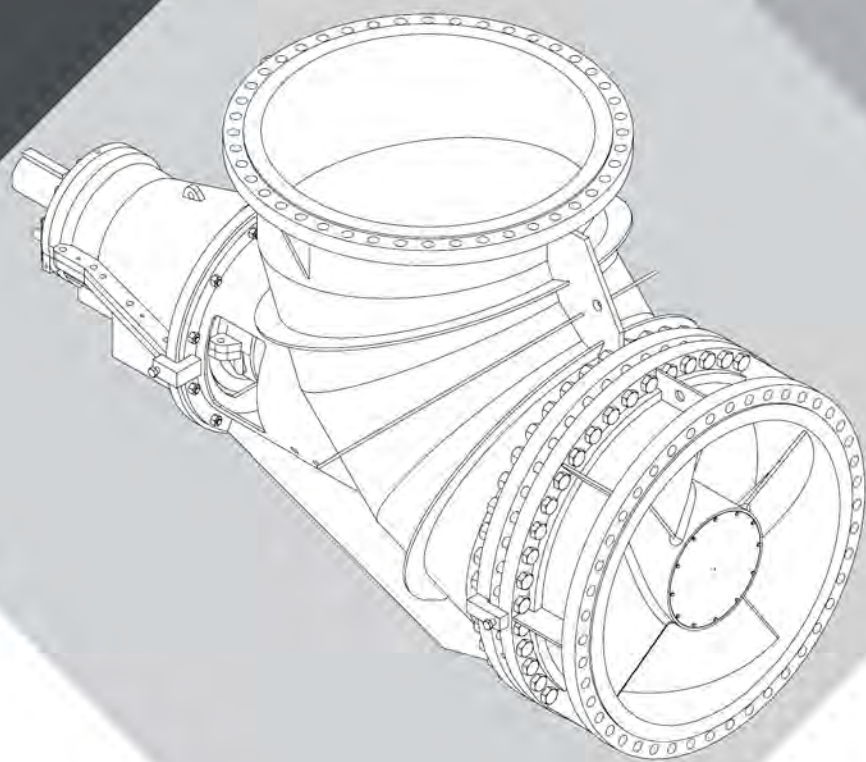




# Installation, Operation, and Maintenance Manual

Model AF (42"/1200mm/54"/60"/66") LM/LMR  
Bearings



**ITT**



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# 1 Introduction and Safety

## 1.1 Introduction

### Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance



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**CAUTION:**

Failure to observe the instructions contained in this manual could result in personal injury and/or property damage, and may void the warranty. Read this manual carefully before installing and using the product.

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**NOTICE:**

Save this manual for future reference and keep it readily available.

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## 1.2 Safety



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**WARNING:**

- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
- Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.
- Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.
- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.

- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
- If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.



**CAUTION:**

Risk of injury and/or property damage. Operating a pump in an inappropriate application can cause over pressurization, overheating, and/or unstable operation. Do not change the service application without the approval of an authorized ITT representative.




## 1.3 Safety terminology and symbols

### About safety messages

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

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

### Hazard levels

Hazard level	Indication
 <b>DANGER:</b>	A hazardous situation which, if not avoided, will result in death or serious injury
 <b>WARNING:</b>	A hazardous situation which, if not avoided, could result in death or serious injury
 <b>CAUTION:</b>	A hazardous situation which, if not avoided, could result in minor or moderate injury
<b>NOTICE:</b>	<ul style="list-style-type: none"> <li>• A potential situation which, if not avoided, could result in undesirable conditions</li> <li>• A practice not related to personal injury</li> </ul>

### Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:



**ELECTRICAL HAZARD:**

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

## 1.4 Environmental safety

### The work area

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



#### **WARNING:**

If the product has been contaminated in any way, such as from toxic chemicals or nuclear radiation, do NOT send the product to ITT until it has been properly decontaminated and advise ITT of these conditions before returning.

### Recycling guidelines

Always recycle according to these guidelines:

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

### Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Dispose appropriately of all waste.
- Handle and dispose of the pumped fluid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

### Reference for electrical installation

For electrical installation requirements, consult your local electric utility.

## 1.5 User safety

### General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

### Safety equipment

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

- Hardhat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

### Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

### Noise



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**WARNING:**

Sound pressure levels may exceed 80 dbA in operating process plants. Clear visual warnings or other indicators should be available to those entering an area with unsafe noise levels. Personnel should wear appropriate hearing protection when working on or around any equipment, including pumps. Consider limiting personnel's exposure time to noise or, where possible, enclosing equipment to reduce noise. Local law may provide specific guidance regarding exposure of personnel to noise and when noise exposure reduction is required.

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### Temperature



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**WARNING:**

Equipment and piping surfaces may exceed 130°F (54°C) in operating process plants. Clear visual warnings or other indicators should alert personnel to surfaces that may reach a potentially unsafe temperature. Do not touch hot surfaces. Allow pumps operating at a high temperature to cool sufficiently before performing maintenance. If touching a hot surface cannot be avoided, personnel should wear appropriate gloves, clothing, and other protective gear as necessary. Local law may provide specific guidance regarding exposure of personnel to unsafe temperatures.

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## 1.6 Precautions before work

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

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Recognize the site emergency exits, eye wash stations, emergency showers and toilets.
- Allow all system and pump components to cool before you handle them.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.



- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

## 1.7 Precautions during work

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



### CAUTION:

Failure to observe the instructions contained in this manual could result in personal injury and/or property damage, and may void the warranty. Read this manual carefully before installing and using the product.

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.

## 1.8 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:

### Description of ATEX

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

### Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an ITT representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079-14).

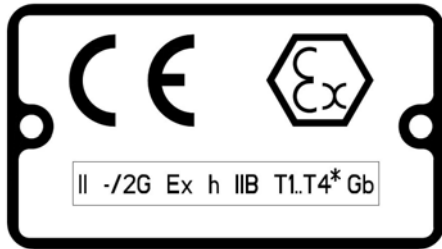
1. Monitoring the pump frame and liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

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 <https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/IOMs/> 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:



**Figure 1: Typical ATEX pump nameplate**

**Table 1: Temperature class definitions**

Code	Maximum permissible surface temperature in °C   °F	Maximum permissible liquid temperature in °C   °F
T1	440   824	372   700
T2	290   554	267   513
T3	195   383	172   342
T4	130   266	107   225
T5	Option not available	Option not available
T6	Option not available	Option not available

\* Maximum liquid temperature may be limited by the pump model and order specific options. [Table 1: Temperature class definitions on page 8](#) is for the purpose of determining T'x' code for ATEX applications with liquid temperatures exceeding 107°C | 225°F.

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.



**WARNING:**

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.
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge. When pumping fluids with conductivity less than 1000 ps/m follow IEC TS 60079 32-1 guidelines.
- Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer’s installation and operation procedures.
- When installing in a potentially explosive environment, ensure that the motor and accessories are properly certified.

- 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.
- Service temperature in an ATEX classified environment is limited to the area classification specified on the ATEX tag affixed to the pump. See nameplate section and pumpage temperature table.
- The coupling used in an ATEX classified environment must be properly certified.
- V-belt drive systems require special precautions to avoid static electricity build up and should be avoided in ATEX applications. Please consult with your ITT/Goulds representative in these cases.
- The coupling guard used in an ATEX classified environment must be constructed from a non-sparking material.
- Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.
- The mechanical seal used in an ATEX classified environment must be properly certified.
- The mechanical seal must have an appropriate seal flush system. Failure to do so will result in excess heat generation and seal failure.
- Packed stuffing boxes are not allowed in an ATEX-classified environment.
- Dynamic seals are not allowed in an ATEX-classified environment.
- Pumps must be fully primed at all times during operation.
- 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.
- Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.
- These bearing lubrication sections list different temperatures of the pumped fluid. If the pump is ATEX-certified and the temperature of the pumped fluid exceeds the permitted temperature values, then consult your ITT representative.
- Cooling systems such as those for bearing lubrication and mechanical-seal systems must be operating properly to prevent excess heat generation, sparks, and premature failure.
- Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation, sparks and premature failure.
- Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.
- Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.
- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check for magnetism on the pump shaft and demagnetize the shaft if there is any detectable magnetism. Magnetism attracts ferritic objects to the impeller, seal, and bearings which can result in excessive heat generation, sparks, and premature failure.
- Leakage of process liquid may result in creation of an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid.
- Leakage of process liquid may result in creation of an explosive atmosphere. Follow all pump and seal assembly procedures.

- A build-up of gases within the pump, sealing system, or process piping system may result in an explosive environment. Make sure the process piping system, pump and sealing system are properly vented prior to operation.
  - Sealing systems that are not self-purging or self-venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
  - Do not apply additional paint or coatings to the pump when in an ATEX environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
  - Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
  - Stray electrical currents may ignite explosive atmospheres ensure adequate shaft ground measures are applied. Ensure drives are certified for variable frequency drive operation by the manufacturer. Use ground brushes on VFD motor applications with conductive couplings or ensure pump shaft is adequately grounded.
  - User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.
  - In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.
  - Move equipment to a safe/non ATEX environment for repairs/adjustments or use spark resistant tools and work methods.
- 

## 1.9 Product approval standards

### Regular standards



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#### **WARNING:**

Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure the pump driver and all other auxiliary components meet the required area classification at the site. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

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All standard products are approved according to CSA standards in Canada and UL standards in USA. The drive unit degree of protection follows IP68 according to standard IEC 60529.

## 1.10 Product warranty

### Coverage

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

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

- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

**Limitations**

The warranty does not cover faults caused by these situations:

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

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

**Warranty claim**

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

# 2 Transportation and Storage

## 2.1 Inspect the delivery

### 2.1.1 Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.  
If the product has been picked up at a distributor, make a claim directly to the distributor.

### 2.1.2 Inspect the unit

1. Remove packing materials from the product.  
Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.  
For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

## 2.2 Transportation guidelines

### 2.2.1 Pump handling



**WARNING:**

Dropping, rolling or tipping units, or applying other shock loads, can cause property damage and/or personal injury. Ensure that the unit is properly supported and secure during lifting and handling.

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**CAUTION:**

Risk of injury or equipment damage from use of inadequate lifting devices. Ensure lifting devices (such as chains, straps, forklifts, cranes, etc.) are rated to sufficient capacity.

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### 2.2.2 Lifting the Pump / Sub-Base



**WARNING:**

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

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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 clears 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.

## 2.3 Storage guidelines

### 2.3.1 Pump storage requirements

Storage requirements depend on the amount of time that you store the unit. The normal packaging is designed only to protect the unit during shipping.

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	<ul style="list-style-type: none"> <li>• Store in a covered and dry location.</li> <li>• Store the unit free from dirt and vibrations.</li> </ul>
Long-term (more than six months)	<ul style="list-style-type: none"> <li>• Store in a covered and dry location.</li> <li>• Store the unit free from heat, dirt, and vibrations.</li> <li>• Rotate the shaft by hand several times at least every three months.</li> </ul>

## 2.4 Uncrating / De-Skidding

Care should be taken when uncrating or de-skidding pumps. If shipment is not delivered in proper 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 books and sheets are included in the shipment - DO NOT DISCARD.

# 3 Product Description

## 3.1 General

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

The design, material and workmanship incorporated into the construction of Goulds pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, are enhanced and extended by periodic inspection and careful maintenance. Keep this instruction manual handy for reference. Further information can be obtained by contacting ITT/Goulds Pumps or your local representative.

Goulds Pumps will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures, nor used on liquids other than stated in the original order acknowledgment without written permission of Goulds Pumps.

### 3.1.1 Pump Description

The AF pump generates flow by the thrust or lift action of the rotating axial vanes of the impeller. It provides high flow rates and low heads which are ideal for re-circulation, evaporator, and generator cooling systems. The AF utilizes an elbow to direct the flow through the suction and out the discharge end of the pump. The pump accommodates top or end suction configurations using either the LMR or LM bearing arrangement. The LMR is for top suction and the LM is for end suction. Arrangements are as follows:

**Table 2: Pump Description**

Power End	Inboard Bearing	Outboard Bearing
LMR	Spherical roller	Spherical thrust/spacer/Spherical roller
LM	Spherical roller	Spherical roller/spacer/Spherical thrust

#### Elbow

AF elbows are fabricated with 150# flat face suction and discharge flanges. They come with fabricated feet for mounting to a sub-base or without feet to be mounted directly in the piping. The elbows have a built in stuffing box and a rear flange for mounting the power end to the elbow. There are also adjusting lugs for aligning the shaft to the stuffing box.

#### Casing

The AF comes with a casing or spool piece to simplify impeller installation and alignment. The casing bolts to the elbow and shrouds the impeller. It has a gasket or o-ring seal between it and the elbow. Adjusting lugs on the elbow center the casing relative to the impeller.

#### Power End

The power end is made up of the bearing housing, bearings, locknuts, lock washers, labyrinth oil seals, shaft, shaft sleeve (w/packing), oil slinger, keys, shaft, and shaft washer.

#### Stuffing Box

The stuffing box is integral with the elbow and provides a mounting surface for a mechanical seal or cylindrical bore with flush ports and gland face for packing. The standard packed box includes (5) rings of



packing and (2) lantern rings to seal the shaft area. (2) flush ports are provided for lubrication. The innermost flush port is used with process flow and the outermost port for water flush. A special alternate packing arrangement is available that includes a throat bushing and additional ring of packing near the gland (see the attached addendum). A gland is used for packing adjustment.

### Shaft Sleeve

If packing is specified, a replaceable wear sleeve is provided with the power end. The sleeve is keyed to prevent rotation. The stuffing box can also be modified to accept a mechanical seal if required.

### Impeller

The impeller is cast with (4) fixed vanes at 0 or +5 degrees, CW or CCW rotation, and top or end suction. The impeller bore is stepped for easy assembly to the shaft. It is held in place with a key, shaft washer, and bolts. It has a cover plate and o-rings to prevent corrosion and allow for easy impeller replacement. The impeller is dynamically balanced (two plane) per ISO 1940 to a quality grade G-16.

### Shaft

The shaft is cantilevered into the elbow to eliminate the need for internal bearings. It is sized for minimal deflection, high critical speed, and extreme corrosion resistance. The shafts are stepped for easy assembly with the impeller. The shaft comes with a replaceable sleeve when used with stuffing boxes.

### Bearings

The inboard radial bearing absorbs shaft radial loads and aligns the pump shaft. It is a spherical roller bearing. The outboard thrust bearing absorbs impeller 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.

### Oil Cooling (Optional)

An oil-cooling coil is available on all sizes, it is installed in the bottom of the bearing housing and circulates water to cool the oil bath. Generally, it is used when process temperatures cause excessive heat build up in the bearing housing and/or bearings.

### Configurations and Drives

The 42", 1200mm, 54", 60", and 66" pumps are usually gear driven and come on a subbase as standard. They can also be pipe mounted with a drive shaft to a motor on a separate subbase.

## 3.2 Nameplate information

### Important information for ordering

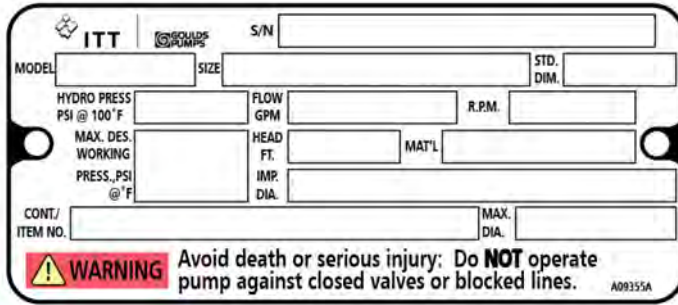
Every pump has nameplates that provide information about the pump. The nameplates are located on the bearing housing.

When you order spare parts, identify this pump information:

- Model
- Size
- Serial number
- Item numbers of the required parts

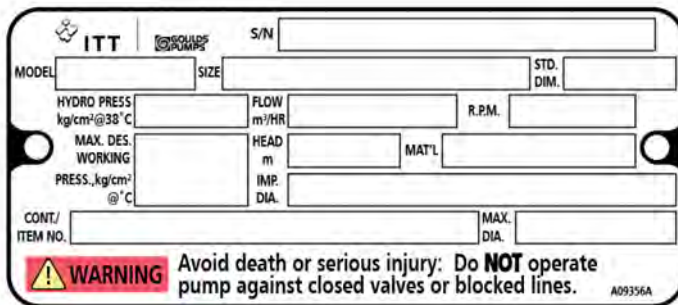
Refer to the nameplate on the bearing housing for most of the information. See Parts List for item numbers.

**Nameplate on the bearing housing using English units**



Nameplate field	Explanation
S/N	Serial number of the pump
MODEL	Pump model
SIZE	Size of the pump
STD. DIM.	Standard ANSI dimensional code
HYRO PRESS PSI	Hydrostatic pressure at 100°F, in PSI
FLOW	Rated pump flow in GPM
R.P.M.	Rated pump speed, revolutions per minute
MAX. DES. WORKING PRESS., PSI	Maximum working pressure at temperature °F, in PSI
HEAD	Rated pump head, in feet
MAT'L.	Material of which the pump is constructed
IMP. DIA.	Impeller diameter, in inches
CONT./ITEM NO.	Customer contract or item number
MAX. DIA.	Maximum impeller diameter, in inches

**Nameplate on the bearing housing using Metric units**

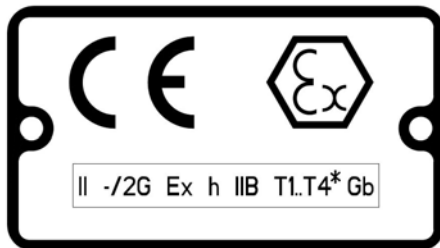


Nameplate field	Explanation
S/N	Serial number of the pump
MODEL	Pump model
SIZE	Size of the pump
STD. DIM.	Standard ANSI dimensional code
HYRO PRESS	Hydrostatic pressure at 38° C, in kg/cm2
FLOW	Rated pump flow in m3/hr
R.P.M.	Rated pump speed, revolutions per minute
MAX. DES. WORKING PRESS. @°C	Maximum working pressure at temperature °C, in kg/cm2
HEAD	Rated pump head, in m

Nameplate field	Explanation
MAT'L.	Material of which the pump is constructed
IMP. DIA.	Impeller diameter, in inches
CONT./ITEM NO.	Customer contract or item number
MAX. DIA.	Maximum impeller diameter, in inches

### ATEX nameplate

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:



**Figure 2: Typical ATEX pump nameplate**

Refer to [Table 1: Temperature class definitions on page 8](#) for pumpage temperature limits.

# 4 Installation

## 4.1 Preinstallation

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.

### 4.1.1 Foundation Requirements

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.

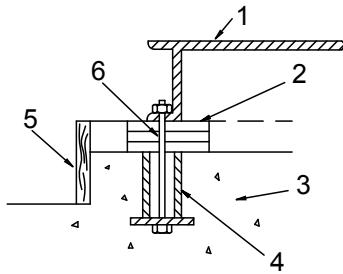
The AF pumps covered by these instructions may be designed to hang in the piping system, furnished with spring loaded sub-base bolts, or have a sub-base designed to be anchor bolted and grouted to the foundation.

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.

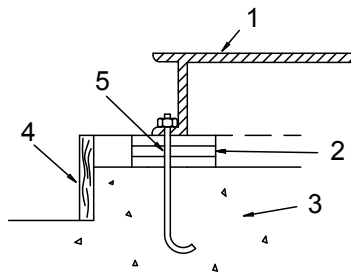
### Sleeve-type bolts



Item	Description
1.	Baseplate
2.	Shims
3.	Foundation
4.	Sleeve
5.	Dam
6.	Bolt

**Figure 3: Sleeve type bolts**

### J-type bolts



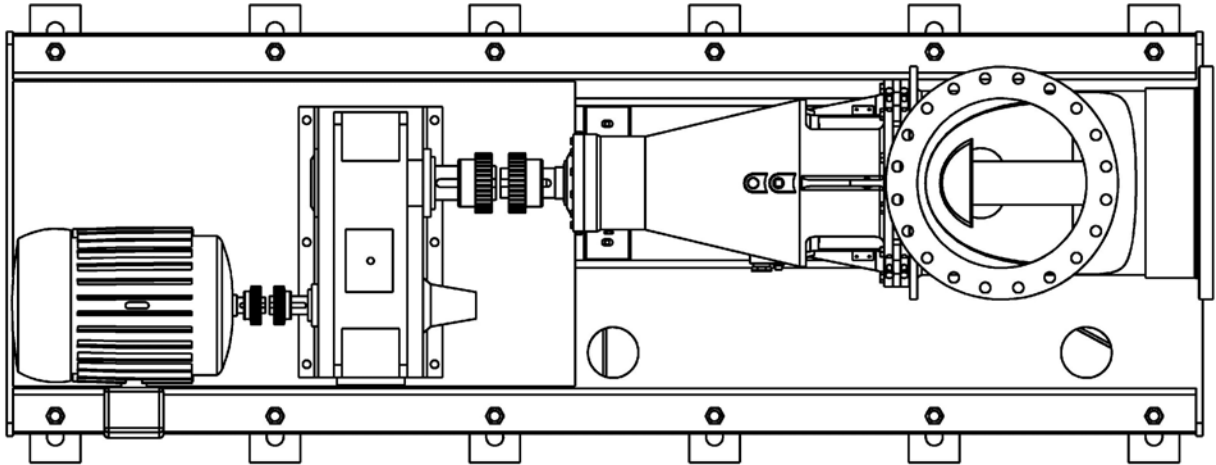
Item	Description
1.	Baseplate
2.	Shims or wedges
3.	Foundation
4.	Dam
5.	Bolt

**Figure 4: J-type bolts**

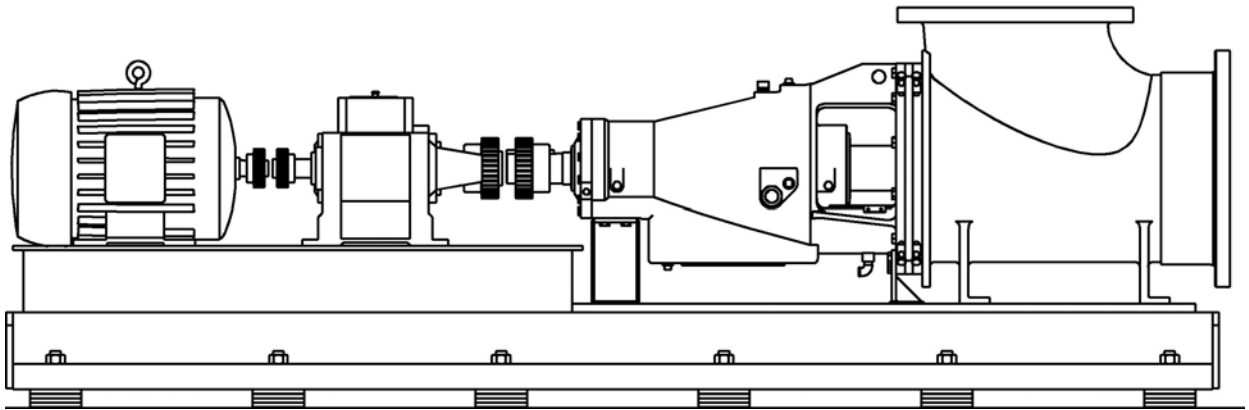
## 4.1.2 Sub-base Leveling

### 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 (see Figure titled *Sub-base, top view*). The coupling should not be reconnected until all realignment operations have been completed. A recommended coupling alignment procedure is included in the following sections.

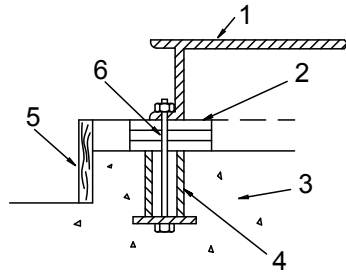


**Figure 5: Sub-base, top view**



**Figure 6: Sub-base, side view**

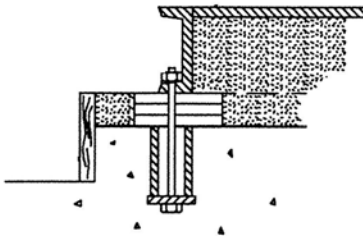
1. The sub-base should be supported on rectangular metal blocks or on metal wedges having a slight taper. There should be support blocks or wedges on both sides of each foundation bolt. A gap of about 19mm | 3/4" to 38mm | 1-1/2" should be allowed between the sub-base and the foundation for grouting, see Figure titled *Sub-base, side view*.
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. 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 3 mm | 0.125" over the length of the base and 1.5 mm | 0.0875" 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 3mm | 1/8" to 6mm | 1/4" 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.



1. Baseplate
2. Shims or wedges
3. Foundation
4. Sleeve
5. Dam
6. Bolt

**Figure 7: Build dam around foundation**

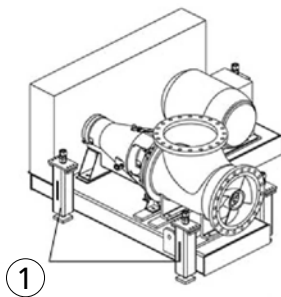
6. Pour grout through the grout holes in the sub-base, up to level of dam. Remove air bubbles from grout as it is poured by puddling, using a vibrator, or pumping the grout into place. Non-shrink grout is recommended.
7. Allow grout to set at least 48 hours.
8. Tighten foundation bolts.



**Figure 8: Tighten foundation bolts**

### 4.1.3 Spring Mounted Base

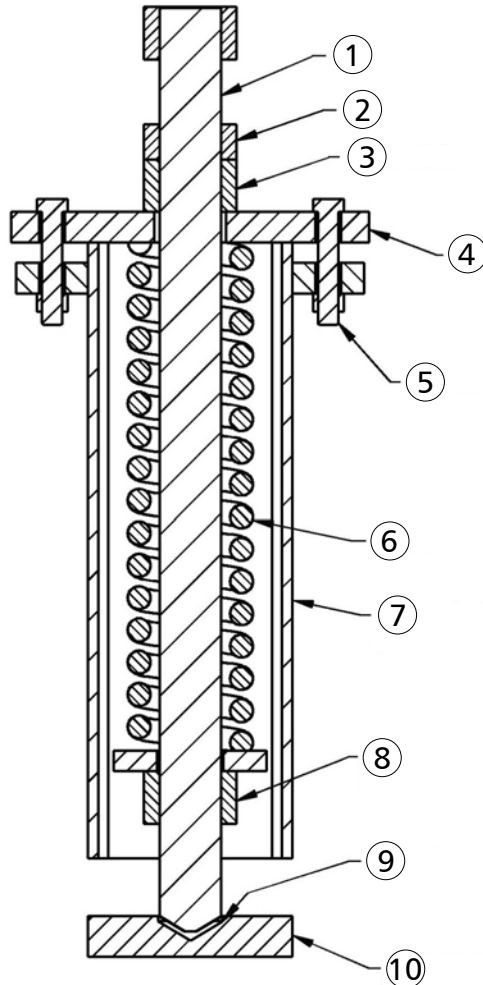
The Figure: *V-belt Driven AF pump on spring mounted sub-base*, shows a V-belt driven AF pump on a spring mounted sub-base. Sub-bases supported by spring pockets assure that the pump remains level, regardless of vertical movement due to thermal pipe expansion during operation.



1. Spring pockets

**Figure 9: V-belt Driven AF pump on spring mounted sub-base**

The following is a brief description of the spring pocket components and their function (see Figure: *Spring pocket components*). 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 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.



- |                    |                                       |
|--------------------|---------------------------------------|
| 1. Adjusting screw | 6. Spring                             |
| 2. Jam nut         | 7. Spring holder (welded to sub-base) |
| 3. Stop nut        | 8. Adjusting screw nut assembly       |
| 4. Spring retainer | 9. Lubricate with oil                 |
| 5. Bolts and nuts  | 10. Adjusting screw holder            |

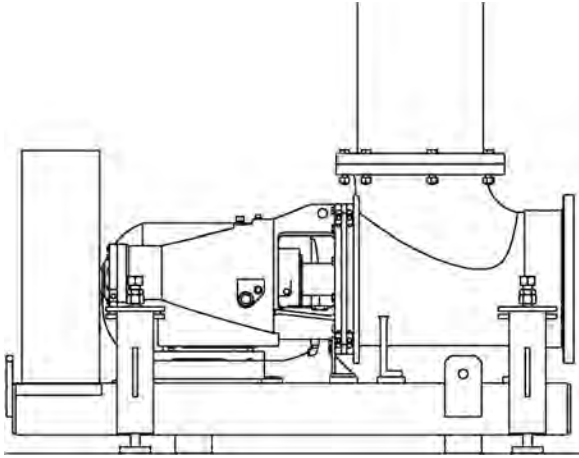
**Figure 10: Spring pocket components**

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. 1.6 mm | 1/16") should exist between the flange of the vertical pipe and the pump elbow with the gasket in place (see Figure: *Blocks placed under sub-base*).
2. Install several flange bolts to help maintain alignment of the flanges.



**Figure 11: Blocks placed under sub-base**



**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.

**NOTICE:**

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: *Spring rate information*.

**Table 3: Spring rate information**

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.	3/4"-10 UNC	13 #

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 0.8 mm | 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.

---

**NOTICE:**

If the flange gap is over 0.8 mm | 1/32", turn the adjusting screws a uniform amount to close the gap. For a gap of 0.8 mm | 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.
- 

**NOTICE:**

Pumps with oil lubrication should be checked for oil 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 screw holders ungrouted.

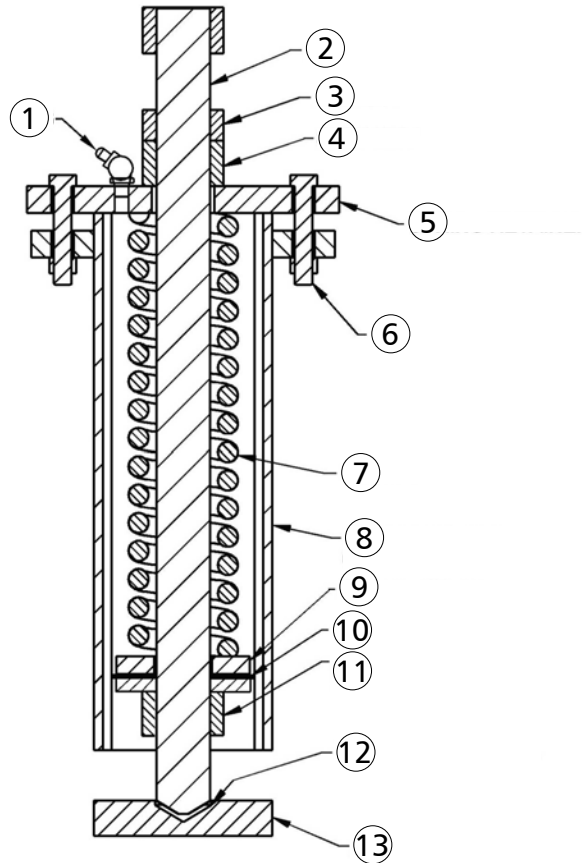
If it becomes necessary to remove a spring assembly from a spring pocket, for safety the following steps should be strictly adhered to:

### 4.1.4 Remove Spring from Spring Pocket

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 pry off the Plexiglas cover and 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, and the weight of the components is more likely to cause distortion when the pump is connected to the rigid pipe system.
4. If a spring is replaced while the system is hot, the stop nut should not be set until the system is cold. The springs must be allowed to push the base back to its cold position.

An optional grease filled spring pocket is shown in Figure: *Grease filled spring pocket assembly*. 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.



- |                    |                                       |
|--------------------|---------------------------------------|
| 1. Grease fitting  | 8. Spring holder (welded to sub-base) |
| 2. Adjusting screw | 9. Seal washer                        |
| 3. Jam nut         | 10. Grease seal                       |
| 4. Stop nut        | 11. Adjusting screw nut assembly      |
| 5. Spring retainer | 12. Lubricate with oil                |
| 6. Bolts and nuts  | 13. Adjusting screw holder            |
| 7. Spring          |                                       |

**Figure 12: Grease filled spring pocket assembly**

## 4.2 Connection of Piping

### General



#### **WARNING:**

Risk of premature failure. Casing deformation can result in misalignment and contact with rotating parts, causing excess heat generation and sparks. Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump.

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.

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:**

Net positive suction head available (NPSH<sub>A</sub>) must always exceed NPSH required (NPSH<sub>R</sub>) as shown on the published performance curve of the pump.

---

(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.
6. A removable spool piece of a minimum of 0.30 m | 1 ft at the connection adjacent to the impeller is recommended to allow impeller alignment measurements during service activities.

#### **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. Increasesers, 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 [4.6 Impeller alignment worksheet on page 36](#) to determine absence of pipe strain. If pipe strain exists, correct the piping.

---

#### NOTICE:

Prior to starting pump, ensure all flush and cooling systems are operating.

---

## 4.3 Pipe Hung Installation

### Location of Unit

The pump should be located in a clean, dry area free from flooding. The area should provide adequate space for maintenance and repair, considering complete disassembly and handling of equipment. The unit should be positioned to provide the most efficient pipeline system.

### Piping

Short, direct suction and discharge pipelines having a minimum of elbows and fittings will result in the least amount of pipe friction. Excessive friction losses will result in insufficient capacity and cavitation. Future access to the pump impeller and shaft will require removal of a section of discharge pipe (spool piece).

---

#### NOTICE:

The horizontal pipe flange 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 may put excessive strain on the pump.

---

### Installation of Pump in Pipeline

1. Connect the pump top flange to the vertical pipe and tighten flange bolts. Level pump within .005"/foot (0.42 mm/meter).
2. Check the impeller clearance in the casing so that it is reasonably well centered using the criteria that the minimum gap at the vane.
3. O.D. is at least 50% of the maximum gap (see the impeller alignment worksheet).
4. Connect the casing flange to the spool piece and tighten the flange bolts.

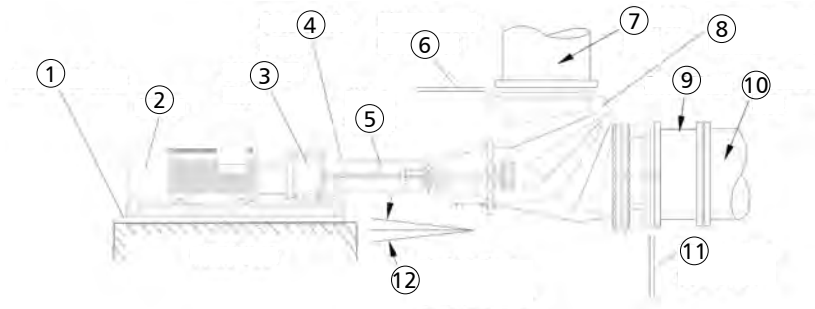
### Installation of the Driver

1. Install the driver (motor and reduction gear on a separate sub-base) as indicated on the installation drawing for the pump. The universal joint drive shaft requires the gear and pump shafts be parallel within 1 degree but off-set as indicated on the drawing. The optimal universal joint life is obtained with off-set shaft angles of 1 to 3 degrees.
2. Level the driver base relative to the pump, in accordance with the proceeding paragraph using leveling wedges adjacent to the anchor bolts. Partially tighten the anchor bolt nuts and check the shaft alignment between the motor and reduction gear. If the alignment is reasonably satisfactory, grout the base in place.

3. After the grout has hardened, tighten the anchor bolt nuts. Check and correct the motor shaft alignment. We recommend the actual shaft misalignment for the flexible couplings be considerably less than the maximum allowed by the coupling manufacturer for long coupling life and reduced vibration levels.

### Connection to Pump Driver

The pipe hung pump is connected to the driver via a drive shaft and universal joints at each end. Follow the drive shaft installation instructions and the angle limits per the pump installation drawing. An extendable guard is provided for the drive shaft and should be used any time the pump driver is rotating.



- |                             |                                |
|-----------------------------|--------------------------------|
| 1. Level sub-base           | 7. Vertical pipe               |
| 2. Motor                    | 8. Pump must be level .005"/ft |
| 3. Reduction gear           | 9. Spool piece                 |
| 4. Extendable guard         | 10. Horizontal pipe            |
| 5. Drive shaft              | 11. Flanges must be parallel   |
| 6. Flanges must be parallel | 12. Shaft off-set +/- 1° to 3° |

Figure 13: Connection to pump driver

## 4.4 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.

**NOTICE:**

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.

**NOTICE:**

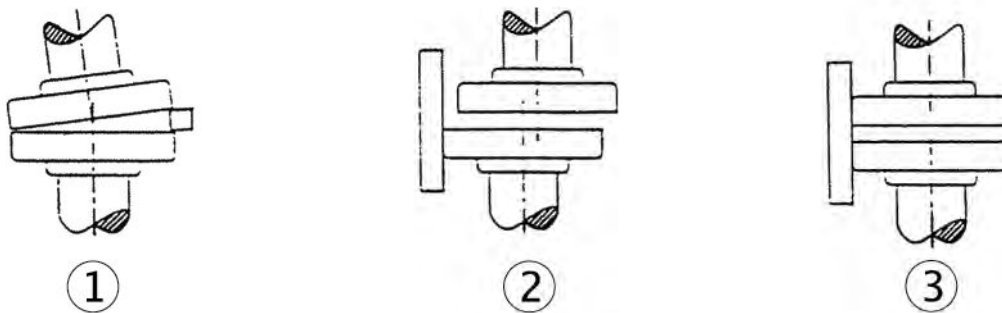
Alignment check must be made if process temperature changes, piping changes, and or pump service is performed.

### 4.4.1 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 Figure: *Sheave alignment*.

**Table 4: Sheave alignment**



1. Parallel misalignment

2. Angular misalignment

3. Perfect alignment

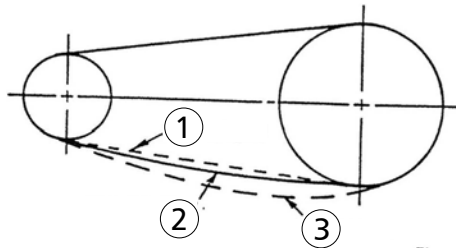
1. **Belt Installation** - When installing new belts, shorten center distance between sheaves so that belts can be placed on the sheave without the use of force. Never 'roll' or 'Pry' the belts into place, as this could damage the belt cords.

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 [4.5 Impeller Alignment on page 34](#).

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

**General Method:**

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 Figure: *Belt tensioning*.



1. Too tight

2. Slight bow

3. Too loose

**Figure 14: Belt tension**



**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.

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.
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.
4. **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.
5. **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.

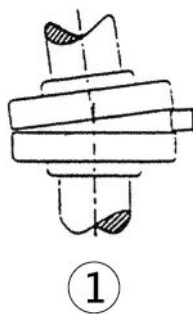
## 4.4.2 Gear Drive (Couplings)

### NOTICE:

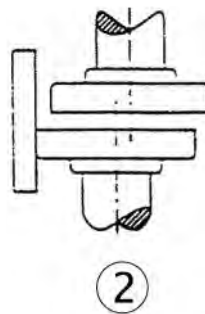


The coupling used in an ATEX classified environment must be properly certified.

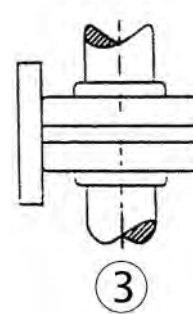
Remove the guard or guards by referring to the assembly/disassembly instructions. Disconnect motor/gearbox and the pump/gearbox coupling halves before proceeding with the alignment. First, align the pump/gearbox coupling then the motor/gearbox coupling. Check both coupling connections for parallel and angular alignment by either the Dial Indicator or Straight-Edge Method outlined below. Good alignment is achieved when the dial indicator readings, for both parallel and angular misalignment, are 0.076mm | 0.003" Total Indicated Reading (T.I.R.) or less when the pump and driver are at operating temperature (Final Alignment). Figure: *Proper coupling alignment*, describes what to look for.



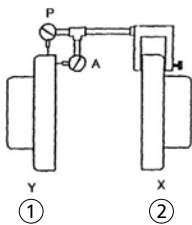
1. Parallel misalignment



2. Angular misalignment



3. Perfect alignment



1. (Motor End) (Gear box end)
2. (Gearbox end) (Pump end)

**Figure 15: Using a dial indicator to check coupling alignment**

1. Mount two dial indicators off one half of the coupling (X) so they contact the other coupling half (Y).
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.
3. 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).
4. Take indicator measurements with hold-down bolts tightened. Loosen hold down bolts prior to making alignment corrections.
5. 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 Goulds Pumps, 240 Fall St., Seneca Falls, New York 13148 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.

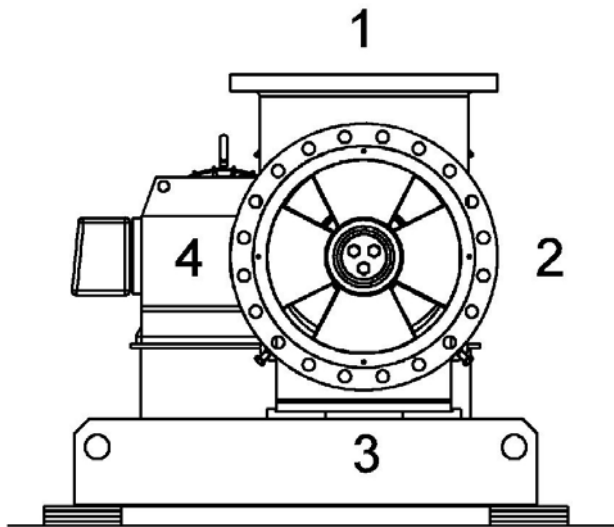
**Angular Alignments**

Couplings are in angular alignment when indicator "A" (Angular Indicator), (refer to Figure: *Proper coupling alignment*) does not vary by more than 0.076mm | 0.003" 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 Figure: *Directions for viewing coupling (view from front end of pump)*.

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.



**Figure 16: Directions for viewing coupling (view from front end of pump)**

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

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

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

**METHOD 2 - Feeler Gauge Method**

For the following steps refer to Figure: *Directions for viewing coupling (view from front end of pump)*.

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 0.076mm | 0.003".
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 0.076mm | 0.003" 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.

---

#### NOTICE:

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

---

#### METHOD 1 - Dial Indicator Method

For the following steps, refer to Figure: *Directions for viewing coupling (view from front end of pump)*.

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 0.076mm | 0.003", 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 0.076mm | 0.003" , 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 0.076mm | 0.003" 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 Figure: *Directions for viewing coupling (view from front end of pump)*.

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 0.076mm | 0.003").
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 0.076mm | 0.003") on the coupling periphery at both positions along the periphery.

---

**NOTICE:**

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 0.076mm | 0.003" 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.

---

**NOTICE:**

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

---

## 4.5 Impeller Alignment

⚠ 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 an 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 casing it must be realigned. The following steps are used to align the impeller.

---

**NOTICE:**

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

---

**Clearance measurement**

The alignment worksheet Figure: *Impeller alignment worksheet*, is used to align the impeller of the AF pump. The measurement procedure is as follows:

Make sure the cap screws fastening the casing to the elbow are tight (if applicable), 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 as shown on the impeller alignment worksheet (approx. 2, 4, 8, and 10 o'clock).

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 gauge 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.

## 4.6 Impeller alignment worksheet

### 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 1 -.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; at 10 o'clock .040, .042, .039, .041**

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

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

## 4.7 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.

**NOTICE:**

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

## 4.8 Installation and Operation Checklist

**Table 5: Installation and Operation Checklist**

Complete	Initial	Description	Reference
		Manual read and understood	AF 42"-66" IOM
		Level foundation	<a href="#">4.1.1 Foundation Requirements on page 18</a>
		Level subbase	Sub-base Leveling <a href="#">4.1.3 Spring Mounted Base on page 21</a>
		Check motor rotation ---CW _____ ---CCW _____	<a href="#">4.7 Rotation Check on page 36</a>
		Component rough alignment complete	<a href="#">4.4 Drive Alignment Procedures on page 28</a> ~ <a href="#">4.4.2 Gear Drive (Couplings) on page 31</a> ~ <a href="#">4.5 Impeller Alignment on page 34</a>
		V-belt tension and alignment per drive mfr.	<a href="#">4.4.1 V-Belt Drive (Sheaves) on page 29</a>
		Coupling alignment per cplg mfr.	<a href="#">4.4.2 Gear Drive (Couplings) on page 31</a>
		Piping installed and alignment rechecked	<a href="#">4.4 Drive Alignment Procedures on page 28</a>
		Mech. seal adjusted per mfr.	Mfgrs Man'l
		Mech. seal adjusted per mfr.	<a href="#">5.5 Final Alignment on page 47</a>
		Impeller alignment and clearance set _____ Inch/Side	<a href="#">4.5 Impeller Alignment on page 34</a> <a href="#">4.6 Impeller alignment worksheet on page 36</a>
		Pump shaft-free turning	<a href="#">5.1 Preparation for start-up on page 38</a>
		Bearing lubrication	<a href="#">6.1.3 Bearing Maintenance on page 50</a>
		V-belt or coupling guards installed	<a href="#">4.4 Drive Alignment Procedures on page 28</a> <a href="#">4.7 Rotation Check on page 36</a>
		Motor electrical connections	Mfgrs Man'l

# 5 Commissioning, Startup, Operation, and Shutdown

## 5.1 Preparation for start-up

---

**NOTICE:**



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

---



Damage occurs from:

### Checking rotation

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.

---

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.



**NOTICE:**

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 [4.6 Impeller alignment worksheet on page 36](#) is filled out and filed with the pump maintenance records for future reference.

**Check for free turning**

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

**Bearings**

The bearing assembly uses spherical roller or ball bearings to carry the radial load, and angular contact ball or tapered roller thrust bearing to carry the axial thrust load from the impeller.

**Lubrication**

The bearing uses oil bath lubrication. Oil lubricated bearing assemblies are shipped without oil. Oil must be added to the bearing housing before starting.

**Table 6: Axial Flow Pump Approx Oil Volume**

Pump Size	Quarts	Liters
42" / 1200mm / 54"	74	70.5
60" / 66"	62	59

Approximate values only. Always fill using sight glass to verify level. Oil level should be at the center of the sight glass. See comments in this section.

Remove the bearing housing breather (113A) and add oil until oil level is at the center of the sight glass. If the unit has an external oil lube system, fill the bearing housing and the reservoir to satisfy the system requirements. Replace the breather. Table: *Axial Flow Pump Approx Oil Volume*, shows the oil volume required.



Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure. Run the pump for 1 minute to fill the oil galleys and in and around each bearing. Check

the sight glass and add oil accordingly. Monitor the oil level indicator for the first 24 hours of operation and maintain fill level.

### Oil Type

Use an industrial quality lubrication oil such as Mobil DTE series, Exxon Teresstic, or similar of ISO VG68. ISO VG46 may be used in ambient temperatures below 4°C | 40°F .

In any case the operating temperature viscosity must be a minimum of 150SSU. Higher ambient temperatures or operating conditions resulting in a bearing frame temperature above 60°C | 140°F) should use an ISO VG100.

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

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. Large capacity (20" and larger) frequent oil change intervals can be avoided by oil sampling and analysis.

### Oil level control

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

### 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 temperature and should not be cause for alarm. Sudden change in temperature without any change in speed or loading can mean a lubrication difficulty or the approach of bearing failure.

For a given speed and loading, the bearing housing temperature will stabilize at some temperature, usually below 93°C | 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.

### Installing bearing

Long bearing life is dependent on careful handling of the bearing when it is out of the housing and during the installation procedure. Dirt and rough handling are prime enemies of precision bearings. Bearings should be pressed, not "hammered" into place. If heat is used to facilitate the installation, a hot oil bath is the best method.



---

#### CAUTION:

Risk of physical injury from hot bearings. Wear insulated gloves when using a bearing heater.

---

### Thrust bearing orientation

[8.2.1 42-54 \(Top Suction\) AF with LMR Bearings on page 70](#) shows the axial thrust bearing (112C) in the outboard location. This is used for top suction pumps.

End suction pumps have the flow and axial thrust in the opposite direction. Therefore, the complete thrust bearing assembly is reoriented in the opposite direction. This does not change the basic disassembly procedure, other than the sequence of installing the thrust bearing assembly components on the shaft.

The illustration shows the thrust bearing (112C) mounted on a sleeve (196). For the other bearing orientation, the bearing is mounted on an extension of the spacer (443), eliminating the separate sleeve.

### Shaft sealing

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

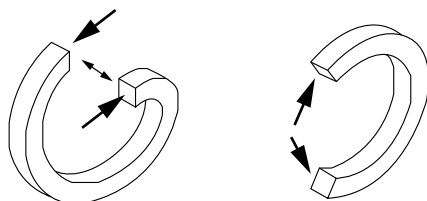
### Packed stuffing box

The original equipment packing is a suitable grade for the service intended. To pack the standard stuffing box use the following procedure: For the special (6) ring packing arrangement see Bearing alignment tool. 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. Appendix 1.

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

For a given speed and loading, the bearing housing temperature will stabilize at some temperature, usually below 93°C | 200°F, which will be the normal temperature for the installation.

2. Form packing over shaft or mandrel of same diameter. Carefully cut to packing length. Discard rings cut too short.
3. Preform 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 Figure: *Packing rings*, for the correct and incorrect method of installing packing.



Correct

Incorrect

### Figure 17: Packing rings

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.

5. Install the first lantern ring into the stuffing box. Failure to properly locate the lantern ring with the flush port will result in insufficient packing lubrication.
6. Install the second and third coil as required by sectional drawing, staggering the cut 90° to 120°.
7. Install the second lantern ring into stuffing box, carefully noting its proper position on the sectional drawing.
8. Install the third and fourth coil as required by sectional drawing, staggering the cut 90° to 120°.
9. After packing and lantern rings are properly installed, insert gland into stuffing box. Tighten gland nuts finger tight only. The shaft should turn freely.
10. Turn lubricant supply on, start pump, and adjust the gland as described below.
11. Periodic maintenance is absolutely required for all packed pumps. Normal shaft run-out should be under 0.13mm | 0.005" to avoid pounding of stuffing box packing. With excessive shaft run-out, shaft straightening or replacement is necessary.

### Gland adjustment

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

### Leakage

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

### 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 Pumps 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 ensure 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.

---

## 5.2 Start the Pump

### Priming the pump



Pumps that are not self-priming must be fully primed at all times during operation.

**DANGER:**

All openings (e.g. pipe connections, flanges) must be sealed off with proper fitting and material prior to filling pump. Failure to plug all openings will result in personal injury.

**WARNING:**

Foreign objects in the pumped liquid or piping system can block the flow and cause excess heat generation, sparks and premature failure. Make sure that the pump and systems are free of foreign objects before and during operation.

**WARNING:**

If pump becomes plugged, shut down pump and unplug prior to restarting.

**CAUTION:**

1. Foreign objects in the pumped liquid or piping system can block the flow and cause excess heat generation, sparks and premature failure. Make sure that the pump and systems are free of foreign objects before and during operation.
2. All equipment and personal safety related devices and controls must be installed and operating properly.
3. 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.
4. Variable speed drivers should be brought to rated speed as quickly as possible.
5. Variable speed drivers should not be adjusted or checked for speed governor or over-speed 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.
6. Pumpage temperatures in excess of 93°C | 200°F will require warmup of pump prior to operation. Circulate a small amount of pumpage through the pump until the casing temperature is within 38°C | 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, re-prime and attempt to restart.

7. 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.
8. Lubricating liquid must be flowing to the stuffing box before pump is started.

**Flush flows**

Prior to starting pump, ensure all flush and cooling systems are operating.

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 unknown, it should be measured with a pressure gauge when the pump is operating. The standard stuffing box is furnished with (1) N.P.T. holes for piping the lubricating liquid. The lubricating liquid is piped into it. 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.

For special (6) row packing arrangement see appendix 1 at the end of this manual for flush pressures and flow rates.

(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:

Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.

---

### Set desired flow

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



#### CAUTION:

To avoid risk of equipment damage, observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

---

## 5.3 Operation

### General considerations



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

1. Do not operate pump below hydraulic minimum flow. For hydraulic minimum flow, refer to technical manual and pump performance curve.
2. Do not operate pump below hydraulic or thermal minimum flow. For hydraulic minimum flows refer to technical manual and pump performance curves. To calculate thermal minimum flow, refer to HI Centrifugal Pump Design and Application ANSI/HI 1.3-2000. Axial flow pumps exhibit hydraulic stall and unstable flow VS. TDH at flows below the minimum continuous flow on the performance curve.
3. Do not operate pump past maximum flow. For maximum flow refer to pump performance curve.
4. To avoid risk of equipment damage, observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

5. Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.
6. Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.
7. NPSHa must always exceed NPSHr as shown on Goulds performance curves received with order.
8. Reference Hydraulic Institute for NPSH and pipe friction values needed to evaluate suction piping.
9. Most axial flow pumps are in evaporator circulation service and since the evaporator performance and the amount of product depends on the rate of liquid circulation, care should be taken to maintain these pumps in good operating condition.

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

1. Temperature drop across the heat exchanger.
  2. Visual inspection of flow in evaporator body.
  3. Testing the circulating pump.
10. Items (1) and (2) above are covered by the system designer.
  11. 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:**

Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.



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

The pump and system must be free of foreign objects. If pump becomes plugged, shut down and unplug prior to restarting pump.

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:
  1. Heat exchanger tubes partially plugged.
  2. Too many heat exchanger tubes blanked off
  3. 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. This could be caused by:
  1. rubber lining pulling away from the suction pipe and partially collapsing,

2. large solids dropping into the suction, or
3. by an 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 or elbow 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 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.

## 5.4 Shut down the pump

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.

---



## 5.5 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.

# 6 Maintenance

## 6.1 Maintenance

### 6.1.1 Preventative Maintenance

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.

- 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.

### 6.1.2 Maintenance schedule


---

#### NOTICE:



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.

---

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

---



#### WARNING:

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

---

#### Maintenance inspections

A maintenance schedule includes these types of inspections:

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

---

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

### Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.
- Perform a vibration analysis.
- Monitor the discharge pressure.
- Monitor the temperature.

### Routine inspections

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

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.\*
- Check the seal chamber and stuffing box for leaks.
  - Ensure that there are no leaks from the mechanical seal.
  - Adjust or replace the packing in the stuffing box if you notice excessive leaking. Refer to "packing gland adjustment".

---

#### **NOTICE:**

\*If equipped, temperature and vibration levels can be retrieved by using your i-ALERT monitoring sensor and app.

---

### Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- Change the oil every three months (2000 operating hours) at minimum.
- If any rubbing noise has been noticed, re-align the impeller.

### Annual inspections

Perform these inspections one time each year:

- Check the pump capacity.
- Check the pump pressure.
- Check the pump power.

If the pump performance does not satisfy your process requirements, and the process requirements have not changed, then perform these steps:

1. Disassemble the pump.
2. Inspect it.
3. Replace worn parts.



**WARNING:**

A worn propeller and/or pump housing can have very sharp edges. Wear protective gloves.

### 6.1.3 Bearing Maintenance



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 the table under ATEX identification, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goulds representative.



For ATEX applications bearing replacement (all) is recommended after 50,000 hours of operation.

#### 6.1.3.1 Oil Lubricated Bearings

1. Remove the bearing housing breather (113A) and add oil until oil level is at the center of the sight glass.
2. If the unit has an external oil lube system, fill the bearing housing and the reservoir to satisfy the system requirements.
3. Replace the breather.

Refer to Oil Volume table for required oil volume.

**Table 7: Axial Flow Pump Approximate Oil Volume**

Pump Size	Quarts	Litres
42" / 1200mm / 54"	74	70.5
60" / 66"	62	59

Approximate values only. Always fill using sight glass to verify level. Oil level should be at the center of the sight glass. See comments in this section.



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

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

#### 6.1.3.2 Acceptable oil for lubricating bearings

Refer to • [Oil Type on page 40](#).

### 6.1.3.3 Oil Level Control

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.

### 6.1.3.4 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 (93°C), 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.

## 6.1.4 Shaft-seal maintenance

### 6.1.4.1 Mechanical-seal maintenance




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**WARNING:**

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

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**CAUTION:**

Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

---

#### Cartridge-type mechanical seals

Cartridge-type mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require disengagement of the holding clips prior to operation, allowing the seal to slide into place. If the seal has been installed in the pump by ITT, these clips have already been disengaged.

#### Other mechanical seal types

For other types of mechanical seals, refer to the instructions provided by the seal manufacturer for installation and setting.

#### Reference drawing

The manufacturer supplies a reference drawing with the data package. Keep this drawing for future use when you perform maintenance and seal adjustments. The seal drawing specifies the required flush fluid and attachment points.

#### Before you start the pump

Check the seal and all flush piping.

### Mechanical seal life

The life of a mechanical seal depends on the cleanliness of the pumped fluid. Due to the diversity of operating conditions, it is not possible to give definite indications as to the life of a mechanical seal.

### 6.1.4.2 Packed stuffing-box maintenance



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**WARNING:**

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

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**WARNING:**

Failure to disconnect and lock out driver power may result in serious physical injury. Never attempt to replace the packing until the driver is properly locked out.

---

### Adjustment of gland

Adjust the gland if the leakage rate is greater than or less than the specified rate.

Evenly adjust each of the two gland bolts with a one-quarter (1/4) turn until the desired leakage rate is obtained. Tighten the bolts to decrease the rate. Loosen the bolts to increase the rate.

### Tightening of packing

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**NOTICE:**

Never over-tighten packing to the point where less than one drop per second is observed. Over-tightening can cause excessive wear and power consumption during operation.

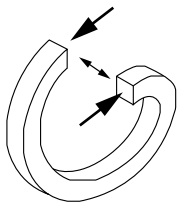
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If you cannot tighten the packing to obtain less than the specified leakage rate, then replace the packing.

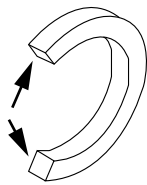
### 6.1.5 Packed Stuffing Box

If the axial flow pump has a standard stuffing box to seal 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 standard 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 (2) 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 second (2) rings of packing from the box.
6. Use threaded rods or a packing puller to remove the second lantern ring from the box.
7. Use a packing puller remove the final ring of packing from the bottom of the box.
8. 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.
9. Install the packing and lantern ring in the reverse order of removal, 1 ring of packing, lantern ring, 2 rings of packing, lantern ring, 2 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.
10. 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 Figure: *Packing rings*.



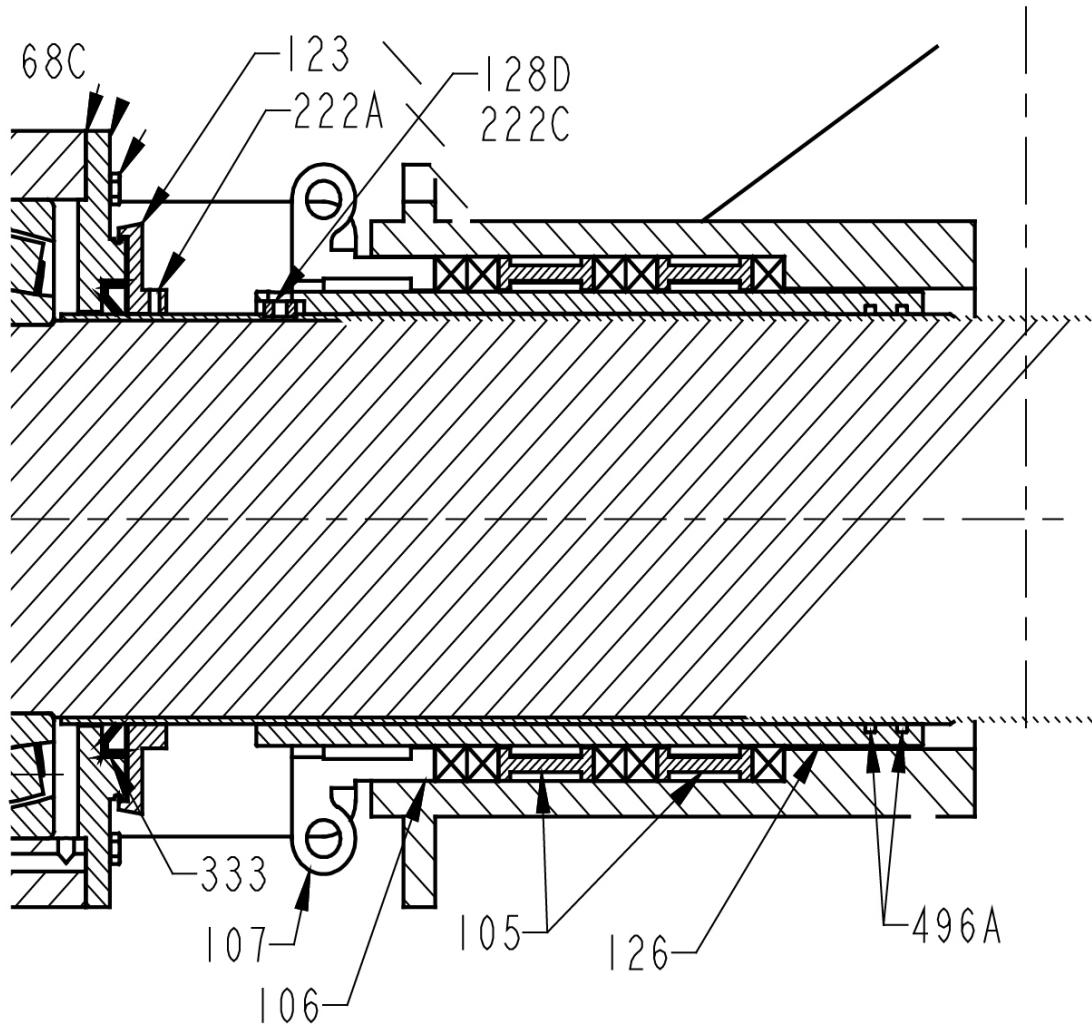
Correct



Incorrect

**Figure 18: Packing rings**

11. Insert the lantern ring with tapered extractor holes facing outward from the box, be sure it is aligned with the flush ports in the stuffing box.



**Figure 19: Insert lantern ring**

12. 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.



13. 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.

## 6.1.6 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.

---

### NOTICE:

If stuffing box is below atmospheric pressure or pumpage is not clean, 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 piping should be connected to the stuffing box flush port inlet.
3. If an outside source of clean liquid is required:
  1. The pressure should be 1.1-1.4 kg/cm<sup>2</sup> | 15-20 psi above suction pressure.
  2. Under extreme temperature and pressure a pipe should also be connected to the flush port outlet.

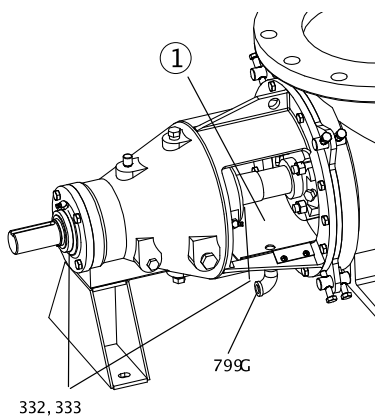
---

### NOTICE:

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.



1. Drip pan (supplied with packing only)

**Figure 20: External drip pan drain**

### 6.1.7 Labyrinth Seals

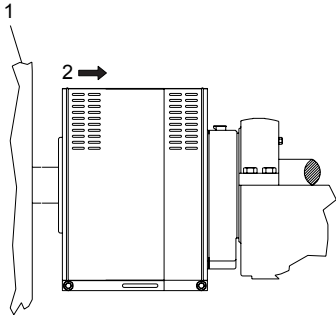
Labyrinth seals are found on the inboard and outboard end caps of the bearing housing to prevent contaminants from entering the bearing housing.

On some older models lip seals were used. These were assisted by cast slingers that fling contaminant fluids away prior to reaching the lip seals. Lip seals do not require any preventative maintenance but should be replaced during any rebuild operations. They can be cleaned occasionally from the outside by removing the slingers.

## 6.2 Disassembly

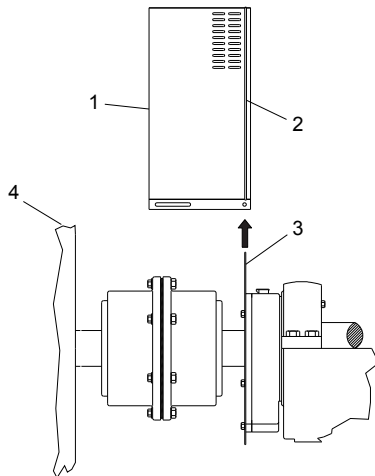
### 6.2.1 Remove the coupling guard

1. Remove the nut, bolt, and washers from the slotted hole in the center of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.



Item	Description
1.	Driver
2.	Slide to remove

3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver half of the coupling guard:
  - a) Slightly spread the bottom apart.
  - b) Lift upwards.
5. Remove the remaining nut, bolt, and washers from the pump side of the coupling guard. It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.
6. Remove the pump half of the coupling guard:
  - a) Slightly spread the bottom apart.
  - b) Lift upwards.



Item	Description
1.	Coupling guard half
2.	Annular groove
3.	Pump end plate
4.	Driver

## 6.2.2 Disassemble the Pump

Refer to the [8.2 AF Parts List 42-54 inch Pumps](#) on page 69, [8.4 AF Parts List 60-66 inch End Suction Pumps](#) on page 76, [8.3 AF Parts List 60-66 inch Top Suction Pumps](#) on page 73, [8.2.3 42-54 AF with LMR Bearings / Mechanical Seal / and Casing Gasket Seal](#) on page 71, [8.2.4 42-54 with LM Bearings / Special Packing Arrangement / Dual Casing O-Ring Seal](#) on page 72, [8.2.2 42-54 \(End Suction\) AF with LM Bearings](#) on page 70, [8.2.1 42-54 \(Top Suction\) AF with LMR Bearings](#) on page 70, [8.3.2 60-66 AF with LMR Bearings / Mechanical Seal and Casing Gasket Seal](#) on page 75, [8.4.1 60-66 \(End Suction\) AF with LM Bearings](#) on page 77, [8.3.1 60-66 \(Top Suction\) AF with LMR Bearings](#) on page 74, [8.4.2 60-66 AF with LM Bearings / Special Packing Arrangement / Dual Casing O-Ring Seal](#) on page 78 for proper part designation in these instructions. The order of steps for disassembly and assembly of the liquid end and power end is the suggested method. However, any workable sequence to accomplish the desired results may be used.

1. Remove all auxiliary water lines to pump and completely drain pump and pipeline. Remove bolts which fasten pump to suction and discharge piping.
2. If the pump is pipe mounted remove it from the piping and support it on adequate cribbing. If the pump is base mounted the casing (100) and power end may be removed while the elbow (315A) remains attached to the base.
3. Support the casing (100) by the lifting eye on top. Loosen and remove all of the bolts and nuts that secure the casing to the elbow (315A). With the casing supported, swing it away from the impeller (101) until it clears and set it down on a hard surface. Be careful not to damage the mating gasket or o-ring surfaces.
4. Disconnect coupling halves and remove any intermediate shafting. Support the impeller (101) with a chain around top vane. Remove the impeller end cap (9988). Remove the screws (370C) that secure the impeller (101) and shaft washer (9985) to the shaft (122). Tapped holes in the hub of the impeller on the discharge side are provided for pulling the impeller from the shaft. If no holes are provided, strapping or chains around the impeller vanes will provide a means of pulling the impeller from the shaft. Always use the shaft center for the center point of a puller. Be sure to retain the impeller key (178).

---

### NOTICE:

If chains are used for pulling, place blocking between chain and impeller vanes.

---

5. Support bearing housing (134) and impeller end of shaft (122). Remove hex head bolts (370G) that secure bearing housing (134) to suction elbow (315A).
6. If packing is used, disassemble the gland (107), packing (106), and lantern rings (105) from stuffing box. If mechanical seal (383) was used, please see the mechanical seal IOM for proper removal of seal.
7. With the power end properly supported. Carefully pull it from suction elbow (315A).
8. The shaft sleeve (126) can be removed by loosening set screw and sliding the sleeve from shaft (122). Be sure to retain the sleeve key (128D).

### 6.2.3 Disassemble the Power End




---

**WARNING:**

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

---

1. Lockout power supply to motor.
2. Close suction and discharge valve.




---

**WARNING:**

The pump may handle hazardous and/or toxic fluids. Skin and eye protection may be required. Precautions must be taken to prevent injury or environmental damage.

---

1. Remove piping from pump.
2. Remove coupling guard and coupling (direct connect) or belt guard and belts (belt drive).
3. Drain oil from bearing housing, disconnect oil circulation system, and remove pump from sub-base.
4. Wash down pump with appropriate cleaner.
5. Disassemble Pump per instructions per that section. Discharge piping and impeller (101) will be disassembled. The power end with the shaft (122) will be removed from the elbow (315A).
6. Remove cap screws (370H) fastening thrust bearing retainer (109) to bearing housing (134). Carefully pull retainer over shaft. Top suction pumps have thrust bearing (112C) at the outboard location and the thrust bearing stationary race and (6) small springs (9890) may be jarred free. Do not damage oil seal (332).
7. Be sure overhung portion of shaft is supported.
8. Remove cap screws (370F) fastening radial bearing retainer (119B) to bearing housing (134). Carefully pull retainer away from bearing housing without damaging lip seal (333).
9. Disassemble bearing halves by removing bolts and knocking out taper pins. Carefully lift top half. The shaft (122) with bearings can be lifted from bottom half of housing
10. Remove thrust end locknut (136) and lockwasher (382).
  - a) For top suction pumps see [8.2.1 42-54 \(Top Suction\) AF with LMR Bearings on page 70](#), the thrust bearing (112C), thrust bearing sleeve (196) and thrust bearing spacer (237) can be pulled from shaft (122). Press or pull radial bearing (112) from shaft by applying force on inner race bearing.
  - b) For end suction pumps see [8.2.2 42-54 \(End Suction\) AF with LM Bearings on page 70](#), press the entire thrust bearing stack off by pushing against stationary race of thrust bearing (112C).
11. Loosen set screws and pull oil wheel (248) off shaft.
12. Push inboard radial bearing (168C) off shaft toward coupling end by applying force on bearing inner race with a press.

## 6.3 Reassembly

### 6.3.1 Reassemble the Pump

1. Be sure shaft (122) and sleeve (126) are clean and free of all burrs. Slide shaft sleeve (126) over shaft (122), making sure that O-rings are in place as indicated on assembly drawing. Secure sleeve with set screw (222C) and key (128D).
2. Provide adequate support for bearing housing (134) and shaft (122). Carefully slide shaft through stuffing box of suction elbow. Bolt bearing housing to suction elbow (315A).
3. Install shaft O-rings (496C & 496D) on shaft (122). Place the shaft key (178) in the keyway. Lubricate the O-rings as required.
4. Carefully install impeller (101) on shaft (122). With shaft washer (9985) in place, install (4) cap screws (370C) to secure the impeller to the shaft. Install impeller end cap (9988) with o-ring (496B) as required.
5. Bolt casing (100) to elbow (315A) with (6) bolts evenly spaced around bolt circle. Leave bolts loose enough to shift casing for alignment with impeller. The actual adjustment of casing is accomplished by turning the adjusting screws (370B) against casing flange.
6. The procedure for setting impeller clearance is described in the ALIGNMENT section of these instructions. When acceptable alignment has been achieved, secure the initial (6) bolts, then install the remaining bolts and tighten.
7. Before connecting the coupling halves, check direction of motor rotation. Manually turn pump shaft to insure no rubbing. Be sure the pump and gear box shafts are in alignment according to the previously discussed alignment procedure.
8. Connect coupling halves and any intermediate shafting.
9. Assemble discharge piping to casing.
10. If packing is used, assemble gland, packing, lantern rings and sleeve into stuffing box. Do not compress too tightly until after start-up. The packing will need to be "run-in" and adjusted for proper flow of lubricating water. If a mechanical seal is used, please see the mechanical seal IOM for proper installation of seal.
11. Connect seal water and cooling lines to pump. Fill the oil lubrication system. Be sure bearing housing oil is level with the center of the sight glass.

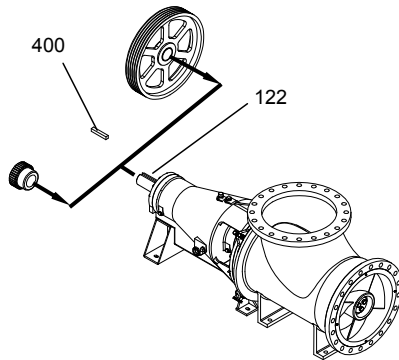
### 6.3.2 Reassemble the Power End

1. Be sure shaft is clean and free from all burrs.
2. Heat inboard radial bearing (168C) in a 200°F (93°C) oil bath or by induction heater. Slide bearing on shaft (122), butting against shaft shoulder. Position oil wheel (248) on shaft (122) and secure with set screws.
3. Heat thrust end bearings (112) & (112C) and sleeve (if used), in 200°F (93°C) oil bath. If thrust bearing rotation race mounts on spacer (443), install race on collar and heat collar with bearing mounted in oil bath.
  - a) For top suction pumps [8.2.1 42-54 \(Top Suction\) AF with LMR Bearings on page 70](#), slide bearing (112), spacer (237), and sleeve into position, tight against each other and against shaft shoulder. After sleeve has cooled, install thrust bearing (112C).
4. When the thrust bearing is in the outboard position the stationary race will usually fit over the lock nut and washer. This saves the trouble of trying to keep the race in position because it can be set aside until retainer (109) is installed.
  - a) For end suction pumps [8.2.2 42-54 \(End Suction\) AF with LM Bearings on page 70](#), slide spacer (443) with mounted thrust bearing (112C), including stationary race, into position against shaft shoulder. If a spacer drive key is used, be sure it is installed. Install bearing (112) against collar.
5. Secure bearings with lockwasher (382) and locknut (136). Retighten locknut while components are cooling to keep them tight together.

6. Install (6) thrust bearing springs (9890) in thrust bearing retainer (109) or bearing housing (134) halves. Use thick grease in each hole to help hold springs until assembly.
7. Lower shaft (122) into bottom half of bearing housing (134). Be careful not to damage bearings or machined fits.
8. If springs (9890) are located in the housing, keep the shaft about 3/8" (.95cm) outboard of normal position so springs are not compressed.
9. Lower top half of housing into position, align with taper pins, and secure together with bolts.
10. Install thrust bearing retainer. Do not damage lip seal.
11. Slide thrust bearing retainer (109) and gasket (360R) onto shaft to contact bearing housing (134). Do not damage lip seal (332). Fasten retainer to bearing housing with cap screws.

### 6.3.3 Reassemble the drive / guard

1. Insert the drive key (400) into the shaft (122) keyseat.
2. Depending on the drive type, install the hub fasteners for a coupling or sheave to the shaft (122). If you have a coupling half 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.



**Figure 21: Coupling reassembly**

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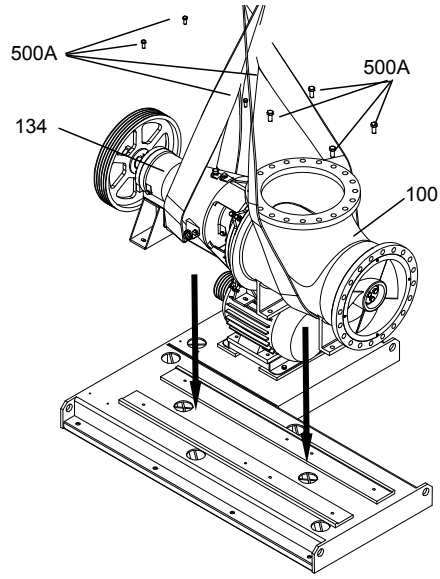
**NOTICE:**

Depending on the drive arrangement, either V-belt or Direct Connect, follow applicable steps.

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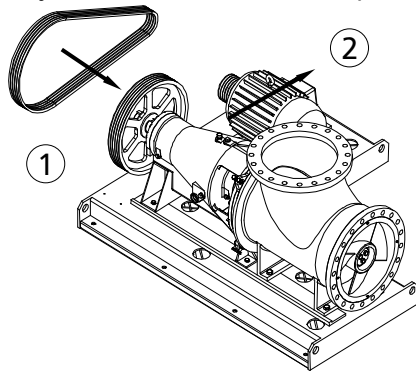
**V-belt configuration**

3. 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.
4. If any shims were found under the bearing housing feet during disassembly replace them at this time
5. Install the pump to sub-base bolts (500A) and remove the lifting straps or chains from around the bearing housing (134) and elbow (100).



**Figure 22: Pump to sub-base reassembly**

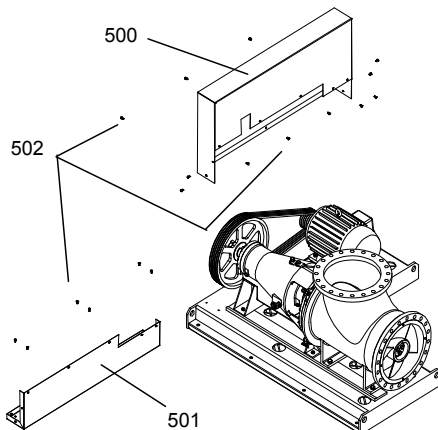
6. Install V-belts and re-apply tension by adjusting the slide base away from the pump.
7. Adjust and check the tension per the drive manufacturers instructions.



1. Install belts
2. Shift slide base

**Figure 23: V-belt installation**

8. Fasten the guard base (501) to the sub-base using screws (502). Install the guard cover (500) using screws (502).

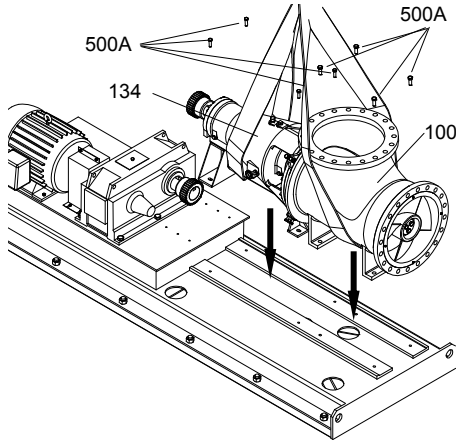


**Figure 24: Guard base to sub-base reassembly**

9. Check impeller alignment and re-align if necessary according to instructions for (impeller alignment).

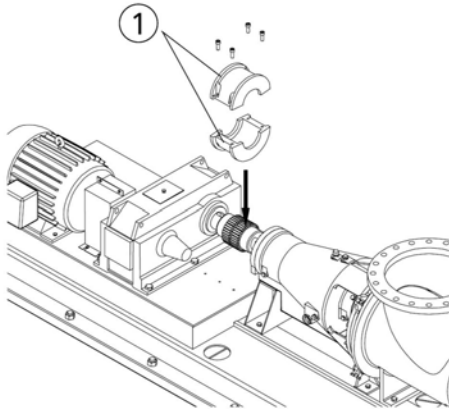
**Direct connect configuration**

10. 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.
11. If any shims were found under the bearing housing feet during disassembly replace them at this time.
12. Install the pump to sub-base bolts (500A) and remove the lifting straps or chains from around the bearing housing (134) and elbow (100).



**Figure 25: Direct drive - pump to sub-base reassembly**

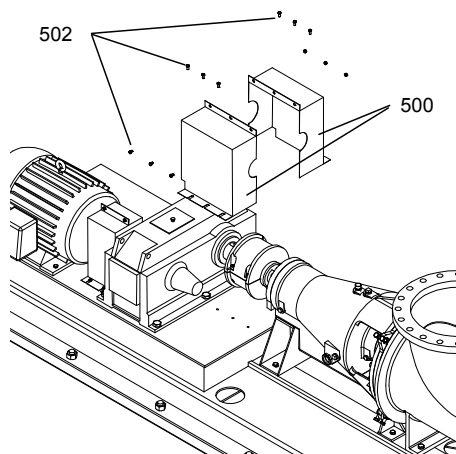
13. Align the gear box and pump coupling halves as described in sub-base installation section.  
If the motor and gear box were moved during disassembly re-align they must be re-aligned also.
14. Wrap the coupling cover around the coupling halves and install the fasteners that hold the coupling cover together.



**Figure 26: Coupling cover reassembly**

15. Bolt the two halves of the coupling guard (500) together and install over the coupling.
16. Fasten the guard to the sub-base using screws (502).





**Figure 27: Coupling guard reassembly**

17. Check impeller alignment and re-align if necessary according to instructions impeller alignment.
18. Fill pump with proper lubricant. Refer to preventative maintenance for requirements.
19. Connect all auxiliary piping and tubing
20. Fill system piping so pump impeller is submerged, flush the pump if necessary.
21. Open all valves controlling flow “to and from” the pump.
22. Unlock 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.

**NOTICE:**

## 6.3.4 Inspections

### Impeller

1. Inspect impeller vanes for damage (101). Check the vane O.D. for erosion. Check the vane surfaces, replace if grooved, worn, or eroded deeper than 3/16" (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" (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.
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.

### 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 .002" (.05 mm) max.
2. Bearing seats and seal areas must be smooth and free of scratches and grooves. Shaft hole threads must be in good condition. Replace if necessary.

### Shaft Sleeve

1. The shaft sleeve (126) should be replaced if badly grooved or worn. Localized wear or grooving greater than 3/32" (2.4 mm) deep is cause for replacement, see Fig. 50.

### **Bearings**

The bearings (112, 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.

---

**NOTICE:**

Do not re-use bearings

---

### **Oil Seals, O-Rings, Gaskets**

Although the oil seals (332, 333), O-rings (351A, 351B, 496A, 496B, 496C) and gaskets (360R, 360X,) may seem OK during inspection and examination, DO NOT RE-USE SEALS when rebuilding the pump. Replace them while pump is disassembled.

# 7 Troubleshooting

## 7.1 Pump Troubleshooting

**Table 8: Pump Troubleshooting**

Symptom	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

7.1 Pump Troubleshooting

Symptom	Cause	Remedy
	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 normally be run between 75% and 125% of BEP
	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 packing manufacturer's instructions
	Pump not assembled correctly	Compare pump assembly to instruction manual
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	Check head and flow, AF's should normally be run between 75% and 125% of BEP
Lubricant contamination	Inspect oil or grease for contaminants	

Symptom	Cause	Remedy
	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 normally be run between 75% and 125% of BEP
	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

7.1 Pump Troubleshooting

Symptom	Cause	Remedy
	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 mfr'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	Check head and flow, AF's should normally be run between 75% and 125% of BEP
	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

# 8 Spare parts

## Recommended spare parts

In order to prevent a long and costly downtime period, especially on critical services, it is advisable that you have these spare parts on hand:

## 8.1 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.

### 8.1.1 Recommended Spare Parts

#### Suggested Spare Parts

Elbow and or Casing (100, 315A)	Outboard Oil Seal (332)
Impeller (101)	Inboard Oil Seal (333)
Gaskets (360R, 360X)	Shaft Sleeve (126) (Optional)
O-Rings (351A, 351B, 496B, 496C, 496D)	Sleeve O-rings (496A) (Optional)
Shaft (122)	Stuffing Box Bushing (473) (Optional)
Inboard Radial Bearing (168C)	Lantern Ring (105) (Optional)
Outboard Thrust Bearings (112, 112C)	Stuffing Box Packing (106) (Optional)
Bearing Lockwasher (382)	Packing Gland (107) (Optional)
Bearing Locknut (136)	

## 8.2 AF Parts List 42-54 inch Pumps

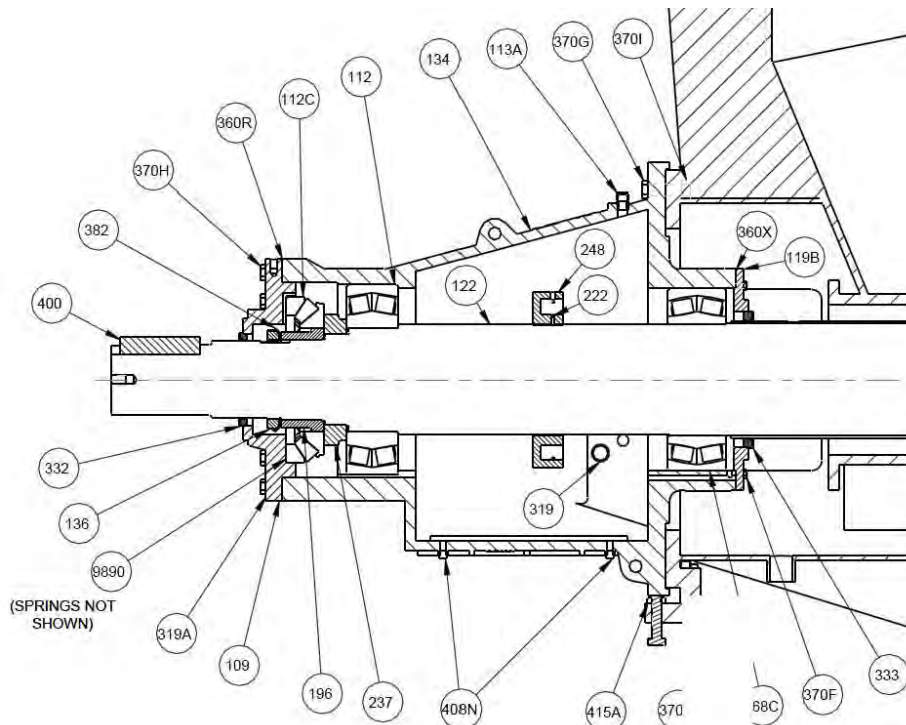
Table 9:

Item	Part Description	Item	Part Description
100	CASING	353	STUD, GLAND
101	PROPELLER	355	HEX NUT, GLAND
105	LANTERN RING	357D	NUT, ELBOW TO CASING
106	PACKING, PACKED BOX	358U	PIPE PLUG [½-14 NPT]
107	GLAND	358V	PIPE PLUG [1"-11.5 NPT]
109	RETAINER, THRUST BEARING	360X	GASKET, BRG., OUTBOARD
112	BEARING, RADIAL, OUTBOARD	360R	GASKET, BRG., INBOARD
112C	BEARING, THRUST	370A	SCREW, PROPELLER END COVER
113A	BREATHER	370B	CAP SCREW
119B	RETAINER, RADIAL BEARING	370C	SCREW, SHAFT WASHER
122	SHAFT	370D	SCREW, ELBOW TO CASING
126	SHAFT SLEEVE	370E	CAP SCREW-ALIGNMENT
128D	SLEEVE KEY	370F	HEX HD CAP SCREW, RADIAL BEARING RETAINER
134	BEARING HOUSING ASSEMBLY	370G	HEX HD CAP SCREW, BEARING FRAME TO ELBOW
Part of 134 assy	SCREW,HHC 1"-8 X 4-1/2"LG	370H	HEX HD CAP SCREW, THRUST RETAINER TO BEARING FRAME

Item	Part Description	Item	Part Description
Part of 134 assy	NUT,HEX 1"- 8 HVY	370I	NUT, HEX, BEARING FRAME TO ELBOW
Part of 134 assy	PIN,TAPER #10 X 3-1/2" (PLN)	382	LOCKWASHER, THRUST BEARING
136	LOCKNUT, THRUST BEARING	400	KEY, COUPLING
168C	BEARING, RADIAL, INBOARD	408N	PIPE PLUG [3/8-18 NPT]
178	PROPELLER KEY	415	JAM NUT
196	SLEEVE, THRUST BEARING	415A	JAM NUT
222	SET SCREW, OIL WHEEL	443	SPACER, THRUST BEARING
222C	SET SCREW, SLEEVE KEY	496A	O-RING, SHAFT SLEEVE
237	SPACER, THRUST BEARING	496B	O-RING, PROPELLER CAP
248	OIL WHEEL	496C	O-RING, SHAFT
315A	ELBOW	972G	MALE CONNECTOR
319	SIGHT WINDOW	972H	FEMALE CONNECTOR
319A	SIGHT WINDOW	984A	COOLING COIL
332	OIL SEAL, INBOARD	9890	SPRINGS, THRUST BRG
333	OIL SEAL, OUTBOARD	9985	SHAFT WASHER/PROPELLER LOCK-PLATE
351A	CASING O-RING	9988	PROPELLER END COVER
351B	CASING O-RING		

### 8.2.1 42-54 (Top Suction) AF with LMR Bearings

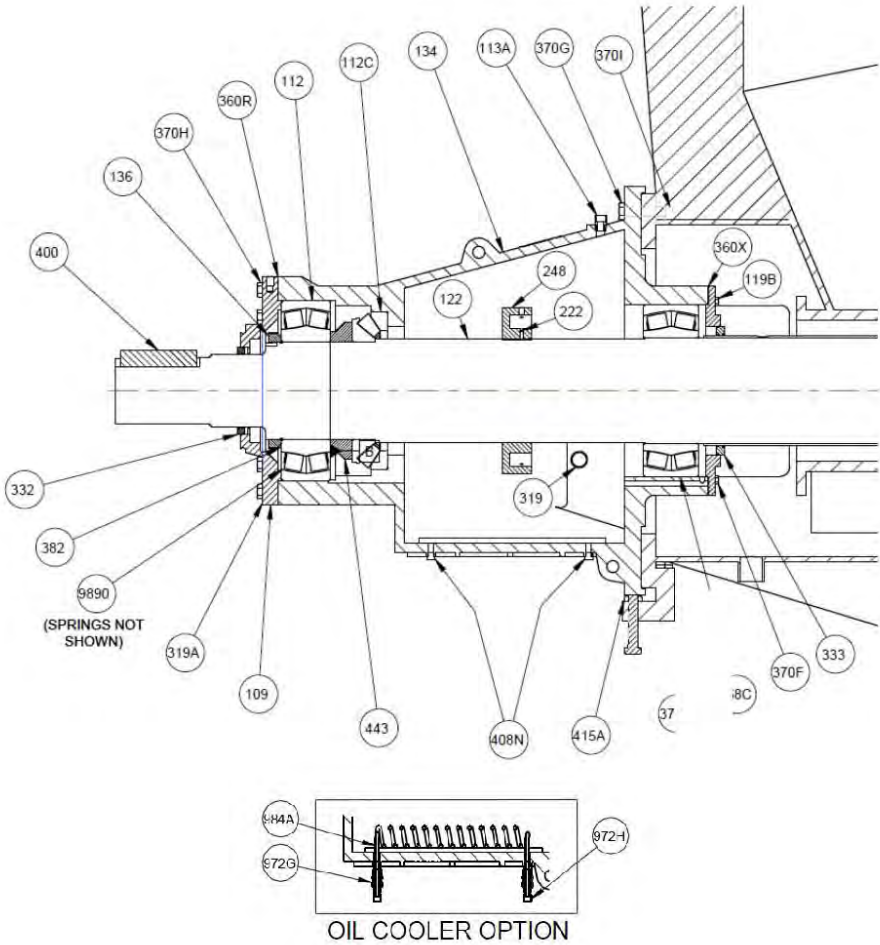
Refer to [8.2 AF Parts List 42-54 inch Pumps on page 69](#)



### 8.2.2 42-54 (End Suction) AF with LM Bearings

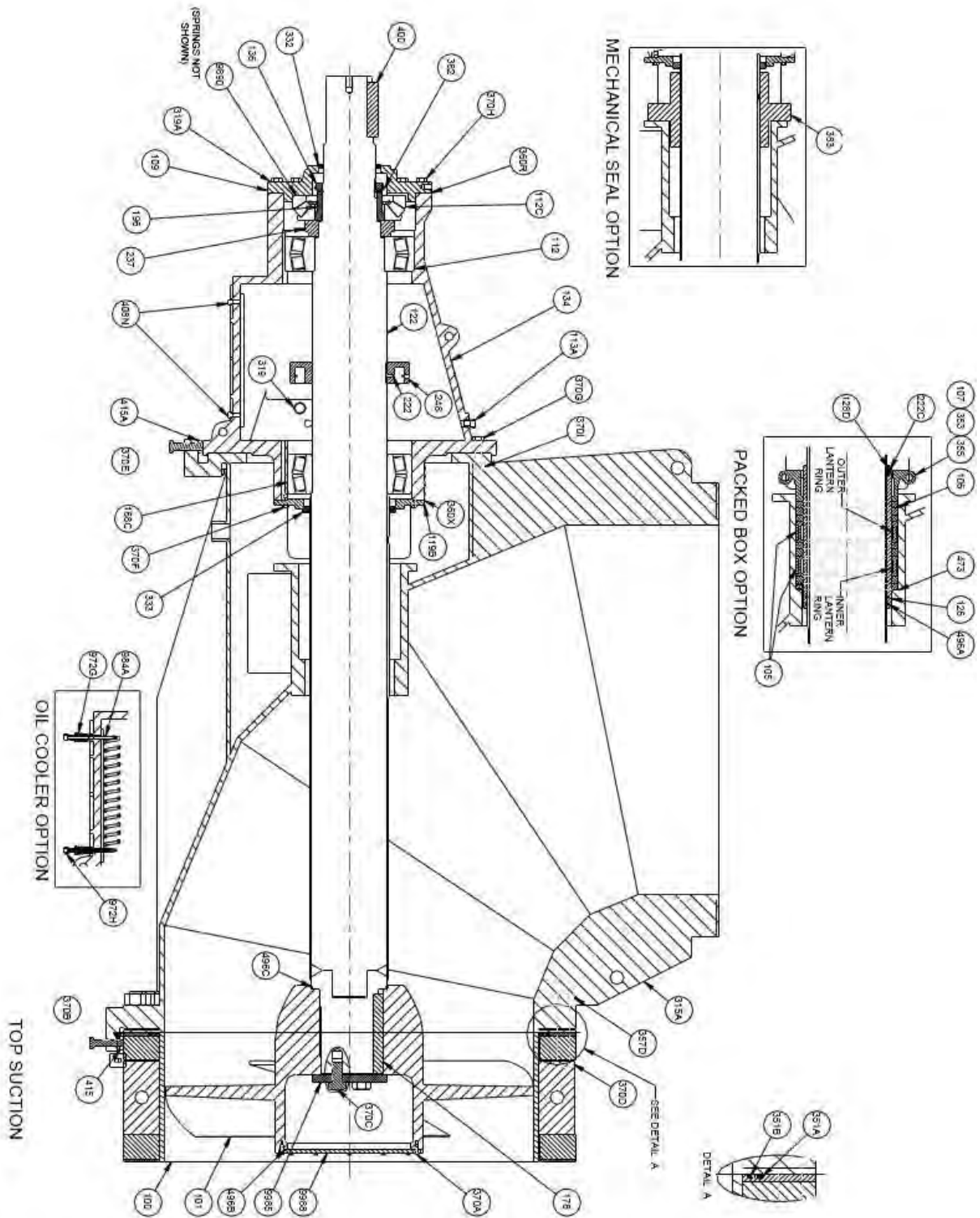
Refer to [8.2 AF Parts List 42-54 inch Pumps on page 69](#)





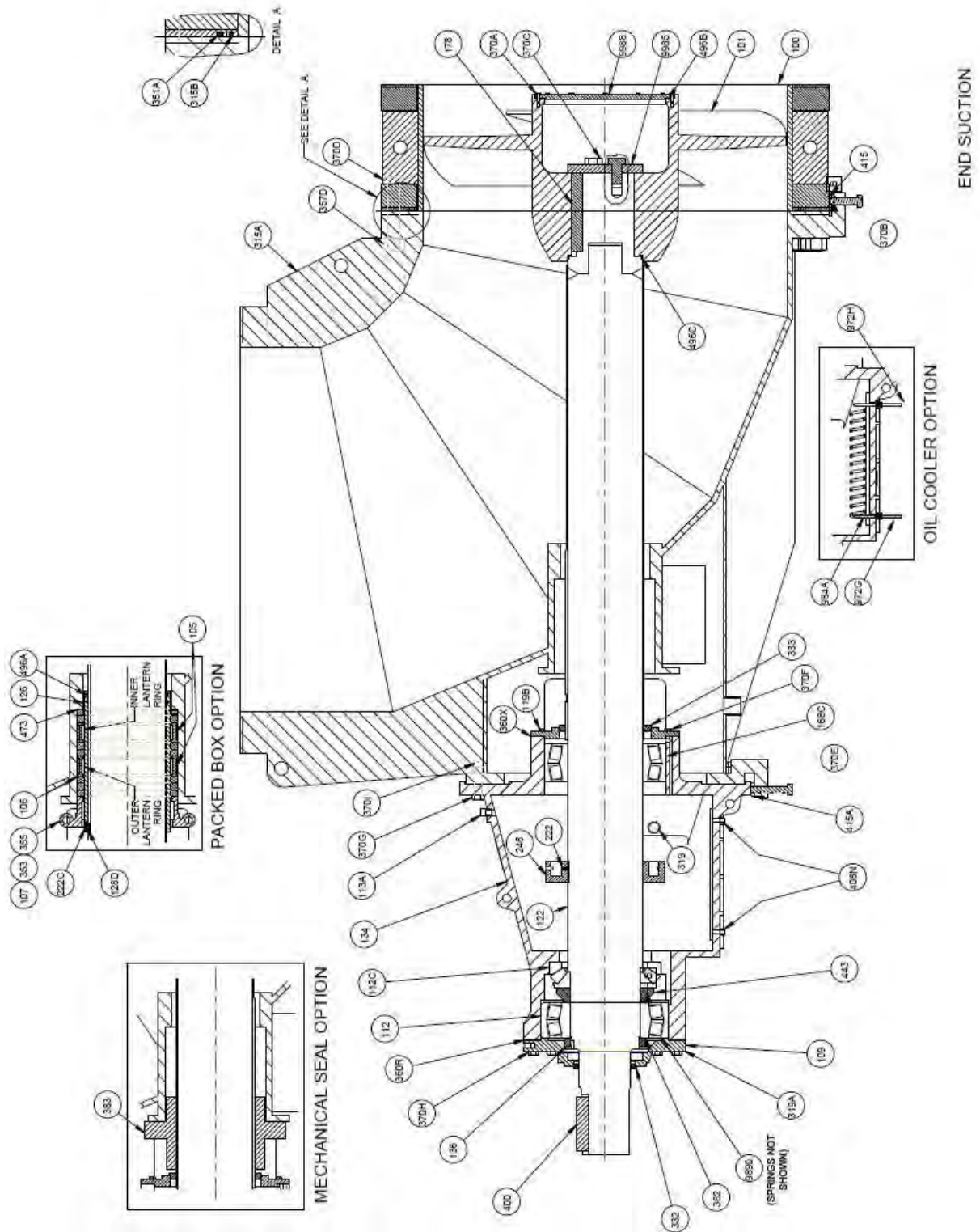
### 8.2.3 42-54 AF with LMR Bearings / Mechanical Seal / and Casing Gasket Seal

Refer to [8.2 AF Parts List 42-54 inch Pumps](#) on page 69



### 8.2.4 42-54 with LM Bearings / Special Packing Arrangement / Dual Casing O-Ring Seal

Refer to [8.2 AF Parts List 42-54 inch Pumps](#) on page 69



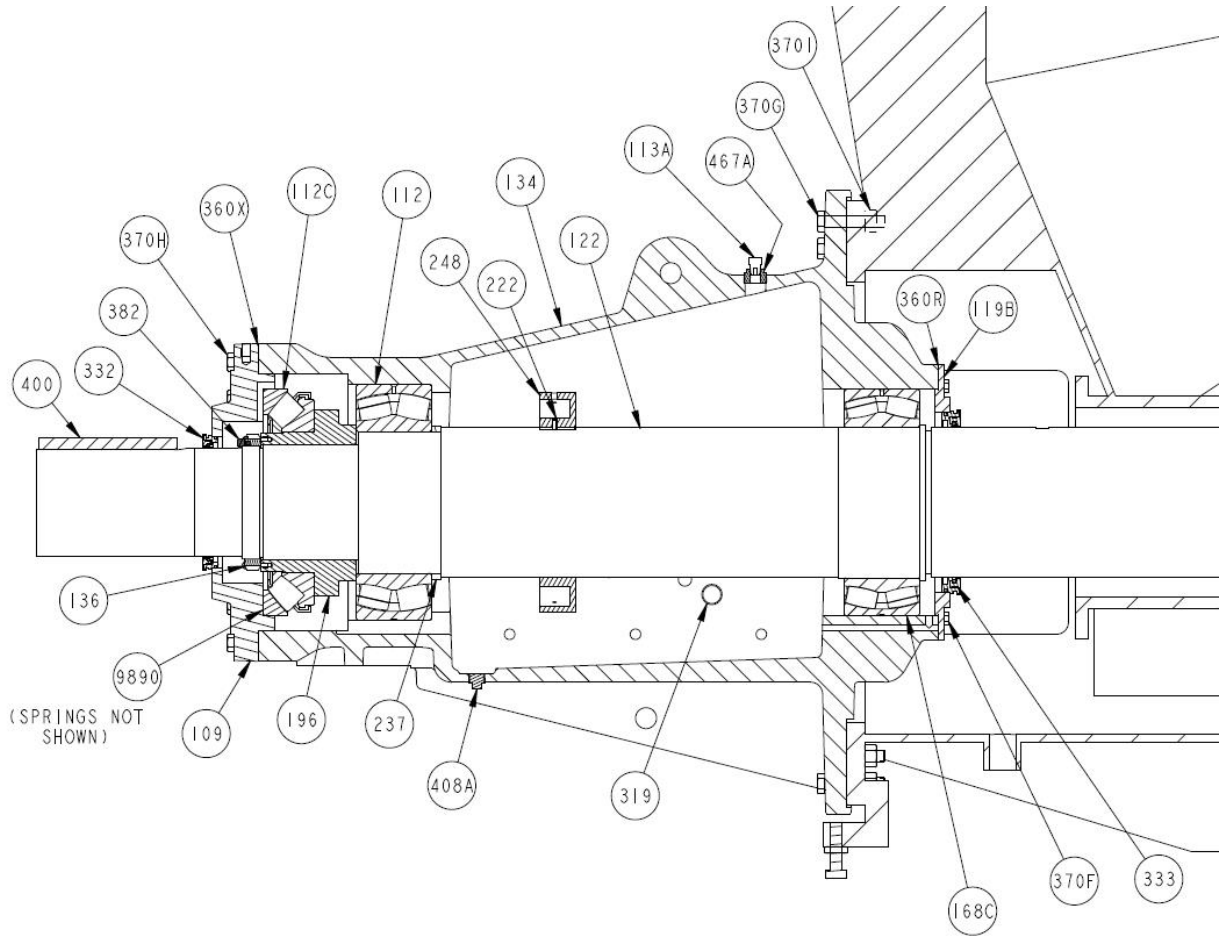
### 8.3 AF Parts List 60-66 inch Top Suction Pumps

Item	Part Description	Item	Part Description
100	CASING	357D	HEX NUT, ELBOW TO CASING

Item	Part Description	Item	Part Description
101	PROPELLER	358U	PIPE PLUG [1/2-14 NPT] (NOT SHOWN)
105	LANTERN RING	358V	PIPE PLUG [1"-11.5 NPT] (NOT SHOWN)
106	PACKING, PACKED BOX	360R	GASKET, BRG., INBOARD
107	GLAND	360X	GASKET, BRG., OUTBOARD
109	RETAINER, THRUST BEARING	370A	STUD, PROPELLER END COVER
112	BEARING, RADIAL, OUTBOARD	370B	CAP SCREW - SUCTION ALIGNMENT
112C	BEARING, THRUST	370C	CAP SCREW, SHAFT WASHER
113A	BREATHER	370D	STUD, ELBOW TO CASING
119B	RETAINER, RADIAL BEARING	370E	CAP SCREW-ALIGNMENT
122	SHAFT	370F	CAP SCREW, RADIAL BEARING RETAIN- ER
126	SHAFT, SLEEVE	370G	CAP SCREW, BEARING FRAME TO EL- BOW
128D	SLEEVE KEY	370H	CAP SCREW, THRUST RETAINER TO BEARING FRAME
134	BEARING FRAME ASSEMBLY	370I	HEX NUT, BEARING FRAME TO ELBOW
136	LOCKNUT, THRUST BEARING	382	LOCKNUT CLIP
168C	BEARING, RADIAL INBOARD	383	MECHANICAL SEAL
178	PROPELLER KEY	400	KEY, COUPLING
196	SLEEVE, THRUST BEARING	408A	PIPE PLUG (1"-11.5 NPT)
222	SET SCREW, OIL WHEEL	408H	PLUG - PROPELLER CAP
222C	SET SCREW, SLEEVE KEY	415	JAM NUT - SUCTION ALIGNMENT
248	OIL WHEEL	415A	JAM NUT - ALIGNMENT
315A	ELBOW	443	SPACER, BEARING
319	SIGHT WINDOW	467A	HEX BUSHING - BREATHER
319A	SIGHT WINDOW	473	THROAT BUSHING
332	OIL SEAL, OUTBOARD	494	FRAME COOLER ASSEMBLY
333	OIL SEAL, INBOARD	496A	O-RING, SHAFT SLEEVE
351A	CASING O-RING	496B	O-RING. PROPELLER END COVER
351B	CASING O-RING	496C	O-RING, SHAFT TO PROPELLER
353	STUD, GLAND	9890	SPRINGS, THRUST BEARING
355	HEX NUT, GLAND	9985	SHAFT WASHER / PROPELLER LOCK- PLATE
		9988	PROPELLER END COVER

### 8.3.1 60-66 (Top Suction) AF with LMR Bearings

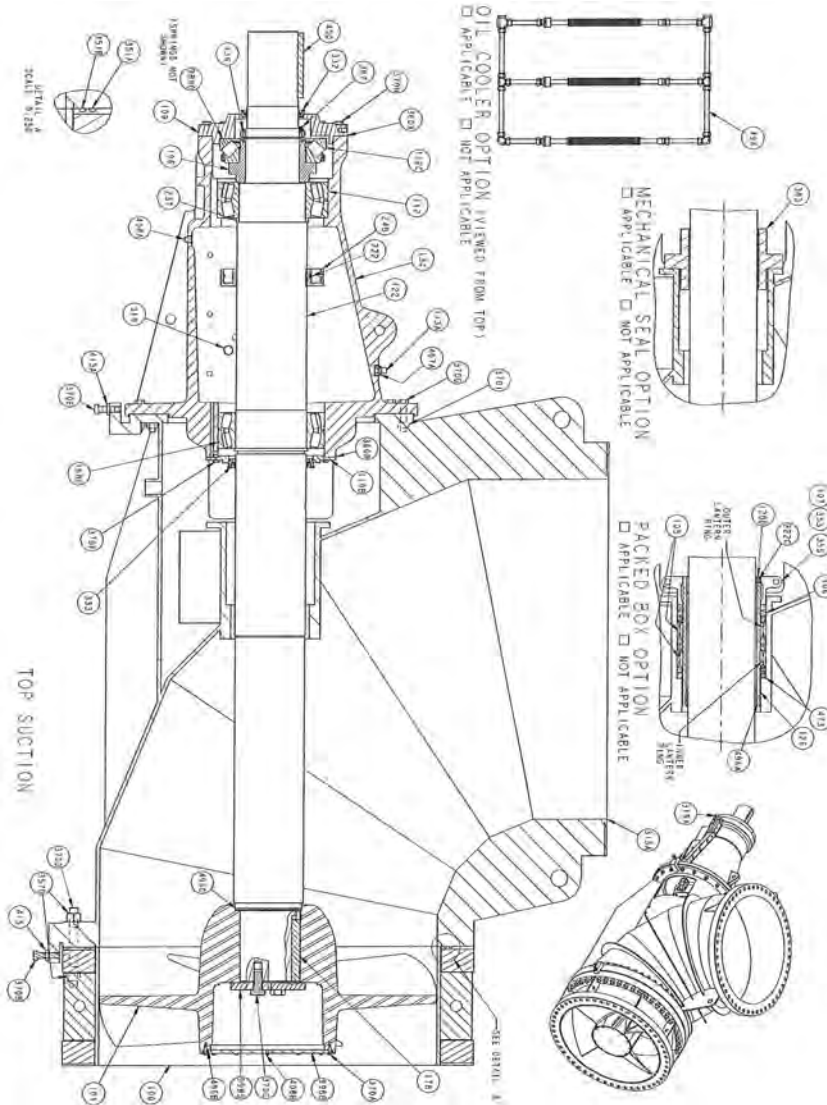
Refer to [8.3.1 60-66 \(Top Suction\) AF with LMR Bearings on page 74](#)



### 8.3.2 60-66 AF with LMR Bearings / Mechanical Seal and Casing Gasket Seal

Refer to [8.3 AF Parts List 60-66 inch Top Suction Pumps](#) on page 73





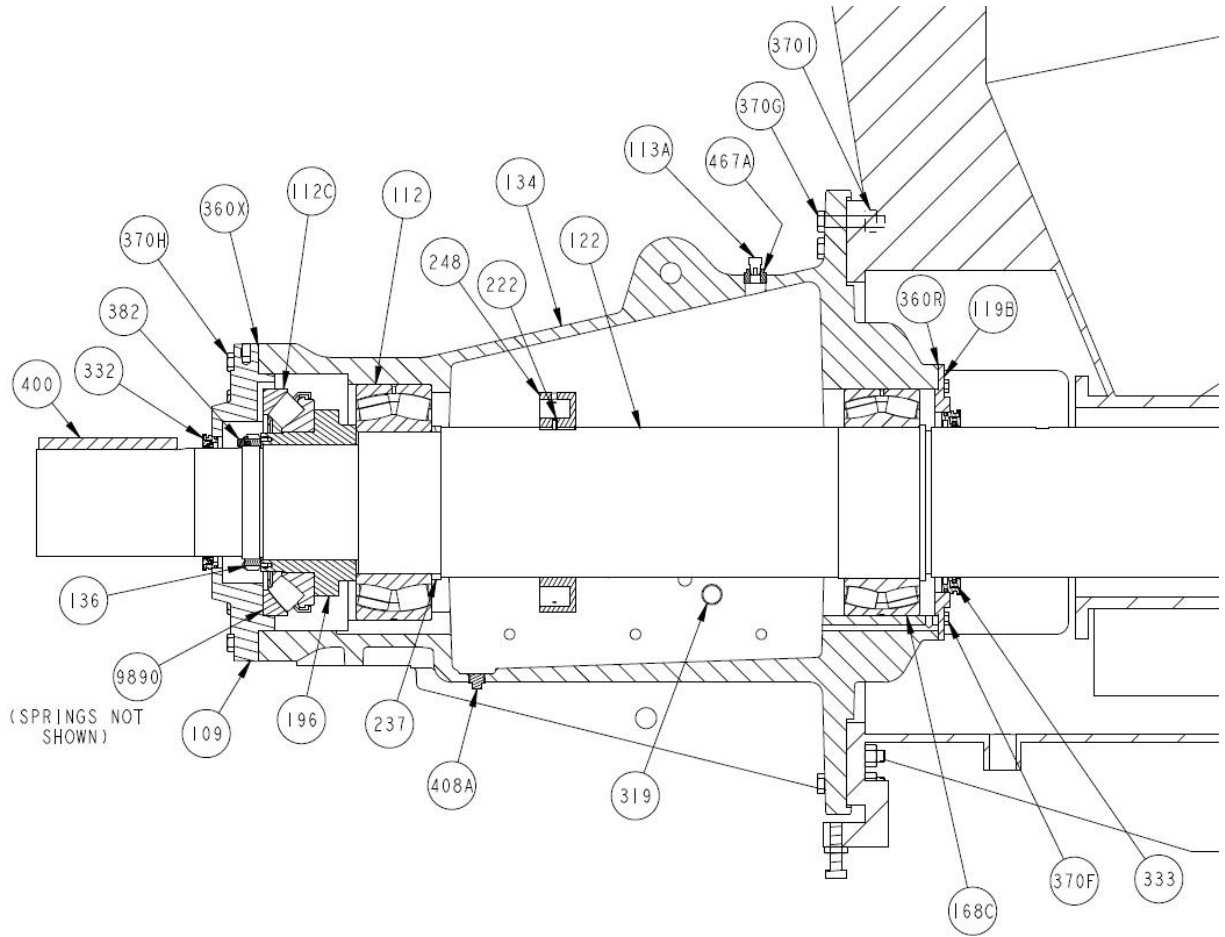
## 8.4 AF Parts List 60-66 inch End Suction Pumps

Item	Part Description	Item	Part Description
100	CASING	357D	HEX NUT, ELBOW TO CASING
101	PROPELLER	358U	PIPE PLUG [1/2"-14 NPT] (NOT SHOWN)
105	LANTERN RING	358V	PIPE PLUG [1"-11.5 NPT] (NOT SHOWN)
106	PACKING, PACKED BOX	360R	GASKET, BRG., INBOARD
107	GLAND	360X	GASKET, BRG., OUTBOARD
109	RETAINER, THRUST BEARING	370A	STUD, PROPELLER END COVER
112	BEARING, RADIAL, OUTBOARD	370B	CAP SCREW - SUCTION ALIGNMENT
112C	BEARING, THRUST	370C	CAP SCREW, SHAFT WASHER
113A	BREATHER	370D	STUD, ELBOW TO CASING
119B	RETAINER, RADIAL BEARING	370E	CAP SCREW-ALIGNMENT
122	SHAFT	370F	CAP SCREW, RADIAL BEARING RETAINER
126	SHAFT, SLEEVE	370G	CAP SCREW, BEARING FRAME TO ELBOW

Item	Part Description	Item	Part Description
128D	SLEEVE KEY	370H	CAP SCREW, THRUST RETAINER TO BEARING FRAME
134	BEARING FRAME ASSEMBLY	370I	HEX NUT, BEARING FRAME TO ELBOW
136	LOCKNUT, THRUST BEARING	382	LOCKNUT CLIP
168C	BEARING, RADIAL INBOARD	383	MECHANICAL SEAL
178	PROPELLER KEY	400	KEY, COUPLING
196	SLEEVE, THRUST BEARING	408A	PIPE PLUG (1"-11.5 NPT)
222	SET SCREW, OIL WHEEL	408H	PLUG - PROPELLER CAP
222C	SET SCREW, SLEEVE KEY	415	JAM NUT - SUCTION ALIGNMENT
248	OIL WHEEL	415A	JAM NUT - ALIGNMENT
315A	ELBOW	443	SPACER, BEARING
319	SIGHT WINDOW	467A	HEX BUSHING - BREATHER
319A	SIGHT WINDOW	473	THROAT BUSHING
332	OIL SEAL, OUTBOARD	494	FRAME COOLER ASSEMBLY
333	OIL SEAL, INBOARD	496A	O-RING, SHAFT SLEEVE
351A	CASING O-RING	496B	O-RING, PROPELLER END COVER
351B	CASING O-RING	496C	O-RING, SHAFT TO PROPELLER
353	STUD, GLAND	9890	SPRINGS, THRUST BEARING
355	HEX NUT, GLAND	9985	SHAFT WASHER / PROPELLER LOCK-PLATE
		9988	PROPELLER END COVER

### 8.4.1 60-66 (End Suction) AF with LM Bearings

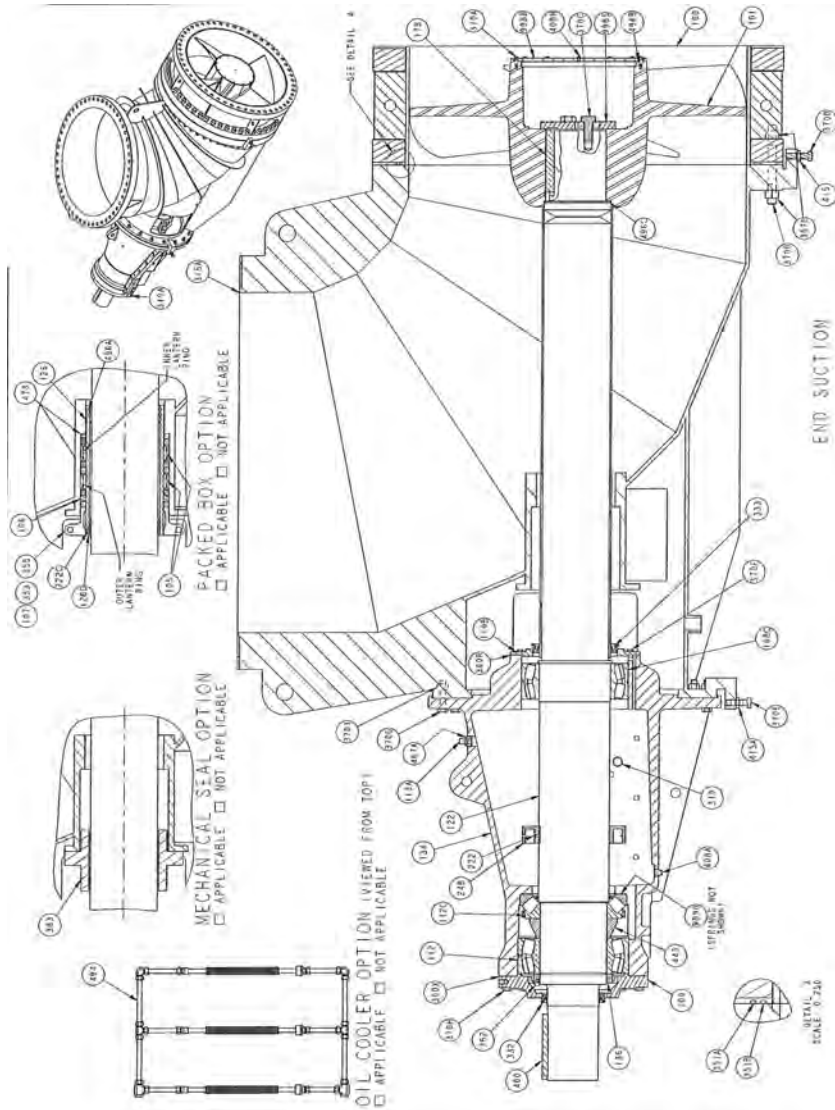
Refer to [8.4 AF Parts List 60-66 inch End Suction Pumps](#) on page 76



### 8.4.2 60-66 AF with LM Bearings / Special Packing Arrangement / Dual Casing O-Ring Seal

Refer to [8.4 AF Parts List 60-66 inch End Suction Pumps](#) on page 76





# 9 Appendix I

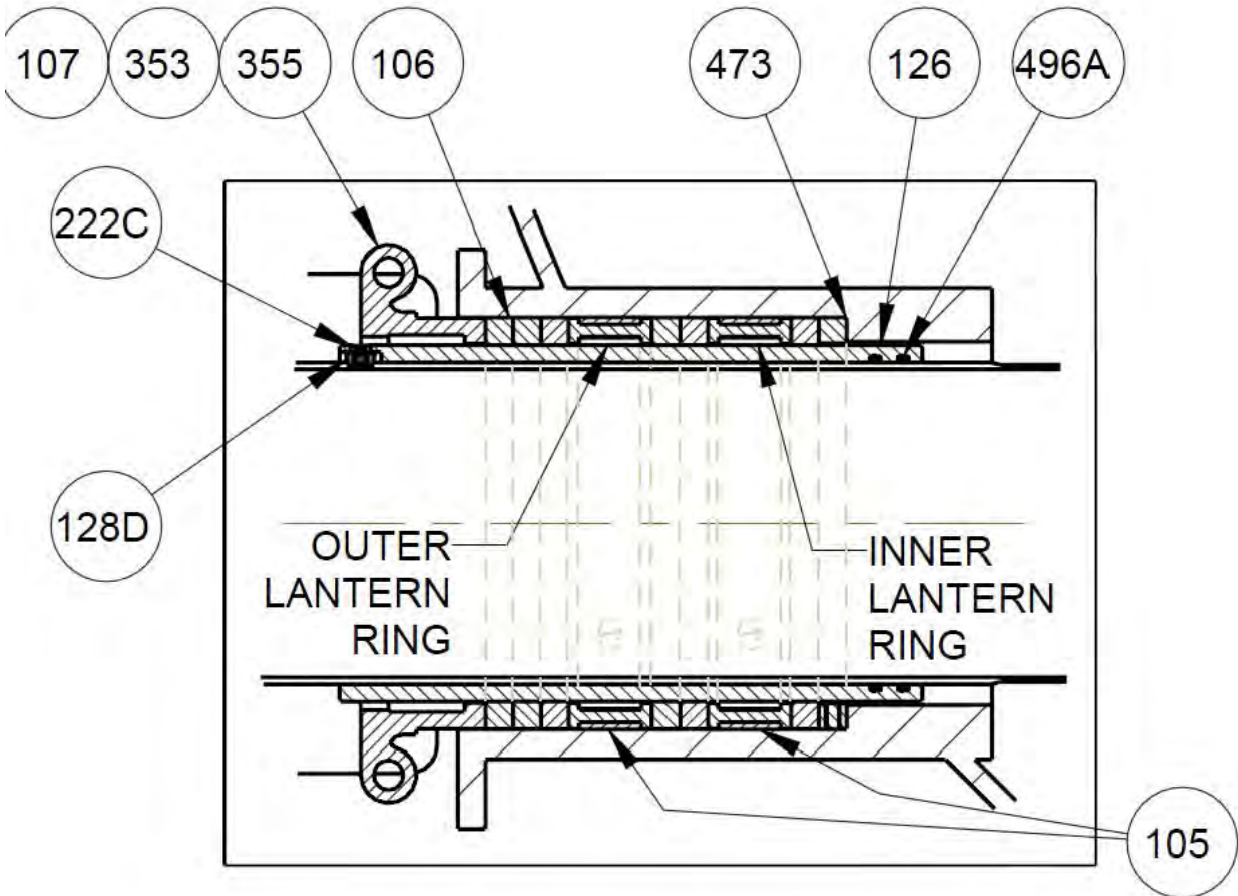
## 9.1 Special Packing Arrangement

(High pressure, dual flush packing)

The following information covers the installation, operation and maintenance of the high pressure, dual flush packing arrangement. This arrangement was developed for high pressure, to minimize product dilution, and to minimize external packing leakage.

### Description

The arrangement consists of (6) rings of packing (106), (2) lantern rings (105), and (1) restrictor bushing arranged as follows: 3P, 1L, 2P, 1L, 1P, 1RB from the gland face to the bottom of the stuffing box, See *High Pressure Dual Flush Packing Arrangement* figure below.



**Figure 28: High Pressure Dual Flush Packing Arrangement**

The inner lantern ring uses product flush to minimize product dilution. This flush should be filtered to reduce particle size and minimize sleeve / packing wear.

The outer lantern ring is supplied with water and is used as with any other packing arrangement to lubricate and cool the packing as the shaft rotates and generates heat.

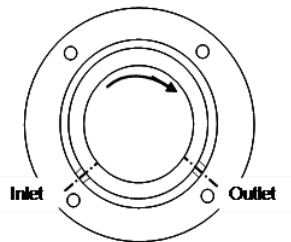
The flush pressures should be 10% higher than the pressure inside the pump. For end suction pumps this will also include pump discharge pressure. Product flush pressure to the inner lantern ring may be slightly less than the water flush pressure to ensure flow toward the inside of the pump.

The flush flow depends on the application, the more heat generated the higher the flows must be to effectively remove the heat. The table below can be used as a starting point for initial setting: The table below represents the flow required with one flush line, for a dual flush arrangement the flow can be divided up equally.

**Table 10: Flush Flow**

Sleeve dia. (inches)	Flush Flow (gpm)
2	.05
3	.15
4	.30
6	1.3
8	2.5
10	5.0
12	8.0

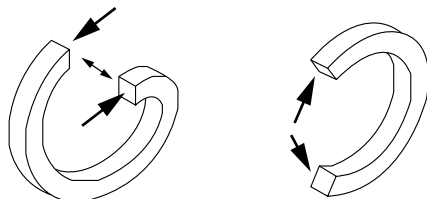
The stuffing box is furnished with (2) inlet and (2) outlet ports for piping of the flush liquid. The inlets are chosen based on shaft rotation direction so the flush flow travels the longer route to the outlet ports (see *Inlet and Outlet Ports* figure). The outlet ports may be plugged, but for improved cooling of the sealing elements, outlet pipes are installed to allow more flow through the stuffing box. With this setup flush flows are regulated by a valve on the outlet line rather than by throttling the flow on the inlet line.



**Figure 29: Inlet and Outlet Ports**

### Installation

1. Be sure the stuffing box and shaft sleeve (126) are clean and free of grit.
2. A PTFE restrictor bushing is used in the bottom of the box and is installed similar to packing (see *Packing Rings* figure). With the restrictor bushing wrapped around the shaft, push it squarely into the stuffing box until it bottoms out. Be sure the ends have not separated and that it sits square in the bottom of the box. Note, where the cut is positioned.
3. Form packing over a mandrel of same shaft diameter and carefully cut packing to length. Discard rings cut too short.
4. Pre-form each ring by coiling 1-1/2 turns.
5. To install packing rings, do not pull straight. Expand the coil as a coil spring, see *Packing Rings* figure, for the correct and incorrect method of installing packing.



Correct

Incorrect

**Figure 30: Packing Rings**

6. Expand the first coil as shown and insert into stuffing box. Tamp the packing up against the restrictor bushing shoulder firmly with a nylon bar or wood rod. Note, where the cut is positioned.
7. Assemble the first lantern ring around the shaft and push it squarely into the stuffing box until it bottoms out against the first ring of packing. Failure to properly locate the lantern ring with respect to the flush ports will result in insufficient packing lubrication. Packing and shaft sleeve damage may result.
8. Install the second and third coil as required by the sectional drawing, staggering the cuts 90° to 120°.
9. Assemble the second lantern ring around the shaft and push it squarely into the stuffing box until it bottoms out on the third ring of packing. Failure to properly locate the lantern ring with respect to the flush ports will result in insufficient packing lubrication. Packing and shaft sleeve damage may result.
10. Install the third, fourth and fifth packing ring as required by the sectional drawing, staggering the cuts 90° to 120°.
11. After all packing and lantern rings have been properly installed, insert gland into stuffing box. Tighten gland nuts finger tight only. The shaft should turn freely.
12. Turn lubricant supply on, start pump, and adjust the gland as described in the operation section that follows.
13. 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.

**Gland Adjustment**

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

**Leakage**

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



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