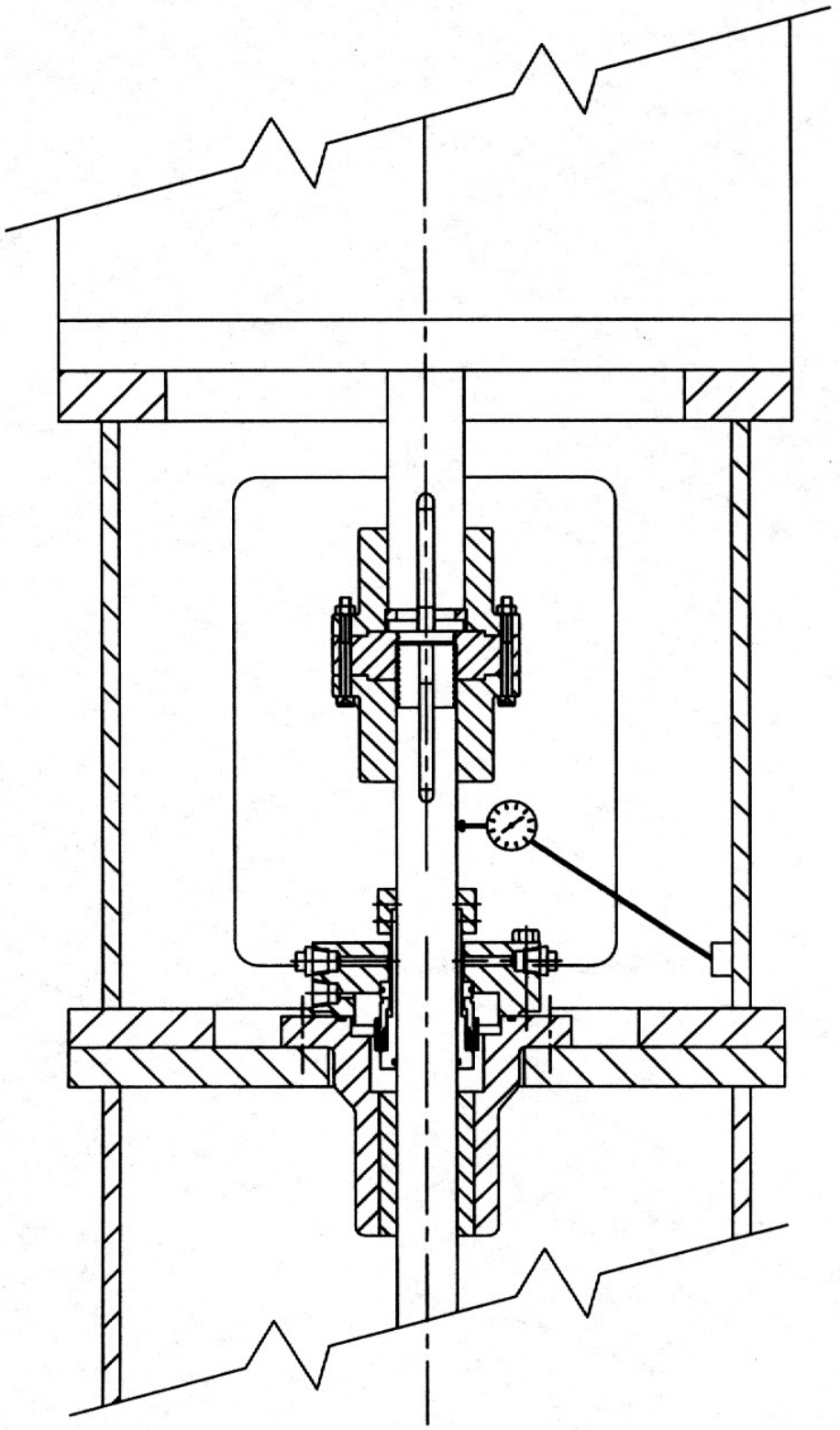


Fig. 11

SINGLE MECHANICAL SEALS

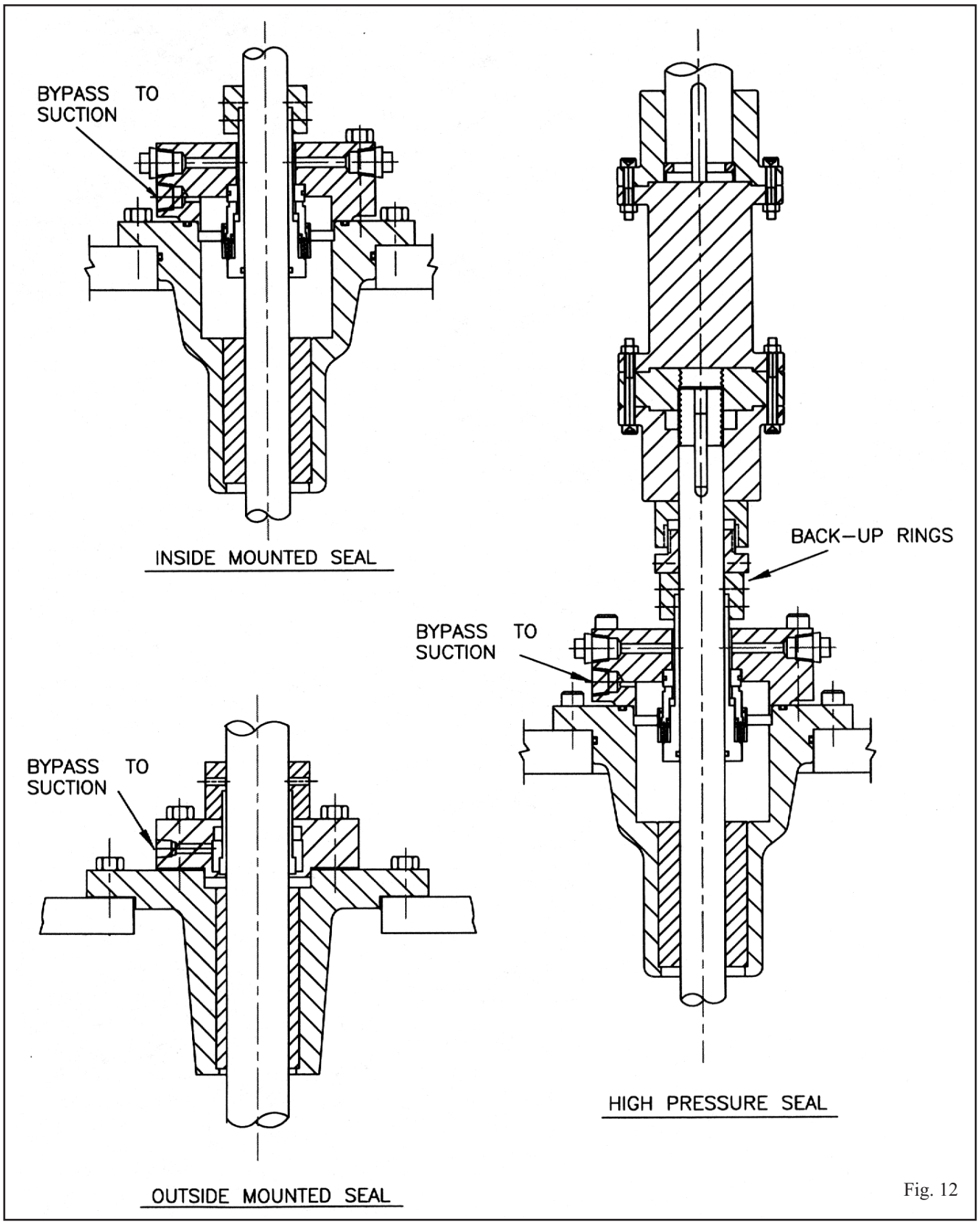
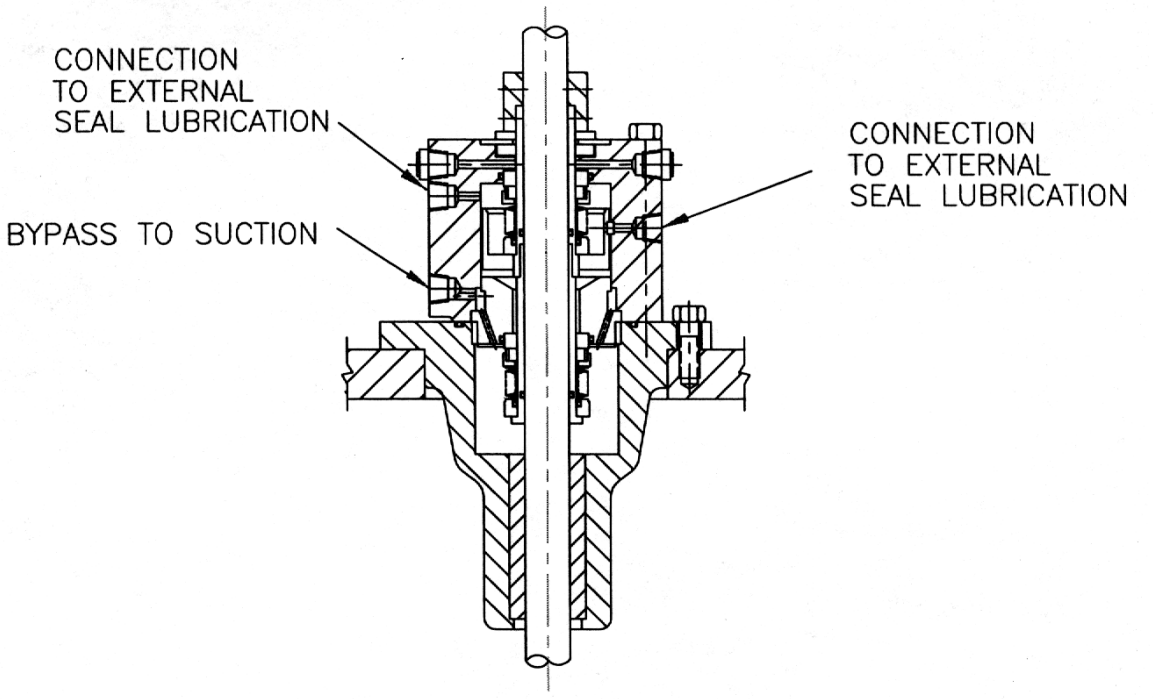
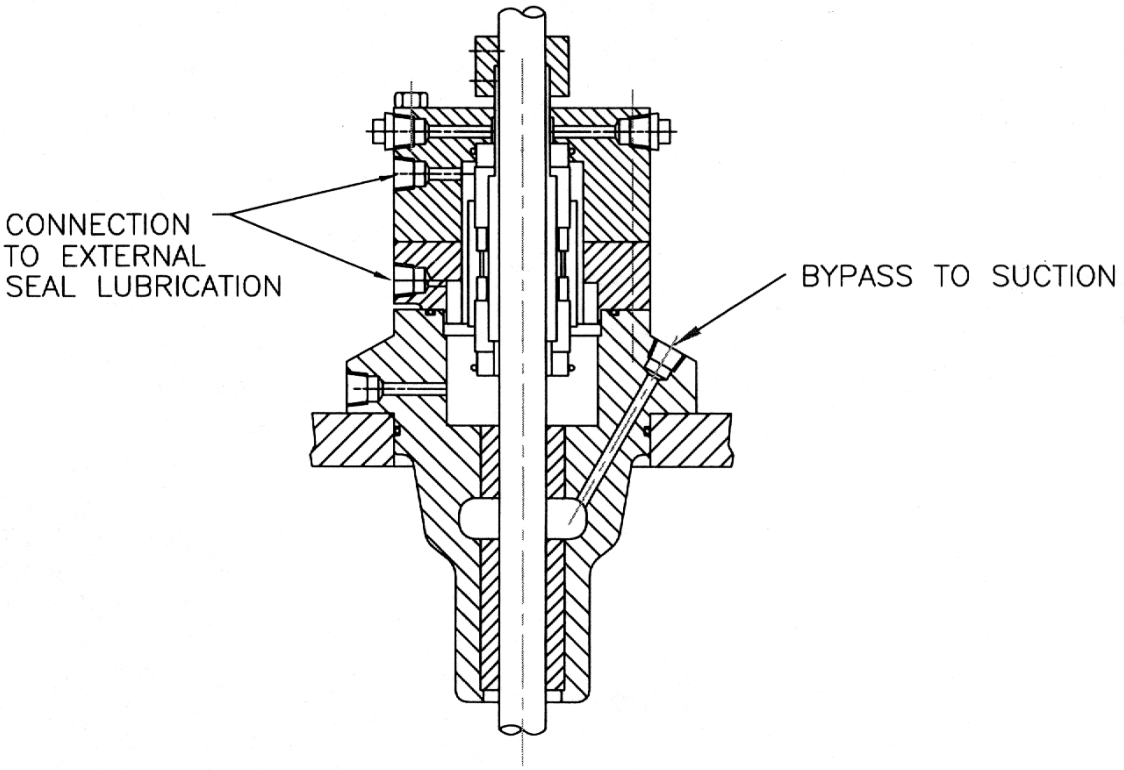


Fig. 12

MECHANICAL SEALS, DOUBLE AND TANDEM MOUNTED



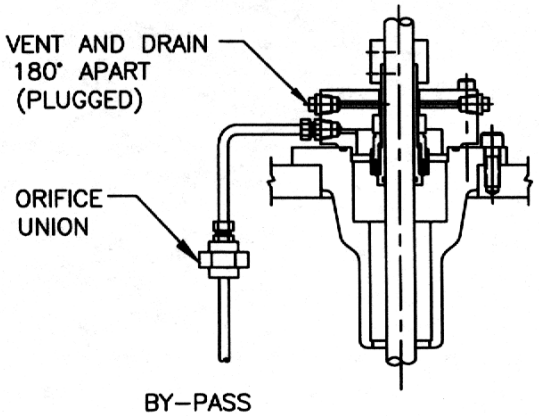
TANDEM MOUNTED SEAL
(DUAL UNPRESSURIZED)



DOUBLE MOUNTED SEAL
(DUAL PRESSURIZED)

Fig. 13

SEAL FLUSH PLANS

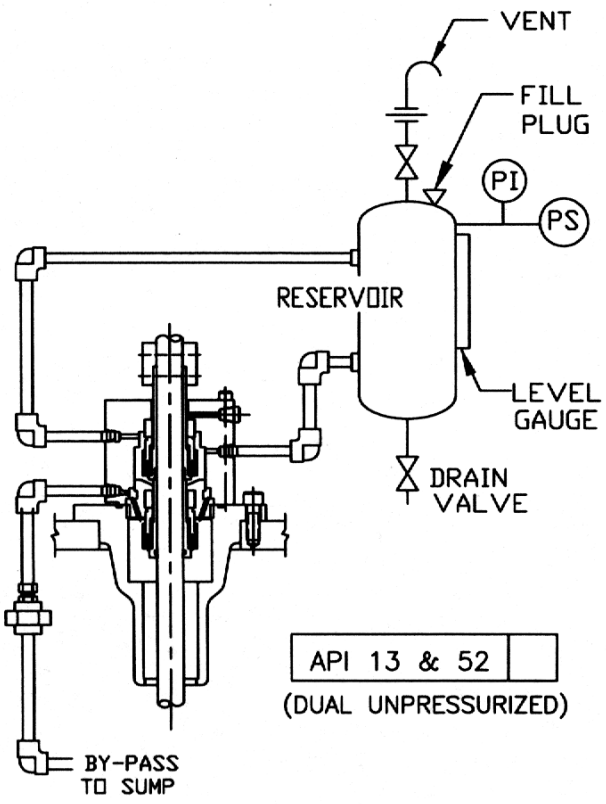


API 13 ☐

TYPICAL FOR SINGLE SEAL

OTHER ☐

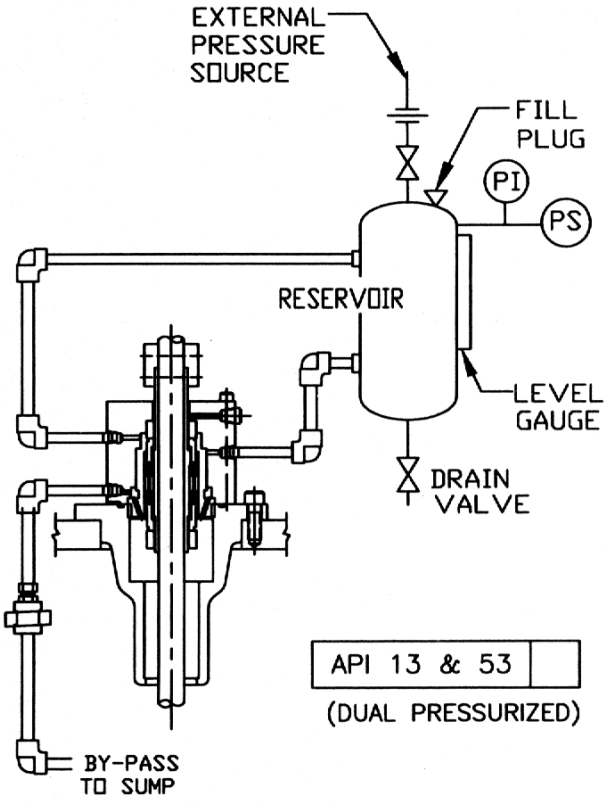
NOTE: REFER TO ORDER DATA PACKAGE FOR JOB SPECIFIC SEAL PLAN DATA



API 13 & 52 ☐

(DUAL UNPRESSURIZED)

TYPICAL FOR TANDEM SEAL



API 13 & 53 ☐

(DUAL PRESSURIZED)

TYPICAL FOR DOUBLE SEAL

(CHECKED BOX INDICATES FLUSH PLAN PROVIDED)

Fig. 14

INSTALLING THE DRIVER-SOLID SHAFT

When installed in a potentially explosive environment, please ensure the motor is properly certified.

INSTALLATION OF A SOLID SHAFT DRIVER

NOTE: When pump is supplied with a thrust pot, do not secure driver to discharge head until after the thrust pot and flexible coupling are installed. (A separate supplement for thrust pots will be furnished as required).

WARNING

Do not work under a heavy suspended object unless there is a positive support and safe guards which will protect personnel should a hoist or sling fail.

Serious damage may result if pump is run in the wrong direction.

The coupling between the driveshaft and discharge head shaft may be a nonspacer type (See Fig. 17), or a spacer type (See Fig. 18). The latter is used on pumps furnished with a mechanical seal to permit servicing of the seal without removal of the driver.

1. Driver support. When a driver support is furnished and not installed, proceed as follows:
   A. Hoist driver support, inspect the mounting surfaces, register, and clean these surfaces thoroughly.
   B. Install driver support on discharge head and secure with capscrews provided.
2. Attach a sling to the lifting lugs of driver, 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, cleaning thoroughly afterward.
3. Orient the motor conduit box in the required position. Align the motor mounting holes with the mating tapped holes on the discharge head. Lower the motor until the registers engage and the motor rests on the discharge head. Secure motor with capscrews provided.
4. On drivers having a nonreverse ratchet or pins, manually turn the driver shaft clockwise viewed from the top until the nonreverse ratchet or pins fully engage.
5. Lubricate motor bearings in accordance with instructions given on lubrication plate attached to the motor case.

NOTE: Please read and follow the motor manufacturer's instructions before lubricating the motor bearings. Too much lubricant can cause the bearings to overheat and fail prematurely.

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 motor would result. Also serious injury to personnel could result.

6. Make temporary electrical connections according to tagged leads or diagram attached to the motor. Motor must rotate counter-clockwise when viewed from the top. See arrow on pump name plate. If motor does not rotate counter-clockwise, you can change the rotation by interchanging any two leads (for three phase only, for single phase motors see motor manufacturer's instructions.)
7. Motor shaft end play adjustment: if required, motor shaft end play shall be checked with a dial indicator prior to connecting the pump coupling to the solid shaft motor. Consult the applicable motor manufacturers instruction manual for detailed information on motor shaft end play.

COUPLING INSTALLATION: (Figs. 17 & 19)

1. Apply a thin film of oil on the pump key (730) and insert key into headshaft keyway seat.
2. Gently lower pump hub of coupling (614) onto headshaft.
3. Thread the adjusting plate (613) onto the headshaft until flush with top of the headshaft.
4. Apply a thin film of oil to the driver key (730) and insert key into drive shaft keyway seat. Place the driver hub (610) onto the drive shaft and with key slide it up the drive shaft until the annular groove is exposed. Install split ring (722) in the groove and slide driver hub down over the split ring to capture it.
5. If the pump is supplied with an adjustable spacer coupling (See Fig. 18), install spacer (612) between headshaft and driveshaft hubs. Secure with capscrews (759) and hex nuts (735).

IMPELLER ADJUSTMENT

Impeller adjustment is identical for all motors and right angle gear drives. Adjustment is accomplished by turning the adjusting plate (613). (See Fig. 17 or 19). The correct adjustment is listed on the Outline Drawing for the specific unit.

NOTE: Mechanical seal, when provided, must not be secured to the shaft prior to impeller adjustment (open or enclosed type impeller's). Shaft must move up or down within the seal assembly.

NOTE: For pumps handling liquids between -50° to 200° F, impeller adjustments can be made under ambient conditions. For liquids in excess of this range, it is recommended that impeller adjustment be made after the pump surface temperature has reached an equilibrium when charged with the pumpage. In those cases, where this is not feasible due to safety considerations or impossible due to external ice build up in cryogenic applications, refer to factory for specific instructions.

Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

Open Impellers

1. With the impellers touching the bottom of the bowls, turn the adjusting plate (613) towards the driver hub (610) or spacer (612) obtain 0.015 inch clearance between the adjusting plate and driver hub or spacer for the first 10 feet of column. Add 0.010" for each additional 10 feet of column. See Figs. 21 or 22.

NOTE: The determination of driver shaft end play can be critical and should be added to this setting. For larger pumps over 8", this amount may be too little; please refer to Outline Drawing.

   Example: total pump length is 50 feet - set open impellers at 0.055 inch.

2. After impeller adjustment, align adjusting plate (613) with the pump hub (614), and tightly draw coupling flanges together with capscrews (759) and nuts (735) (See Figs. 17 or 19).

3. Set seal after impeller adjustment. Securely tighten all set screws in the collar. Remove the spacer between the gland plate and collar. Retain spacer for future resetting of seal.

NOTE: When impellers are reset, the seal must also be reset.

Enclosed Impellers

1. For enclosed impellers obtain the clearance between the adjusting plate and driver hub or spacer as specified on the outline drawing (See Figs. 17 or 19).

INSTALLATION OF SOLID SHAFT RIGHT ANGLE GEAR DRIVE

WARNING

Do not work under a heavy suspended object unless there is a positive support and safe guards which will protect personnel should a hoist or sling fail.

1. The coupling shown between the drive shaft and head shaft may be a non-spacer type (See Fig. 17) or a spacer type (See Fig. 19). The latter is used on pumps furnished with mechanical seal to permit servicing of the seal without lifting the gear.

2. Driver support: when a driver support is furnished and not installed, proceed as follows:

   A. Hoist driver support, inspect mounting surfaces, register, and clean these surfaces thoroughly.

   B. Install driver support on the discharge head and secure with capscrews provided.

3. Attach a sling to the eye bolts or lugs of gearhead. Hoist gearhead, inspect the mounting surface, register, and clean these surfaces thoroughly. If any burrs are found, remove burrs with a smooth mill file cleaning thoroughly afterward.

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. Lower the gearhead until the registers engage and the gearhead is set firmly in place on the discharge head. Secure the gearhead with capscrews provided.

5. On gearheads having non-reverse ratchet or pins, manually turn the shaft clockwise viewed from the top until the non-reverse ratchet or pins are fully engaged.

NOTE: 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 checking rotation. Do not operate in reverse direction of these arrows as serious damage or injury can occur.

6. Some gearheads are equipped with an oil cooling system which is supplied with cooling fluid from the pump or 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 outlet on the discharge side of the discharge head, connect tubing from the outlet on gearhead back to sump or drain.

CAUTION

Do not use rigid pipe for this purpose. rigid pipe is susceptible to leakage at the joints due to vibration.

7. Fill the gearhead oil reservoir with a high grade of turbine oil. Consult the manufacturer's instructions for the frequency of oil change and other data on maintenance.

CAUTION

Do not use automotive oils.

8. Gearhead shaft end play adjustment. If required, gearhead shaft end play shall be checked with a dial indicator prior to connecting pump coupling to solid shaft gear. Consult the applicable gear manufacturers instruction manual for detailed information on gearhead shaft end play.

9. Coupling installation. Follow instructions given under the *COUPLING INSTALLATION* section.

⚠ 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 the gearhead input 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 lift. 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 on the prime mover (engine or steam turbine) and coupling or drive shaft. When a Fast type coupling or equivalent is used instead of the double universal type of shaft used with engine drives, no "offset" between drive and driven shafts is permitted.

INSTALLING THE DRIVER-HOLLOW SHAFT

INSTALLATION OF A HOLLOW SHAFT DRIVER

This refers to either VHS type electric motors or hollow-shaft type gear drives. A small paragraph will be devoted to combination electric motor and right angle gear drives.

NOTE: When pump is supplied with a thrust pot, do not secure driver to discharge head until after the thrust pot and flexible coupling are installed.

⚠ WARNING

Do not work under a heavy suspended object unless there is a positive support and safe guards which will protect personnel should a hoist or sling fail.

1. The driveshaft projecting through the quill or hollow-shaft of the driver is separate from the pump shaft and connected to same by a rigid flanged coupling or threaded coupling.

2. Driver support. When a driver support is furnished and not installed, proceed as follows.
   A. Hoist driver support, inspect the mounting surfaces, register, and clean these surfaces thoroughly.

   B. Install driver support on discharge head and secure with capscrews provided.

3. Attach a sling to the lifting lugs of driver, 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, cleaning thoroughly afterward.

4. Orient the motor conduit box in the required position. Align the motor mounting holes with the mating tapped holes on the discharge head. Lower the motor until the registers engage and the motor rests on the discharge head. Secure motor with capscrews provided.

5. On drivers having a nonreverse ratchet or pins, manually turn the driver shaft clockwise viewed from the top until the nonreverse ratchet or pins fully engage.

6. Lubricate motor bearings in accordance with instructions given on lubrication plate attached to the motor case.

7. The driving mechanism of all hollow-shaft drives is shown on Fig. 15. The drive shaft (606) extends up through the quill or hollow-shaft of the motor (or gear drive) and is held in place by an adjusting nut (604), which not only carries all the static and hydraulic thrust of the impellers and shaft but also provides the adjustment for the impeller clearances.

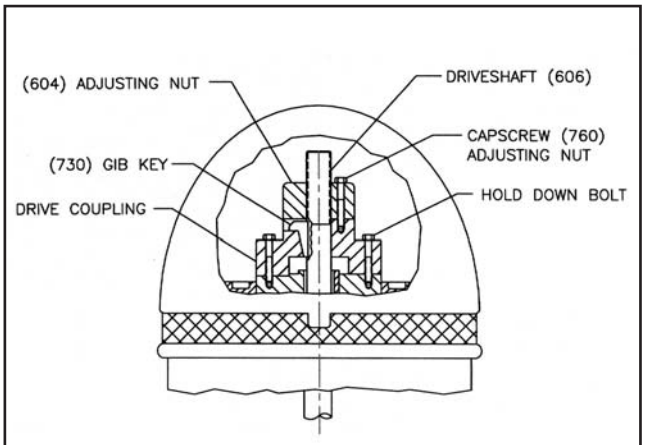


Fig. 15

8. After lowering and orienting the motor and/or gear drive as explained above, remove the drive coupling and hold down bolts as shown in Fig. 15.

9. Screw the adjusting nut (604) loosely onto the end of driveshaft (606). Clean thoroughly and attach a light line below the nut. Lower the driveshaft through the motor quill shaft. Examine closely for dirt or burrs between shaft ends. Raise the driveshaft/adjusting nut assembly to allow room to install the rigid flanged coupling.

10. Make up the head shaft coupling using suitable thread compounds as described below.

TYPE AR RIGID FLANGED COUPLING ASSEMBLY PROCEDURE (See Fig. 21)

1. Disassemble coupling. Be certain that all components are clean and no foreign matter is lodged in any of the machined recesses or registers. Insert driver key (730) into the driver keyway and slide driver hub (610) onto driver shaft. Position hub such that the threaded shaft end is exposed to allow mounting of threaded sleeves on the shaft end. If necessary for ease of assembly, temporarily secure hub in this position by means of tape, rope, or other convenient means.

2. Screw the threaded ring (607) onto the driver shaft until the ring extends beyond the shaft end between 0.06" and 0.09" (1.5mm and 2.4mm). This insures that the driver and pumpshaft ends will not contact each other when the coupling is completely assembled.

3. Insert the pump key (730) in the pumpshaft keyway and slide the pump hub (614) onto the pumpshaft. Position hub so the threaded shaft end is exposed.

4. Screw the threaded ring (611) onto the pumpshaft until the ring extends beyond shaft end between 0.06" and 0.09" (1.5mm and 2.4mm). This insures that the driver and pumpshaft ends will not contact each other when the coupling is completely assembled. Position hub so the threaded shaft end is exposed.

5. Slide pump hub (614) towards the threaded ring (611) until the threaded ring is fully seated in its register in the hub - hold hub in this position.

6. Insert the alignment ring (727) into the register in the pump hub (614).

7. Slide the driver hub (610) towards the pump hub (614) until the driver shaft threaded ring (607) is fully seated in the register in the driver hub (610).

8. Insert all the coupling hub capscrews (759) and hex nuts (735) and tighten finger tight only.

9. See Fig. 21. Measure the gap between the coupling hub faces. In a properly assembled coupling, the gap will be between 0.014" and 0.026" (0.35mm and 0.66mm). This assures proper clamping of the threaded rings (607 & 611). If the gap is not correct, disassemble the coupling and check that all parts are clean and free of foreign matter. Then reassemble the coupling per instructions above. The alignment ring (727) will be compressed between the coupling hubs.
10. Tighten all coupling hub capscrews (759).

COMPLETION OF INSTALLATION OF A HOLLOW SHAFT DRIVER

1. Remove lifting line and see if driveshaft centers inside the motor quill shaft within 0.06" (1.5mm). If it does not, misalignment is indicated.

2. Any driveshaft misalignment with driver quill shaft could be caused by a bent driveshaft, burrs or foreign matter between shaft ends or any of the mounting flanges: motor to mount, mount to discharge head, discharge head mounting to plate or the plate itself could be out of level. If the latter, shimming between it and discharge head base will correct it. Also, check concentricity of motor to motor stand to discharge head.

3. With the motor in place and the driveshaft projecting through the motor quill shaft, connect up the electricity and check motor rotation. This should be counter-clockwise when viewed from the top. See arrow on pump nameplate. If motor does not rotate counter-clockwise, you can change the rotation by interchanging any two leads (for three phase only, for single phase motors see motor manufacturer's instructions.)

CAUTION

Never check motor rotation with the drive coupling in place. The bore clearance between the drive coupling and the pump shaft O.D. is so close that should the motor spin with this shaft stationary, galling and locking together is very likely to take place.

4. Install motor drive coupling, inserting the ratchet pins if a non-reverse ratchet is used. Match the coupling lugs with corresponding holes in motor. Pull down hold down bolts evenly, making sure drive coupling is properly seated in the register fit.

5. Fit gib key (760) into keyway, by filing if necessary, to where there is a snug but sliding fit. This key must be able to be removed by gentle leverage with a screwdriver under it.

6. Be careful that the gib key (760) is not too high so as to hold up the adjusting nut (604) from seating on the drive coupling. If it is, cut off some of it.

7. Install adjusting nut (604) to hand tight.

GEAR DRIVES WITH ENGINES

1. The procedure for installing a hollow-shaft gear is exactly the same as for the motor.

2. Checking pump rotation is very simple matter. Check the arrows of rotation on the engine. Throw out the clutch, take a bar and jack over the flexible drive shaft in direction of engine rotation, and note if it turns the pump shaft in the proper direction.

NOTE: engines almost invariably turn clockwise when looking toward the gear drive.

COMBINATION ENGINE AND MOTOR DRIVES

1. On these drives the motor is invariably on top with a projecting head shaft extension.

2. Follow all procedures outlined in *Installation* section, except that motor must be lowered over this extended driveshaft and great care must be taken to center it exactly so as not to bump or misalign the shaft while the motor is being lowered into place.

3. There are several methods of running engines without electric motors and visa versa, requiring simple adjustments to the combination drive, but they are too numerous to mention here and can be obtained from the gear manufacturer's instructions included with the shipment.

IMPELLER ADJUSTMENT FOR ALL HOLLOW - SHAFT DRIVES

NOTE: Shaft adjustment up or down is accomplished by turning the adjusting nut (604) Fig. 22.

NOTE: There are five holes in the adjusting nut and only four in the motor coupling.

Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

Open Impellers

NOTE: Although mechanical seals are scarcely ever provided with hollow shaft drives, they must be disengaged prior to impeller adjustment when they are.

Impeller adjustment procedures must be followed to prevent unintended contact of rotating parts.

1. With shafting all the way down and the impellers resting on their seats, turn the adjusting nut (604) in a counter-clockwise direction, thus lifting the shaft until the impellers just clear their seats and the shaft turns freely by hand. This removes all deflection from the shaft.

2. Align hole "A" in the adjusting nut (604) and hole "C" in the motor coupling (See Fig. 22) or whatever similar holes are in like position. If care is exercised this will give an initial impeller clearance of from 0.001" to 0.003" (0.02mm to 0.07mm) depending on shaft size and thread data shown in *Table 3*.

Table 3 - Impeller Vertical Movement

Shaft Size	Thread	Vertical Movement in 1/20th Turns
¾" (19 mm)	¾-16 LH	.003" (.076 mm)
1" (25 mm)	1-12 LH	.004" (.10 mm)
1 3/16" (30 mm)	1-12 LH	.005" (.12 mm)
1½" (38 mm)	1-10 LH	.005" (.12 mm)
1 11/16" (42 mm)	1-10 LH	.005" (.12 mm)
1 15/16" (49 mm)	1-10 LH	.005" (.12 mm)
2 3/16" (55 mm)	1-10 LH	.005" (.12 mm)
2 7/16" (62 mm)	1-10 LH	.005" (.12 mm)
2 11/16" (68 mm)	1-8 LH	.006" (.15 mm)

3. Insert capscrew into hole "B" provided these are the nearest matching holes for counter-clockwise rotation of adjusting nut, turn adjusting nut (604) counter-clockwise until holes "B" and "D" line up. This gives 1/20 of one turn, the minimum possible adjustment. 1/20 of a turn = 0.004" (0.1mm) on shaft with 12 threads per inch, 0.005" (0.12mm) on one with 10 threads per inch, etc. as shown in *Table 3.*

4. Normal impeller clearance for open impellers is considered to be 0.015" (0.38mm) for the first 10 ft (3m) of column length and 0.010" (0.25mm) additional clearance for each 10 ft (3m) of length thereafter. This can be reduced in some instances where necessary, but should not be attempted without consulting the factory or nearest district office, or unless a factory serviceman is present. The impellers should never be permitted to run on their seats when the pump is operating, as this will gradually grind them off and reduce the pump capacity. See Outline Drawing for this setting.

Closed Impellers

1. The same procedure is followed as described for Open Impellers. The adjustment is not nearly as critical as for open impellers and a clearance of 0.12" (3.2mm) in smaller sizes of bowls up to 8", (20.32cm) is recommended. A clearance of 3/16" (4.8mm) in bowls larger than 8" is considered adequate. See Outline Drawing for this setting.

Impeller Adjustment procedures must be followed to prevent unintended contact of rotating parts.

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ADJUSTABLE COUPLING TYPE A FOR PACKING

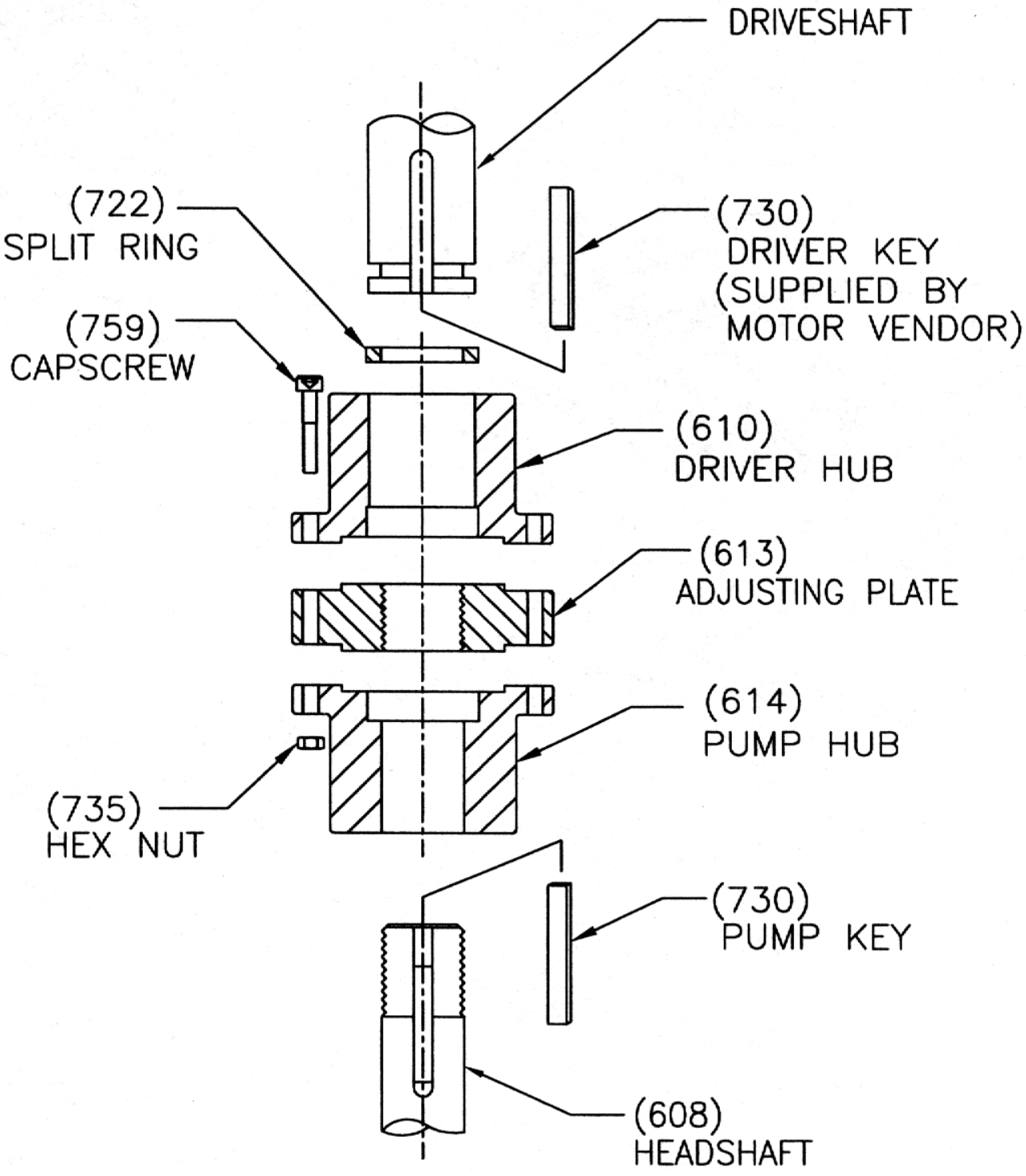


Fig. 16

ADJUSTABLE COUPLING TYPE A FOR PACKING IMPELLER ADJUSTMENT

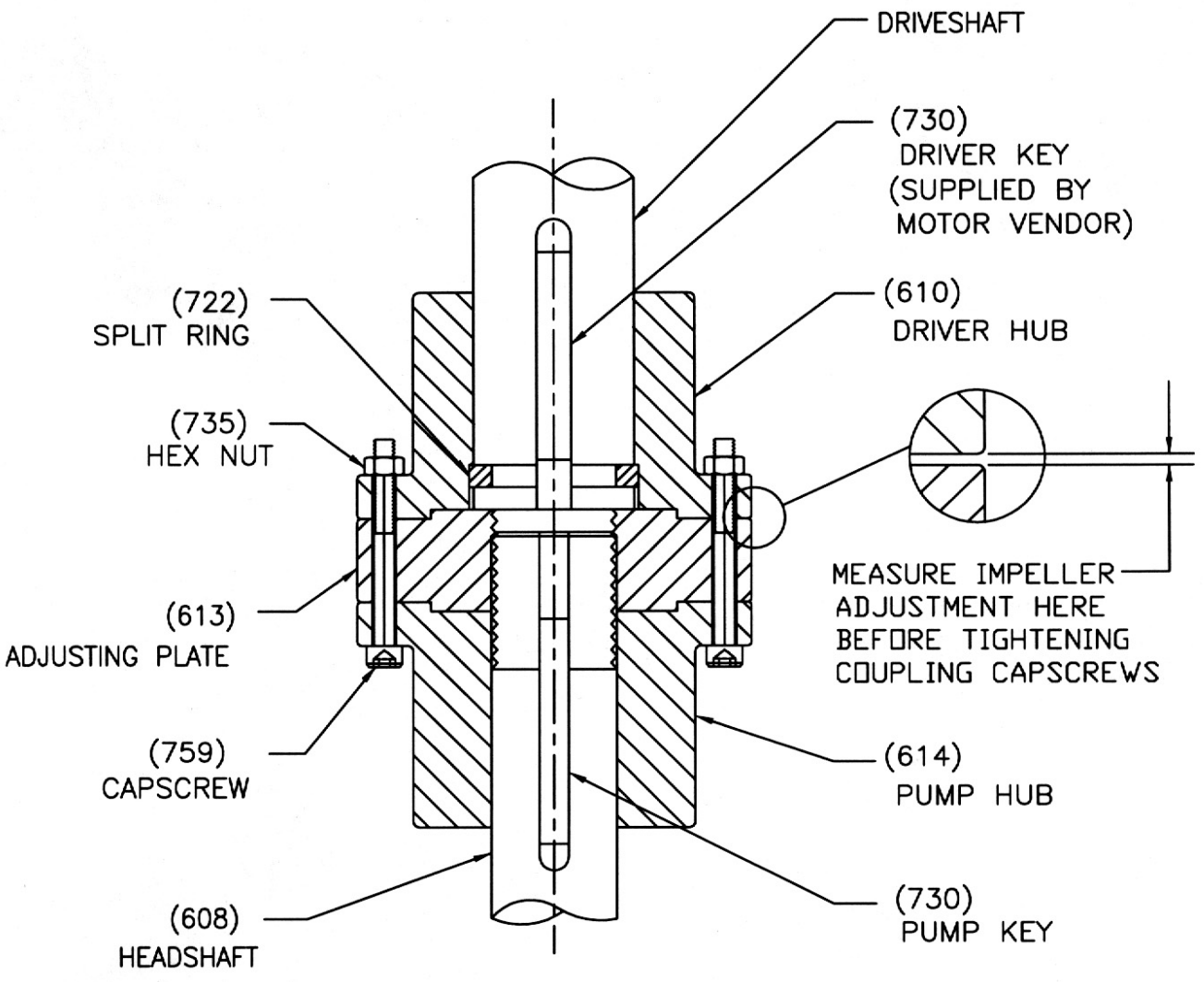


Fig. 17

SPACER COUPLING TYPE AS (FOR SEALS)

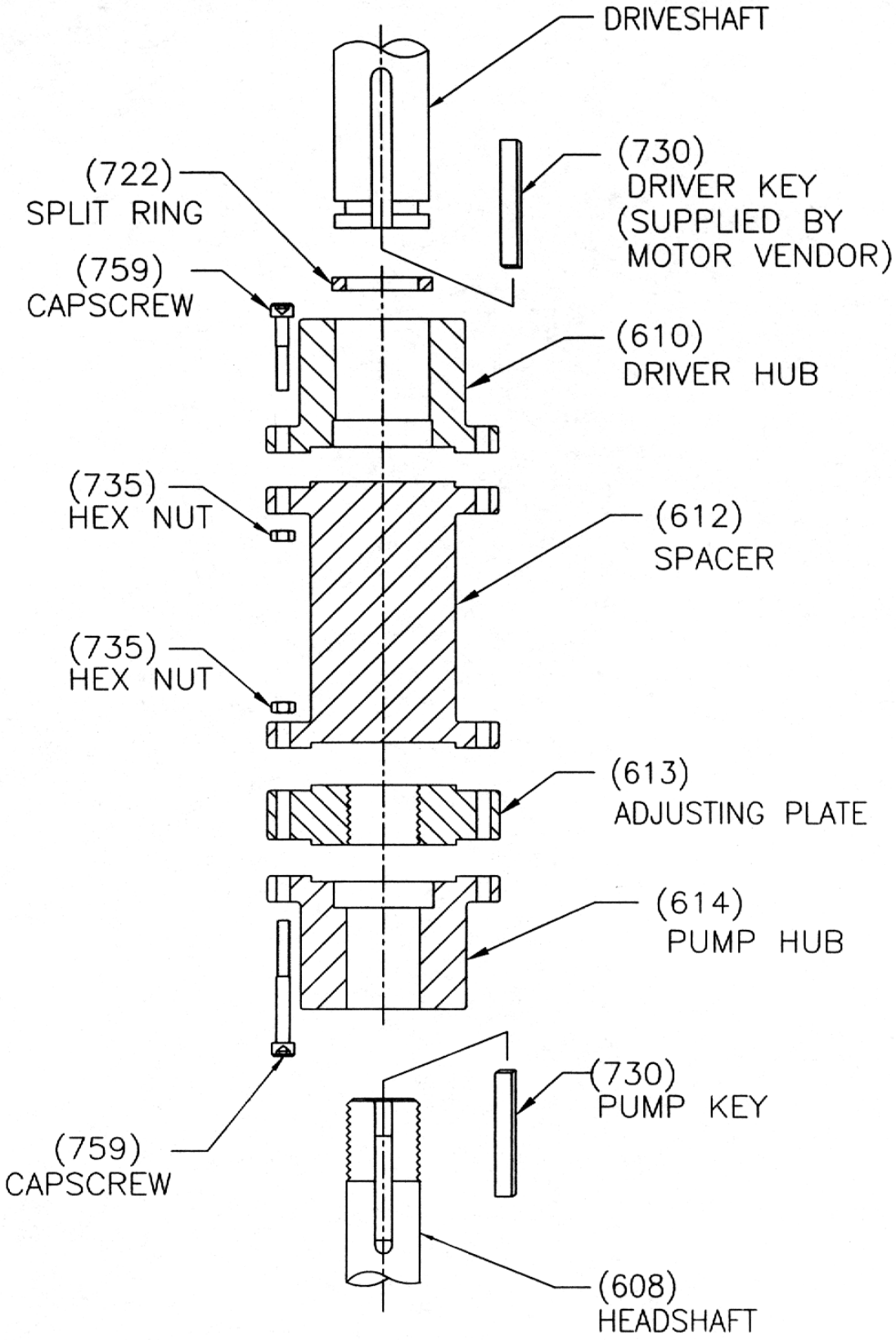


Fig. 18

SPACER COUPLING TYPE AS (FOR SEALS) IMPELLER ADJUSTMENT

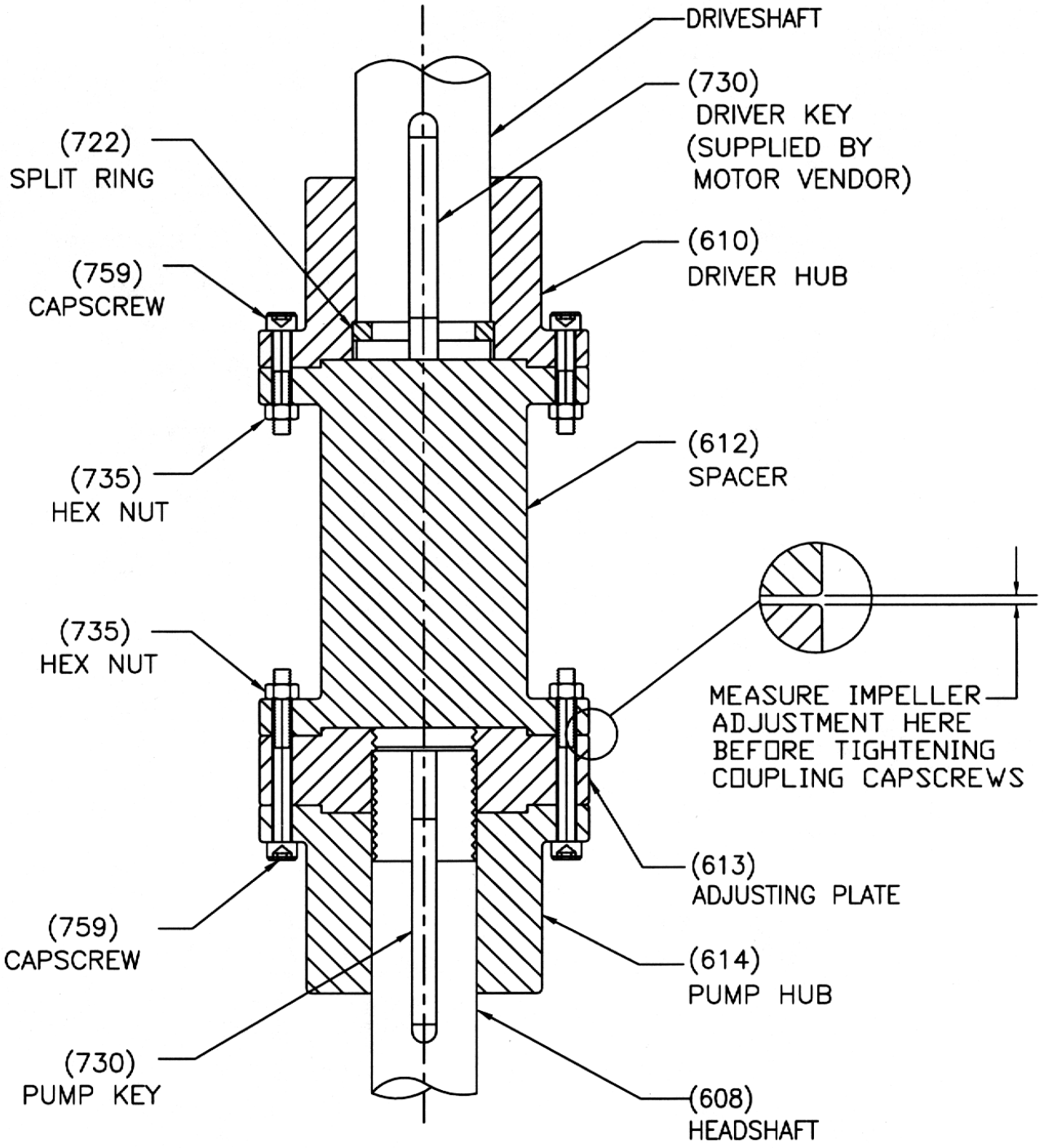


Fig. 19

RIGID COUPLING TYPE AR (FOR VHS DRIVERS)

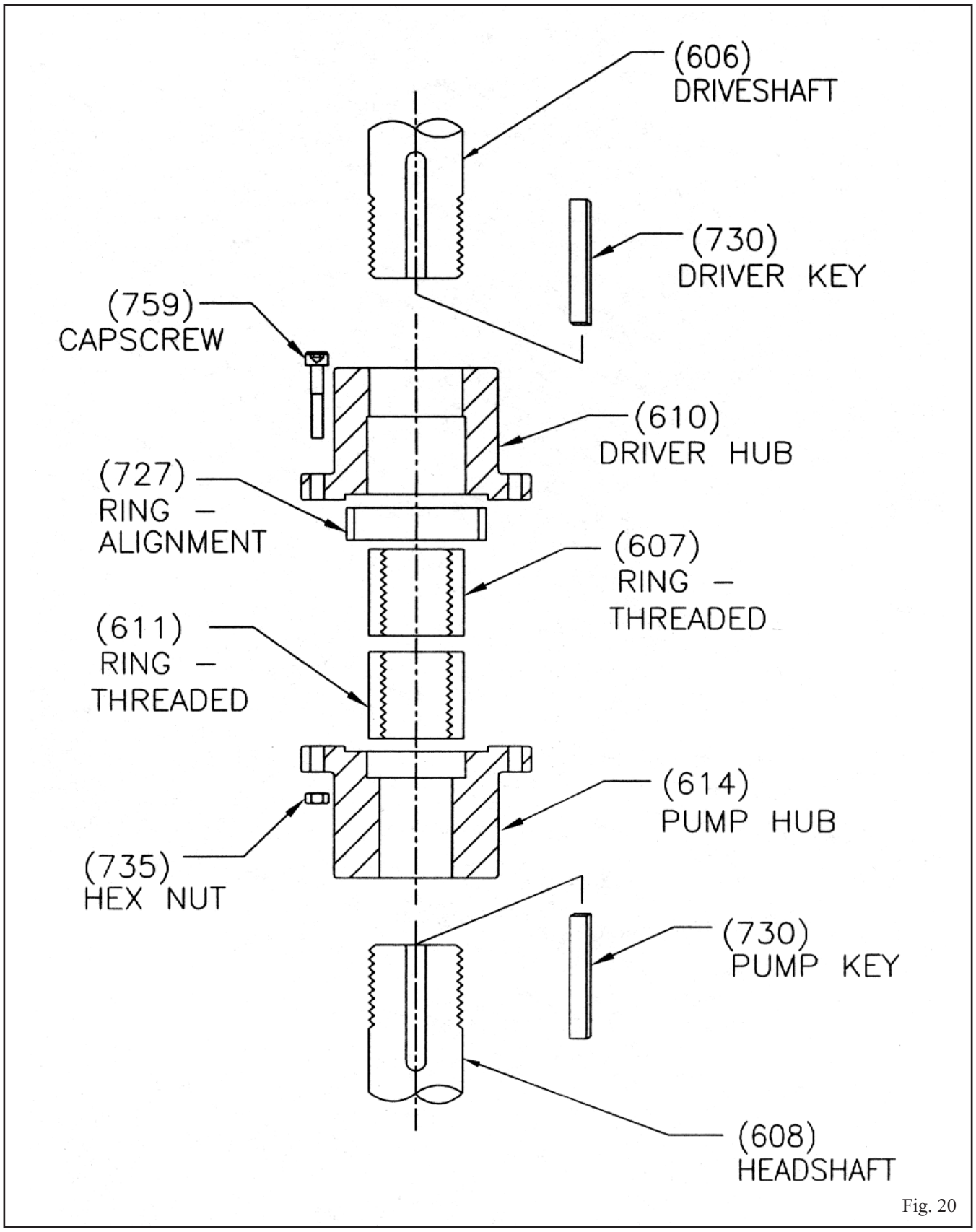
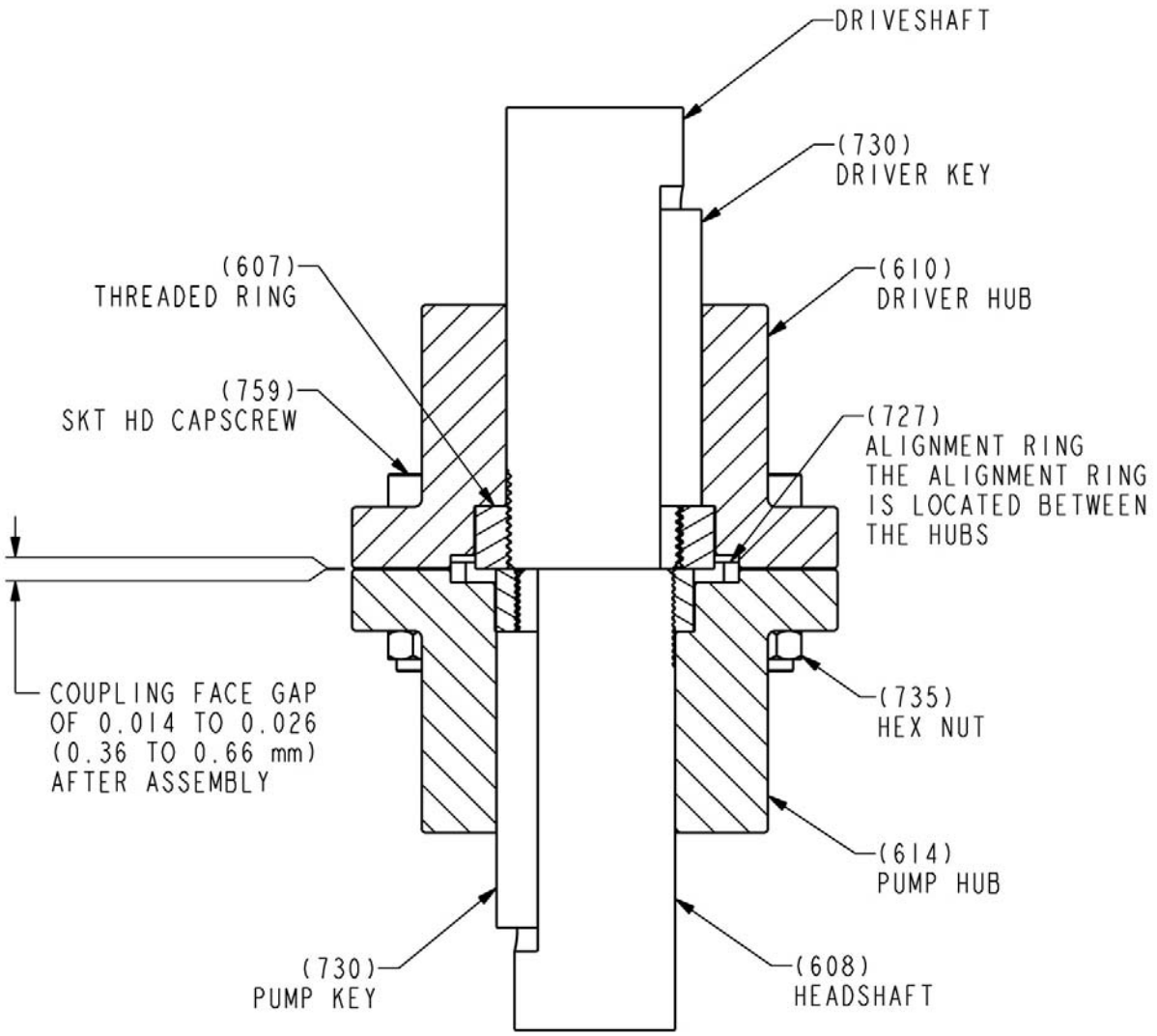


Fig. 20

RIGID COUPLING TYPE AR (FOR VHS DRIVERS) IMPELLER ADJUSTMENT



RIGID COUPLING (TYPE AR)

Fig. 21

IMPELLER ADJUSTMENT FOR HOLLOW SHAFT DRIVER

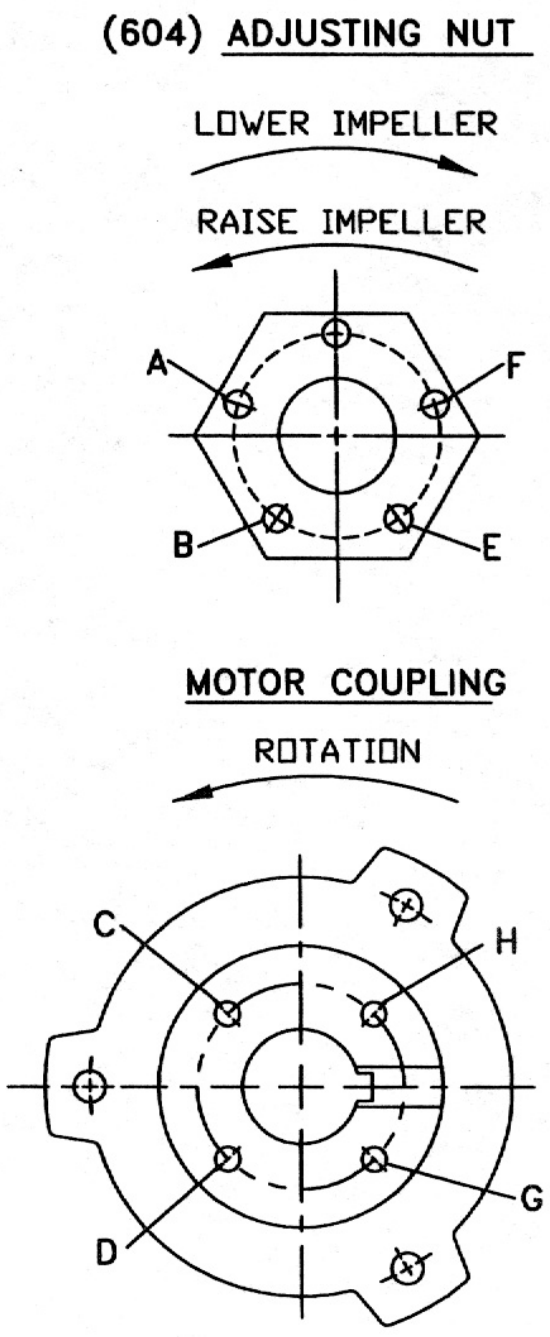


Fig. 22

PIPING

GENERAL

Guidelines for piping are given in the "Hydraulic Institute Standards" available from: Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054-3802 and must be reviewed prior to pump installation.

WARNING

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.

1. All piping must be supported independently of, and line up naturally with, the pump flanges.
2. Piping runs should be as short as possible to minimize friction losses.
3. **DO NOT** connect piping to pump until grout has hardened and pump and driver hold-down bolts have been tightened.

The coupling guard used in an ATEX classified environment must be constructed from a non-sparking material.

Dynamic seals are not allowed in an ATEX classified environment.

OPERATION

When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a ITT Goulds representative before proceeding.

Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

PUMP START-UP AND OPERATION

PRE-START PROCEDURE

Consult the applicable manufacturer's instructions for detailed information for the prime mover (electric motor, engine, or steam turbine), coupling, drive shaft, gear-head or mechanical seal. When applicable to the pump and prior to start-up, check the following:

1. Confirm that the following procedures described in the "Installing the Drivers" sections have been performed:
   A. Wiring of Driver.
   B. Driver must rotate counterclockwise (CCW) when viewed from above.

WARNING

For VSS motor, do not check motor rotation unless motor is bolted to pump and driver hub is disconnected from pump hub. For VHS motor, do not check motor rotation unless motor is bolted to pump and drive coupling is removed.

Serious damage may result if pump is run in the wrong direction.

   C. Check alignment between pump and driver.
   D. Impeller Adjustment has been made.
   E. Mechanical seal lock collar is attached to shaft.
2. Make sure mechanical seal is properly lubricated and all piping to seal is connected. Also, check that all cooling, heating and flushing lines are operating and regulated.
3. All connections to driver and starting device match wiring diagram.
4. Voltage, phase, and frequency on motor nameplate agree with line current.
5. Rotate shaft manually to ensure impellers are not binding.
6. Verify that driver bearings are properly lubricated and check oil level in housing.
7. Check that auxiliary seal components are properly vented.
8. Inspect discharge piping connection and pressure gauges for proper operation.

START-UP PRECAUTIONS

1. All equipment and personal safety related devices and controls must be installed and operating properly.
2. To prevent premature pump failure at initial start-up due to dirt or debris in the pipe system, ensure the system has been adequately cleaned and flushed.
3. Variable speed drivers should be brought to rated speed as quickly as possible.
4. Variable speed drivers should not be adjusted or checked for speed governor or overspeed trip settings while coupled to the pump at initial start-up. If settings have not been verified, uncouple the unit and refer to driver manufacturer's instructions for assistance.

5. Running a new or rebuilt pump at slow speeds may not provide enough flow to adequately flush and cool the stuffing box bushing's close running surfaces.

6. Pumpage temperatures in excess of 200° F (93° C) will require warm-up of pump prior to operation. Circulate a small amount of pumpage through the pump until the casing temperature is within 100° F (38° C) of the pumpage temperature and evenly heated.

NOTE: Warm-up rate should not exceed 1.4° C (2.5° F) per minute.

PRECISION ALIGNMENT

A Precision Alignment Procedure, Section MA027, has been written that describes our factory precision alignment. Section MA027 will be supplied as an addition to our Standard Instruction Manual, when precision alignment is a Purchase Order requirement.

PRIMING

CAUTION

The pump must be properly vented through the discharge head / barrel vent connections. This is especially important for fluids with suction pressures close to their vapor pressures. Vent Piping must be continuously rising back to source so fluid cannot collect in the vent line.

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

NPSHa must always exceed NPSHr as shown on ITT Goulds performance curves.

Pump must never be throttled on the suction side by allowing suction strainer to become clogged.

STARTING PUMP

1. Partially close valve in discharge line.

2. Crack open suction side valves on pressurized systems slowly. Open suction valves fully.

3. Vent system when the pump surface temperature has reached an equilibrium.

4. Start pump.

CAUTION

Immediately observe pressure gauges. If discharge pressure is not quickly attained, stop driver, reprime, and attempt to restart.

5. When pump is operating at full speed, slowly open discharge valve. If driver overheats or there is excessive vibration, stop the pump.

CAUTION

Observe pump for vibration levels, bearing temperature and excessive noise. If normal levels are exceeded, shut down and resolve.

Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

NOTE: If the impellers have not been finally adjusted, due to extreme liquid temperature, they should be adjusted prior to start-up and after pump surface temperatures have reached equilibrium.

CAUTION

Do not operate the pump outside the preferred operating range except during startup.

STUFFING BOX

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

With the pump in operation, there should 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 the discharge head. If the pump runs hot and the 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 preceding procedure. Run pump 15 minutes, check leakage, if it exceeds two drops per second, adjust packing as described in *PACKING ADJUSTMENT AND REPLACEMENT*.

MECHANICAL SEAL

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

If seal leaks slightly at start-up, 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 qualities. When a seal starts out with a slight leak and gets progressively less while running, it is indicative of leakage across the seal faces. Continued running will eliminate this. 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 *Preventive Maintenance* section for probable cause.

THRUST POT INSTALLATION

Thrust pots are not standard on most pumps. A separate supplement will be inserted for pumps with thrust pots.

SHUTDOWN

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

WARNING

When handling hazardous and/or toxic fluids, proper personal protective equipment should be worn. If pump is being drained, precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.

PREVENTIVE MAINTENANCE

Preventive maintenance includes periodic inspection of oil level in thrust pots, relubrication of electric motors, gear drives and prime mover. Systematic inspection of the pump and its components shall be made at regular intervals. The frequency required depends upon the operating conditions of the pump and its environment. See *Preventive Maintenance* procedures. Consult the applicable manufacturer's instructions for detailed information on maintenance for the prime mover, driveshaft, electric motors and gear drives. Any deviation in performance or operations from what is expected can be traced to some specific cause. Variances from initial performance will indicate changing system conditions, wear, or impending breakdown of the unit.

The* Preventive Maintenance *section must be adhered to in order to keep the applicable ATEX classification of the equipment. Failure to follow these procedures will void the ATEX classification for the equipment.

WARNING

Before initiating maintenance procedures, disconnect all power sources to the equipment and accessories and completely discharge all parts and accessories which retain electric charge. Failure to comply may result in severe personnel injury or death.

PACKING ADJUSTMENT AND REPLACEMENT

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

Pumps equipped with packing shall be adjusted whenever the leakage rate exceeds two drops per second. If there is no leakage or the stuffing box overheats, do not back off gland nuts while pump is running as this will allow the entire set of rings to move away from the bottom of the box without relieving pressure of the packing on the shaft. Stop the pump and allow packing to cool, then restart the pump. It may be necessary to repeat this procedure several times before proper amount of liquid comes through to efficiently prevent overheating. If leakage is excessive, 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 to 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 shut down 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 to two drops 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 pull 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 spring, and cut through the coil with a sharp knife. For repacking sequence, refer to the *Installation* section.

THRUST POT LUBRICATION AND MAINTENANCE

⚠ WARNING

Pumps are shipped without oil. Oil lubricated anti- bearings must be lubricated at the jobsite.

It is a good practice to flush the oil reservoir before first time operation and at the time of oil changes to remove all grit particles in the oil reservoir sump. Use the same type of oil to flush reservoir as specified for lubrication. Because of the special nature of the turbine oil recommended, it is wise to keep a supply on hand. Remove drain plug (747) before flushing. Flushing oil may be poured through oil fill opening in cover (770) after removing oil fill plug (747). The proper oil level when the unit is not running shall be not more than 1/8" to 1/4" from the top of the oil sight gauge (771). Overfilling may result in overheating of the unit. During operation the oil level in the sight gauge may be higher than the recommended range mentioned above. Under no circumstance is it allowed to rotate the unit when the oil in the sight gauge is not at the required level.

To avoid oxidation of the anti-friction bearings during shut-down periods lasting longer than one week, it is recommended to fill up the oil reservoir until the oil runs over the oil retainer tube (651) and down the shaft (647) so that the bearings remain completely immersed in the oil. Before startup, do not forget to drain the excess oil to its required level. Oil change depends on the severity of the environment. Generally speaking, when the oil in the sight gauge changes to a darkish brown color it is time for an oil change. However, for a longer bearing life, it is recommended that the oil be changed every six months. Be sure to flush the oil reservoir (see above) with each oil change. See the special thrust pot supplement.

PREVENTIVE MAINTENANCE PROCEDURES

PROCEDURE	TIME INTERVAL (in operating hours)
Clean dirt, oil and grease from driver and discharge head.	As required
Clean driver ventilation passage to prevent overheating.	As required
Change lubrication in gear drive.	2,000 or once a year
Change lubrication in thrust pot.	See Supplement
Tighten all loose bolts, and check for excessive vibration.	As required
If packing is grease lubricated, add as required.	100
Check that there is some leakage through stuffing box while pump is in operation. Do not tighten gland nuts unless necessary, refer to *Installation* section for tightening requirements.	As required
Maintain a liquid film of lubrication between the seal rubbing faces.	As required
Regrease motor bearings:	
1800 RPM and above	1000
Below 1800 RPM	2000

INSPECTION INTERVALS

Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive,

or if the environment is classified as potentially explosive.

CORRECTIVE MAINTENANCE

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

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. See *Installation* section.
	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 submergence of bowl assembly	Check for adequate submergence
	B. Obstruction in liquid passage	Pull pump, inspect impeller and bowl
	C. Barrel / Discharge head not properly vented	Open vent
	D. Suction Valve Closed	Confirm valve position
3. Not enough liquid delivered	A. Speed is too low	Check if driver is directly across the line and receiving full voltage
	B. Wrong rotation	Check for CCW rotation when viewed from above. Check engagement of motor coupling
	C. Total pump head is too high	Check pipe friction losses. Larger piping may correct condition
	D. Partial obstruction in liquid passages	See Step 2-B
	E. Cavitation	Insufficient NPSH available
	F. Impellers adjusted too high if semi-open construction	See *Installation* section
	G. Barrel / Discharge head not properly vented	Open vent
	H. Suction Valve Partially Open	Confirm valve position
4. Not enough pressure	A. Speed is too low	See step 1-B
	B. Obstruction in liquid passages.	Pull pump and inspect impeller and bowl passages
	C. Wrong rotation.	See step 3-B
	D. Impellers adjusted too high if semi-open construction	See *Installation* section
	E. Barrel / Discharge head not properly vented	Open vent
	F. Suction Valve Partially Open	Confirm valve position
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 for which designed	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 frequency on motor
	E. Misalignment	Re-align pump and driver
	F. Barrel / Discharge head not properly vented	Open vent
	G. Suction valve partially open	Confirm valve position
	H. Suction valve closed	Confirm valve position

TROUBLE	PROBABLE CAUSE	REMEDY
6. Pump takes too much power	A. Damaged impeller	Inspect, replace if damaged
	B. Foreign object lodged between impeller and bowl	Remove object as required
	C. Specific gravity higher than pump designed for	Test liquid for viscosity and specific gravity
	D. Viscosity too high, partial freezing of pumpage	Check for both. They can cause drag on impeller
	E. Defective bearing	Replace bearing, check shaft or shaft sleeve for scoring
	F. Packing is too tight	Release gland pressure. Retighten. Refer to *PACKING ADJUSTMENT AND REPLACEMENT*. Keep leakage flowing. If no leakage, check packing, sleeve or shaft.
7. Pump is noisy	A. Cavitation (Insufficient NPSH available)	Increase liquid level in sump
	B. Bent shaft	Straighten as required. See *Installation* section for runout limits
	C. Rotating parts binding, loose or broken	Replace as required
	D. Bearings are worn out	Replace bearings
	E. Barrel / Discharge head not properly vented	Open vent
	F. Suction Valve partially open	Confirm valve position
8. Excessive vibrations	A. 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.
	B. Motor or gear driveshaft end play maladjustment	See *INSTALLATION OF A SOLID SHAFT DRIVER* (VSS), or *INSTALLATION OF A HOLLOW SHAFT DRIVER* (VHS).
	C. Barrel / discharge head not properly vented	Open vent
	D. Suction valve partially open	Confirm valve position
9. 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 or liquid being pumped.
10. Stuffing box is overheating	A. Packing is too tight	Release gland pressure. See *Installation* section
	B. Packing is not lubricated	Release gland pressure and replace all packing if burnt or damaged. Regrease packing as required.
	C. Wrong grade of packing	Consult factory
	D. Stuffing box improperly packed	Repack stuffing box
11. Packing wears too fast	A. Shaft or shaft sleeve worn or scored	Pull pump and remachine, or replace shaft and/or sleeve
	B. Insufficient or no lubrication	Repack and make sure packing is loose enough to allow some leakage
	C. Improperly packed	Repack properly, make sure all old packing is removed and stuffing box is clean
	D. Wrong grade of packing	Consult factory

TROUBLE	PROBABLE CAUSE	REMEDY
12. Mechanical seal leaks steadily	A. Faces are not flat	Gland bolts possibly too tight, causing warpage of gland and insert, remove, check and reinstall
	B. Shaft packing nicked or chipped during installation	Replace packing
	C. Carbon insert cracked or face of insert or seal ring chipped during installation	Remove, inspect and replace as required
	D. Seal faces scored from foreign particles between faces	Install strainer, filter or cyclone separator as required to filter out foreign particles
13. Seal squeals during operation	A. Inadequate amount of liquid at the seal faces	Bypass flush line may be necessary. If one is in use it may need to be enlarged to produce more flow.
14. Carbon dust accumulating on outside of gland ring	A. Inadequate amount of liquid at the seal faces	Consult factory
	B. Liquid film flashing and evaporating between seal faces and leaving residue which is grinding away the carbon	Consult factory
15. Seal leaks, nothing appears to be wrong	A. Faces are not flat	Seal faces should be replaced or relapped
16. 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. Abrasives 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 seal components. Recirculation or bypass line may be necessary.
	D. Improper choice of seal	Consult factory

DISASSEMBLY AND REASSEMBLY

⚠ WARNING

Before starting, lock out driver power to prevent accidental start-up and physical injury.

NOTE: Pump components should be match-marked prior to disassembly to ensure they are reassembled in the correct location.

HEAD AND COLUMN

1. If equipped with mechanical seals, loosen set screws fastening seal to pump shaft so pump shaft can slide up or down within the seal.
2. On pumps which are driven through a gear drive, remove the driveshaft between the gear and the prime mover.
3. On pumps which are electric motor driven, remove the electrical connections at the conduit box and tag the electrical leads so they can be reassembled the same way they were disassembled.
4. Uncouple driver (or gear box) from pump shaft and mounting flanges and lift off by the lifting lugs or eyebolts as furnished.

⚠ WARNING

Never try to lift entire pump assembly by the lifting lugs or eyebolts furnished for the driver only.

5. Disconnect discharge head from discharge piping. Remove all hold down bolts and integral piping. Remove coupling, packing box or mechanical seal, and proceed with disassembly down to the bowls by reversing the procedures described in detail for assembling the unit.

BOWL ASSEMBLY

The bowl assembly is composed of a suction bell, intermediate bowl(s), top bowl, impellers and securing hardware, bearings, and pump shaft.

Turbine bowl impellers are secured to the shaft by either a taper collet or a key and split thrust ring. Follow only those procedures that apply to the particular construction supplied.

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

TAPER COLLET CONSTRUCTION BOWL DISASSEMBLY

1. Remove capscrews that secure top bowl (669) to intermediate bowl (670).
2. Slide top bowl off the pumpshaft (660).
3. Pull shaft out as far as possible and strike impeller hub utilizing a collet driver or equivalent sliding along the pump shaft to drive the impeller off the taper collet. (See Fig. 23.)

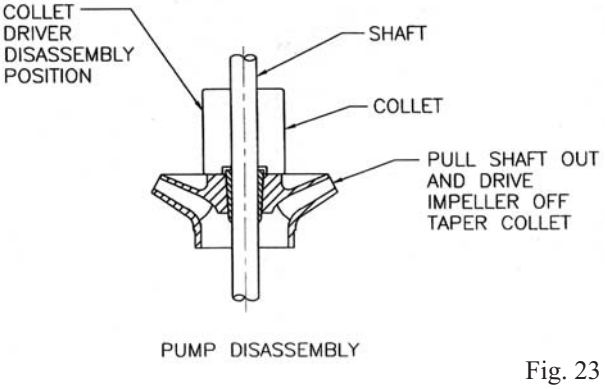


Fig. 23

4. After the impeller is freed, insert a screwdriver into the slot in the taper collet and spread it to remove the collet. Slide the collet off the pumpshaft.
5. Repeat the above procedures until the bowl assembly is completely disassembled.

KEYED CONSTRUCTION BOWL DISASSEMBLY

1. Remove capscrews that secure top bowl (669) to intermediate bowl (670).
2. Slide top bowl off the pumpshaft (660).
3. Remove capscrews (759) and split thrust ring (725) from pumpshaft.
4. Slide impeller off the pumpshaft and remove the key (730). If impeller is seized to the shaft, strike impeller with a fiber mallet and drive impeller off the pumpshaft.
5. Repeat the above procedures until the bowl assembly is completely disassembled.

TURBINE BOWL - WEAR RING REMOVAL

1. Remove set screws or grind off tack weld, when rings are furnished with those locking methods.
2. Utilizing a diamond point chisel, cut two "V" shaped grooves on the bowl wear ring approximately 180° apart. Use extreme care not to damage the wear ring seat.
3. With a chisel or drift, knock the end of one half of the ring in, and pry the ring out.
4. 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.

IMPELLER WEAR RING REMOVAL

1. Remove set screws or grind off tack weld, when rings are furnished with those locking methods.
2. Utilizing a diamond point chisel, cut two "V" shaped grooves on the impeller wear ring approximately 180° apart. Use extreme care not to damage the wear ring seat.
3. With a chisel or drift, knock the end of one half of the ring out, and pry the ring off.
4. On special materials such as chrome steel, set up the impeller in a lathe and machine the wear ring off using extreme care not to machine or damage the ring seat.

BOWL, SUCTION BELL, AND LINESHAFT BEARING REMOVAL

1. Utilizing an arbor press and a piece of pipe or sleeve with an outside diameter slightly smaller that the diameter of the bowl or lineshaft bearing housing bore, press the bearing off.
2. Remove suction bell bearing by setting the suction bell in a lathe and machine the bearing off. The suction bell bearing can also be removed by using bearing pullers and pulling the bearing out.

NOTE: Bowl bearings are press fit. Do not remove unless replacement is necessary.

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 0.005" (0.12mm) T.I.R. for every 10 feet (3m) of shaft length.
4. On pumps equipped with a mechanical seal, check that the shaft or sleeve is free of pits, burrs, or sharp edges to prevent cutting or improper sealing of the seal o-rings. Remove 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.

TURBINE BOWL AND IMPELLER WEAR RING INSTALLATION

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

BOWL, SUCTION BELL, AND LINESHAFT BEARING INSTALLATION

1. Press bearing (653) into retainer (652) using an arbor press or equal.
2. Press bearing (690) into suction bell (689) using an arbor press or equal.
3. Press bearings (672) into intermediate bowl (670) and top bowl (669). Place the bowl with the flange downward and press bearing through chamfered side of bowl hub until the bearing is flush with the hub using an arbor press or equal.

TAPER COLLET CONSTRUCTION BOWL ASSEMBLY

1. For ease in reassembly apply a thin film of turbine oil to all mating and threaded parts.
2. If the pump is equipped with a sand collar, slide the pumpshaft into the suction bell bearing until the sand collar rests against the suction bell and skip to step 4 to install the impellers. If a pumpshaft (660) is replaced and the sand collar is not assembled to the shaft, install the sand collar. The sand collar is attached to the shaft with a shrink fit. The shaft is machined with a 0.01" (0.25mm) groove to locate the sand collar. The large diameter of the counterbore of the sand collar goes toward the suction bell bearing. Heat the sand collar until it slips over the shaft and quickly position it so that the top of the sand collar is even with the locating groove before it cools. Slide the pumpshaft into the suction bell bearing until the sand collar rests against the suction bell. Skip to step 4 to install the impellers.

⚠ WARNING

Wear protective gloves and use appropriate eye protection to prevent injury when handling hot parts.

3. If the pump is NOT equipped with a sand collar, use the "X" dimension given in *Table 5* to locate the pumpshaft with respect to the suction bell as follows:

   A. Insert the pumpshaft into the suction bell bearing until it bottoms out, then pull the shaft out until the distance between the groove on the shaft and the top of the suction bell hub (not the top of the bearing) is correct for the particular pump. (See Fig. 24.)

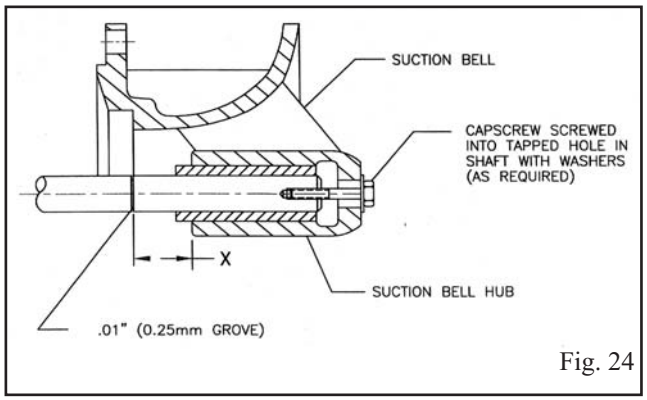


Fig. 24

   B. Hold the shaft in this position by inserting a capscrew with a washer into the hole in the end of the suction bell and then into the threaded hole in the end of the shaft.

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

5. Insert a screwdriver into the slot in the taper collet (677). Spread the slot and slide the collet over the pump shaft. Hold the impeller against bowl and slide the collet into the impeller hub.

6. Hold shaft with capsrew and washer against the suction bell and drive the taper collet into place with a collet driver. After collet is in place, recheck "X" dimension.

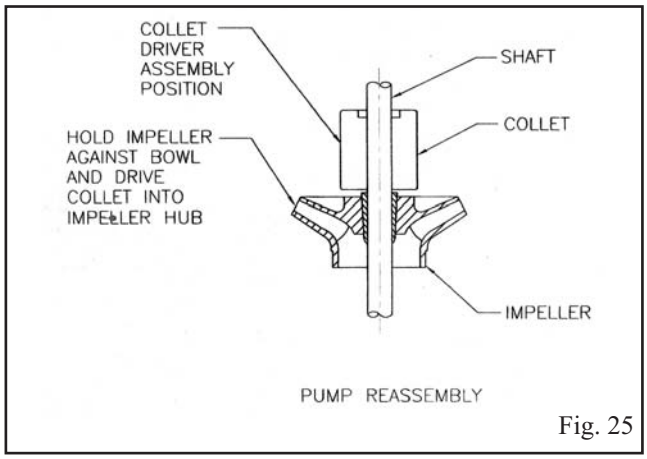


Fig. 25

7. Slide intermediate bowl (670) onto shaft and secure with capscrews provided.

8. Repeat preceding procedure for number of stages required.

9. Remove capscrew and washer and check that the shaft rotates freely without dragging or binding. Also check for adequate lateral end play.

KEYED CONSTRUCTION BOWL ASSEMBLY

1. Install key (730E) into pumpshaft keyway, slide impeller (673) over shaft and locate it on the key.

2. Install split thrust ring (725) on pumpshaft groove and secure to impeller with capscrews (759F).

3. Slide intermediate bowl (670) over pumpshaft and secure to suction bell (689) with capscrews (759F).

3. Repeat preceding procedures for the number of stages required.

FINAL ASSEMBLY

After reassembly of bowl assembly, reassemble pump as described in *Installation* secion. Refer to *Operation* section for startup and adjusting procedures.

Table 5
Pump Shaft Set Up Dimensions

Pump Size	"X" Dimension inches	"X" Dimension mm
4D	1.31	33.3
6A	1.37	34.9
6J	1.37	34.9
6D	1.37	34.9
7A	1.37	34.9
8A	1.37	34.9
8J	1.37	34.9
8D	1.37	34.9
9A	1.37	34.9
10A	1.75	44.5
10J	1.75	44.5
10D	1.75	44.5
10L	2.12	54.0
11A	2.12	54.0
12J	2.12	54.0
12D	2.25	57.2
14J	2.75	69.9
14H	2.75	69.9
14D	2.75	69.9
16D - Bell	1.75	44.5
16D - Bowl	2.75	69.9
18H	2.75	69.9
20H	0.87	22.2
28T	4.50	114.3
36T	6.25	158.3

APPENDIX I

APPENDIX I

FIELD SERVICE

INSTALLATION AND START-UP CHECKLIST

Customer: _____ ITT Goulds Pump Serial No: _____

Pump Model: Pump Size: _____ Stages: _____

Use this checklist in conjunction with the standard instruction manual furnished with the equipment. Initial each item completed or write N/A if not applicable. Once you have completed this checklist, please forward a copy to VPO Field Service for entry into our Q.A. records. We suggest a separate checklist for each individual pump. If you have any questions, contact us immediately at (562) 949-2113 or facsimile (562) 695-8523.

Part 1: System and Installation Inspections and Checklist

_____ 1) Verify that the pump foundation (head, barrel, sub-base, etc.) is level to within .005 inch per foot. Note that on API units the level requirement is .001 inch per foot.

_____ 2) Inspect the foundation to determine whether it appears adequately designed to handle the weight and loading of the pump. Note that ITT Goulds does not design foundations and is not responsible for foundation inadequacies.

_____ 3) Insure that the head, or barrel, or sub-base, etc., is properly grouted using high quality non-shrink grout. This can be verified by "sounding" the foundation.

_____ 4) Insure that all the anchor bolts are tight.

_____ 5) Insure that the discharge piping is properly supported and that there is no excess nozzle loading on the discharge flange. Verify this by loosening and then checking freedom of the flange bolting.

_____ 6) On units with flexible or expansion joints attached to pump discharge, insure that tie rods are in place and properly installed.

_____ 7) Insure that all valves operate freely and are properly installed for the direction of flow. Also insure that they have the proper pressure rating.

_____ 8) In conjunction with your contact or customer's rep, verify where the pumpage is going and that the system is properly "lined up" for the test.

_____ 9) Verify that the pumpage supply will be continuously available for the duration of the test. It is very important that the initial run is at least ten minutes in duration in order to completely "flush" the pump.

_____ 10) If possible, verify the cleanliness of the pumpage and piping. If on hand during the installation, insure that the sump, barrel and piping are clean. Units always recommend using start-up strainers and/or start-up bearings.

_____ 11) Verify the suction valve is open and the barrel and head are properly vented.

APPENDIX I
FIELD SERVICE
INSTALLATION AND START-UP CHECKLIST

Part 2: Pump Assembly Pre-Start Inspections and Checks

_____ 1) Verify that the drivers (motors, gears, engines, etc.) are properly lubricated before start-up. On drives with grease lubricated motor bearings, insist that they be greased on-site as motor vendors generally only add grease to the bearing itself during assembly. Inspection will usually reveal the in and out ports as well as the reservoir to be "dry." Lubrication information can usually be found on special tags on most motors or in the motor manuals and this gives type and quantity of lubrication to be used.

_____ 2) Determine the allowable number of cold/hot starts with the motor vendor. This is very important especially during initial start-up when numerous "bugs" have to be worked out of the system and controls. The general rule of thumb is two cold or one hot start per hour. Exceeding the recommended starts breaks down the motor's insulation and can cause failure. Megger the motor if possible.

_____ 3) Prior to coupling up the driver to the pump, verify proper rotation of the driver by "bumping" it. Note that the proper rotation for our vertical pumps is CCW when viewed from above. In addition to verifying rotation, run uncoupled to insure that the driver runs smooth and sounds normal. Note that on units with VHS motors, you must remove the driveshaft if a coupling is provided and the steady bushing and driver coupling in the event one is not provided. On drivers with NRR's, remove rachet pins if possible. Otherwise, rotate the drive coupling clockwise until pin stops tight against rachet plate. If customer refuses to allow a check of rotation, make a notation in Section 4B and have customer sign and date before proceeding.

_____ 4) Only after verifying the proper rotation of the driver, proceed with the coupling of the pump to the driver. On VSS units with flanged coupling (except "AR" type), you will set the impeller lift at this point. On VHS units you will set the impeller lift using the adjusting nut atop the motor after making up the threaded or "AR" coupling. The specific impeller lift required for an individual pump will be listed on the pump nameplate and can also be found on the Outline Drawing.

_____ 5) Special alignment of the pump to the motor is not usually required as all components are equipped with register fits. An exception to this is a pump equipped with jacking bolts. A unit so equipped requires the motor be physically aligned to the pump.

_____ 6) Upon completion of coupling of the pump to the driver, and the setting of the impeller lift, verify using a dial indicator that the shaft run-out above the sealing element is not excessive.

LIMITS: PACKING = MAX. .008" MECHANICAL SEAL = MAX. .005" (.002" FOR API)

_____ 7) On units with packing, do not over-tighten the gland. Excessive leakage should be eliminated over time and not all at once. Normal leakage is 60 drops/minute = 13 liters/day.

_____ 8) On units with seals, the seal should rotate freely. Ensure that the seal spacers are removed. Verify that the seal piping is properly installed.

APPENDIX I
FIELD SERVICE
INSTALLATION AND START-UP CHECKLIST

Part 3: Starting Unit

_____ 1) After all checks in Parts 1 and 2 are completed, conduct a start-up meeting with customer to discuss the actual procedures they might require during start-up and commissioning. Also, verify with the customer that their "system" is ready for pumpage.

_____ 2) When the system is ready, push the start button and adjust the discharge valve to meet the design point (if required).

_____ 3) Watch for signs of trouble (look and listen). Again, the unit must run at least ten minutes to flush out the pump and system.

_____ 4) Verify that the unit runs smoothly with no unusual noise, vibration, or overheating.

_____ 5) Run the unit for one hour mechanical test (if possible).

Part 4: Readings and Notes

A) Readings:

Impeller Lift: _____Shaft Runout:_____

Megger: _____

Vibration: _____

B) Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____ _____

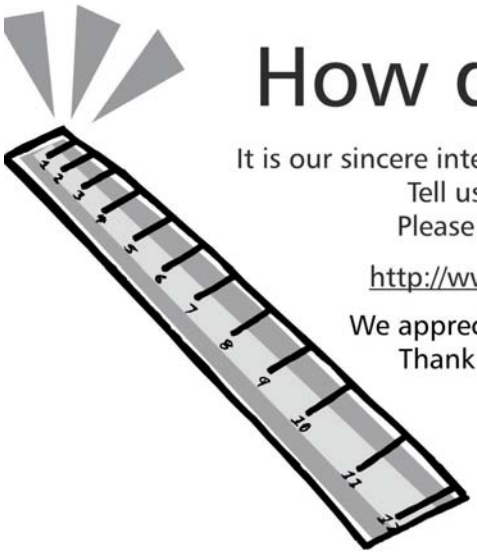
ITT Goulds Pumps Representative Date:

HOW TO ORDER

When ordering parts call
1-800-446-8537
or your local ITT Goulds Representative

EMERGENCY SERVICE

Emergency parts service is available
24 hours/day, 365 days/year . . .
Call 1-800-446-8537



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