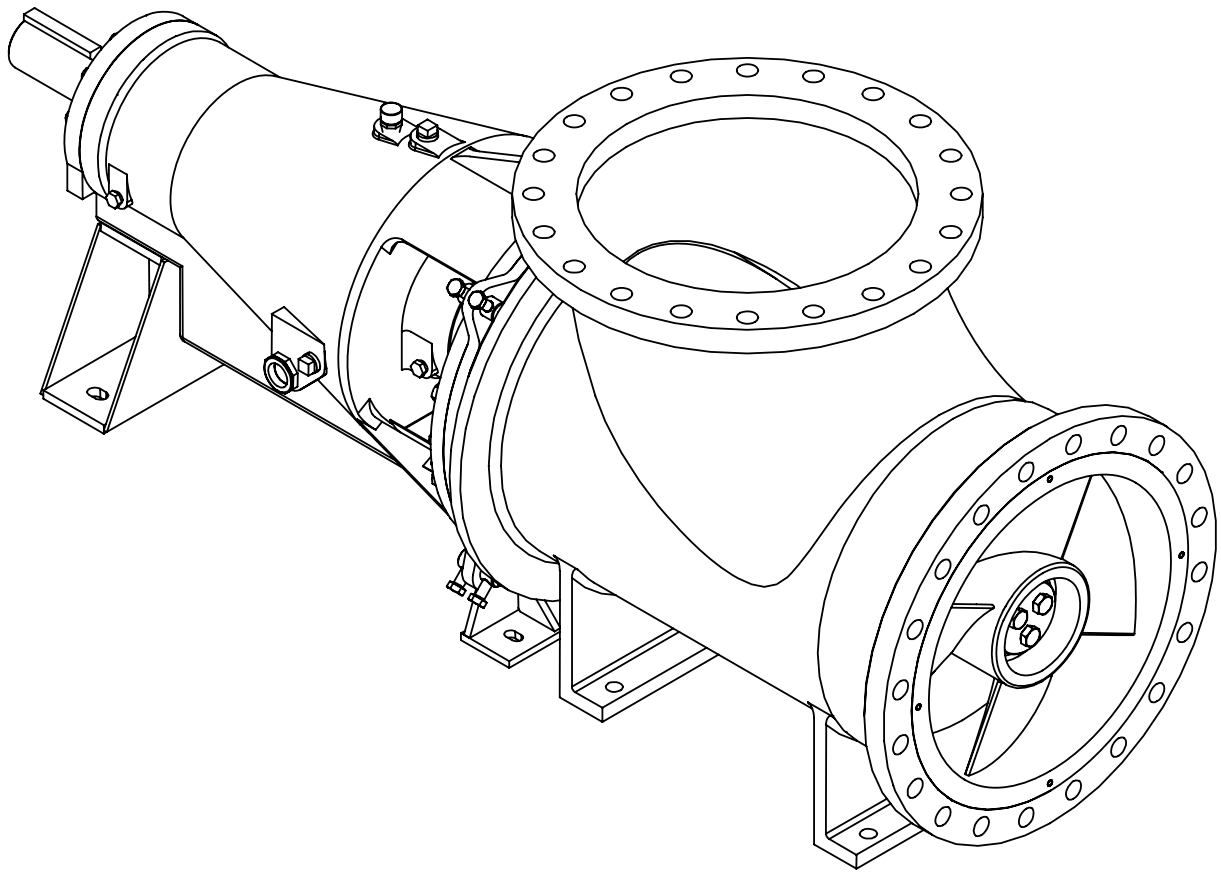
GOULDS PUMPS

Installation, Operation and Maintenance Instructions



Model AF (6”-36”) MXR Bearings

ITT

FOREWORD

This manual provides instructions for the Installation, Operation, and Maintenance of the Goulds Axial Flow (AF) pump model. This manual covers the standard product. For special options, supplemental instructions are supplied. **This manual must be read and understood before installation and start-up.**

The design, materials 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 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 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 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 Goulds Pumps, Inc.

Supervision by an authorized Goulds representative is recommended to assure proper installation.

Additional manuals can be obtained by contacting your local Goulds representative or by calling 1-800-446-8537.

THIS MANUAL EXPLAINS

- **Proper Installation**
- **Start-up Procedures**
- **Operation Procedures**
- **Routine Maintenance**
- **Pump Overhaul**
- **Trouble shooting**
- **Order Spare 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.

GENERAL INFORMATION

PUMP DESCRIPTION

The AF pump generates flow by the thrust or lift action of rotating axial vanes of the impeller. Axial flow pumps generate high flow rates and low head which are ideal for re-circulation, evaporator, and generator cooling systems. The AF has an elbow that directs the flow through the suction and out the discharge end of the pump. It can be used in the top or end suction configuration depending on the customer's needs. Refer to original factory documentation for the arrangement of your pump. The model AF is based on (6) power ends and (12) hydraulic pump sizes. The first (3) power ends have ball bearings, the others have taper and spherical roller bearings. Groupings are as follows:

Power End	Inboard Bearing	Outboard Bearing	Pump Size
1MXR	Ball	(2) Ang. Contact	6", 8", 10"
2MXR	Ball	(2) Ang. Contact	12", 14"
3MXR	Ball	(2) Ang. Contact	16", 18"
4MXR	Sphrcl Roller	Taper Roller	20", 24"
5MXR	Sphrcl Roller	Taper Roller	700mm, 30"
6MXR	Sphrcl Roller	Taper Roller	36"

Elbow – The elbow is cast with 150# flat face suction and discharge flanges, it comes with an opening in the rear for a back-pullout. The back-pullout consists of the bearing housing, shaft, and impeller. The elbow has cast feet for mounting to a sub-base or it can be mounted directly in the piping. It also comes with an optional elbow liner.

Elbow or Casing Liner (Optional) – An optional liner provides erosion and corrosion protection for longer elbow or casing life. It may also come with a serrated inside diameter for pumping stringy material.

Back-Pullout - The back-pullout is based on the (6) power ends listed previously. It consists of a bearing housing, bearings, stuffing box cover, locknuts, lockwashers, labyrinth oil seals, shaft, shaft sleeve (w/packing), oil slinger (20" ~36"), impeller, keys, shaft washer, and a front and back foot.

Stuffing Box Cover – The cast stuffing box cover is used to close the rear of the elbow and provide a mounting surface for a mechanical seal or stuffing box and gland. Inside it has a machined flat face with a (3) or (4) bolt pattern to accept a stuffing box or standard cartridge mechanical seal. When used with a mechanical seal it has a cast in 5 deg. taper bore opening to assist in ejecting particles from the seal area. The cover comes with adjusting ears that allow for centering on the shaft and also to center the impeller in the elbow.

Mechanical Seal Adapter (Optional) – An optional adapter is used when the mechanical seal requires a restrictor bushing. The restrictor bushing is supplied with the mechanical seal.

Optional
Packed Stuffing Box / Sleeve – The stuffing box is cast and is separate from the elbow and stuffing box cover. It comes with a replaceable wear sleeve that is keyed to the shaft. Included are 5 rings of packing and a lantern ring to seal the shaft area. Two flush ports provide packing lubrication. A gland is used for packing adjustment. The stuffing box can also be modified to accept a mechanical seal if required.

Casing – A sacrificial wear casing is provided on the 700mm and 36" sizes. Adjusting lugs are used to center the casing relative to the impeller. The casing has 150# flanges for mounting to the elbow and comes with an optional liner.

Impeller - The impeller is cast with (4) fixed vanes. It is machined with internal steps for easy assembly onto the shaft. It comes configured for 0 or +5 degree, clockwise or counterclockwise rotation, and top or end suction. The impeller is held in place with a shaft washer and bolts. The 700mm and 36" impellers come with cover plates and o-rings, to seal them from the pumpage.

The seal prevents corrosion and allows for easy impeller replacement. The impeller is dynamically balanced (double plane) per ISO 1940 to a quality grade G-16.

Shaft – The shaft is cantilevered into the pump elbow to eliminate the need for internal bearings. It is designed to have small deflections, high critical speeds, and corrosion resistance. The shafts are stepped for easy assembly with the impeller.

Bearings - The inboard radial bearing absorbs radial loads and aligns the pump shaft. It is either a ball or spherical roller bearing, depending on pump size. The outboard thrust bearing absorbs thrust loads and comes as either back-to-back angular contacts or a single taper roller bearing, depending on pump size. Lubrication is by flood oil or grease, depending on customer requirements.

Oil Cooling (Optional) – An oil cooling option is available on 12" and larger sizes. A coiled tube mounted inside the bearing housing circulates water to cool the oil bath. It is attached to the bottom of the bearing housing by a removable bottom plate and gasket. It is generally used when process temperatures cause excessive heat build up in the bearing housing and or bearings.

Configurations and Drives – Most AF pumps are V-belt driven to allow for varying speeds. V-belts can be configured for side by side, overhead, under-slung, or vertical operation. The pumps can also be configured with gear reducers and or jack shafts for direct connect operation.

Maximum Sphere Size – The maximum solid size that the AF can pass depends on the pump size. The following are the maximum sphere sizes for each pump:

Pump Size	Sphere Size	Pump Size	Sphere Size
6"	1.5"	18"	4.5"
8"	2.0"	20"	5.0"
10"	2.5"	24"	6.0"
12"	3.0"	700mm	6.0"
14"	3.5"	30"	7.5"
16"	4.0"	36"	9.0"

NAMEPLATE INFORMATION

Every Goulds pump has a nameplate that provides information about the pump, including hydraulic characteristics. The nameplate for the AF is located on the bearing housing. Note the format of the pump size: Discharge X Suction - Impeller Diameter in inches (Example 20"X20"-20", see Fig. 1). When ordering spare parts you will need to identify pump model, size, serial number, and the item number of required parts. Information can be found in this manual.

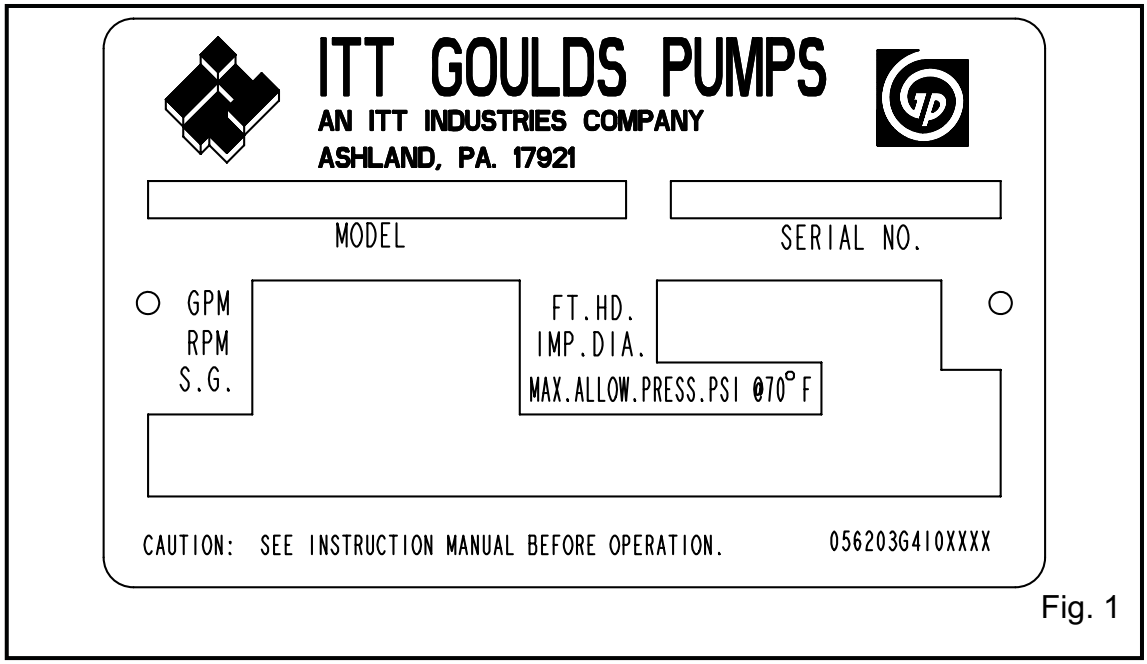

Fig. 1

RECEIVING THE PUMP

Inspect the pump as soon as it is received. Carefully check that everything is in good order. Make notes of damaged or missing items on the receipt and freight bill. File any claims with the transportation company as soon as possible.

STORAGE REQUIREMENTS

Short Term: (Less than 6 months) Goulds normal packaging is via a skid. It is designed to protect the pump during shipping only. Upon receipt, store in a covered and dry location.

Long Term: (More than 6 months) Goulds long-term packaging via crating. Preservative treatment of bearings and machined surfaces is required. Rotate the shaft several times every 3 months. Refer to driver manufacturers instruction manual for their long-term storage procedures. Store in a covered dry location.

Note: Long term storage treatment can be purchased with initial pump order.

UNCRATING/DE-SKIDDING

Care should be taken when uncrating or de-skidding pumps. If shipment is not delivered in good order, and in accordance with the bill of lading, note the damage or shortage on both the receipt and freight bill.

Make any claims to the transportation company promptly. Instruction sheets as well as the instruction book for the pump is included in the shipment - DO NOT DISCARD.

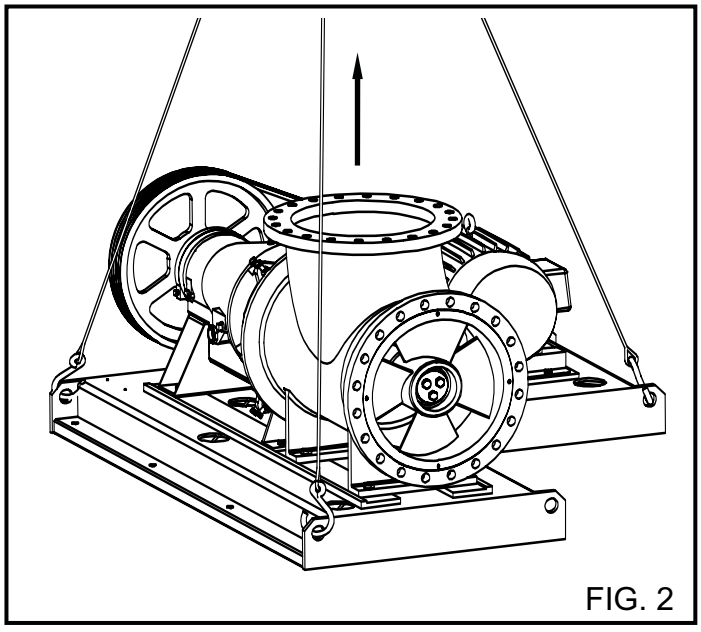

FIG. 2

HANDLING

⚠ WARNING

Pump and components are heavy. Failure to properly lift and support equipment could result in serious physical injury, or damage to pumps.

Use care when moving pumps. Lifting equipment must be able to adequately support the entire assembly. Lift assembled unit by the lifting holes found in the sub-base. If the motor, sheaves, and guard are in place be sure that the lifting cable or chain does not come in contact with these components. If necessary remove the guard or use a spreader bar to prevent damage. In case the motor ships separate use the eyebolts or lifting lugs found on the motor to hoist it into place on the sub-base (Figs. 2 and 3 show examples of proper lifting techniques).

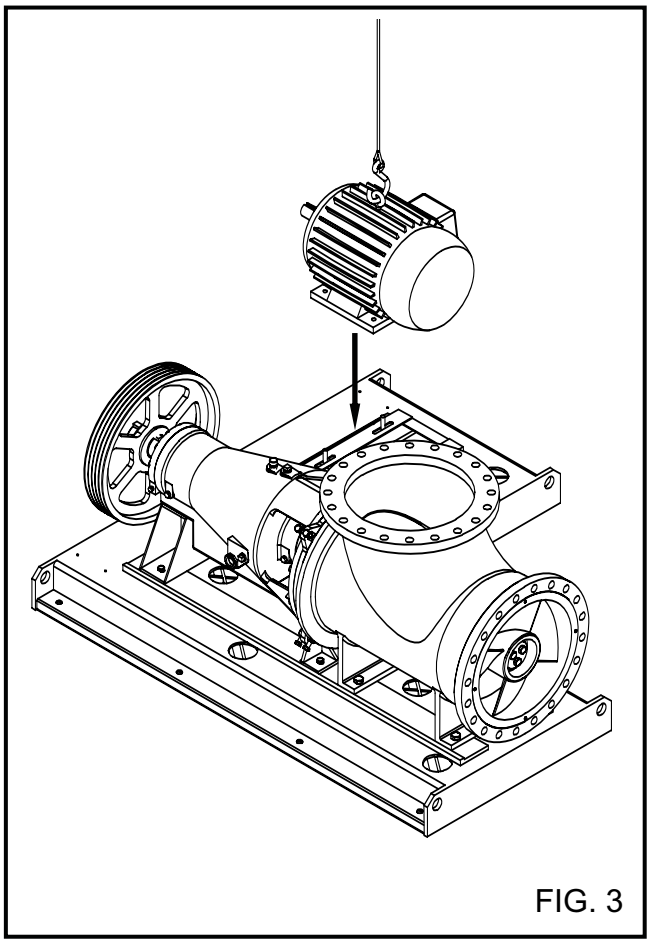

FIG. 3

INSTALLATION AND OPERATION CHECKLIST

Model AF

COMPLETE	INITIAL	DESCRIPTION	PAGE NO.
		Manual read and understood	1~69
		Level foundation	15
		Level subbase	15 ~ 19
		Check motor rotation ---CW ____---CCW ____	29
		Component rough alignment complete	21 ~ 28
		V-belt tension and alignment per drive mfgr.	21
		Coupling alignment per cplg mfgr.	23
		Piping installed and alignment rechecked	21,22,36
		Mech. seal adjusted per mfgr.	Mfgrs Mnl
		Seal flush connected	33,34
		Impeller alignment and clearance set Inch/Side	26 ~ 28
		Pump shaft-free turning	32
		Bearing types and lubrication	12,32,39
		V-belt or coupling guards installed	60,61
		Motor electrical connections	Mfgrs Mnl

INSTALLATION

PREPARATION FOR INSTALLATION

AF units are usually shipped completely assembled. Check all bolts and nuts on the entire unit and make sure they are securely tightened.
If necessary install and adjust drive components per manufacturer's recommendations

Equipment that will operate in a potentially explosive environment must be installed in accordance with the following instructions.

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

LOCATION/FOUNDATION

AF pump shall 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 pump should have a supply of clean liquid for packing or mechanical seal lubrication. The pump shall be positioned to provide the most efficient pipeline system.

The AF pumps covered by these instructions may be designed to hang in the piping system, furnished with spring loaded sub-base bolts, or have a sub-base 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 shall not be any adverse movement or settling over a long period of time.

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

The most commonly used foundation bolts are the sleeve-type (Fig 4) and J type (Fig. 5).

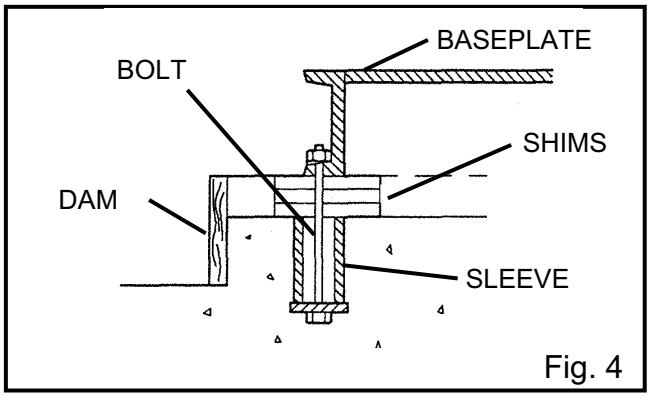

Fig. 4

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.

Foundation bolts are located according to the bolt hole dimensions shown on the installation drawing. Bolt size is based on hole size, they should be 1/8” to ¼” under the sub-base hole size. For information on spring mounted sub-bases, see the following section under spring mounted bases.

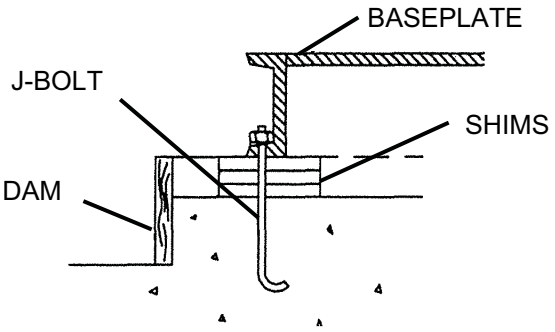

Fig. 5

SUB-BASE INSTALLATIONS

GROUTED BASE

When the unit is received with the pump and driver mounted to the sub-base, it should be placed on the foundation and the coupling halves or V-belts disconnected (Fig. 6). The coupling should not be reconnected until all realignment operations have been completed. A recommended coupling alignment procedure is included in the following sections.

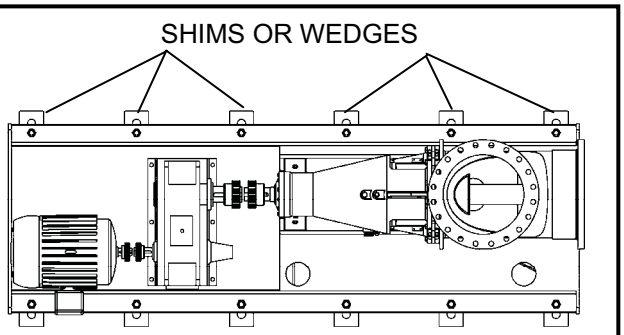

Fig. 6

1. The sub-base should be supported on rectangular metal blocks or on metal wedges having a slight taper. There should be support blocks or wedges on both sides of each foundation bolt. A gap of about 3/4" to 1-1/2' should be allowed between the sub-base and the foundation for grouting (Fig. 7).

2. Adjust the metal supports or wedges until the shafts of the pump and driver and sub-base are level. Check the coupling faces, as well as the suction and discharge flanges of the pump, for horizontal and 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 sub-base as required. In most cases, factory alignment will be regained by shimming under the sub-base alone.

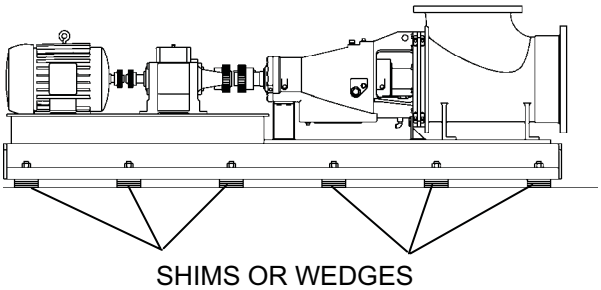

Fig. 7

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

3. The sub-base 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. The bolts which secure the pump sub-base to the foundation should be 1/8” - ¼” less in diameter than the holes in the sub-base (hole size is shown on the certified installation drawing).

4. Clean outside areas of sub-base that will contact grout. Do not use oil-based cleaners because grout will not bond to it. Refer to grout manufacturer's instructions.

5. Build a dam around foundation and thoroughly wet the foundation (Fig. 8)

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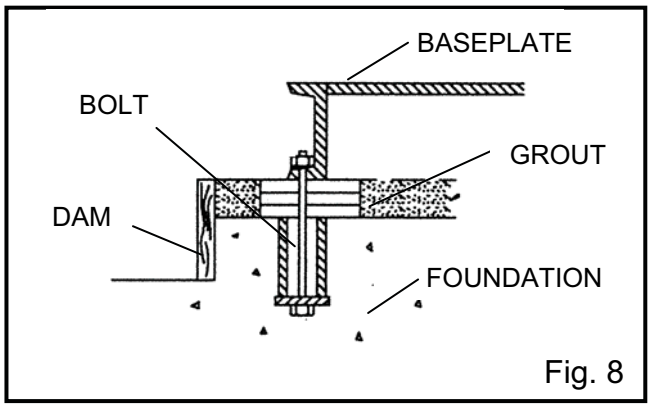


Fig. 8

6. Pour grout through the grout holes in the sub-base, 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.

7. Allow grout to set.

8. Fill remainder of sub-base with grout. Remove air as before (Fig. 9)

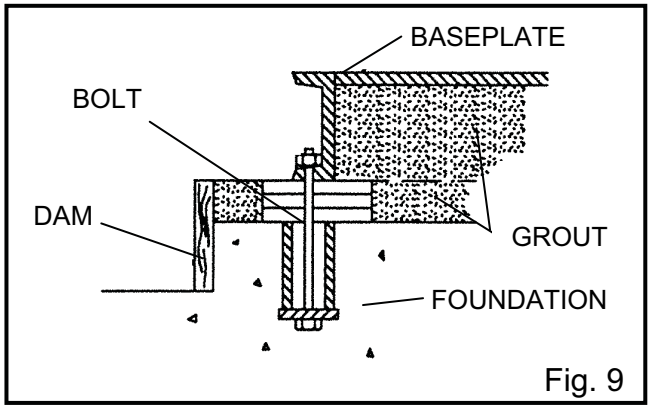


Fig. 9

9. Allow grout to set at least 48 hours.

10. Tighten foundation bolts.

SPRING MOUNTED BASE

Fig. 10 shows a V-belt driven AF pump on a spring mounted sub-base. Sub-bases supported by spring pockets assure that the pump remains level, regardless of vertical movement due to thermal pipe expansion during operation.

The following is a brief description of the spring pocket components and their function (see Fig. 11). The adjusting screw is used to compress or relax the spring. Turning the screw causes the adjusting screw nut assembly to move vertically and change the amount of force the spring exerts against the spring retainer, which

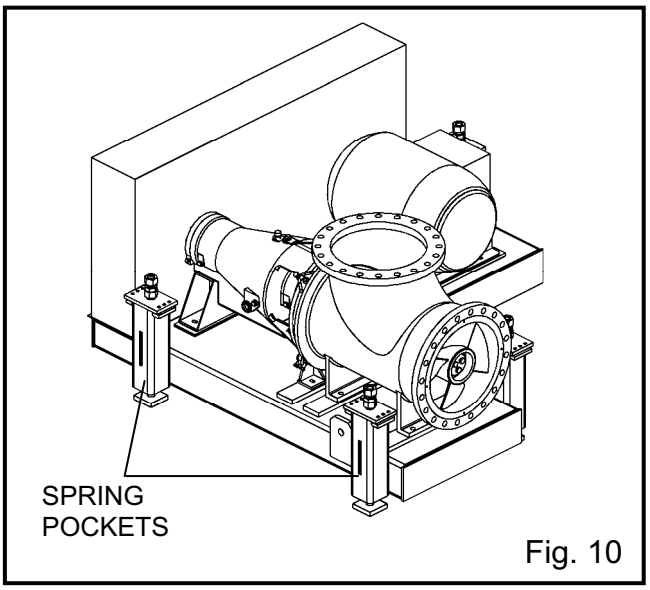


Fig. 10

is fastened to the sub-base. The stop nut is to limit the vertical up motion of the sub-base in case part of the load is removed from the pump unit when the system is cold. The jam nut keeps the stop nut from turning during normal operation when the sub-base has been pushed down from the thermal expansion. The adjusting screw holder is a bearing surface for the end of the adjusting screw and serves to hold the end of the screw in a fixed location.

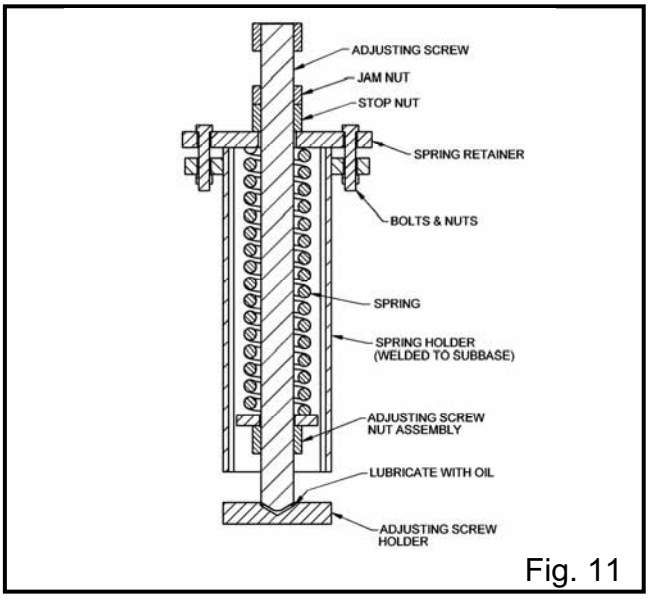


Fig. 11

The adjusting screw was lubricated at the factory but should be re-lubricated with heavy protective grease during the pump installation. The springs and other parts should be coated with an agent to protect the surface from corrosion, and a heavy lubricant should be applied to the adjusting screw holder pocket.

The following steps are used to set the springs and level the sub-base:

1. Place blocks under the sub-base, near each spring holder, and position the sub-base level on the blocks. A small gap (approx. 1/16") should exist between the flange of the vertical pipe and the pump elbow with the gasket in place (Fig. 12).

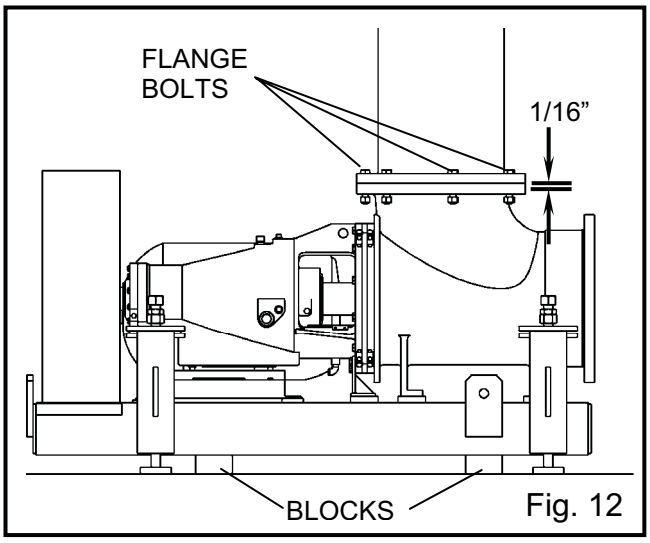


Fig. 12

2. Install several flange bolts to help maintain alignment of the flanges.

WARNING

Do not tighten bolts.

3. Position the adjusting screw holders, while the adjusting screw end is seated in the hole, in the direction of the horizontal thermal expansion. This will allow the required horizontal motion without having the adjusting screw nut assembly hit the walls of the spring holder. Make sure there is sufficient clearance between the adjusting screw holder and the bottom of the sub-base for vertical thermal expansion. This clearance is usually shown on the pump installation drawing.

NOTE: Each spring carries a share of the unit load but generally do not carry equal loads. Each holder has a small "window" to check the spring coil spacing, which is an indication of the relative load on the spring. The installation drawing may indicate the approximate number of turns required for each spring location, especially if the unit uses more than (4) springs. If necessary refer to table 1 for spring rate information.

4. Turn the adjusting screws until the bottom of the sub-base just clears each block. Next adjust each screw evenly until the pump flange and gasket are less than 1/32" away from the pipe flange. Careful adjustment is necessary to keep the pump level and obtain better weight distribution on the springs. After the springs have been loaded and adjusted, the base should be off the support blocks and level.

5. Check the alignment of the impeller and the pump elbow. If necessary, correct the alignment by adjusting the springs or by using shims.

NOTE: If the flange gap is over 1/32", turn the adjusting screws a uniform amount to close the gap. For a gap of 1/32" or less, omit this step.

6. Tighten the vertical pipe flange bolts, recheck the alignment and connect the horizontal pipe flange to the elbow. The pump unit should be level and there should not be any rubbing of the impeller in the elbow when the shaft is turned by hand.
7. Run each stop nut down to make light contact with the spring retainer. Lock in place by turning the jam nut down tight against the stop nut.

8. Inspect each spring holder to check the gap between the coils of the spring. There must be enough total gap to accommodate the downward thermal expansion of the system without having them compressed solid.

NOTE: Pumps with oil lubrication should be checked for being level while thermal expansion is taking place. It may be necessary to add oil to the bearing housing to provide the proper oil level to the higher bearing. A line parallel with the sub-base deck through the proper oil level line will show the correct level at the highest end of the bearing housing. A horizontal line back from that point will establish the proper level mark on the sight gauge.

The system should be operated at normal temperature before the adjusting screw holders are grouted in place. Some customers operate their units with the adjusting

Spring Size	Wire Size	Spring Rate	Adjusting Screw Size	Load Change per Full Turn
1	.812"	1140 #/in.	1-1/2"-6 UNC	190 #
2	.750"	760 #/in.	1-1/2"-6 UNC	127 #
3	.532"	560 #/in.	1-1/2"-6 UNC	93 #
4	1.00"	1000 #/in.	2"-4-1/2 UNC	222 #
5	.375"	133 #/in.	¾"-10 UNC	13 #

Table 1

screw holders un-grouted.
If it becomes necessary to remove a spring assembly from a spring pocket, for safety the following steps should be strictly adhered to:

1. Make sure the spring is relaxed. If the spring cannot be relaxed with the adjusting screw, the safest method is to cut the coils using a torch.

2. Remove the bolts or cap screws, which fasten the spring retainer to the holder and lift out the entire assembly.

3. When the pump is connected to the system and a spring is removed, there should be support under the sub-base near the spring location until the spring has been replaced and adjusted. Distortion of the sub-base will affect the pump alignment,

4. and the weight of the components is more likely to cause distortion when the pump is connected to the rigid pipe system.

5. If a spring is replaced while the system is hot, the stop nut should not be set until the system is cold.

6. The springs must be allowed to push the base back to its cold position.

An optional grease filled spring pocket is shown in figure 13. The difference between the standard pocket and the grease filled pocket is the addition of a grease fitting and grease seal. Adjustment and setting of the grease filled pocket are identical.

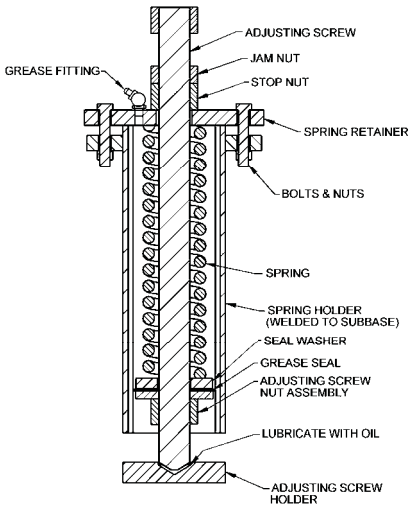


Fig. 13

3

PIPE HUNG INSTALLATIONS

PIPE SUPPORT DESIGN REQUIREMENTS

1. Piping supports must meet Hydraulic Institute, ASME/ANSI, DIN requirements, in conjunction with standard construction practices.

2. Piping shall be stiff enough to prevent unwanted pump vibrations.

3. Thermal expansion of the piping must be accounted for by the piping/system designer.

4. Refer to the installation/dimensional drawing for pump weights

5. Refer to pump flange load drawing for allowable loads

6. Follow the power transmission manufacturer's recommendations for angular limits and thermal movement of the pump relative to pump driver.

NOTE: Future access to the pump impeller and shaft will require removal of a section of the horizontal pipe. The piping shall have a spool piece for this purpose (See Fig. 14).

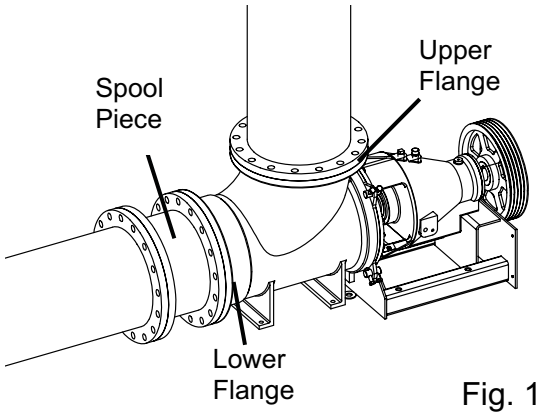


Fig. 14

INSTALLATION OF THE PUMP IN THE PIPING

1. Connect the elbow upper flange to the vertical pipe run and tighten the flange bolts.

2. Check the impeller clearance in the elbow/casing to be sure it is well centered using the criteria that the minimum gap at the vane O.D. is at least ½ the maximum gap. See the impeller check sheet on pg. 28 of this IOM.

3. Connect the horizontal pipe or spool piece to the elbow lower flange and tighten the flange bolts.

4. Check pump for level. Pump should be less than 1/2 degree (0.1"/ft) from horizontal so bearings are not starved of oil (see Fig.15). Be sure thermal expansion does not cause this angle to be exceeded.

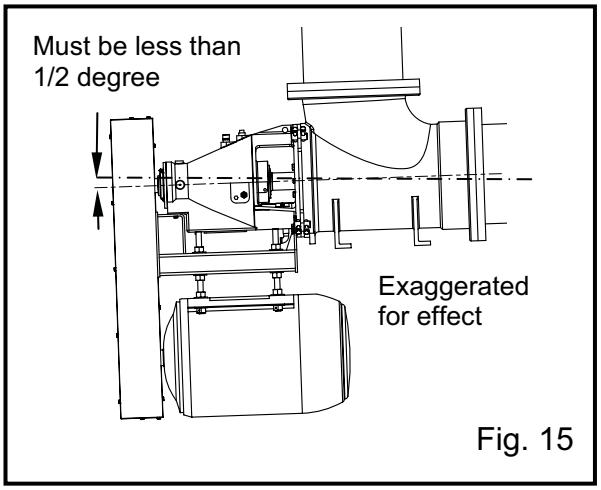


Fig. 15

5. With the underslung arrangement install the motor after the pump is connected to the piping. Be sure motor shaft is parallel to the pump shaft in the horizontal and vertical plane (see Fig.16).

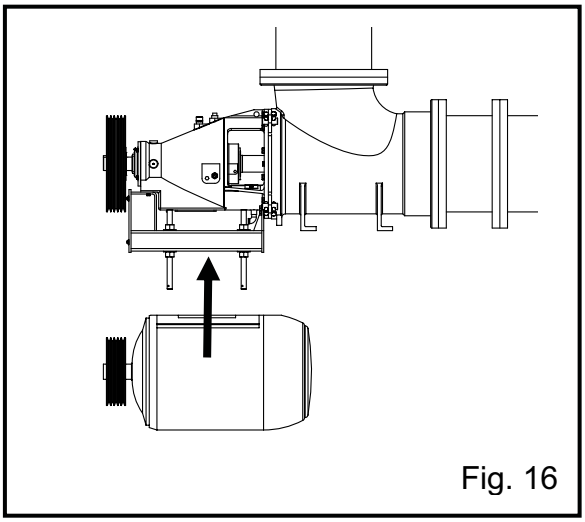


Fig. 16

6. If pump unit is direct drive utilizing a drive shaft, refer to the drive shaft manufacturer's installation manual for mounting instructions.

NOTE: PIPE FLANGES MUST BE PARALLEL WITH THE PUMP FLANGE BEFORE THE BOLTS ARE TIGHTENED. If the flanges are not parallel, forcing them parallel by tightening the bolts will cause excessive strain on the pump.

CONNECTION OF PIPING

GENERAL

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.

Guidelines for piping are given in the "Hydraulic Institutes Standards" available from: Hydraulic Institute, 30200 Detroit Road, Cleveland OH 44145-1967 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 the pump and driver. 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 with the pump flanges.

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

3. DO NOT connect piping to the pump until the 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 pump out of alignment.

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

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

SUCTION AND DISCHARGE PIPING

WARNING

NPSHA must always exceed NPSHR as shown on Goulds performance curves received with order. (Reference Hydraulic Institute for NPSH and pipe friction values needed to evaluate suction piping

Properly installed suction piping is a necessity for trouble-free pump operation. Suction piping should be flushed BEFORE connection to the pump.

1. 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.

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

3. To prevent suction cavitation, horizontal reducers should be eccentric with the sloping side down and concentric for vertical applications.

4. Pump must never be throttled on suction side.

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

Suction lift conditions

1. Suction pipe must be free from air pockets.

2. Suction piping must slope upwards to pump.

3. All joints must be airtight.

Suction head/Flooded suction conditions

1. An isolation valve should be installed in the suction line at least two pipe diameters from the suction 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 pump suction flange.

5. The size of entrance from supply should be one or two sizes larger 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 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 priming, 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.

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 system.

Final Piping 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 impeller alignment procedure outlined on pg. 26 to determine absence of pipe strain. If pipe strain exists, correct piping.

DRIVE ALIGNMENT PROCEDURES

Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.

WARNING

Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.

Lock out driver power to prevent electric shock, accidental start-up and physical injury.

The AF pump comes with two drive variations, V-belt and gear driven. Accurate alignment of both systems is essential to long pump life and reduced pump problems.

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.

Alignment is achieved by adding or removing shims from under the feet of the driver and gearbox and shifting equipment horizontally by adjusting bolts as needed.

NOTE: Proper alignment is the responsibility of the installer and user of the unit.

Trouble free operation can be accomplished by following these procedures.

Initial Alignment (Cold Alignment)

- **Before Grouting Sub-base -** To ensure alignment can be attained. **After Grouting Sub-base -** To ensure no changes have occurred during the mounting process.

- **After Spring Setting –** To ensure no changes have occurred during the leveling 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.

NOTE: Alignment check must be made if process temperature changes, piping changes, and or pump service is performed.

V-BELT DRIVE (SHEAVES)

Well designed and properly installed V-belt drives are capable of running for years. AF pumps come in several different belt drive configurations i.e. side by side, overhead, underslung or “Z” mount. Installation and alignment procedures are similar for all configurations. Remove the guard or guards by referring to the assembly/disassembly instructions. There are a few items that should be checked during installation and alignment.

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 parallel and angular alignment of the pump and drive sheaves, see Fig. 17.

1. **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.

2. **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.

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

4. **Impeller Alignment after Belt Tensioning** – If the impeller was aligned prior to belt tensioning a check should be made to determine that it is still centered. An off center impeller may rub and cause unnecessary pump damage. Belt Tension will usually cause impeller misalignment opposite the motor. Be sure to align or re-align in accordance with the Impeller Alignment section page 26.

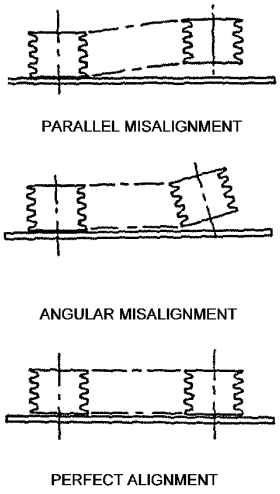


Fig. 17

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 a proximately the same sag between the sheaves. Apply tension to the belts by increasing the center distance until the belts are snug, see Fig. 18.

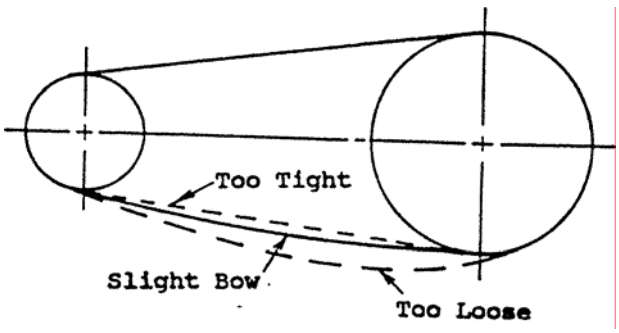


Fig. 18

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

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.

GEAR DRIVE (COUPLINGS)

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

Remove the guard or guards by referring to the assembly/disassembly instructions. Disconnect motor/gearbox and the pump/gearbox coupling halves before proceeding with the alignment. First, align the pump/gearbox coupling then the motor/gearbox coupling. Check both coupling connections for parallel and angular alignment by either the Dial Indicator or Straight-Edge Method outlined below.

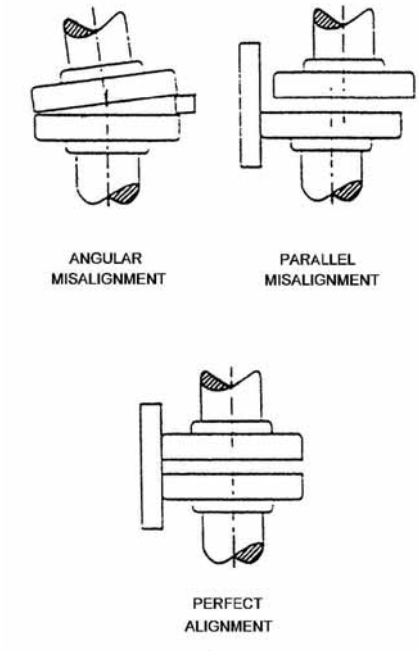


Fig. 19

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. 19 describes what to look for.

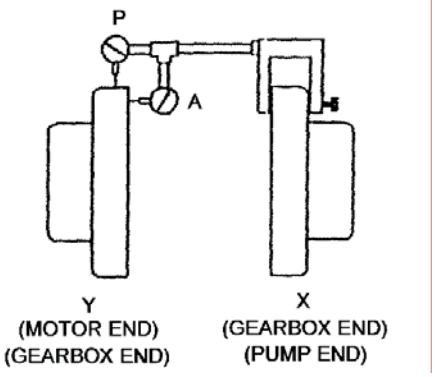


Fig. 20

1. Mount two dial indicators off one half of the coupling (X) so they contact the other coupling half (Y) (Fig. 20).

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

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 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 Goulds Pumps, Ashland Operations, 500 E. Centre St. Ashland, Pa 17921 or your local representative.

ALIGNMENT PROCEDURE

On gear driven AF pumps angular and parallel misalignment are corrected in the vertical direction by means of shims under the motor or gearbox mounting feet, and in the horizontal direction by adjusting bolts that slide the motor or gearbox in the proper direction.

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

Couplings are in angular alignment when indicator “A“ (Angular Indicator), Fig 20, does not vary by more than .003” (.076mm) as measured at four points on the coupling periphery 90° apart at operating temperature. Outlined below are two acceptable methods to achieve the desired alignment.

METHOD 1 - Dial Indicator Method

For steps 1 through 5 refer to Fig. 21.

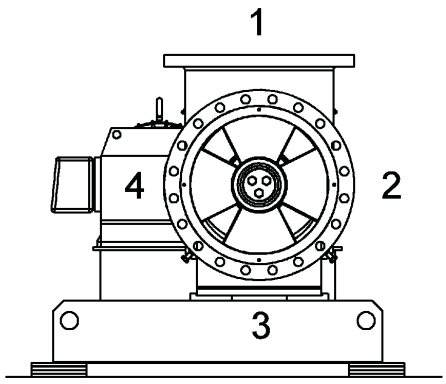
1. Zero indicator “A” at position 1 of coupling half (Y). Mark this position on both flanges.

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 under the motor or gearbox feet to attain the proper alignment.



Directions for viewing coupling
View from front end of pump
Fig. 21

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.

METHOD 2 - Feeler Gauge Method

For the following steps refer to Fig. 21.

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 that fits snugly between the two flanges.

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

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

5. Record the largest gauge size that 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 under the motor or gearbox feet to attain the proper alignment.

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

8. Repeat steps 1-6 substituting positions 2 and 4 for position 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 that are acceptable to achieve the desired alignment.

NOTE: Equal amounts of shims must be added to or removed from each driver foot. Otherwise the vertical angular alignment will be affected.

METHOD I - Dial Indicator Method

For the following steps, refer to Fig. 21.

1. Zero the 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 -** 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 - 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 or gearbox lower.

When using positions 2 and 4 in steps 1 - 2, correct any misalignment by sliding the motor or gearbox 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. 21.

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

2. Adjust the motor or gearbox 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

COMPLETE ALIGNMENT

A unit is in complete alignment when both indicators "A" (angular) and "P" (parallel) do not vary by more than .003" (.076 mm) as measured at four points 90° apart.

Vertical Correction (Top-to-Bottom)

1. Zero indicators "A" and "P" at top dead center (12 o'clock) of coupling half (Y).

2. Rotate indicator to bottom dead center (6 o'clock). Observe the needles and record the readings.

3. Make corrections as outlined previously.

Horizontal Correction (Side-to-Side)

1. Zero indicators "A" and "P" on the left side of coupling half (Y), 90° from top dead center (9 o'clock).

2. Rotate indicators through, top dead center to the right side, 180° from the start (3 o'clock), Observe the needle, measure and record the reading.

3. Make corrections as outlined previously.

4. Recheck both vertical and horizontal readings to ensure adjustment of one did not disturb the other. Correct as necessary.

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. Shifting of the sub-base 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.

NOTE: With experience, the installer will understand the interaction between angular and parallel and will make corrections appropriately.

IMPELLER ALIGNMENT

GENERAL

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

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.

The AF impeller has been aligned at the factory but should be checked prior to pump operation. The impeller requires several thousandths of and inch of clearance to prevent rubbing due to the action of 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.

Turn the shaft by hand, if the impeller rubs the inside of the elbow or casing it must be realigned. The following steps are used to align the impeller.

There are (2) types of impeller adjustment for the AF pump. **Type 1** has adjusting lugs on the stuffing box cover, **Type 2** has adjusting lugs on the elbow. Type 1 moves the back-pullout relative to the elbow. Type 2 moves the casing relative to the impeller to set the clearance (see Figs. 22 and 23).

Note: Impeller rubbing is often caused by pipe strain or belt tension. Pipe strain must be eliminated prior to impeller alignment. The impeller should aligned after proper belt tensioning.

Clearance measurement - The alignment worksheet on page 28 is used to align the impeller of the AF pump. The measurement procedure is as follows:

Make sure the cap screws fastening the bearing housing to the elbow, **Type 1**, or the casing to the elbow, **Type 2**, are tight, so an accurate measurement of the impeller clearances can be made prior to adjustment.

Mark each blade 1, 2, 3 and 4 and then align the impeller blades with the adjusting lugs on the stuffing box cover (approx. 2, 4, 8, and 10 o'clock) **Type 1**, or elbow (approx. 4, 8 o'clock) **Type 2**

Rotate the shaft and measure the gap between each blade and the casing at all four clock positions indicated on the worksheet. The value of interest is the largest value of feeler gage thickness that will slide easily the whole length of the vane tip.

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

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

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

Impeller Alignment – (Type 1)

1. Loosen the bolts that attach the bearing housing to the elbow.

2. Use the adjusting bolts closest to the elbow to adjust the impeller clearance, see Fig. 22. The (2) upper adjusting bolts are used to raise and lower the impeller. The upper and lower adjusting bolts on either side are used to center the impeller left to right in the elbow.

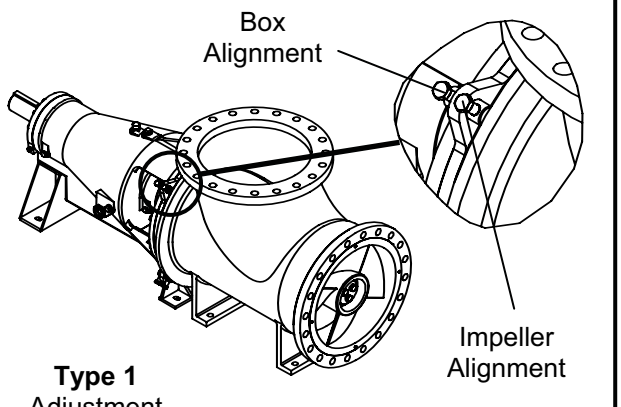


Fig. 22

3. Move the back pullout relative to the elbow until the impeller is centered. At this point it is recommended that the Impeller Alignment Worksheet (on the following page) be filled out and filed with the pump maintenance records for future reference.

4. Tighten the bolts between the bearing housing and elbow and re-check the clearance to be sure the adjustments have centered the impeller. If the impeller is centered the bearing housing may be taper pinned to the elbow to maintain alignment.

Impeller Alignment – (Type 2)

1. Loosen the bolts that attach the casing to the elbow.

2. Use the adjusting bolts attached to the elbow to adjust the impeller clearance, see Fig. 23. The (2) adjusting bolts are used to raise and lower the casing and shift the casing left to right relative to the impeller.

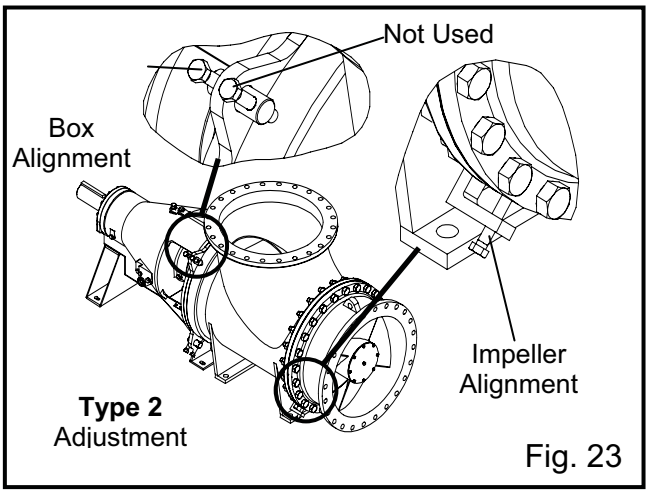


Fig. 23

3. Move the casing relative to the impeller until the impeller is centered. At this point it is recommended that the Impeller Alignment Worksheet (on the following page) be filled out and filed with the pump maintenance records for future reference.

4. Tighten the bolts between the casing and the elbow and re-check the clearance to be sure the adjustments have centered the impeller. If the impeller is centered the casing may be taper pinned to the elbow to maintain alignment.

INSTALLATION AND OPERATING INSTRUCTIONS

AXIAL FLOW PUMP
IMPELLER ALIGNMENT WORKSHEET
4 VANE IMPELLER

PUMP SERIAL NO.: _____ DATE: _____

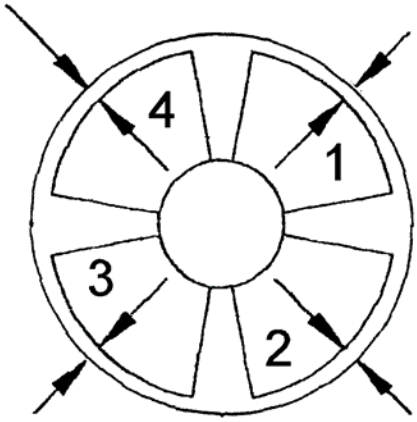
PUMP SIZE: _____ PUMP ALIGNED BY: _____

10 O'CLOCK

VANE 1 _____
VANE 2 _____
VANE 3 _____
VANE 4 _____

2 O'CLOCK

VANE 1 _____
VANE 2 _____
VANE 3 _____
VANE 4 _____



8 O'CLOCK

VANE 1 _____
VANE 2 _____
VANE 3 _____
VANE 4 _____

4 O'CLOCK

VANE 1 _____
VANE 2 _____
VANE 3 _____
VANE 4 _____

Impeller Alignment - The measurement procedure is as follows:

1. Note the number of blades. Mark each blade 1, 2, 3, 4.

2. Rotate the shaft and measure the gap between each blade and the casing at the 2, 4, 8, and 10 o'clock positions. The value of interest is the largest value of feeler gage thickness that 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 that is smaller than the calculated minimum clearance the prop is not sufficiently centered and should be adjusted.

Example: 4 Vane impeller. At 2 o'clock the readings are VANE I ~.040, VANE 2 ~.041, VANE 3 ~.040, VANE 4 ~ .042; at 4 o'clock.050,.051,.050, .051; at 8 o'clock.050,.052,.051,.050; al 10 o'clock.040,.042,.039,.041

$$\text{Average clearance} = \frac{\text{SUM OF READINGS}}{\text{NUMBER OF READINGS}} = \frac{.040+.041+.040+.042+\ldots}{16} = .0456"$$

$$\text{Minimum clearance} = \frac{\text{AVERAGE CLEARANCE}}{2} = \frac{.0456"}{2} = .0228"$$

ROTATION CHECK

Before the V-belts or couplings are installed, the motor should be wired and the direction of rotation checked. A rotation arrow is located on the bearing housing (134C).

Serious damage could occur if the pump is run the wrong direction.

When installing in a potentially explosive environment, ensure that the motor is properly certified.

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OPERATION

PREPARATION FOR OPERATION

CHECKING ROTATION

When installing in a potentially explosive environment, ensure that the motor is properly certified.

Damage occurs from:

1. Increased vibration levels-affects bearings, stuffing box or seal chamber and mechanical seal
2. Increased radial loads Stresses on shaft and bearings
3. Heat build up-Vaporization causing rotating parts to score or seize
4. Cavitation-damage to internal surfaces of pump

CAUTION

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

WARNING

Lock out power to prevent accidental start-up and physical injury.

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

A check must be made to be sure motor rotation coincides with the pump rotation direction. Depending on your pump arrangement (V-belt or gear-drive) use one of the following methods to check motor rotation.

Direct Connect

1. Lock out power to the driver.
2. Remove the pump coupling guard.
3. Make sure the coupling halves are securely fastened to shafts.
4. Unlock driver power.
5. Make sure everyone is clear. Jog the driver just long enough to determine direction of rotation of the output shaft of the gearbox. Rotation must correspond to an arrow on bearing housing.
6. Lock out power to driver.
7. Replace the pump coupling guard.

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

V-BELT

1. Lock out power to the driver.
2. Remove the V-belt guard.
3. Make sure the sheaves are securely fastened to shafts.
4. Unlock driver power.
5. Make sure everyone is clear. Jog the driver just long enough to determine direction of rotation. Rotation must correspond to an arrow on bearing housing.
6. Lock out power to driver.
7. Replace the V-belt guard.

CHECK IMPELLER CLEARANCE

Check impeller clearance before installing the pump. The impeller must not rub when the shaft is turned by hand, therefore it is recommended that the Impeller Alignment Worksheet (shown on pg. 28) is filled out

and filed with the pump maintenance records for future reference.

CHECK FOR FREE TURNING

Before pump is started, rotate the pump by hand to be sure it turns freely, and does not rub or bind

BEARING LUBRICATION

Before start up, the pump should be checked for proper lubrication. AF pumps are flood-oil or grease lubricated. Lubrication method is usually dependent on the pump operating conditions. The following paragraphs describe both methods of lubrication.

FLOOD OIL

Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.

Oil lubricated bearings use an oil bath for lubrication. Oil lubricated bearing assemblies are shipped without oil. **ADD OIL TO THE HOUSING UNTIL IT IS AT THE CENTERLINE OF THE SIGHT GLASS**. Oil must be added to the bearing housing before starting. If the unit has an external oil lube system, fill the bearing housing and the reservoir to satisfy the system requirements.

Run the pump for 1 minute to fill the oil galleys and in and around each bearing. Check the oil level indicator and add oil accordingly. Monitor the oil level indicator for the first 24 hours of operation and maintain fill level.

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.

If the level of oil in the bearing housing (134C) is too high, excessive heat may be generated due to churning. 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.

GREASE

Bearings are hand-packed at the factory and have sufficient grease for at least 24 hours of operation after startup. 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 or 3 weeks of continuous operation.

NORMAL BEARING TEMPERATURE

The running temperature for a bearing assembly depends on many factors such as speed, bearing loads, lubrication, ambient air temperatures, and condition of 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 the installation. Higher temperatures than this normal temperature, without any change in speed or loading can mean a lubrication difficulty or the approach of bearing failure.

SHAFT SEALING

A packed stuffing box or mechanical seal is used to seal the AF pump shaft. Both methods are described below.

PACKED STUFFING BOX

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

The original equipment packing is a suitable grade for the service intended. To pack the stuffing box use the following procedure: (refer to Fig. 26, page 40)

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

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

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

4. To install packing rings, do not pull straight. Expand the coil as a coil spring, see Fig 26 and 42 for the correct and incorrect method of installing packing.

5. 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.

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

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

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

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

10. 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.

MECHANICAL SEAL

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

The mechanical seal must always be properly flushed. Failure to do so will result in excess heat generation and seal failure.

Most mechanical seals are installed and adjusted at the factory. A common seal type used on the AF pump is the cartridge type. Cartridge seals are preset at the seal manufacturer's facility and require no field settings. Due to size and design, some installed mechanical seals are supplied with holding clips. These clips keep the sealing faces apart to avoid damage during transport. The clips must be removed before the shaft is to be rotated. Pumps with retained seal faces will be specifically marked and instructions from the seal manufacturer for clip removal will be provided. If the seal has been installed in the pump at the Goulds factory, these clips have already been removed. For other types of mechanical seals, refer to the seal manufacturer's instructions for installation and setting.

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 seal gland. Clear, grit-free liquid is necessary. Goulds Pumps 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.

Dynamic seals are not allowed in an ATEX classified environment.

STARTING PUMP

PRIMING PUMP

Pumps that are not self-priming must be fully primed at all times during 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 manufacturers instructions for assistance.

5 Pumpage temperatures in excess of 200°F will require warmup of pump prior to operation. Circulate a small amount of pumpage throught the pump until the casing temperature is within 100°F of the pumpage temperature and evenly heated.

When starting pump, immediately observe pressure gauges. If discharge pressure is not quickly attained, stop driver, reprime and attempt to restart**.**

Never start the pump until it has been properly primed. Check the pump impeller for submergence. The pump must be full of liquid with specified submergence head above the impeller. Do not run the pump dry, as this might damage pump and seal components.

FLUSH FLOWS

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 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 when the pump is operating.

The stuffing box is furnished with (2) 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 flow through the stuffing box for cooling). The lubricating flow should be regulated by the valve in the outlet pipe rather than by throttling the flow in the supply pipe.

DRIVER

Start driver.

CAUTION

Immediately observe pressure gauges. If discharge pressure is not quickly attained-stop driver, check submergence level and attempt to restart

SET DESIRED FLOW

If your system is equipped with a variable frequency drive (VFD) or a variable speed V-belt drive, you may this point want to set your speed for the desired flow.

CAUTION

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

OPERATION

GENERAL CONSIDERATIONS

Service temperature in an ATEX classified environment is limited by the table in the ATEX identification section.

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.

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

Always operate the pump at or near the rated conditions to prevent damage resulting form cavitation or recirculation.

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

Pump must never be throttled on suction side.

NPSHa must always exceed NPSHr as shown on Goulds performane curves received with order. Reference Hydraulic Institute for NPSH and pipe frictionvalues needed to evaluate suction piping.

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:

- Temperature drop across the heat exchanger.
- Visual inspection of flow in evaporator body.
- Testing the circulating pump.

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

While field conditions preclude absolute accuracy, a check of pump performance will give reasonably close results. This can be done by installing a mercury manometer 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 TDH against which the pump is actually operating. If a manometer is used, then inches of mercury times 1.0455 divided by specific gravity equals TDH, providing water is in both legs of the manometer and connecting lines.
Check the pump speed and determine flow rate (gpm) from the pump curve. This curve will also give efficiency from which the hp requirement can be determined. A double check is to take motor ammeter readings, convert to hp, figure 90% drive efficiency, and use it against the pump curve to get 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.

OPERATING AT REDUCED CAPACITY

WARNING

DO NOT operate pump below minimum rated flows or with a discharge valve closed. This condition may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.

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

Listed below are some causes for circulation loss. Keep in mind that operation at reduced capacities can cause damage to the pump.

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

   a) Heat exchanger tubes partially plugged.

   b) Too many heat exchanger tubes blanked off.

   c) Improperly sized or partially plugged strainer.

2. Viscosity of slurry higher than it should be.

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 motors for any reason or after any electrical system changes or modifications, always check motors for correct direction of rotation.

7. Worn pump impeller and/or casing. On a new pump, clearance between tip of 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:

High Hp Demand

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

NOISY OR ROUGH OPERATION

1. Throttled suction or plugging
2. Impeller rubbing in casing

Damage

Damage occurs from:

1. *Increased vibration levels* - Affects bearings, stuffing box seal chamber, and mechanical seals.
2. *Heat build up* - Vaporization causing rotating parts to score or seize.
3. Cavitation - Damage to internal surfaces of pump.
4. Loose impeller
5. Broken impeller blade
6. Bearings not properly lubricated
7. Bent shaft
8. Impeller out of balance.

Operating Under Freezing Conditions

Exposure to freezing conditions, while pump is idle, could cause liquid to freeze and damage the pump. Liquid inside pump should be drained.

SHUTDOWN

1. Turn off power to pump motor.
2. In case of necessary maintenance or pump inspection, lock driver to prevent accidental rotation.

WARNING

When handling hazardous and/or toxic fluids, skin and eye protection are required. 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 regulation.

FINAL ALIGNMENT

1. Run the pump under actual conditions for a sufficient length of time to bring the pump and driver up to operating temperature.
2. Check alignment per alignment procedure outlined earlier.

PREVENTATIVE MAINTENANCE

GENERAL COMMENTS

A routine maintenance program can extend the life of your pump. Well maintained equipment will last longer and require fewer repairs. You should keep maintenance records, this will help pinpoint causes of problems.

Condition Monitoring

For additional safety precautions, and where noted in this manual, condition monitoring devices should be used.

This includes, but is not limited to:

- Pressure gauges
- Flow meters
- Level indicators
- Motor load readings
- Temperature detectors
- Bearing monitors
- Leak detectors
- PumpSmart control system

For assistance in selecting the proper instrumentation and its use, please contact your ITT/Goulds representative.

MAINTENANCE SCHEDULE

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.

Routine Maintenance

- Bearing lubrication
- Seal monitoring
- Vibration analysis
- Discharge pressure
- Temperature monitoring

ROUTINE INSPECTIONS

Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.

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 environment regulations.

- Check for unusual noise, vibration and bearing temperatures.
- Inspect pump and piping for leaks
- Check seal chamber/stuffing box leakage
- Packing: Excessive leakage requires adjustment or possible packing replacement. Refer to page 35 for packing gland adjustment.
- Mechanical Seal: Should be no leakage.

3 MONTH INSPECTIONS

- Check foundation and hold down bolts for tightness.
- If pump has been idle, check packing. Replace if necessary.
- If any rubbing noise has been noticed, re-align the impeller.
- Oil should be changed at least every 3 months (2000 hrs) or more often if there are any adverse atmospheric conditions that might contaminate or break down the oil, or if it is cloudy or contaminated as seen through the sight glass.

ANNUAL INSPECTIONS

- Check pump capacity, pressure and power. If pump performance does not satisfy your process requirements, and process requirements have not changed, pump should be disassembled, inspected, and worn parts should be replaced, otherwise, a system inspection should be done.

MAINTENANCE OF BEARINGS

Operation of the unit without proper lubrication will cause bearing failure, and pump seizure.

Throughout this section on bearing lubrication, different pumpage temperatures are listed. If the equipment is ATEX certified and the listed temperature exceeds the applicable value shown in Table 1 under ATEX identification, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goulds representative.

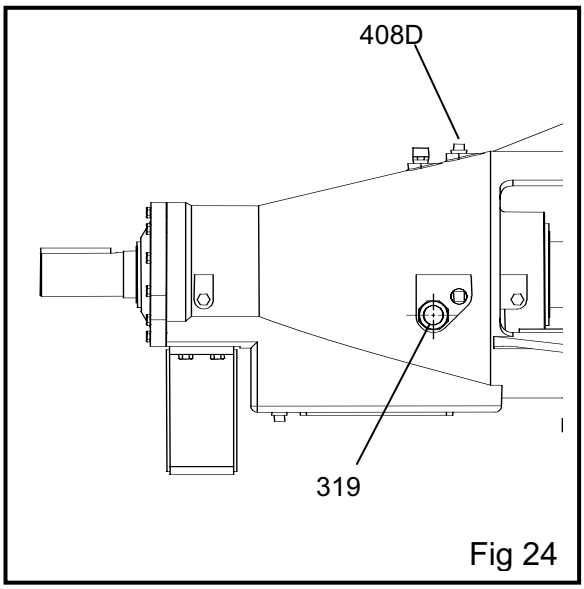


Fig 24

OIL LUBRICATED BEARINGS

Remove the fill plug (408D) and add oil until oil level is at the center of the sight glass (319). Replace the fill plug, see Fig. 24 and Table 2.

AXIAL FLOW PUMP OIL VOLUME

Pump Size	Quarts	Litres
6”	1	.95
8”	1	.95
10”	1	.95
12”	4	3.80
14”	4	3.80
16”	8	7.60
18”	8	7.60
20”	19	18.10
24”	19	18.10
700mm	19	18.10
30”	19	18.10
36”	29	27.55

Table 2

Change the oil after 200 hours of new bearings, thereafter every 2000 operating hours or 3 months (whichever comes first).

Goulds recommends 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.

The viscosity of the oil should be 150 SSU at the operating temperature to prevent accelerated bearing wear. 150° F is the maximum temperature at which a typical 30 wt. oil will supply the required viscosity.

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 on bearings to use oil that is too heavy rather than too light.

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.

GREASE LUBRICATED BEARINGS

The bearings are pre-lubricated at the factory. Re-grease bearings every 500 operating hours or after every 3 weeks of continuous operation.

Re-grease Procedure:

NOTE: ***When re-greasing there is danger of impurities entering the bearing housing. The grease container, the grease device, and fittings, must be clean.***

1. Wipe dirt from the grease fittings.

2. Fill both grease cavities through the grease fittings (193A and 193B) found on the bearing housing (134C). Use recommended grease and fill until slight resistance is felt in the grease gun, see Fig. 25.

3. Wipe excess grease from fittings.

4. Ensure the bearing housing labyrinth seals are still seated in place and have not been pushed from their seats by grease pressure.

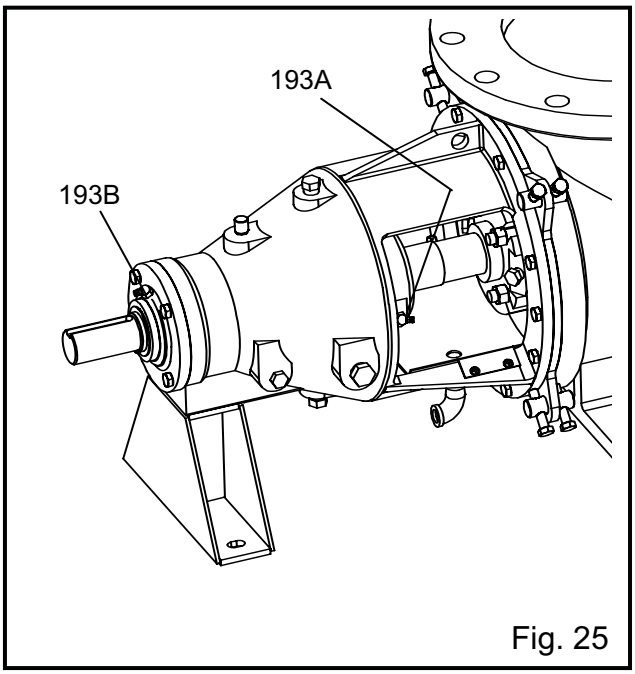


Fig. 25

NOTE: ***The bearing temperature usually rises after re-greasing due to an excess supply of grease. Temperature will return to normal after pump has run and purged excess from the bearings, usually two to four hours.***

For most operating conditions a lithium complex soap based grease of NLGI consistency No. 2 is recommended. This grease is acceptable for bearing temperatures of -15°F to 350°F (-26°C to 177°C). If another brand is desired, it should be checked with the supplier for being equivalent to the above.

LUBRICATING GREASE REQUIREMENTS

Lubricant Brand	Pumpage temp. below 350°F (177°C)	Pumpage temp. above 350°F (177°C)
NLGI Grade	2	3
Mobil	Mobilux #2	-----
Mobil	Mobilith AW2	Mobilith AW3
Humble	Lidok #2	-----
Exxon	Unirex N2	Unirex N3
Shell	Alvania #2	-----
Sunoco	Multipurpose EP	-----
SKF	LGMT 2	LGMT 3
Texaco Regal	Starfak #2	-----

Table 3

Bearing temperatures are generally about 20°F (18°C) higher than bearing housing outer surface temperature.

CAUTION

Never mix greases of different consistency (NLG 1 or 3 with NLG 2) or different thickener. For example never mix a lithium base grease with polyurea base grease.

Pumpage temperatures above 350°F (177°C) should be lubricated by a high temperature. Mineral oil grease. Mineral oil greases should have oxidation stabilizers and a consistency of NLGI 3.

MAINTENANCE OF SHAFT SEALS

MECHANICAL SEAL

When mechanical seals are furnished, a manufacturer's reference drawing is supplied with the data package. This drawing should be kept for future use when performing maintenance and adjusting the seal. The seal drawing will also specify required flush piping attachment points. The seal and all flush piping must be checked and installed as needed prior to starting the pump.

The life of a mechanical seal depends on various factors such as cleanliness of the liquid handled and its lubricating properties. Due to the diversity of operating conditions it is, however, not possible to give definite indications as to its life.

WARNING

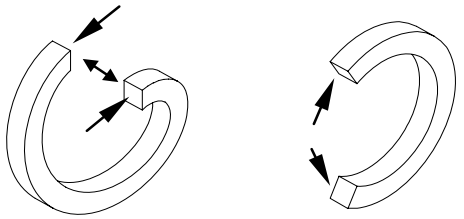
Never operate the pump without liquid supplied to the mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if the mechanical seal fails.

PACKED STUFFING BOX

If the axial flow pump has a stuffing box that seals the rotating shaft the packing rings were installed at the factory, but at some point during the life of the pump they must be replaced. The following steps are used to replace the packing:

1. Drain the system or isolate the pumpage from the pump before replacing the packing.
2. Remove the nuts from the gland studs that hold the gland in place.
3. Use a packing puller remove the first (3) rows of packing from the box.
4. Use threaded rods or a packing puller to remove the lantern ring from the box.
5. Use a packing puller remove the final (2) rings of packing from the box.
6. Clean the stuffing box of any grit or build-up. Clean the shaft sleeve prior to replacing the packing. If the sleeve is damaged, now is the time to replace it.
7. Install the packing and lantern ring in the reverse order of removal, 2 rings of packing, lantern ring, 3 rings of packing, and the gland. Firmly seat each ring. Stagger joints in each ring 90°. Make sure center of lantern ring lines up with flush tap in the stuffing box.
8. Die formed packing rings are used when re-packing a box. Care must be used during their installation. To install packing, twist the ring sideways just enough to get it around the shaft. Do not attempt to pull rings straight out, see Fig. 26.

PACKING RINGS



CORRECT INCORRECT

Fig. 26

9. Insert the lantern ring with tapped extractor holes facing outward from the box, be sure it is aligned with the flush ports in the stuffing box, see Fig. 27.
10. Install the gland nuts finger tight. Then with the lubricating supply on and the pump running, gradually tighten the gland nuts one flat at a time, while observing the leakage and stuffing box temperature. Packing requires time to run-in.
11. Allow a minimum of ½ hour between adjustments. If the leakage is reduced quickly, the packing will overheat and may be destroyed. The shaft sleeve may also become damaged. The normal leakage

for a properly adjusted stuffing box, depending on the shaft size and speed, varies from a few drops per second to a small trickle out of the gland.

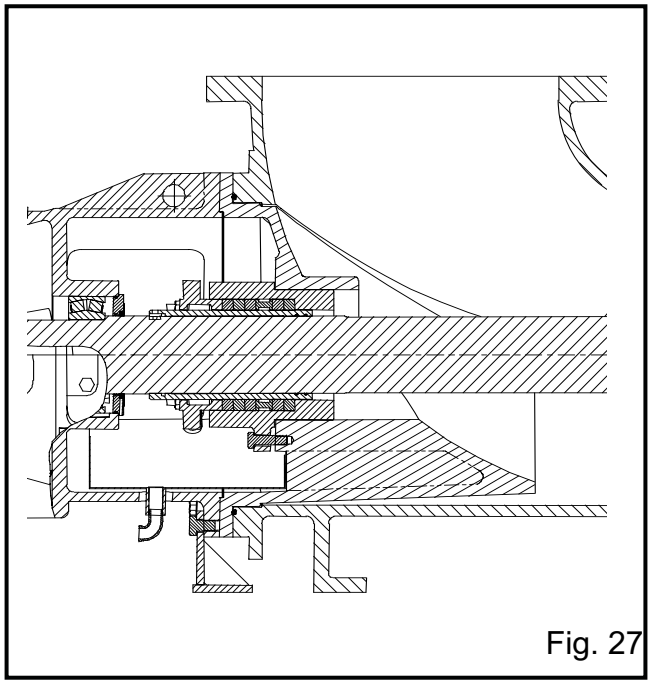


Fig. 27

LABYRINTH SEALS

Labyrinth seals have been provided to extend the life of the bearings and prevent premature bearing housing rebuild. They should occasionally be cleaned externally and checked for wear, see Fig. 28.

CONNECTION OF SEALING LIQUID

If stuffing box pressure is above atmospheric pressure and the pumpage is clean, normal gland leakage of 40-60 drops per minute is usually sufficient to lubricate and cool packing and sealing liquid is not required.

NOTE: Otherwise an external flush should be used to lubricate and cool packing.

An external sealing liquid is required when:

1. Abrasive particles in the pumpage could score the shaft sleeve.

2. Stuffing box pressure is below atmospheric pressure due to pump running when suction source is under vacuum. Under these conditions, packing will not be cooled and lubricated and air will be drawn into the pump. If an outside source of clean compatible liquid is required, the pressure should be 15-20 psi (1.1-1.4 kg/cm^2) above suction pressure. The piping should be connected to the stuffing box flush port inlet.

3. Under extreme temperature and pressure a pipe should also be connected to the flush port outlet.

NOTE: Most packing requires lubrication. Failure to lubricate packing may shorten the life of the packing and pump.

4. An external drip pan (799G) drain is provided to carry away normal gland leakage, see Fig. 28.

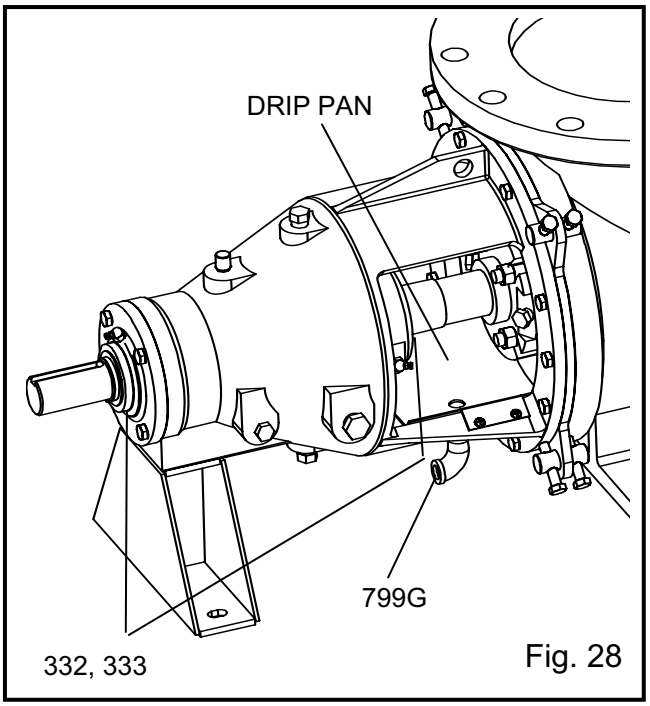


Fig. 28

Pump Troubleshooting

PROBLEM	PROBABLE CAUSE	REMEDY
No liquid delivered or intermittent flow	Pump not primed or prime lost, liquid level does not completely fill elbow	Fill system piping completely so the impeller is submerged
	Suction inlet clogged	Remove obstructions from pump inlet
	Impeller clogged with foreign material	Back flush pump or manually clean impeller
	Suction and /or discharge valve closed or clogged	Open valves to remove shut-off condition
	Wrong direction of rotation	Change rotation to concur with direction indicated by the arrow on the bearing housing
	Suction piping incorrect	Replace or modify suction piping
	Insufficient NPSH available	Increase liquid level or lower pump
	Air leak in suction line	Test suction piping for leaks
	Speed (rpm) too low	New drive or gear box to obtain higher pump speed
	Excess air entrapped in liquid	Install vent in piping or eliminate air source
Pump not producing rated flow or head	Impeller partly clogged	Back flush pump or manually clean impeller
	Insufficient suction head	Fill system piping so the liquid level is above the pump impeller centerline
	Pump not primed or prime lost, pump does not completely fill elbow	Fill system piping completely so the impeller is submerged
	Suction and/or discharge valve closed or clogged	Open valves to remove partially blocked condition
	Suction piping incorrect	Replace or modify suction piping
	Excessive air entrapped in liquid	Install vent in piping or eliminate air source
	Speed (rpm) too low	New drive or gear box to obtain higher pump speed
	Incorrect rotation	Check motor wiring
	Incorrect impeller or impeller diameter	Check vane angles and/ or impeller clearances
	System head too high	Check system curve calculations, reduce system resistance
	Instruments give erroneous readings	Check and calibrate instruments, replace if necessary
	Worn or broken impeller, bent vanes	Inspect and replace if necessary
	Pump assembled incorrectly	Compare pump assembly to instruction manual
Wear of internal wetted parts is accelerated	Insufficient NPSH available	Increase liquid level or lower pump
	Chemicals in liquid other than specified	Analyze pumpage and correct or change pump wet end materials to suit pumpage composition
	Pump assembled incorrectly	Compare pump assembly to instruction manual
	Higher solids concentration than specified	Analyze pumpage and correct or change pump wet end materials to harder composition
Excessive leakage from stuffing box	Packing gland improperly adjusted	Tighten gland nuts
	Stuffing box improperly packed	Check packing and re-pack box
	Worn mechanical seal parts	Replace worn parts
	Overheating mechanical seal	Check lubrication and cooling lines
	Shaft sleeve scored	Re-machine or replace as required
Packing has short life	Pump run off design point	Check head and flow, AF's should be run at <75% BEP > 115%
	Shaft/shaft sleeve worn	Replace shaft or shaft sleeve if necessary
	Packing gland not properly adjusted	Replace packing and readjust gland as specified in the operating manual
	Packing not properly installed	Check head and flow, AF's should be run at <75% BEP > 115%
	Pump not assembled correctly	Compare pump assembly to instruction manual

Table 4

Pump Troubleshooting (Cont'd)

PROBLEM	PROBABLE CAUSE	REMEDY
Bearings run hot and or fail on a regular basis	Lubricant level	Be sure the oil level is at center line of sight glass
	Improper lubricant	Check lubricant for suitability
	Not lubricated enough	Increase frequency of grease lubrication
	Broken or bent impeller vanes	Check impeller dimensions and vane layout
	Excessive shaft misalignment	Check shaft run-out and consult factory
	Inadequate lubricant cooling	Check pumpage temperature and add oil cooling system if necessary
	Axial thrust or radial load higher than bearing rating	Calculate bearing life for make and model bearing
	Improper coupling lubrication	Check coupling lubrication schedule in manufacturers installation, operation, maintenance manual
	Coupling out of balance	Check pump and drive component vibration levels, rebalance coupling if necessary
	Suction pressure too high	Check liquid levels and static suction pressure
	Bearing incorrectly installed	Check bearing orientation to sectional drawing
	Impeller out of balance	Check pump vibrations, if necessary rebalance impeller
	Excessive shaft deflection	Check shaft diameter, sag and deflection, consult factory
	Pump run off design point	Fill system piping completely so the impeller is submerged
	Lubricant contamination	Inspect oil or grease for contaminants
	Piping not properly anchored	Check to see if excessive pipe strain is being transferred to pump flanges
	Pump and/or driver not secured to sub-base	Check fasteners, if loose check alignment and re-tighten
	Specific gravity higher than specified	Analyze pumpage and compare to specified gravity
	Viscosity higher than specified	Analyze pumpage and compare to specified viscosity
	Pump assembled incorrectly	Compare pump assembly to instruction manual
	Partly clogged impeller causing Imbalance	Back flush pump or manually clean impeller
Pump is noisy or vibrates at higher than normal levels	Broken or bent impeller or shaft	Replace as required
	Pump foundation not rigid or sub-base not completely secured	Tighten hold down bolts on sub-base Check foundation rigidity
	Impeller out of balance	Check impeller balance
	Motor not secure	Check motor fasteners
	Improper coupling lubrication	Check coupling lubrication schedule in manufacturers installation, operation, maintenance manual
	Bearing incorrectly installed	Check bearing orientation to sectional drawing
	Coupling out of balance	Check pump and drive component vibration levels, rebalance coupling if necessary
	Pump operating speed too close to system's natural frequency	Change speed to be +/- 20% of the pumps natural frequency
	Impeller partly clogged	Back flush pump or manually clean impeller
	Impeller clearances too tight	Check impeller clearances adjust if necessary
	Pump assembled incorrectly	Compare pump assembly to instruction manual
	Pump run off design point	Check head and flow, AF's should be run at <75% BEP > 115%
	Excessive shaft deflection	Check shaft diameter, sag and deflection, consult factory
	Worn bearings	Replace
	Suction or discharge piping not anchored or properly supported	Anchor per Hydraulic Institute Standards manual recommendation
	Suction and/or discharge valve closed or clogged	Open valves to remove partially blocked condition
	Excessive shaft misalignment	Check shaft run-out and consult factory
	Pump assembled incorrectly	Compare pump assembly to instruction manual
	Pump is cavitating, insufficient NPSH available	System problem, increase liquid level or lower pump
High rate of mechanical seal failure	Insufficient NPSH available	Increase liquid level or lower pump
	Excessive shaft misalignment	Check shaft run-out and consult factory
	Suction pressure too high	Check liquid levels and static suction pressure
	Bearing installed incorrectly	Check bearing orientation to sectional drawing
	Impeller out of balance	Check pump vibrations, if necessary rebalance impeller
	Overheating of seal faces	Check flush flow with mfgr's recommendation, increase if necessary
	Excessive shaft deflection	Check shaft diameter, sag and deflection, consult factory
	Lack of seal flush to seal faces	Check shaft diameter, sag and deflection, consult factory
	Incorrect seal installation	Check seal materials vs. pumpage to determine compatibility
	Pump is run dry	Fill system piping completely so the impeller is submerged
	Pump run off design point	Fill system piping completely so the impeller is submerged
	Shaft/shaft sleeve worn	Replace shaft or shaft sleeve if necessary
	Coupling out of balance	Check pump and drive component vibration levels, rebalance coupling if necessary
	Sub-base not installed correctly	Compare pump sub-base installation to instruction manual
	Bearing failing	Replace if necessary
	Piping not properly anchored	Check to see if excessive pipe strain is being transferred to pump flanges
	Pump and/or driver not secured to sub-base	Check fasteners, if loose check alignment and re-tighten
	Specific gravity higher than specified	Analyze pumpage and compare to specified gravity
	Viscosity higher than specified	Analyze pumpage and compare to specified viscosity
	Pump assembled incorrectly	Compare pump assembly to instruction manual
Motor requires excessive power	Head higher than rating. Reduced flow	Check for fouling in the piping or obstruction in discharge
	Liquid heavier than expected	Check specific gravity and viscosity
	Incorrect rotation	Jog motor and check rotation
	Pump run off design point	Check measured head and flow to specified head and flow
	Stuffing box packing too tight	Readjust packing. Replace if worn
	Rotating parts binding, internal clearances too tight	Check internal wearing parts for proper clearances

Table 4 (Cont'd)

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DISASSEMBLY & RE-ASSEMBLY

REQUIRED TOOLS

- Safety glasses, leather gloves
- 11/16", 7/8", 1-1/16", 1-1/4", 1-5/8" wrenches or sockets
- Lifting slings or chains
- Induction bearing heater
- Brass drift punch
- Spanner wrench
- Allen wrenches
- Torque wrench with sockets
- Micrometer
- Cleaning Agents
- Feeler gauges
- Bearing puller
- Crane or hoist
- Lifting eyebolt (dependent on pump size)

DISASSEMBLY

Disassembly procedures were written assuming the entire pump and sub-base have been removed from the piping. In most cases only the back pullout will need to be removed for maintenance, the elbow can remain in the piping.

WARNING

Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and or equipment damage.

WARNING

The AF may handle hazardous and/or toxic fluids. Skin and eye protection is required. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable Environmental Regulations.

NOTE: Before disassembling the pump for overhaul, ensure all replacement parts are available.

WARNING

Lock out driver power to prevent accidental start-up and physical injury.

1. Shut all valves controlling flow "to and from" the pump.

WARNING

Operator must be aware of pumpage and safety precautions to prevent physical injury.

2. Drain liquid from piping, flush the pump if necessary.
3. Disconnect all auxiliary piping and tubing.

4. If the pump is oil lubricated drain all oil from the bearing housing before attempting to move the pump.

5. Depending on the drive arrangement, either direct connect or V-belt, use steps 6, 7 and 8, or 9, 10 and 11 respectively.

GUARD / DRIVE

Direct Connect Configuration

6. Remove the pump coupling guard screws and guard (501), see Fig. 29.

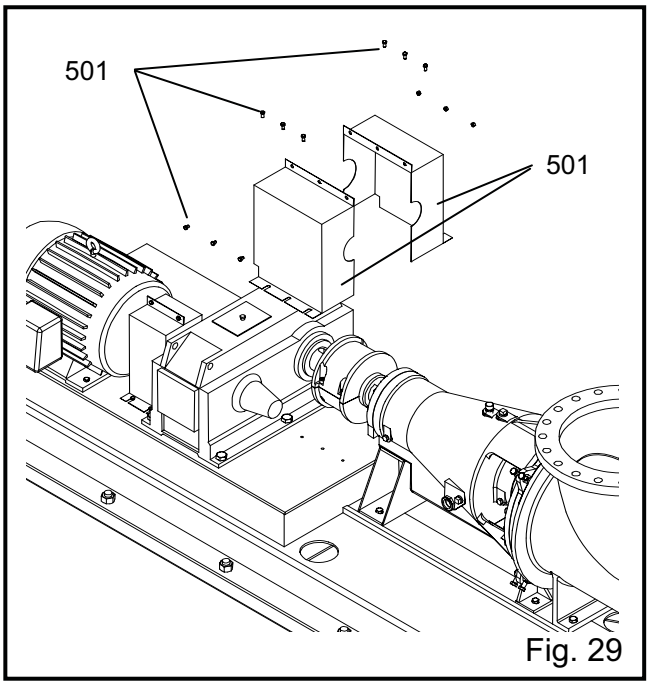


Fig. 29

7. Remove the fasteners that hold the coupling cover halves together, remove each half and set it aside for re-assembly. Do not remove the hubs from the gear drive and pump shafts, see Fig. 30.

8. Remove the pump to sub-base bolts (372V) and wrap lifting straps or chains around the bearing housing (134C) and elbow (315A), see Fig. 31. Use care when lifting the pump from the subbase. Be sure all lifting devices are rated for the pump weight. If any shims are found under the bearing housing feet match mark and retain them for re-assembly.

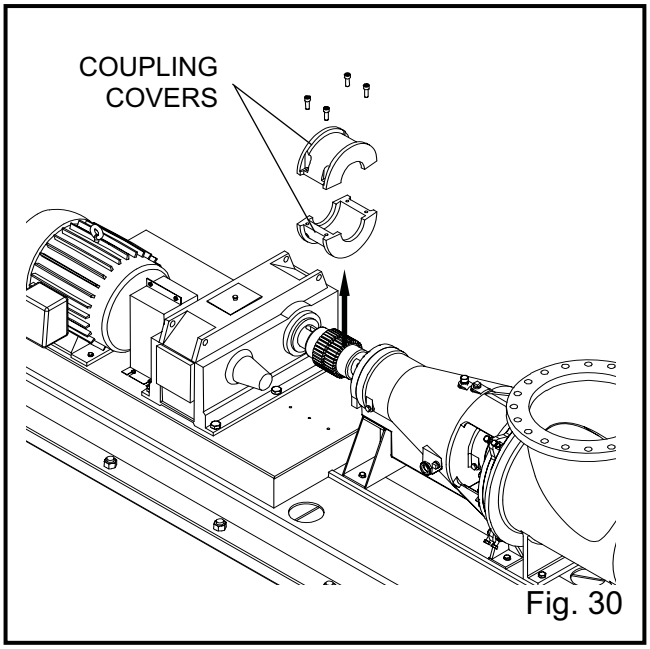


Fig. 30

V-Belt Configuration

9. Remove the V-belt guard screws and the guard cover (500) from guard base, see Fig. 32.

10. Relieve the belt tension by adjusting the slide base toward the pump then remove the belts, see Fig. 33.

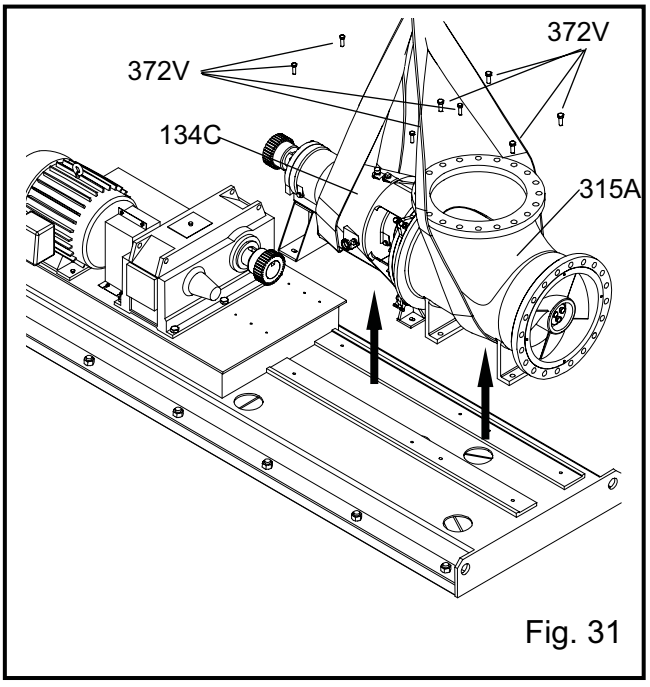


Fig. 31

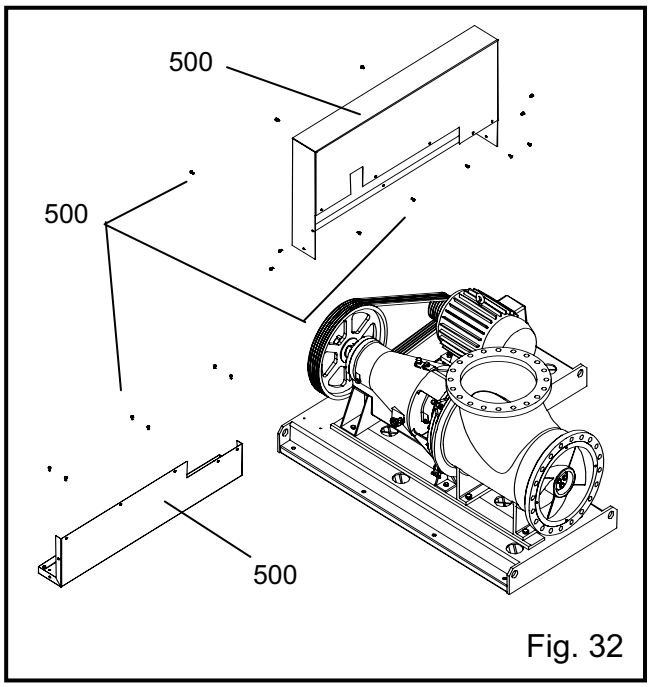


Fig. 32

11. Remove the pump to sub-base bolts (372V) and wrap lifting straps or chains around the bearing housing (134C) and elbow (315A), see Fig. 34. Using a crane, lift the pump vertically from the sub-base. Be careful not to damage the pump by striking any beams or walls that may be near the pump. If any shims are found under the bearing housing feet retain them for re-assembly later.

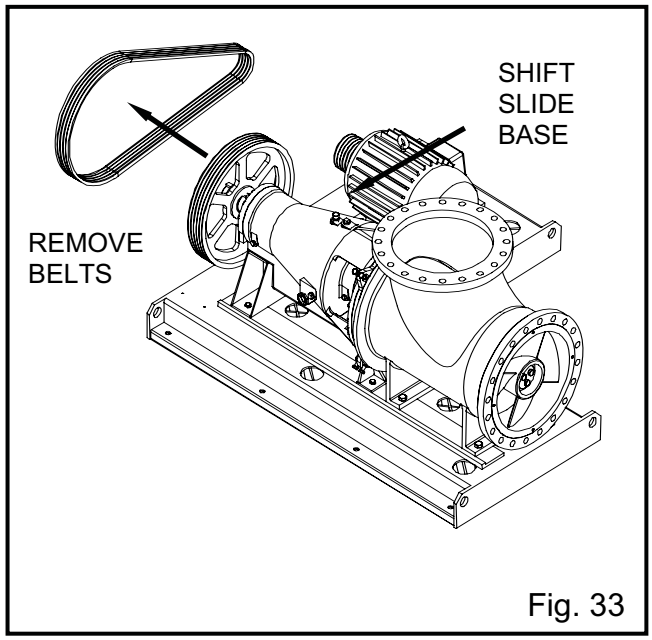


Fig. 33

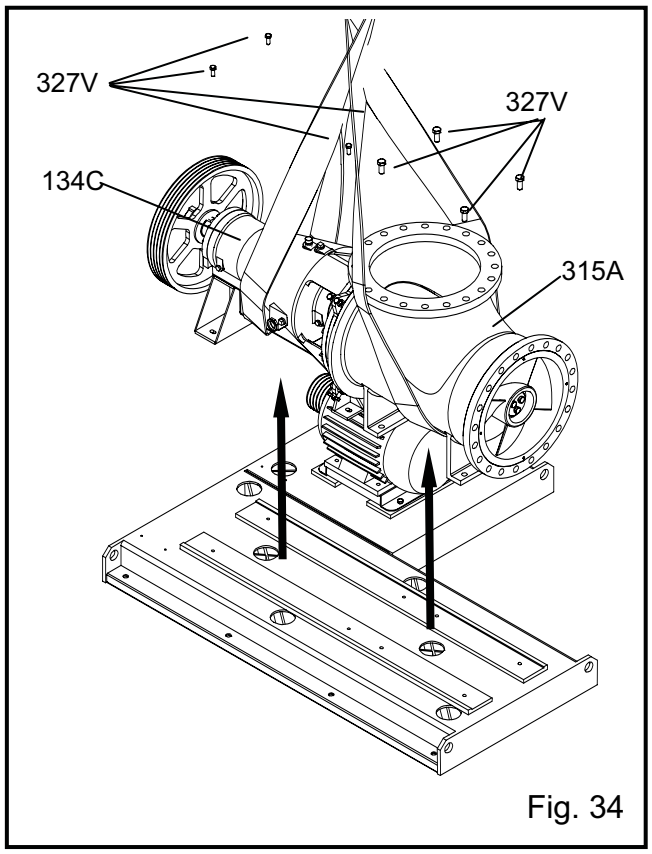


Fig. 34

12. Depending on the drive type, remove the hub fasteners that hold the coupling or pump sheave to the shaft (122). Remove either a coupling half or pump sheave and key (400). If the coupling half is interference fit, heat may be necessary to remove it from the shaft. Drive instructions are included with the data package. Follow the manufacturer's instructions for coupling or sheave removal.

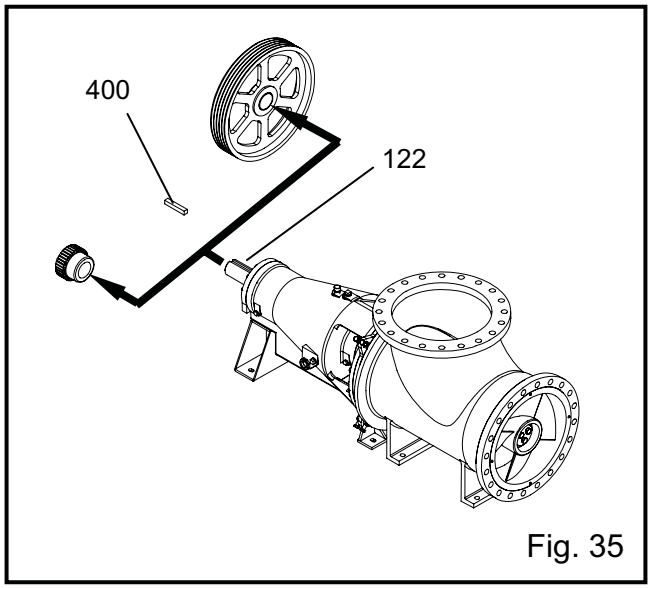


Fig. 35

BACK-PULLOUT / ELBOW OR ELBOW WITH CASING / LINER (OPTION)

Elbow

13. Set the pump down on a smooth flat surface to stabilize it for disassembly. Loosen the impeller adjusting bolts (356A) so that they are clear of the rear elbow flange. Remove the bolts (789L, 799O) that attach the back-pullout (903A) to the elbow (315A). With the elbow held in place, slide the back-pullout from the elbow. Remove the face o-ring (351) between the elbow and the back-pullout, discard and order a replacement. Be sure to order the correct o-ring material, see Fig. 36.

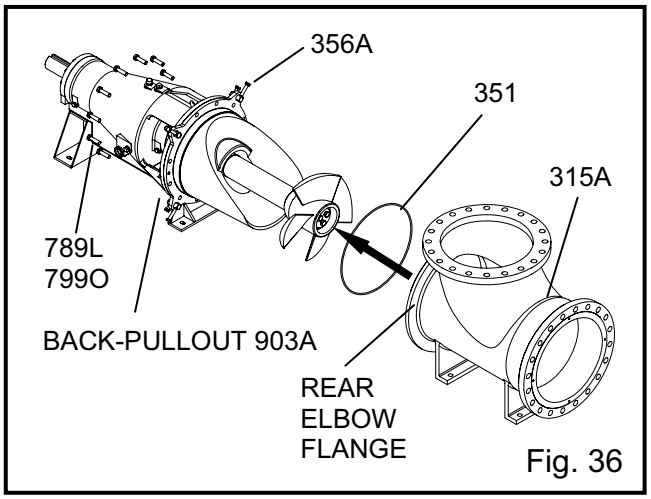


Fig. 36

Elbow with Casing

14. The 700mm & 36” sizes come with a separate casing. Remove the bolts (799C) and nuts (799D) that secure the casing (100) to the elbow (315A). Remove the casing and discard the mating o-ring or gasket (351A). Loosen the four screws (356A). Remove the bolts (789l & 799O) that secure the back-pullout (903A) to the elbow and discard the o-ring (351), see Fig. 37.

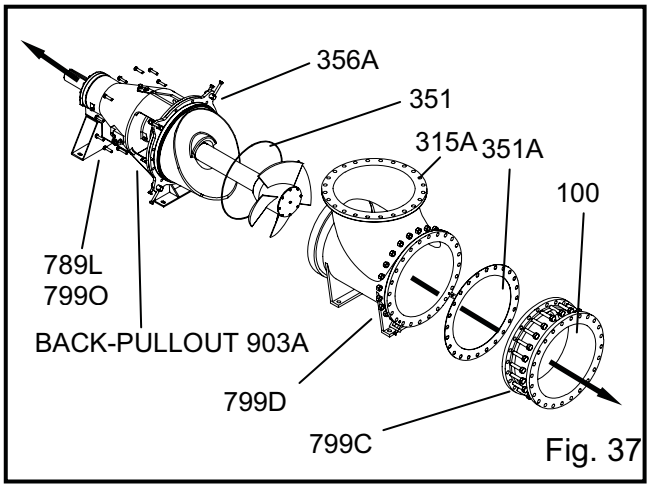


Fig. 37

Liner (option)

15. If the elbow (315A) or casing (100) has an optional liner (103A) now is the time to remove it. Four tapped holes in the liner flange are used with screws to jack the liner from its seat. If the liner has been in service this may require considerable effort due to corrosion. If the liner is worn or deeply eroded, order a replacement for re-assembly, see Fig. 38.

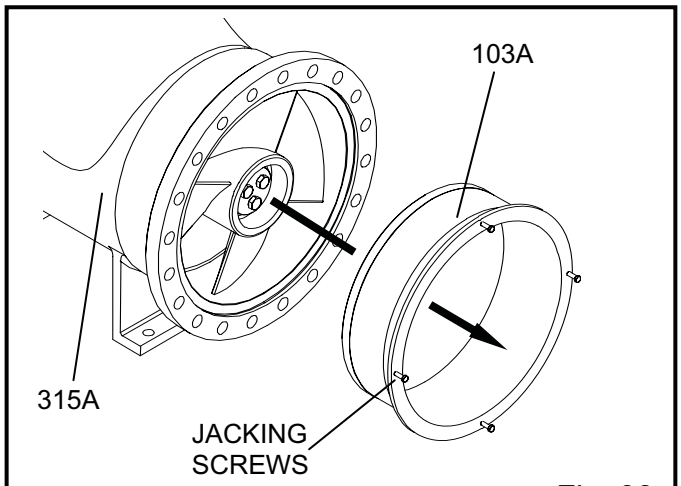


Fig. 38

IMPELLER

Standard Impeller

16. Remove the bolts (198) that hold the shaft washer (199) in place. Remove the shaft washer. To remove the impeller (101), use a wooden mallet and gently tap it to break it loose from the shaft (122). Pull the impeller from the shaft, retain the shaft key (178), see Fig. 39.

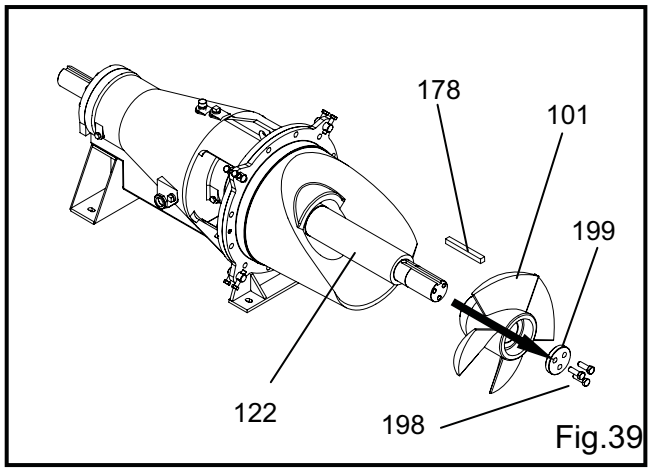


Fig.39

Sealed Impeller

17. 700mm and 36” sizes use an impeller cover (998E) and O-rings to keep pumpage out of the impeller cavity. The impeller cover must be removed first to get to the shaft washer (199). Remove the bolts (799B) and cover (998E) from the impeller (101). Remove the cover o-ring (412T). Remove the bolts (198) and shaft washer (199). To remove the impeller (101), use a wooden mallet and gently tap it to break it loose from the shaft (122). Pull the impeller off the shaft, retain the shaft key (178), and discard the impeller o-ring (412A). A pipe plug (358I) located in the center of the cover is used to test the impeller seal after re-assembly, do not remove this plug, see Fig. 40.

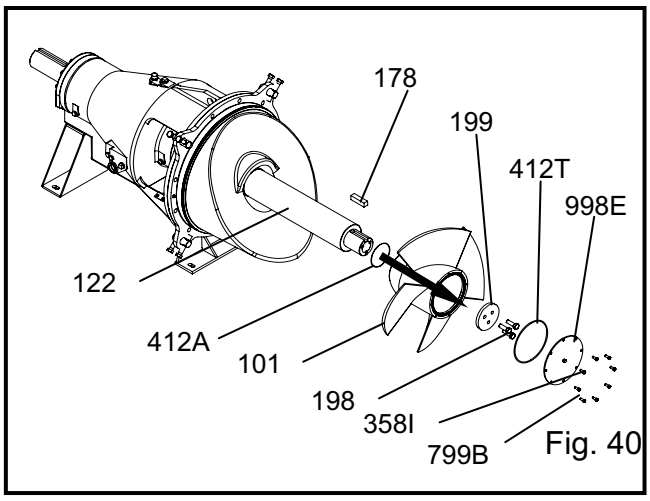


Fig. 40

SEAL / STUFFING BOX COVER

- Mechanical Seal w/ Optional Adapter

18. Be sure all gland flush tubing is disconnected. The mechanical seal (383) is removed from the stuffing cover (184) by removing the seal nuts (353) and pulling the seal away from the stuffing box cover (184). It is unnecessary to remove the gland studs (355) unless they are damaged. If the seal includes a restrictor bushing (496B) and optional adapter (108B) remove these now. Remove and discard the adapter gasket (211). Next remove the stuffing box cover (184) by removing (2) screws (370C) that secure the stuffing box cover (184) to the bearing housing (134C). Remove the stuffing box cover from the bearing housing. On larger pumps use a sling or hook and chain to securely support the weight of the stuffing box cover during removal. Remove the adjusting bolts (356A) and all four adjusting lugs (415). Be careful not to scuff or scar the pump shaft (122) during removal, see. Fig. 41.

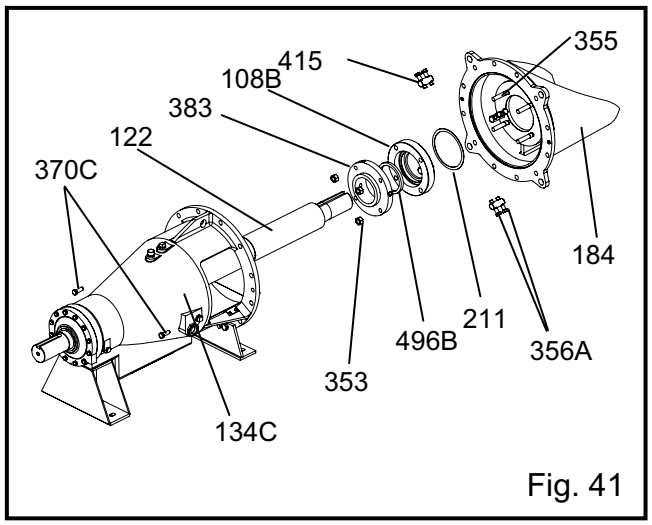


Fig. 41

Packed Box

19. With a packed box, the gland nuts (353), gland (107), packing (106) and lantern ring (105) must be removed before the stuffing box cover (184). Remove all flush tubing. Remove the impeller adjusting bolts (365A) and all (4) adjusting lugs (415). Remove the two bolts (370C) that secure the stuffing box cover (184) to the bearing housing (134C) then remove the stuffing box cover. On larger pumps use a sling or hook and chain to support the weight of the stuffing box cover during removal. Be careful not to scuff or scar the pump shaft (122) or sleeve (126) during removal. Next remove the stuffing box (220), bolts (799E) and gasket (351W). Finally remove the set screw (469D) and key (178D) that secure the shaft sleeve (126) to the shaft (122). If the sleeve is immovable use a brass drift to knock it from its seat. Be careful not to mar or scratch the shaft during the process. Remove and discard the o-rings (412D), see Fig. 42.

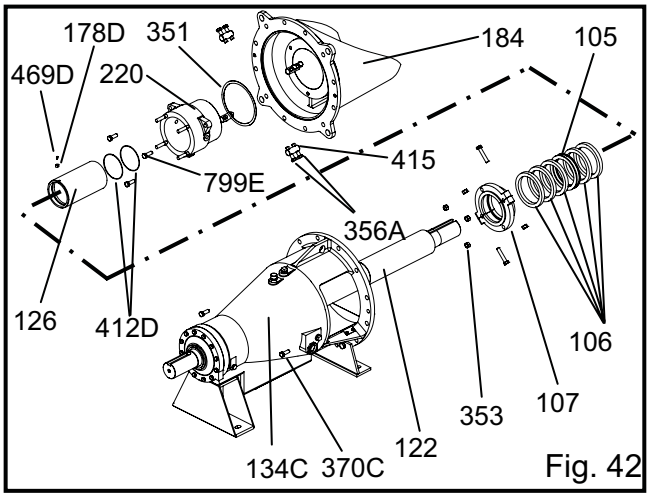


Fig. 42

DRIP PAN

20. Remove the street elbow (799G) from the drip pan nipple, then the screws (799H) and washers (799I) that secure the drip pan (179) to the bearing housing (134C). Pull the drip pan from the bearing housing, see Fig. 43.

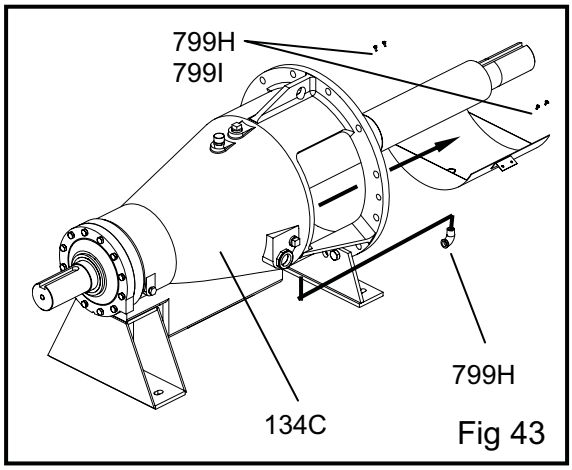


Fig 43

BEARING HOUSING

21. Before removing the bearings carefully remove the labyrinth seals from the outboard and inboard positions (332, 333). Use a sharp edged tool or screwdriver to remove them from the bearing housing. Be careful not to damage the shaft (122) or seat, see Fig. 44.

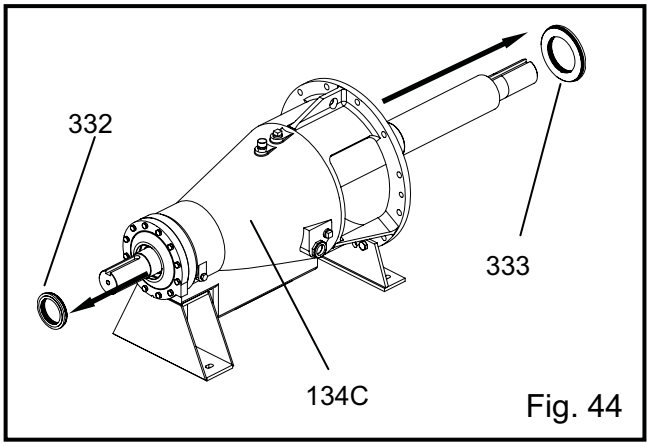


Fig. 44

22. Lift the bearing housing up vertically by the drive end using an eyebolt and chain. Be careful not to damage the impeller end of the shaft. Place the bearing housing on a bench or stand so that the shaft protrudes down through it. At this time, remove the screws (799F & 370Y) that secure the front (239B) and rear feet (239A). Remove the screws (788Z) that secure the thrust bearing retainer (119C) to the bearing housing. Remove the retainer and discard the gasket/shims (331) or o-ring (412Y), see Fig. 45.

23. Using the eye bolt already threaded into the shaft, pull the rotating assembly from the bearing housing, see Fig . 46. Once the rotating assembly has been removed place it on a set of wooden V-blocks for bearing removal, see Fig.'s 47 and 48.

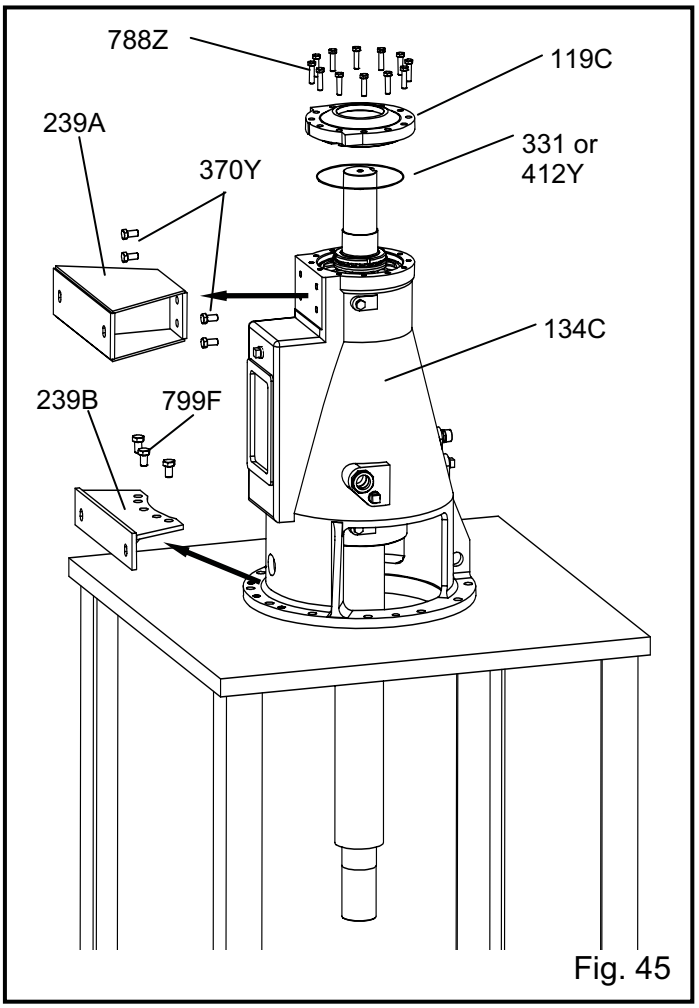


Fig. 45

ROTATING ELEMENT

1MXR-3MXR Configurations:

24. In order to remove the bearings first pry the tangs of the lock-washer (382) from the lock-nut (136). Then, using a spanner wrench remove the lock-nut (136) and lockwasher (382). This thrust bearing configuration consists of two back to back angular contact bearings. Use a bearing puller to remove both thrust bearings (112C). Finally, use a puller to remove the inboard radial bearing (168C) from the opposite end of the shaft. Be careful not to damage the shaft, see Fig. 47.

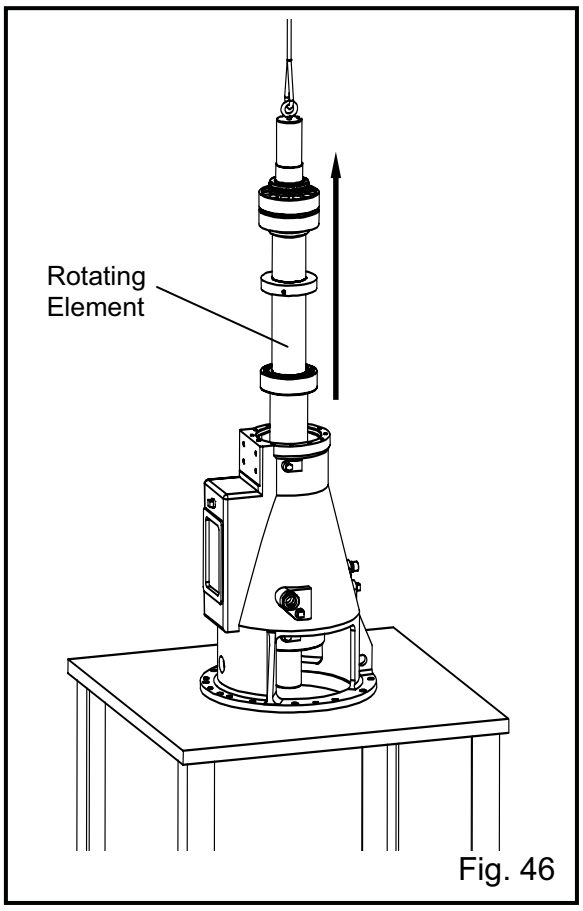


Fig. 46

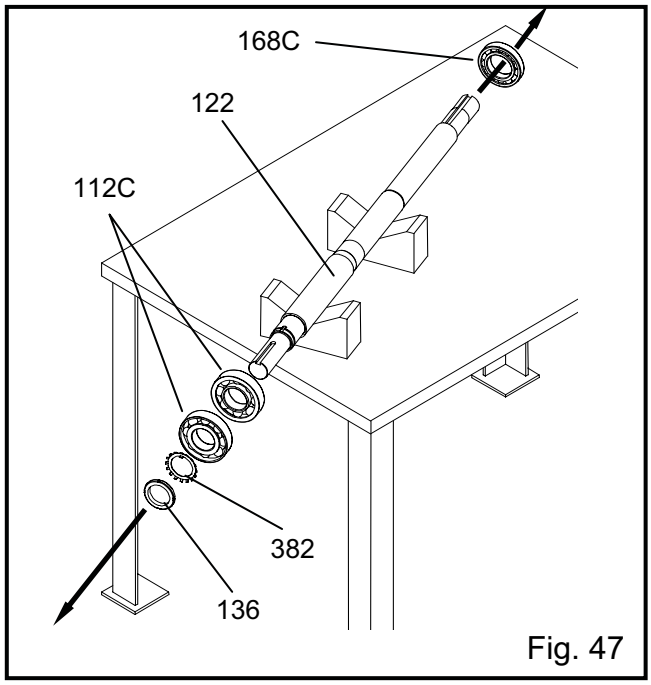


Fig. 47

4MXR-6MXR Configurations:

25. In order to remove the bearings first pry the tangs of the lock-washer (382) from the lock-nut (136). Use a spanner wrench to remove the lock-nut (136) and lockwasher (382). Slide off the keyed washer (142B). This thrust bearing configuration is an indirectly mounted taper roller bearing. Use a bearing puller to remove the thrust bearing (112C). Next, remove the thrust bearing collar (443X) and oil wheel (248). The oil wheel has one to three set screws (222N) that hold it to the shaft (122). The collar and oil wheel must be removed prior to removing the inboard bearing. Finally, use a puller to remove the inboard radial bearing (168C) from the drive end of the shaft. Be careful not to damage the shaft, see Fig. 48.

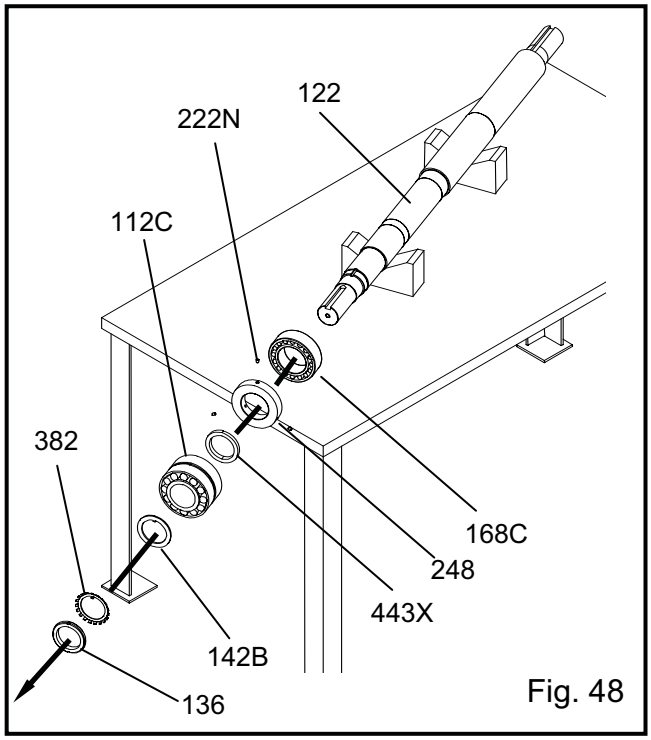


Fig. 48

COOLING COIL (OPTIONAL) / SIGHT GLASS / BREATHER AND PLUGS

Loosen and remove the screws (370F) that secure the cover plate (113B) to the bearing housing (134C) and discard the gasket. (360E). Remove the cover plate and coil. Disconnect the connectors (972G and 972H) from the cover plate and remove the cooling coil (984A). see Fig. 49.

Finally, if necessary remove the breather (113A), pipe plugs (408D, 408, 408A, 251C) and the sight glass (319).

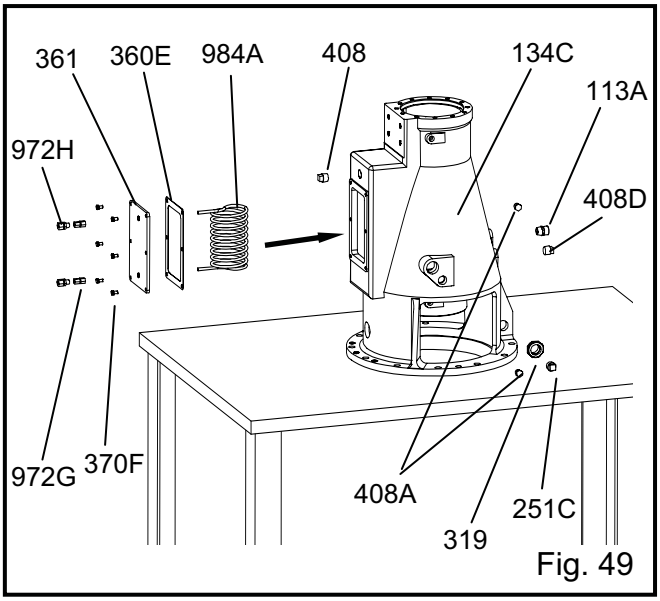


Fig. 49

INSPECTIONS

Before re-assembly all AF wear parts should be inspected using the following methods to insure the pump will perform properly. Any part not meeting the required criteria should be replaced.

NOTE: Clean parts in solvent to remove oil, or grease or dirt. Protect machined surfaces against damage during cleaning.

ELBOW / CASING / LINER (OPTIONAL)

The elbow and or casing (315A or 100) and liner (103A) should be inspected for excessive wear or pitting in the impeller and gasket areas. They should be repaired or replaced if wear or corrosion exceeds the following criteria, see Fig. 50.

1. Localized wear or grooving greater than 1/8 in. (3.2mm) deep.
2. Pitting greater than 1/8 in. (3.2mm) deep.
3. Inspect case gasket seat surface for irregularities.

IMPELLER

1. Inspect impeller vanes for damage (101), Fig. 51. Check the vane O.D. for erosion. Check the vane surfaces, replace if grooved, worn or eroded deeper than 3/16 in. (5.0 mm.) Excessive impeller wear may cause a reduction in performance.
2. Inspect the leading and trailing edges of the vanes for pitting, erosion or corrosion damage replace if grooved or worn deeper than 3/16 in. (5.0 mm.)
3. Inspect the root (vane attach point at hub) of each vane for cracks. Impeller vane failure can cause unbalance in the rotating assembly that will lead to catastrophic failure of the pump.

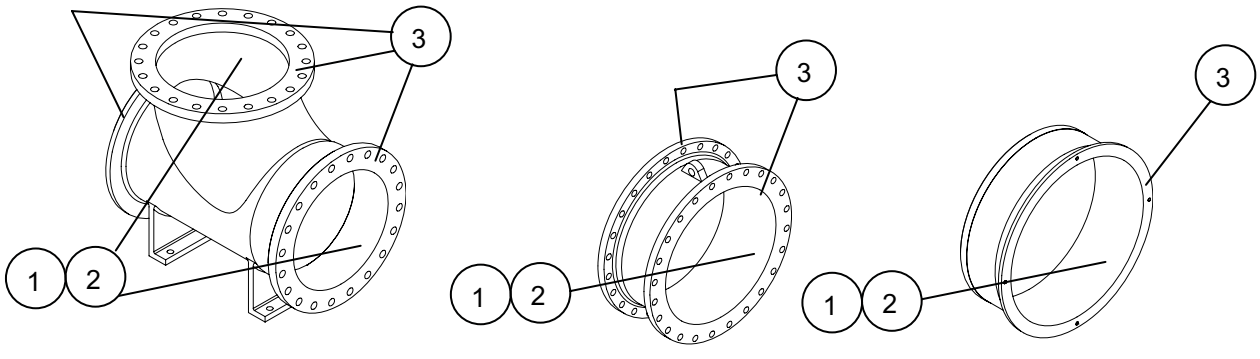


Fig. 50

4. Inspect the keyway and stepped bores for signs of pitting, wear or corrosion damage.

5. Check the O-ring groove and bolt holes for signs of pitting or corrosion.

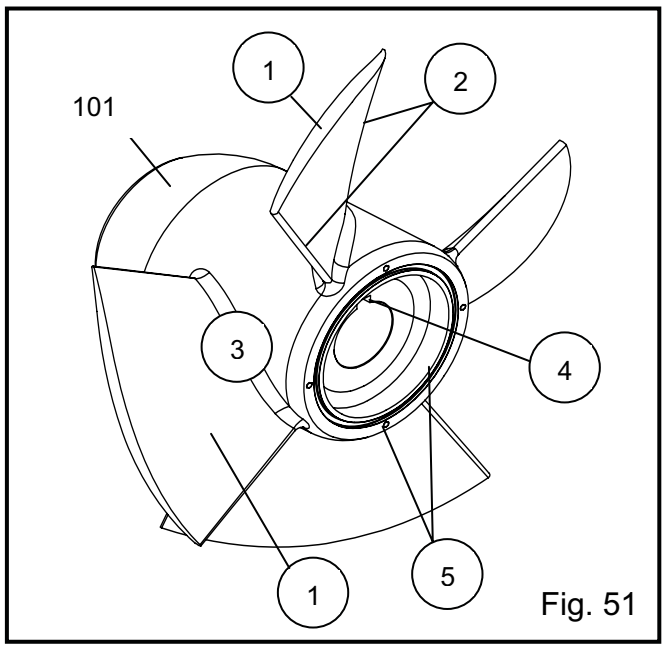


Fig. 51

SHAFT

1. Check the shaft (122) for straightness, wear, corrosion, and radial run-out. Maximum run-out for non-contact portions of the shaft is .003 in. max., see Fig. 52.

2. For all contacting surfaces such as bearing seats, sleeve seats, and impeller mounting surfaces see Table 5 on the following page.

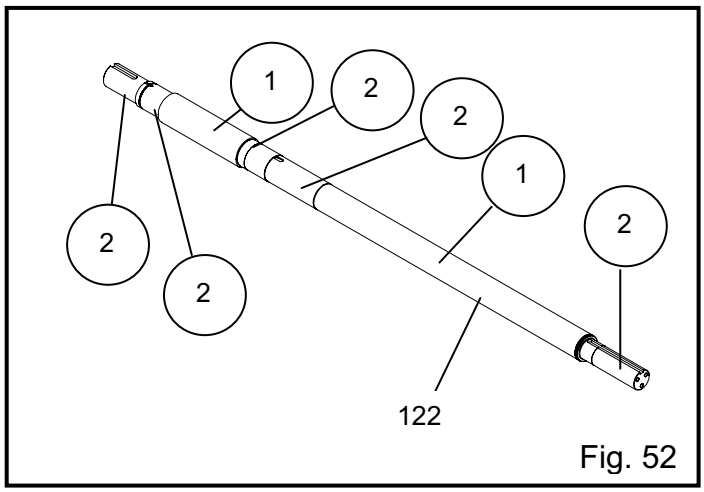


Fig. 52

SHAFT SLEEVE

1. The shaft sleeve (126) should be replaced if badly grooved or worn. Localized wear or grooving greater than 3/32 in. (2.4 mm) deep is cause for replacement, see Fig. 53.

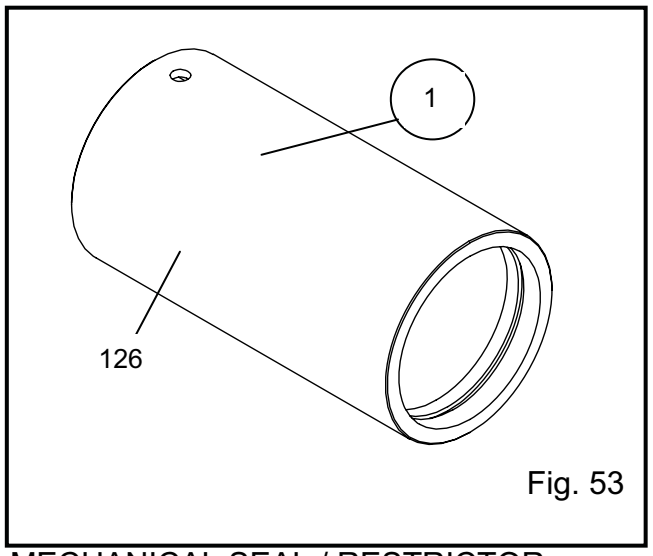


Fig. 53

MECHANICAL SEAL / RESTRICTOR BUSHING

1. Refer to the mechanical seal (383) vendor's manual for inspection instructions.

2. The restrictor bushing, (496B) if necessary should be replaced during re-assembly.

STUFFING BOX

1. Check the stuffing box (220) for localized wear or grooving greater than 1/16 in. (1.6 mm) deep.

2. Pitting greater than 1/16 in. (3.2mm) deep.

3. Inspect stuffing box gasket seat surface for any irregularities.

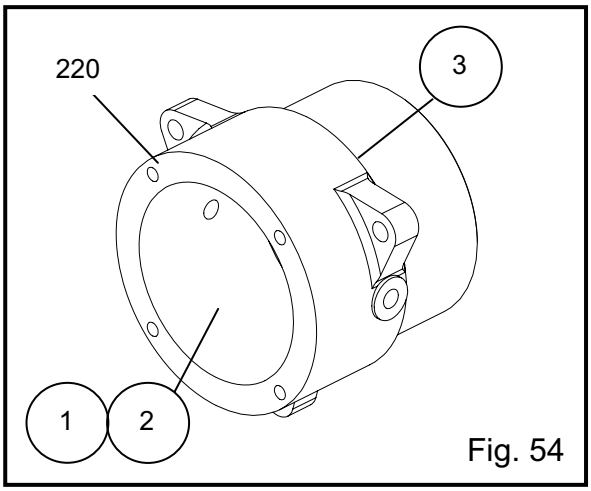


Fig. 54

BEARING HOUSING

Inspect the bearing housing (134C) bores for signs of scarring or galling from the outer race. Table 6 gives the critical bore dimensions for the housings. The bores should not be eggy and should be concentric, see Fig. 55.

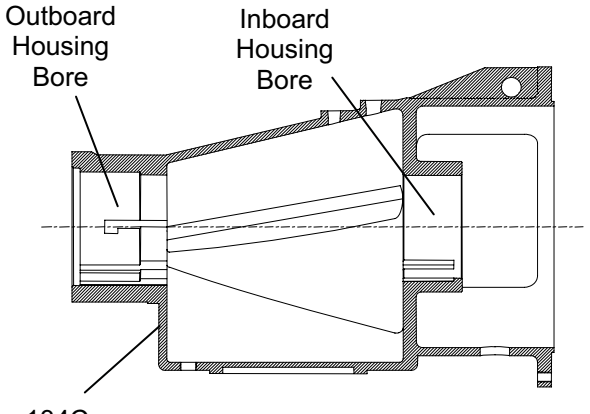


Fig. 55

BEARINGS

The bearings (112C and 168C) should be inspected for contamination and damage. The condition of the bearing will provide useful information on operating conditions in the bearing housing. Lubrication condition and residue should be noted. Bearing damage should be investigated to determine the cause. If cause is not normal wear, it should be corrected before the pump is returned to service.

DO NOT RE-USE BEARINGS.

Labyrinth Seals and O-rings

Although the labyrinth seals (332, 333), O-rings (351, 351A, 351W, 412A, 412D, 412T, 412Y, 496D) and gaskets (331, 351A, 351W, 211) may seem OK during inspection and examination, **DO NOT RE-USE SEALS** when rebuilding the pump. Replace them while pump is disassembled.

Critical Axial Flow Dimensions and Tolerances

Pump Size	Inboard Housing Bore	Outboard Housing Bore	Inboard Bearing Seat	Outboard Bearing Seat	Mech. Seal Seat	Sleeve Seat	Impeller End	
							1st Step	2nd Step
6	3.5442 3.5433	3.9379 3.9370	1.9690 1.9686	1.7722 1.7718	1.750 1.748	1.687 1.685	1.2495 1.2485	
8							1.3745	
10							1.3735	
12	4.7253 4.7244	5.5128 5.5118	2.5597 2.5592	2.5597 2.5592	2.500 2.498	2.437 2.435	1.9995 1.9985	2.0307 2.0297
14							1.9895 1.9885	1.9995 1.9985
16	5.9076 5.9055	6.6950 6.6929	3.3472 3.3466	3.1502 3.1497	3.250 3.248	3.248 3.247	2.5935 2.5925	2.6245 2.6235
18							2.6245 2.6235	2.6555 2.6545
20	7.8758 7.8740	8.3780 8.3770	4.7263 4.7254	4.2531 4.2521	5.250 5.248	5.188 5.186	3.6240 3.6230	3.6552 3.6542
24							4.0000 3.9985	4.0300 4.0290
700mm	9.8449	10.7530	5.9071	4.7534	6.250	6.187	3.999	
30	9.8431	10.7520	5.9061	4.7524	6.248	6.186	3.998	
36	11.0262 11.0244	12.0030 12.0020	6.6945 6.6935	5.7525 5.7515	7.000 6.998	6.9360 6.9335	4.7180 4.7165	4.7490 4.7475

Table 5.

RE-ASSEMBLY

Re-assembly of the AF is done opposite the order of disassembly with a few exceptions. Be sure the parts are clean and free of burrs and scratches. Every assembly step should be double-checked to ensure proper order and technique to prevent having to partially disassemble the step you just finished.

COOLING COIL (OPTIONAL) / SIGHT GLASS / BREATHER AND PLUGS

The optional cooling coil is installed by first fastening two modified male connectors (972G) to the cooling coil cover (113B). Insert the ends of the cooling coil (984A) through the male connectors (972G) and screw the female connector (972H) to the male compressing the tubing in-between. Attach the cover plate (113B) to the bearing housing (134C) using a new gasket (360E) and the six screws (370F) w/ O-rings (370F) see Fig. 56.

Install the breather (113A), pipe plugs (408, 408A, 408D, 251C) and sight glass (319) in the locations shown in Fig. 56.

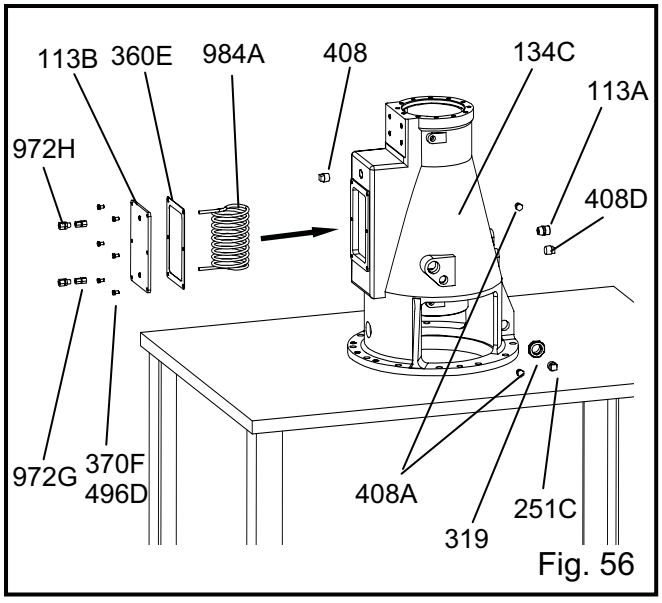


Fig. 56

ROTATING ELEMENT

1MXR-3MXR Configurations:

1. Heat the inboard radial bearing (168C) to 225°F using an induction heater. Slide the bearing onto the impeller end of the shaft (122), push it on until it rests flush and square against the shaft shoulder, see Fig. 57 and the sectional drawing at the end of this section.

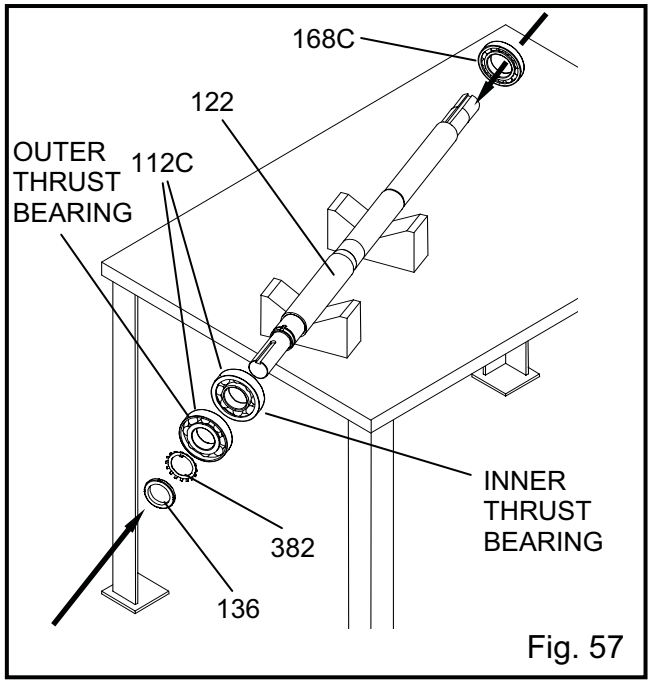


Fig. 57

WARNING

Use insulated gloves when using a bearing heater. Bearings get hot and can cause physical injury.

2. Heat the inner thrust bearing (112C) to 225°F. The thrust bearings are mounted back-to-back, so before placing the bearing on the shaft (122) be sure that the large diameter face of the inner race is facing the shaft shoulder.

3. Heat the outer thrust bearing (112C) to 225°F. Slide the bearing onto the shaft with the small diameter of the inner race facing the inner thrust bearing. Be sure it rests flush and square against the inner thrust bearing.

4. Before the bearings cool install the bearing lock-washer (382) and lock nut (136). Tighten until snug. Re-tighten the lock nut (136) several times before the bearing cools completely. The tapered end of the locknut (136) should face toward the lock washer (382). Be sure that no clearance exists between the outer and inner thrust bearing (112C). With the nut secure align the slots with the lock-washer tangs and bend the lock washer tangs into the nut slots.

5. If the pump is grease lubricated pack the inboard (168C) and outboard bearings (112C) with suitable grease. Make sure the races are fully packed.

6

4MXR-6MXR Configurations:

6. Heat the inboard radial bearing (168C) to 225°F using an induction heater. Slide the bearing onto the drive end of the shaft (122) push it on until it rests flush and square against the inboard shoulder, see Fig. 58.

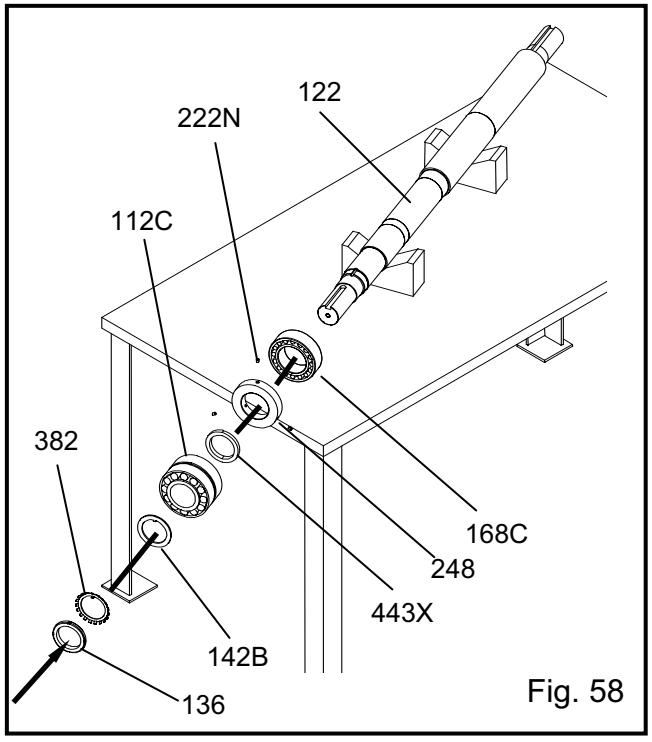


Fig. 58

WARNING

Use insulated gloves when using a bearing heater. Bearing will get hot and can cause physical injury.

7. Install the oil wheel (248) by sliding it onto the shaft with the open end facing the inboard bearing (168C). With the oil wheel up against its shoulder install the set screws (222N) that hold it to the shaft (122).

8. Heat may be applied to the thrust bearing collar (443X) if necessary to install on the shaft. Install it with the tapered end facing the oil wheel (248).

9. Heat the thrust bearing (112C) to 225°F. Install one row of roller bearings and the inner race on the shaft (122). Be sure to slide the bearing on the shaft until it is flush and square up against the thrust bearing collar (443X).

10. While the thrust bearing is still hot install the outer row of rollers and the outer race. Install the keyed washer (142B), lock-washer (382) with its tang in the groove on the shaft (122) and the lock nut (136) with tapered end toward the lock washer (382). Tighten the whole unit until snug. Re-tighten the lock nut (136) several times before the bearing cools completely. Be sure no clearance exists between the inner race, collar (443X) and shaft shoulder (122). With the locknut secure align the slots with the tangs of the lock-washer and bend the lock washer tangs into the nut slots.

11. If the pump is grease lubricated pack the inboard (168C) and outboard bearings (112C) with suitable grease. Make sure the races are fully packed.

BEARING HOUSING

12. Thread an eyebolt into the end of the shaft (122), lift and lower the rotating element into the bearing housing (134C), see Fig. 59. A collar similar to that shown on pg. 69 should be used to prevent misalignment of the inboard radial bearing.

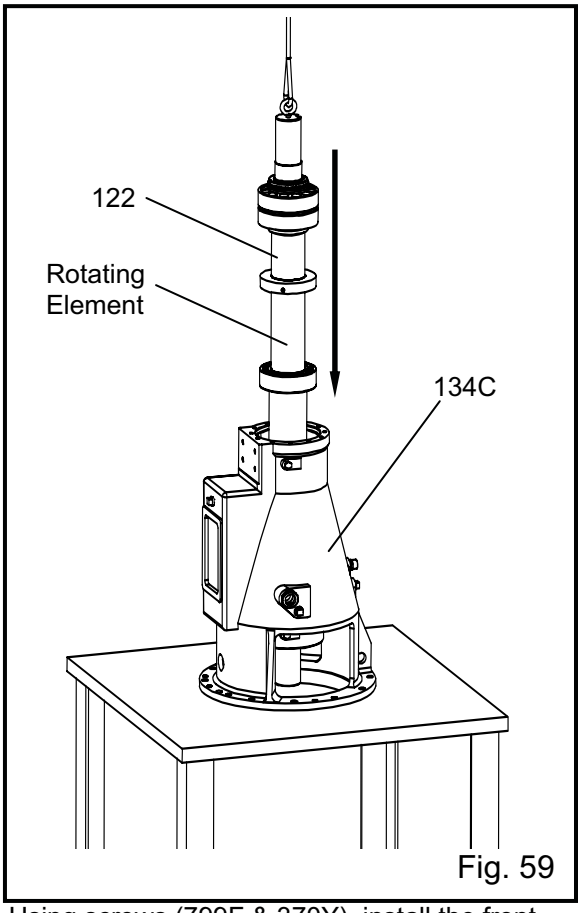


Fig. 59

26. Using screws (799F & 370Y), install the front (239B) and rear feet (239A). Install the thrust bearing retainer (119C), O-ring (412Y) (4MXR ~ 6MXR) or gaskets (331) (1MXR~ 3MXR). See the assembly drawing for proper shimming of gasketed pumps. Install the screws (788Z) that secure the thrust bearing retainer (119C) to the bearing housing (134C), see Fig. 60.

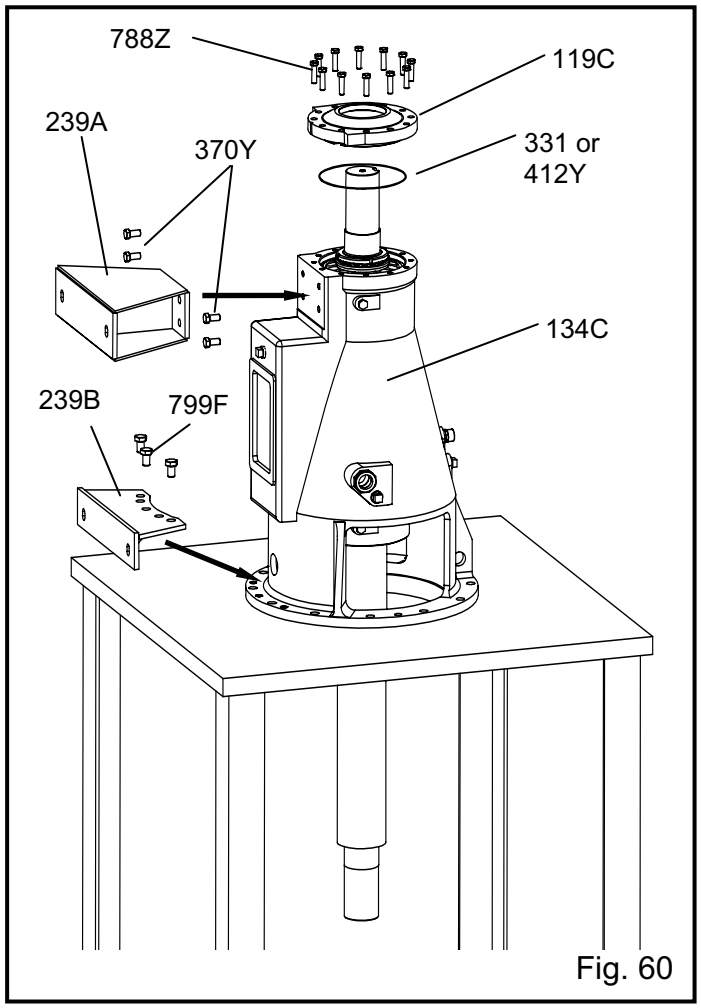


Fig. 60

13. Install the outboard and inboard labyrinth seals (132) and (133). The drains should be located at the bottom and face inward when mounted, see Fig. 61.

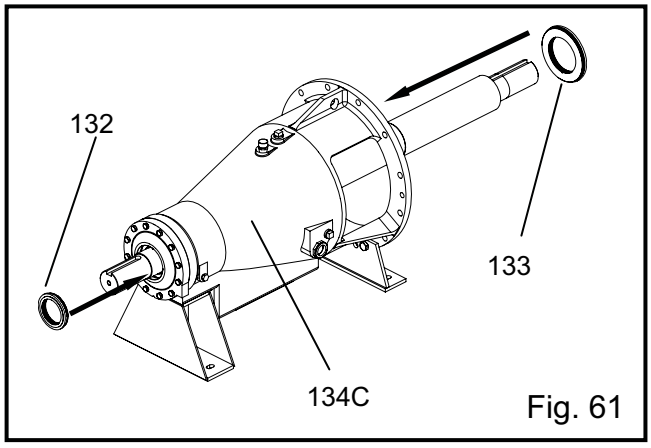


Fig. 61

DRIP PAN

14. Tilt the drip pan (179) so the attachment ears clear the bearing housing (134C) flange and the nipple protrudes through the cast hole in the bottom of the bearing housing. Secure the drip pan to the bearing housing ribs using the two screws (799H) and washers (799I). Thread the street elbow (799G) into nipple on the bottom of the drip pan, see Fig. 62.

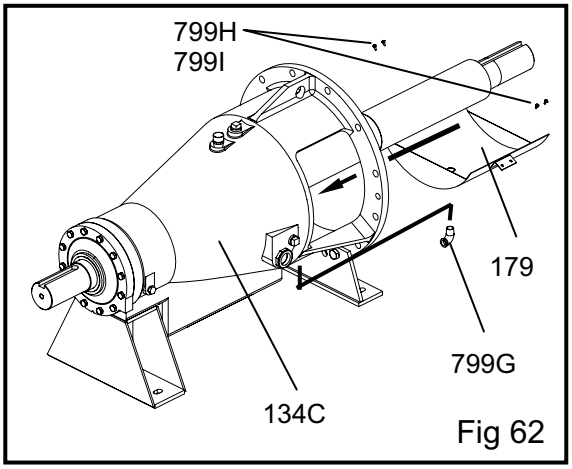


Fig 62

SEAL / STUFFING BOX COVER

Packed Box

15. Place the sleeve key (178D) into the shaft (122) key seat. Slip the O-ring (412D) into the shaft sleeve (126) then slide the sleeve onto the shaft until the keyways are lined up. Install the set screw (469D) and tighten it to lock the sleeve in place. Be careful not to mar or scratch the sleeve or shaft during the process. Attach the stuffing box (220) and gasket (351W) to the stuffing box cover (184) using screws (799E). If removed re-install the four studs (355). On larger pumps use a sling or hook and chain to support the weight of the stuffing box cover during installation. Mount the stuffing box cover (184) to the register of the bearing housing (134C). Be careful not to scuff or scar the pump shaft (122) or sleeve (126) during installation. Secure the stuffing box cover (184) to the bearing housing (134C) using bolts (370C). Pack the stuffing box initially with two rings of packing (106) staggering the joints for each row. Insert the lantern ring (105) being sure that the lantern ring lines up with the flush ports. If the lantern ring has taps for removal make sure they face out of the box. Insert three more rings of packing (106), gland (107), and gland nuts (353), tighten the nuts only hand tight. Install all flush tubing that may have been removed during disassembly, see Fig. 63.

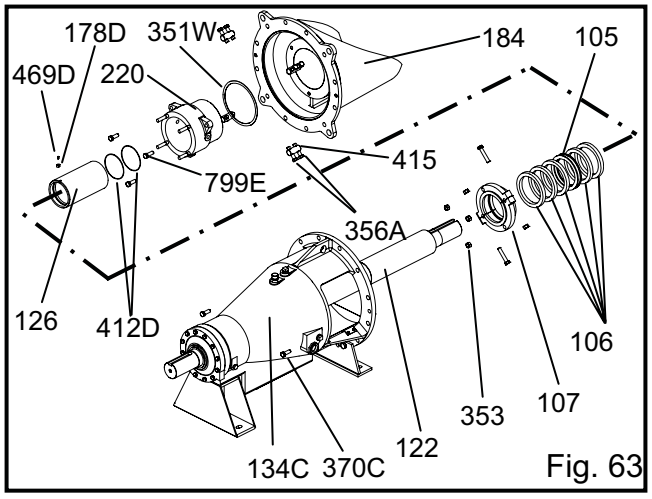


Fig. 63

Mechanical Seal w/ Optional Adapter

16. The loose mechanical seal (383, 108) components and gaskets (211) are slid onto the shaft (122) first before the stuffing box cover (184) can be installed. If the seal includes a restrictor bushing (496B) an optional adapter (108B) will be included with the pump. On large pumps use a sling or hook and chain to securely support the weight of the stuffing box cover during installation. Mount the stuffing box cover on the bearing housing (134C) register. Secure the stuffing box cover (184) to the bearing housing (134C) using two bolts (370C). Be careful not to scuff or mar the pump shaft (122) during installation. Install the four adjusting lugs (415) and impeller adjusting bolts (356A). Use the upper adjusting screws (356A) closest to the bearing housing to center the stuffing box cover on the shaft. The seal manufacturers instructions should be followed to correctly install and align the mechanical seal. Lastly, install the seal gland nuts (353) and secure the seal to the stuffing box cover (184). Be sure all gland quench or flush tubing is connected. see. Fig. 64.

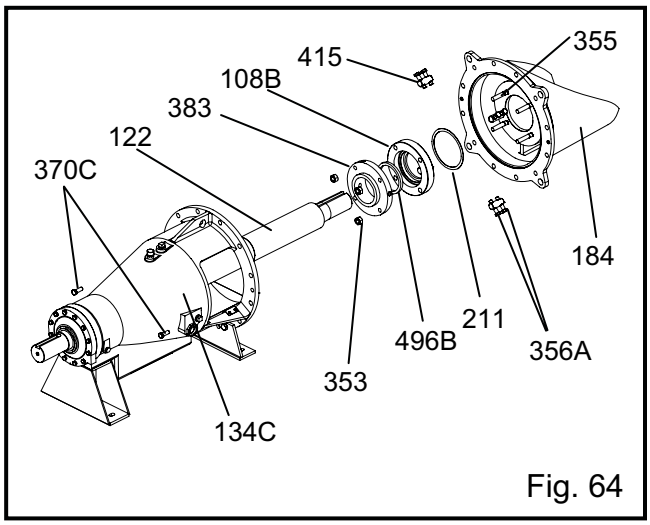


Fig. 64

IMPELLER

Standard Impeller

17. Install the shaft key (178). Slide the impeller (101) onto the shaft (122) and if necessary use a wooden mallet to set it in place against the shaft shoulder. Install the shaft washer (199) and fasteners (198), tighten to lock the impeller (101) in place, see Fig. 65.

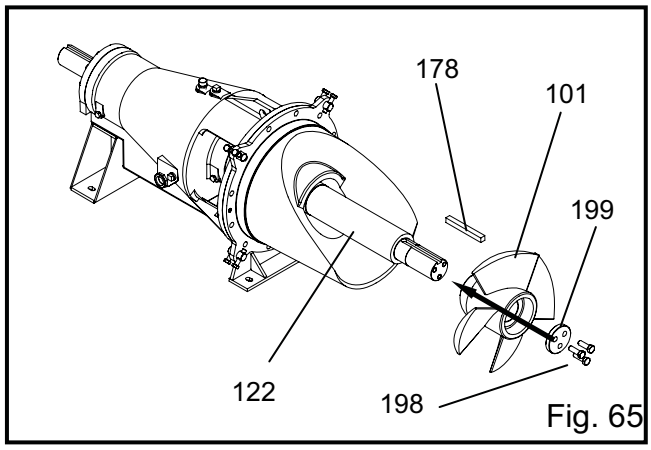


Fig. 65

Sealed Impeller

18. 700mm and 36” sizes use an impeller cover and O-rings to keep pumpage out of the impeller cavity. First, install the shaft key (178) on the shaft. Using some silicone stick the impeller O-ring (412A) to the back side of the impeller (101). Slide the impeller (101) onto the shaft (122). If necessary use a wooden mallet to set it in place against the shaft shoulder. Install the shaft washer (199) and bolts (198). Place the O-ring (412T) on the cover and fasten the cover (998E) to the impeller (101) using bolts (370M). Some impeller covers have a pipe test plug (408H) located on the face of the cover to test the cavity seal after re-assembly, Re-install this plug (358I), see Fig. 66.

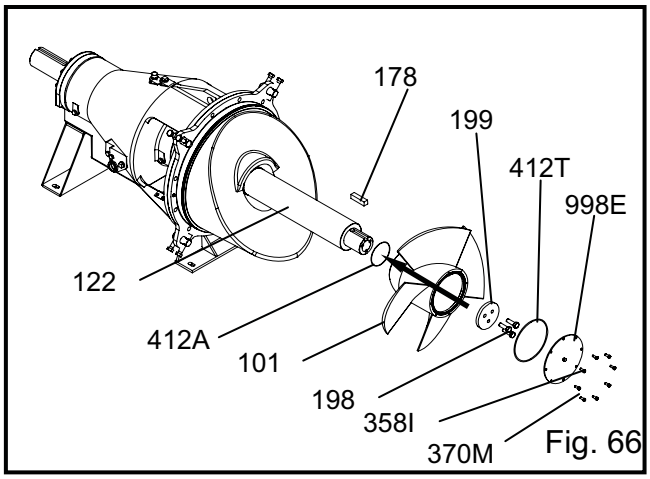


Fig. 66

Back-Pullout / Elbow or Elbow with Casing / Liner (option)

Elbow

13. Set the pump down on a smooth flat surface to stabilize it for assembly. Loosen the impeller adjusting bolts (356A) so that they are clear of the rear elbow flange. Insert the O-ring (351) into the elbow groove and hold in place with a small amount of grease. With the elbow held in place, slide the back-pullout into the elbow (315A). Install the bolts (789L and 799O) that secure the back-pullout to the elbow (315A). Be sure to use the correct O-ring material for the pumpage, see Fig. 67.

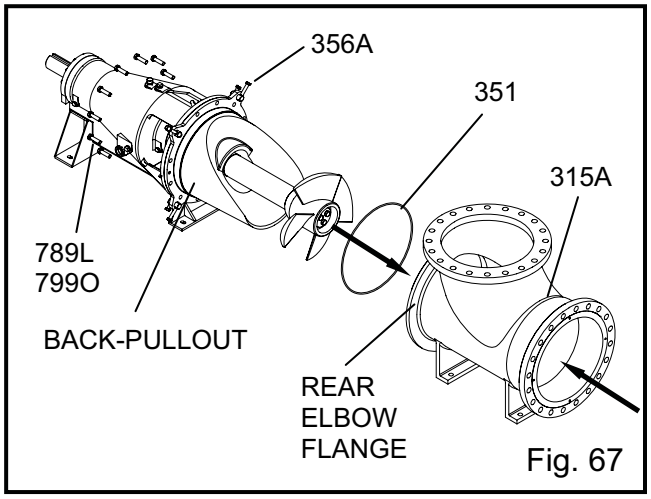


Fig. 67

Elbow with Casing

14. The 700mm & 36" size pumps come with a separate casing (100). Loosen the adjusting screws (356A) so that they are clear of the elbow flange. Insert O-ring (351) into the elbow groove and hold in place with a small amount of grease. Be sure to use the correct O-ring material for the pumpage. With the elbow fixed, slide the back-pullout into the elbow (315A) and install bolts (789L and 799O). Insert the O-ring or gasket (351A) between the casing (100) and elbow (315A). Attach the casing (100) to the elbow (315A) using the bolts (799C) and nuts (799D). With casing (100) slightly loose adjust casing to center the impeller., see Fig. 68.

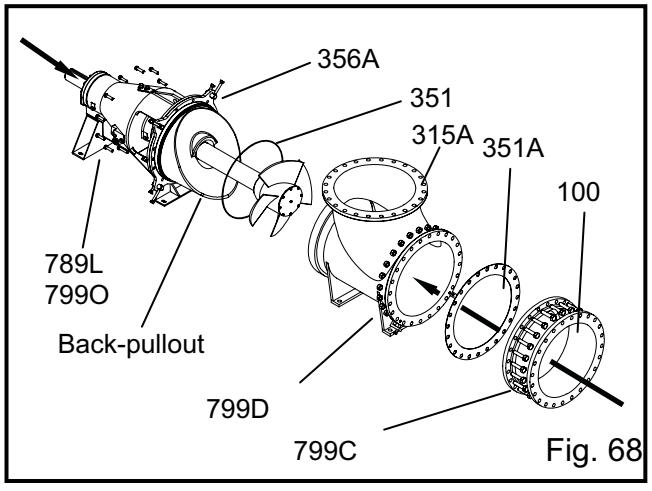


Fig. 68

Liner (option)

15. If the elbow (100) or casing (100) has an optional liner (103A) now is the time to install it. The liner may require some effort to install try using a wooden mallet if resistance is noticed. The liner is sealed when it is compressed against the pipe flange and requires no gasket. If a replacement is necessary be sure to order the correct material for the pumpage, see Fig. 69.

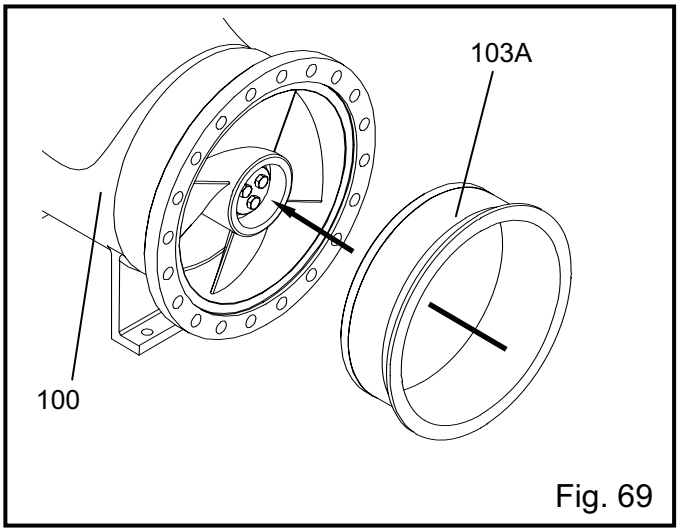


Fig. 69

DRIVE / GUARD

19. Insert the drive key (400) into the shaft (122) keyseat. Depending on the drive type, install the hub fasteners for a coupling or sheave to the shaft (122). If you have a coupling halve that is interference fit, you may need to heat it before installing on the shaft (122). Drive instructions are included with the data package. Follow the manufacturer's instructions for coupling or sheave installation, see Fig. 70 on the following page.

20. Depending on the drive arrangement, either V-belt or Direct Connect, use steps 21, 22 and 23, or 24, 25 and 26 respectively.

V-Belt Configuration

21. Using a crane, lift the pump into place on the sub-base. Be careful not to damage the pump by striking any beams or walls that may be near the pump. If any shims were found under the bearing housing feet during disassembly replace them at this time. Install the pump to sub-base bolts (500A) and remove the lifting straps or chains from

around the bearing housing (134) and elbow (100), see Fig. 71.

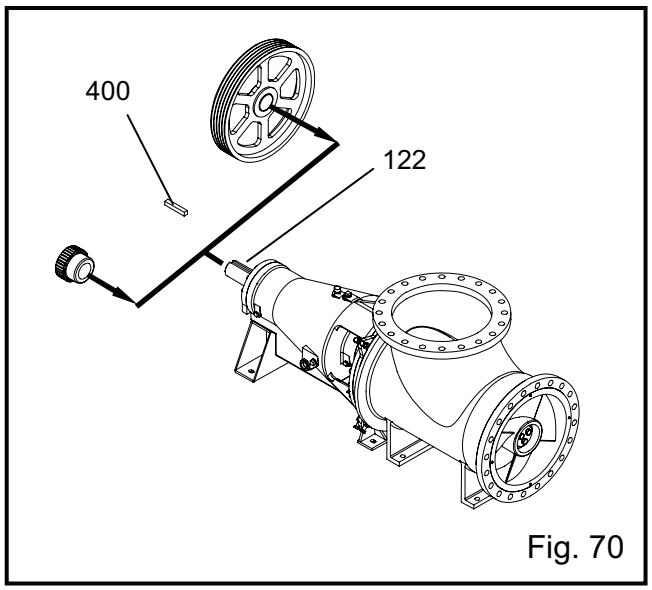


Fig. 70

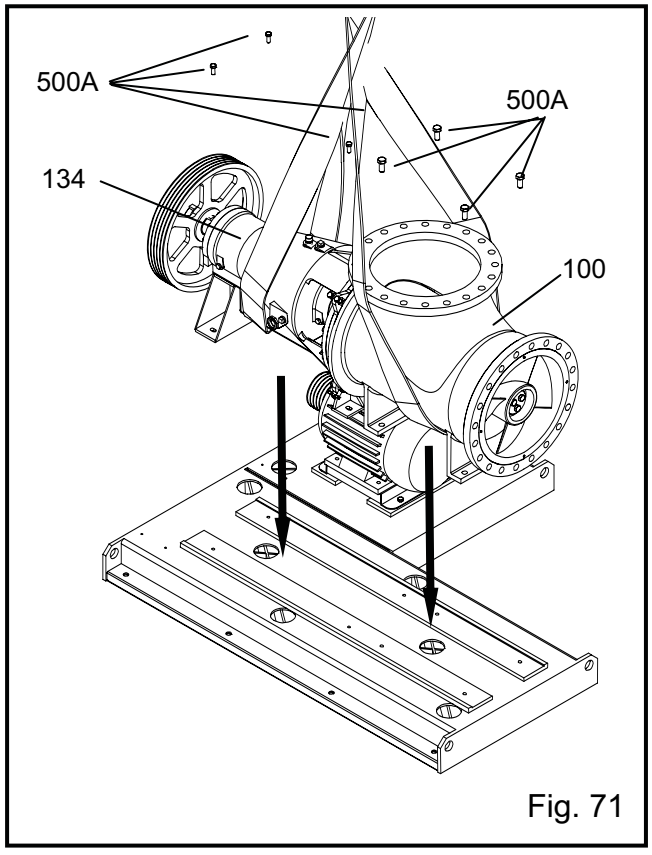


Fig. 71

22. Install V-belts and re-apply tension by adjusting the slide base away from the pump. Adjust and check the tension per the drive manufacturers instructions, see Fig. 72.

23. Fasten the guard base (501) to the sub-base using screws (502). Install the guard cover (500) using screws (502), see Fig. 73.

24. Check impeller alignment and re-align if necessary

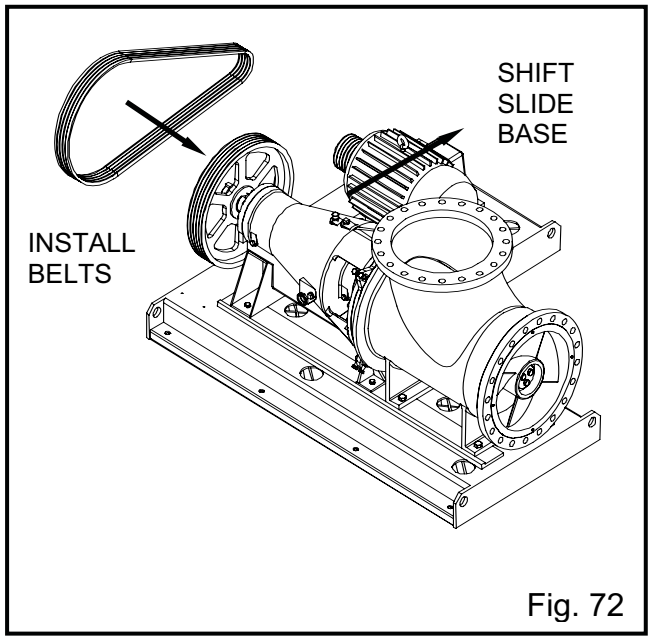


Fig. 72

according to instructions on pg. 28 of section 3.

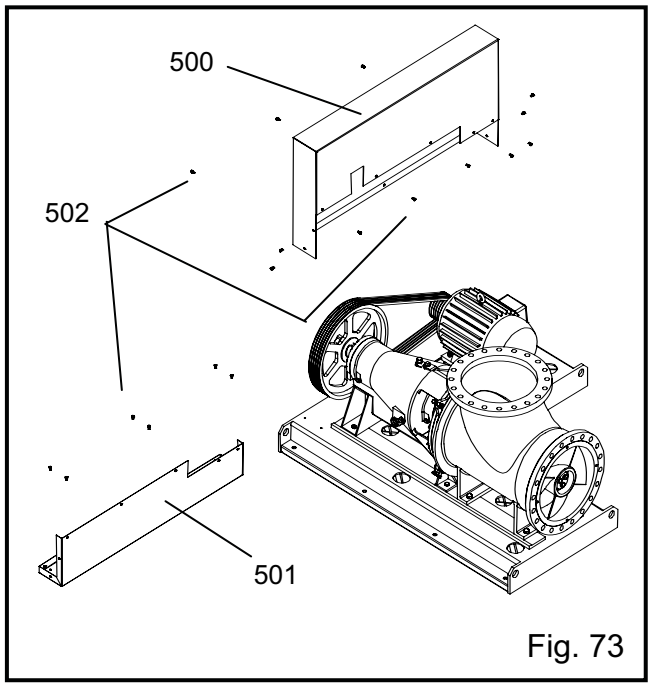


Fig. 73

Direct Connect Configuration

25. Using a crane, lift the pump into place on the sub-base. Be careful not to damage the pump by striking any beams or walls that may be near the pump. If any shims were found under the bearing housing feet during disassembly replace them at

this time. Install the pump to sub-base bolts (500A) and remove the lifting straps or chains from around the bearing housing (134) and elbow (100), see Fig. 74.

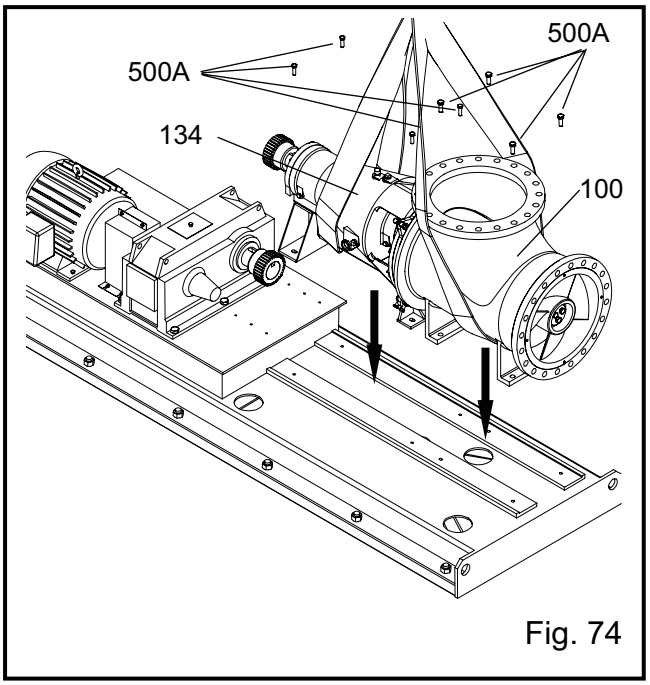


Fig. 74

26. Align the gear box and pump coupling halves as described on pg.'s 20 ~ 23 of section 3. If the motor and gear box were moved during disassembly re-align they must be re-aligned also.

27. Wrap the coupling cover around the coupling halves and install the fasteners that hold the coupling cover together, see Fig. 75.

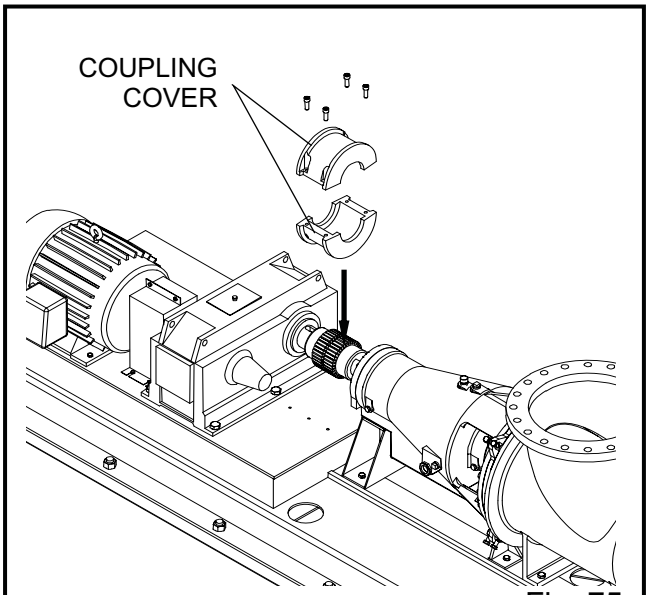


Fig. 75

28. Bolt the two halves of the coupling guard (500) together and install over the coupling. Fasten the guard to the sub-base using screws (502), see Fig. 76.

29. Check impeller alignment and re-align if necessary

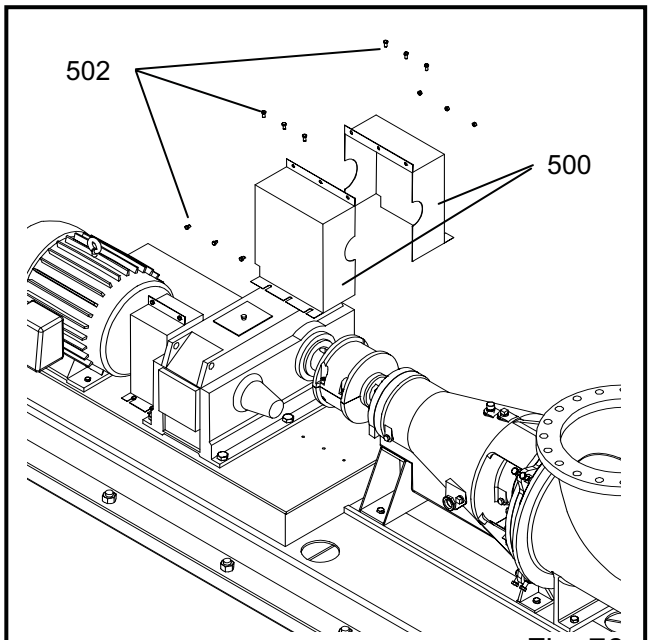


Fig. 76

according to instructions on pg. 28 of section 3.

30. Fill pump with proper lubricant. Refer to preventative maintenance for requirements.

31. Connect all auxiliary piping and tubing.

32. Fill system piping so pump impeller is submerged, flush the pump if necessary.

33. Open all valves controlling flow "to and from" the pump.

34. Un-lock driver power and jog the pump motor to be sure the pump rotates with no binding or rubs. If all is proper, continue with pump start-up.

WARNING

With power unlocked be careful so as to prevent accidental start-up and physical injury.

WARNING

Operator should be aware of pumpage and safety precautions to prevent physical injury.

AF SECTIONAL

(shown with optional restrictor bushing adapter)

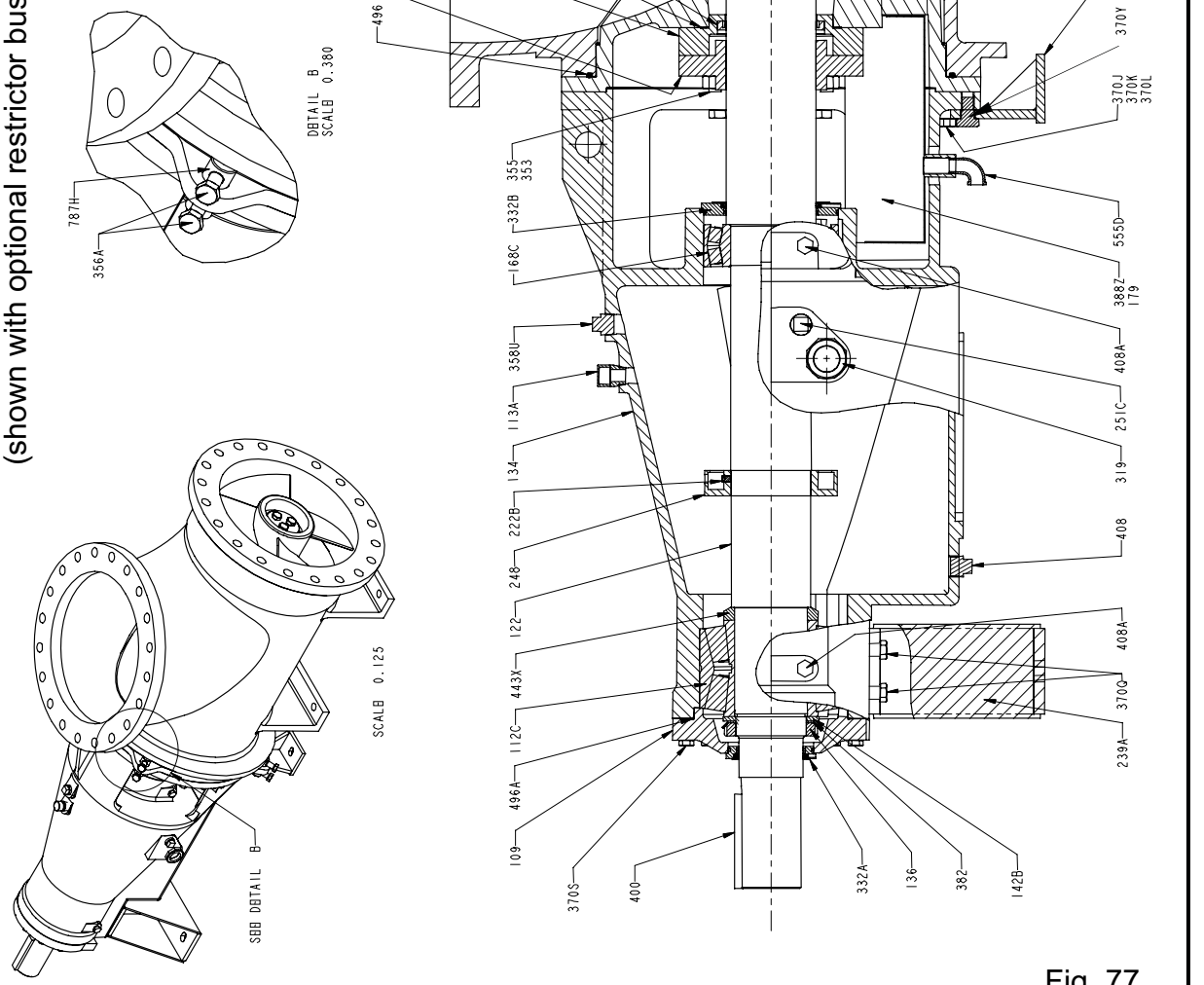


Fig. 77

Parts List and Materials of Construction

Item	Part Name	Standard Materials of Construction									
		Cast Iron	304	316	Alloy 20	Duplex SS	904L	Monel	Inconel	Nickel	Titanium
100	Elbow	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
101	Impeller	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
105	Lantern ring	Teflon									
106	Packing	Dependent on Pumpage									
107	Gland	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
112C	Outboard bearing	Steel									
113A	Oil breather	Steel									
109	Thrust bearing retainer	1000									
122	Shaft	2206	2228	2229	2230	3279	2369	2150	2266	2155	2156
126	Shaft Sleeve	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
134	Bearing housing	1000									
136	Bearing locknut	Steel									
142B	Keyed washer	Steel									
168C	Inboard bearing	Steel									
178	Impeller key	2213	2228	2229	2230	2248	2369	2150	2266	2155	2156
178D	Sleeve key	2213	2228	2229	2230	2248	2369	2150	2266	2155	2156
179	Drip pan	316 standard. Other options available.									
184	Stuffing box cover	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
198	Impeller screw	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
199	Impeller lockplate	3201	2228	3211	2230	3270	2369	2150	2266	2155	2156
220	Stuffing Box	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
222A	Set screw, Sleeve	2213	2228	2229	2230	2248	2369	2150	2266	2155	2156
222B	Set screw, Oil wheel	Steel									
239B	Frame foot, inboard	Steel									
239A	Frame foot, outboard	Steel									
248	Oil wheel	Iron									
251C	Plug, Oiler	Steel									
315A	Elbow w/ Casing	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
315B	Liner, Elbow	1002	1284	1245	1283	1247	1233	1119	1273	1601	1220
332A	Laby seal, outboard	Carbon Filled Teflon									
332B	Laby seal, inboard	Carbon Filled Teflon									
351	Gasket, Stuff. Box	5302	5303								5309
351A	Gasket, Elbow/Casing	5302	5303								5309
353	Gland stud	2229									
355	Gland nuts										
357G	Nuts, Casing	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
356A	Adjusting bolts	Steel									
358U	Oil fill plug	Steel									
360W	Cover, Oil Cooling	Steel									
361	Gasket, Oil Cooling	5302									
370F	HHCS, Oil Cooling	Steel									
370G	HHCS Casing	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
370J	HHCS Bearing Housing / Elbow	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
370K	HHCS Foot, Front	Steel									
370H	HHCS SB Cover-Frame	Steel									
370L	HHCS SB Cover-Bearing Housing	Steel									

Parts List and Materials of Construction

Item	Part Name	Standard Materials of Construction									
		Cast Iron	304	316	Alloy 20	Duplex SS	904L	Monel	Inconel	Nickel	Titanium
370M	HHCS Impeller Cover	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
370Q	Frame Foot, Rear	Steel									
370S	End Cover Screws	Steel									
370U	HHCS Adj. lug	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
370V	HHCS Adj screw	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
370Y	Frame foot screws	Steel									
382	Lock washer	Steel									
383	Mechanical Seal	As specified									
388Z	Drip Pan Screws	Stainless									
400	Coupling Key	Steel									
408	Plug, Drain	Steel									
408A	Sensor plugs	Steel									
408H	Plug, Impeller	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
412F	O-ring, Sleeve	5302	5303								5309
443X	Spacer	Steel									
496	O-ring, Stuffing Box Cover	5302	5303								5309
496A	O-ring End Cover	BUNA-N									
496B	O-ring, Impeller Cap	5302	5303								5309
496C	O-ring, Impeller Nose	5302	5303								5309
540C	Gasket, Bearing Housing	5302									
555D	Drip Pan Elbow	Stainless Steel Standard. Other options available.									
600Z	HHCS, SBX/SBXCVR	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
787H	Adjusting Bar	Steel									
9727	Male Connector	Steel									
9728	Female Connector	Steel									
9841	Cooling Coil	2229									
9879	Adjusting Lug, Casing	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156
9985	Impeller Cover	2210	2228	2229	2230	2248	2369	2150	2266	2155	2156

AF OPTIONS

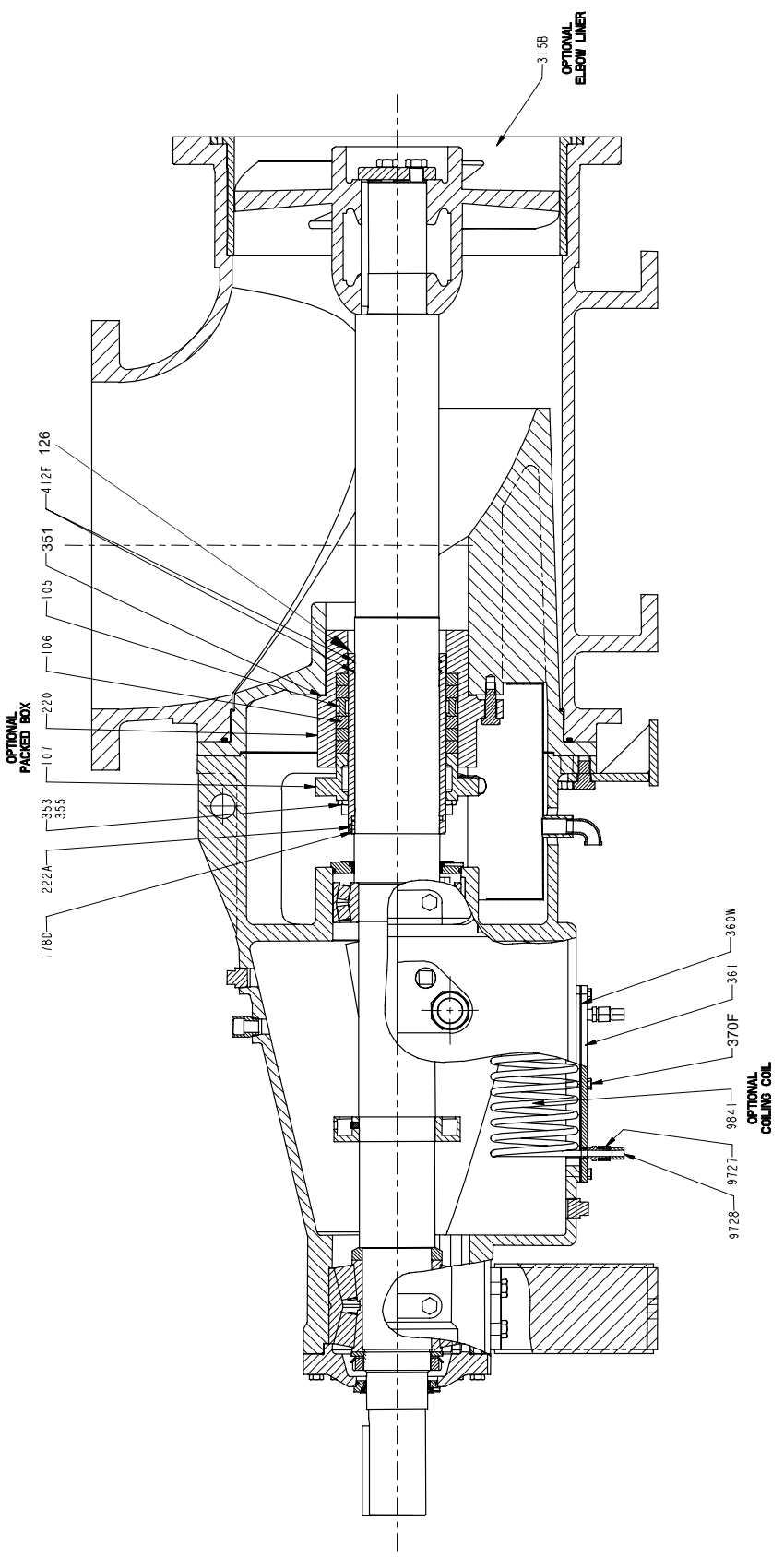
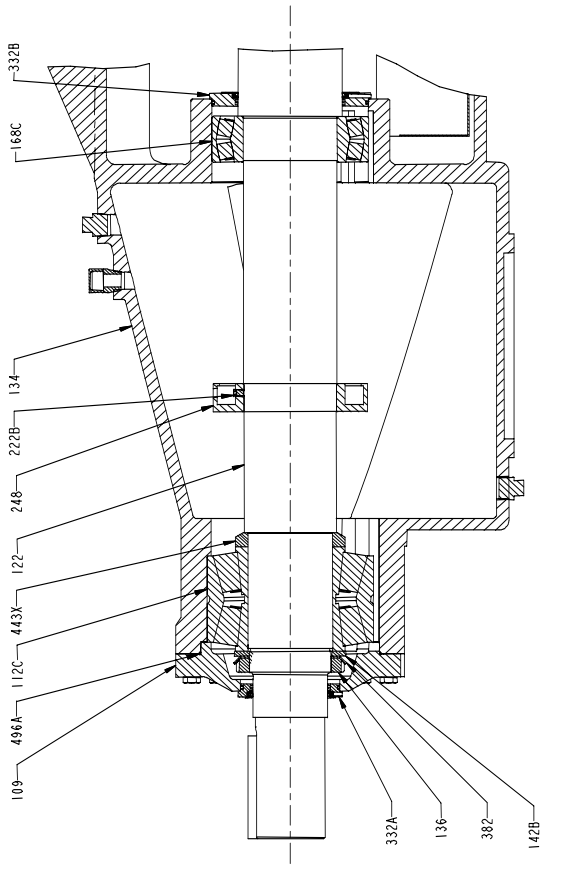
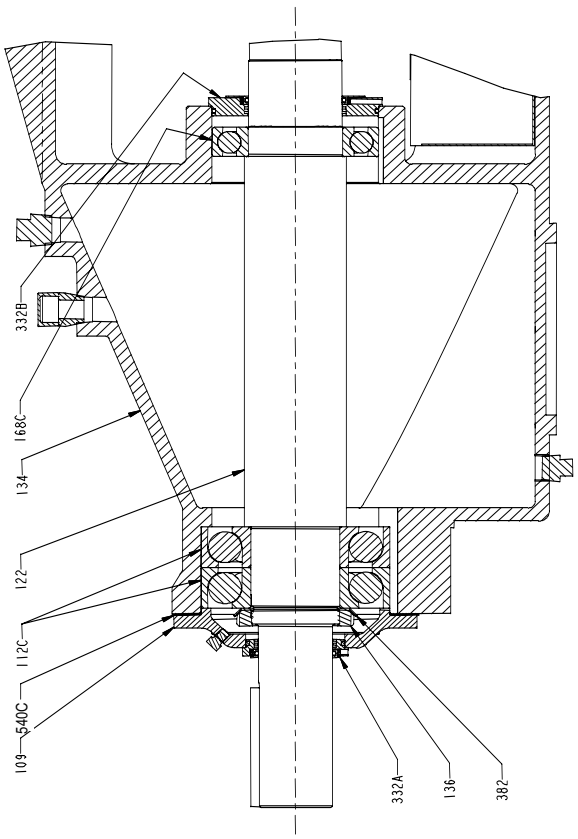


Fig. 78

MXR BEARING CONFIGURATIONS



4MXR – 6MXR



1MXR – 3MXR

Fig. 79

6

AF WITH SEPARATE CASING

(sizes 700mm and 36" only)

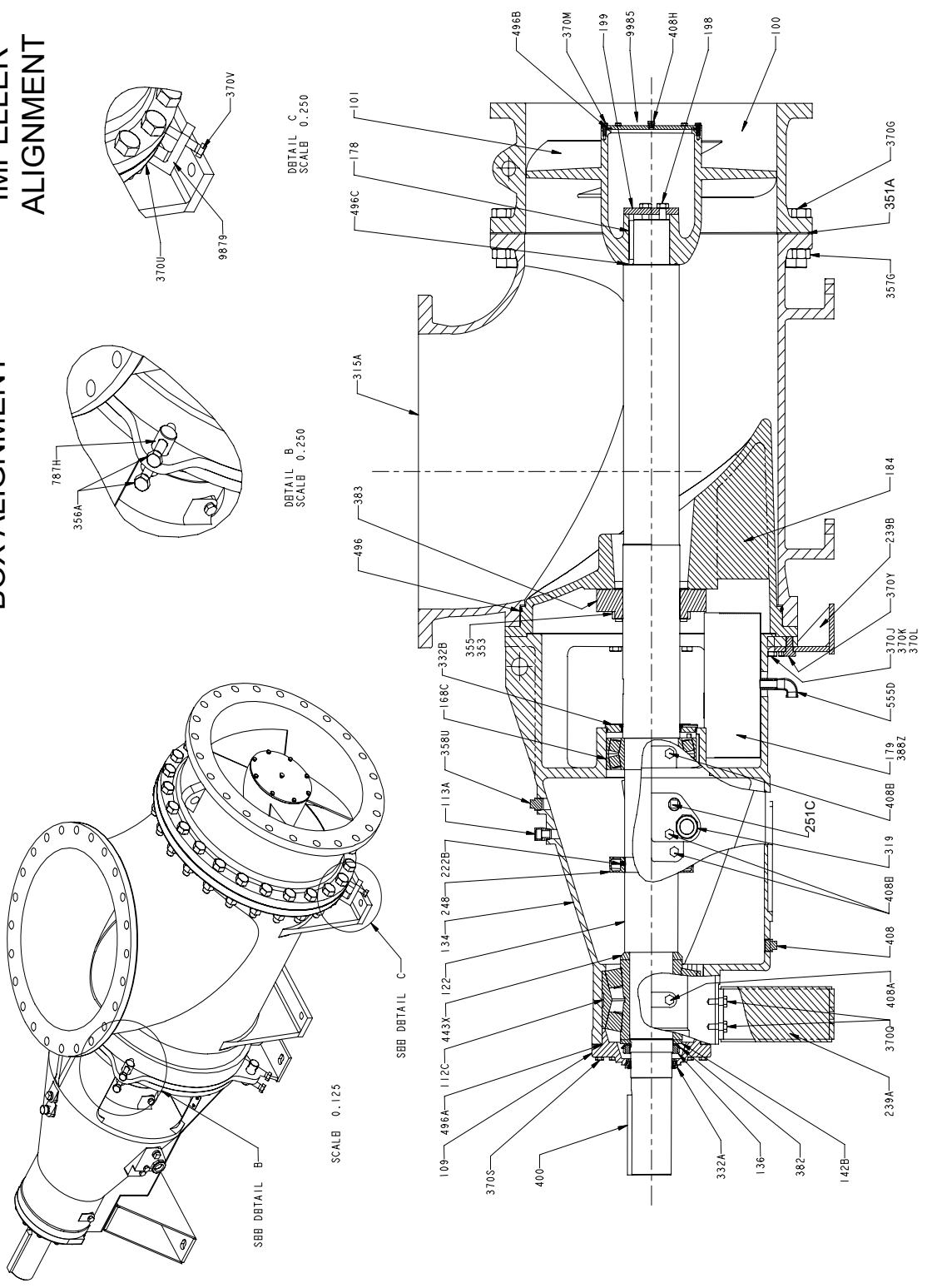


Fig. 80

SPARE PARTS

When ordering spare parts, always state Goulds Serial No., and indicate part name and item number from relevant sectional drawing. It is imperative for service reliability to have a sufficient stock of readily available spares.

RECOMMENDED SPARE PARTS

Suggested Spare Parts

- Elbow and or Casing (100, 315A)
- Impeller (101)
- Gaskets (211, 331, 351, 351A, 540C)
- O-Rings (496, 496B, 496C)
- Shaft (122)
- Inboard Radial Bearing (168C)
- Outboard Thrust Bearing or Bearings (112C)
- Bearing Lockwasher (382)
- Bearing Locknut (136)
- Outboard Labyrinth Seal (332A)
- Inboard Labyrinth Seal (332B)
- Shaft Sleeve (126) (Optional)
- Sleeve O-rings (412F) (Optional)
- Stuffing Box Bushing (125Z) (Optional)
- Lantern Ring (105) (Optional)
- Stuffing Box Packing (106) (Optional)
- Packing Gland (107) (Optional)

HOW TO ORDER PARTS

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

EMERGENCY SERVICE

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

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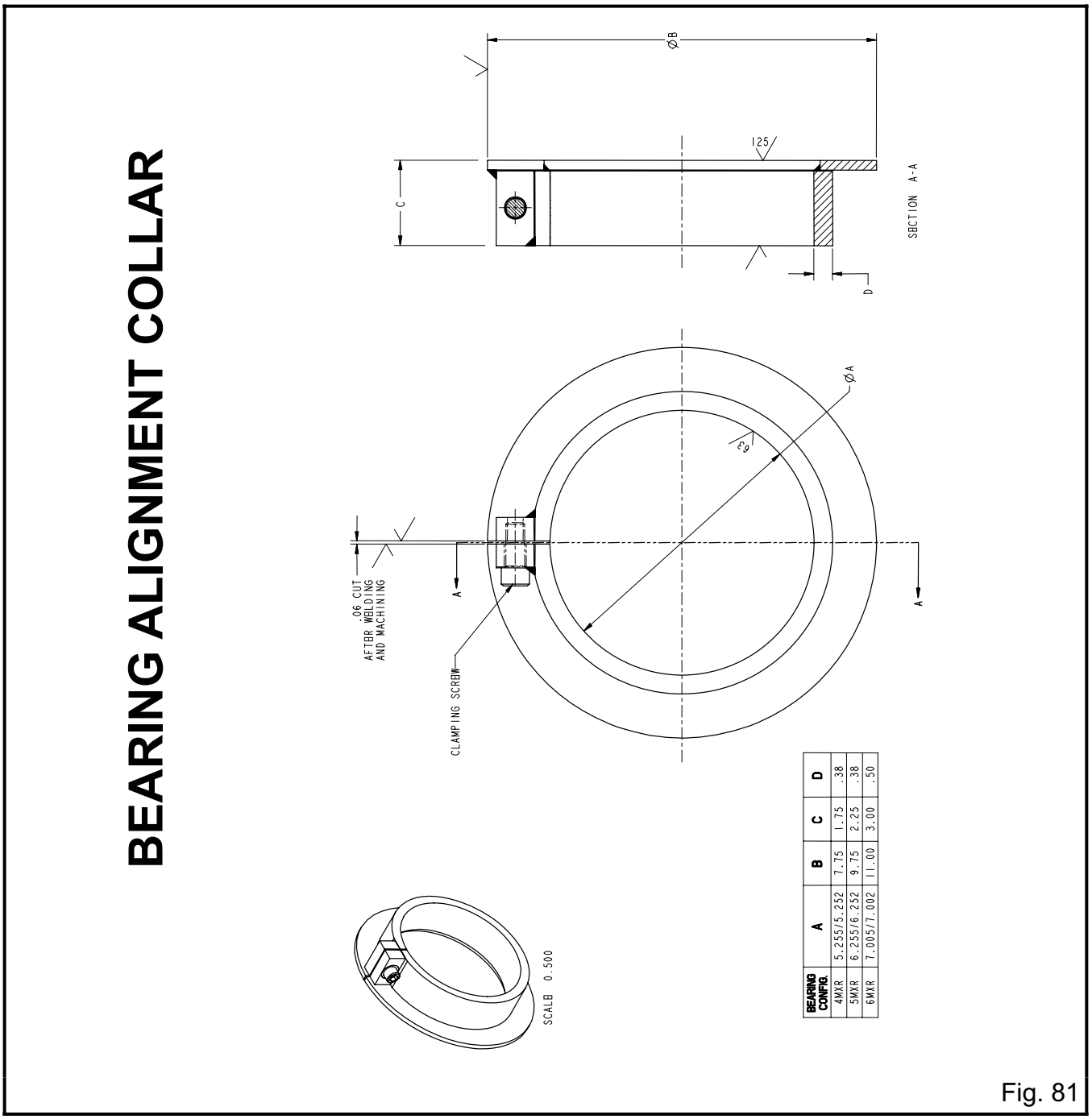
APPENDIX 1

BEARING ALIGNMENT COLLAR DETAIL

The bearing alignment collar is used to install the radial bearing on the 4MXR, 5MXR, and 6MXR bearing configurations. It is recommended that you use this tool so as not to damage the radial bearing and or bearing housing during rotating assembly installation.



BEARING CONFIG.	A	B	C	D
4MXR	5.255/5.252	7.75	1.75	.38
5MXR	6.255/6.252	9.75	2.25	.38
6MXR	7.005/7.002	11.00	3.00	.50

Fig. 81

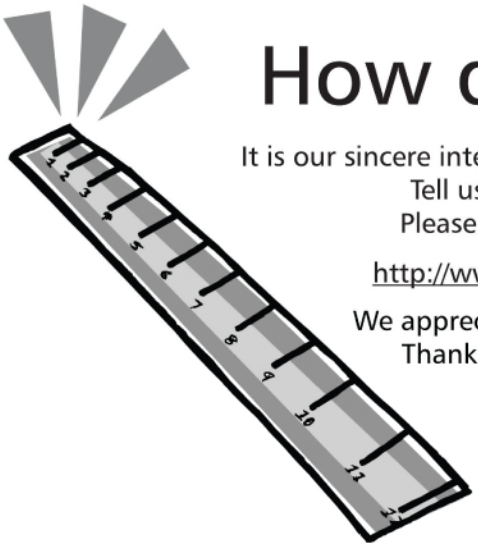
8

HOW TO ORDER

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

EMERGENCY SERVICE

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



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