

 **GOULDS PUMPS**

# Installation, Operation and Maintenance Instructions

3335



**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.

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**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.

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**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.

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**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, and Electrical 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.

## 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. |
|---------|--|

1.4 General precautions

|         |   |   |
|---------|---|---|
| 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 |   | <p>Safety Apparel:</p> <ul style="list-style-type: none"> <li>• Insulated work gloves when handling hot bearings or using bearing heater</li> <li>• Heavy work gloves when handling parts with sharp edges, especially impellers</li> <li>• Safety glasses (with side shields) for eye protection</li> <li>• Steel-toed shoes for foot protection when handling parts, heavy tools, etc.</li> <li>• Other personal protective equipment to protect against hazardous/toxic fluids</li> </ul>  |
| WARNING |   | <p>Receiving:</p> <p>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 <a href="http://www.gouldspumps.com/literature_ioms.html">www.gouldspumps.com/literature_ioms.html</a> 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.</p> |
| WARNING |   | <p>Alignment:</p> <p>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.</p>  |
| 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 |   | <p>Piping:</p> <p>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.</p>   |
| WARNING |   | <p>Flanged Connections:</p> <p>Use only fasteners of the proper size and material.</p>  |
| 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 |   | 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 |   | 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 |   | 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:<br>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 |  | <p>Noise:</p> <p>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.</p>  |
| WARNING |  | <p>Temperature:</p> <p>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.</p> |

## 1.5 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 Introduction

## 2.1 Introduction

This instruction manual is intended to assist those involved with the installation, operation, and maintenance of Goulds Model 3335 Multi-Stage Pumps. It is recommended that this manual be thoroughly reviewed prior to installing or performing any work on the pump or motor.

# 3 General

## 3.1 Importance of instructions

The design, material, and workmanship incorporated into the construction of Goulds pumps make them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, are enhanced and extended by correct application, proper installation, periodic inspection, and careful maintenance.

This instruction manual was prepared to assist operators in understanding the construction and correct methods of installing, operation, and maintaining these pumps.

Study thoroughly Sections 3, 4, 5 and carefully follow the instructions for installation and operation. Sections 6,7 and 8 are answers to trouble and maintenance questions. Keep this instruction manual handy for reference. Further information can be obtained by contacting your local branch office or the Engineered Products Division, Goulds Pumps, Inc., Seneca Falls, New York 13148.

## 3.2 Special warnings

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

## 3.3 Receiving inspection - shortages

Care should be taken when unloading pumps. If shipment is not delivered in good order and in accordance with the Bill-of-Lading, note the damage or shortage on both receipt and freight bill. Make any claims to the transportation company promptly. Instruction sheets on various components, as well as the Instruction Book for the pump, are included in the shipment - Do not discard.

## 3.4 Preservation and storage

Goulds normal domestic storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during covered storage at the job-site and for a short period between installation and start-up.

## 3.5 Handling techniques

Care should be used in moving pumps. Where required by weight and size of units, slings and mechanical lifting equipment should be used.

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# 4 Installation

## 4.1 General

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. The unit should be mounted on a substantial rigid and leveled base to prevent distortion of the pump. Grouting of the base is recommended. Oil lubricated pumps must be installed in the horizontal position. The Model 3335 should never run dry. If there is any possibility that the pumps source of liquid might fail, a protective device should be incorporated into the system to shut the pump down.

## 4.2 Piping

The suction pipe must never be smaller than diameter of pump suction nozzle. Use of suction pipe one or two sizes larger is desirable. Quick closing valves should be avoided to protect the pump from damage due to shock. All piping should be independently supported and align naturally to the pump flanges.

Piping should be run from the pump with final connections made at a point downstream. This is to prevent problems with pump flange bolt hole alignment. The discharge head should never be loosened to make up piping downstream of the pump. For operation at low flow, or to ensure liquid will always be flowing through the pump, a bypass line should be installed. The bypass line should be returned to the liquid source and injected below minimum liquid level to prevent air entrainment. If a bypass line is not used, it is recommended that precautions be taken to insure that the pump will not run dry, run at closed discharge, or handle pumpage of excessive temperature at pump suction. Devices which can protect the pump from the above problems are flow switches or high temperature switches.

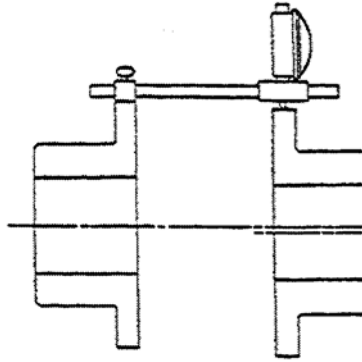
Install gauge connections at the pump discharge and suction. The connections should be located between the pump and its discharge and suction valves. When a suction screen is used an additional connection is recommended for measuring pressure drop across the screen.

## 4.3 Alignment procedures

Pump and motor must be brought into both parallel and angular alignment, using one of the methods listed below. Use of the dial indicator method of parallel alignment is preferred.

### Parallel Alignment - Dial Indicator Method

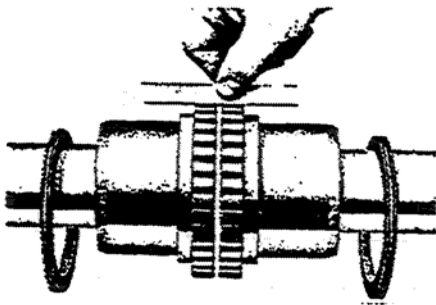
Mount a dial indicator on the driver shaft to read on the pump coupling hub. "Zero" the dial indicator at the top. Turn the driver shaft and check the dial indicator reading at four points 90° apart on the pump coupling hub. Correct the parallel alignment by moving the driver side to side or by shimming it up or down. Parallel alignment is achieved when side to side readings agree within 0.004" TIR. Set motors .002" (.004" TIR) to .004" (.008" TIR). Low regardless of pumpage temperature. Note: TIR is Total Indicator Reading.



**Figure 1: Dial indicator method**

**Parallel Alignment - Straight Edge Method**

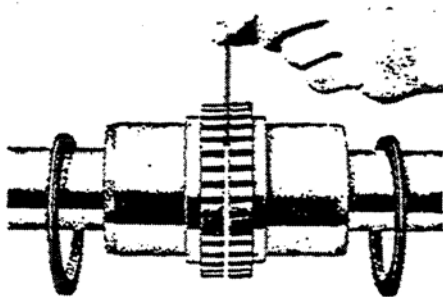
Place a straight edge across both coupling hubs at four points 90° apart. Use a feeler gauge to measure the amount of misalignment at each of the four points. Make alignment corrections by moving driver side to side or by shimming it up or down. The unit will be in reasonable alignment when the straight edge rests evenly on both hubs in all four locations.



**Figure 2: Straight edge method**

**Angular Alignment**

Using taper or feel gauge, measure the gap between driver and pump coupling hubs at four points 90° apart, beginning at top. Correct angular alignment by moving the driver side to side or by shimming. Angular alignment is achieved when thickness gauge readings do not vary by more than .002"



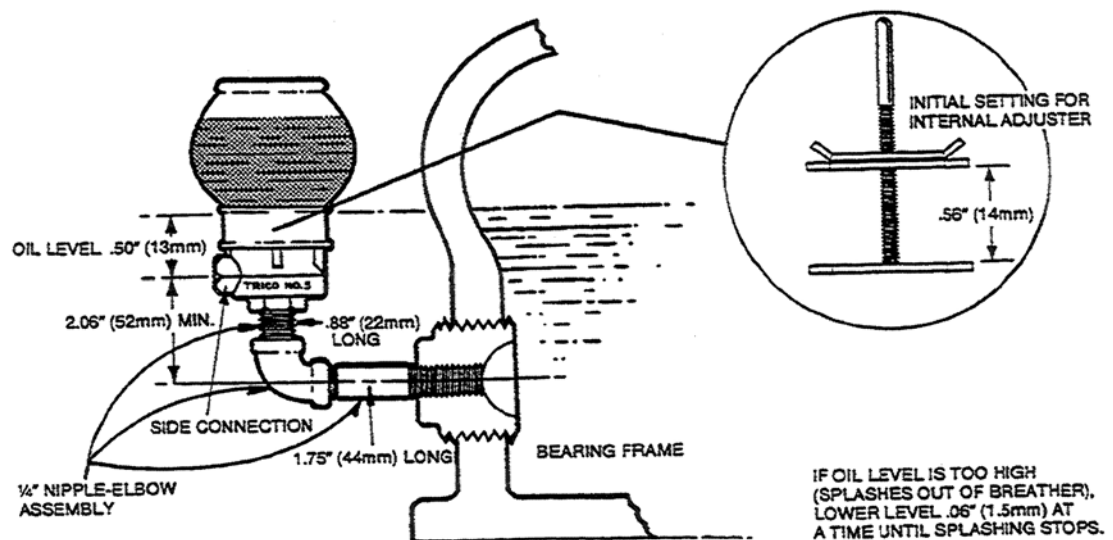
**Figure 3: Taper or feeler gauge method**

## 4.4 Rotation check and connection of coupling

Before coupling is connected, jag motor to check for correct rotation. Motor rotation should be counter-clockwise when viewed from coupling end. If electric power is not available, do not connect coupling until correct rotation has been verified.

## 4.5 Lubrication

1. H frames have flood oil lubricated bearings. The bearings are not lubricated at the factory. A constant level oiler is packed with the pump. Use a good quality turbine oil of 300 SSU viscosity at 100°F (Approx. SAE 20). Oil should be renewed at 3 month intervals.
2. Assemble the constant level oiler as illustrated in Figure 5. The constant level oiler can be installed on either side of the bearing frame.
3. Check and set the oiler adjustment. The setting dimension A of 9/16" is illustrated below.



**Figure 4: Oiler adjustment**

4. Fill bearing reservoir using oiler bottle. Several fillings will be required. Never fill the frame through the frame breather hole located at the Top of the frame or through the oiler cup without use of the bottle. This can result in overfilling and high oil temperature.

# 5 Operation

## 5.1 Start-up check

Rotate pump shaft by hand to be sure it is free. If pump cannot be turned by hand, or binding and rubbing are noticed, correct before starting. Insure that alignment and rotation procedures in Installation section have been followed.

## 5.2 Start-up procedure

1. Pump suction pipe and pump must be full of liquid before pump is started. Open suction valve fully and prime the pump. Vent air out of pump through recirculation line Or gauge connection at pump discharge. If suction supply is below pump, priming can be accomplished by an ejector or priming pump. A foot valve should be used in the suction line to maintain the prime when pump is shut down.
2. If auxiliary piping for cooling and/or flushing from an outside source is being used, open valves and establish flows.
3. The pump discharge valve should be not more than 10% open to establish and control flow.
4. Start the pump. Slowly open the discharge valve as the system fills and pressurizes.

## 5.3 Operational checks

Inspect pump carefully and frequently during the first few hours of operation. Mechanical seal may weep slightly but should "run in" in a few hours. Be sure all auxiliary lines (cooling, flushing, sealing, etc.) are functioning properly. Check pump bearings for excessive heating. An uncooled bearing temperature of 190° is normal. Check motor for excessive heating. Check complete unit for excessive vibration or unusual noise. Do not run pump at greatly reduced flow because all the motor horsepower will go into heating the liquid in the pump and damage may result. Do not run pump beyond maximum recommended flow since damage could result due to excessive wear on the back washers (546).

**Table 2: Recommended flow**

|                                     |                                  | Maximum recommended flow         |  |
|-------------------------------------|----------------------------------|----------------------------------|--|
| HDB210                              | 60 Hertz Speed->3550 RPM         | 50 Hertz Speed 2900 RPM          |  |
|                                     | 280 GPM (63.6 m <sup>3</sup> /h) | 230 GPM (52.3 m <sup>3</sup> /h) |  |
| Minimum flow for 14 stage pump only |                                  |                                  |  |
|                                     | 90 GPM (63.6 m <sup>3</sup> /h)  | 82 GPM (18. 6 m <sup>3</sup> /h) |  |

## 5.4 Shut down procedure

If pump is installed with a check valve, it can be shut down without closing any valves. When no check valve is used, the discharge valve must be closed before the pump is stopped to prevent backflow through the pump. If the pump is to be serviced, be sure suction valves are closed, auxiliary cooling and flushing flows are shutoff and motor is locked out before working on pump.

# 6 Preventative and Corrective Maintenance

## 6.1 Lubrication

Refer to [4.5 Lubrication on page 11](#) for lubrication procedures for pump. Oil should be renewed at 3 month intervals. Follow motor and coupling manufacturer's lubrication instructions.

## 6.2 Mechanical seal

The seal requires no attention other than to make sure that circulation lines, where installed, do not become clogged.

## 6.3 Vibration

It is good practice to periodically monitor vibration of the pump. Normally vibration level will be well below accepted standards. Of equal importance is that the vibration level does not increase. If a problem with vibration is encountered, refer to [8.1 Troubleshooting on page 21](#).

## 6.4 Performance

If performance deteriorates, refer to [8.1 Troubleshooting on page 21](#).

# 7 Disassembly and Reassembly

## 7.1 Disassembly of pump

1. Lock out power source.
2. Shut off valves controlling flow to and from pump. Disconnect piping.
3. Uncouple pump. See coupling manufacturer's instructions for removal.
4. Drain oil through oil drain plug on bottom of bearing frame (228A)
5. Drain pump through plug (408A) in bottom of casing adapter. If pump has handled corrosive liquids, the motor end should be elevated to assure complete draining. Flushing recommended.
6. Loosen set screw in coupling hub (233) and remove hub and key (400) from stub shaft. (330)
7. Loosen pump foot retaining bolt (371U) so that the discharge head (152) can turn in casing (100). Do not remove pump foot at this time.
8. Place a wrench on the discharge head (152). Loosen the discharge head. Insure casing (100) is free to turn on case adapter (108). Threads are right hand. Do not completely unscrew discharge head or casing.
9. Set pump in a vertical position. It will be necessary to secure the bearing frame (228A) to a suitable support high enough off floor to protect the pump shaft from damage. Remove discharge head (152) and pump foot (131). Unscrew and remove casing (100) from case adaptor (108). The casing must be removed vertically so that the pump shaft will not be bent. The total overhead clearance required will be the total pump length plus the length of the casing (100).
10. Remove the shaft retaining ring (361) and shims (331) from shaft (122). Remove sleeves (157). Mark all parts for reassembly.
11. Slide diffusers (150), impellers (101), shims (331) and intermediate bearings (260) off shaft (122). Also, note spacer blanks (150A) substituted for some of the stages. These will be located at the discharge end of the pump. Mark each impeller, diffuser, intermediate bearing and shim washer to identify its position in the pump to aid in reassembly.
12. Remove impeller key (178) from shaft.
13. Unbolt and remove casing adapter (108) from bearing end cover (109c).
14. Remove pump shaft (122) from splined end of stub shaft. For pumps with special mechanical seal arrangements, the seal seat mount (158) is removed when the shaft is pulled out of the splined end of the stub shaft. This must be done carefully to avoid mechanical seal damage.
15. Remove seal from shaft only if it is to be replaced. Use care to avoid cutting rubber bellows on splined teeth of pump shaft. Remove retaining ring (361D) from shaft.
16. To remove the drive collar (522) and split collet (524) from the shaft, tap the drive collar (522) away from the splined end of the shaft (122) and off the split collet (524). A piece of pipe sized to seat against the larger end of the drive collar should be used for this. Spread the split collet with a suitable tool, remove it from the groove in the shaft and slide it off the shaft.
17. Remove seal seat mount (158) if not already pulled in step 14. Note: Before dismantling bearing frame, mark all pieces for reassembly.
18. Unbolt and remove bearing end cover (109C) and wave washer (529) from bearing frame (228A).
19. Unbolt and remove end cover. (109A).
20. Remove stub shaft assembly from bearing frame (228A).
21. Bend tang of bearing lockwasher (382) out of slot in bearing locknut (136).
22. Remove thrust bearing locknut (136) and bearing lockwasher (382)
23. Remove ball bearings (112A) and (168A) using a suitable puller or press. Care must be taken to prevent damage to bearings if they are to be reused. Do not use a hammer to drive shaft through bearings. Protect bearings from contamination.

## 7.2 Inspection and overhaul

1. O-rings (412K) & (412L) - Inspect and replace if damaged.



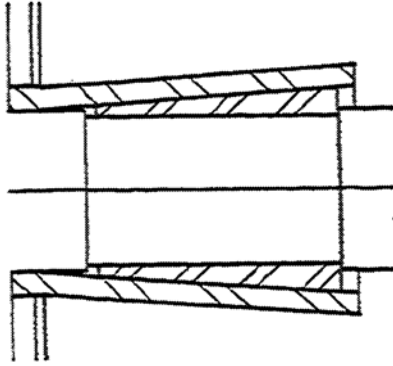
2. Shaft (122) Check shaft for runout to be sure it is not bent. Bearing seats, retaining ring grooves, Keyways, surfaces under oil seals, and surface under mechanical seal should be in good condition.
3. Mechanical Seal (383) Replace if faces are worn, scarred, or cracked, or if elastomeric bellows is damaged.
4. Backwashers (546) - Inspect and replace if worn. The backwashers (546) are nominal .030" (0.8mm) thick, replace if worn to less than .020" (0.5mm).
5. Intermediate and discharge head bearings - Check for excessive wear in carbon bushings. Replace as necessary.
6. Oil seal (332A) & (3330) - Replace if worn or damaged.
7. Diffusers (150) - Male and female lock fits should be checked for foreign materials or damage.
8. General - All parts should be clean and free of burrs before assembly. This is especially important at O-ring grooves, threads, bearing areas and diffuser locks.

## 7.3 Reassembly of power end

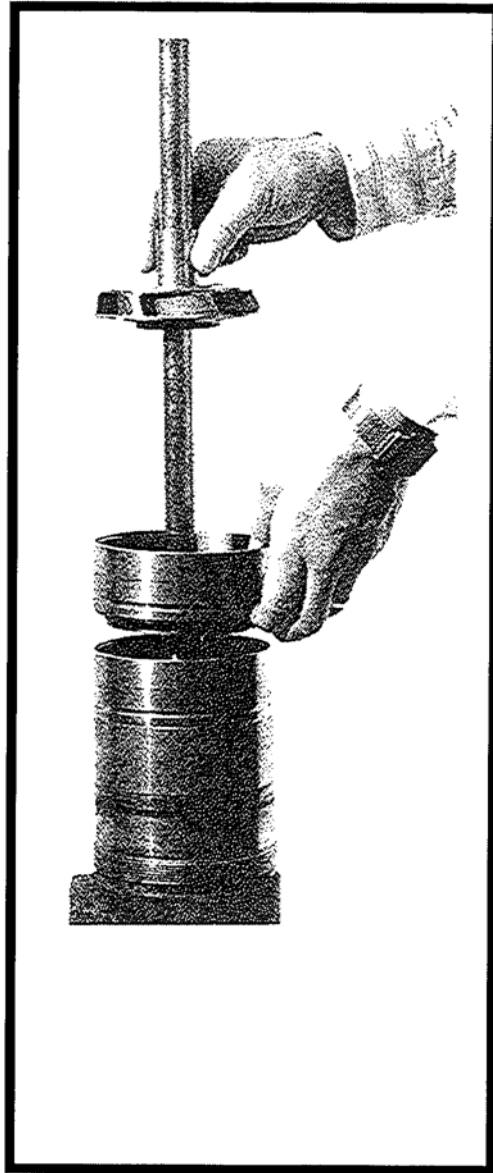
1. Clean the frame (228A), and bearing end covers (109A) and (109C). Press in new oil seals (332A) and (333D) with the lips facing in.
2. The H frame uses a single deep groove radial bearing and two angular contact thrust bearings. The radial bearing (168A) has both outer race edges the same thickness. Press radial bearing (168A) on from splined end of shaft. The thrust bearings (112A) are installed in tandem with the thin edge of the outer races facing the radial bearing (168A). Press the thrust bearings on individually. Press on inner races only.
3. Install bearing lock washer (382). Thread bearing locknut (136) on stub shaft (380) and tighten firmly. Set bearing lock washer (382) tang in groove in bearing locknut (136).
4. Install bearing end cover (109C) with gasket (360) and tighten cap bolt (370N) evenly. Ensure word "TOP" in end cover is up.
5. Place wave washer (529) in bottom of bearing frame (228A) against bearing end cover (109C).
6. After lightly oiling the bearing frame bore and bearing outer races, install the stub shaft assembly. This is a sliding fit: Do not tap.
7. Install bearing end cover (109A) and gasket (360). Tighten cap screws evenly. Ensure word "TOP" on end cover is up.
8. Replace pump coupling hub (233) and key (400).

## 7.4 Reassembly of liquid end

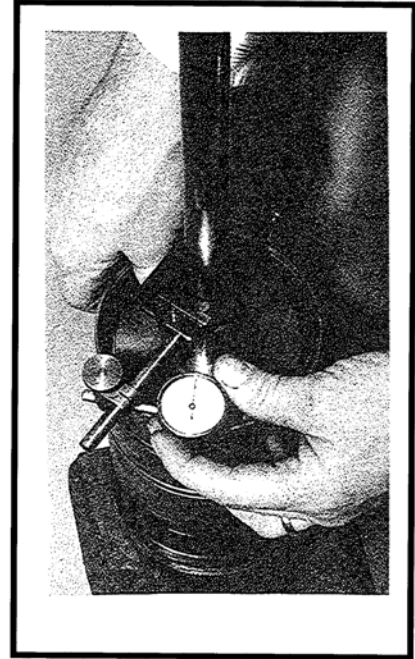
1. Install O-ring (412L) on stationary seat mount (158) and install seal mount (158) into end cover (109C).
2. Install O-ring on stationary seat of mechanical seal (383B). Lubricate O-ring well. Press stationary seat into seal mount (158).
3. To install the drive collar (522) and split collet (524) slide the drive collar (522) over the shaft, past the long groove for the split collet (524), with the arrow end away from the splined end of the shaft. Spread the split collet (524) with a suitable tool, slide it onto the shaft with the narrow end away from the splined end of the shaft. Seat the split collet (524) into the long groove. Push the drive collar (522) over the split collet (524). Drive the collar over the split collet firmly until movement stops. Do not mar or damage face of collar. The split collet (524) must still be in the groove, butted against the edge closest to the splined end of the shaft. If the drive collar (522) and split collet (524) are not positioned and seated properly as shown in Figure 5, damage to the pump will occur in operation.
4. Install mechanical seal retaining ring (361D) on shaft (122) in groove near splined end.



5. Slide rotary unit of mechanical seal (383A) over splined end of pump shaft (122) and against retaining ring (361D). Use care to avoid cutting rubber bellows on splined teeth.
6. With bearing frame assembly remounted on support structure in the vertical position, bolt casing adapter (108) to end cover (109C), install O-ring (412K).
7. Slide splined end of pump shaft (122) into splined insert of stub shaft (380). Ensure rotary seal ring does not drop out of rotary seal.
8. Install impeller key (178) in shaft (122).
9. Check to ensure that the drive collar is properly located. To do this, it is first necessary to be sure the pump shaft is in its proper operating position, which is with the splined end of the shaft bottomed in the stub shaft. Push the shaft down firmly until it bottoms in the stub shaft. The mechanical seal will tend to raise the shaft, pressure must be maintained to keep the shaft bottomed. Lay a straight edge across the casing adapter and against the shaft. There should be a gap between the top of the drive collar and the straight edge of up to approximately one-eighth inch. If the drive collar is too high, a problem exists with parts. recheck the drive collar (524) location to ensure it is seated properly.



**Figure 5: Move diffuser up and down**



**Figure 6: Move diffuser up and down**

10. Proper location of the impellers on the shaft is obtained by the use of shims (331) between the drive collar and the first stage impeller hub, and also between the hubs of the remaining impellers. Shims are supplied in .010" and .030" thicknesses. Slide sufficient shims over the shaft and against the drive collar until the top of the shim stack is flush with the straight edge across the casing adapter. Remember that the shaft must be bottomed during this procedure.
11. Ensure back washers (546) are in place on all impellers.
12. Install the suction diffuser (151) on the casing adapter (108). Ensure suction diffuser (151) and casing adapter (108) fits are clean and that the diffuser is free to turn in the casing.
13. Install the first stage impeller (201) on shaft (122).
14. Push shaft and impeller down firmly until the splined end of the shaft bottoms in the stub shaft. Install a dial indicator as shown in Fig. 7. With the shaft bottomed, move the diffuser up and down squarely as shown in Fig. 8 and Fig. 9. The amount of up and down movement is read on the dial indicator is the actual front clearance.
15. Actual front clearance must be equal to required front clearance shown in Table 4. If not, add or remove shims between the drive collar and first stage impeller hub as required.

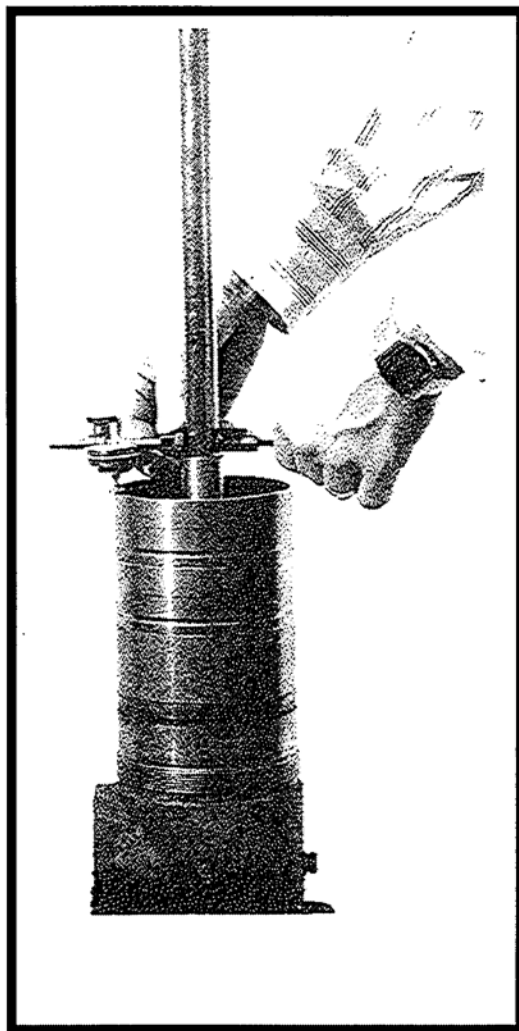


Figure 7:

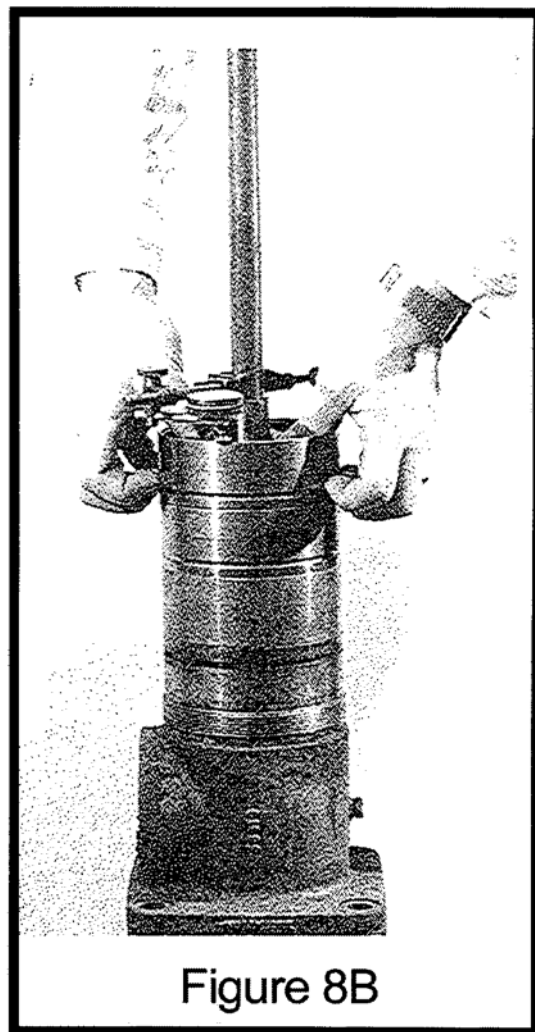


Figure 8B

Figure 8:

Table 3: Required front clearance

| HDB210 Impeller Stack          | Required Front Clearance |
|--------------------------------|--------------------------|
| 1st Stack (2 stages)           | +0.030 ± .005"           |
| 2nd Stack (3rd to 8th stages)  | +0.030 ± .005"           |
| 3rd Stack (9th to 14th stages) | +0.20 ± .005"            |

- Continue adding diffusers and impellers checking each one for proper Front Clearance. Shim each impeller as necessary. Install intermediate bearings (268) with intermediate bearing shaft sleeves (157B) where required. Refer to Table 5 for intermediate bearing location

Table 4: Intermediate bearing location

| Size      | Stage | Bearing: | Stage | Bearing | Stage |
|-----------|-------|----------|-------|---------|-------|
| HDBZ10-6  | 2     | 1        | 4     | -       | -     |
| HDB210-8  | 2     | 1        | 6     | -       | -     |
| HDBZ10-10 | 2     | 1        | 6     | 1       | 2     |
| HDB210-12 | 2     | 1        | 6     | 1       | 4     |
| HDB210-14 | 2     | 1        | 6     | 1       | 6     |

17. Install spacer sleeves (157) after the last impeller has been installed and its Front Clearance has been set. Check space between end of last spacer sleeve (157) and snap ring groove in end of shaft. Add shims as necessary under the last spacer until the spacer sleeve covers approximately  $\frac{1}{2}$  of the snap ring groove. Enter the shaft retaining ring (snap ring) (361) over the shaft and press down until it snaps in the groove.
18. Install O-ring (412K) on the discharge head (152).
19. Slide casing (100) over assembly and screw onto casing adapter (108). O-ring should be lubricated to aid in assembly.
20. Screw discharge head (152) into casing (100).
21. Replace pump foot (131). Tighten cap screw (371U) finger tight. Tighten firmly after start-up and when pump has reached operating temperature.
22. Lay pump in horizontal position. Secure frame to floor. Discharge head must be tightened to the following minimum torque value 600 ft. - lbs. (813 newton metres). Operation of pump without proper torque on discharge head (152) can result in damage to the pump. Do not loosen discharge head to align flange bolt holes. When holes do not align, the discharge head can be tightened more to obtain alignment.
23. Pump is now ready for re-installation. Follow applicable installation, lubrication and start-up procedures. Refer to [4.3 Alignment procedures on page 9](#) and [4.5 Lubrication on page 11](#).

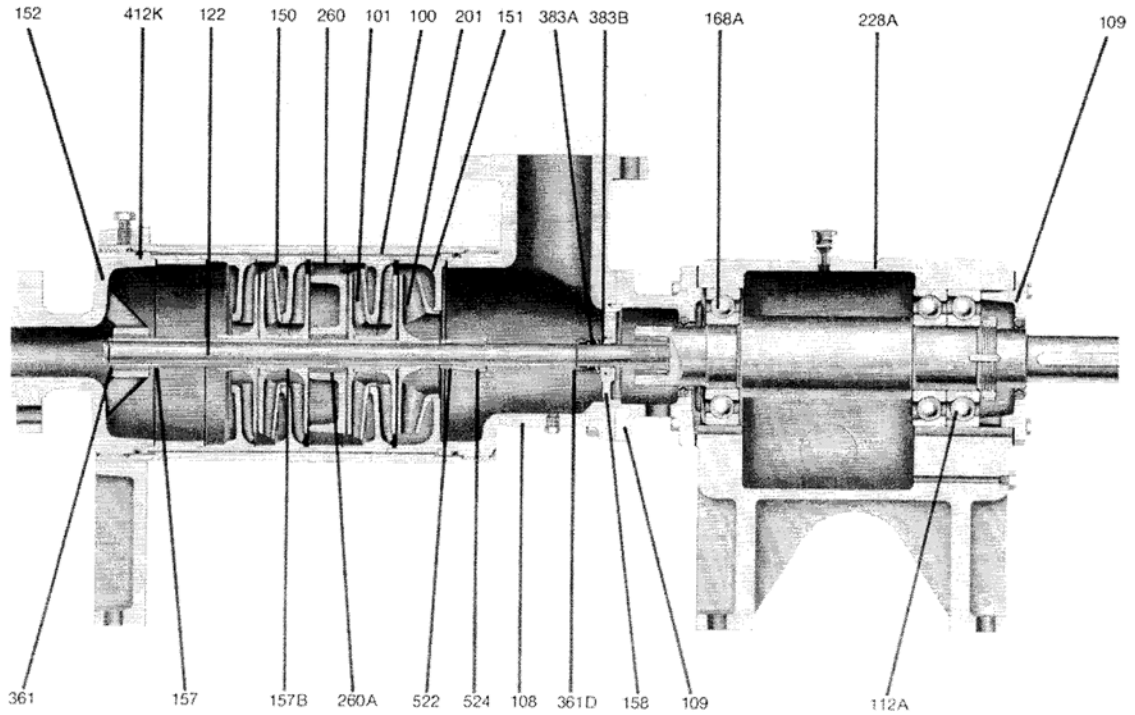
## 7.5 Bearing replacement

1. Lock out power and remove motor from base.
2. Support liquid end and remove the bearing frame assembly from the pump by removing cap screws (371L).
3. Unbolt and remove bearing end cover (109A).
4. Remove stub shaft assembly. Replace bearings as needed.

## 7.6 Mechanical seal replacement

1. Lock out power and remove motor from base. Support liquid end and remove the bearing frame (228A) from case adapter (108) by removing end cover (109) to case adaptor (108) screws.
2. Pull stationary seat mount (158) from fit in case adapter (108). Push stationary seat (385B) out of fit in stationary seat mount (158). Clean parts and install new stationary seat. Renew O-ring as needed.
3. Slide rotary seal unit (383A) off pump shaft (122.)
4. Slide new rotary unit over splined end of pump shaft (122) up against retaining ring (361D). Lubricate shaft to avoid damaging rubber bellows of rotary seal unit.
5. Reinstall stationary seat mount (158) with O-ring (412L) in case adapter (108) fit.
6. Reinstall bearing frame (228A) and tighten bearing frame (228A) to case adapter (108) screws.
7. Refer to mechanical seal drawing for special seal arrangements.

7.6 Mechanical seal replacement



| Parts List and Materials of Construction |                                   |                    |                         |
|--|-----------------------------------|--------------------|-------------------------|
| Item No.                                 | Part Name                         | Material           |                         |
|  |                                   | Standard           | 316SS                   |
| 100                                      | Casing                            | Carbon Steel/316SS | 316SS                   |
| 101                                      | Impeller                          | Ni-Resist II       | 316SS                   |
| 108                                      | Casing Adapter                    | Ductile Iron       | 316SS                   |
| 109                                      | Bearing End Cover                 | Cast Iron          | Cast Iron               |
| 112A                                     | Ball Bearing, Thrust              | Steel              | Steel                   |
| 122                                      | Shaft                             | K-Monel            | K-Monel                 |
| 150                                      | Diffuser                          | 316SS              | 316SS                   |
| 151                                      | Suction Diffuser                  | 316SS              | 316SS                   |
| 152                                      | Discharge Head                    | Ductile Iron       | 316SS                   |
| 157                                      | Spacer Sleeve                     | 316SS              | 316SS                   |
| 157B                                     | Inter                             | 316SS              | 316SS                   |
|  |                                   | 316SS              | 316SS                   |
|  |                                   | Steel              | Steel                   |
|  |                                   | K-Monel            | K-Monel                 |
|  |                                   | Ni-Resist II       | 316SS                   |
|  |                                   | Cast Iron          | Cast Iron               |
|  | Right Outer                       | White Metal/Glass  | White Metal/Glass       |
|  | Bearing Spider                    | Ductile Iron       | 316SS                   |
| 260A                                     | Bearing                           | Carbon             | Carbon                  |
| 361                                      | Retaining Ring -- Shaft           | Stainless Steel    | Stainless Steel         |
| 361D                                     | Retaining Ring -- Mechanical Seal | Stainless Steel    | Stainless Steel         |
| 383A                                     | Rotary Seal                       | 18-8SS, Viton      | 18-8SS, Viton           |
| 383B                                     | Stationary Seat                   | Ni-Resist, Viton   | Tungsten Carbide, Viton |
| 412K                                     | O-Ring Casing                     | Viton              | Viton                   |
| 522                                      | Drive Collar                      | 316SS              | 316SS                   |
| 524                                      | Split Collet                      | 316SS              | 316SS                   |

# 8 Troubleshooting

## 8.1 Troubleshooting

| Problem   | Possible Causes and Correction                          |
|---|---|
| A. No liquid delivered, not enough liquid delivered, or not enough pressure | 1, 2, 3, 4, s, 6, 7t, 8', 9, 10, 11, 12, 14, 17, 22, 23 |
| B. Pump works a while then quits  | 4, 5, 7, 8, 9, ll, 12, 22, 23                           |
| C. Pump takes too much power  | 15, 19, 19  |
| D. Pump is noisy or vibrates  | 15, 16, 20, 21, 23, 24                                  |
| E. Pump leaks excessively at seal housing                                   | 8   |
| F. High bearing temperature   | 23, 24, 25  |

### Causes and corrective measures

1. Pump not primed or properly vented - check that casing and suction pipe are completely filled with liquid.
2. Speed too low - check whether or not motor wiring is correct and receives full voltage, or turbine receives full steam pressure.
3. System discharge head too high - check system head (particularly friction losses).
4. Suction lift too high - check NPSH available (suction piping too small or too long may cause excessive friction losses.) Check with vacuum or compound gauge.
5. Pump or piping obstructed - check for obstructions.
6. Wrong direction of rotation - check rotation.
7. Air pocket or leak in suction line - check suction piping for air pockets and/or air leaks.
8. Incorrect or damaged seal allowing leakage of air into pump casing OT liquid leakage out - inspect seal or replace as required.
9. Not enough suction head for hot or volatile liquids - increase suction head, consult factory.
10. Foot valve too small - install correct size foot valve.
11. Foot valve or suction pipe not immersed deep enough - consult factory for proper depth. Use baffle to eliminate vortices.
12. Entrained air or gases in liquid - consult factory.
13. Impeller damaged - inspect and replace as required.
14. Rotating parts bind - check internal wearing parts for clearances.
15. Coupling or pump and driver misaligned - check alignment and realign if required.
16. Improper pressure gauge location - check correct position and discharge nozzle or pipe.
17. Head lower than rating: pumps too much liquid - consult factory. 18.) Liquid heavier than anticipated - check specific gravity and 19.) Cavitation - increase NPSH available. Consult factory.
18. Improper bearing lubrication or bearings worn out - inspect and replace as required.
19. Internal recirculation due to damaged diffusers or diffuser O-rings. Replace damaged diffusers and O-rings.
20. Diffusers spinning, due to insufficient torque on discharge head. Replace damaged diffusers and reassemble with proper torque on discharge head.
21. Pump not properly secured to base or piping not properly supported - provide for secure bolting to base> proper base structure and support of pipes.
22. Incorrect bearing frame oil level (high or low) follow lubrication instructions.

# 9 Spare Parts

## 9.1 Ordering 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. Ball Bearings. Replacement angular contact thrust bearings must have races properly ground for the appropriate mounting configuration. Angular contact bearings which are universally ground may be mounted in tandem, back-to-back, or face-to-face configuration. The mounting configuration should be specified when replacement bearings are ordered from local sources to assure proper grinding of outer races. (Tandem for model 3335.)
2. Oil Seals
3. Bearing locknut
4. Bearing lock washer
5. Mechanical Seal
6. Casing O-ring
7. O-rings for seal seat, seal mount and casing

Also desirable but more dependent on plant practice is complete set of impellers and diffusers for the pump.

## 9.2 Instructions for ordering spare parts

Repair orders will be handled with the minimum of problems

if the following information is accurately supplied:

1. Nameplate Data
2. Pump Serial Number
3. Pump Model Number
4. Pump size
5. Pump Construction
6. Order Data
  1. Part name
  2. Part number (item number). These names and numbers should agree with those on the Sectional View



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