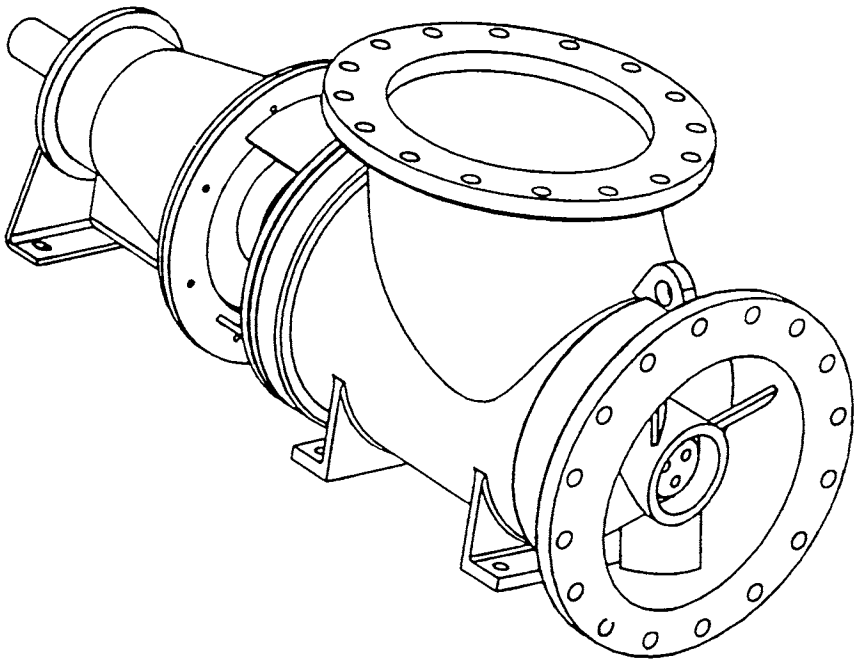
GOULDS PUMPS

INSTALLATION, OPERATION and MAINTENANCE INSTRUCTIONS



MPAF
(MX Brg.)

ITT

FOREWORD

This manual provides instructions for the Installation, Operation, and Maintenance of the Goulds Model MPAF.

The design, materials, and workmanship incorporated in the construction of Goulds pumps makes them capable of giving, 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.

Goulds shall not be liable for 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 Goulds parts are used.

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

To assure proper installation, supervision from an authorized manufacturer's representative is recommended.

Additional manuals can be obtained by contacting your local Goulds representative.

THIS MANUAL EXPLAINS

Proper Installation
Start-up Procedures
Operation Procedures
Routine Maintenance
Pump Overhaul
Trouble Shooting
Ordering Spares or Repair Parts

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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:

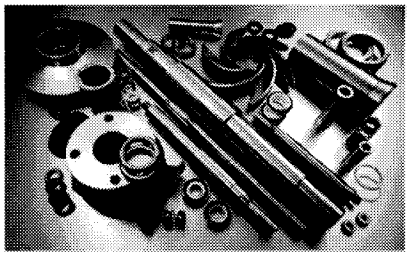
II = Group 2
2 = Category 2
G/D = Gas and Dust present
T4 = Temperature class, can be T1 to T6 (see Table 1)

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.

INSTALLATION AND OPERATING INSTRUCTIONS

SECTION I - GENERAL

INTRODUCTION

This instruction manual is intended to assist those involved with the installation, operation and maintenance of Goulds SPD slurry pumps. It is recommended that this manual be thoroughly reviewed prior to installing or performing any work on the pump or motor.

I-A. IMPORTANCE OF INSTRUCTIONS

The design, material, and workmanship incorporated in the construction of 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 periodic inspection and careful maintenance. This Instruction Manual was prepared to assist operators in understanding the construction and correct methods of installing, operating, and maintaining these pumps.

Study thoroughly Sections I, II, III, and carefully follow the instructions for installation and operation. Sections IV, V, VI, and VII are answers to trouble and maintenance questions.

Keep this instruction manual handy for reference. Further information can be obtained by contacting the Slurry Pump Division, East Centre St., Ashland, PA 17921 or your local representative.

I-B. SPECIAL WARNINGS

Goulds' Slurry Pump Division will not be liable for any damages or delay caused by failure to comply with the provisions of this Instruction Manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures higher than, nor used with liquids other than stated in the original order acknowledgement, without written permission of the Slurry Pump Division, Goulds Pumps, Inc.

I-C. RECEIVING AND INSPECTION - SHORTAGES

Care should be taken when unloading any Goulds' pump. If shipment is not delivered in good order and in accordance with the bill of lading, note the damage and shortage on both the receipt and freight bill. MAKE ANY CLAIMS TO THE TRANSPORTATION COMPANY PROMPTLY.

Instruction sheets on various components as well as the Instruction Book for the pump are included in the shipment. DO NOT DISCARD.

I-D. PRESERVATION AND STORAGE

Short Term: (Less than 6 months) Gould's Slurry Pump Division's normal domestic shipping and storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during short term covered storage at the jobsite and for a short period between installation and start-up. Unless otherwise specified, it is assumed the pump will be installed upon delivery. Additional protection can be provided by request.

One approach to preserve the pump is to provide special preservatives and wrapping before shipment. However, after installation, the protective wrappings will have been removed. Therefore, application of preservatives after installation is considered good practice.

Long Term: (More than 6 months) If the pump is to be idle and exposed to the elements for an extended period, either before or after installation, special precautions are required. Preservative treatment of bearings and machined surfaces will be required. Also, driver and coupling manufacturers should be contacted for long term storage procedures. Hand rotation of the shaft is recommended every 30 days to prevent damage to the bearings.

INSTALLATION AND OPERATING INSTRUCTIONS

SECTION II – INSTALLATION INSTRUCTIONS – AXIAL FLOW PUMPS

This section is a general installation and operating instruction for the MPAF pumps. There are specific instructions for the bearing assembly (SECTION IV) and the liquid end (SECTION V) which follow this section. For a pump furnished with an inflatable shaft seal and/or a spring supported subbase, appendices are added.

To insure pump performance and operating life, proper installation and reasonable maintenance are required. The following instructions are a guide for installation and maintenance personnel and the pump operator. We recommend becoming familiar with these instructions before the pump is installed, started, or disassembled for any reason, to avoid unnecessary lost time and added expense.

II-A. LOCATION AND FOUNDATION OF THE PUMP

Location: For all MPAF pumps, the unit should be located in a clean, dry area free from flooding. The area should provide adequate space for operation, maintenance, inspection and repair, considering complete disassembly and handling of equipment. The unit should be positioned to provide the most efficient pipeline system.

Foundation: The MPAF pumps covered by these instructions may be designed to hang in the piping system, furnished with spring loaded subbase bolts, or have a subbase designed to be anchor bolted and grouted to the foundation.

The foundation must be substantial enough to absorb any vibration and form a permanent, rigid support for the pumping unit to the degree that there will not be any adverse movement or settling over a long period of time.

Foundations for anchor bolted and grouted subbases are typically concrete with anchor bolts cast in to secure the pump.

The most commonly used foundation bolts are the sleeve-type (Fig 2A) and J type (Fig. 2B). Both designs permit movement for final bolt adjustment. Anchor bolts should be located in the concrete by a template dimensioned from the pump installation drawing . The top of the sleeve- type bolt should be temporarily sealed with waste material to prevent concrete from entering during the concrete pouring operation.

Spring loaded bolts assure that the pump remains level, regardless of vertical movement due to thermal pipe expansion created during operation. The location and size of the foundation bolts are shown on the outline assembly drawing, provided with the pump data package. For more information on spring mounted subbases, see APPENDIX A (if applicable).

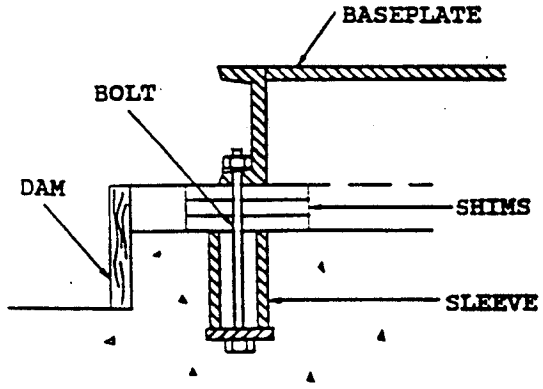


Fig. 2A Sleeve type foundation bolts.

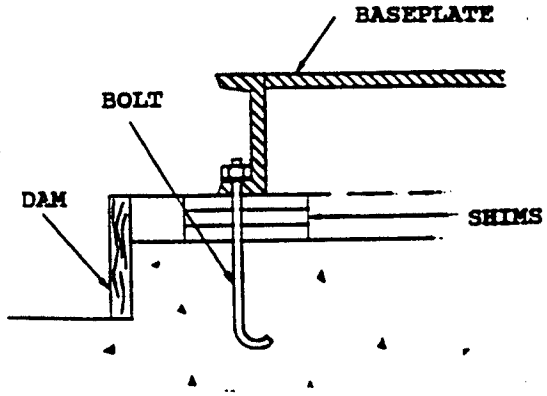


Fig. 2B J-type foundation bolts.

INSTALLATION AND OPERATING INSTRUCTIONS

II-B. INSTALLING PUMP ON THE FOUNDATION

When the unit is received with the pump and driver mounted on a subbase, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until all realignment operations have been completed. A recommended coupling alignment procedure is included in section II-G.

For pumps with spring supported subbases, refer to Appendix A rather than the following paragraphs, which are for anchor bolted subbases.

The subbase should be supported on rectangular metal blocks or on metal wedges having a slight taper. There should be one supporting block or wedge on each side of each foundation bolt. A gap of about 3/4" to 1-1/2" should be allowed between the subbase and the foundation for grouting.

Adjust the metal supports or wedges until the shafts of the pump and the driver are level. Check the coupling faces, as well as the suction and discharge flanges of the pump, for horzontal or vertical position by means of a level. Check also for any internal rubbing in the pump. Correct, if necessary, by adjusting the supports or wedges under the subbase as required. In most cases, factory alignment will be regained by shimming under the subbase alone.

Provisions must be made to support the discharge piping independently from the pump to prevent excessive loads and maintain pump-driver alignment.

II-C. GROUTING

When the alignment is correct, the foundation bolts should be tightened evenly, one-half turn past hand tight. The unit can then be grouted to the foundation. The subbase should be completely filled with grout, and it is desirable to grout the leveling pieces or wedges in place. Foundation bolts should not be fully tightened until the grout has hardened.

The bolts which secure the pump to the foundation should be 1/8" - 1/4" less in diameter than the holes in the pump frame (size is shown on the certified dimension drawing).

Level Subbase: The subbase should be level to within .125 in. (3 mm) over the length of the base and .0875 in. (1.5 mm) over the width of the base.

Bases anchored with conventional foundation bolts use shims on both sides of the anchor bolts to level the base. Spring loaded foundation bolts use a combination of internal bolt adjustment and shimming to level the base. If the unit is furnished with a spring supported subbase, follow the spring adjustment instructions in Appendix A.

II-D. SUCTION AND DISCHARGE PIPING

Properly installed suction piping is a necessity for trouble-free pump operation. Suction piping should be flushed before connection to the pump. Short suction and discharge pipelines having a minimum of elbows and fittings result in the least amount of pipe friction.

General Piping Guidelines:

Guidelines for piping are given in the "Hydraulic Institute Standards" and must be reviewed prior to pump installation.

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

Caution

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 THE PUMP AND DRIVER. PIPE STRAIN WILL ADVERSELY EFFECT THE RELIABILITY OF THE PUMP.

2. Piping runs should be as short as possible to minimize friction losses.

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

4. It is suggested that expansion loops or joints be properly installed in suction and/or

discharge lines when handling liquids at elevated temperatures, so linear expansion of piping will not draw the pump out of alignment.

5. The piping should be arranged to allow for pump flushing prior to removal of the unit on services handling corrosive liquids.

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

Suction Piping:

1. Excessive friction losses will cause cavitation.

2. Use of elbows close to the pump suction flange should be avoided. There should be a minimum of 2 pipe diameters of straight pipe between the elbow and suction inlet. Where used, elbows should be long radius.

3. Use suction piping one or two sizes larger than the pump suction, with a reducer at the suction flange. Suction piping should never be a smaller diameter than the pump suction.

4. The piping should not contain high spots which could trap air pockets.

5. Reducers, if used, should be eccentric at the pump suction flange, with the sloping side down.

6. Flow regulating valves must **not** be located on the suction side of the pump. Flow should never be throttled on the suction side.

7. Suction strainers, when used, must have a net "free area" of at least three (3) times the suction pipe area.

8. Separate suction lines are recommended when more than one pump is operating from the same source of supply.

Suction Lift Conditions:

1. Suction pipes must be free from air pockets.

2. Suction piping must slope upwards to pump.

3. All joints must be air tight.

4. A means of priming the pump must be provided, such as a foot valve.

Suction Head/Flooded Suction Conditions:

1. An isolation valve should be installed in the suction line to permit closing of the line for pump inspection and maintenance.

2. Keep suction pipe free from air pockets.

3. Piping should be level or slope gradually downward from the source of supply.

4. No portion of the piping should extend below the pump suction flange.

5. The size of entrance from the supply should be no smaller than the suction pipe.

6. The suction pipe must be adequately submerged below the liquid surface to prevent vortices and air entrainment at the supply.

Discharge Piping:

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

2. Increasers, if used, should be placed between pump and check valves.

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

4. Excessive friction losses will result in insufficient flow.

The pumps are not designed to carry loads imposed by the weight of the pipeline. The pipe must be supported independently near the pump to prevent any strain being transmitted to the pump.

Arrangements should be made to keep the pump from back-spinning severely during shutdown. On a long discharge line, a non-slam check valve should be installed.

Warning

THIS UNIT MUST NEVER BE USED WITHOUT PRIOR INSTALLATION OF THE SAFETY GUARDS FOR ROTATING PARTS AS PRESCRIBED BY O.S.H.A.

OPERTION OF THIS PUMP WITH BOTH THE SUCTION AND DISCHARGE VALVES CLOSED FOR EVEN BRIEF PERIODS OF TIME IS AN UNACCEPTABLE AND DANGEROUS PRACTICE. IT CAN RAPIDLY LEAD TO A VIOLENT PUMP FAILURE.

II-E. INSTALLING THE PUMP AND DRIVER

1. Piping Connection - Connect the elbow side (or top) opening to the pipeline. If the unit is supported with a spring supported subbase, follow the spring adjustment instructions in Appendix A.

2. Install the Driver -

Warning

INCORRECT ROTATION COULD RESULT IN CONSIDERABLE DAMAGE TO THE PUMP.

Warning

LOCKOUT POWER TO THE DRIVER BEFORE CHECKING THE MOTOR ROTATION.

a) Check the driver rotation before connecting the driver to the pump. Pump direction of rotation is indicated by an arrow on the elbow or casing.

b) Connect the driver to the pump. If the pump is driven by belts, align the sheaves and tighten the belts, using care to avoid excessive belt tension. See SECTION II - F V-Belts for more information on V-belt installation.

If the pump is driven with universal joint shafting, the shafts must be parallel within 1° but offset to have an angular misalignment of at least 1° at normal system operating temperature. For more information, consult the universal shaft manufacturer.

3. Check Impeller Clearance -

a) Impeller must not rub when shaft is turned by hand. If the impeller rubs or almost rubs, refer to the liquid end section for corrective action.

b) It is recommended that the IMPELLER ALIGNMENT WORKSHEET (on the next page) be filled out and filed with the pump maintenance records for future reference.

See SECTION V-A - Impeller Adjustment for more information on impeller adjustment.

4. Final Piping Connection - Connect the other pump flange (closest to impeller) to the system

a) Check the flanges before tightening bolts to be sure no severe strain will be placed on the pump when flanges are forced together with bolts. If necessary, correct the piping.

b) Turn pump shaft by hand to check for impeller rubbing. Impeller may rub if last flange connection has placed strain on the pump.

II-F. V-BELTS

Well designed and properly installed v-belt drives are capable of running for years. There are a few points that should be checked periodically.

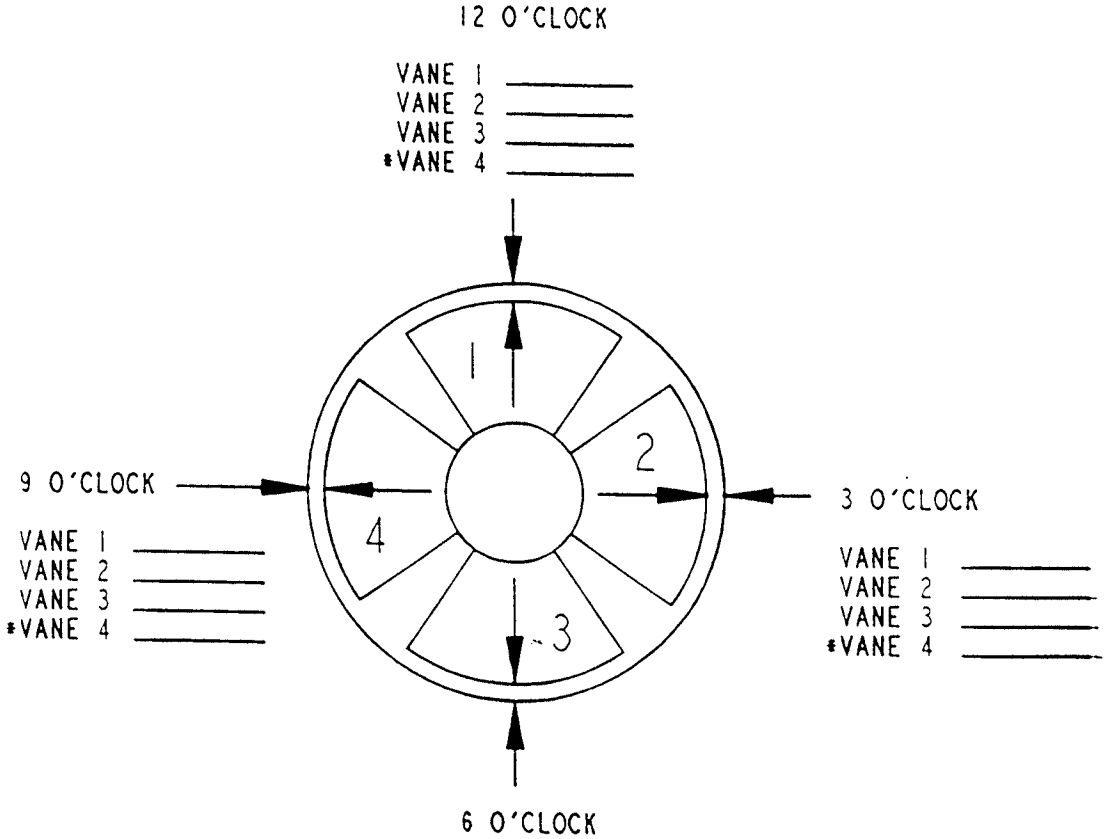
1. Sheave Alignment - Alignment must be maintained for full power transmission, minimum vibration, and long drive life. A dial indicator can be used to check runout on the periphery and face of each sheave. A straight edge can be used to check the alignment of the pump and drive sheaves in the vertical direction. See Fig. 3 page 7.

2. Belt Installation - When installing new belts, shorten center distance between sheaves so that belts can be placed on the sheave without the use of force. Never "roll" or "pry" the belts into place, as this could damage the belt cords.

AXIAL FLOW PUMP
IMPELLER ALIGNMENT WORKSHEET
3 OR 4 VANE IMPELLER

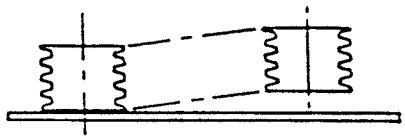
PUMP SERIAL NO.: _____ DATE: _____

PUMP SIZE: _____ PUMP ALIGNED BY: _____

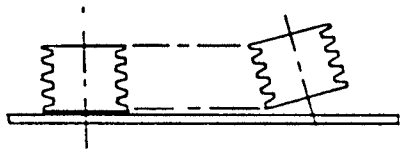


$$\text{MINIMUM CLEARANCE} = \frac{\text{SUM OF ALL CLEARANCES}}{\text{NUMBER OF MEASUREMENTS}} \times \frac{1}{2}$$

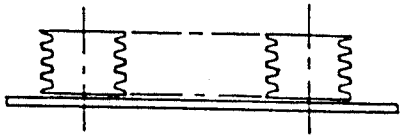
* NOTE: FOR THE THREE VANE IMPELLER, ROTATE AND MEASURE 3 CLEARANCES AT EACH CLOCK POSITION (ONE CLEARANCE FOR EACH VANE). FOR THE 4 VANE IMPELLER MEASURE 4 CLEARANCES AT EACH CLOCK POSITION.



Parallel Misalignment



Angular Misalignment



Perfect Alignment

Fig. 3. V-belt drive alignment.

3. Check Belt Fit - Regardless of the belt section used, the belt should never be allowed to bottom in the groove. This will cause the belts to lose their wedging action and slippage can occur. Sheaves or belts that permit such a condition to occur should be changed.

4. Maintain Proper Belt Tension - Proper tension is essential for long belt life. Improper tension could cause belt fatigue and/or hot bearings.

The general method of tensioning belts is given below, and should satisfy most drive requirements.

General Method:

STEP 1. Reduce the center distance so that the belts may be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so that both belt spans have approximately the same sag between the sheaves. Apply tension to the belts by increasing the center distance until the belts are snug, see Fig. 4.

Warning

DO NOT OPERATE THE PUMP WITHOUT THE PROPER DRIVE GUARD IN PLACE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN PERSONAL INJURY TO OPERATING PERSONNEL.

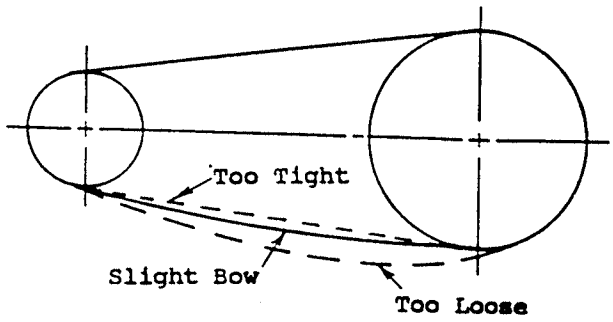


Figure 4. V-belt tension positions.

STEP 2. Operate the drive a few minutes to seat the belts in the sheave grooves. Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taut during the peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the belts squeal as the motor begins operation or at some subsequent peak load, they are not tight enough to deliver the torque demanded by the drive machine. The drive should be stopped and the belts tightened.

STEP 3. Check the tension on a new drive frequently during the first day by observing the slack side span. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack side.

Other methods of determining proper belt tension can be obtained from the drive manufacturer.

5. Use Belt Guards - Belt guards protect personnel from danger and the drive from contamination. Inspect periodically to assure that belts do not rub against guard.

6. Keep Belts Clean – Dirt and grease reduce belt life. An occasional wiping with a dry cloth to remove any build-up of a foreign material can extend the life of the belt. Should oil or grease splatter onto the belts, clean with soap and water.

Belt dressing affects performance only temporarily and is never recommended. Maintaining a clean drive is a better practice.

If any questions arise pertaining to the drive limitations, consult the manufacturer.

II-G. COUPLING ALIGNMENT

Warning

BEFORE BEGINNING ANY ALIGNMENT PROCEDURE, MAKE SURE DRIVER POWER IS LOCKED OUT.

The points at which alignment are checked and adjusted are:

– **Initial Alignment** is done prior to operation when the pump and the driver are at ambient temperature.

– **Final Alignment** is done after operation when the pump and driver are at operating temperature.

NOTE: PROPER ALIGNMENT IS THE RESPONSIBILITY OF THE INSTALLER AND USER OF THE UNIT.

Accurate alignment of the equipment must be attained. Trouble free operation can be accomplished by following these procedures.

ALIGNMENT CHECKS

Initial Alignment (Cold Alignment)

– Before Mounting Baseplate – To ensure alignment can be attained.

– After Mounting Baseplate – To ensure no changes have occurred during the mounting process.

– After Connecting Piping – To ensure pipe strains have not altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

Final Alignment (Hot Alignment)

– After First Run – To obtain correct alignment when both pump and driver are at operating temperature. Thereafter, alignment should be checked periodically in accordance with plant operating procedures.

ALIGNMENT CRITERIA

Disconnect coupling halves before proceeding with the alignment. Check for parallel and angular alignment with either the Dial Indicator Method or the Straight-Edge Method outlined below.

The faces and outside diameters of the coupling halves must be square and concentric with the bores. Good alignment is achieved when the dial indicator readings, for both parallel and angular misalignment, are .003" (.076mm) Total Indicated Reading (T.I.R.) or less when the pump and driver are at operating temperature (Final Alignment). Fig. 5 provides a picture of what to look for.

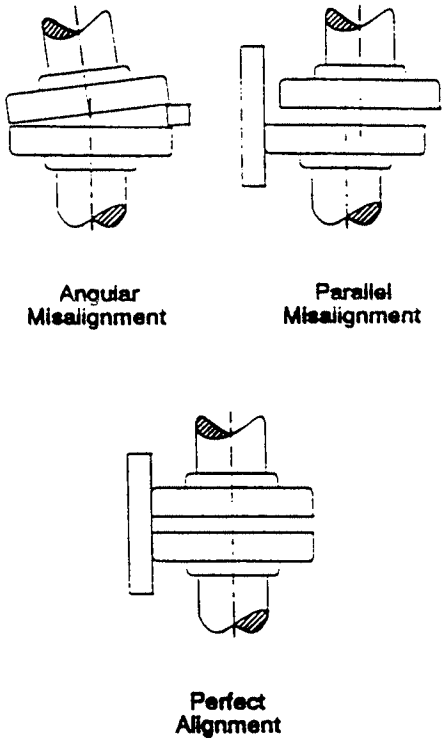


Fig. 5. Coupling alignment positions.

INSTALLATION AND OPERATING INSTRUCTIONS

SET-UP

1. Mount two dial indicators on one of the coupling halves (X) so that they contact the other coupling half (Y), see Fig. 6.

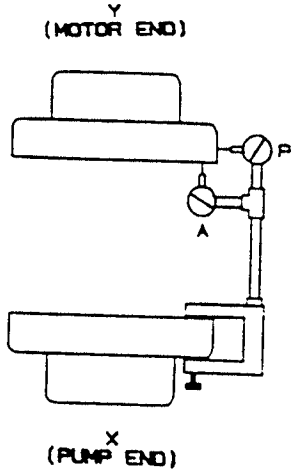


Fig. 6. Dial indicator set-up.

2. Check setting of indicators by rotating coupling half X to ensure indicators stay in contact with coupling half Y but do not bottom out. Adjust indicators accordingly.

MEASUREMENT TECHNIQUES

1. To ensure accuracy of indicator readings, always rotate both coupling halves together so indicators contact the same point on coupling half Y. This will eliminate any measurement problems due to runout on coupling half Y.

2. Take indicator measurements with driver hold-down bolts tightened. Loosen hold-down bolts prior to making alignment corrections.

3. Take care not to damage indicators when moving driver during alignment corrections.

Keep this instruction manual handy for reference. Further information can be obtained by contacting the Slurry Pump Division, East Centre St., Ashland, PA 17921 or your local representative.

ALIGNMENT PROCEDURE

A check for both angular and parallel alignment must be completed and the necessary adjustments be made to obtain the .003" (.076mm) T.I.R. stated in the alignment criteria.

Angular and parallel misalignment in the vertical direction, on MPAF pumps, are corrected by means of shims under the motor mounting feet. In the horizontal direction, alignment is corrected simply by sliding the motor into the proper location.

After each adjustment, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustments already made in another direction. It should not be necessary to adjust the pump in any way.

ANGULAR ALIGNMENT

A unit is in angular alignment when indicator A (Angular Indicator), Fig 6, does not vary by more than .003" (.076mm) as measured at four points on the coupling periphery 90° apart at operating temperature. There are two methods outlined below which are acceptable to achieve the desired alignment.

METHOD 1 - Dial Indicator Method

For the following steps, refer to Fig. 7, pg. 10.

1. Zero indicator A at position 1 of coupling half Y. Mark this position on both flanges.

2. Rotate both flanges 180° to position 3. Observe needle and record reading.

3. Negative Reading - The coupling halves are further apart at position 3 than position 1.

Positive Reading - The coupling halves are closer at position 3 than position 1.

4. Correct any misalignment by shimming the motor under its feet to attain the proper alignment.

When using positions 2 and 4 in steps 1 - 3, correct any misalignment by sliding the motor back and forth to attain the proper alignment.

5. Repeat steps 1-4 substituting position 2 for position 1 and position 4 for position 3. Use the same marks made on the coupling from position 1 and be sure to turn the coupling halves together.

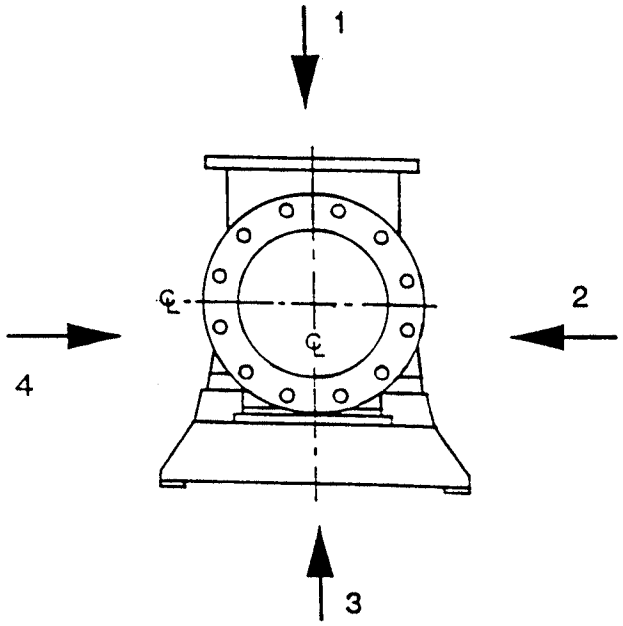


Figure 7. Directions of viewing coupling
View from front of pump.

METHOD 2 - Feeler Gauge Method

For the following steps refer to Fig. 7.

1. Insert a feeler gauge at position 1 at the periphery of the couplings. Mark this position on both flanges.

2. Record the largest gauge size which fits snugly between the two flanges.

3. Rotate both flanges to position 3 - 180°.

4. Insert a feeler gauge at position 3 at the periphery of the couplings.

5. Record the largest gauge size which fits snugly between the two flanges.

6. Calculate the difference between the readings at positions 1 and 3. The difference should not be greater than .003" (.076mm).

7. Correct any misalignment by shimming the motor under its feet to attain the proper alignment.

When using positions 2 and 4 in steps 1 - 6, correct any misalignment by sliding the motor back and forth to attain the proper alignment.

8. Repeat steps 1-6 substituting positions 2 and 4 for positions 1 and 3 respectively. Use the same marks made on the coupling from position 1 and be sure to turn the coupling halves together.

PARALLEL ALIGNMENT

The unit is in parallel alignment when indicator P (Parallel Indicator) does not vary by more than .003" (.076mm) as measured at four points on the coupling periphery 90° apart at operating temperature. There are two methods outlined below which are acceptable to achieve the desired alignment.

METHOD 1 - Dial Indicator Method

For the following steps, refer to Fig. 7.

1. Zero indicator P at position 1 of coupling half Y. Mark this position on both flanges.

2. Rotate both flanges 180° to position 3. Observe needle and record reading.

3. Negative Reading - The coupling half Y is shifted toward position 1.

If the value is greater than .003" (.076mm), correct the misalignment by evenly (at equal amounts on both sides) shimming the motor higher.

When using positions 2 and 4 in steps 1 - 2, correct any misalignment by sliding the motor evenly toward position 2.

Positive Reading - The coupling half Y is shifted toward position 3.

If the value is greater than .003" (.076mm), correct the misalignment by evenly (at equal amounts on both sides) shimming the motor lower.

When using positions 2 and 4 in steps 1 - 2, correct any misalignment by sliding the motor evenly toward position 4.

4. Repeat steps 1-3 until indicator P reads .003" (.076mm) or less.

5. Once the ideal alignment is reached, repeat steps 1-4 substituting position 2 for position 1 and position 4 for position 3.

METHOD 2 - Straight-Edge Method

For the following steps refer to Fig. 7, pg. 10..

1. Place a straight edge across the two coupling flanges at position 1 and mark the spot on both flanges.

2. Adjust the motor so that the straight-edge rests evenly on both flanges (within .003" - .076mm).

3. Rotate both flanges 90° to positions 2 and repeat steps one and two.

4. The unit will be in parallel alignment when the straight edge rests evenly (within .003" - .076mm) on the coupling periphery at both positions along the periphery.

NOTE: Care must be taken to have the straight edge parallel to the axis of the shafts

II-H. FACTORS THAT MAY DISTURB ALIGNMENT

The unit should be checked periodically for alignment. If the unit does not stay in line after being properly installed, the following are possible causes:

1. Settling or spring of the foundation.

2. Wear of bearings.

3. Pipe strains distorting or shifting the machine.

4. Spring of the base plate due to heat created from an adjacent heat source.

5. Shifting of the building structure due to variable loading or other causes.

6. Loose nuts or bolts on the pump or driver assembly.

II-I. STUFFING BOX - PACKING

1. Lubrication - In the conventional stuffing box, packing or mechanical seals are used to seal the rotating shaft. Generally, a clear liquid such as water is used to lubricate and cool the sealing elements. The lubricating liquid pressure must be 10-15 PSI higher than the pressure inside the elbow to prevent pumpage from entering the sealing elements. The lubricating liquid must be clean and free of grit. Shaft sleeve scoring, packing destruction, and mechanical seal face damage will result from contaminated lubricant.

The stuffing box may be on the suction or the discharge side of the impeller, depending on the direction of flow through the elbow ordered by the customer. If the pressure inside the elbow is not known, it should be measured with a pressure gauge on the discharge pipe when the pump is operating.

The stuffing box is furnished with two N.P.T. holes for piping the lubricating liquid. The lubricating liquid is piped into one of them. Some users simply plug the other hole. For additional cooling of the sealing elements, an outlet pipe with a valve can be installed to allow more liquid to flow through the stuffing box. Double mechanical seals have no leakage and usually require a lubricant flowthrough the stuffing box for cooling. The lubricant flow should be regulated by the valve in the outlet pipe rather than by throttling the flow in the supply pipe.

2. Packing - Original equipment packing is a suitable grade for the service intended.

3. Packing Procedure -

Refer to Fig. 8, page 12 for the following instructions.

a) Stuffing box and shaft sleeve must be clean and free of grit.

b) Form packing over shaft or mandrel of same diameter. Carefully cut to packing length. Discard rings cut too short.

c) Pre-form each ring by coiling 1-1/2 turns.

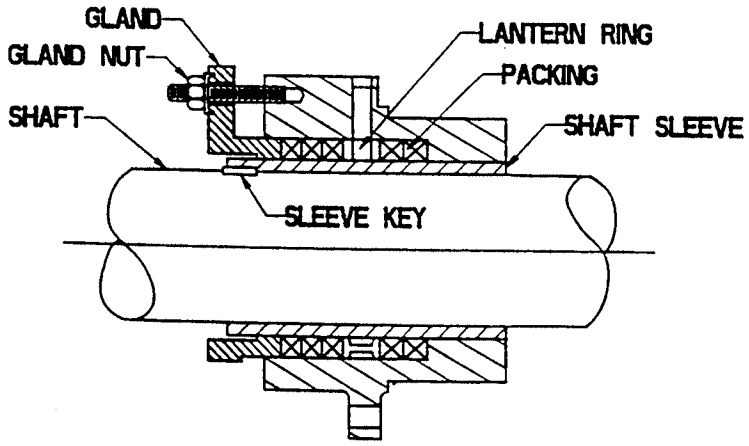


Fig. 8. Typical stuffing box.

d) To install packing rings, do not pull straight. Expand the coil as a coil spring, see Fig 9A and 9B for the correct and incorrect method of installing packing.

e) Expand the first coil as shown and insert into stuffing box. Tamp packing to stuffing box shoulder firmly with the gland. Note where the cut is positioned.

f) Install the second and third coil as required by assembly drawing, staggering the cut 90° to 120°.

g) Insert lantern ring into stuffing box, carefully noting its proper position on the assembly drawing. Failure to properly locate the lantern ring will result in insufficient packing lubrication. Packing and shaft sleeve damage may result.

h) After packing and lantern ring are properly installed, insert gland into stuffing box. Tighten gland nuts finger tight only. The shaft should turn freely.

i) Turn lubricant supply on, start pump, and adjust the gland as described in Section III-E Stuffing Box Adjustment.

j) Periodic maintenance is absolutely required for all packed pumps. Normal shaft run-out should be under .005" to avoid pounding of stuffing box packing. With excessive shaft run-out, shaft straightening or replacement is necessary.

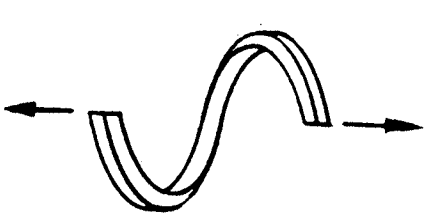


Fig. 9A. Correct

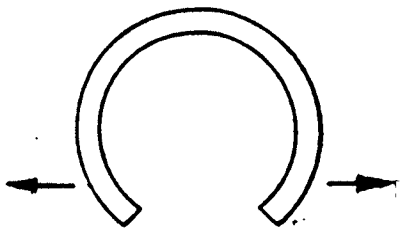


Fig. 9B. Incorrect.

Fig. 9. Stuffing Box Packing.

4. Stuffing Box Adjustment – See SECTION III–E. Stuffing Box Adjustment.

II–J. STUFFING BOX – MECHANICAL SEAL

Most mechanical seals are installed and adjusted at the factory. Due to size and design, some installed mechanical seals are supplied with shipping retainers. Shipping retainers hold the sealing faces apart to avoid damage during transport. Shipping retainers must be removed before shaft is to be rotated. Pumps with retained seal faces will be specifically marked and instructions from the seal manufacturer for retainer removal will be provided.

Mechanical seals have a stationary and a rotating sealing face. Commonly, these sealing rings are of carbon and ceramic material, brittle in nature, and easily damaged. As the sealing rings seat with the operation of the pump, a compatible wear pattern develops between the mating surfaces. To disassemble the mechanical seal after the wear pattern is established would necessitate the replacement of the rotating element and stationary sealing elements. Do not replace only one component.

To insure the life and sealing characteristics of the mechanical seal, lubricating liquid must be circulated through the stuffing box. Clear, grit–free liquid is necessary.

Special seal information and replacement seal elements can be provided by the seal manufacturer. Goulds strongly recommends the stocking of replacement sealing elements.

Warning

DO NOT MAKE SHAFT ADJUSTMENTS ON MECHANICAL SEAL INSTALLATIONS WITHOUT CONSULTING SEAL INSTRUCTIONS AND THE PUMP ASSEMBLY DRAWING. DAMAGE TO THE MECHANICAL SEAL MAY RESULT.

SECTION III – AXIAL FLOW PUMP START-UP

Before the pump is started, the following should be checked:

III-A. BEARING LUBRICATION – The bearings must have adequate lubrication. Consult SECTION IV – Bearing Lubrication of this instruction manual for more specific information.

Caution

IMPROPER LUBRICATION COULD RESULT IN SERIOUS DAMAGE TO THE BEARINGS AND POSSIBLE PUMP FAILURE.

III-B. SHAFT ROTATION – The pump shaft must turn without any binding or rubbing. By manually turning the rotating element, only the uniform frictional drag of the bearings and the stuffing box should be sensed. If the shaft does not turn freely, it should be checked to determine the cause of binding.

III-C. CHECKING ROTATION – The direction of rotation of the driver must be checked before it can be coupled with the pump. The direction of rotation of the pumps is indicated in a prominent location. For pumps with impellers threaded on the shaft, reverse rotation would back the shaft from the impeller thread. Considerable damage may occur.

Caution

SERIOUS DAMAGE MAY RESULT IF THE PUMP IS RUN IN THE WRONG DIRECTION.

1. Lockout power to the driver.

Warning

LOCKOUT DRIVER POWER TO PREVENT ACCIDENTAL START-UP.

2. Disconnect coupling from the driver or the belts from the drive. Make sure no parts are loose.

3. Reinstall drive guard.

4. Unlock driver power.

5. Make sure everyone is clear of the driver. Jog the driver just long enough to determine the direction of rotation. Rotation must correspond to the arrow on the pump.

6. Reinstall driver power.

III-D. STUFFING BOX LUBE LINES – Lubricating liquid must be flowing to the stuffing box before the pump is started. Both mechanical seals and packing require lubrication for continued service. See SECTION II-H – Stuffing Box for more information on packing lubrication.

III-E.STUFFING BOX ADJUSTMENT – During the first few hours of operation:

1. Gland Adjustment – Adjust the stuffing box if packing is used. When the pump is first started, there should be considerable leakage by the gland to cool the packing. Gradually tighten the gland nuts one flat at a time while observing the leakage and the stuffing box temperature. Packing requires time to "run in" and extra coolant (leakage) while it is being "run in". If the leakage is reduced too quickly, the packing will overheat and may be destroyed. The shaft sleeve may also be damaged.

2. Leakage – The normal leakage for a properly adjusted stuffing box, depending on shaft size and speed, varies from a few drops a second to a small trickle out of the gland.

III-F. PRIMING – Never install pump until it has been properly primed

pump starting – make sure suction and discharge valves are fully open.

INSTALLATION AND OPERATING INSTRUCTIONS

Warning

THIS UNIT MUST NEVER BE USED WITHOUT PRIOR INSTALLATION OF THE SAFETY GUARDS FOR ROTATING PARTS AS PRESCRIBED BY O.S.H.A.

OPERATION OF THIS PUMP WITH THE DISCHARGE AND/OR SUCTION VALVES CLOSED FOR EVEN BRIEF PERIODS OF TIME IS AN UNACCEPTABLE AND DANGEROUS PRACTICE. A GREAT DANGER EXISTS FROM POSSIBLE EXPLOSION.

DO NOT APPLY HEAT TO THE NOSE OF THE IMPELLER. DANGER OF EXPLOSION.

SECTION IV – TYPE "MX" BEARING

The MX bearing uses a pair of angular contact bearings in the outboard bearing to carry the combined radial and axial thrust forces. A single row radial bearing in the inboard position carries the shaft weight and counter force from a belt drive system.

This assembly is used with horizontal and vertical MPAF pumps, with the only change being the position of the inboard bearing grease fitting.

The larger MX bearing housings are a split design to facilitate disassembly and assembly. This allows using an alternate bottom housing half with a larger reservoir for oil lubrication.

IV–A. BEARING LUBRICATION AND CARE

At the first start–up, place a couple of drops of oil on the shaft by each lip seal.

Grease Lubrication

If the pump is furnished with grease lubrication, the bearings were hand packed with Mobilux #2 grease unless otherwise specified by the customer. Other suitable greases are Humble Lidok #2, Texaco Regal Starfak #2 and Shell Alvania #2. If another brand is desired, it should be checked with the supplier for being equivalent to the above.

The bearings have sufficient grease for at least 24 hours of operation after start–up. The bearings will run hotter than normal for the first few hours until the grease is worked out of the ball path and the bearings have "run–in". Adding more grease during this period may increase the bearing temperature. After the first re–greasing, a small amount of grease should be added at each fitting every 500 hours of operation.

Oil Lubrication

When the pump is furnished with oil lubrication, a good grade of oil should be used to insure long bearing life.

Warning

PUMPS FURNISHED FOR OIL LUBRICATION ARE SHIPPED WITHOUT OIL. ADD OIL UNTIL THE LEVEL IS UP TO THE OIL LEVEL LINE BEFORE THE UNIT IS STARTED.

If too much oil is added, there will be excessive heat generated in the bearings and there may be leakage from the shaft seals.

Run pumps for 15 seconds to fill splash reservoirs in the bearing housing. Check oil level indicator and add oil accordingly. Monitor oil level indicator for the first 24 hours of operation and maintain fill level.

If the unit has an external oil lube system, fill the bearing housing and the reservoir to satisfy the system requirements. Goulds recommends a commercial oil such as

Mobil D.T.E. oil BB
Shell Tellus #72

or an equal quality grade oil. However, a good grade of non–detergent oil of SAE#30 or #40 is usually satisfactory. Consult a reputable supplier for acceptable substitutes for the oils mentioned.

For the best results, the minimum oil viscosity should be maintained as follows:

Operating temp. below 150° F – SAE 30
Operating temp. below 160° F – SAE 40
Operating temp. below 180° F – SAE 50

An oil with a higher viscosity than required will increase the bearing operating temperature because of the extra viscous drag, but never to the point where the viscosity becomes lower than required from the increased heat generation. It is therefore better for the bearings to have an oil that is too heavy rather than too light.

The oil should be a premium R & O type with a SAE 30 viscosity, such as Shell Tellus 41 or Exxon Teresstic 65. Detergent automotive oils are not considered to be satisfactory for anti–friction bearing

lubrication. The lubricating oil should have a minimum viscosity of 100 SSU at the bearing operating temperature.

Change the oil after the first 200 hours of operation. For normal operating conditions, change the oil at least four (4) times a year. If the bearing assembly is exposed to dirty or moist conditions, the oil should be changed more often.

IV-B. OIL LEVEL CONTROL

If the level of oil in the bearing housing is too high, excessive heat may be generated due to churning and there may be leakage from the shaft seals. If the level is too low, excessive heat may be generated due to inadequate lubrication. A liquid level switch connected to the oil sump can be used to warn of a dangerous oil level condition.

Observe the oil level requirements shown on the assembly drawing furnished with the pump. If excessive heat is experienced within these levels, consult the factory. Be sure that the shaft centerline is horizontal through the bearing housing.

IV-C. NORMAL BEARING TEMPERATURE

The running temperature for a bearing assembly depends on many factors such as speed, bearing loads, ambient air temperatures, and the condition of the bearings. Temperatures higher than the human hand can tolerate are very satisfactory for good bearing operation and should not cause any alarm.

For a given speed and loading, the bearing housing temperature will stabilize at some temperature, usually below 200° F which will be the normal temperature for that installation. Higher temperatures than this normal temperature, without any change in the speed or loading, can mean a lubrication difficulty or the approach of a bearing failure.

NOTE: TEMPERATURES ABOVE 220° F MAY REDUCE THE OIL FILM THICKNESS TO A POINT WHERE THE BEARINGS MAY NOT BE ADEQUATELY LUBRICATED EVEN THOUGH THERE IS A SUFFICIENT QUANTITY OF LUBRICANT.

IV-D. INSTALLING A BEARING

Long bearing life is quite dependent on careful handling of the bearing when it is out of the housing and during the installation procedure, because dirt and rough handling are prime enemies of precision bearings. Bearings should be pressed, not "hammered", into place. If heat is used to facilitate the installation, a hot oil bath is the best method. Bearings for grease lubrication should be hand packed with grease to insure adequate lubrication at start-up.

IV-E. DISASSEMBLY OF THE "MX" BEARING HOUSING

Refer to Fig. 10 for the following instructions.

1. After the liquid has been removed in accordance with the instructions for that section, remove the cap screws which secure the bearing housing to the hub extender (9833) and separate the two components.

2. Slide excluder (9905) off the impeller end of the shaft.

3. Remove the cap screws securing the retainers (109) and (119B) to the bearing housing. Slide the retainers off the end of the shaft. The non-split bearing housing uses seal (333) as a retainer – it is not removed at this time.

4. A) Split Bearing Housing:

Remove the bolts securing the housing halves together. Knock out taper pins, lift off upper housing half and lift the shaft out of the lower housing half.

B) Solid Bearing Housing:

Carefully slide shaft out of housing.

5. Remove locknut (136) and lockwasher (382). Press bearings (112C) and (168C) off of the shaft, using force against the bearing inner race. Force on the outer race may damage the bearing.

IV-F. ASSEMBLY OF THE "MX" BEARING HOUSING

1. Clean and inspect all bearing assembly components. Be sure old sealer has been scrapped from the housing split. The shaft and housing should not have any burrs or rough areas that could be detrimental to the seals or proper seating of the bearings.

2. Install the bearings (112C) and (168C) an the shaft and secure the thrust bearings with lockwasher (382) and locknut(136). Make sure the thrust bearings have been oriented according to the assembly drawing furnished with the pump.

NOTE: IF THE BEARINGS ARE GREASE LUBRICATED, THEY SHOULD BE HAND-PACKED WITH GREASE TO HAVE EACH BALL PATH FILLED APPROXIMATELY ONE-THIRD FULL OF GREASE.

Caution

DO NOT OVERFILL THE BEARINGS.

3. a) Split Bearing Housing:

1) Place the shaft in the bottom housing half.
2) Apply a 1/16" bead of oil resistant silicone sealant slightly inside of the bolt holes on the mating surface of the lower housing half. DO NOT ALLOW TO DRY! Immediately lower top half of housing into position, align with taper pins, and secure together with bolts.

b) Solid Bearing Housing:

Slide shaft, with bearings, into housing. This is usually easier if the housing is vertical and the shaft is lowered into position. The radial bearing (168C) outer race may cock as it enters the housing bore, in which case the shaft should be lifted slightly and another attempt made.

4. Install thrust bearing retainer (109) with sufficient shims to leave a gap of .005"-.008" for prevention of clamping bearing outer races together. Do this by installing the retainer without shims; cap screws slightly tightened. Measure the gap between retainer and housing and make shim about .005" thicker than the measured gap.

5. Install retainer (119B) or seal (333) if the housing is solid.

6. Slide the excluder (9905) into position, close to but not touching the retainer or seal.

7. Check for free rotation of the shaft.

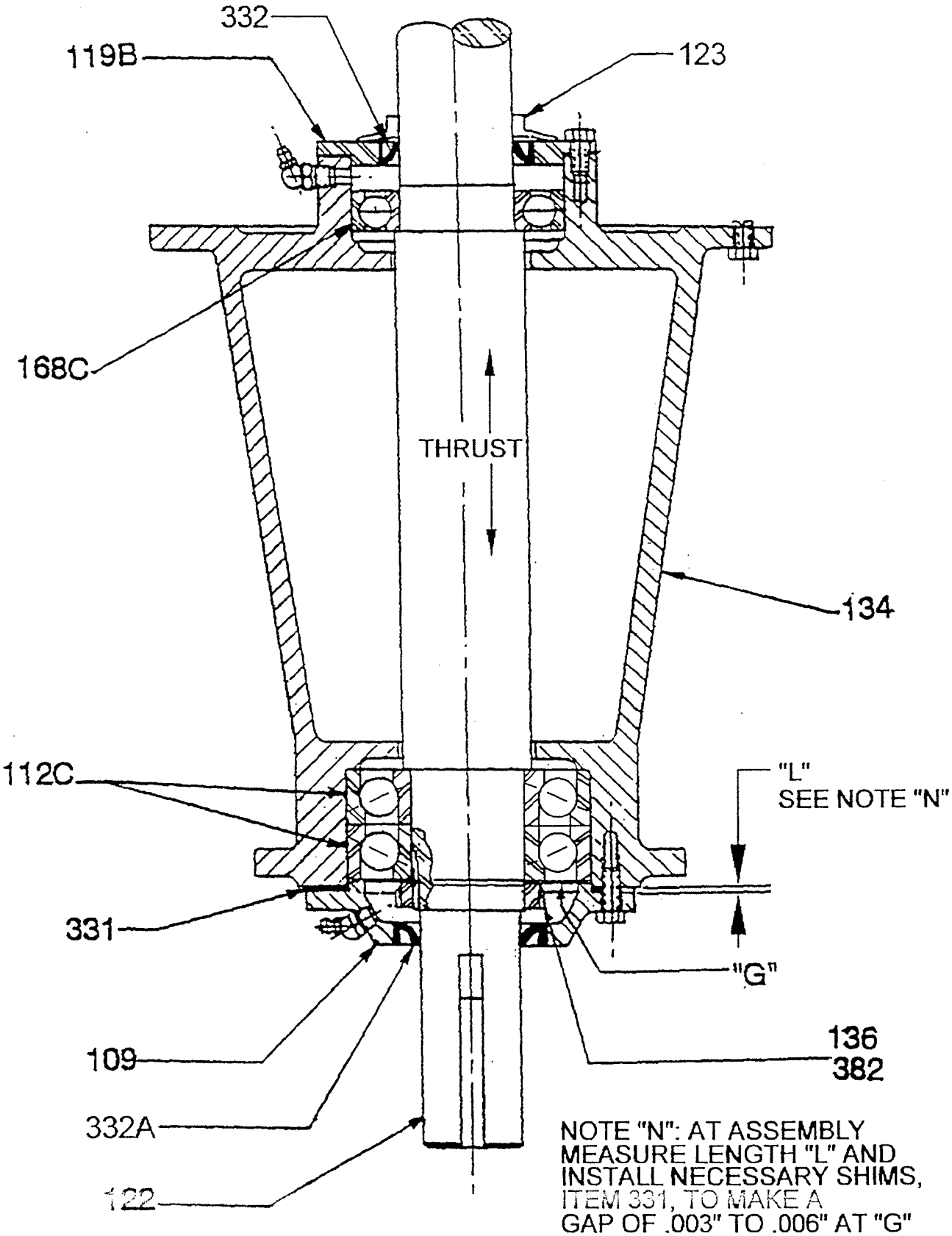


FIG. 10 THE "MX" BEARING ASSEMBLY

INSTALLATION AND OPERATING INSTRUCTIONS

SECTION V – MPAF LIQUID END WITH BACK PULLOUT

The MPAF liquid end uses a modified elbow design to allow the back pullout option as illustrated in this section. Elbows without the back pullout option are a single piece.

The elbow may be furnished with the inflatable shaft seal option, see illustration in Appendix B, if applicable. A separate section is included with these instructiuons for the inflatable seals when furnished with the pump.

The MPAF pump with the back pullout option requires a separately machined stuffing box (220). This is semi-permanently fastened into place and is not normally removed. If the pump is furnished for vertical shaft installation, the cavity around the stuffing box, below the drain, is filled with a suitable grout.

The larger size MPAF pumps may have a plate covering the end of the impeller hub to allow sealing of the impeller hub cavity.

V-A. IMPELLER CLEARANCE ADJUSTMENT

The impeller requires several thousandths of an inch minimum clearance to prevent rubbing due to the action of the hydraulic forces when the pump is operating. Many corrosion-resistant alloys will gall and build up if rubbing occurs, therefore, pumps using these alloys need to be free from any rubbing.

Clearance adjustment is made by moving the stuffing box cover (184) on the elbow (315A) and/or by the use of thin shims in one area of the mating surface of these two parts. The pump was aligned at the factory and taper pinned in the aligned position. Before disturbing this position, make sure the cap screws fastening the bearing housing to the hub extender and the extender to the elbow are tight.

NOTE: IMPELLER RUBBING IS OFTEN CAUSED BY PIPE STRAIN. PIPE STRAIN MUST BE ELIMINATED PRIOR TO IMPELLER ALIGNMENT.

Impeller Alignment – Use the alignment worksheet for the MPAF pump. The measurement procedure is as follows:

1. Note the number of blades. Mark each 1, 2, 3 or 1, 2, 3, 4 depending on the number of vanes.

2. Rotate the shaft and measure the gap between each blade and the casing at the 12, 3, 6, and 9 o'clock positions indicated by the worksheet. The value of interest is the largest value of feeler gage thickness which will slide easily the whole length of the vane tip.

3. Add the measurements for all positions together and divide by the number of measurements. This will give the average measurement.

4. Divide the average measurement by 2. This will give the minimum clearance.

5. If any blade has a clearance in any of the positions which is smaller than the calculated minimum clearance the prop is not sufficiently centered and should be adjusted.

Example: 3- vane impeller. At 12 o'clock the readings are VANE 1- .040, VANE 2- .041, VANE 3 – .040; at 3 o'clock .050, .051, .050; at 6 o'clock .050, .052, .051; at 9 o'clock .040, .042, .039.

$$\text{AVERAGE CLEARANCE} = \frac{\text{SUM OF READINGS}}{\text{NUMBER OF READINGS}} = \frac{.040+.041+.040+.....}{12} = .0455"$$

$$\text{MINIMUM CLEARANCE} = \frac{\text{AVERAGE CLEARANCE}}{2} = .0455/2 = .0228"$$

V-B. DISASSEMBLY OF THE LIQUID END

Warning

ISOLATE THE PUMP FROM THE PIPING SYSTEM AND DRAIN THE LIQUID IN THE PUMP PRIOR TO DISMANTLING THE PUMP AND PIPING.

1. Drain the liquid (pumpage) from the elbow (315A). Remove the piping from the impeller end of the elbow.

2. Remove the impeller (101). The impeller fastening screw (370C) is locked into place with socket head set screws that have to be removed before the fastening screw is turned. After screw (370C) is removed, pull impeller off of the shaft.

3. Remove cap screws fastening the bearing housing (134) to the hub extender (9833). Pull the shaft, with housing, out of the hub assembly.

NOTE: FOR MECHANICAL SEAL EQUIPPED PUMPS, DISASSEMBLY MAY BE REQUIRED FROM THE STUFFING BOX. REFER TO MECHANICAL SEAL DRAWING.

4. Remove set screw(s) locking the sleeve (126) to the shaft and pull the sleeve off of the shaft.

5 Remove gland (107), packing, and lantern ring (105) from the stuffing box.

6. If required, the stuffing box hub (220) can be removed from the hub disc (184).

V-C. ASSEMBLY OF THE LIQUID END

1. Install the hub (220), if removed, with gasket (211) in the hub disc (184). Secure in place with three (3) cap screws. Make sure all pipes into the hub are in place and tight.

If the pump is furnished with an inflatable seal, install the seal in hub and secure in place with seal retainer.

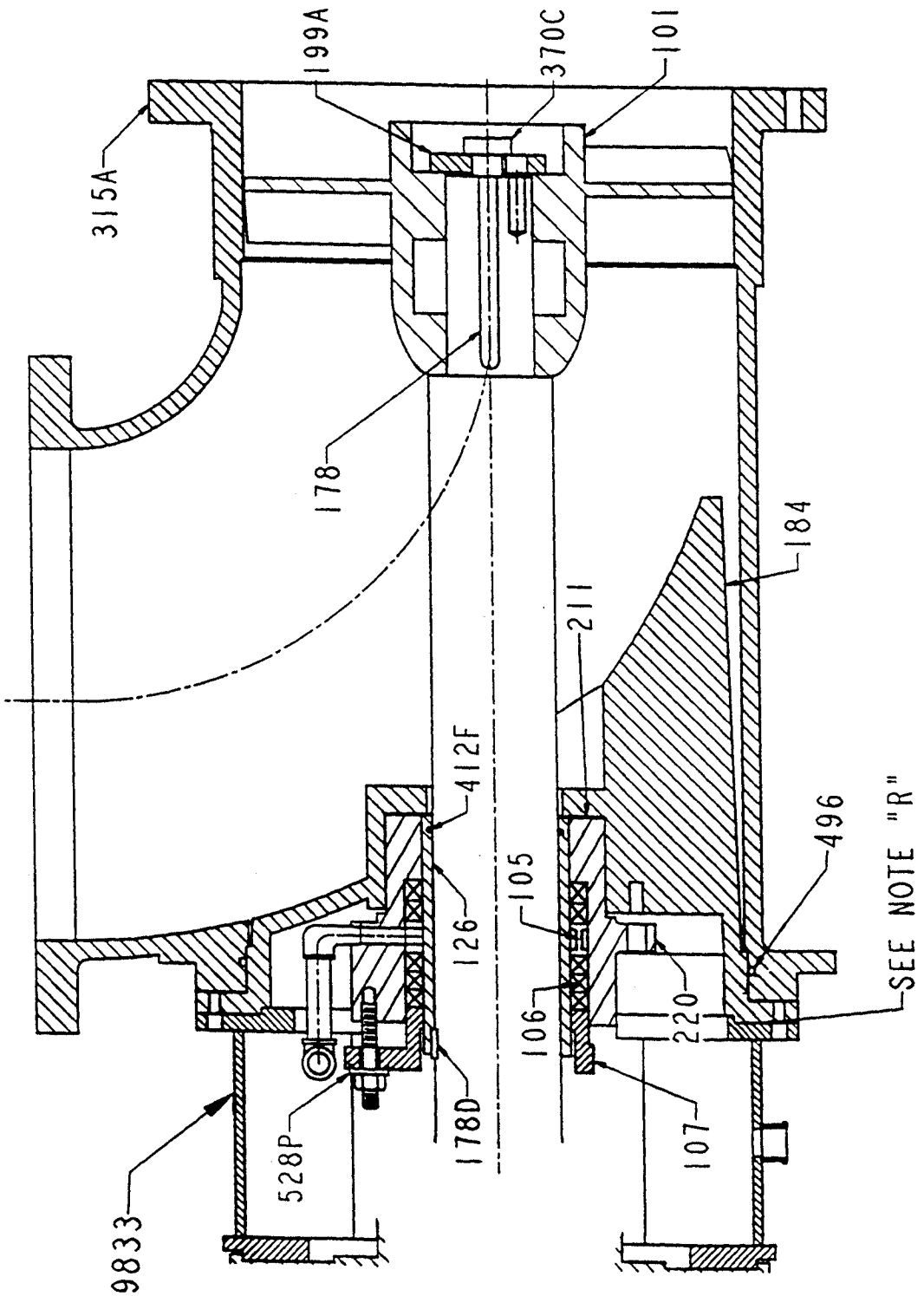
2. Install shaft sleeve, with o-ring (412F), in place and secure with set screws. If a key is used, be sure it has been installed. If pump is furnished with a mechanical seal, refer to the mechanical seal drawing and install over the sleeve.

3. Slide the shaft assembly into place. Align the housing (134) to the hub extender (9833), using taper pins and fasten with cap screws.

4. Install the impeller (101) and drive key (178), fastening in place with washer (199A) and cap screw (370C). Tighten cap screw to have flats next to set screw holes. Install set screws to prevent cap screws and washers from being able to turn.

5. Turn shaft by hand to check for impeller rubbing. If necessary, correct as described in section V-A - IMPELLER CLEARANCE ADJUSTMENT.

6. Repack the stuffing box with packing, seal cage, and gland. Do not overtighten the gland.



NOTE "R": AT ASSEMBLY, SEAL WITH SILASTIC 732 RTV

Fig. 11. MPAF liquid end.

SECTION VI – OPERATION AND TROUBLE SHOOTING

Most Axial Flow pumps are in evaporator circulation service, and since the evaporator performance and the amount of product depends on the rate of liquid circulation, care should be taken to maintain these pumps in good operating condition.

When production drops off, it is usually due to lower circulation rate. An approximation of this rate can be made by several methods:

1) Temperature drop across the heat exchanger
2) Visual inspection of flow in body
3) Testing the circulating pump

Items (1) and (2) above are covered by the evaporator manufacturer.

VI–A. PERFORMANCE CHECK –

While field conditions preclude absolute accuracy, a check of pump performance will give reasonably close results. This can be done by installing a pressure measuring device at pipe taps located at least one pipe diameter away from the suction and discharge flanges of the pump. If gauges are used, the pressure differential times 2.31 divided by the specific gravity of the slurry indicates the total head in feet against which the pump is actually operating.

Check the pump speed and determine the flow rate in gallons per minute from the pump curve. This curve will also give efficiency from which the horsepower (Hp) requirement can be determined. A double check is to take motor ammeter readings, convert to Hp, figure 90% drive efficiency then use it against the curve to get the GPM. This is only an approximate check, as the Hp curve on some applications is rather flat, but is probably within 7–1/2%. It is important to take and record these readings when the equipment is new, so that later readings can be judged on a relative basis.

VI–B. CAUSES OF CIRCULATION LOSS –

1. Increase in TDH against which the pump operates could be caused by:

a) Heat exchanger tubes partially blocked
b) Too many heat exchanger tubes blocked off
c) Improperly sized or partially plugged strainer

2. Viscosity of slurry is higher than the design viscosity of the system

3. Pump speed low. V–belt drive may be slipping and operating pump below design speed.

4. Pump throttled on suction side. Could be caused by rubber lining pulling away from the suction pipe and partially collapsing, by large solids dropping into suction, or by improperly sized or plugged strainer in the suction pipe.

5. Pump partially plugged by large solid jammed between two impeller blades. This will also cause rough operation with excessive vibration.

6. Incorrect pump rotation. When changing motor for any reason or after any electrical system changes or modifications, always check motor for correct direction of rotation. The coupling should be removed for checking for proper rotation.

7. Worn pump impeller and/or casing. On a new pump, clearance between the tip of the impeller blade and casing is carefully determined. As this clearance increases, pump performance decreases.

It is not practical to predict performance at any given clearance without running a test at this clearance. On small pumps, this effect is magnified as the percentage of impeller blade area lost from wear and corrosion is higher.

Other pump conditions and possible causes are:

VI-C. HIGH HORSEPOWER DEMAND -

1. Increased head or viscosity
2. Pump speed too high
3. Specific gravity of slurry is higher than normal
4. Packing gland pulled up too tight
5. Impeller rubbing in casing

VI-D. NOISY ROUGH OPERATION -

1. Throttled suction or plugging
2. Impeller rubbing in casing
3. Loose impeller
4. Broken impeller blade
5. Bearings not properly lubricated
6. Bent Shaft
7. Impeller out of balance

VI-E. WATER HAMMER

Water hammer is a high pressure surge in a pipe system created by a rapid change in flow rate and may result in extensive damage to the pump and piping. One of the most common causes is the sudden closing of a flow control device. A sudden partial blockage of the pipe line has the same effect as a sudden valve closure.

VI-F. GENERAL CONSIDERATIONS

Never vary capacity with regulating valve in the discharge line. NEVER throttle flow from the suction side.

Driver may overload if the pumpage specific gravity (density) is greater than originally assumed, or the rated flow rate is exceeded.

Warning

DO NOT OPERATE PUMP BELOW MINIMUM RATED FLOWS OR WITH THE DISCHARGE VALVE CLOSED. THESE CONDITIONS CAN QUICKLY LEAD TO PUMP FAILURE.

Always operate the pump at or near the rated conditions to prevent damage resulting from cavitation or recirculation. Operating at reduced capacity can cause increased vibration levels, heat build-up, and cavitation. Continued operation at these conditions will then cause premature bearing and/or mechanical seal failure, stuffing box damage, and scoring or seizing of rotating parts.

SECTION VII – ORDERING SPARE PARTS

VII-A. REPLACEMENT PARTS PROCEDURE

To insure against possible long and costly down time periods, especially on critical services, it is advisable to have spare parts on hand.

Repair orders will be handled with a minimum of delay if the following directions are followed:

1. Give model number, size of pump, and serial number. These can be obtained from the nameplate on the pump.

2. Write plainly the name and part number of each part required. These names and numbers should agree with those on the Bill of Material.

3. Give the number of parts required.

4. Give complete shipping instructions.

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