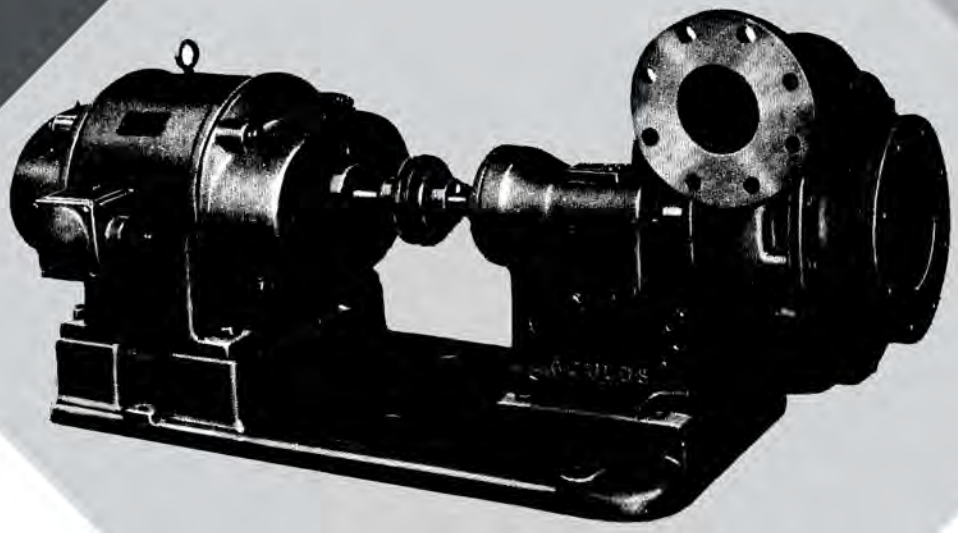
GOULDS PUMPS

Installation, Operation, and Maintenance Manual

Model 3755



ITT

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1 Introduction and Safety

1.1 Important Safety Notice

To: Our Valued Customers:

User safety is a major focus in the design of our products. Following the precautions outlined in this manual will minimize your risk of injury.

ITT Goulds pumps will provide safe, trouble-free service when properly installed, maintained, and operated.

Safe installation, operation, and maintenance of ITT Goulds Pumps equipment are an essential end user responsibility. This Pump Safety Manual identifies specific safety risks that must be considered at all times during product life. Understanding and adhering to these safety warnings is mandatory to ensure personnel, property, and/or the environment will not be harmed. Adherence to these warnings alone, however, is not sufficient — it is anticipated that the end user will also comply with industry and corporate safety standards. Identifying and eliminating unsafe installation, operating and maintenance practices is the responsibility of all individuals involved in the installation, operation, and maintenance of industrial equipment.

Please take the time to review and understand the safe installation, operation, and maintenance guidelines outlined in this Pump Safety Manual and the Instruction, Operation, and Maintenance (IOM) manual. Current manuals are available at https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/ or by contacting your nearest Goulds Pumps sales representative.

These manuals must be read and understood before installation and start-up.

For additional information, contact your nearest Goulds Pumps sales representative or visit our Web site at https://www.gouldspumps.com

1.2 Safety warnings

Specific to pumping equipment, significant risks bear reinforcement above and beyond normal safety precautions.

WARNING:
A pump is a pressure vessel with rotating parts that can be hazardous. Any pressure vessel can explode, rupture, or discharge its contents if sufficiently over pressurized causing death, personal injury, property damage, and/or damage to the environment. All necessary measures must be taken to ensure over pressurization does not occur.

WARNING:
Operation of any pumping system with a blocked suction and discharge must be avoided in all cases. Operation, even for a brief period under these conditions, can cause superheating of enclosed pumpage and result in a violent explosion. All necessary measures must be taken by the end user to ensure this condition is avoided.

WARNING:
The pump may handle hazardous and/or toxic fluids. Care must be taken to identify the contents of the pump and eliminate the possibility of exposure, particularly if hazardous and/or toxic. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks.

WARNING:
Pumping equipment Instruction, Operation, and Maintenance manuals clearly identify accepted methods for disassembling pumping units. These methods must be adhered to. Specifically, applying heat to impellers and/or impeller retaining devices to aid in their removal is strictly forbidden. Trapped liquid can rapidly expand and result in a violent explosion and injury.

ITT Goulds Pumps will not accept responsibility for physical injury, damage, or delays caused by a failure to observe the instructions for installation, operation, and maintenance contained in this Pump Safety Manual or the current IOM available at http://www.gouldspumps.com/literature.

1.3 Safety

Definitions

Throughout this manual the words Warning, Caution, Electrical, and ATEX are used to indicate where special operator attention is required.

Observe all Cautions and Warnings highlighted in the Pump Safety Manual and the IOM provided with your equipment.

WARNING:
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
Example: Pump shall never be operated without coupling guard installed correctly.

CAUTION:
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
Example: Throttling flow from the suction side may cause cavitation and pump damage.

Electrical Hazard:

WARNING:
Indicates the possibility of electrical risks if directions are not followed.
Example: Lock out driver power to prevent electric shock, accidental start-up, and physical injury.

ATEX:

WARNING:
When installed in potentially explosive atmospheres, the instructions that follow the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact an ITT Goulds Pumps representative before proceeding.
Example: Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

1.4 General precautions

WARNING:
A pump is a pressure vessel with rotating parts that can be hazardous. Hazardous fluids may be contained by the pump including high temperature, flammable, acidic, caustic, explosive, and other risks. Operators and maintenance personnel must realize this and follow safety measures. Personal injuries will result if procedures outlined in this manual are not followed. ITT Goulds Pumps will not accept responsibility for physical injury, damage or delays caused by a failure to observe the instructions in this manual and the IOM provided with your equipment.

Table 1: General Precautions

WARNING		NEVER APPLY HEAT TO REMOVE IMPELLER. It may explode due to trapped liquid.
WARNING		NEVER use heat to disassemble pump due to risk of explosion from tapped liquid.
WARNING		NEVER operate pump without coupling guard correctly installed.
WARNING		NEVER run pump below recommended minimum flow when dry, or without prime.
WARNING		ALWAYS lock out power to the driver before performing pump maintenance.
WARNING		NEVER operate pump without safety devices installed.
WARNING		NEVER operate pump with discharge valve closed.
WARNING		NEVER operate pump with suction valve closed.
WARNING		DO NOT change service application without approval of an authorized ITT Goulds Pumps representative.
WARNING		Safety Apparel: • Insulated work gloves when handling hot bearings or using bearing heater • Heavy work gloves when handling parts with sharp edges, especially impellers • Safety glasses (with side shields) for eye protection • Steel-toed shoes for foot protection when handling parts, heavy tools, etc. • Other personal protective equipment to protect against hazardous/toxic fluids
WARNING		Receiving: Assembled pumping units and their components are heavy. Failure to properly lift and support equipment can result in serious physical injury and/or

		equipment damage. Lift equipment only at specifically identified lifting points or as instructed in the current IOM. Current manuals are available at www.gouldspumps.com/literature_ioms.html or from your local ITT Goulds Pumps sales representative. Note: Lifting devices (eyebolts, slings, spreaders, etc.) must be rated, selected, and used for the entire load being lifted.
WARNING		Alignment: Shaft alignment procedures must be followed to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow coupling manufacturer's coupling installation and operation procedures.
WARNING		Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.
CAUTION		Piping: Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.
WARNING		Flanged Connections: Use only fasteners of the proper size and material.
WARNING		Replace all corroded fasteners.
WARNING		Ensure all fasteners are properly tightened and there are no missing fasteners.
WARNING		Startup and Operation: When installing in a potentially explosive environment, please ensure that the motor is properly certified.
WARNING		Operating pump in reverse rotation may result in contact of metal parts, heat generation, and breach of containment.
WARNING		Lock out driver power to prevent accidental start-up and physical injury.
WARNING		The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
WARNING		If using a cartridge mechanical seal, the centering clips must be installed and set screws loosened prior to setting impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.
WARNING		The coupling used in an ATEX classified environment must be properly certified and must be constructed from a non-sparking material.
WARNING		Never operate a pump without coupling guard properly installed. Personal injury will occur if pump is run without coupling guard.

WARNING		Make sure to properly lubricate the bearings. Failure to do so may result in excess heat generation, sparks, and / or premature failure.
CAUTION		The mechanical seal used in an ATEX classified environment must be properly certified. Prior to start up, ensure all points of potential leakage of process fluid to the work environment are closed.
CAUTION		Never operate the pump without liquid supplied to mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if mechanical seal fails.
WARNING		Never attempt to replace packing until the driver is properly locked out and the coupling spacer is removed.
WARNING		Dynamic seals are not allowed in an ATEX classified environment.
WARNING		DO NOT operate pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury
WARNING		Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
WARNING		Shutdown, Disassembly, and Reassembly: Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes must be worn at all times.
WARNING		The pump may handle hazardous and/or toxic fluids. Observe proper decontamination procedures. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
WARNING		Operator must be aware of pumpage and safety precautions to prevent physical injury.
WARNING		Lock out driver power to prevent accidental startup and physical injury.
CAUTION		Allow all system and pump components to cool before handling them to prevent physical injury.
CAUTION		If pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107, there may be a risk of static electric discharge from plastic parts that are not properly grounded. If pumped fluid is non-conductive, pump should be drained and flushed with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.
WARNING		Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.
CAUTION		Wear heavy work gloves when handling impellers as sharp edges may cause physical injury.
CAUTION		Wear insulated gloves when using a bearing heater. Bearings will get hot and can cause physical injury.

WARNING		Noise: 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.
WARNING		Temperature: Equipment and piping surfaces may exceed 130ºF (54ºC) 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.

1.5 ATEX Considerations and Intended Use

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

Description of ATEX

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

Guidelines for compliance

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

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

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

Current IOMs are available at https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/IOMs/ or from your local ITT Goulds Pumps Sales representative.

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

Figure 1: Typical ATEX pump nameplate

Table 2: Temperature class definitions

Code	Maximum permissible pumpage temperature in °C | °F	Minimum permissible pumpage temperature in °C | °F
T1	450 | 842	372 | 700
T2	300 | 572	277 | 530
T3	200 | 392	177 | 350
T4	135 | 275	113 | 235
T5	100 | 212	Option not available
T6	85 | 185	Option not available

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

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.

1.6 Parts

The use of genuine Goulds parts will provide the safest and most reliable operation of your pump. ITT Goulds Pumps ISO certification and quality control procedures ensure the parts are manufactured to the highest quality and safety levels.

Please contact your local Goulds representative for details on genuine Goulds parts.

2 Installation

2.1 Location

Pumping unit should be placed as close as practical to the source of supply. Always allow sufficient head room to remove the upper half casing of the pump and the rotating element. Floor space allotted to the pumping unit should be sufficient for inspection and maintenance.

2.2 Prepare the foundation

1. The foundation should be substantial in order to absorb any vibration and to form a permanent rigid support for the bedplate. A concrete foundation poured on a solid footing, using a one-three-five mix, of a liberal thickness to support the pumping unit is satisfactory.
2. Foundation Bolts:
   a) The location and size of the foundation bolts is shown on the outline assembly drawing supplied for the pumping unit.
   b) Each bolt should be installed with a pipe sleeve around it - to allow for adjustment. The inside sleeve diameter should be 2½ to 3 times the diameter of the bolt. Place a washer between bolt head and sleeve to hold bolt in position. Stuff waste around foundation bolts to prevent concrete from entering between the bolt and pipe sleeve. See Figure 2: Foundation on page 10.
   c) The foundation bolts should be of sufficient length so that they project through the nut approximately ¼" after allowance has been made for grouting (¾" to 1½"), the thickness of the bedplate, and the thickness of the foundation bolt nut. See Figure 2: Foundation on page 10.

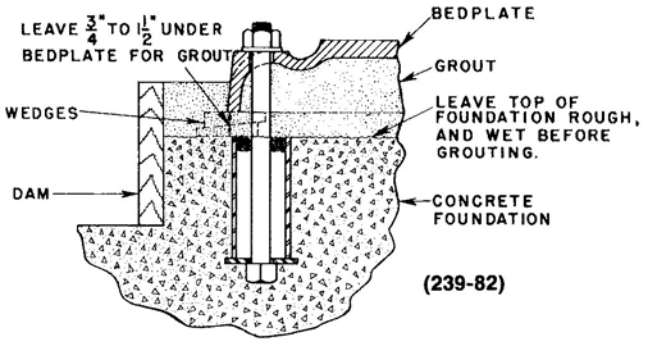


Figure 2: Foundation

3. Preparing Foundation for Mounting:

   Prior to setting unit upon the foundation, clean the top surface of concrete.
4. Mounting unit on foundation
   a) Put the pumping unit in place on the wedges. The wedges should be placed at four points, two below the approximate center of the pump and two below the approximate center of the driver (See Figure 2). Some installations may require additional wedges near the middle of the bedplate.
   b) Disconnect coupling between pump and driver if other than insert-spider type.
   c) By adjustment of the wedges, bring the unit to an approximate level and provide for the proper distance above the foundation for grouting (¾" to 1½"). Plumb the suction and discharge flanges. By further adjustment of the wedges, bring the coupling halves into reasonable alignment. Check by method described in Section 2.3 Alignment - initial on page 11, steps 4 through 6.
   d) After the wedges have been adjusted, tighten foundation bolts evenly but only finger tight.

NOTICE:

Final tightening of foundation bolts is done after grout has set 48 hours.

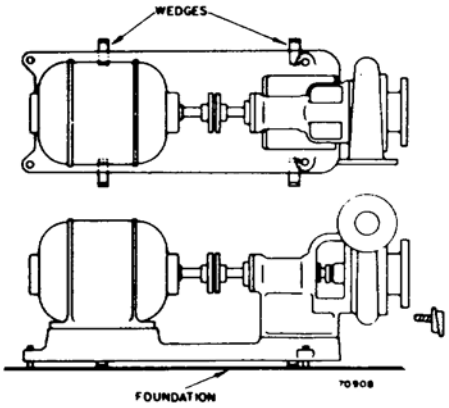


Figure 3:

5. Grouting Unit on Foundation:
   a) Build wood dam around foundation as shown in Figure 2: Foundation on page 10. Wet top surface of concrete foundation thoroughly.
   b) Pour grout in hole provided in the top of the bedplate. Use of a non-shrink grout is recommended. The grout should be thin enough to flow out under the bedplate. A mixture of one part Portland cement to three parts sharp sand may also be used. Cement grout should not be so thin that the cement will separate from the sand.
   c) The 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 in the top of the bedplate.
   d) With a trowel, strike along the top of the wood dam to give a neat, finished appearance at this point.
   e) Allow grout to harden at least 48 hours.

2.3 Alignment - initial

Alignment of the pump and driver through the flexible coupling is of extreme importance for trouble-free mechanical operation.

If the driver was mounted at the factory, the unit was in alignment before it left our assembly department. However, in transit and subsequent handling, this factory alignment was probably destroyed; and, it is now necessary to reestablish the alignment. As directed in Foundation (Step 4, Mounting unit on foundation), only approximate alignment was obtained by wedging under bedplate before grouting.

The following are suggested steps to establish the initial alignment of the pumping 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 4.3 Alignment - final on page 21 and must be followed.

1. Be sure coupling halves are disconnected as previously instructed, except *spider-insert* type.
2. Tighten foundation bolts.

3. Tighten pump and driver hold-down bolts.
4. Check gap and angular misalignment, shaft axes concentric but not parallel.
    1. Coupling other than *spider-insert* type.

        The normal gap (distance between coupling halves) is 1/8". Check angular misalignment by inserting a feeler or taper gauge at four points on the circumference of the coupling halves at 90 degree intervals. See Figure 4: Checking angular alignment, except spider-insert type on page 12. The unit will be in angular alignment when the measurements show the coupling faces are the same distance apart at all points. Adjustment for gap and for obtaining angular alignment is obtained be loosening the driver hold down bolts and shifting or shimming driver as required. Tighten driver hold down bolts after adjustments are made.

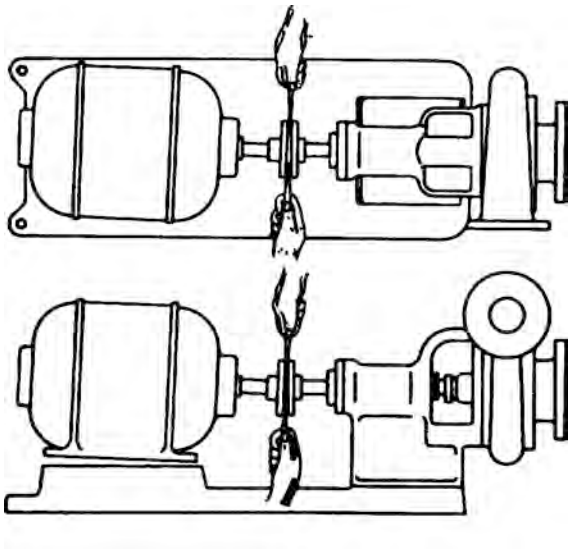
        

        Figure 4: Checking angular alignment, except spider-insert type

    2. *Spider-insert* type coupling.

        The normal gap (distance of the space between coupling halves and the thickness of the spider-insert) is 1/16". Check angular misalignment by using calipers at four points on the circumference of the outer ends of the coupling hubs at 90 degree intervals. See Figure 5: Checking angular alignment, spider-insert type on page 13. The unit will be in angular alignment when the measurements show the coupling hubs to be the same distance apart at all points. Adjustment for obtaining the gap and angular alignment is obtained be loosening the driver hold down bolts and shifting or shimming driver as required. Tighten driver hold down bolts after adjustments are made.

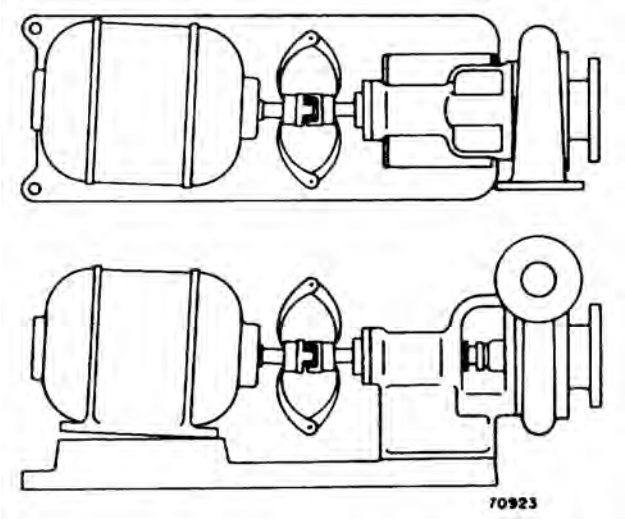


Figure 5: Checking angular alignment, spider-insert type

5. Check parallel misalignment: shaft axes parallel but not concentric, by laying a straight edge across both coupling rims at top, bottom and both sides. See Figure 6: Checking parallel alignment on page 13. This applies to both types of couplings.

   The unit will be in horizontal alignment when the straight edge rests evenly on both halves of the coupling at each side.

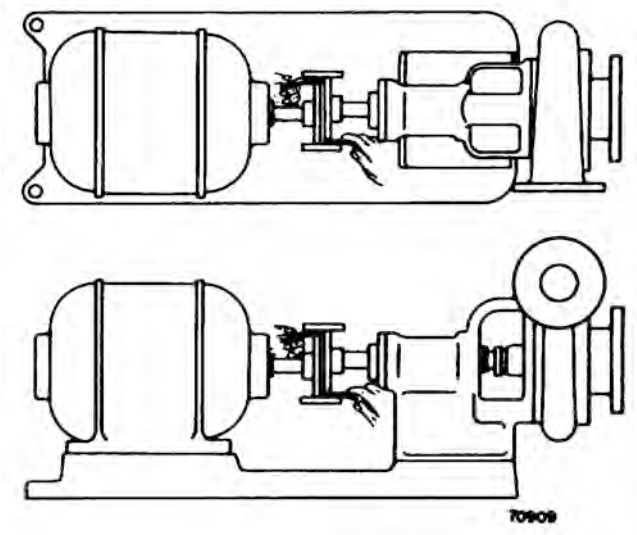


Figure 6: Checking parallel alignment

In order to secure vertical parallel alignment under actual operating conditions, the driver shaft must be set higher or lower than the pump shaft to compensate for vertical expansion. A suggested, approximate cold setting for motor driven pumps is outlined below:

1. When pumping cold liquids, or when pump bearings are being cooled, set the motor shaft .006" below the pump shaft.
2. When pumping hot liquids (150º to 180ºF), and cooling is not used, set the motor and pump shafts at same height.

   Measure the difference in shaft heights by laying a straight edge across the shaft hubs and checking with feelers.

Thin shim should be used under the driver feet to establish parallel alignment. (In some instances, shims may be required under the pump feet).

6. Alignment in one direction may alter the alignment in another. Check through each alignment procedure after making any alignment alteration.

2.4 Piping - general

1. All piping must be supported independently of the pump. The piping should always "lineup" 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.
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. See Section 2.7 Connection of piping on page 16.
4. When handling liquids at elevated temperatures, arrangements must be made for expansion loops or expansion joints so that the linear expansion of the pipe will not cause the pumping unit to be drawn out of alignment.

2.5 Install suction piping

1. General - properly installed suction piping is of extreme importance for trouble-free centrifugal pump operation.
   a) The suction pipe should be as large or larger than the pump suction.
   b) Increasers, if used, should be eccentric and preferably at the pump suction flange, sloping side down.
   c) A centrifugal pump should never be throttled on the suction side for capacity adjustment.
2. Installations With Pump Above Source of Supply - Suction Lift:
   a) Keep suction pipe free from air pockets.
   - No portion of piping should extend above the pump suction nozzle.

   b) All joints must be air tight.
   c) The suction pipe should always be submerged into the source of supply as shown in Figure 7: Pipe submergence and entrance calculation on page 15.
   d) A foot valve should only be used if necessary for priming, or, if the pump is to be used on intermittent service and is required to hold its prime.
   e) Suction strainers when used should have a net free area of at least three times the suction pipe area.
3. Installations With Pump Below Source of Supply - Suction Head or Flooded Suction:
   a) A gate valve should be installed in the suction line to permit closing the line for pump inspection and maintenance.
   b) The size of the entrance from the source of supply or minimum submergence over the entrance should be calculated from the data shown in Figure 7: Pipe submergence and entrance calculation on page 15 for applicable condition to prevent air from being drawn into pipe.

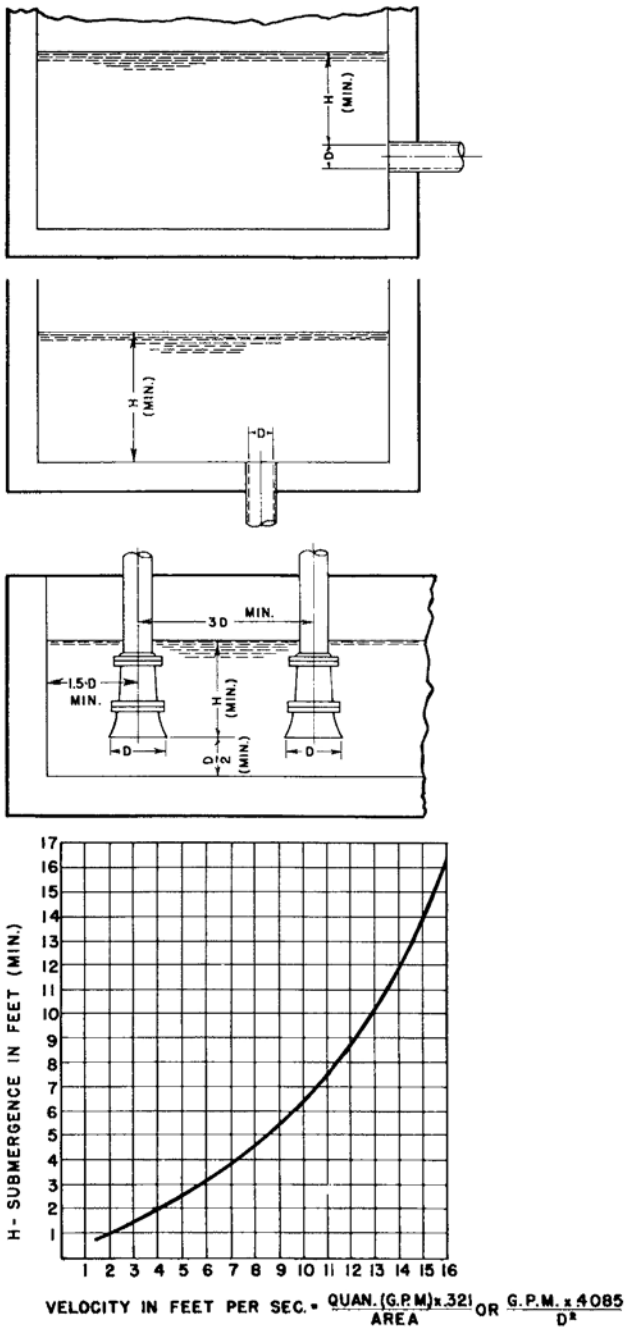


Figure 7: Pipe submergence and entrance calculation

2.6 Piping - discharge

1. A gate valve and a check valve 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 capacity and for inspection and maintenance of the pump.
2. Increasers, if used in discharge line, should be placed between the check valve and the pump.

2.7 Connection of piping

Connect suction and discharge piping. Rotate the pump shaft by hand several complete revolutions to be sure that there is no binding and that all parts are free. Recheck alignment as described in Section Alignment - initial. If the connection of the piping causes unit to be out of alignment, correct piping to relieve strain on the pump.

2.8 Check rotation

These pumps are built in right hand construction, i.e., clockwise rotation from driver end. The direction of rotation is marked on the pump casing. Make sure that the driver rotates in the same direction. On electric motors, jog starting switch with coupling disconnected to be sure wiring is connected for correct rotation. If the pump is run dry, the rotating parts within the pump may gall and seize to the stationary parts as they depend on the liquid being pumped for lubrication.

2.9 Connection of coupling

Connect coupling, following instructions for the particular make of coupling furnished. The data is supplied separately, giving complete instructions for connection, lubrication, alignment and maintenance. Spider-insert type couplings are pre-assembled.

3 Preparation for Operation

3.1 Pump bearings

1. Grease lubricated bearings

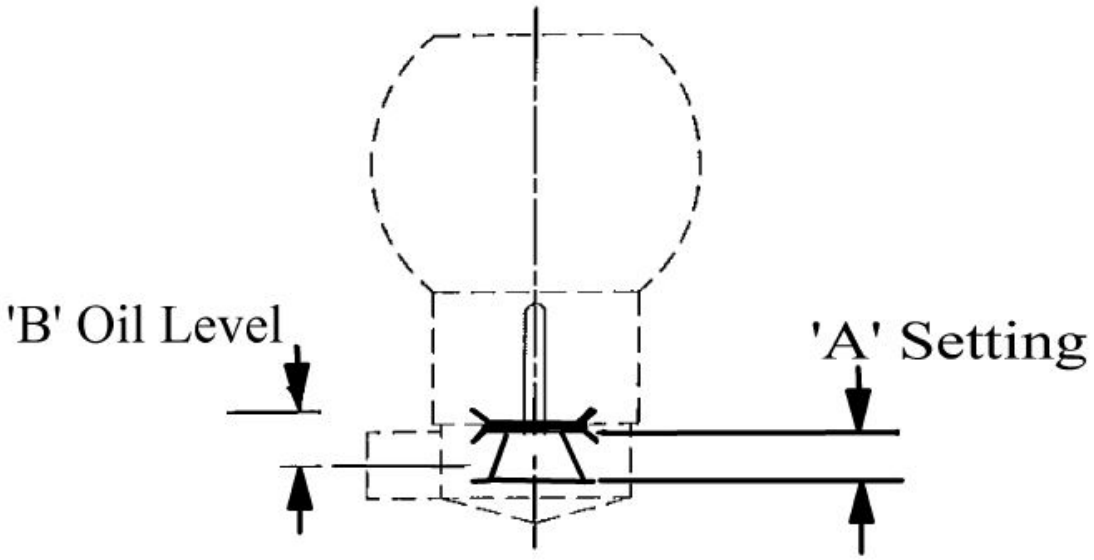
   Sufficient lubricant is inserted at the factory for 2000 hours of operation.
2. Oil lubricated bearings
   1. Remove adjustment assembly from oiler.
   2. Adjust bars to Dim. A.
   3. Lock in position.
   4. Replace adjustment assembly in oiler.

Oil lubricated, and are not lubricated before leaving the factory.

A high quality turbine type oil, with rust and oxidation inhibitors, should be used. For the great majority of operation conditions, oil temperature will run between 50 and 180°F. In this range an oil of 300 SSU viscosity at 100°F. (approximately SAE 20) should be used.

If oil temperature exceeds 180°F for extended periods, use of cooling water in the frame cooling jacket is recommended. For extreme conditions, refer to factory or a lubrication expert for a recommendation.

The constant level oiler (251) is found in the box of fittings shipped with the pump. Oiler needs to be set to maintain proper oil level. Set the oiler to dimensions A and B as shown in Figure 8: Oiler setting on page 17.



Oiler Size	A	B
#3 (4 oz.)	19/32"	½"

Figure 8: Oiler setting

Install the constant level oiler (251) in the frame (228A).

Fill the oiler bottle with the proper grade of oil, and replace in the oiler. The frame is filled when an oil level remains in the bottle. Several fillings of the bottle may be required. Never fill the frame through the breather (113-A) or through the oiler without use of the bottle.

The oil capacities of the frames are: Groups S, 7 oz.; Group M, 12 oz.; Group L, 26 oz.. This does not include any oil in the oiler.

3.2 Driver bearings

Check to be sure the driver bearings are properly lubricated.

3.3 Stuffing box

Packing

1. Stuffing box with packing rings:

   These pumps are furnished with packed stuffing box. In the box of fittings accompanying the pump will be found the stuffing box packing. The standard packing is white metal, graphite, long fiber asbestos and is die formed to facilitate installation.

   When installing the packing, twist the rings sideways just enough to get them around the shaft.

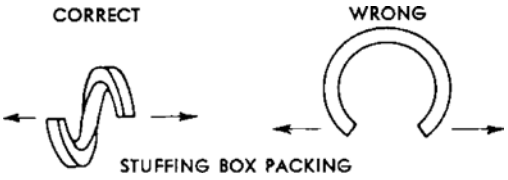


Figure 9: Stuffing box packing

NOTICE:

Do not attempt to pull rings straight out to get them over shaft.

   Slide the lantern ring (105) out and away from the stuffing box. (Refer to 7.4 Sectional views, parts list and interchangeability tables on page 29. Insert three rings of packing, staggering the joints. The lantern ring should then be inserted in the stuffing box. When it is in its proper position, it will be directly opposite the sealing inlet connection.

   After the lantern ring is in place, insert two more rings of packing on Group S and M and three more on Group L, staggering the joints. One extra ring is furnished in each set of packing. The extra ring should be added as required.

   Place one gland half in lower position in stuffing box. Slide cupped washers over studs and on the bosses of the gland to hold gland halves together.

   Place two gland nuts on the studs and draw up evenly but not tight.

2. Stuffing box with mechanical seal:

   When mechanical seals are furnished, they are installed and adjusted at the factory. The seal instructions and seal drawing are shipped with the pump. These should be read for any special instructions and filed for future use in maintaining the pump.

   If the pump has a single mechanical seal and is handling clear liquid, be sure circulating line from casing to stuffing box is connected. It is sometimes removed to prevent damage during shipment. This line ensures circulation of liquid around seal. If pump is handling abrasive solids which might score the seal faces, the seal is usually flushed with clear compatible liquid from an outside

source. The flush liquid keeps the solids in the pumpage away from the seal faces. A restricting bushing in the bottom of the stuffing box is used to control dilution of pumpage. Flush liquid pressure should be great enough to ensure steady flow into the stuffing box.

On double seal installations a clear compatible liquid from as outside source should be circulated through the stuffing box. Two ¼" pipe tap openings provide entrance and exit of lubricating liquid to the seal chamber. The lubricating liquid seal pressure should be approximately 20 pounds greater than the suction pressure. Valves in the lines can be used to control flow and pressure. Sufficient flow should be allowed to prevent excessive heat generation in the stuffing box. If pumpage temperature is above 250ºF then this lubricating should be cooled to prevent hat transfer along the shaft to the bearings. The circulating liquid provides lubrication to the seal faces and prevents the pumpage from entering between them. The circulating liquid pressure should be maintained as long as there is suction pressure.

3.4 Connection of sealing liquid or greased lubricator (packed box)

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

Sealing liquid or grease lubricator is required:

1. When abrasive particles in the pumpage could score the shaft.
2. Stuffing box pressure may be below atmospheric on pumps with two wearing rings if pump is running with suction lift, or if suction source is under vacuum. (Refer to 7.4 Sectional views, parts list and interchangeability tables on page 29 for list of pumps with two wearing rings.) Under these conditions, the packing will not be cooled and lubricated, and the air will be drawn into the pump.

Sealing liquid may be supplied by circulating pumpage to the lantern ring through a line from casing to the ¼" pipe tap seal connection in the stuffing box. The other seal connection is plugged. If the liquid is abrasive, an outside source of clean compatible liquid must be used at a pressure 20 to 40 psi above suction pressure.

A grease lubricator is supplied when the use of a recirculating pumpage or outside sealing liquid is not desired. the grease should be compatible with, and insoluble in the pumpage.

3.5 Connection to quenching gland

A quench type gland with tapped holes in the upper and lower gland halves can be supplied on special order. Use of a quench gland is required when the pumped liquid is:

1. Between 180ºF and 220ºF, if cooling water is not connected to the frame.
2. Between 250ºF and 350ºF, in addition to frame cooling.

Quenching is also suggested on applications where the pump is handling volatile or toxic liquids in order to smother the gland leakage, which can then be piped away.

The quenching liquid must be from an outside source and should be piped with flexible pipe into the opening in the upper gland half and out the opening in the lower gland half. A shut-off valve should be installed in the quenching line.

3.6 Connection of cooling water piping

The frame must be water cooled when the pumped liquid is:

1. Between 180ºF and 220ºF, if quench gland is not used.

2. Between 220ºF and 250ºF.
3. Between 250ºF and 350ºF, in addition to gland quenching.

The inlet piping must be at the bottom and the outlet at the top as shown in the sectional assembly , refer to 7.4 Sectional views, parts list and interchangeability tables on page 29. The inlet should be on one side of the frame and the outlet on the other side. The remaining holes must be plugged. The cooling liquid must be supplied from an outside source and a shut-off valve should be installed in the supply line to regulate the flow of the cooling liquid.

3.7 Connection of drain piping

Connect the ¾" pipe tap openings (from the drip pockets directly below the stuffing box) to drain. On pumps equipped with a drip basin (247) connect to the tapped opening on the end of the drip basin (¼" pipe tap on Group S and 3/8" on Group M and L) and out through the frame to drain.

4 Starting Pump

4.1 Priming

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

If the pump is run dry, the rotating parts within the pump may gall and seize to the stationary parts as they depend on liquid being pumped for lubrication.

4.2 Adjustment of stuffing box gland

With pump running at rated speed, stuffing box glands can be adjusted. Draw gland nuts up evenly and only one-sixth 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 off the pump and allow the boxes to cool. Several starts may be necessary before the boxes run 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. It must be borne in mind that it takes newly-installed packing some time to "run in" and that during this period, frequent attention and careful adjustments are necessary. See Stuffing box for final adjustments of gland.

4.3 Alignment - final

Final alignment can only be accomplished after unit has been run under actual operating conditions for a sufficient length of time to bring the unit up to operating temperatures.

After this warm-up period has elapsed, stop the unit and immediately and check the coupling alignment.

Follow the alignment procedure as outlined in 2.3 Alignment - initial on page 11, with the exception of Step 5. which allows for "growth" of the parts due to temperature difference between the driver and the pump. At the operating temperature, the unit will be in correct horizontal and vertical parallel alignment when a straight edge rests evenly on both halves of coupling rims at four points 90° apart.

As cautioned in 2.3 Alignment - initial on page 11 Step 6., changing alignment in one direction may alter the alignment in another. Check through each alignment procedure after making any alignment change.

4.4 Doweling

Doweling is not required on these pumps. Patented lock washers are furnished which hold the pump and driver feet securely in place.

5 Operation

5.1 Stuffing box

1. Stuffing Boxes with Packing Rings - Less Quenching Gland and grease lubricator:

   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 shaft. Always draw up gland nuts evenly and when pump is running.

   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 box with packing rings with grease lubricator:

   Operation is the same as directed 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.
3. Stuffing Boxes With Packing Rings - With Quenching Gland:

   The same precautions as described above apply. However, the amount of leakage through the packing cannot be so readily ascertained, 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.. In no instance should the gland be drawn up tight.
4. Stuffing Boxes with Mechanical Seal:

   This type of box requires no attention other than to make sure that the circulating lines do not become clogged.

5.2 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. If this condition exists over a long period, 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; and furthermore, if running clearances have enlarged due to wear, seizure may not take place. 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 by-passed 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 of 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.

5.3 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 rapidly 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.

5.4 Operating with surge conditions in line

If 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.

5.5 Operating under freezing conditions

When exposed to freezing conditions and pump is standing idle, liquid inside the pump should be drained by removing drain plug in bottom of casing (100) and opening pipe plug at top.

6 Trouble Check List

6.1 No liquid delivered

1. Pump not primed - casing and suction pipe not completely filled with liquid.
2. Speed too low*.
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.

* 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.

6.2 Not enough liquid delivered

1. Pump not primed - casing and suction pipe not completely filled with liquid.
2. Speed too low.*
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

* 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.

6.3 Not enough pressure

1. Speed too low.*

2. Air or gases in liquid.
3. Impeller diameter may be too small.
4. Mechanical defects:
    - Impeller clearance too great
    - Impeller damaged
5. Wrong direction of rotation or impeller installed backwards.
6. Be sure pressure gauge is in correct place on discharge nozzle or discharge pipe.

* 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.

6.4 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.

6.5 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.

    * 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.
4. Mechanical defects:
    - Shaft bent
    - Rotating element binds
    - Stuffing box too tight
    - Pump and driving unit misaligned.
5. Wrong direction of rotation.

6.6 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.

6.7 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
    - Pump and driving unit misaligned.

7 Care and Maintenance

7.1 Lubrication

1. Grease lubricated bearings.

   As specified in 3.1 Pump bearings on page 17, bearings are lubricated at the factory for 2000 hours or three months service. Do not grease at too frequent intervals. It is suggested that additional or replacement lubricant be added only after 2000 hours operation or at three month intervals.

   Insert grease through Alemite fittings (193) into bearing housing until grease appears through relief fitting (113). Do not add additional lubricant after grease appears through relief fitting.

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

   The ball bearing grease should be a sodium or lithium base, NGLI #2 consistency. Do not use graphite.
2. Oil lubricated bearings.
   1. Keep oiler bottle filled with correct grade oil. Refer to 3.1 Pump bearings on page 17. Oiler will maintain constant oil level in frame.
   2. Every four weeks,drain oil from frame, and flush with kerosine. Refill frame as directed in 3.1 Pump bearings on page 17.
   3. If oiler adjustment is lost or disturbed, reset as directed in 3.1 Pump bearings on page 17.

7.2 Repacking stuffing box

1. Loosen gland nuts and slide gland along shaft out of stuffing box. Remove gland halves from pump.
2. Remove the outer rings of packing with the aid of a packing hook.
3. Remove lantern ring (105) by inserting a wire hook in the slots in the outer edge of the ring and pulling ring from box.
4. Remove the three inner rings of packing with the aid of a packing hook.
5. Remove all foreign matter from stuffing box.
6. Install stuffing box packing as described in 3.3 Stuffing box on page 18.

7.3 Replacing shaft sleeve

The shaft sleeve must be in good condition to effectively seal the fluid through the stuffing box.

1. Shut off and disconnect all piping including seal piping to stuffing box if supplied.
2. Drain liquid from pump.
3. Unscrew nuts from studs (356) is casing and remove suction cover (182).
4. Remove impeller nut (304) and impeller washer (199) from shaft.
5. By use of a suitable puller similar to that shown in Figure 10: Impeller puller on page 28 pull impeller from shaft (puller must push against shaft as shown. Do not use a type that pulls from casing). All impellers are provided with two tapped holes to facilitate use of puller. If key (178) remained in shaft, remove it.

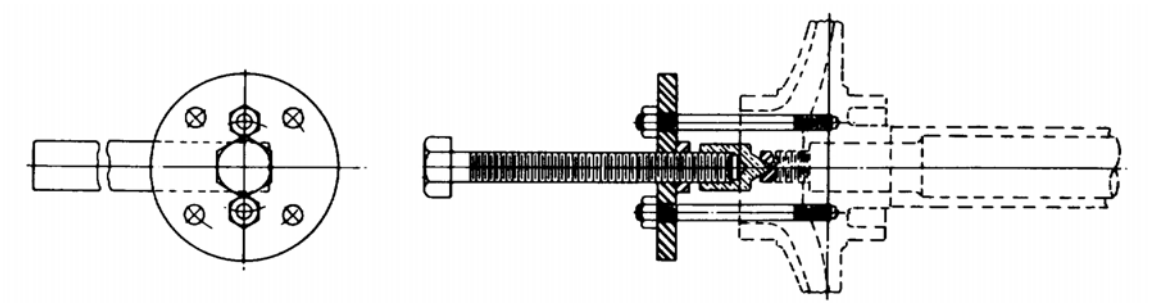


Figure 10: Impeller puller

6. Remove stuffing box gland (107).
7. Remove bolts (370B) and pull casing (100) from frame (228).
8. Remove stuffing box packing and lantern ring (105) from casing. Retain lantern ring.
9. Loosen set screw in deflector (123) until deflector will rotate on sleeve.
10. By use of a suitable puller similar to that shown in Figure 11: Shaft sleeve puller on page 28, pull shaft sleeve (126) from shaft. All deflectors are provided with tapped holes to facilitate use of a puller.

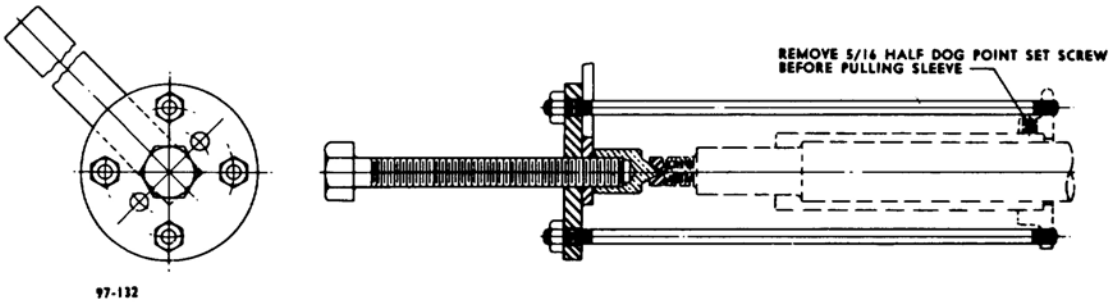
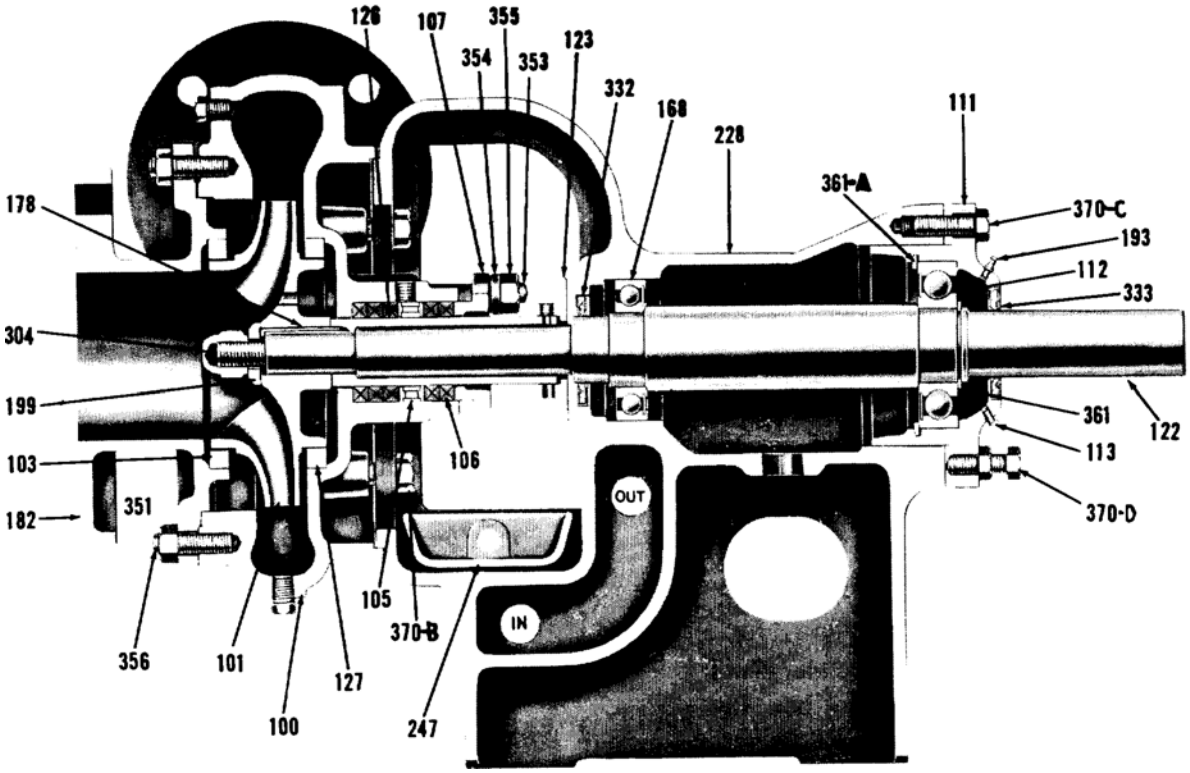


Figure 11: Shaft sleeve puller

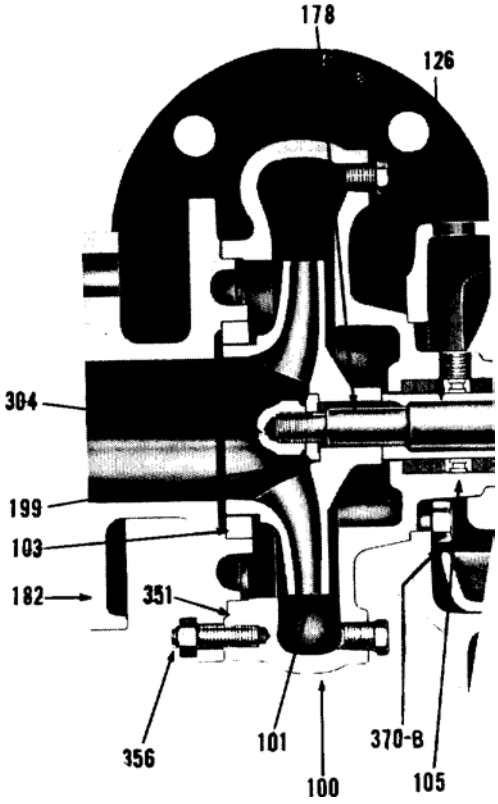
11. Replace deflector on shaft and slide it against frame.
12. Be sure shaft is clean. Place a few drops of oil on shaft and press new shaft sleeve (126) on shaft, being sure that sleeve keyway and shaft keyway are in alignment.
13. Fasten deflector (123) to shaft sleeve (126) by tightening set screw, being sure that point of set screw enters hole in shaft.
14. Slide lantern ring along shaft sleeve and wire temporarily to deflector (123).
15. Replace casing (100) and bolts (370B).
16. Replace impeller key (178) in shaft, being sure that key enters keyway in sleeve.
17. Slide impeller on shaft as far as possible.
18. Using a soft metal hammer, tap evenly on center of impeller until shaft threads protrude beyond impeller.
19. Push impeller on the remaining distance with impeller nut (304) and washer (199).
20. Replace suction cover (182), gasket (351) and nuts on studs (356).
21. Repack stuffing box with new packing as directed in 3.3 Stuffing box on page 18.
22. Connect all piping.
23. Start pump as directed in
Starting Pump.

7.4 Sectional views, parts list and interchangeability tables



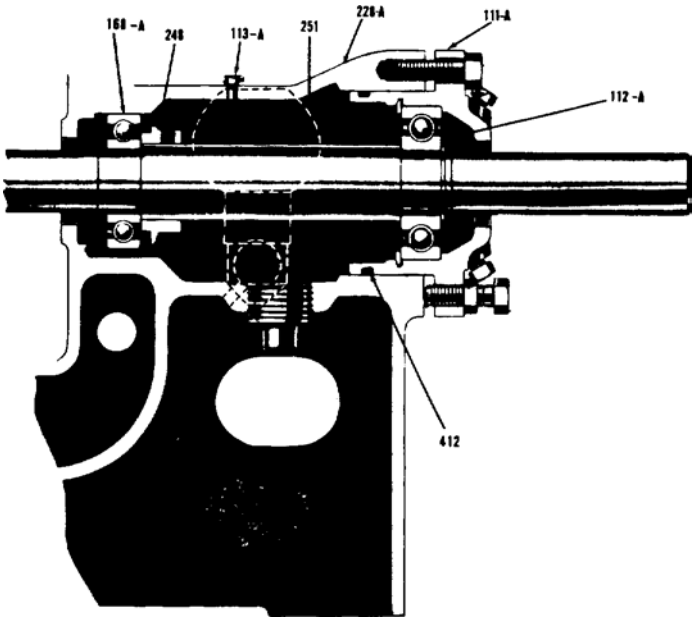
Sizes - with two casing wearing rings

2x2-7, 3x3-5, 1-1/2x2-9, 2x2-1/2-9, 2-1/2x3-9, 2x3-7, 3x4-7, 4x5-7, 5x5-7, 6x6-9, 2-1/2x3-11, 3x4-11, 4x6-11H, 8x8-11, 2-1/2x3-13, 3x4-13, 4x6-13, 4x6-13L, 6x8-13



Sizes - with suction wearing ring only

1-1/4x1-1/2-5, 1-1/4x1-1/2-7, 1-1/4x1-1/2-8, 1-1/2x2-5, 2-1/2x2-1/2-6, 4x4-7



Oil lubricated bearing construction

ITEM No.	No. REQ'D. PER PUMP	PART NAME	MATERIAL			INTERCHANGEABILITY BY GROUP AND CASING CLASS																									
			BZ. FITTED	ALL IRON	ALL BZ	GROUP S									GROUP M														GROUP L		
						1-1/4 x 1-1/2-5	1-1/4 x 1-1/2-7	1-1/4 x 1-1/2-8	1-1/2 x 2-5	2 x 2-7	2-1/2 x 2-1/2-6	3 x 3-5	4 x 4-7	1-1/2 x 2-9	2 x 2-1/2-9	2 x 3-7	2-1/2 x 3-9	2-1/2 x 3-11	2-1/2 x 3-13	3 x 4-7	3 x 4-11	3 x 4-13	4 x 5-7	4 x 6-11H	4 x 6-13	5 x 5-7	6 x 6-9	8 x 8-11	4 x 6-13L	6 x 8-13
100	1	CASING	1000	1000	1103																										
101	1	IMPELLER	1103	1000	1103																										
182	1	SUCTION COVER	1000	1000	1103																										
103	1	WEARING RING—SUCTION	1106	1000	1106	1	1	1	2	3	4	5	6	7	8	5	9	5	5	6	6	6	6	11	10	10	11	12	11	16
105	1	LANTERN RING	1102	1000	1102	S	S	S	S	S	S	S	S															L	L	L
106	1 SET	STUFFING BOX PACKING	*DIE FORMED			S	S	S	S	S	S	S	S															L	L	L
107	1	STUFFING BOX SPLIT GLAND	1106	1000	1106	S	S	S	S	S	S	S	S															L	L	L
111	1	BEARING HOUSING (GREASE LUBE)	1000			S	S	S	S	S	S	S	S															L	L	L
111-A	1	BEARING HOUSING (OIL LUB.)	1000			S	S	S	S	S	S	S	S															L	L	L
112	1	BALL BEARING—COUPLING END (GREASE LUB.)	Steel			S	S	S	S	S	S	S	S															L	L	L
112-A	1	BALL BEARING—COUPLING END (OIL LUB.)	Steel			S	S	S	S	S	S	S	S															L	L	L
113	2	GREASE RELIEF FITTING	Steel			L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
113-A	1	OIL BREATHER FITTING	Steel			L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
122	1	SHAFT	SAE 1112			S	S	S	S	S	S	S	S															L	L	L
123	1	DEFLECTOR	1102	1000	1102	S	S	S	S	S	S	S	S															L	L	L
126	1	SHAFT SLEEVE	1106	AISI 303	1106	S	S	S	S	S	S	S	S															L	L	L
127	1	WEARING RING—DISCHARGE	1106	1000	1106	—	—	—	—	3	—	4	—	7	8	5	9	9	9	6	6	13	6	15	14	10	10	11	11	16
168	1	BALL BEARING—INBOARD (GREASE LUB.)	Steel			S	S	S	S	S	S	S	S															L	L	L
168-A	1	BALL BEARING—INBOARD (OIL LUB.)	Steel			S	S	S	S	S	S	S	S															L	L	L
178	1	IMPELLER KEY	AISI 303			S	S	S	S	S	S	S	S															L	L	L
182	1	SUCTION COVER (LISTED AFTER 101 ABOVE)																												
193	2	GREASE FITTING	Steel			L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
199	1	IMPELLER WASHER	AISI 303			S	S	S	S	S	S	S	S															L	L	L
228	1	FRAME (GREASE LUBE)	1000			S	S	S	S	S	S	S	S															L	L	L
228-A	1	FRAME (OIL LUBE)	1000			S	S	S	S	S	S	S	S															L	L	L
247	1	DRIP BASIN	None	None	1103	S	S	S	S	S	S	S	S															L	L	L
248	1	OIL THROWER	Steel			S	S	S	S	S	S	S	S															L	L	L
251	1	CONSTANT LEVEL OILER	Steel and Glass			L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
304	1	IMPELLER NUT	AISI 304			S	S	S	S	S	S	S	S															L	L	L
332	1	GREASE OR OIL SEAL (COUPLING END)				S	S	S	S	S	S	S	S															L	L	L
333	1	GREASE OR OIL SEAL (INBOARD)																												
351	1	SUCTION COVER GASKET	Non-Asbestos			1	2	3	1	2	4	1	5	6	7	5	7	8	9	5	8	9	5	8	9	5	10	11	9	9
353	2	GLAND STUD	14% Cr. Steel AISI 416			S	S	S	S	S	S	S	S	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
354	2	GLAND HOLDING WASHER	14% Cr. Steel AISI 416			L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
355	2	GLAND STUD NUT	Steel			S	S	S	S	S	S	S	S	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
356	8 to 16	STUDS & HEX. NUTS (Casing to Cover)	Steel			1	1	2	1	1	1	1	2	2	2	2	2	3	2	2	3	2	2	3	2	2	2	3	2	2
361	1	RETAINER RING (Shaft)	Steel			S	S	S	S	S	S	S	S															L	L	L
361-A	1	RETAINER RING (Brg. Housing)	Steel			S	S	S	S	S	S	S	S															L	L	L
370-B	4	HEX. HD. MACH. BOLTS (Casing to Frame)	Steel			S	S	S	S	S	S	S	S															L	L	L
370-C	3 to 4	HEX. HD. TAP BOLTS (Brg. Housing)	Steel			S	S	S	S	S	S	S	S	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
370-D	3 to 4	HEX. HD. TAP BOLTS (Brg. Housing)	Steel			S	S	S	S	S	S	S	S	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
412	1	O RING	Buna Rubber			S	S	S	S	S	S	S	S															L	L	L

*WHITE METAL, GRAPHITE, LONG FIBRE Non-Asbestos

CONSTRUCTION DETAILS

GENERAL	WEIGHT—BARE PUMP BRONZE FITTED IN POUNDS	78	81	89	78	89	89	91	121	182	172	164	196	203	220	192	225	230	205	257	250	225	247	534	475	500
	CASING THICKNESS—MIN	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	5/16"	5/16"	5/16"	5/16"	3/8"	3/8"	5/16"	3/8"	1/2"	5/16"	3/8"	1/2"	5/16"	3/8"	3/8"	1/2"	1/2"
	MAXIMUM DIAMETER SOLIDS	5/32	3/16	3/16	5/16	1/4	1/2	5/8	5/8	1/4	1/4	7/16	5/16	11/32	5/16	1/2	11/32	7/16	1/2	3/4	7/8	1/2	1⅛	1¼	7/8	7/8
	†MAXIMUM TOTAL WORKING PRESSURE PSI	150	150	150	150	150	150	150	100	150	150	150	150	150	150	150	150	150	150	150	150	150	150	100	150	150
	MAXIMUM TEST PRESSURE PSI	250	250	250	250	250	250	250	150	250	250	250	250	250	250	250	250	250	250	250	250	250	250	150	250	250
	NUMBER OF WEARING RINGS	1	1	1	1	2	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	SIZE PRIME TAPPING	1/4	1/4	1/4	1/4	3/8	3/8	1/2	1/2	3/8	3/8	3/8	1/2	1/4	1/4	1/2	1/4	3/8	1/2	1/2	3/8	1/2	3/4	3/4	3/8	3/8
STUFF BOX	STUFFING BOX BORE	1-5/8								2-3/8														3		
	STUFFING BOX DEPTH	1-7/8								2-5/8														3-1/8		
	STUFFING BOX PACKING SIZE	1/4" Sq.								3/8" Sq.														3/8"		
	STUFFING BOX—NUMBER OF PACKING RINGS	5								5														6		
	WIDTH OF LANTERN RING	7/16								5/8														3/4		
SHAFT	SHAFT DIAMETER AT IMPELLER	11/16								1														1-3/8		
	SHAFT DIAMETER IN STUFFING BOX	7/8								1-1/4														1-3/4		
	SHAFT DIAMETER AT COUPLING END	1-1/8								1-5/8														2-1/8		
	SHAFT SLEEVE O.D. IN STUFFING BOX	1-1/8								1-5/8														2-1/4		
BRGS.	‡BALL BEARING—COUPLING END	MRC 306-SF or Equal								MRC 309-SF or Equal														*		
	‡BALL BEARING—INBOARD	MRC 206-SF or Equal								MRC 209-SF or Equal														▲		
TEMP. LIMITS	MAX. LIQUID TEMP. (Without Cooling)	180°F																								
	MAX. LIQUID TEMP. (With Quenching Gland)	220°F																								
	MAX. LIQUID TEMP. (With Water Cooled Frame)	250°F																								
	MAX. LIQUID TEMP. (With Quenching Gland & W.C. Frame)	350°F																								

* MRC 313 SF OR EQUAL
▲ MRC 312MF OR EQUAL
† ANY PART OF WHICH MAY BE SUCTION PRESSURE
‡ SINGLE SHIELDED GREASE LUBE, UNSHIELDED OIL LUBE.

1000 CAST IRON CORRESPONDS TO ASTM A278-59T CLASS 25

TYPICAL BRONZE ANALYSIS

NO.	Cu%	Sn%	Pb%	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	—	—	.10-.15

7.5 Wearing rings

Casing wearing rings are provided for both hubs of the impeller on some sizes and only on the suction hub on others. Refer to section vi-d. These rings allow a small clearance to be maintained between the

rotating impeller and the stationary casing wearing rings. For proper hydraulic performance these clearances should be maintained as indicated below. Ring should be replaced when clearances have worn to those listed under replacement clearance.

Table shows original clearances and suggested replacement clearances as follows:

Table 3: Recommended clearances

Ring Bore Dia. (inches)	Diametrical Clearance (inches)	
	Original	Replacement
under 2" Dia.	0.010-0.014	0.020-0.024
2" to 2-1/2" Dia.	0.011-0.015	0.021-0.025
2-1/2" to 3-1/2" Dia.	0.014-0.018	0.024-0.028
3-1/2" to 4 -1/2" Dia.	0.016-0.020	0.026-0.030
over 4-1/2" Dia.	0.018-0.022	0.028-0.032

To check ring clearances or for replacement proceed as follows:

1. Shut off all piping and disconnect suction piping.
2. Drain liquid from pump.
3. Unscrew nuts from studs (356) and remove cover (182) from casing.

   If pump has only a suction wearing ring, as indicated in 7.4 Sectional views, parts list and interchangeability tables on page 29, then check outside diameter of impeller hub and inside diameter of casing wearing ring in casing cover.

   If pump is designed with two wearing rings:
4. Remove impeller nut (304) and washer (199).
5. By use of a suitable puller similar to that shown in Figure 10: Impeller puller on page 28 pull impeller from shaft. (Puller must push against shaft as shown. Do not use a type that pulls from casing). All impellers are provided with two tapped holes to facilitate use of puller.
6. Check diameters of both hubs and rings. If clearances are excessive, the rings should be replaced. See recommended clearances table above.
7. Remove rings from cover and casing.
8. Clean bore in which rings seat and press new rings evenly into place.
9. Replace impeller, washer, nut and casing cover as directed in Figure 10: Impeller puller on page 28 Steps 16 through 23.

7.6 Replacing impeller

1. Shut off all piping and disconnect suction piping.
2. Drain liquid from pump.
3. Unscrew nuts on studs (356) and remove suction cover (182) from casing.
4. Remove impeller nut (304) and impeller washer (199) from shaft.
5. By use of a suitable puller similar to that shown in Figure 10: Impeller puller on page 28, pull impeller from shaft. (Puller must push against shaft as shown. Do not use a type that pulls from casing). All impellers are provided with two tapped holes to facilitate use of puller.
6. Check diameters of impeller hubs and wearing rings to determine if new rings are needed. Replace rings in suction cover or casing if necessary. Refer to Table 3: Recommended clearances on page 32.
7. Slide new impeller on shaft as far as possible.
8. Using a soft metal hammer, tap evenly on center of impeller until shaft threads protrude beyond impeller.

9. Push impeller on the remaining distance with impeller nut (304) and washer (199).
10. Replace suction cover (182) and nuts on studs (356).
11. Connect suction piping.
12. Start pump as directed in Starting Pump.

7.7 Replacing shaft or bearings

For grease lubricated bearings:

1. Shut off and disconnect all piping.
2. Drain liquid from pump.
3. Disconnect coupling.
4. Remove pump hold-down bolts and remove pump from bedplate.
5. Remove impeller as instructed in 7.5 Wearing rings on page 31 and impeller key (178).
6. Remove gland assembly as instructed in 7.2 Repacking stuffing box on page 27.
7. Loosen set screw in deflector (123).
8. Note the distance from the end of the shaft to the coupling face of the pump half coupling so that the coupling half can be correctly positioned when assembled. Pull the coupling from pump with a suitable puller.
9. Remove coupling key.
10. Remove machine bolts (370C) from bearing housing (111).
11. Shaft and bearings can now be pulled through coupling end of frame (228).
12. To remove ball bearing-coupling end (112) proceed as follows:

    Using suitable pliers, remove the bearing housing retaining ring (361A) which is seated in the housing and shoulders against the outer race of the bearing. The housing can now be slipped over the bearings. Remove the shaft retaining ring (361) which is seated in the shaft and retains the inner race of the bearing. With the use of a suitable bearing puller, which engages the bearing on the inner race only, remove coupling end bearing (112).
13. To remove ball-bearing inboard end (168) slide suitable pipe or sleeve over shaft to bearing, being sure that the pipe rests on the inner race. By evenly tapping the free end of the pipe, the bearing will be forced off without damaging the shaft. Inspect shaft and bearings. If shaft is bent it must be straightened. If necessary, replace the shaft. Bearing should spin smoothly and evenly. If bearings are not in first class condition, they should be replaced. If bearings are to be reused they should be carefully cleaned with kerosene. The bearing housing and frame should also be flushed and cleaned.

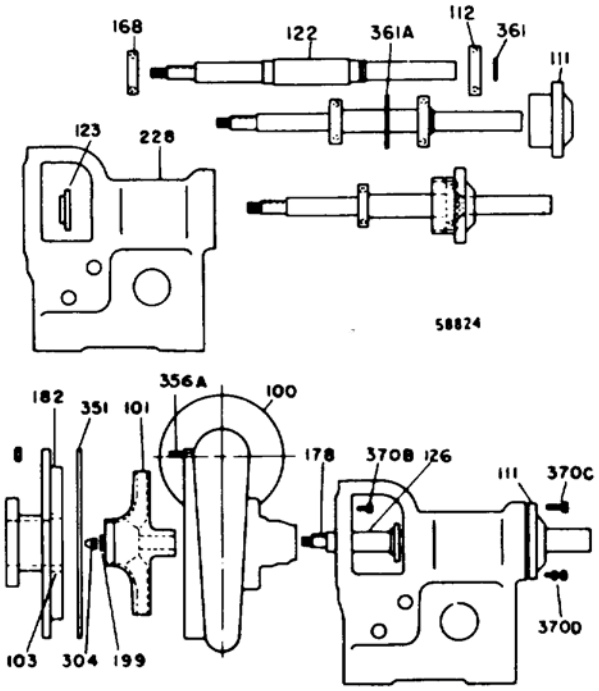


Figure 12: Exploded assembly

14. It is important that all parts are free from dirt and grit while being assembled. Note that these bearings are shielded on one side to retain the grease and they must be installed properly as shown in 7.4 Sectional views, parts list and interchangeability tables on page 29.
15. To replace the ball bearing-inboard end (168), oil shaft at bearing seat and slide bearing over the shaft as far as possible by hand. Place the pipe or sleeve used to remove the bearing over the shaft and against the bearing, being sure that it rests only on the inner race. Tap evenly until the bearing is seated firmly against the shaft shoulder. Care should be taken not to mar the shaft, especially where it contacts the grease seal (333) or in the stuffing box area.
16. To replace ball bearing-coupling end (112) oil shaft at bearing seat and slide bearing over the shaft as far as possible by hand. Using a suitable pipe or sleeve which rests only on the inner race of the bearing, tap evenly on the free end of the pipe until the bearing is seated firmly against the shaft shoulder. Insert the retaining ring (361) in the shaft groove. Carefully slide the bearing housing (111) over the shaft and bearing as far as possible. Insert the retaining ring (361A) in the groove in the bearing housing. All retaining ring grooves must be clean and the retaining rings must be properly seated. Note that the flat sides of the rings are against the bearing and the tapered sides away from the bearing.
17. Carefully insert shaft, bearings and bearing housing in frame. Remember to place the deflector (123) on shaft as it protrudes through grease seal (332).
18. Be sure shaft is clean. Place a few drops of oil on shaft and press sleeve (126) on shaft, being sure that sleeve keyway and shaft keyway are in alignment. Fasten deflector on sleeve by tightening set screw, being sure that point enters hole in sleeve.
19. Loosen bolts (370D) and push shaft unit toward water end so that bearing housing flange is against end of frame.
20. Replace casing (100) and bolts (370B).
21. Replace impeller key (178) in shaft.
22. Slide impeller on shaft as far as possible.

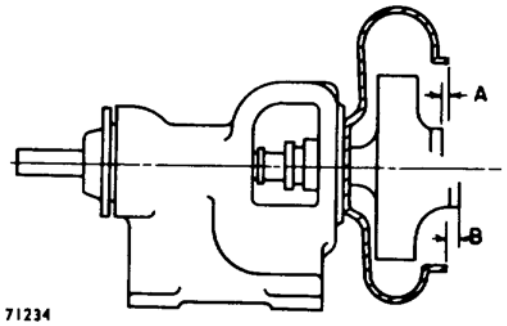


Table 4: Impeller locating table

Size	A	B	Size	A	B
1 ¼ x 1 ½-5		1/16	2 ½ x 3-9	0	0
1 ¼ x 1 ½-7		1/16	2 ½ x 3-13		1/16
1 ¼ x 1 ½-8		3/16	3 x 4-7	1/4	
1 ½ x 2-5	3/16		3 x 4-13	0	0
2 x 2-7	0	0	4 x 5-7	1/4	
2 ½ x 2 ½-6	0	0	4 x 6-11H		1/4
3 x 3-5		1/8	4 x 6-13		1/8
4 x 4-7	1/4		5 x 5-7		1/8
1 ½ x 2-9		3/16	6 x 6-9		3/16
2 x 2 ½-9		3/32	8 x 8-11	1/8	
2 x 3-7	0	0	4 x 6-13L		7/16
			6 x 8-13	1/8	

Figure 13: Impeller locating

23. Using a soft metal hammer, tap evenly on center of impeller until shaft threads protrude beyond impeller. Shaft must be held to prevent axial movement during this operation.
24. Push impeller on remaining distance with impeller nut (304) and washer (199).
25. Refer to Table 4: Impeller locating table on page 35. Adjust bolts (370D) and (370C) evenly until distances between impeller and casing correspond to that shown in table.
26. Tighten evenly bolts (370C) and jam nuts on bolts (370D).
27. Replace suction cover (182), gasket (351) and nuts on studs (356).
28. To replace pump half coupling on shaft, screw a ½" diameter std approximately 1 ¼" longer than the length of the coupling hub on Group S pumps (a 5/8" diameter stud approximately 1 ½" longer than the length of the coupling hub on Group M and L pumps) into the end of the shaft. Insert the coupling key in shaft. Put oil or white lead on the shaft and in the coupling bore. Place the complete pump half coupling in position over the stud and align the key with the keyway. Place washers over the stud and against the coupling hub and pull coupling half on with a nut placed on the stud. Locate the coupling half in the same position on the shaft as it was before dismantling.
29. Place pump on bedplate, insert hold-down bolts and align unit as directed in 2.3 Alignment - initial on page 11.
30. Insert grease through Alemite fitting as directed in 7.1 Lubrication on page 27.
31. Connect coupling.
32. Connect piping as directed in 2.7 Connection of piping on page 16.
33. Follow directions in
Starting Pump for initial operating conditions and for starting.

For oil lubricated bearings:

1. Follow steps 1 through 4 as for grease lubricated bearings.
2. Remove constant level oiler (251).
3. Turn down oil pipe (190). Remove drain plug and drained oil from oil reservoir in frame (228A).
4. Follow steps 5 through 12 as for grease lubricated bearings.
5. Using a suitable bearing puller, remove inboard ball bearing (168A).
6. Loosen set screw in oil thrower (248) and slide oil thrower off pump end of shaft. Inspect shaft and bearings as directed in second paragraph of step 13.
7. To replace oil thrower (248), oil shoulder on shaft lightly and slide thrower on. Be sure that beveled side faces coupling end of shaft. Slide thrower on shoulder but do not tighten set screw at this time.
8. Replace ball bearings as directed in steps 15 and 16. Oil lubricated ball bearings are unshielded.
9. Slide thrower (248) up against inner race of inboard bearing (168A) and tighten set screw.
10. Completely assemble as in steps 17 through 33.

7.8 Replacing casing

1. Shut off and disconnect all piping including the seal piping if supplied.
2. Drain liquid from pump.
3. Unscrew nuts from studs (356) and remove suction cover (182) from casing.
4. Remove impeller nut (304) and impeller washer (199) from shaft.
5. By use of a suitable puller similar to that shown if Figure 10: Impeller puller on page 28, pull impeller from shaft. (Puller must push against shaft as shown. Do not use a type that pulls from casing). All impellers are provided with two tapped holes to facilitate use of puller.
6. Remove stuffing box gland (107).
7. Unscrew hex head machine bolts (370B) and remove casing from frame.
8. Remove old packing and lantern ring from stuffing box. Discard old packing but replace lantern ring on shaft sleeve.
9. New casings are supplied with wearing ring if design requires it.
10. Place new casing in position on frame, insert and tighten hex bolts (370B).
11. Oil shaft and key.
12. Slide impeller on shaft and key as far as possible.
13. Using a soft metal hammer, tap evenly on center of impeller until shaft threads protrude beyond impeller.
14. Push impeller on the remaining distance with impeller nut (304) and washer (199). Check impeller location per chart in Table 4: Impeller locating table on page 35.
15. Replace suction cover (182), gasket, (351) and nuts on studs (356).
16. Connect all piping.
17. Repack stuffing box as directed in 3.3 Stuffing box on page 18.
18. Start pump as directed in
    Starting Pump.

7.9 Spare parts

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

1. One set of group parts should be maintained for every one to three pumps of that particular group size in operation. Pumps of the same group size have all parts interchangeable except casing, suction cover, impeller and wearing rings, see interchangeability table in 7.4 Sectional views, parts list and interchangeability tables on page 29. The following is a list of recommended group parts
    1. Stuffing box packing (106) - one set required
    2. Stuffing box gland complete (107) - one required.
    3. Ball bearing-coupling end (112) - one required.
    4. Ball bearing-inboard (108) - one required.
    5. Shaft (122) - one required.
    6. Impeller key (178) - one required.
    7. Impeller nut (304) - one required.
    8. Impeller washer (199) - one required.
    9. Shaft sleeve (126) - one required.
2. For each size pump it is suggested that one set of wearing rings be maintained.

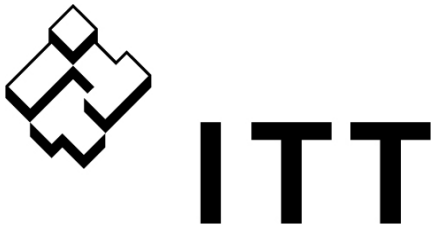
7.10 Instructions for ordering spare parts

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 material of the parts required. These names and numbers should agree with those on the Sectional View.
3. Give the number of parts required.
4. Give complete shipping instructions.

For more information, call your nearest Goulds sales representative or visit our website at http://www.gouldspumps.com.

Visit our website for the latest version of this document and more information:
http://www.gouldspumps.com



Goulds Pumps Inc.
240 Fall Street
Seneca Falls, NY 13148
USA

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