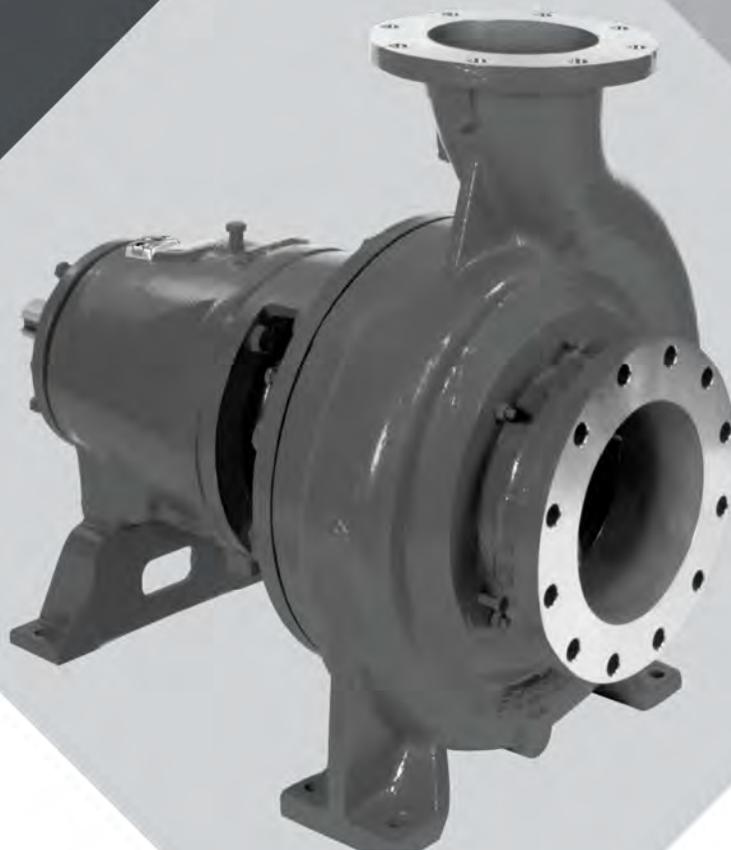


 **GOULDS PUMPS**

Installation, Operation and Maintenance Instructions

3175



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



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.

NOTICE:

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

1.1.1 Requesting other information

Special versions can be supplied with supplementary instruction leaflets. See the sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or in the sales documents, please contact the nearest ITT representative.

Always specify the exact product type and serial number when requesting technical information or spare parts.

1.2 Safety



WARNING:

- 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.
- 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.

- 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.
- 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.
- 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.
- 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.



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.



WARNING:

This product contains Carbon Black a chemical known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov

1.2.1 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
	DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
	WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
	CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
	NOTICE:	<ul style="list-style-type: none"> • A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

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

1.2.1.1 The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.



1.2.2 Environmental safety

The work area

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

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid 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.



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.

Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 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



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.

Temperature



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.

1.2.3.1 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.
- 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.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

1.2.3.2 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.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.

1.2.3.3 Hazardous liquids

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who work with biologically hazardous liquids are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.
- A small amount of liquid will be present in certain areas like the seal chamber.

1.2.3.4 Wash the skin and eyes

1. Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	<ol style="list-style-type: none"> 1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	<ol style="list-style-type: none"> 1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.3 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.



1.4 Ex 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:



Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, EN 60079-17).

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

Description of Ex-Directives

The Ex-directives are a specification enforced in Europe and the United Kingdom for electrical and non-electrical equipment installed in those locations. Ex-directives deal with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmospheres. The relevance of the Ex-requirements is not limited to Europe or the UK. 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 liquid end temperature.
2. Maintaining proper bearing lubrication.

3. Ensuring that the pump is operated in the intended hydraulic range.

The Ex 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 Ex classified environment, are identified by an Ex tag secured to the pump or the baseplate on which it is mounted. A typical tag would look like this:

If applicable, your pump may have either a CE Ex (ATEX) tag or UKCA Ex tag affixed to the pump. See the Safety section for a description of the symbols and codes. Typical nameplate only shown below, the actual area classification may be different.

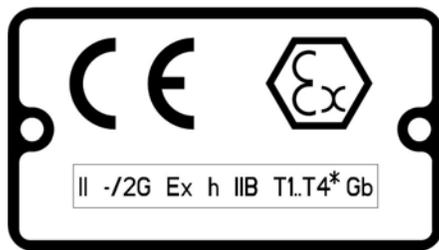


Figure 1: Typical Ex nameplate



Figure 2: Typical UKCA Ex 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 10](#) is for the purpose of determining T'x' code for Ex 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.

ISO 80079-37:2016 Section 5.7

Recommended bearing replacement interval (based on L10 life) = 17,500 hours of operation.

2 Transportation and Storage

2.1 Transportation and Storage

2.1.1 Inspect the delivery

2.1.1.1 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.

2.1.1.2 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.

2.1.2 Transportation guidelines

2.1.2.1 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.



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.

2.1.2.2 Lifting methods



WARNING:

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
- Safe lifting points are specifically identified in this manual. It is critical to lift the equipment only at these points. Integral lifting eyes or eye bolts on pump and motor components are intended for use in lifting the individual components only.

- Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

Table 2: Methods

Pump type	Lifting method
Bare pump without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A bare pump with lifting handles	Lift the pump by the handles.
A base-mounted pump	Use slings under the pump casing and the drive unit, or under the base rails.
A base-mounted pump with baseplate lifting lugs	Use slings through the baseplate lifting lugs.

Examples

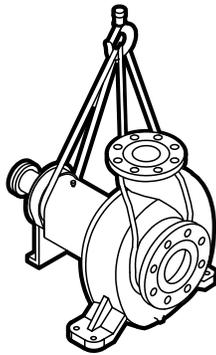


Figure 3: Example of a proper lifting method

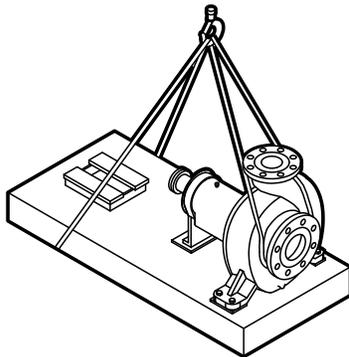


Figure 4: Example of a proper lifting method

NOTICE:

Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

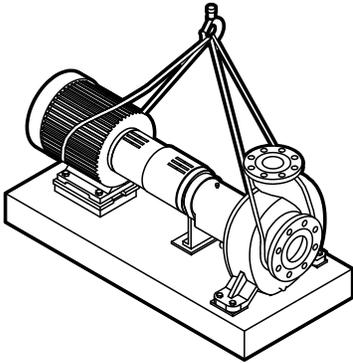


Figure 5: Example of a proper lifting method

NOTICE:

Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

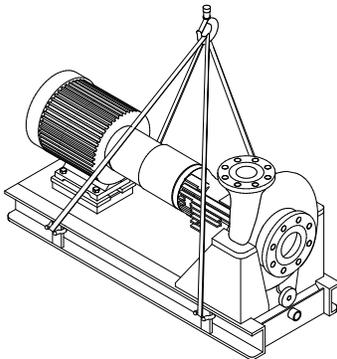


Figure 6: Example of a proper lifting method

NOTICE:

When lifting a unit for which a strap cannot be secured at the suction flange, secure the strap through the frame/frame adapter. Securing at the frame adapter will prevent slipping of the strap and possible equipment damage.

2.1.3 Storage guidelines

2.1.3.1 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"> • Store in a covered and dry location. • Store the unit free from dirt and vibrations.
Long-term (more than six months)	<ul style="list-style-type: none"> • Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations.

Length of time in storage	Storage requirements
	<ul style="list-style-type: none"> • Rotate the shaft by hand several times at least every three months.

NOTICE:

Risk of damage to the mechanical seal or shaft sleeve on units supplied with cartridge mechanical seals. Make sure to install and tighten the centering clips and loosen the set screws in the seal locking ring.

Treat bearing and machined surfaces so that they are well preserved. Refer to drive unit and coupling manufacturers for their long-term storage procedures.

You can purchase long-term storage treatment with the initial unit order or you can purchase it and apply it after the units are already in the field. Contact your local ITT sales representative.

2.1.3.2 Frostproofing

Table 3: Situations when the pump is or is not frostproof

Situation	Condition
Operating	The pump is frostproof.
Immersed in a liquid	The pump is frostproof.
Lifted out of a liquid into a temperature below freezing	The impeller might freeze.

3 Product Description

3.1 Description of Units



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.

Reference is made to several different types of pumps in the following text. To enable the reader to associate these terms to his particular unit, photographs of typical units with an identifying description are shown below.

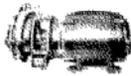


Figure 7: Close Coupled

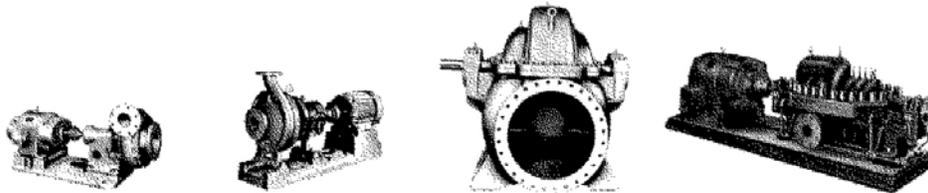


Figure 8: Horizontal



Figure 9: Vertical

3.2 General description i-ALERT[®] Equipment Condition Monitor

Description

The i-ALERT[®] Equipment Condition Monitor is a compact, battery-operated monitoring device that continuously measures the vibration and temperature of the pump power end. The i-ALERT[®] sensor uses blinking red LEDs and wireless notification to alert the pump operator when the pump exceeds vibration and temperature limits. This allows the pump operator to make changes to the process or the pump before a catastrophic failure occurs. The Condition Monitor is also equipped with a single green LED to indicate when it is operational and has sufficient battery life. (i-ALERT[®] Bluetooth Equipment Condition Monitor option available. The i-ALERT[®] monitor allows customers to identify potential problems before

they become costly failures. It tracks vibration, temperature and run-time hours and wirelessly syncs the data with a smart phone or tablet the i-ALERT[®] mobile app. More information available on

More information available on <http://www.ittproservices.com/aftermarket-products/monitoring/i-alert2/i-ALERT2.com>

Current IOMs are available at <http://www.gouldspumps.com/en-us/tools> - and - resources/literature/IOMs, <http://i-alert.com> or your local ITT Goulds Pumps Sales Rep.

Alarm mode

The condition monitor enters alarm mode when either vibration or temperature limits are exceeded over two consecutive readings within a ten minute period. Alarm mode is indicated with two red flashing LEDs within two second intervals.

Temperature and vibration limits

Variable	Limit
Temperature	91°C 195°F
Vibration	100% increase over the baseline level

Battery life

The i-ALERT[®]2 Condition Monitor battery is not replaceable. You must replace the entire unit once the battery runs out of power.

The battery life is not covered as part of the standard pump warranty.

This table shows the average condition monitor battery life under normal and alarm-mode operating conditions.

Condition monitor operational state	Battery life
Normal operating and environmental conditions	Three to five years
Alarm mode	One year

3.3 Nameplate information

Important information for ordering

Every pump has nameplates that provide information about the pump. The nameplates are located on the casing and the bearing frame.

When you order spare parts, identify this pump information:

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

Item numbers can be found in the spare parts list.

Refer to the nameplate on the pump casing for most of the information. See Parts List for item numbers.

Nameplate types

Nameplate	Description
Pump casing	Provides information about the hydraulic characteristics of the pump.

Nameplate	Description
Pump	The formula for the pump size is: Discharge x Suction - Nominal Maximum Impeller Diameter in inches. (Example: 2x3-8)
Bearing frame	Provides information about the lubrication system used.
Ex	If applicable, your pump unit might have an Ex nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the Ex specifications of this pump.

Nameplate on the pump casing using English units

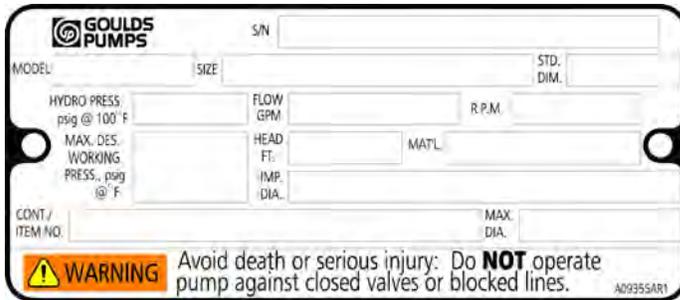


Figure 10: Nameplate on the pump casing using English units

Table 4: Explanation of nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute
FT HD	Rated pump head, in feet
RPM	Rated pump speed, revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST.	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX DSGN PSI @ 100°F	Maximum pressure at 100°F according to the pump design

Nameplate on the pump casing using metric units

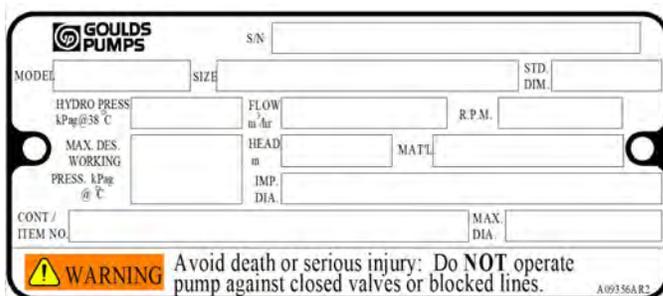


Figure 11: Metric units - nameplate on pump casing

Table 5: Explanation of the nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter
MAX. DIA.	Maximum impeller diameter
M ³ /HR	Rated pump flow, in cubic meters per hour
M HD	Rated pump head, in meters
RPM	Rated pump speed, in revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX. DSGN kPag @ 20°C	Kilopascal at 20°C

Nameplate on the bearing frame

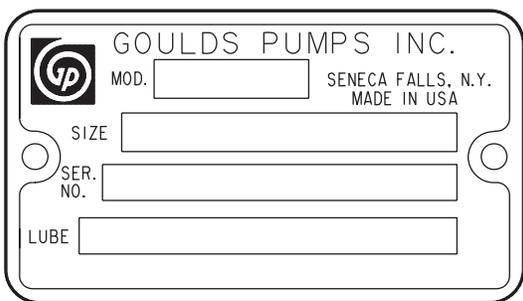


Figure 12: Nameplate on the bearing frame

Table 6: Explanation of the nameplate on the bearing frame

Nameplate field	Explanation
BRG. O. B.	Outboard bearing designation
BRG. I. B.	Inboard bearing designation
S/N	Serial number of the pump
LUBE	Lubricant, oil or grease

Ex nameplate

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

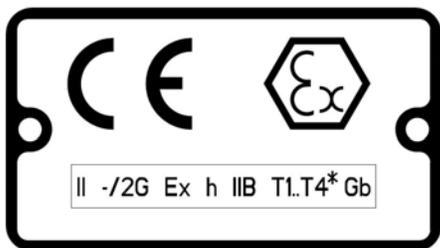


Figure 13: Typical Ex nameplate



Figure 14: Typical UKCA Ex nameplate

Table 7: 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

ISO 80079-37:2016 Section 5.7

Recommended bearing replacement interval (based on L10 life) = 17,500 hours of operation.

The code classification marked on the equipment should be in accordance with the specified area where the equipment will be installed. If it is not, please contact your ITT/Goolds representative before proceeding.

**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.

4 Installation

4.1 Pre-installation

Precautions



WARNING:

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
 - All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to verify it is connected correctly.
-

NOTICE:

- Electrical connections must be made by certified electricians in compliance with all international, national, state and local regulations.
 - Supervision by an authorized ITT representative is recommended to ensure proper installation. Improper installation may result in equipment damage or decreased performance.
-

4.2 Location

Pumping unit should be placed as close as practical to the source of supply. Floor space and head room allotted to the unit must be sufficient for inspection and maintenance. Be sure to allow for crane or hoist service. On horizontally split case pumps, always allow sufficient head room to remove the upper half casing

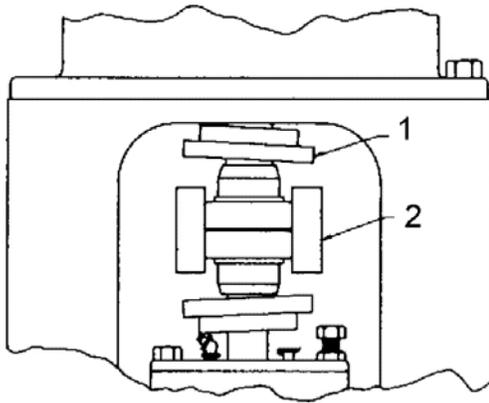
4.3 Install Close-Coupled and Vertical Pumps

1. Close Coupled
 - a) A "close-coupled" pump may be mounted horizontally or in a vertical position provided motor is above pump.
 - b) The unit should be bolted to a concrete foundation or an adequately supported structure, substantial enough to absorb any vibration and to form a permanent rigid support for the unit. All units have holddown bolt holes in the motor feet and pump/ adapter feet. Depending upon the motor frame, the pump or adapter feet may be higher or lower than the motor feet.
 - c) Shim as required, then bolt all feet securely to support or foundation. Since the pump is mounted on the motor, permanent alignment is "built in". No subsequent alignment is necessary.
2. Vertical
 - a) Vertical pumps may be mounted directly on a pit, using either the pump support plate only or in conjunction with a pit or tank cover. The units are shipped completely assembled except for motor, pit cover (if any), and float controls.
 - b) Check all bolts and nuts on the entire unit to make sure they are securely tightened.
 - c) Connect float and controls as shown in sectional view at [8.3 Parts List on page 86](#).
3. Installation must be done with care to avoid damage and insure proper operation. It is recommended that a man be stationed inside the pit, whenever possible, to assist in the initial installation.

4. Lower the assembled pump (less motor) carefully into the pit. Guide unit carefully so that it does not strike sides of pit. When unit is in place, level the support plate. Shim under support plate as required. Pump must hang perfectly vertical to avoid placing a bending stress on the unit.
5. The support plate should be bolted to an adequately supported structure, substantial enough to absorb any vibration and to form a permanent, rigid support for the unit.
6. Place motor on motor support and tighten bolts (with lode washers) snugly.
7. Check for alignment by laying a straight edge across coupling hubs at four points 90° apart. See image below. When the straight edge rests evenly at all four points, the coupling is aligned.

NOTICE:

Alignment of the coupling is of extreme importance for trouble-free mechanical operation.



1. Coupling cover

2. Straight edge

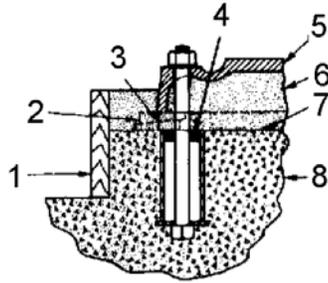
Figure 15: Coupling Alignment

8. The machined faces of the motor support and motor will provide angular alignment. However, any foreign material or burrs on the surface will destroy this alignment. Make sure surfaces are clean and smooth.

4.4 Install Horizontal Pumps

Bed plate mounted units are normally mounted on a concrete foundation of liberal thickness poured on a solid footing, using a one-three-five mix. The foundation should be substantial in order to absorb any vibration and to form a permanent, rigid support for the pumping unit.

1. The location and size of foundation bolts are shown on the outline assembly drawing supplied for the unit.
2. When unit is mounted on a concrete foundation, each foundation bolt should be installed with a pipe sleeve around it to allow for adjustment.
 - a) Place a washer between the bolt head and sleeve to hold bolts. See image below.



- | | |
|--|--|
| 1. Dam | 5. Bedplate |
| 2. Wedges | 6. Grout |
| 3. Leave 3/4" to 1-1/2" under bedplate for grout | 7. Leave top of foundation rough and wet before grouting |
| 4. Waste | 8. Concrete foundation |

Figure 16: Concrete Foundation

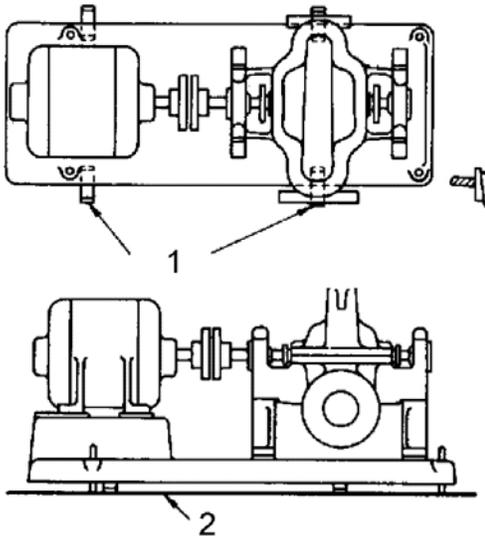
The I. D. of the sleeve should be 2 1/2 - 3 times the bolt diameter.

- b) Stuff waste around bolts to prevent concrete from entering between bolt and sleeve. Bolts should be of sufficient length so that they project through the nuts approximately 1/4" after allowance has been made for grouting, bedplate thickness, and nut thickness.

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

3. Put the unit in place on wedges. The wedges should be placed at four points as shown in the image below. Some long installations may require additional wedges near the middle of the bedplate.



- | | |
|-----------|---------------|
| 1. Wedges | 2. Foundation |
|-----------|---------------|

Figure 17: Wedge placement

4. Disconnect coupling between pump and driver.

NOTICE:

"Spider-Insert" couplings, as shown in the image below, need not be disconnected.

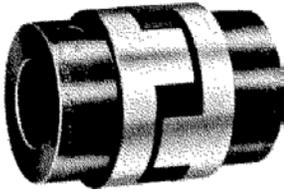


Figure 18: Spider-Insert Couplings

5. By adjustment of wedges, bring the bedplate to an approximate level and provide the proper distance above the foundation for grouting 10.05mm to 38.1mm | 3/4" to 1-1/2". Level or plumb the suction and discharge flanges. Bring pump and motor shafts into reasonable alignment making absolutely certain that motor shaft is not above pump shaft or if it is, that there is a sufficient thickness of shims under the motor feet to allow for adjustment during alignment.
6. Tighten foundation bolts, but only finger tight. Maintain the level of the bedplate.

NOTICE:

Final tightening is done after pump is grouted and grout has set at least 48 hours.

7. Build wood dam around foundation as shown in [Figure 16: Concrete Foundation on page 22](#), and thoroughly wet top surface of foundation. Pour grout in hole provided in top of bedplate. Use of non-shrink grout is recommended. Grout should be thin enough to flow out under the bedplate but not so wet that sand and cement will separate. Grout should be puddled continuously as it is poured to expel the air and completely fill the space under the bedplate to the level of the grout hole. Strike along top of dam with trowel to give a neat finished appearance. Allow grout to harden at least 48 hours.
8. Tighten foundation bolts.
9. Tighten pump hold-down bolts.

4.5 Pump-to-driver alignment

Precautions

**WARNING:**

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

4.5.1 General Alignment Procedures

Alignment of the pump and driver is of extreme importance for trouble-free mechanical operation. The following are suggested steps to establish the initial alignment of the unit.

NOTICE:

This is an initial alignment. The final alignment is done after the unit has been run under actual operating conditions. The final alignment procedure is outlined in [5.21 Final Alignment on page 55](#) and must be followed. Make sure: motor starting switch is "locked out" to prevent accidental rotation.

Any coupling manufacturer's instruction sheets, sent with the pump, should be studied and used when installing, aligning, or servicing coupling. Note that coupling hubs are not necessarily mounted flush with the shaft ends.

If instructions are not available, the following procedure may be used. The procedure is given for two basic coupling types:

1. Flexible Coupling - Normally furnished on all units except "back pull-out". Normally not assembled (except "spider-insert" type which are preassembled) .
2. Flexible Spacer Coupling - Furnished as standard on all "back pull-out" units. Contains a removable spacer piece located between coupling hubs.

NOTICE:

Note that alignment in one direction may alter alignment in another. Check through each alignment procedure after making any alignment alteration.

4.5.1.1 Parallel Alignment

1. Unit is in parallel misalignment when the shaft axes are parallel but not concentric. Shift driver as required.
2. In order to obtain vertical parallel alignment under actual operating conditions, the driver shaft may have to be set higher or lower (using thin shim stock) than the pump shaft due to differences in expansion rates. Pump expansion rates vary with pump design. The following is a suggested cold setting for motor driven units:

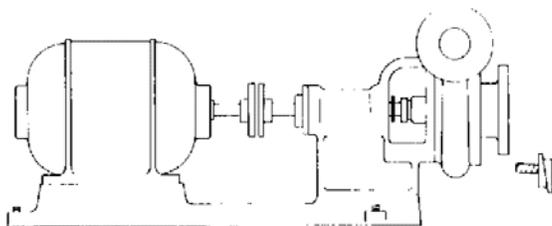


Figure 19: Frame Mounted Units

Option	Description
Pumpage Temperature	Set
Above Ambient	Motor
Temperature	Shaft

Option	Description
Ambient	0.102mm - 0.152mm 0.004" - 0.006" Low
38°C 100°F	0.051mm - 0.102mm 0.002" - 0.004" Low
93°C 200°F	0.000mm - 0.051mm 0.000" - 0.002" Low
149°C 300°F	0.000mm - 0.051mm 0.000" - 0.002" High

Set motor shaft .002"-.004" low regardless of pumpage temperature.

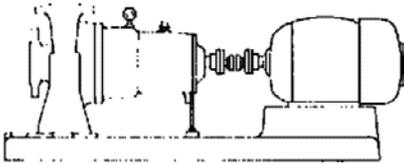
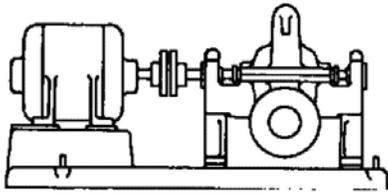


Figure 20: Pedestal Mounted Units

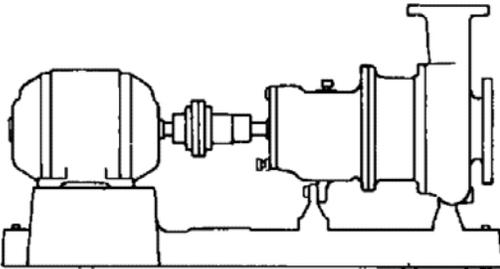


Figure 21: Casing Mounted Units

Option	Description
Pumpage Temperature	Set
Above Ambient	Motor
Temperature	Shaft

Option	Description
Ambient	0.051mm - 0.102mm 0.002" - 0.004" Low
38°C 100°F	0.000mm - 0.051mm 0.000" - 0.002" High
93°C 200°F	0.102mm - 0.152mm 0.004" - 0.006" High
149°C 300°F	0.203mm - 0.254mm 0.008" - 0.010" High
204°C 400°F	0.305mm - 0.356mm 0.012" - 0.014" High
260°C 500°F	0.406mm - 0.457mm 0.016" - 0.018" High

3. To check the parallel alignment:
 - a) Flexible Couplings: Place a straight edge across both coupling hubs at four points 90° apart. The unit will be in parallel alignment when the straight edge rests evenly on both halves. See image below.
 - b) "Spider-Insert" Couplings: Place a straight edge across both coupling hubs at four points 90° apart. The unit will be in parallel alignment when the straight edge rests evenly on both halves. See image below.

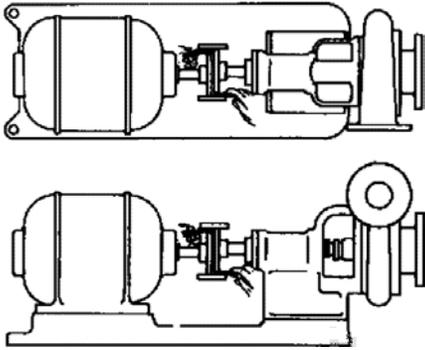
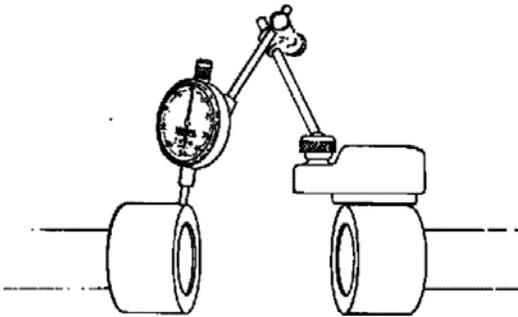


Figure 22: Parallel Alignment with Straight edge

- a) Flexible Spacer Couplings: Place a dial indicator on one hub and rotate that hub 360° while taking readings on the outside diameter of the other hub. When indicator does not deflect more than 0.051mm | 0.002" total, parallel alignment is achieved. See image below.

Figure 23: Parallel Alignment with Dial Indicator



4.5.1.2 Angular Alignment

1. Unit is in angular misalignment when the shaft axes are concentric, but not parallel. Shim unit as required.
 - a) Flexible Couplings: The normal "gap" (distance between coupling halves) is approximately 3.175mm | 1/8". However, the coupling manufacturer's instructions should be followed. Insert a "feeler" or taper gauge at 90° intervals on the circumference of the hubs. When the "gap" is identical within 0.051mm | .002", the unit is in angular alignment. See image below.

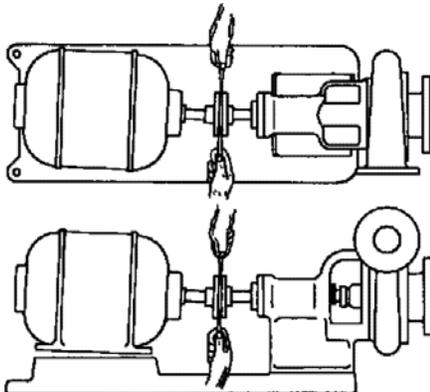


Figure 24: Angular Alignment with Flexible Couplings

- b) Spider Couplings: The normal "gap" (distance between hub and insert) is approximately 1.588mm | 1/16". However, the coupling manufacturer's instructions should be followed. Check

alignment by using calipers at 90° intervals on the circumference on the outer end of hubs. When caliper measurements are identical, the unit is in angular alignment. See image below.

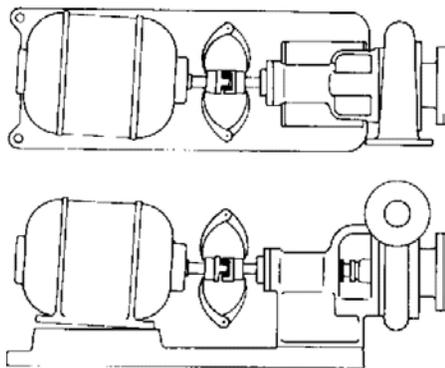


Figure 25: Angular Alignment with Calipers

- c) Flexible Spacer Couplings: Place a dial indicator on one shaft hub and rotate that hub 360°. Take readings from the face of the other hub. Alignment is achieved when indicator does not deflect more than .002". See image below.

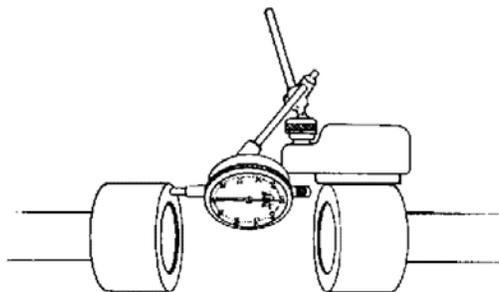


Figure 26: Angular Alignment with Dial Indicator

4.6 General Piping



WARNING:

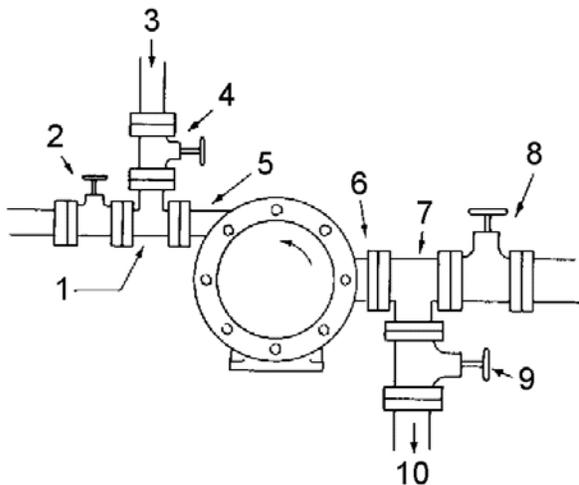
- Risk of premature failure. Casing deformation can result in misalignment and contact with rotating parts, causing excess heat generation and sparks. Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump.
 - Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
 - Use fasteners of the proper size and material only.
 - Replace all corroded fasteners.
 - Ensure that all fasteners are properly tightened and that there are no missing fasteners.
-
1. All piping must be supported independently of the pump. The piping should always "line-up" naturally with the pump flanges. Never draw the piping into place by use of force at the flanged suction and discharge connections of the pump, as this may impose dangerous strains on the unit and cause misalignment between pump and driver.

2. The piping, both suction and discharge, should be as short and direct as possible. Avoid all unnecessary elbows, bends, and fittings, as they increase the friction losses in the piping. The size of pipe and fittings should be carefully selected and of sufficient size to keep the friction losses as low as practical.
3. Piping must not be connected to the pump until the grout has thoroughly hardened and the foundation bolts, as well as driver and pump hold down bolts have been tightened.
4. When handling liquids at elevated temperatures, it is suggested that expansion loops or joints be properly installed in suction and/or discharge lines so that linear expansion of the piping will not draw the pump out of alignment.

If such expansion loops or joints are not used, the forces and moments, due to thermal expansion of the piping system, that can act upon the pump inlet and discharge flanges must be determined and must not exceed the limits permissible for the specific pump in question.

Such installations require extremely careful and precise attention to hot alignment procedures. See [5.21 Final Alignment on page 55](#).

5. On units handling corrosives, the piping can be arranged so that corrosives can be flushed from pump prior to opening unit for service. See image below. During operation, valves "1" and "3" would be closed, "2" and "4" open. Prior to dismantling, close valves "2" and "4", open "1" and "3". Introducing water at valve "3" will allow water to flush pump and drain at valve "1".



- | | |
|----------------|--------------|
| 1. Tee | 6. Suction |
| 2. Valve "A" | 7. Tee |
| 3. Flush water | 8. Valve "2" |
| 4. Valve "3" | 9. Valve "1" |
| 5. Discharge | 10. To waste |

Figure 27: Piping

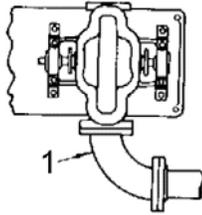
4.7 General Suction Piping

Properly installed suction piping is of extreme importance for trouble-free centrifugal pump operation.

1. Use of elbows close to the pump suction flange should be avoided. Where used, elbows should be long radius.

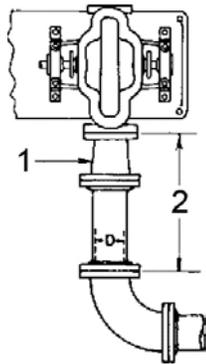
On double suction pumps, if an elbow must be used at the pump suction flange, it must be in a vertical position only. If an elbow must be used in other than a vertical position, it is permissible

only providing there is a minimum of two diameters of straight pipe between the elbow and pump suction flange.



1. Elbow must be vertical when next to pump

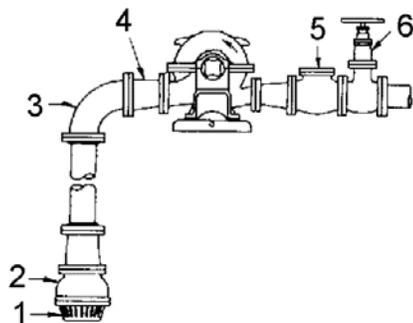
Figure 28: Wrong



1. Eccentric reducer - with top horizontal
2. Must be at least 2D

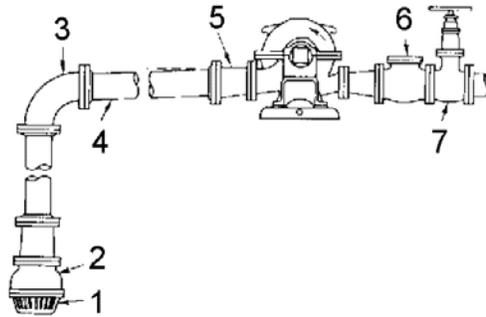
Figure 29: Recommended

2. The suction pipe should never be of smaller diameter than the pump suction. Use of suction pipe one or two sizes larger than the pump suction, with a reducer at the pump suction flange, is desirable.
3. Reducers, if used, should be eccentric and preferably at the pump suction flange, sloping side down.



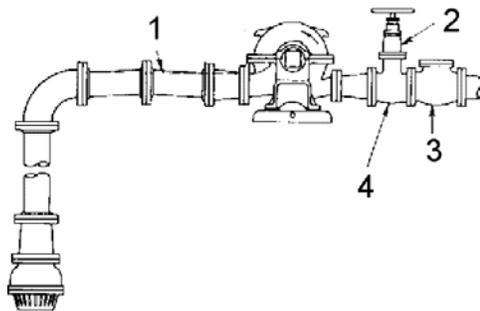
- | | |
|-------------------------|----------------------|
| 1. Strainer | 4. Eccentric reducer |
| 2. Foot valve (if used) | 5. Check valve |
| 3. Long radius elbow | 6. Gate valve |

Figure 30: Correct Piping



- | | |
|--|----------------------|
| 1. Strainer | 5. Eccentric reducer |
| 2. Foot valve (if used) | 6. Check valve |
| 3. Long radius elbow | 7. Gate valve |
| 4. Suction pipe slopes upwards from source of supply | |

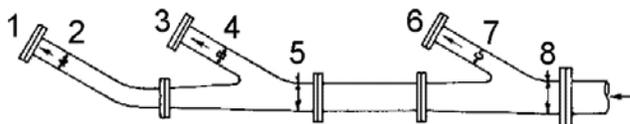
Figure 31: Correct Piping



1. Air pocket because eccentric reducer is not used and because suction pipe does not slope gradually upward from supply
2. Gate valve
3. Check valve
4. Gate valve should not be between check valve and pump

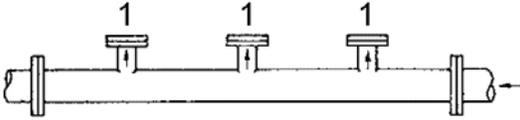
Figure 32: Incorrect Piping

4. A centrifugal pump should never be throttled on the suction side.
5. Suction strainers, when used, should have a net "free area" of at least three times the suction pipe area.
6. Separate suction lines should be used when more than one pump is operating from the same source of supply. If it is not possible to have separate lines, see recommended piping arrangement shown in the image below.



- | | |
|-------------|---------------------------------|
| 1. Pump | 5. Area = "A" + "B" (min) |
| 2. Area "A" | 6. Pump |
| 3. Pump | 7. Area "C" |
| 4. Area "B" | 8. Area = "A" + "B" + "C" (min) |

Figure 33: Recommended Piping Arrangement (when separate suction lines are not possible)



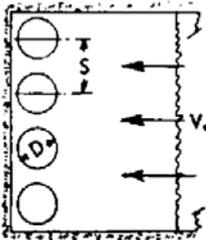
1. Pump

Figure 34: Incorrect Piping Arrangement

4.8 Suction Piping Design for Large Pumps

Large units taking their suction supply from sumps require special attention. A properly designed sump is a must. The larger the unit, the more important these considerations become. A 3000 GPM pump should be considered a large unit.

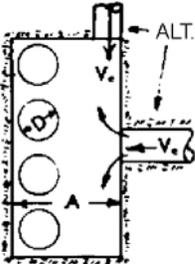
The following sketches will show the preferred pipe arrangement within the sump. Pipe should be located near the back wall of the sump as shown in image below and should not be subjected to rapid changes in direction of the flow pattern.



$V_e = 1\text{fps}$ or less

$S = 1\text{-}1/2$ to $2D$

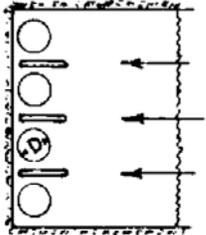
Figure 35: Recommended Pipe Arrangement



$V_e = 2\text{fps}$ and up

If $A =$ less than $8D$

Figure 36: Not Recommended



Add wall thickness to centerline distance round or ogive wall ends. Gap at rear of wall appx. $D/3$

Figure 37: Recommended

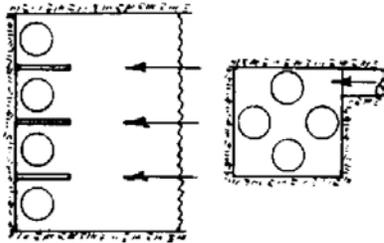
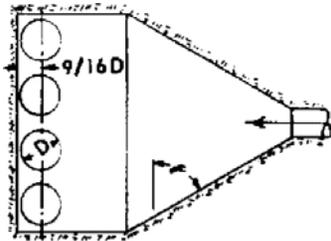


Figure 38: Neither Recommended



Min $O^C = 45^\circ$

Preferred $O^C = 75^\circ$

Figure 39: Recommended

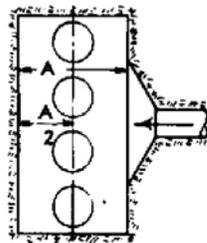


Figure 40: Not Recommended

The velocity of the water approaching the pump suction pipe should be kept to a maximum of one foot per second to avoid air being drawn into the pump. Pump suction inlet velocities and submergence (the height of the water above the pump inlet) are two additional factors that must be considered. These factors vary so greatly with the size and capacities of the individual pumps and systems that past experience, or a good reference, should be relied upon in arriving at these values.

The suction pipe should be sized to obtain a flow velocity of 4 to 7 feet per second. Changes in flow direction should be avoided wherever possible, especially near the pump suction. A reducer at the pump suction flange to smoothly accelerate and stabilize flow into the pump is desirable.

Refer to the nearest Goulds representative for further information.

4.8.1 Installations with Pump Above Source of Supply - Suction Lift

1. Keep suction pipe free from air pockets - See [Figure 32: Incorrect Piping on page 30](#).
2. Piping should slope upwards from source of supply.
3. No portion of piping should extend above the pump suction nozzle.
4. All joints must be air tight.

4.8.2 Installations with Pump Below Source of Supply - Suction Head or Flooded Suction

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

2. Keep suction pipe free from air pockets.

4.9 Discharge Piping

1. Gate and check valves should be installed in the discharge line. The check valve should be located between the gate valve and pump to permit inspection of the check valve. The gate valve is required for priming, regulation of flow and for inspection and maintenance of the pump. The check valve is required to prevent reverse flow through the pump when the driver is turned off.
2. Increasesers, if used in discharge line, should be placed between the pump and check valves.
3. If quick-closing valves are installed in the system, cushioning devices should be used to protect the pump from surges and water hammer.

4.10 Connection of Piping

1. Connect suction and discharge piping to the pump.
2. Rotate pump shaft several times by hand to be sure there is no binding and that all parts are free.
3. Recheck alignment.

NOTICE:

On non-metallic pumps, use gaskets which are suitable for the flanges. PTFE envelope style is recommended.

4.11 Rotation



WARNING:

- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

NOTICE:

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

1. Before coupling is connected, the motor should be wired and the direction of rotation checked.
2. The direction of rotation is marked on the pump. Make sure driver rotates in the same direction.

4.12 Connection of Coupling



WARNING:

Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

4.13 Install the coupling guard

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-

1. Connect coupling. Follow the manufacturer's instructions.
"Spider-Insert" type couplings are pre-assembled.
 2. If a coupling guard is furnished with the unit, make sure it is securely fastened.
-



WARNING:



- The coupling guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.
 - 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.
-

4.13 Install the coupling guard



WARNING:

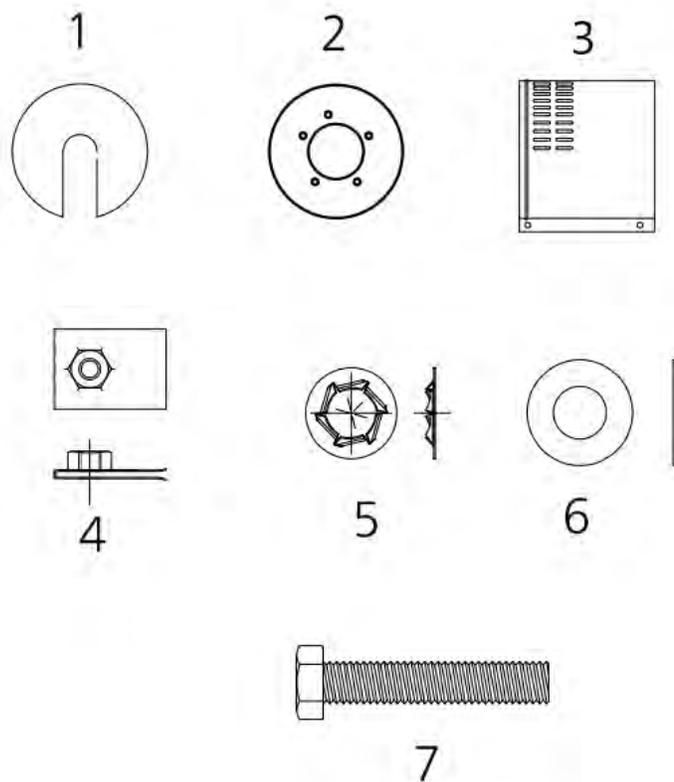
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.
 - Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-



WARNING:

The coupling guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.

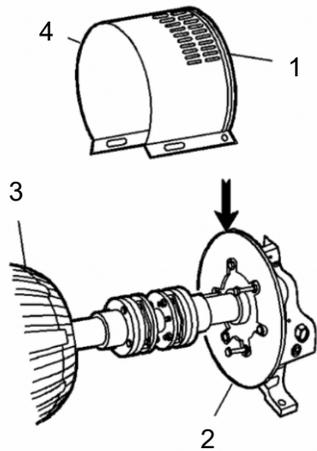
Required parts:



Part No.	Description	Part No.	Description
1	Cover driver	5	Retainer (Qty 3)
2	Cover pump	6	Washer (Qty 4)
3	Guard (Qty 2)	7	Hex head bolt (Qty 3)
4	U-nut (Qty 3)		

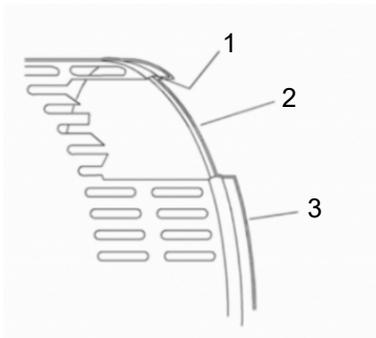
Figure 41: Required parts

1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
2. Put the pump-side end plate in place.
If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.
3. Slightly spread the opening of the coupling guard half and place it over the pump end plate.
 - a) The annular groove in the guard is located around the end plate.
 - b) Position the opening (flange) so that it does not interfere with the piping but still allows for access when you install the bolts.



Item	Description
1.	Annular groove
2.	Pump-side end plate
3.	Driver
4.	Pump half of the coupling guard

Figure 42: Align pump end guard half with annular groove



Item	Description
1.	Annular groove
2.	End plate (pump end)
2.	Guard half

Figure 43: Annular groove in coupling guard

4. Place one washer over the bolt and insert the bolt through the round hole at the front end of the guard half.

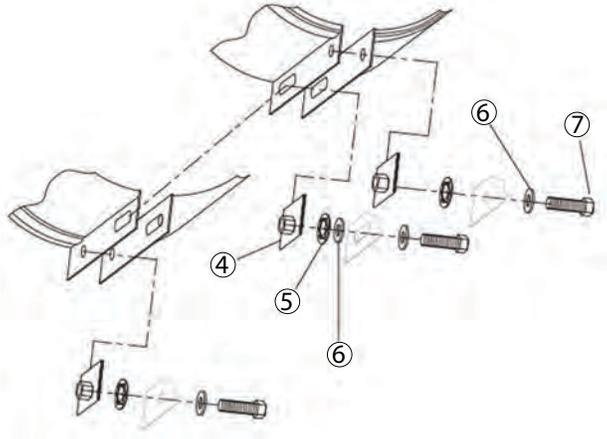


Figure 44: Captured hardware component assembly

5. Install the bolt retainer over the exposed end of the bolt, and the U-Nut into the slot in the coupling guard if it was not done from the factory.
6. Thread bolt into the U-Nut and tighten firmly.
7. Slightly spread the opening of the remaining coupling guard half and place it over the installed coupling guard half so that the annular groove in the remaining coupling guard half faces the motor.

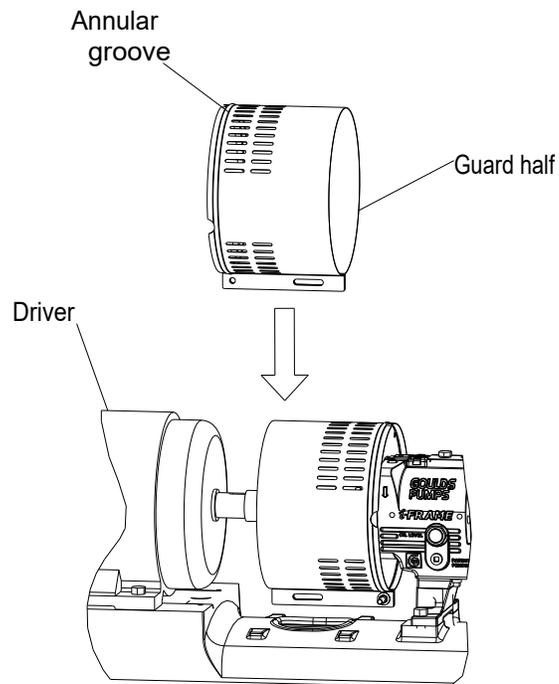


Figure 45: Placement of driver half of coupling guard

8. Place the end plate over the driver shaft and locate the end plate in the annular groove at the rear of the coupling guard half.

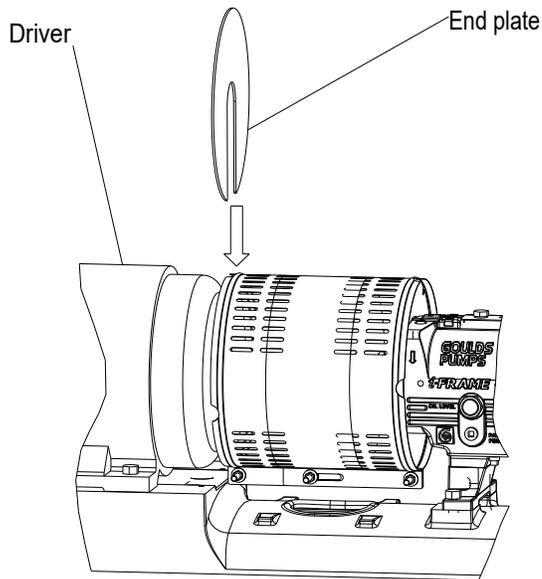


Figure 46: Placement of driver half of coupling guard

9. Hand-tighten only. Repeat Steps 4 through 6 for the rear end of the coupling guard half. The hole is located on the driver-side of the coupling guard half.
10. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.

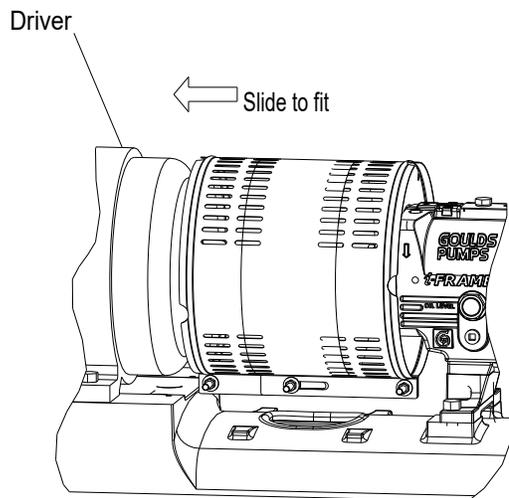


Figure 47: Slide driver-half of coupling guard towards motor

11. Repeat Steps 4 through 6 for the center slots in the coupling guard.
12. Tighten all nuts on the guard assembly.

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup



WARNING:

- Risk of serious physical injury or death. Exceeding any of the pump operating limits (e.g. - pressure, temperature, power, etc.) could result in equipment failure, such as explosion, seizure, or breach of containment. Assure that the system operating conditions are within the capabilities of the pump.
 - Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Ensure all openings are sealed prior to filling the pump.
 - Breach of containment can cause fire, burns, and other serious injury. Failure to follow these precautions before starting the unit may lead to dangerous operating conditions, equipment failure, and breach of containment.
 - 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.
 - Risk of breach of containment and equipment damage. Ensure the pump operates only between minimum and maximum rated flows. Operation outside of these limits can cause high vibration, mechanical seal and/or shaft failure, and/or loss of prime.
-



WARNING:

- 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.
 - 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.
 - Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-

Precautions

WARNING:

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



CAUTION:

When a cartridge mechanical seal is used, ensure that the set screws in the seal locking ring are tightened and that the centering clips have been removed prior to startup. This prevents seal or shaft sleeve damage by ensuring that the seal is properly installed and centered on the sleeve.

NOTICE:

- Verify the driver settings before you start any pump. Refer to the applicable drive equipment IOMs and operating procedures.
 - Excessive warm-up rates can cause equipment damage. Ensure the warm-up rate does not exceed 1.4°C | 2.5°F per minute.
-

NOTICE:

You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
-

5.2 Pump Bearings

Oil Lubrication

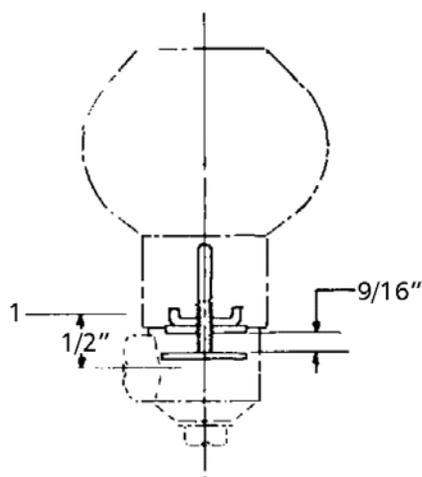


WARNING:



Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

Oil lubricated pumps are not lubricated at the factory. A high quality turbine type oil, with rust and oxidation inhibitors, should be used. Constant level oilers are supplied with most oil lubricated pumps. They are included in the box of fittings which accompanies the pump. The oiler was adjusted to maintain proper oil level before leaving the factory. The adjustment should be checked in case this setting was disturbed. See image below. Check the assembly dimension print for proper location.



1 - Oil level

Figure 48: Oiler

Instructions

1. Remove adjustment assembly from oiler
2. Adjust bars to 9/16"
3. Lock in position
4. Replace adjustment assembly in oiler

Under normal operating conditions, an oil of 300 SSU viscosity at 38°C | 100°F. (approximately SAE-20) should be used. For extreme conditions refer to the factory or a lubrication expert for a recommendation.

Fill the bottle with the proper grade of oil and replace in the oiler housing. Oil reservoir in bearing housing is filled when an oil level remains in the bottle. Several fillings of bottle will be required. Never fill through the oil vent or through the oiler without use of the bottle.

Grease Lubrication

NOTICE:

Grease can settle in equipment left idle leaving bearings improperly lubricated. Check the greasing on a pump that has been out of service for a long period of time and re-grease if necessary.

Grease lubricated pumps can be identified by the grease fittings located on the bearing housing. Sufficient lubricant is inserted at the factory for 2,000 hours of operation. Do not grease at too frequent intervals.

It is suggested that additional or replacement lubricant be added after 2,000 hours or at three-month intervals.

The lubricant should be renewed in the housings at least once annually. This should be done when the annual overhaul is made.

The grease should be of sodium lithium base, NGLI #2 consistency. Do not use graphite. Further greasing instructions are included in [6.2 Lubricate the Pump on page 62](#).

Vertical Pump Bearings

The bearing above the pump support plate is a ball bearing and is grease lubricated. Follow the previous instructions for grease lubrication.

The pump steady bearings (below the pump support plate) are sleeve type and made of various materials depending upon the application of the pump. See [6.2 Lubricate the Pump on page 62](#) for specific details.

Close-Coupled Pumps

"Close-coupled" pumps contain no pump bearings. The only bearings in the unit are contained within the motor. Make sure that the motor bearings are properly lubricated. Refer to the motor manufacturer for instructions.

5.3 Driver Bearing and Coupling

Check to be sure that driver bearings are properly lubricated. Contact the motor manufacturer for lubrication instructions. Refer to coupling instructions supplied separately for coupling lubrication.

5.4 Stuffing Box Packing



WARNING:



- Packed stuffing boxes are not allowed in an Ex-classified environment.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

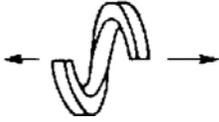
NOTICE:

Make sure to lubricate the packing. Failure to do so may result in shortening the life of the packing and the pump.

Before packing the stuffing box, make sure box is clean and contains no foreign material. If unit has a metal lantern ring, assembled with the pump, make sure ring is outside the stuffing box.

Stuffing box packing is furnished in the box of fittings which accompanies the pump. When packing the stuffing box, refer to the [8.3 Parts List on page 86](#) for the arrangement of packing rings and lantern ring. Depending upon the particular pump and/or application, the lantern ring may be in the middle or bottom of the stuffing box, incorporated in another part or not used at all.

Some packing rings are die-formed and special care must be taken during installation. To install, twist the ring sideways just enough to get it around the shaft or sleeve. Do not attempt to pull rings straight out. See image below. Another form of packing ring is the bulk-type packing which is cut to the proper length. Each piece should be placed around the shaft or sleeve and the ends of the packing should just meet to form a smooth, perfect ring. If necessary, the ends should be trimmed to obtain this fit.

**Figure 49: Correct****Figure 50: Incorrect**

There are two basic types of lantern rings - PTFE and metal. Two-piece PTFE lantern rings are supplied in most units. Install as shown below. Note: 2 pieces make one ring. Notches must face one another but need not be aligned.



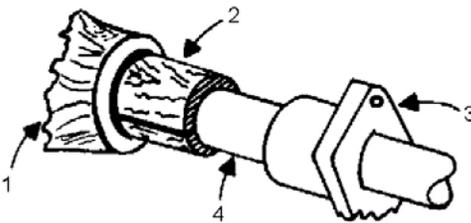
Correct



Incorrect

Figure 51: Metal Lantern Ring**Figure 52: PTFE Lantern Ring**

To pack the stuffing box, install the packing and lantern ring in the proper sequence. Each ring should be installed separately. Firmly seat each ring. Use of a wooden split bushing is recommended. See image below. Use gland to jack the bushing and ring into the box. Stagger joints in each ring 90°. Make sure center of lantern ring lines up with flush tap in the stuffing box. Any extra rings are spares.

**Figure 53: Wooden split bushing**

- | | |
|---------------------------|----------|
| 1. Stuffing box | 3. Gland |
| 2. Wooden "split bushing" | 4. Shaft |

Tighten the gland nuts evenly but not tight. Follow adjustment procedure outlined in [5.20 Initial Inspection After Starting on page 54](#).

5.5 Remove Packing

To remove packing from the stuffing box, the following steps should be followed:



WARNING:



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

1. Remove gland assembly.
2. Remove packing with a "packing hook."
3. Remove lantern ring by inserting a wire hook into the ring on the outer edge.
4. Clean the stuffing box.
5. On horizontally split case pumps, an alternate method of removing packing is to remove the upper half casing.
See [6.5 Disassemble the Pump on page 67](#).
 - a) Remove packing and lantern ring and inspect sleeves.
 - b) If deeply grooved, sleeves should be replaced.

5.6 Mechanical Seals



WARNING:



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



CAUTION:



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

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.

When mechanical seals are furnished, the description and identification is indicated on the order write-ups which are a part of the order acknowledgement, dimension print, and the packing list. Separate seal manufacturers' installation drawings are attached to the pump. The seals are installed and adjusted at the factory. The manufacturer's drawings should be filed for future use in maintaining the seal and in adjusting the seal when the pump is disassembled. To properly prepare the seal for operation, various cooling and flushing flows may have to be connected. In some cases, these flows are recirculated from the pump casing; in others, liquid from an outside source may be used. Connect cooling and flushing flows to seal as directed in subsequent steps.

5.7 Install the shaft guard - if provided



WARNING:

- 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.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.

5.8 Connection of Sealing Liquid or Grease Lubricator (Packed Box)

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

Sealing liquid or grease lubricator is required when:

1. Abrasive particles in the pumpage could score the shaft or sleeve.
2. Stuffing box pressure may be below atmospheric pressure due to pump running with suction lift, or when suction source is under vacuum. Under these conditions, the packing will not be cooled and lubricated and air will be drawn into the pump.

Sealing Liquid

Sealing liquid may be supplied by recirculation of pumpage through a line from the casing to the stuffing box. If the pumpage is abrasive, an outside source of clean compatible liquid must be used at a pressure of 30 to 50 PSI above suction pressure.

Grease Lubricator

The grease lubricator is supplied when the use of recirculating pumpage or outside sealing liquid is not desired. The grease should be insoluble in the pumpage.

5.9 Connection of Cooling Water Piping

Quench Gland

Most pumps which contain stuffing box packing have quench glands. Quenching prevents heat transfer along the pump shaft to the bearings. Quenching is also most important for smothering vapors and fumes given off at the stuffing box. This is particularly true on applications such as hot water.

The quenching liquid (usually water) must be from an outside source. It should be piped, with flexible pipe, into the tapped opening on top of the stuffing box gland. A shut-off valve should be installed.

Bearings

Bearing cooling is available on some units. When it is available, cooling water must be connected to the jacket when pumping hot liquids. See the temperature limits listed under "Construction Details" in [8.3 Parts List on page 86](#). Valves should be installed in the coolant supply lines to regulate the flow.

Stuffing Boxes

Some units are equipped with cooling jackets around the stuffing box as standard. It is optional on various other models. Coolant lines are connected in the same manner as the bearing cooling lines.

Casing Pedestals

On some models, water cooled pedestals are available. Connection of coolant lines is made in the same manner as above.

Mechanical Seals

Seal materials (carbon, ceramic, PTFE, etc.) are suitable for use at temperatures to 260°C | 500°F. (100°C to 121°C | 212°F to 250°F if seal has rubber parts). However, for satisfactory operation, there must be a liquid film between the seal faces to lubricate them. If the liquid flashes to vapor, the faces will run dry and be damaged. To prevent this, the liquid must be cool. In general, this requires that the liquid be cooled so that the vapor pressure is well below the stuffing box pressure. Doubtful cases should be referred to Goulds for a recommendation. Refer to seal manufacturer's drawing for location of taps. Some methods which may be used to cool the seal are:

1. Dead Ended Seal Chamber

No liquid is circulated through the stuffing box. The isolated or "dead ended" liquid around the seal is cooled by circulating water in the stuffing box jacket, if any.

2. Cool Liquid Flushing - External Source

A clean, cool compatible liquid is injected from an outside source directly into the seal chamber. The flushing liquid must be at a pressure 20 to 40 PSI greater than the pressure in the stuffing box. One-half to two GPM should be injected. A control valve and rotometer placed in the inlet line permits accurate regulation. Cooling water can be circulated through the stuffing box water jacket (if any) in addition to the external flush.

3. Cool Liquid Flushing - Product Cooling

In this arrangement, pumped liquid is piped from the pump casing, cooled in an external heat exchanger, then injected into the seal chamber. A control valve together with a rotometer and/or a dial thermometer should be installed in a line from the exchanger to the seal chamber. One-half to two GPM should be circulated. Cooling water, one to three GPM, should be circulated through the stuffing box jacket, if any.

5.10 Connection of Drain Piping

All units contain tapped openings around the stuffing box for draining leakage. On corrosion resistant units, a drain pan is supplied with a tapped opening. Check the assembly dimension print for size and location.

5.11 Connection of Equalizing Piping

Some multi-stage pumps have equalizing piping to equalize pressure on the stuffing boxes (see [8.3 Parts List on page 86](#)). This piping is in the box of fittings which accompanies the pump. The ends of the piping must be connected to the openings in each stuffing box.

5.12 Impeller Adjustment

Some end suction pumps, in addition to vertical pumps, have means of adjusting impeller clearance within the casing. The clearance was set at the factory, but in transit, the clearance may have been lost. Proper clearance must be attained before a pump is operated or serious damage may occur. Check and reset impeller clearance by method described in [6.3 Impeller Clearance Adjustment on page 64](#).

5.13 Check for Free Turning



WARNING:

- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

1. Rotate shaft by hand to be sure rotating element is free. If element rubs or binds:
 - a) Check alignment.
 - b) Remove pipe loads.
 - c) Check impeller clearance (if external adjustment is possible) as outlined in [6.3 Impeller Clearance Adjustment on page 64](#).
 - d) If unit is equipped with leveling bolts on frame or casing foot, then check to be sure that bolts are not overtightened.

5.14 Regulation of Cooling and Flushing Liquids

The supply of liquid to any cooling jackets, quench glands, or mechanical seals should be regulated by valves in the supply line. Approximate flow rates are as follows:

- Quench Glands - ½ to 1 GPM
- Cooling Jackets - 1 to 3 GPM
- Mechanical Seals - ½ to 2 GPM

The cooling lines should be checked periodically to see that they have not become clogged.

5.15 Priming



WARNING:



These pumps are not self priming and must be fully primed at all times during operation. Loss of prime can lead to excessive heat and severe damage to the pump and seal.

The pump must always be fully primed and the suction pipe full of liquid before pump is started.

If pump is run dry, the rotating parts within the pump may seize to the stationary parts since they depend upon the liquid being pumped for lubrication.

Several different methods of priming can be used, depending upon the type of installation and service involved.

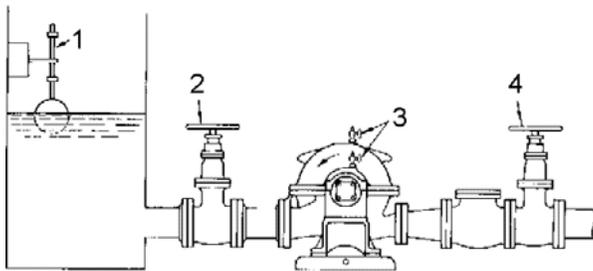
Vertical sump pumps, when submerged, need not be primed since the pump is filled with liquid.

NOTICE:

On glass-lined pumps, the thermal shock limit of the glass varies with the conditions of operation. Do not introduce liquid to pump if temperature difference between liquid and pump is 100°F. Gradually heat pump before introducing hot liquids.

1. Suction Supply Above Pump

When pump is installed as shown below, pump will prime itself.



- | | |
|-----------------------|-------------------------|
| 1. Float switch | 3. Air vent valves |
| 2. Suction gate valve | 4. Discharge gate valve |

Figure 54: Self priming

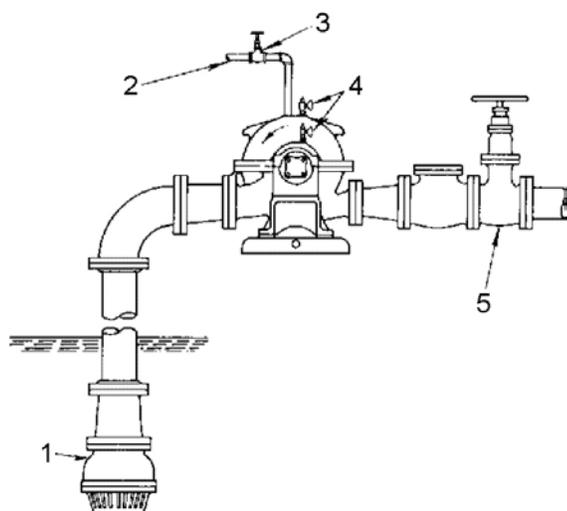
- a) Open gate valve on suction and close discharge gate valve.
- b) Open air vent valves until all air is expelled and water flows through openings.
- c) Close air vent valves, start pump and open discharge gate valve. Pump will continue to be primed for any future starting.

This method is the simplest and, particularly for automatic operation, the safest. A float switch in the suction reservoir can be arranged to stop pump, should there be failure of liquid supply.

2. Prime with Foot Valve

With pump installed on suction lift, with foot valve at end of suction line, priming can be done any of the following three ways: In methods (1) and (2), the pump will remain primed, provided foot valve is tight. Any failure, however, of foot valve when pump is standing idle, will permit the pump to lose its prime. During long idle periods, the pump can also lose its prime through leakage from stuffing boxes.

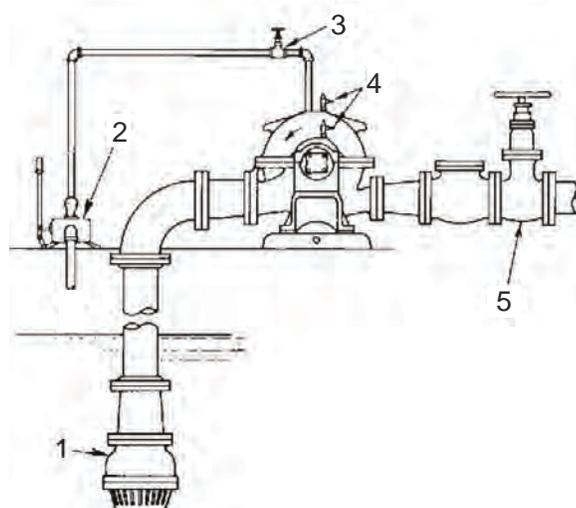
- a) Outside Supply: Close discharge gate valve, open air vent valves and open valve in priming supply line until all air is expelled and water issues from vent openings. Close air vent valves, close valve in priming supply line, and start pump; then open discharge gate valve.



- | | |
|-----------------------------|-------------------------|
| 1. Foot valve | 4. Air vent valves |
| 2. From some outside supply | 5. Discharge gate valve |
| 3. Shut off valve | |

Figure 55: Foot valve

- b) By Separate Hand, or Manually Controlled, Priming Pump: Close discharge gate valve (keep air vent valves dosed) and open valve in line to priming pump. Exhaust air from pump and suction piping until water flows from priming pump. With priming pump running, close valve in priming line, start pump and open discharge gate valve. An alternate method is to reverse connections on priming pump and extending priming pump suction to source of liquid supply. The pump may be primed by pumping liquid into casing until liquid comes out of the open air vent valves.

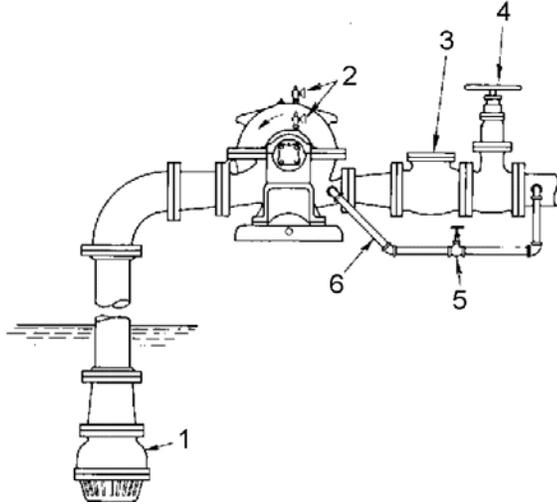


- | | |
|-------------------|--------------------|
| 1. Foot valve | 4. Air vent valves |
| 2. Priming pump | 5. Discharge valve |
| 3. Shut off valve | |

Figure 56: Hand or manually controlled pump

In methods a and b above, the pump will remain primed, provided foot valve is tight. Any failure, however, of foot valve when pump is standing idle, will permit the pump to lose its prime. During long idle periods, the pump can also lose its prime through leakage from stuffing boxes.

- c) **Bypassing Around Discharge Check Valve:** This method can be used only when there is liquid under some pressure in the discharge line. The original prime must be effected from some outside source. After subsequent idle periods, open air vent valves and open valve in bypass line around discharge check and gate valves until liquid flows from air vent openings. Close air vent valves and bypass valve, start pump and open discharge gate valve.

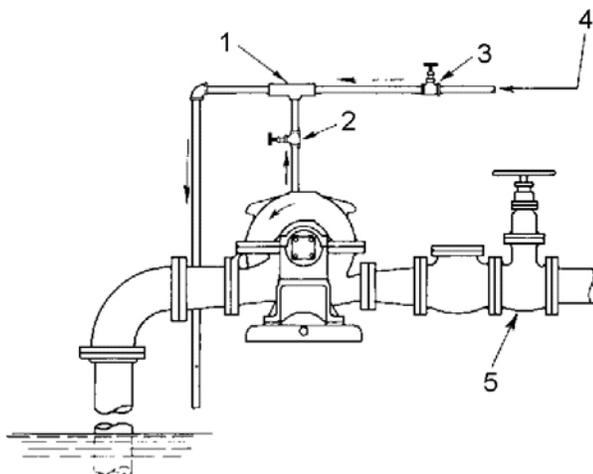


- | | |
|--------------------------|-------------------------|
| 1. Foot valve | 4. Discharge gate valve |
| 2. Air vent valves | 5. Shut off valve |
| 3. Discharge check valve | 6. By-pass line |

Figure 57: Bypassing

The valve in bypass can be left open, in which event, during idle periods, loss through foot valve is constantly replenished from discharge line. This system is used for automatic operation where idle periods are of short duration and there is no danger of exhausting all liquid from discharge line, due to a leaky foot valve. The foot valve must be capable of withstanding static head pressure of the system.

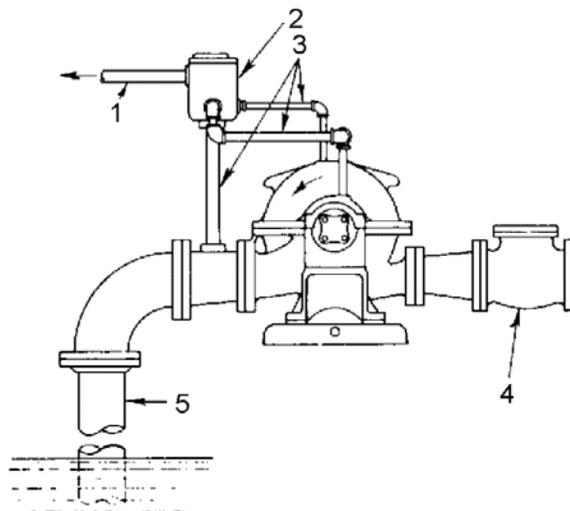
3. **Priming by Ejection**
- a) On suction lift installation, an ejector, operated by steam, compressed air, or water under pressure, and connected to tapped opening in top of casing can be used to remove air from casing and suction line, thus priming the pump. See image below.



- | | |
|---------------|--|
| 1 - Ejector | 4 - Steam, compressed air, or water under pressure |
| 2 - Valve "S" | 5 - Discharge gate valve |
| 3 - Valve "E" | |

Figure 58: Ejection

- b) Close discharge gate valve, open valve "E" in steam, air or water pressure supply line. Open valve "S" in suction pipe of ejector connected to pump casing. Air will be evacuated and liquid will be drawn up into suction pipe and pump casing. When all air is evacuated, start pump, close valve "S" and valve "E", and open discharge gate valve.
4. Priming by Automatic Primer Pump
- a) Where there is a fluctuating suction lift that occasionally might drop below the normal limits of the pump, or for installations where there is any quantity of air entrained in the pumpage, the system shown below is very well adapted.



- | | |
|--|---------------------------|
| 1 - To primer pump | 4 - Discharge check valve |
| 2 - Priming valve | 5 - Suction pipe |
| 3 - These lines must slope upward from pump to eliminate pockets | |

Figure 59: Automatic primer pump

- b) A vacuum tank and a vacuum gauge can be installed near the primer pump and the vacuum switch set to automatically start or stop the primer pump according to the vacuum required to keep the system primed.

5.16 Start the pump



WARNING:

- Risk of equipment damage, seal failure and breach of containment. Ensure all flush and cooling systems are operating correctly prior to starting pump.
 -
-

NOTICE:

- 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.
 - 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.
-

1. Fully close the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
5. If the pump fails to reach the correct pressure, perform these steps:
 - a) Stop the driver.
 - b) Restart the driver.
6. Monitor the pump while it is operating:
 - a) Check the pump for bearing temperature, excessive vibration, and noise.
 - b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.
7. Repeat steps 5 and 6 until the pump runs properly.

5.17 Activate the i-ALERT[®] Health Monitor



WARNING:

Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

By using the i-ALERT[®] Health monitor or the i-ALERT[®]2 Bluetooth Equipment Health Monitor, you agree to be bound by the Terms and Conditions of the [3.2 General description i-ALERT[®] Equipment Condition Monitor on page 15](#)

The health monitor is ready for activation when the pump is running and has reached a steady flow, pressure, and temperature. This process only takes a few minutes.

1. Place a small magnet on the health monitor over the ITT logo and then remove it, as this example shows.

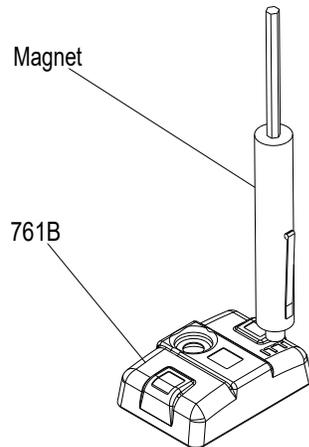


Figure 60: i-ALERT® Health monitor activation

When the condition monitor is activated it:

1. Displays a series of red LEDs followed by a solid green LED.
2. Collects eight samples that are spaced one second apart.
3. Averages these readings to establish the baseline vibration level.
4. Flashes a green LED after approximately twelve seconds.

For the first ten minutes, the green LED flashes every second for five consecutive flashes and then pauses to take a vibration reading. More frequent measurements (every six seconds) are taken in this startup period so that an alarm can be immediately detected.

5.18 i-ALERT® Equipment Health Monitor



WARNING:

Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

For all information refer to the i-ALERT® Equipment Health Monitor Installation, Operation and Maintenance manual. <https://www.i-alert.com/support/>

5.19 Pump operation precautions

General considerations



WARNING:

- 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.

- 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.
-
-

NOTICE:

- Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
 - The specific gravity or viscosity of the fluid is greater than expected
 - The pumped fluid exceeds the rated flow rate.
 - 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.
-

Operation at reduced capacity



WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.
 - 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.
 - Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.
-
-

NOTICE:

- Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available (NPSH_A) always exceeds NPSH required (NPSH₃) as shown on the published performance curve of the pump.
 -
-

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that will freeze that is inside the pump and any auxiliary equipment. Failure to do so can cause liquid to freeze and damage the pump. Note that different liquids freeze at different temperatures. Some pump designs do not drain completely and may require flushing with a liquid that doesn't freeze.

5.20 Initial Inspection After Starting

Packed Box

With pump running at rated speed, the stuffing box gland can be adjusted. Draw gland nuts up evenly and only 1/6 of a turn at a time, allowing sufficient time between adjustments for the packing to adjust

itself and the effect on the leakage to be observed. If any sign of heating is evident, shut down the pump and allow the box to cool. Several starts may be necessary before the box runs cool. Do not back off the gland nuts on a hot box as this will usually result in liquid leaking between the outer edge of the packing and the stuffing box bore. Remember that it takes newly installed packing some time to "run in" and that during this period, frequent attention and careful adjustments are necessary. See [5.23 Stuffing Box Operation on page 56](#).

Mechanical Seal

The mechanical seal was adjusted at the factory. If the seal leaks slightly when pump is first started, a few hours run-in will allow seal to adjust itself. Never run seal dry. Make sure cooling flow lines, if any, are operating properly.

5.21 Final Alignment



WARNING:

- Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.
 - Follow the coupling installation and operation procedures from the coupling manufacturer.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

1. Final adjustment can only be accomplished after the unit has been run under actual operating conditions for a sufficient length of time to bring the unit up to operating temperature.
2. After this warm-up period has elapsed, stop the unit and immediately disconnect the coupling and check the alignment.
 - a) On "Back-Pull Out" end suction units, the frame foot should be loosened to relieve any strain due to thermal expansion.
 - b) On units which have jacking bolts on the foot, loosen the hold-down bolts.
 - c) On units which have a slotted hole on the foot near the bearing frame, loosen the foot-to-bearing frame bolt.
3. Make sure motor switch is "locked out" to prevent accidental rotation. After a minute or two, retighten foot bolts.
4. Repeat each alignment procedure outlined in [4.5.1 General Alignment Procedures on page 23](#).
5. Reconnect coupling.
6. Check final alignment after approximately one week of operation.

5.22 Doweling

Some units do not require doweling since lock washers are furnished which hold the pump and driver feet securely in place. On other units, the pump and driver feet should be doweled after installation is

completed, and the unit is in correct final alignment. Taper dowel pins, included in the box of fittings, are furnished for these units.

NOTICE:

On all multi-stage units, dowel pins (if supplied) should be used on the coupling end of pump only. Do not dowel feet on outboard end of pump.

1. On units to be doweled (except those noted above), drill through two diagonally opposite feet of the pump into the bedplate.
Use a reamer with a ¼" per foot taper. The dowels should extend well into the bedplate but project above the pump feet.
2. Drivers should also be doweled but the driver manufacturer should be contacted for instructions.

5.23 Stuffing Box Operation



WARNING:



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

1. Stuffing boxes with packing rings - less quenching liquid or grease lubricator:
 1. Periodically inspect stuffing box to see that there is sufficient leakage to lubricate the packing and maintain a cool box. Never draw up packing so that the stuffing box heats, as this will cause damage to both packing and sleeve. Draw up gland nuts slowly and evenly and only when pump is running.
 2. After pump has been in operation for some time and the packing has been completely run in, at least 40 to 60 drops per minute of the liquid should be allowed to trickle from the stuffing box at all times for cooling and lubricating the packing and shaft sleeve.
2. Stuffing boxes with packing rings-with quenching liquid:
 1. The same precautions as described above apply. However, the amount of leakage through the packing cannot be easily determined, due to the quenching liquid. In most cases, the valve on the quenching liquid supply line can be shut off for a short period and the amount of leakage determined as in step 1 above.
 2. In no instance should the gland be drawn up tight. Never throttle the clean liquid supply into the stuffing box as a substitute for proper adjustment of packing - a steady flow from the seal cage into the pump is required to prevent entrance of pumpage into the packing.
3. Stuffing boxes with packing rings - with grease lubricator:
 1. Operation is the same as directed in step 1 above, with the addition that the handle on the lubricator should be given a turn or two about every 100 hours of operation.
4. Stuffing boxes with mechanical seal:
 1. This type of box requires no attention other than to make sure that the circulating lines do not become clogged.

5.24 Operating at Reduced Capacities

Do not operate a centrifugal pump at greatly reduced capacities or with discharge gate valve closed, because the energy required to drive the pump is converted into heat. The temperature of the liquid in the

pump may increase until the boiling point is reached. If this occurs, the rotating parts are exposed to vapor with no lubrication and they may score or even seize to the stationary parts.

NOTICE:

If running clearances have enlarged due to wear, seizure may not take place and continued operation under these conditions may create an explosive hazard due to the confined vapor under high pressure and temperature.

To guard against possible damage, protective devices are available, such as:

1. Liquid temperature relay or thermostat which will shut off the unit if the liquid temperature in the pump exceeds a predetermined maximum. This device guards against possible damage due to running the pump against a closed valve.
2. Constant open by-pass orifice between the pump discharge and any check or regulating valve in the discharge line. The liquid through the orifice is returned to the suction source. The amount of liquid bypassed is a function of input horsepower and the allowable temperature rise. This device also is insurance against damage due to running the pump against a closed discharge valve or very low flow conditions.
3. Bearing temperature relay which will shut the unit down if the bearing temperature exceeds a predetermined maximum.
4. Low suction pressure control which will shut off the unit should the suction pressure drop below a pre-established minimum. A centrifugal pump should never be throttled for capacity adjustment on the suction side.

5.25 Operating at Reduced Head

On motor driven pumps, when discharge head or pressure is allowed to drop considerably below the rated point for any length of time, the motor should be watched for heating because the pump capacity increases with reduced head, as does horsepower consumption. If this condition is likely to persist, arrangements should be made either to manually or automatically throttle the discharge valve to build up head to a safe point.

5.26 Operating with Surge Conditions in Line

If a pump is installed with a quick closing valve in discharge line that closes when pump is running, dangerous pressure surges may be built up that can cause damage to the pump or line. In services of this kind, some cushioning arrangement must be provided to protect the pumping equipment.

5.27 Operating under Freezing Conditions

When exposed to freezing conditions and pump is standing idle, liquid inside the pump should be drained by removing drain plugs in bottom of casing and opening air cocks at top. Liquid inside cooling jackets or glands should also be drained.

5.28 Deactivate the i-ALERT[®] Equipment Health Monitor

NOTICE:

Always deactivate the health monitor when the pump is going to be shut down for an extended period of time. Failure to do so will result in reduced battery life.

1. Touch and hold a small magnet to the health monitor over the ITT logo until the red LEDs blink three times.
This should take 10-15 seconds if the health monitor is in normal operating mode and approximately five seconds if the condition monitor is in alarm mode.
2. Remove the magnet.

If the deactivation is successful, solid red LEDs will be displayed.

5.29 Reset the i-ALERT® Health Monitor

To deactivate or reset the i-ALERT® monitor, please refer to the i-ALERT® IOM, <http://i-alert.com/>

Always reset the health monitor when the pump is started after maintenance, system change, or being shut down for an extended period of time. Failure to do so may result in false baseline levels that could cause the health monitor to alert in error.

6 Maintenance

6.1 Bearing Maintenance



tion.

For Ex applications bearing replacement (all) is recommended after 25,000 hours of operation.

6.1.1 Bearing Temperatures



WARNING:



These bearing lubrication sections list different temperatures of the pumped fluid. If the pump is Ex-certified and the temperature of the pumped fluid exceeds the permitted temperature values, then consult your ITT representative.

All bearings operate at some temperature above that of the surrounding atmosphere, unless cooled. Heat is generated within the bearing due to rolling friction, churning of oil and the "drag" of the race.

Do not use the human hand as a thermometer. A temperature which feels "hot" varies from 49°C to 53°C | 120° F - 130°F, depending upon the individual. Above this temperature, the human hand is worthless in estimating temperature.

Bearing temperatures up to 82°C | 180°F are normal. Determine the temperature accurately by placing a contact type thermometer against the bearing housing. It should be recorded in a convenient location for reference. The stability of the temperature, rather than the number of degrees is the best indication of normal operation. A sudden increase in temperature is an indication of danger and a sign al to investigate. The unit should be checked for abnormal hydraulic operation and unnecessary loads, such as coupling misalignment, etc.

6.1.2 Bearing Inspection

- Ball and Roller Bearings

Ball and roller bearings can be checked for visible wear by slowly turning the races and watching for pits or worn areas on the balls, rollers or raceways. The bearings can also be inspected by holding the inner race and spinning the outer race. If any rasping noises are emitted or the bearing "catches", it should be replaced. If any wear on the races is apparent, replacement is suggested.

- Sleeve Bearing

Sleeve bearings should be inspected to determine if any deep scratches or gouges (other than oil grooves) are present. The babbitted surfaes should also be free of high or low spots. Unless these surfaces are completely smooth, they should be replaced if they cannot be "scraped in."

6.1.3 Clean the Bearings

The life of a bearing can be drastically reduced if contaminated with even a small amount of dust or dirt. All bearing assembly operations should be done in as dust-free an atmosphere as possible. All tools, as well as the hands, should be kept clean.

1. If new bearings are to be installed, they should not be unwrapped until ready for installation and should not be cleaned or washed.
2. If old bearings are dirty, they should be replaced. Washing the bearings does not guarantee cleanliness and is risky at best. If new bearings are not readily available, and immediate reassembly is necessary, dirty bearings can be cleaned as follows:
 - a) Pour one or two quarts of clean, water-free kerosene into a clean pail.
 - b) Dip the bearings into the kerosene and agitate slowly.
 - c) Repeat until bearing is completely clean.
 - d) Blow dry with clean filtered compressed air.
 - e) With ball bearings, hold the two races together, but allow the inner race to rotate a few turns now and then to dislodge the kerosene from the retainer pockets.
 - f) When the bearing has been blown dry, oil it immediately with a good grade of clean machine oil to prevent corrosion or rust.
3. If there is any question as to the condition of bearings, it is always best to replace them. This may prevent an unplanned shutdown.

6.1.4 Bearing Removal



CAUTION:

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

1. Ball Bearings
 - a) A puller such as the one shown below should be used. The puller bar must be "square" with the end of the shaft at all times in order to keep even pressure on the outer circumference of the bearing.

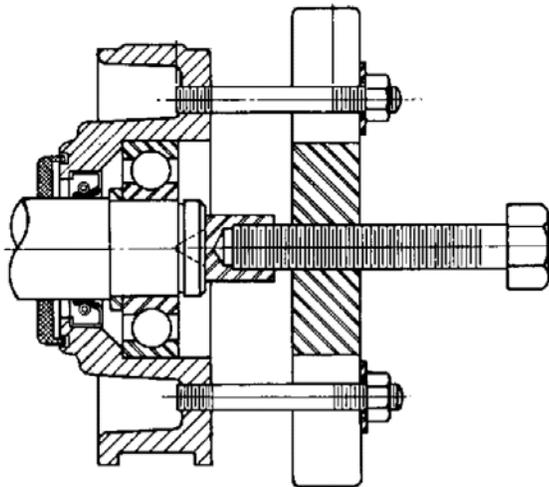


Figure 61: Bearing puller

- b) The puller screw should be tightened steadily to enable the bearing to slide smoothly off the shaft.
On some units, the bearing housings slide off the bearings and the puller such as the one shown below should be used. This type of puller pulls directly against the bearing itself. The puller bar must be "square" with the end of the shaft at all times and the puller screw should be tightened steadily to enable the bearings to slide smoothly off the shaft.

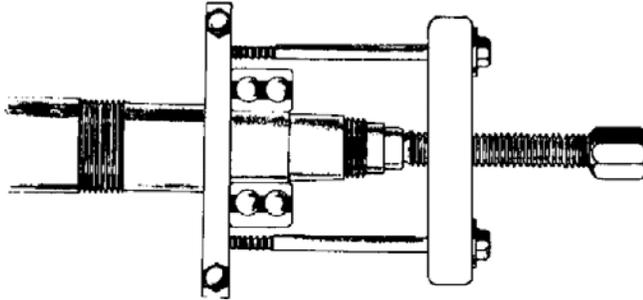


Figure 62: Bearing puller

NOTICE:

Do not damage the end of the shaft.

2. Sleeve Bearings
 - a) After the bearing shells have been removed, a bearing puller, such as shown above should be used to remove the ball bearing.
 - b) The puller bar must be "square" with the end of the shaft at all times and the puller screw should be tightened steadily to enable the bearing to slide smoothly off the shaft. Do not damage the end of the shaft.
3. After the bearings have been removed, they should be wrapped in dean paper or cloth to prevent contamination. Other parts which surround the bearings, such as bearing housings, should be kept clean in the same manner.

6.1.5 Install the Ball Bearings

NOTICE:

There are several methods used to install bearings. The recommended method is to use an induction heater that heats as well as demagnetizes the bearings. Failure to use this method may result in equipment damage.

1. A film of clean machine oil should be applied to the bearing seat on the shaft.
2. The bearing should be started on the shaft by tapping the inner race with a hammer or mallet. Do not use a lead mall. The bearing must be kept "square" at all times.
3. Once the bearing is located on the shaft, a driving sleeve, such as the one shown below should be used. The sleeve should contact the inner race of the bearing only. The bearing should be pressed or driven until it contacts shoulder "x".

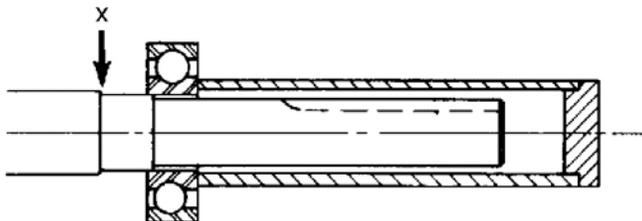


Figure 63: Driving sleeve

4. Duplex thrust bearings must be mounted in the proper position as described in [6.8 Reassemble the Pump on page 74](#).

6.2 Lubricate the Pump



WARNING:



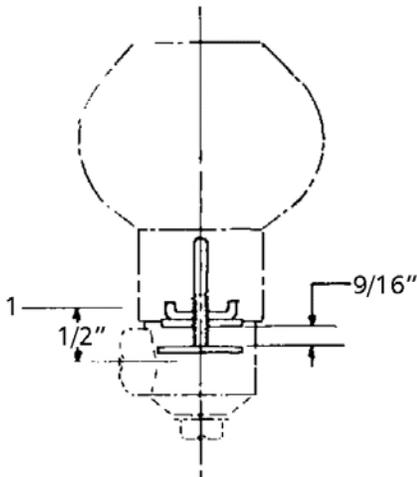
Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

1. Oil Lubrication

Refer to [5.2 Pump Bearings on page 40](#) for oil specifications. Oil lubricated ball bearings are standard on the Model 3175. The bearings are not lubricated at the factory.

Oil lubricated pumps are supplied with an oiler which maintains a constant oil level in the bearing frame. Refer to [6.5 Disassemble the Pump on page 67](#) for oiler location.

- a) Before installing the oiler on the bearing frame, check the oiler adjustment.



1 - Oil level

Figure 64: Oiler

Instructions

- i. Remove adjustment assembly from oiler
 - ii. Adjust bars to 9/16"
 - iii. Lock in position
 - iv. Replace adjustment assembly in oiler
- b) Install oiler on either side near oil level groove marked on frame.
 - c) Fill the oiler bottle with oil and replace in the oiler housing. Oil reservoir in bearing frame is filled when oil remains visible in the bottle. Several fillings of the bottle will be required. Never fill through the oil vent or the oiler without use of the bottle.

For information only: The Model 3175 bearing frame oil capacities are:

Group	Approx. Capacity
S	167 oz 5 Qts.
M	133 oz 4 Qts.
L	100 oz 3 Qts.

2. Grease Lubrication - To lubricate pump: Insert grease through grease fittings while shaft is rotating, until clean grease appears through the relief caps. Refer to [5.2 Pump Bearings on page 40](#) for grease specifications. Grease lubrication is optional on the Model 3175. These units can be identified by the grease fitting located on the bearing housing. Bearings are lubricated at the factory. Do not grease at too frequent intervals.

To lubricate pump: Insert grease through grease fittings while shaft is rotating, until clean grease appears through the relief caps.

NOTICE:

Risk of equipment damage. Ensure that the grease container, the greasing device, and the fittings are clean. Failure to do so can result in impurities entering the bearing housing while re-greasing the bearings.

3. Conversion From Oil to Greased Lubrication

NOTICE:

- Grease can settle in equipment left idle leaving bearings improperly lubricated. Check the greasing on a pump that has been out of service for a long period of time and re-grease if necessary.
- Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the grease type or consistency, remove the rotor and old grease from the housing before regreasing.

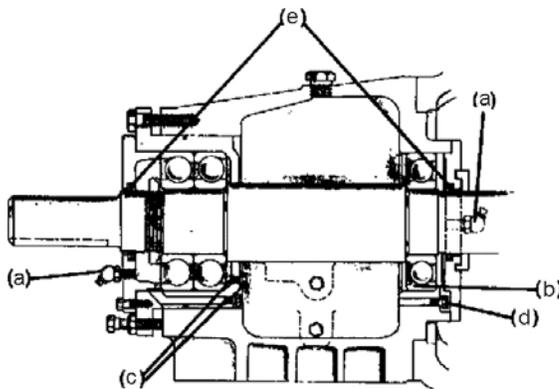


Figure 65: Grease lubricated bearings

- a) For oil lubrication, both bearing end covers (inboard and outboard) are equipped with two 1/8" taps that are plugged. To convert to grease lube, 1/8" Alemite fittings are installed in place of these plugs.
- b) Radial bearings are changed to have a shield on the frame reservoir side of the balls. The following are correct designations:

Frame	MRC Bearing No.
S	313 SF
M	317 MF
L	222 MF

- c) The bearing housing should have three 3.175mm | 1/8" recirculation openings plugged.
- d) Bearing frame should have one recirculation opening at the radial bearing plugged.

- e) Position of oil seals remain unchanged with lips facing away from bearings.

6.3 Impeller Clearance Adjustment



WARNING:

Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
- Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.



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.

If a gradual loss in head and/or capacity occurs, performance can be restored by adjusting the impeller. If performance cannot be restored by adjustment, pump should be disassembled as directed in [6.5 Disassemble the Pump on page 67](#) and the impeller and casing inspected for wear.

Either a feeler gauge or a dial indicator can be used to set the impeller clearance.

Feeler Gauge Method

1. Loosen adjustment bolts and nuts (371A & 423B).
2. Tighten bolts (370C) evenly, while slowly rotating the shaft, until the impeller just starts to rub on the casing.
3. Loosen each bolt (370C) until a 0.38 mm | .015" feeler gauge can be placed between the bearing housing flange and underside of head of bolts (370C).
4. Be sure that jam nuts on bolts (371A & 423B) are loose. Tighten each bolt (371A & 423B) a flat at a time until bearing housing is tight against bolts (370C). Be sure that all bolts (370C, 371A & 423B) are tight. Tighten jam nuts on bolts (371A & 423B).

A - Feeler Gauge

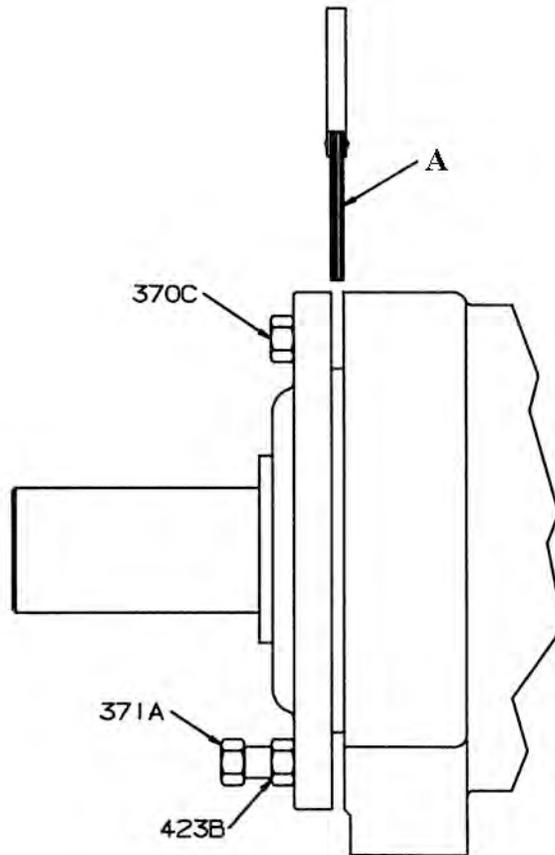


Figure 66: Feeler Gauge Method

Dial-Indicator Method

1. Remove one bolt (370C) and thread a pipe or rod in its place. This is to hold a dial indicator as shown below.
2. Loosen adjustment bolts and nuts (371A & 423B).
3. Tighten each bolt (370C) evenly, while slowly rotating the shaft, until impeller just starts to rub against casing.
4. Clamp a dial indicator so that the button rests against the end of the shaft, or against the front of the face of the coupling, and set indicator at zero.
5. Loosen bolts (370C) about 6 flats.
6. Be sure that jam nuts on the bolts (371A & 423B) are loose. Tighten bolts (371A & 423B) a flat at a time, until the dial indicator shows that the shaft has moved 0.38mm | 0.015".
7. Tighten bolts (370C), then check to be sure all bolts (371A & 423B) are tight. Finally, tighten jam nuts on bolts (371A & 423B).

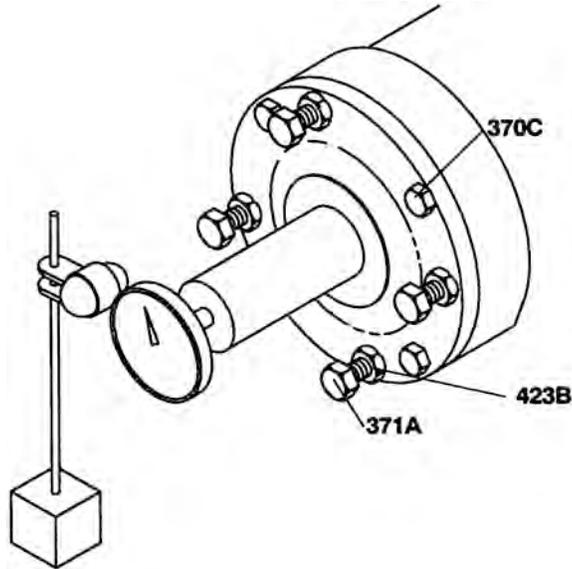


Figure 67: Dial Indicator Method

When either of the above methods, the rotating element and impeller have been moved 0.20mm to 0.38mm | 0.008" to 0.015" away from the casing, thus giving the required clearance between these two parts. Rotate shaft several times to check for free turning.

6.4 Disassembly precautions



WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- 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.
- Handling heavy equipment poses a crush hazard. Use caution during handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.
- 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.
- Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
- Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.

**CAUTION:**

- Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.

6.5 Disassemble the Pump

**WARNING:**

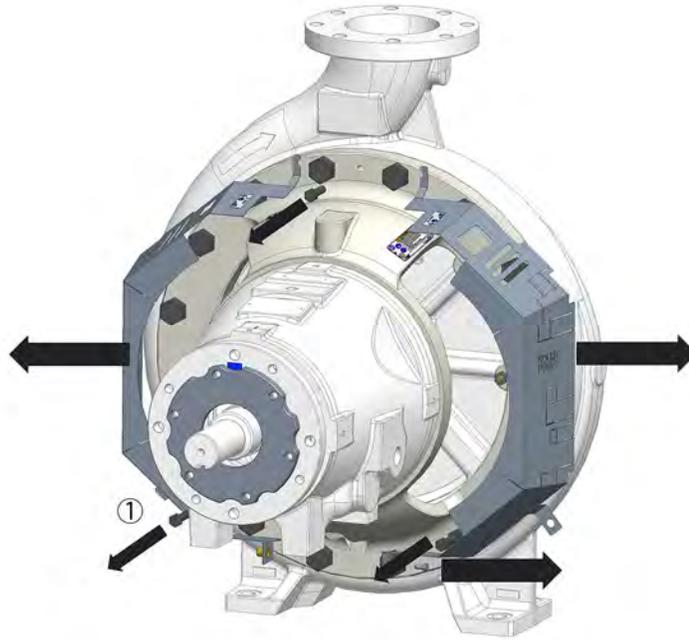
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
 - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Lifting and handling heavy equipment or components poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.
- Risk of severe physical injury or death from explosion of trapped liquid. Never use heat to remove parts unless explicitly stated in this manual.

The back pull-out feature of this pump allows the complete back pull-out assembly (bearing frame and rotating element) to be removed without disturbing suction or discharge piping or driver.

The [8.3 Parts List on page 86](#) contains a complete sectional view of the pump and parts list with the proper identification numbers. Refer to this section as required during maintenance procedures and when ordering spare or repair parts.

To prepare pump for disassembly, proceed as follows:

1. Lock out power supply to motor.
2. Shut off all valves controlling flow to and from the pump.
3. Drain liquid from pump. Remove casing drain plug (if supplied) which is located on bottom of casing at lowest point.
4. Remove all auxiliary tubing and piping.
5. Flush the pump to remove corrosive or toxic pumpage if required.
6. Disconnect coupling and remove coupling spacer (refer to coupling instructions).
7. Drain oil (remove drain plug) and remove bottle oiler.
8. Remove the shaft guard, if provided.
 - Do not remove the clip that retains the bolt on the guard to maintain a captive fastener.
 - Retain each guard half with fasteners for reinstallation.



Item	Description
1.	Mounting bolt

Figure 68: Remove the shaft guard - if provided

9. If unit has stuffing box packing, remove the gland stud nuts. The gland is in two halves and can be removed.

The numbers located on the following figures refer to the procedure steps. For example, number 1 on Figure 5A refers to Step 1.

1. Place chain or sling from crane or hoist through eye bolt.

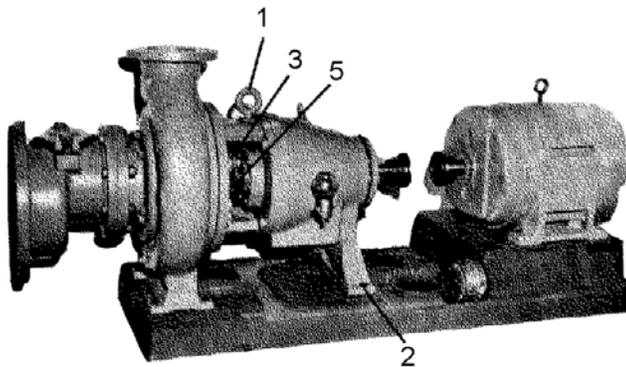


Figure 69: Disassembly

2. Remove frame foot hold-down bolts.
 3. Remove bolts which hold frame adapter to casing.
 4. Adjust sling tension to support back pull-out assembly.
 5. Slide the back pull-out assembly from the casing. The Model 3175 has jacking bolts to assist disassembly. Screw the jacking bolts into the tapped holes in the frame adapter. Tighten bolts evenly, a flat at a time, to jack back pull-out assembly from casing
- If working space is available to the side of the bedplate, the "pull-out assembly" can be turned perpendicular to the bedplate. Replace one pedestal hold-down bolt in bedplate and support the bearing frame flange with blocks. Complete disassembly of the "pull-out" assembly" can be accomplished on the job site. If preferred, it can be removed to an available work area.

- Remove casing gasket.

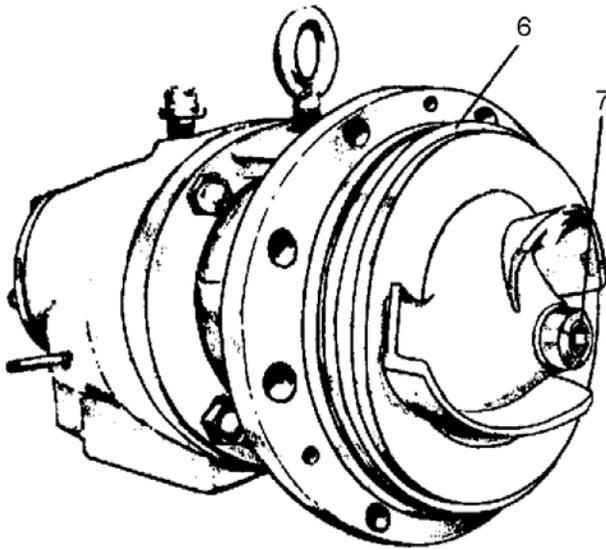
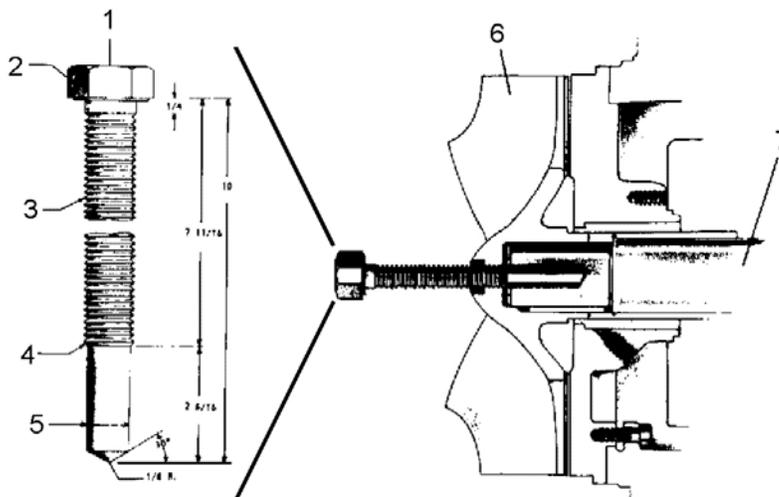


Figure 70: Pull-out assembly

- Remove the impeller screw with 3/4" Allen wrench. Prevent the shaft from rotating by using a wrench on coupling "flats". Do not lose or damage the impeller screw O-ring.



- Impeller puller stud - Mach. from std 1" H.H.M bolt
- 1-1/2 width across flats
- 1" $11/12$ R.H. threads
- 1/16 x 45° chamfer

- 13/16 \pm 0 to 1/32
- Impeller
- Shaft

Figure 71: Impeller Puller Stud

Thread the impeller puller stud into the end of the impeller. This stud pushes against the shaft and pulls the impeller as the stud is turned clockwise.

- Remove impeller key from the shaft.
Do not lose or damage the shaft sleeve O-ring which seals between the impeller and sleeve.



CAUTION:

Risk of physical injury from sharp edges. Wear heavy work gloves when handling impellers.

9. If unit has mechanical seal, remove gland stud nuts. The gland is a solid ring and cannot be removed after unbolting. Carefully slide the gland off the gland studs and move back on shaft and shaft sleeve. Avoid contact with exposed lapped seal faces and keep them clean.

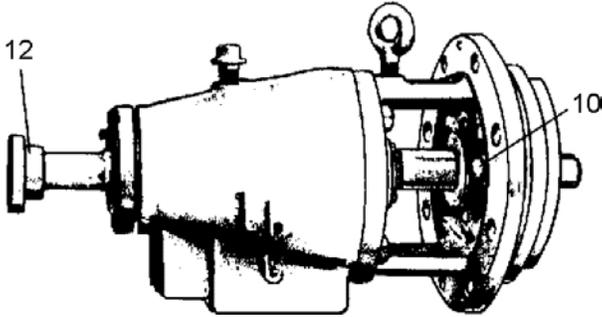


Figure 72: Removal of gland stud nuts and gland

10. Remove the adapter to stuffing box bolts. Pull the stuffing box cover from the frame adapter. (On some units, specifically the 18 and 22 inch units, tapped holes are provided in the frame adapter for the use of jacking bolts to assist disassembly of the stuffing box cover). Do not allow the stuffing box cover to strike the shaft, shaft sleeve, or any mechanical seal part.
11.
 - a) If the pump has a packed stuffing box, remove packing and lantern ring from the stuffing box cover.
 - b) If the pump has a mechanical seal, the rotary portion of seal will slide off with the sleeve. Do not damage seal faces.
12. Scribe shaft at coupling hub for proper positioning of hub during reassembly and remove hub. To disassemble remainder of the liquid end; casing, suction sideplate, and suction piece (if supplied), proceed as follows:
13. Disconnect suction and discharge flanges.
14. Remove casing hold-down bolts and move casing toward driver. If preferred, casing can be removed from bedplate for further disassembly.
15. Remove suction sideplate nuts.

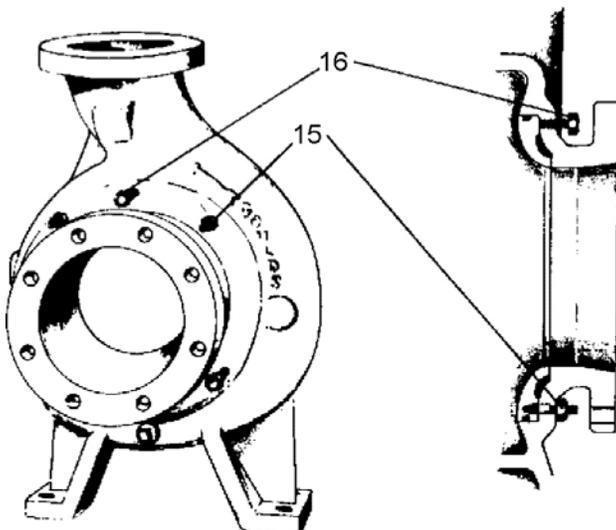


Figure 73: Liquid end disassembly

16. Remove the suction sideplate by tightening the jacking screws evenly. Be sure not to damage the sideplate O-ring. Remove the sideplate-to-casing gasket.
To complete disassembly of the power end, proceed as follows:
17. Remove the bolts which hold the frame adapter to the bearing frame. Remove the frame adapter.
18. Remove the deflector from the shaft.
19. Remove the bolts which hold the inboard bearing end cover to the frame. Remove the end cover.
Do not damage the oil seal.
20. Tap the oil seal from the inboard bearing end cover if replacement of seal is required. Refer to [6.7 Inspection and Overhaul on page 72](#) for replacement sizes.
21. Remove bearing housing bolts (2). Impeller adjustment bolts with jam nuts (1) can be used to assist in the removal of the shaft and bearing assembly from the bearing frame.

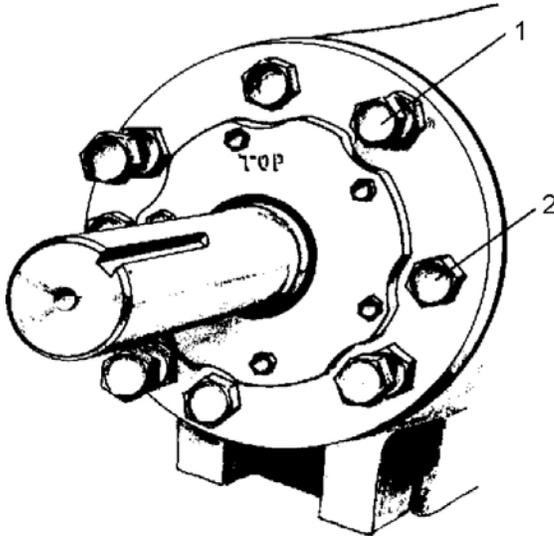


Figure 74: Bearing housing bolt removal

22. Slide the complete shaft assembly from back end of bearing frame. This includes the shaft, both bearings (radial and thrust), and bearing housing. Do not lose or damage bearing housing O-ring.

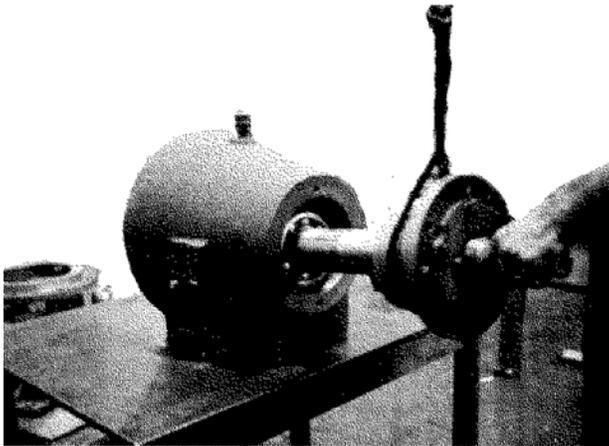


Figure 75: Shaft removal

23. Remove the inboard bearing using a bearing puller as shown in [6.1.4 Bearing Removal on page 60](#). Care must be taken to prevent damage to bearing. Never use a hammer to drive shaft through bearing. Protect bearing from contamination.
24. Remove the bolts which hold the bearing end cover to the bearing housing. Remove the bearing end cover. Be sure shaft is free of burrs so the oil seal will not be damaged.

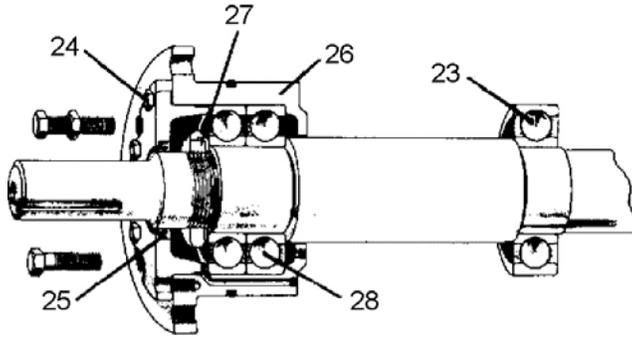


Figure 76: Bolt removal

25. Tap the oil seal from the coupling end bearing end cover if replacement of seal is required. Refer to [6.7 Inspection and Overhaul on page 72](#) for replacement sizes.
26. Slide the bearing housing off shaft.
27. Straighten "tang" in lock washer and remove bearing lock nut and washer.
28. Remove coupling end bearing using a bearing puller as shown in [6.1.4 Bearing Removal on page 60](#). Care must be taken to prevent damage to bearings. Never use a hammer to drive shaft through bearing. Protect bearing from contamination.

6.6 Guidelines for i-ALERT® Equipment Health Monitor disposal

Precautions



WARNING:

- Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.
-

Guidelines

The battery contained in the condition monitor does not contain enough lithium to qualify as reactive hazardous waste. Use these guidelines when disposing of the condition monitor.

- The condition monitor is safe for disposal in the normal municipal waste stream.
- Adhere to local laws when you dispose of the condition monitor.

6.7 Inspection and Overhaul

Impeller



WARNING:

- Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Replace all gaskets and O-rings at each overhaul or disassembly.
 - Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Inspect and ensure gasket sealing surfaces are not damaged and repair or replace as necessary.
 - Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
 - Use fasteners of the proper size and material only.
-

- Replace all corroded fasteners.
- Ensure that all fasteners are properly tightened and that there are no missing fasteners.

**CAUTION:**

Risk of physical injury from sharp edges. Wear heavy work gloves when handling impellers.

Replace if impeller shows excessive erosion (especially on ejector vanes on back side of impeller), corrosion, extreme wear or vane breakage. O-ring groove and impeller hub must be in good condition. Impeller has a push fit on shaft 0.000mm to 0.038mm | 0.000" to 0.0015" loose. Check impeller balance.

Sideplate

To maintain maximum efficiency, the clearance between sideplate and impeller should be 0.038mm | 0.015". Overall travel in casing is between 1.499mm and 2.159mm | 0.059" and 0.085". Sideplates should be inspected for erosion, pitting or excessive wear. Replacement is required when distance between impeller and suction sideplate cannot be held to 0.038mm | 0.015" with the axial impeller adjustment.

Shaft

Check for runout to see that the shaft is not bent. Bearing seats and oil seal areas must be in perfect condition and free of scratches and grooves. O.D. and finish in these areas must be within bearing manufacturer's specifications. Check that the keyway is free of corrosion. Replace shaft if necessary.

Shaft Sleeve

The shaft sleeve is a push fit and is bored: "S"- 0.000mm to 0.051mm | 0.000" to 0.002"; "M" & "L" - 0.025mm to 0.076mm | 0.001" to 0.003" larger than the shaft and should tap easily on the shaft. If the sleeve does not tap on easily, the bore and shaft should be inspected to see that they are free from foreign matter or burrs. The fit of the key in the keyway should also be checked to see that it is not causing binding. The key should have a sliding fit on the sides and should have clearance at the top. Sleeve surface in stuffing box must be smooth and free of grooves. If grooved, replace. O-ring groove must be in good condition. The original diametric clearance between shaft sleeve and stuffing box bushing is 0.635mm to 0.813mm | 0.025" to 0.032". If this clearance has increased to more than 1.27mm | 0.050", the shaft sleeve, and at times, the stuffing box bushing should be replaced.

Mechanical Seal

Lapped seal faces, gaskets, and shaft sealing members must be in perfect condition or excessive leakage may result. Replace worn or damaged parts.

Ball Bearings

Replace if worn, loose, rough or noisy when rotated. If dirty, refer to [6.1.3 Clean the Bearings on page 59](#). Replacement bearings must be proper size and type as specified in the Construction Details in [8.3 Parts List on page 86](#). New bearings should not be unwrapped until ready for use.

Oil Seals

Inspect and replace if torn or otherwise damaged. The sizes are:

Table 8: Coupling end

Group	Vendor	Vendor Part No.
S	Crane	237-325-16

Group	Vendor	Vendor Part No.
M	Chicago Rawhide	31177
L	Crane	412-525-16

Table 9: Inboard

Group	Vendor	Vendor Part No.
S	Crane	250-325-12
M	Chicago Rawhide	33041
L	Garlock	53 X 2687

Seals are held by a press fit. Lips on seals should face out (away from bearings). One side of bored hole for oil seal is chamfered so that seal will start easily when pressed in.

General

NOTICE:

Protect machined surfaces while cleaning the parts. Failure to do so may result in equipment damage.

All parts should be clean before assembly. This is especially important at O-ring grooves, threads, lock fits, gasket surfaces, and bearing areas. Any burrs should be removed with crocus cloth.

6.8 Reassemble the Pump

This procedure covers reassembly of the pump after complete disassembly. Be sure all directions in [6.7 Inspection and Overhaul on page 72](#) have been followed.



WARNING:

Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

1. Oil bearing seat on coupling end of shaft. Slide coupling end bearing (duplex, mounted back to-back) on shaft as far as possible by hand. Place pipe or driving sleeve (such as the one shown in [6.1.5 Install the Ball Bearings on page 61](#)) over shaft, making sure it rests against inner race only. Make sure bearing is "square" on shaft. Tap or press evenly until bearing is seated firmly against the shaft shoulder. Do not mar the shaft, especially where it contacts oil seal. The duplex bearings supplied by the factory as standard are manufactured by MRC. If equivalent bearings of other manufacturer's are used, the arrangement will vary. The duplex bearing arrangement depends on the type of construction used by the manufacturer. Refer to the manufacturer's instructions packed with the bearings for duplex mounting arrangement.
2. Insert the bearing lock washer, pressing tang into shaft keyway until it is firmly against the bearing.
3. Oil shaft threads lightly and snug the bearing locknut against the lock washer. Tighten firmly with a spanner wrench. Seat tang securely into slot in locknut with drift pin. If necessary, tighten locknut slightly to match tang with slot. Do not loosen locknut to position.

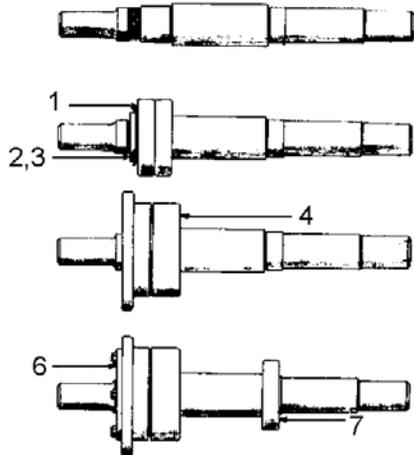
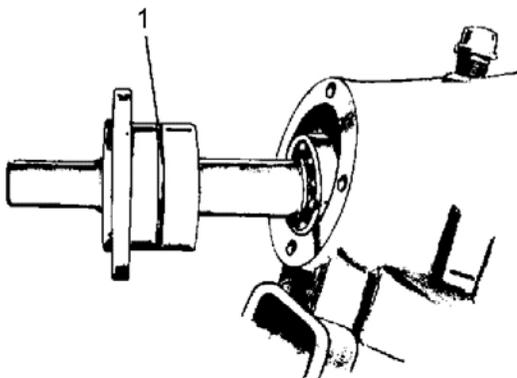


Figure 77: Pump reassembly

4. Slide bearing housing with O-ring in place, over impeller end of shaft and over outboard bearing.
5. Tap outboard oil seal in place on bearing end cover (coupling end).
6. Place bearing end cover and 0.152mm | 0.006" white manila gasket over coupling end of shaft and fit into bearing housing. If oil seal is dry, oil lightly before sliding over shaft. Be sure to position "TOP" (cast on cover) in line with "TOP" on housing. Bolt end cover firmly to housing.
7. Oil inboard bearing seat on shaft. Slide inboard ball bearing on shaft as far as possible by hand. Place pipe or sleeve (such as the one shown in [6.1.5 Install the Ball Bearings on page 61](#)) over shaft, making sure bearing is "square" on shaft. Tap or press sleeve evenly until bearing is seated firmly against shaft shoulder. Do not mar shaft, especially where it contacts the oil seal or in stuffing box area.
8. Place a small amount of O-ring lubricant on inside of bearing frame at bearing housing and inboard bearing seats, on O-ring, and on inboard oil seal. Slide shaft assembly into the bearing frame as far as possible. When the bearing housing is properly installed (oil return hole at the bottom), the word "TOP" located on the flange of the bearing housing will line up with the top of bearing frame. Be sure bearing housing O-ring (1) is in place in groove on housing. Insert bearing housing bolts into bearing housing and screw about 12.7mm | 1/2" into frame to hold shaft during further assembly.

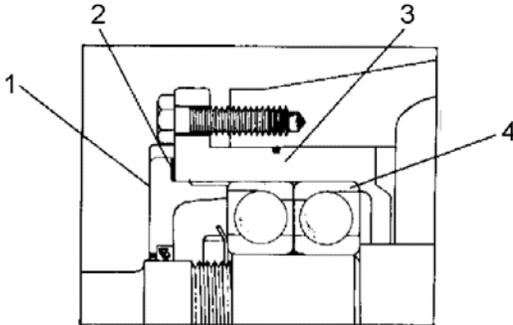


1. O-ring

Figure 78: Bearing housing O-ring

9. Tap oil seal into the bearing end cover (inboard).
10. Slide gasket and inboard bearing end cover over shaft and bolt to bearing frame.
11. Slide deflector on shaft with flat side in until it rests against the bearing frame.
12. Bearing end play may be determined at this point as follows: Clamp dial indicator to the pump so that the button rests against the end of the shaft. Push the shaft back and forth as far as possible. Total end play must be at least 0.025 | 0.001" and not more than 0.203mm | 0.008". If end play is

less than 0.025mm | 0.001" add coupling end bearing end cover gaskets made from 0.152mm | 0.006" thick manila paper. If end play is greater than 0.203mm | 0.008" remove gaskets. Because of machining tolerances, duplex thrust bearings may vary in width by up to 0.762mm | 0.030". A correctly assembled pump may require as few as one, or as many as three 0.152mm | 0.006" thick gaskets. Refer to image below.



1. Bearing end cover
2. Gaskets - 0.006" thick
3. Bearing housing
4. Duplex thrust bearing

Figure 79: Bearing end play

13. Install and position coupling hub at scribe mark on shaft.
14. Bolt bearing frame to frame adapter.

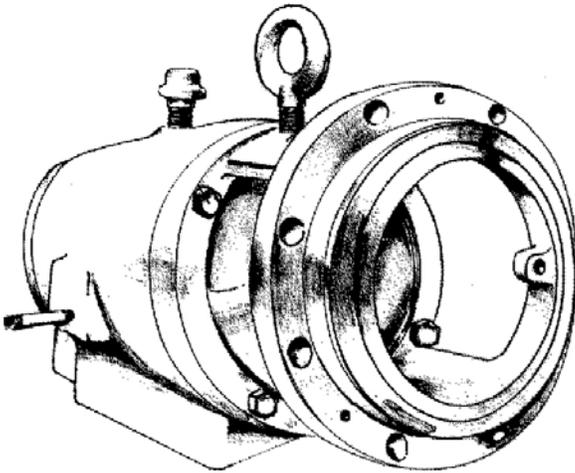


Figure 80: Bearing frame to bearing adapter

15. To install shaft sleeve and stuffing box cover:
 - a) On units with a packed stuffing box, slide shaft sleeve with O-ring in place on the shaft. Tap stuffing box bushing into place by using a sleeve. Check sleeve O.D. and bushing I.D. so it meets requirements of [6.7 Inspection and Overhaul on page 72](#). Lift stuffing box cover into position at impeller end of shaft. Guide stuffing box cover over shaft and sleeve to prevent contact to these surfaces. Bolt the stuffing box cover to the frame adapter.
 - b) On units with a mechanical seal, refer to the order acknowledgement and seal drawing (supplied with the pump) to determine seal type and mounting dimensions.
16. The following instructions refer to pumps equipped with mechanical seals.
 - a) Before mounting any seals, wipe the seal faces carefully with a clean, soft doth and oil lightly with clean oil.

- b) Assemble gland, stationary seat, gland and seat gaskets. Carefully slide assembly on sleeve.
- c) Lightly oil the rotary portion of the seal and slide on sleeve. Position rotary at proper distance from end of sleeve. Correct dimension is shown on the seal drawing. See [6.9 Set the Mechanical Seals on page 79](#) for methods of positioning the rotary.
- d) Slide the stuffing box cover over shaft. Bolt the stuffing box cover to the frame adapter.

NOTICE:

Be careful not to damage seal on units with double seals. Make sure inboard stationary seat is properly positioned.

17. Place stuffing box cover-to-casing gasket against shoulder of stuffing box cover. Small amounts of O-ring lube may be used on both sides of gasket to seal and secure gasket in place.

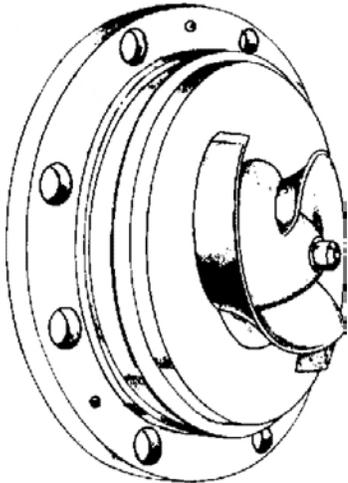


Figure 81: Stuffing box cover-to-casing gasket

18. Lubricate shaft keyway and insert impeller key in shaft and shaft sleeve. Lubricate shaft and slide impeller on shaft as far as possible. Replace impeller screw O-ring every time impeller is removed. Apply thread locker (Loctite 246 or equivalent) to impeller screw, install, and pull impeller on shaft the remainder of distance with impeller screw. Torque impeller screw to 300 N-m (220 ft-lb) for 7/8in screw and 954 N-m (704 ft-lb) for 1-1/4in screw. Prevent shaft from rotating by using a spanner or strap wrench.
19. Place O-ring in outer groove of suction sideplate. Install the sideplate-to-casing gasket. Tighten the four sideplate-to-casing studs in tapped holes in sideplate. Place suction sideplate in casing, making sure not to damage the sideplate O-ring. Liberal amounts of O-ring lube may be used to assist in sliding in place. Install and tighten four nuts on sideplate-to-casing studs.
20. Tighten casing hold down bolts.
21. Connect suction and discharge flanges. Care should be taken to prevent excessive pump flange loading.

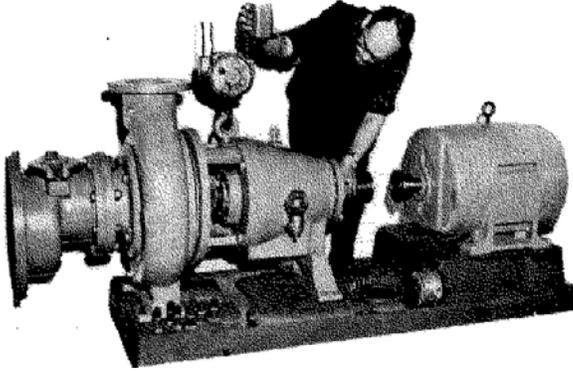


Figure 82: O-ring and suction sideplate-to-casing gasket

22. Slide the completely assembled "back-pull-out" unit into the casing. Tighten the frame adapter to casing bolts evenly to assure that gap between adapter and casing is even. Check with a feeler gauge at 4 points 90° apart around the adapter.



WARNING:

Lifting and handling heavy equipment or components poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

Follow torque specifications in the table below for frame adaptor to casing bolts.

Table 10: Frame Adapter to Casing Bolts Torque Specifications

Casing Size	Torque, N-m ft-lbs
12 inch	91 67
14 inch	244 180
18 inch	201 148
22 inch	233 172
28 inch	499 368

23. Install pedestal hold-down bolts. Frame pedestal is not to be flush with bedplate. Clearance of 1/4" is normal. Install shims under pedestal before tightening.
24. Set impeller clearance as outlined in [6.3 Impeller Clearance Adjustment on page 64](#). Clearance between impeller and sideplate should be set at 0.381mm | 0.015" to maintain optimum efficiency. Overall travel must be 1.499mm to 2.159mm | 0.059" to 0.085" dependent on tolerances. If not, check casing gasket to be sure it is 1.588mm | 1/16" thick.
25. If unit requires stuffing box packing, refer to [5.4 Stuffing Box Packing on page 42](#) and pack as directed. Refer also to [6.10 Stuffing Box on page 80](#) for alternate methods of packing.
26. Replace auxiliary piping.
27. Follow procedures outlined in this manual for preparation and operation of the unit.

NOTICE:

Pay particular attention to instructions concerning alignment and lubrication.

6.9 Set the Mechanical Seals



WARNING:



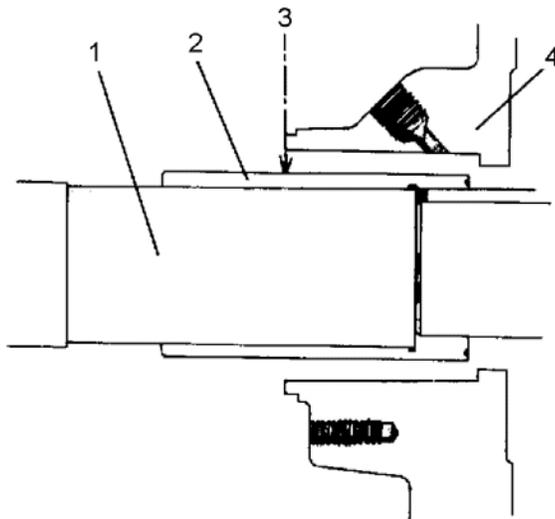
The mechanical seal used in an Ex classified environment must be properly certified.



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.

1. With the bearing frame-shaft assembly completed, carefully slide the gland-stationary seat assembly, with gaskets in place on the shaft. Install shaft sleeve.
2. Carefully slide the stuffing box cover over the sleeve and bolt to the bearing frame.
3. The following method may be employed to determine the correct positioning of the rotary portion of the mechanical seal:
 - a) Scribe the shaft sleeve at the face of the stuffing box.



1. Shaft
2. Sleeve
3. Scribe
4. Stuffing box

Figure 83: Shaft sleeve

- b) Unbolt and remove the stuffing box cover. Remove sleeve. Lightly lubricate the rotary portion of the seal and slide onto the sleeve.
- c) Compress the rotary to the correct "working length". Refer to the seal manufacturer's drawing for correct dimensions. Tighten set screws.

6.10 Stuffing Box

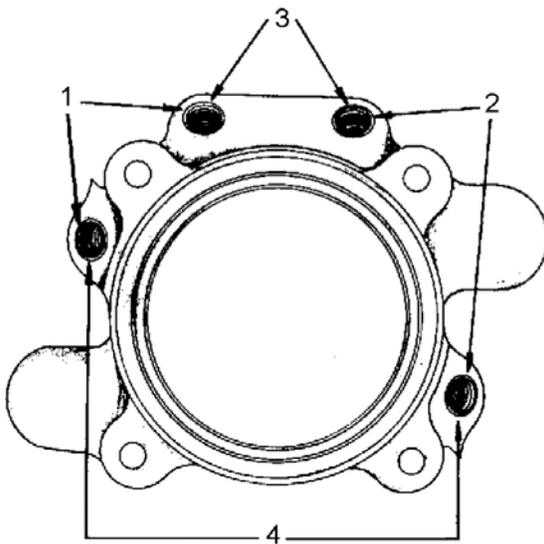


WARNING:



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

The standard stuffing box cover has four pipe taps for sealing or flushing liquid to the packing or mechanical seal. Two are used for in and out connections to the throat of the stuffing box for paper stock services with the lantern ring positioned next to the stuffing box throat bushing. Two are alternately used for evaporator or chemical services as in and out connections. The image below shows a stuffing box and location of holes, and the holes used for evaporator service and paper stock service.



1. Out
2. In
3. For paper stock service
4. For process and evaporator service

Figure 84: Stuffing box

6.11 Shaft guard installation (if provided)

6.11.1 Install the shaft guard



WARNING:

- 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.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
 - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
-

Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.

1. Assemble a guard half from each side of the pump and fasten to the bearing frame.

7 Troubleshooting

7.1 Troubleshooting Checklist

1. No liquid delivered
 1. Pump not primed - casing and suction pipe not completely filled with liquid.
 2. Speed too low.*¹
 3. Discharge head too high. Check system head (particularly friction loss).
 4. Suction lift too high (suction pipe may be too small or long, causing excessive friction loss). Check with vacuum or compound gauge.
 5. Impeller or suction pipe or opening completely plugged.
 6. Wrong direction of rotation or impeller installed backwards.
 7. Air pocket in suction line.
 8. Stuffing box packing worn - or liquid seal plugged - allowing leakage of air into pump casing.
 9. Air leak in suction line.
 10. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service.
2. Not enough liquid delivered
 1. Pump not primed - casing and suction pipe not completely filled with liquid.
 2. Speed too low.*²
 3. Discharge head higher than anticipated. Check system head (particularly friction loss).
 4. Suction lift too high (suction pipe may be too small or long, causing excessive friction loss.) Check with vacuum or compound gauge.
 5. Impeller or suction pipe or opening partially plugged.
 6. Wrong direction of rotation or impeller installed backwards.
 7. Air pocket in suction line.
 8. Stuffing box packing worn - or liquid seal plugged - allowing leakage of air into pump casing.
 9. Air leak in suction line.
 10. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service
 11. Foot valve too small.
 12. Foot valve or suction pipe not immersed deeply enough.
 13. Mechanical defects:
 - Impeller clearance too great
 - Impeller damage
3. Not enough pressure
 1. Speed too low.*³
 2. Air or gases in liquid.
 3. Impeller diameter may be too small.
 4. Mechanical defects:
 - Impeller clearance too great
 - Impeller damage

-
5. Wrong direction of rotation or impeller installed backwards.
 6. Be sure pressure gauge is in correct place on discharge nozzle or discharge pipe.
 4. Pump works a while and then quits
 1. Leaky suction line.
 2. Stuffing box packing worn - or liquid seal plugged - allowing leakage of air into pump casing.
 3. Air pocket in suction line.
 4. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service.
 5. Air or gases in liquid.
 6. Suction lift too high (suction pipe may be too small or long, causing excessive friction loss). Check with vacuum or compound gauge.
 7. Impeller plugged.
 8. Obstruction in suction or discharge line.
 9. Casing gaskets damaged.
 5. Pump takes too much power
 1. Speed too high.
 2. Head lower than rating, pumps too much liquid.
 3. Liquid heavier than anticipated. Check viscosity and specific gravity.
 4. Mechanical defects:
 - Shaft bent
 - Rotating element binds
 - Stuffing box too tight
 - Impeller clearance too great
 5. Wrong direction of rotation, or impeller installed backwards.
 6. Pump leaks excessively at stuffing box
 1. Packing is worn or not properly lubricated.
 2. Packing is incorrectly inserted or not properly run in.
 3. Packing is not correct for liquid handled.
 4. Shaft sleeve scored.
 5. Insufficient packing.
 6. Damaged mechanical seal.
 7. Pump is noisy or vibrates
 1. Hydraulic noise - cavitation, suction lift too high. Check with vacuum or compound gauge.
 2. Mechanical defects:
 - Shaft bent
 - Rotating parts bind, are loose or broken
 - Bearings worn out
 - Coupling misaligned
 8. High bearing temperature

See [6.1.1 Bearing Temperatures on page 59](#)

 1. Pump and driver misalignment.
 2. Pump capacity too low.
-

3. Improper lubrication.
4. Excessive vibration.
5. Bent shaft.
6. Rotating element binds.

- *1 When directly connected to electric motors, check whether motor wiring is correct and receives full voltage. When directly connected to steam turbines, make sure that turbine receives full steam pressure.
- *2 When directly connected to electric motors, check whether motor wiring is correct and receives full voltage. When directly connected to steam turbines, make sure that turbine receives full steam pressure.
- *3 When directly connected to electric motors, check whether motor wiring is correct and receives full voltage. When directly connected to steam turbines, make sure that turbine receives full steam pressure.

7.2 i-ALERT® Equipment Health Monitor troubleshooting

To troubleshoot the i-ALERT® Equipment Health Monitor, please refer to the i-ALERT® Equipment Health Monitor IOM or <https://www.ittproservices.com/Our-Services/Aftermarket-Products/Monitoring/i-ALERT2-condition-monitor/>

Symptom	Cause	Remedy
There are no green or red flashing LEDs.	The battery is dead.	Replace the condition monitor.
	The unit is deactivated.	Activate the condition monitor.
	The unit is malfunctioning.	Consult your ITT representative for a warranty replacement.
The red LEDs are flashing, but the temperature and vibration are at acceptable levels.	The baseline is bad.	Check the temperature and vibration levels and reset the condition monitor.
	The unit is malfunctioning.	Consult your ITT representative for a warranty replacement.

8 Parts List and Cross-Sectionals

8.1 Spare Parts

To ensure against possible long and costly "downtime" periods, especially on critical services, it is advisable to have spare parts on hand.

The most desirable parts to have on hand are the following:

1. Horizontally Split Case Pumps
 1. "Rotating element". This is a group of assembled parts, including bearings, bearing housings, shaft, impeller(s), wearing rings, stuffing box bushings, and all rotating parts except the coupling.
 2. Stuffing box packing (if any) - one set for each stuffing box.
 3. Stuffing box gland packing (if any) - one set for each gland.
 4. Mechanical Seals (if any) - one seal for each stuffing box.
2. Frame Mounted End Suction Pumps
 1. "Support Head". This is a group of assembled parts which includes all parts except the casing, suction cover and coupling. The impeller is not mounted on the shaft.
 2. Stuffing box packing (if any) - one set.
 3. Stuffing box gland packing (if any) - one set.
 4. Mechanical seal (if any) - one.
3. "Back Pull-Out" End Suction Pumps
 1. "Back Pull-Out assembly". This is a group of assembled parts which includes all parts except the casing and the coupling.
 2. Stuffing box packing (if any) - one set.
 3. Stuffing box gland packing (if any) - one set.
 4. Mechanical seal (if any) - one.

An alternate, though not as desirable as that stated above, is to have on hand parts that are most likely to wear and which can be used as needed.

Following is a list of these suggested parts:

1. Stuffing box packing (if any) - one set for each stuffing box.
2. Stuffing box gland packing (if any) - one set.
3. Mechanical seal (if any).
4. Shaft sleeve (if any).
5. Ball bearings - one of each.
6. Shaft nut (if any).
7. Bearing locknut and washer (if any).
8. Wearing rings (if any).
9. Shaft - one required.
10. Impeller key (if any).
11. Stuffing box bushings (if any).

If it is not convenient or desirable to carry the spare parts listed above, the following list is suggested as a minimum for servicing the pump under ordinary conditions of wear:

1. Stuffing box packing (if any) - one set for each stuffing box.
2. Stuffing box gland packing (if any) - one set.

3. Shaft sleeve (if any).
4. Ball bearings - one of each.
5. Shaft nut (if any).
6. Bearing locknut and washer (if any).

8.2 Instructions for Ordering Spare Parts

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

1. Give Model No., size of the pump and serial number. These can all be obtained from the name-plate.
2. Write plainly the names, part numbers and materials of the parts required. These names and numbers should agree with those on the [8.3 Parts List on page 86](#).
3. Give the number of parts required.
4. Give complete shipping instructions.

8.3 Parts List

Table 11: Construction details

		Group S						Group M						Group L																					
		3x6-14	3x8-14	4x6-14	4x10-1	4x6-18	4x10-1	6x8-14	6x12-1	6x8-18	6x12-1	6x8-22	6x12-2	8x10-1	8x14-1	8x10-1	8x14-1	8x10-1	8x14-1	8x10-2	8x14-2	20x12-	18x16-	18x12-	20x16-	22x14-	18x18-	18x14-	22x18-	22x14-	18x20-	18x14-	22x20-	28x18-	22
Gen-eral	Net wgt. bronze fitted bare pump w/ suction piece	850	925	1050	1100	1525	1700	1550	1600	1725	1800	1900	2050	2000	2350	2125	2800	4500																	
	Min. casing thickness C.I. bronze*1	9/16	19/32	21/32	21/32	23/32	12/16	11/16	3/4	13/16	7/8	7/8	15/16	15/16	31/32	31/32	1-1/16	1-1/4																	
	Min. casing thickness steel*2	7/16	1/2	17/32	17/32	9/16	21/32	9/16	19/32	5/8	11/16	11/16	3/4	3/4	3/4	3/4	12/16	1-1/16																	
	Max. dia. solids	1-1/8	2	1-3/8	2-7/8	2	1-5/8	3-3/4	2-3/4	2-1/8	2-1/2	2-3/8	2-7/8	2-1/4	1-5/8	2-1/8	3																		
Pressure limits	Max. working pressure - PSIG	See Pressure - Temperature Chart 150% of maximum working pressure at 100°F																																	
	Max. test pressure - PSIG																																		
Temp. limits	Max liquid temp. oil lube without cooling	250°F 350°F for C.I. 450°F for Steel						250°F 350°F for C.I., 450F for Steel						250°F 350°F for C.I., 450F for Steel																					
	Max liquid temp. oil lube w/ frame cooling																			250°F															

		Group S						Group M								Group L																					
		3x6-14	3x8-14	4x6-14	4x10-1	4x6-18	4x10-1	6x8-14	6x12-1	6x8-18	6x12-1	6x8-22	6x12-2	6x10-1	8x14-1	8x10-1	8x14-1	8x10-1	8x14-1	8x10-1	8x14-1	8x10-2	8x14-2	20x12-	16x16-	16x12-	20x16-	22x14-	18x18-	18x14-	22x18-	22x14-	18x20-	18x14-	22x20-	22x18-	22
	Max liquid temp. grease lube																																				
HP limits	H.P. per 100RPM	9.52						23.8								63.5																					
Shaft Dia.	At impeller	1-7/8						2-3/4								3 ^{3/8}																					
	Under shaft sleeve	2-1/2						3-5/16								4 ^{5/16}																					
	At coupling	1-7/8						2-3/8								3 ^{3/8}																					
	Between bearings	3-1/8						4								4 ^{7/8}																					
Sleeve O.D.	Thru stuffing box	3						3 ^{3/4}								4 ^{3/4}																					
Bearings	Coupling end	MRC 7313 DB or equal MRC 313 S or equal 12-1/4						MRC 7317 DB or equal MRC 317 M or equal 11-11/16								MRC 7222 P.D.B or equal MRC 222 M or equal 11 ^{1/8}																					
	Inboard (pump end)																																				
	Bearing span																																				
	Shaft overhang	10 ³¹ / ₃₂	11 ¹³ / ₃₂	11 ¹ / ₁₆	11 ²⁷ / ₃₂	11 ¹⁹ / ₃₂	11 ¹³ / ₃₂	12 ⁷ / ₁₆	11 ²⁹ / ₃₂	12 ⁷ / ₃₂	11 ⁵ / ₈	12 ⁹ / ₁₆	1 ¹ / ₈	12 ¹³ / ₁₆	12 ¹ / ₁₆	13 ¹ / ₈	12 ³ / ₈	13 ⁷ / ₃₂																			
Stuffing box	Bore																																				
	Depth to stuffing box bushing																																				
	Packing size	4						4-3/4								5-3/4																					
	Number packing rings	3-11/16						3-11/16								3-11/16																					
	Width of lantern ring	1/2 x 1/2						1/2 x 1/2								1/2 x 1/2																					
	Distance from end of stuffing box to nearest obstruction	5						5								5																					
			1						1								1																				
		3-1/8						3-1/8								3-1/4																					

*1 Includes 1/8 corrosion allowance

*2 Includes 1/8 corrosion allowance

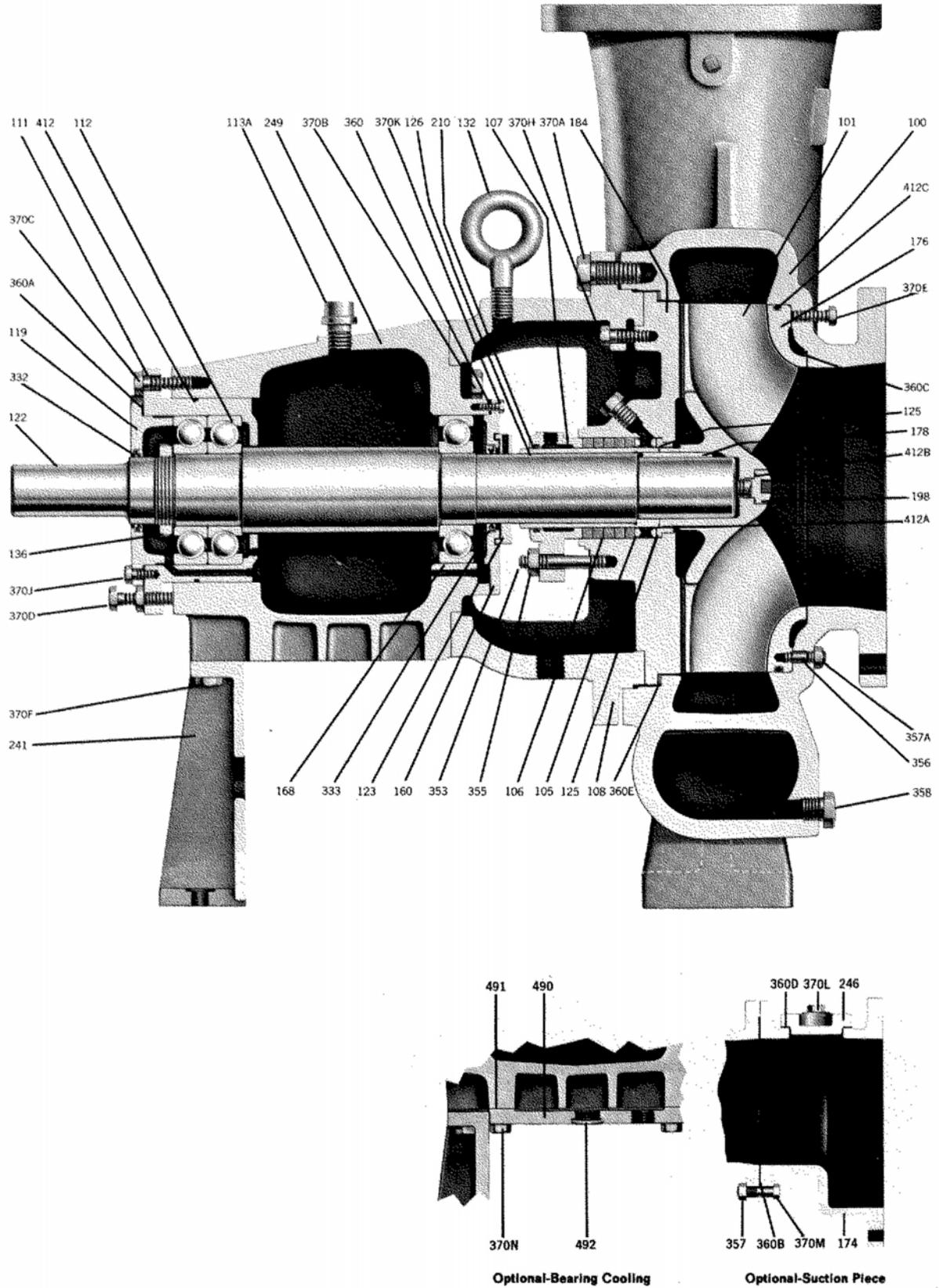


Figure 85: Sectional View and Parts List

Table 12: Materials of Construction

Material	Cu %	Sn %	Ph %	Zn %	Ni %	P %
1102	84-86	4-6	4-6	4-6	-	-
1103	87	6	4.5	1.75	0.75	-
1106	84	8	8	-	-	0.10-0.15

1000 - Cast Iron - conforms to ASTM A-278 Class 25

1003 - Cast Iron - conforms to ASTM A-278 Class 30

303 - Designates AISI Type 303 stainless steel

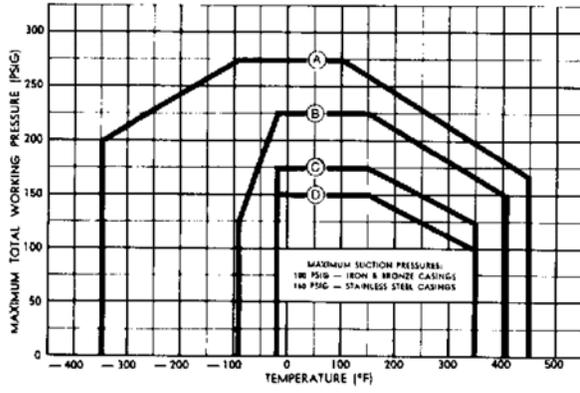
316 - Designates AISI Type 316 stainless steel (wrought) or ASTM A-296 Grade CF-8M and ACI-CF-8M (cast)

Table 13: Pressure Temperature Capability

Pump Size	Curve	Pump Casing Material	Acceptable Minimum Standard ANSI*1 Mating Flanges and Fittings	
			Discharge	Suction
3 x 6-14	A	316 Stainless steel	150 PSI flat face steel	150 PSI flat face steel
4 x 6-14	B	Bronze (1103)	150 PSI flat face bronze or steel	150 PSI flat face bronze or steel
4 x 6-18				
6 x 8-14				
6 x 8-18				
6 x 8-22				
8 x 10-14				
8 x 10-18	C	Cast iron (1003)	125 PSI cast iron	125 PSI cast iron
8 x 10-18H				
8 x 10-22				
10 x 12-18				
10 x 12-22				
12 x 14-18				
12 x 14-22	C	Cast iron (1003)	125 PSI cast iron	125 PSI cast iron
14 x 14-18				
14 x 14-22				
14 x 14-18	A	316 Stainless steel	150 PSI flat face steel	150 PSI flat face steel
14 x 14-22	B	Bronze (1103)	150 PSI flat face steel	150 PSI flat face steel
18 x 18-22	D	Cast iron (1003)	125 PSI cast iron	125 PSI cast iron

*1 American National Standards Institute, formerly USASI and ASA

For other materials, refer to factory



8.4 Parts list and interchangeability chart

Item No.	No. required per pump	Part Name	Material						Group S				Group M						Group L						
			Bronze fitted	All iron	All bronze	All 316SS	All iron SS trim	All bronze SS trim	3x6-14 and 3x8-14	4x6-14 and 4x10-14	4x6-18 and 4x10-18	6x8-14 and 6x12-14	6x8-18 and 6x12-18	6x8-22 and 6x12-22	8x10-14 and 8x14-14	8x10-18 and 8x14-18	8x10-18H and 8x14-18H	8x10-22 and 8x14-22	10x12-18 and 10x16-18	10x12-22 and 10x16-22	12x14-18 and 12x18-18	12x14-22 and 12x18-22	14x14-18 and 14x20-18	14x14-22 and 14x20-22	18x18-22
125	1	Stuffing box throat bushing	1103	1000	1103	Al SI 316	1000	1103	S				M						L						
126	1	Shaft sleeve	1106	1000	1106	AISI 316		S				M						L							
132	1	Eye bolt	Steel						S				S						S						
136	1	Bearing lock-nut w/lock-washer	Steel						S				M						L						
160	1	Bearing end cover, in-board	1000						S				M						L						
168	1	Ball bearing, inboard	Steel						S				M						L						
174	1	Suction piece	1000	1103	316	1000	1103	A	B	B	C	C	C	D	D	D	D	E	E	F	F	G	G		
176	1	Suction side plate	1000	1106	316	1000	1106	A	B	C	D	E	F	G	H	J	K	N	O	P	Q	P	Q	R	
178	1	Impeller key	AISI 303						S				M						L						
184	1	Stuffing box cover	1000	1103	Al SI 316	1000	1103	A	A	B	A	D	E	F	D	D	E	D	G	H	G	H	G	G	
198	1	Impeller screw	AISI 316						S				S						S						
210	1	Gland packing	Non-asbestos						S				M						L						
241	1	Frame pedestal	1000						A	A	B	B	C	D	C	D	D	E	E	F	G	G	G	H	J

Item No.	No. required per pump	Part Name	Material						Group S						Group M						Group L					
			Bronze fitted	All iron	All bronze	All 316SS	All iron SS trim	All bronze SS trim	3x6-14 and 3x8-14	4x6-14 and 4x10-14	4x6-18 and 4x10-18	6x8-14 and 6x12-14	6x8-18 and 6x12-18	6x8-22 and 6x12-22	8x10-14 and 8x14-14	8x10-18 and 8x14-18	8x10-18H and 8x14-18H	8x10-22 and 8x14-22	10x12-18 and 10x16-18	10x12-22 and 10x16-22	12x14-18 and 12x18-18	12x14-22 and 12x18-22	14x14-18 and 14x20-18	14x14-22 and 14x20-22	18x18-22	
246	1	Hand hole cover	1000	1103	3106	1000	1103	S						S						S						
247	1	Drip basin, not shown	-	316			-	316	S						S						S					
248	1	Bearing frame	1000						S						M						L					
251	1	Bottle oiler constant level							S						S						S					
332	1	Oil seal, coupling end							S						M						L					
333	1	Oil seal, in-board							S						M						L					
353	2	Gland stud	AISI 303						S						S						S					
355	2	Gland stud nut	AISI 304						S						S						S					
356	4	Stud, suction side plate to casing	AISI 303						A	A	A	A	A	A	A	B	A	A	C	A	C	A	B	A	C	C
357	8-20	Hex nut, suction piece to casing bolt	Steel						A	A	A	A	A	A	B	B	B	B	B	B	B	C	C	C	C	
357 A	4	Hex nut, side plate stud	AISI 303						S						S						S					
358	1	Pipe plug, casing drain	1102	1000	1102	3106	1000	1102	S						S						S					
360	1	Gasket, bearing end cover, in-board	.006 white manilla paper						S						M						L					
360 A	1	Gasket, bearing end	.006 white manilla paper						S						M						L					

8.4 Parts list and interchangeability chart

Item No.	No. required per pump	Part Name	Material					Group S				Group M						Group L				
			Bronze fitted	All iron	All bronze	All 316SS	All iron SS trim	All bronze SS trim	3x6-14 and 3x8-14	4x6-14 and 4x10-14	4x6-18 and 4x10-18	6x8-14 and 6x12-14	6x8-18 and 6x12-18	6x8-22 and 6x12-22	8x10-14 and 8x14-14	8x10-18 and 8x14-18	8x10-18H and 8x14-18H	8x10-22 and 8x14-22	10x12-18 and 10x16-18	10x12-22 and 10x16-22	12x14-18 and 12x18-18	12x14-22 and 12x18-22
490	1	Water jacket cover, optional	1000					S				S						S				
491	1	Gasket, water jacket cover	Non-asbestos					S				S						S				
492	1	Welch plug	416SS					S				S						S				

8.5 Pump Selection Chart

Table 15: Index and Selection

	Model Number and Pump Type	Described in Bulletin	No. of Sizes and Ranges	Max. Capacity G.P.M.	Max Head Feet	Max Temp. °F	Max Working Pressure	Type of Impeller	Class of Construction
Process	3196-STD AVS Chemical	725.1	18 1" - 4"	1600	750	500	375	Open	A, B, C, F
	3196-XL 3196-HT	725.1 XL	5 6" & 8"	4250	230	500 700	375	Open	A, B, C, F A, B, C
	3706 Small glassed	725.2	1 1"	100	115	350	150	Open	D
	3708 Glassed	725.2	4 1" - 3"	700	150	350	150	Semi-Open	D
	3107 PTFE	725.3	1 1"	70	110	300	150	Open	E
	3198 AVS PTFE	725.3	2 1 ½" & 3"	800	410	300	225	Open	E
	2520 Liquid Ring	725.6	1 1 ½"	60	85	212	75	Strgt. Blade	1 & B
	3604 Close-Coupled Small Alloy	725.7	1 ¾"	16	28	220	75	Semi-Open	B
	3199 Single Stage, Direct Con.	725.8	3 1" - 1 ½"	220	150	350	150	Open	A, B, C
	3716 Cer-Vit		1 1 ½"	140	140	350	100	Open	Cer. - Vit
High Temp. Process	3735-HPI Centerline mounted	724.2	21 1" - 6"	1900	900	800	600	Encl.	C
	3736 HPI Foot mounted	724.2	21 1" - 6"	1900	900	500	600	Encl.	C
Stock	3135 Diagonally split casing	723.1	12 3" - 8"	4000	300	200	150	Open	A, B, C
	3175 Back pull out	723.4	17 3" - 18"	12500	320	450	275	Open	A, B, C
General Service	3655 Single Stg, Close Coupled	710.1	25 1 ¼" - 8"	3800	400	250	150	Encl.	A

8.5 Pump Selection Chart

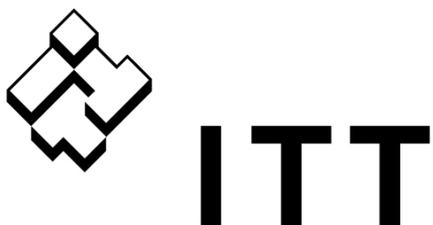
	Model Number and Pump Type	Described in Bulletin	No. of Sizes and Ranges	Max. Capacity G.P.M.	Max Head Feet	Max Temp. °F	Max Working Pressure	Type of Impeller	Class of Construction
	3755 Single stage, direct Con.	715.1	25 1 ¼" - 8"	3800	400	350	150	Encl.	A
	3345 Two Stg, Direct Con.	718.2	1 1"	120	500	350	250	Encl.	A
	3320 Two Stg, Close-Coupled	713.1	1 1"	120	500	250	250	Encl.	A
	3189 Single Stg, Direct Con.	720.4	2 6" & 8"	3200	155	350	150	Open	A
Multi Stage	3316 Two stage	722.6	10 1" - 8"	3000	1000	400	500	Encl.	A & B in all sizes. C in most sizes
	3330 Medium Pressure	722.1	21 3" - 8"	2100	1000	350	370	Encl.	A & B
	3360-65 High Pressure	722.4	11 3" - 8"	2600	3400	350	1200	Encl.	A & B
Double Suction	3405	721.6	39 2" - 12"	6400	550	350	250	Encl.	A & B in all sizes. C in 4" - 12"
	3404 Vertically Mtd.	721.15	39 2" - 12"	6400	525	350	250	Encl.	A & B in all sizes. C in 4" - 12"
	3415DV	721.7	8 8" - 18"	15000	550	275	275	Encl.	A, B, C
	3420-23 Horiz. & Bottom Suction	721.8 and .9	7 16" - 36"	75000	400	275	200	Encl.	A, B, C
	3450-60 Horiz. & Bottom Suction	721.2	3 14" - 16"	16000	200	250	250	Encl.	A
Vertical	3171 Vertical Centrifugal	726.1	21 1" - 8"	3180	290	450	150	Open	A & C
	VIT Vertical Turbine	3A.1	18 4" - 36"	20000	3000	250	-	Open	1, 3, 5, 8

Table 16: Materials of Construction

The table at the right shows a code for construction materials. They are listed in the last column of the Index and Selection chart above. Materials listed include both normal inventory alloys and some others built only to order. For specific information on delivery consult your Goulds sales engineer.

Class		Materials of Construction
A	1	All iron (ASTM A278)
	2	Bronze fitted
	3	All bronze. See bulletin for spec.
	4	Ductile iron (ASTM A395)
B	5	Ni-Resist (Type 2) (ASTM A436)
C	6	Carbon steel (ASTM A216 Grade WCA & WCB)
	7	11-13% chrome stainless (ACI CA15)
	8	316 stainless (ACI CF8M)
	9	Gould A LOV 20 (ACI CN 7 MCU)
	10	Other special sand cast machinable alloys such as low, medium and high carbon steels, ACI CF 8C (347) 316 ELC, monel, nickel.
	11	ISO B and C
D	12	All iron, glassed
E	13	Ductile iron, molded-in-place PTFE
F	14	Titanium

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