

IMPORTANT SAFETY NOTICE

To: Our Valued Customers

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

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

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

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

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

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

SAFETY WARNINGS

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

 **WARNING**

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

 **WARNING**

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

 **WARNING**

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

 **WARNING**

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

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

SAFETY

DEFINITIONS

Throughout this manual the words **WARNING**, **CAUTION**, **ELECTRICAL**, and **ATEX** are used to indicate where special operator attention is required.

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



WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Example: Pump shall never be operated without coupling guard installed correctly.



CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Example: Throttling flow from the suction side may cause cavitation and pump damage.




ELECTRICAL HAZARD

Indicates the possibility of electrical risks if directions are not followed.

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









When installed in potentially explosive atmospheres, the instructions that follow the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact an ITT Goulds Pumps representative before proceeding.














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



GENERAL PRECAUTIONS

WARNING

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

General Precautions		
WARNING		NEVER APPLY HEAT TO REMOVE IMPELLER. It may explode due to trapped liquid.
WARNING		NEVER use heat to disassemble pump due to risk of explosion from tapped liquid.
WARNING		NEVER operate pump without coupling guard correctly installed.
WARNING		NEVER run pump below recommended minimum flow when dry, or without prime.
WARNING		ALWAYS lock out power to the driver before performing pump maintenance.
WARNING		NEVER operate pump without safety devices installed.
WARNING		NEVER operate pump with discharge valve closed.
WARNING		NEVER operate pump with suction valve closed.
WARNING		DO NOT change service application without approval of an authorized ITT Goulds Pumps representative.
WARNING		<p>Safety Apparel:</p> <ul style="list-style-type: none"> ♦ 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		<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 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.</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>

General Precautions		
WARNING		Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.
CAUTION		Piping: Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.
WARNING		Flanged Connections: Use only fasteners of the proper size and material.
WARNING		Replace all corroded fasteners.
WARNING		Ensure all fasteners are properly tightened and there are no missing fasteners.
WARNING		Startup and Operation: When installing in a potentially explosive environment, please ensure that the motor is properly certified.
WARNING		Operating pump in reverse rotation may result in contact of metal parts, heat generation, and breach of containment.
WARNING		Lock out driver power to prevent accidental start-up and physical injury.
WARNING		The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
WARNING		If using a cartridge mechanical seal, the centering clips must be installed and set screws loosened prior to setting impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.
WARNING		The coupling used in an ATEX classified environment must be properly certified and must be constructed from a non-sparking material.
WARNING		Never operate a pump without coupling guard properly installed. Personal injury will occur if pump is run without coupling guard.
WARNING		Make sure to properly lubricate the bearings. Failure to do so may result in excess heat generation, sparks, and / or premature failure.
CAUTION		The mechanical seal used in an ATEX classified environment must be properly certified. Prior to start up, ensure all points of potential leakage of process fluid to the work environment are closed.
CAUTION		Never operate the pump without liquid supplied to mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if mechanical seal fails.
WARNING		Never attempt to replace packing until the driver is properly locked out and the coupling spacer is removed.
WARNING		Dynamic seals are not allowed in an ATEX classified environment.
WARNING		DO NOT operate pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.

General Precautions		
WARNING		Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
WARNING		Shutdown, Disassembly, and Reassembly: Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes must be worn at all times.
WARNING		The pump may handle hazardous and/or toxic fluids. Observe proper decontamination procedures. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
WARNING		Operator must be aware of pumpage and safety precautions to prevent physical injury.
WARNING		Lock out driver power to prevent accidental startup and physical injury.
CAUTION		Allow all system and pump components to cool before handling them to prevent physical injury.
CAUTION		If pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107, there may be a risk of static electric discharge from plastic parts that are not properly grounded. If pumped fluid is non-conductive, pump should be drained and flushed with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.
WARNING		Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.
CAUTION		Wear heavy work gloves when handling impellers as sharp edges may cause physical injury.
CAUTION		Wear insulated gloves when using a bearing heater. Bearings will get hot and can cause physical injury.

ATEX CONSIDERATIONS and INTENDED USE

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

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

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

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



The CE and the Ex designate the ATEX compliance. The code directly below these symbols reads as follows:

- II = Group 2
- 2 = Category 2
- G/D = Gas and Dust present
- T4 = Temperature class, can be T1 to T6 (see Table 1)

Code	Max permissible surface temperature °F (°C)	Max permissible liquid temperature °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

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

PARTS



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

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

TABLE OF CONTENTS

SECTION

i.	INTRODUCTION AND GENERAL INSTRUCTIONS
ii.	BULLETIN
1.	F.O. WRITE-UP
2.	PERFORMANCE DATA
3.	CERTIFIED DIMENSION PRINT
4.	CROSS SECTIONAL DRAWING W/BILLS OF MATERIAL
5.	SEAL/PACKING- DRAWINGS AND INSTRUCTIONS
6.	PIPING DRAWING
7.	DRIVER DRAWINGS AND INSTRUCTIONS
8.	ACCESSORIES - DRAWINGS AND INSTRUCTIONS
9.	INSTALLATION, OPERATION INSTRUCTIONS
10.	PUMP DISSASSEMBLY AND REASSEMBLY INSTRUCTIONS
11.	TROUBLE SHOOTING

INTRODUCTION

This instruction manual is intended to assist those involved with the installation, operation, and maintenance of Goulds Model 3300 Multi Stage pumps. It is recommended that this manual be thoroughly reviewed prior to installing or performing any work on the pump or motor.

I - GENERAL

A. Importance of Instructions

The design, material and workmanship incorporated in the construction of Goulds pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, 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, operating and maintaining these pumps. Sections I through IV give information concerning pump construction, performance and dimensions. Sections V through VIII give information on seals, piping and accessories. Study thoroughly Section IX and carefully follow the instructions for installation and operation. Sections X and XI are answers to trouble and maintenance questions. Keep this instruction manual handy for reference. Further information can be obtained by contacting the Engineered Products Division, Goulds Pumps, Inc., Seneca Falls, New York 13148, or your local branch office.

B. 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.

C. Receiving Inspection - Shortages

Care should be taken when unloading pumps. If shipment is not delivered in good order and 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!!

D. Preservation and Storage

Goulds normal domestic storage preparation is suitable for protecting the pump during shipment in covered storage at the jobsite, and for a short period between installation and startup.

If the pump is to be idle and exposed to the elements for an extended period, either before or after installation, special precautions are required. One approach is to provide special preservatives and wrapping before shipment. However, after installation, the protective wrappings will have been removed. Therefore, application of preservatives after installation is considered a good practice. Information about various long term preservation and storage options available can be obtained from your local Goulds representative.

The driver, coupling, and mechanical seal manufacturers should be contacted for their recommendations on preservation and protection procedures.

E. Handling Techniques

Care should be used in moving pumps. Where required by size of units, slings should be put under both pump and motor. Where required by size, holes are provided in bedplates for the use of lifting bars.

I - INSTALLATION

A. Location

Pumping unit should be placed as close as practical to the source of supply. Floor space and head room allotted to the unit must be sufficient for inspection and maintenance. Be sure to allow for crane or hoist service.

B. Foundation and Baseplate

Bedplate mounted units are normally mounted on a concrete foundation of liberal thickness poured on a solid footing and using a one-three-five mix.

The foundation should be substantial in order to absorb any vibration and to form a permanent, rigid support for the pumping unit.

1. The location and size of foundation bolts are shown on the outline assembly drawing supplied for the unit.
2. When unit is mounted on a concrete foundation, each foundation bolt should be installed with a pipe sleeve around it to allow for adjustment. The I.D. of the sleeve should be 2½-3 times the bolt diameter. Place a washer between the bolt head and sleeve to hold bolts. (See Fig. 1)

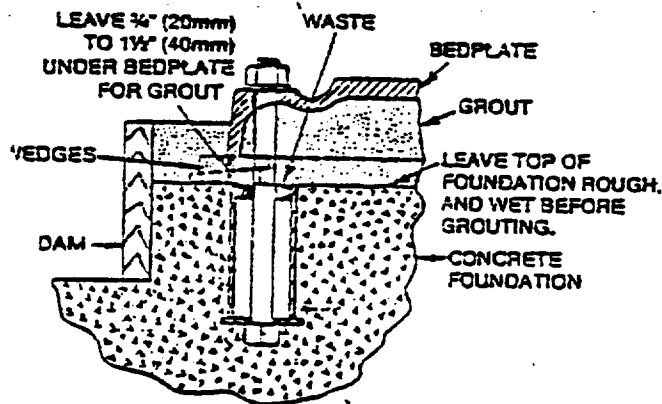


FIGURE 1

Stuff waste around bolts to prevent concrete from entering between bolt and sleeve. Bolts should be of sufficient length so that they project through the nuts approximately .25 inch (6mm) after allowance has been made for grouting, bedplate thickness, and nut thickness.

3. Put the unit in place on wedges. THE WEDGES SHOULD BE PLACED AT SIX POINTS AS SHOWN IN FIG. 2. Some long installations may require additional wedges near the middle of the bedplate.

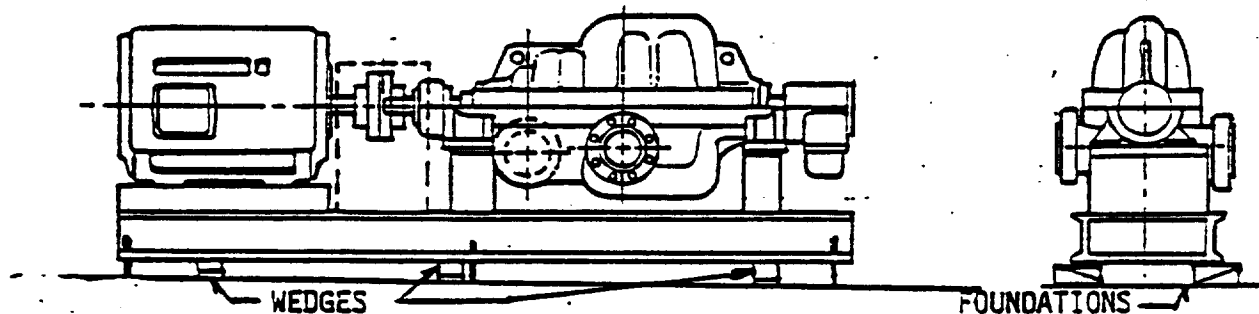


FIGURE 2

4. Disconnect coupling between pump and driver.
5. By adjustment of wedges, bring the bedplate to an approximate level and provide the proper distance above the foundation for grouting ($3/4"$, 20mm to $1\frac{1}{2}"$, 40mm). Level or plumb the suction and discharge flanges. Bring pump and motor shafts into reasonable alignment making ABSOLUTELY CERTAIN that there is a sufficient thickness of shims under the motor feet to allow for adjustment during the alignment.
6. Snug foundation bolts to maintain the level of the bedplate while grout is being poured. NOTE: Final tightening is done after pump is grouted and grout has set at least 48 hours.
7. Build wood dam around foundation as shown in Fig. 1, and thoroughly wet top surface of foundation. Pour grout in hole provided in top of bedplate. Use of non-shrink grout is recommended. Grout should be thin enough to flow out under the bedplate, but not so wet that sand and cement will separate. Grout should be puddled continuously as it is poured to expel the air and completely fill grout hole. Strike along top of dam with trowel to give a neat finished appearance. Remove wedges when grout has hardened at least 48 hours. All motor and or turbine bases must be filled with grout.
8. Tighten foundation bolts.
9. Tighten pump hold-down bolts.

C. Piping - General

1. All piping must be supported independently of the pump. The piping should always "line-up" naturally with the pump flanges. NEVER DRAW THE PIPING INTO PLACE BY USE OF FORCE AT THE FLANGES SUCTION AND DISCHARGE CONNECTIONS OF THE PUMP AS THIS MAY IMPOSE DANGEROUS STRAINS ON THE UNIT AND CAUSE MISALIGNMENT BETWEEN THE PUMP AND DRIVER.

2. The piping, both suction and discharge, should be as short and direct as possible. Avoid all unnecessary elbows, bends, and fittings, as they increase the friction losses in the piping. The size of pipe and fittings should be carefully selected and of sufficient size to keep the friction losses as low as practical.
3. Piping must not be connected to the pump until the grout has thoroughly hardened and the foundation bolts, as well as driver and pump hold down bolts, have been tightened.
4. When handling liquids at elevated temperatures, it is suggested that expansion loops or joints be properly installed in suction and/or discharge lines so that linear expansion of the piping will not draw the pump out of alignment. If such expansion loops or joints are not used, the forces and moments due to thermal expansion of the piping system, that can act upon the pump inlet and discharge flanges, must be determined and must not exceed the limits permissible for the specific pump in question.
Such installations require extremely careful and precise attention to hot alignment procedures. See Section I - 6 entitled "Alignment Final".

D. Piping - Suction

General

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

1. Use of elbows close to the pump suction flange should be avoided. Where used, elbows should be long radius.
2. The suction pipe should never be of smaller diameter than the pump suction. Use of suction pipe one or two sizes larger than the pump suction, with a reducer at the pump suction, with a reducer at the pump suction flange, is desirable.
3. Reducers, if used, should be eccentric and preferably at the pump suction flange, sloping side down.
4. A CENTRIFUGAL PUMP SHOULD NEVER BE THROTTLED ON THE SUCTION SIDE.
5. Suction strainers, when used, should have a net "free area" of at least three times the suction pipe area.

Installations with pump above source of supply --- Suction Lift

1. Keep suction pipe free from air pockets.
2. Piping should slope upwards from source of supply.
3. No portion of piping should extend above the pump suction nozzle.
4. All joints MUST be air tight.

Installation with pump below source of supply --- Suction Head or Flooded Suction

1. A gate valve should be installed in the suction line to permit closing of the line for pump inspection and maintenance.
2. Keep suction pipe free from air pockets.
3. Piping should be level or slope gradually downward from the source of supply.
4. No portion of the piping should extend below pump suction flange.
5. The size of entrance from supply should be no smaller than the suction pipe.
6. The suction pipe should be adequately submerged below the liquid surface at the supply.

E. Piping - Discharge

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

F. Alignment Procedures

General

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

NOTE: THIS IS AN INITIAL ALIGNMENT. The final alignment is done after the unit has been run under actual operating conditions. The final alignment procedure must be followed.

Make sure motor starting switch is "locked out" to prevent accidental rotation.

Coupling manufacturer's instruction sheets, sent with the pump, should be studied and used when installing or servicing coupling. Note that coupling hubs are not necessarily mounted flush with the shaft ends. The alignment must agree with the recommendations of the pump and/or driver manufacturer. NOTE THAT ALIGNMENT IN ONE DIRECTION MAY ALTER ALIGNMENT IN ANOTHER. CHECK THROUGH EACH ALIGNMENT PROCEDURE AFTER MAKING ANY ALIGNMENT ALTERATION.

Angular Alignment

Unit is in angular misalignment when the shaft axes are concentric, but not parallel. Shim unit as required.

Place a dial indicator on one shaft hub and rotate that hub 360° . Take readings from the face of the other hub. Alignment is achieved when indicator does not deflect more than $.002"$ (0.05mm), see Fig. 3. Coupling gap should be set per the pump dimension print or the recommendations of the coupling manufacturer.

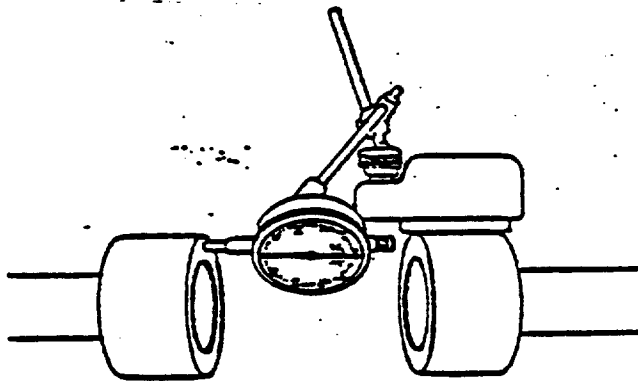


Figure 3

Parallel Alignment

Unit is in parallel misalignment when the shaft axes are parallel but not concentric. Shift driver as required.

In order to obtain vertical parallel alignment under actual operating conditions, the driver shaft may have to be set lower (using thin shim stock) than the pump shaft due to differences in the expansion rates. Pump expansion rates vary with pump design. The following is a suggested cold setting for motor driven units:

Set motor shaft $.002"$ $-.004"$ (0.05 to 0.10 mm) low, regardless of pumpage temperature.

To check the parallel alignment:

1. Establish the elevation required. Note that the elevation relates to motor driven units only. For turbine driven units, consult the turbine manufacturer for thermal rise estimates.
2. Align the unit to the elevation required using a dial indicator mounted on one machine and reading on the other (See Fig. 4). Turning both machines together, take four readings at points 90° apart. Shim the driver as necessary to satisfy the elevation requirement. The alignment is satisfactory when the machines are within $.002"$ ($.05\text{mm}$) TIR of the elevation requirement established in step one and within $.002"$ (0.05 mm) TIR side to side.

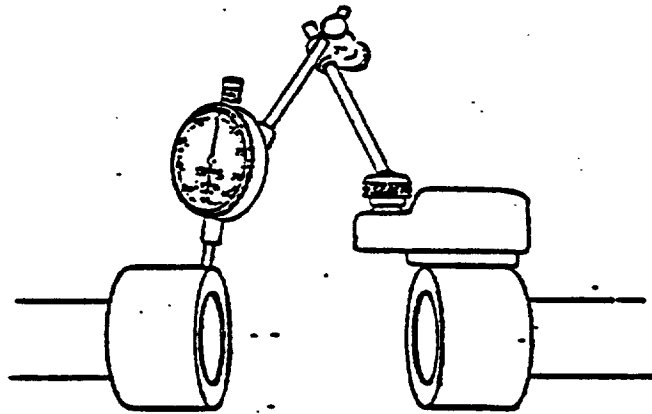


FIGURE 4

G. Alignment - Final

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

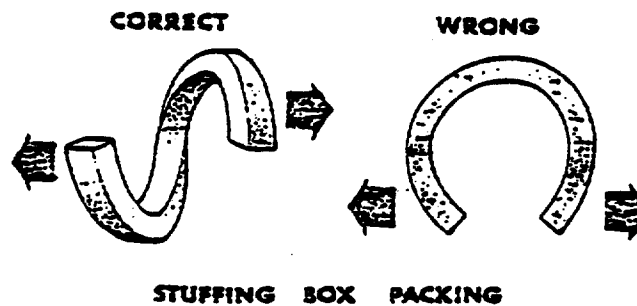
After this warm-up period has elapsed, stop the unit and IMMEDIATELY DISCONNECT THE COUPLING, CHECK THE ALIGNMENT. Make sure motor switch is "locked out" to prevent accidental rotation. Repeat each alignment procedure outlined in I-F. Reconnect Coupling.

Check final alignment after approximately one week of operation.

H. Stuffing Box

1. Packing

Stuffing box packing and gland are in the box of fittings supplied with the pump. Install 3 rings of packing, slide lantern ring in, install 3 more rings of packing and the gland. Twist rings sideways, instead of straight out, when putting them on the shaft to avoid damaging them. Seat each ring firmly as it is installed, and stagger the joints 90°. Gland should be drawn up only finger tight.



A. Startup

1. Checklist

a. Lubrication

Ring oil lubricated ball bearings are standard on all Model 3300 units. THE BEARINGS ARE NOT LUBRICATED AT THE FACTORY. On units supplied with pivot shoe thrust bearings, see Section 8 for Lubrication instructions. Use a high quality turbine type oil (300 SSU @ 100°F) with rust and oxidation inhibitors. oil lubricated pumps are supplied with oilers which maintains a constant oil level in the bearing housing.

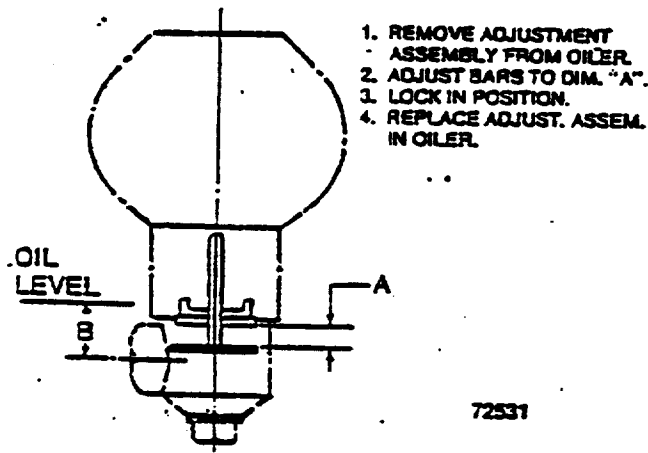


FIGURE 5

72531

Oiler Size	A	B
#10 16 oz. (0.47 L)	27/32" (21.4mm)	3/4" (19.1mm)

- 1) Before installing the oilers on the bearing housings, check the oiler adjustment.
 - 2) Install oilers on the bearing housings on the side where the oiler level groove is located. Tap connection is 1/4" NPT. The 3/8" NPT connection is to be used for draining only.
 - 3) Fill oiler bottle with oil and place it in oiler housing. Oil reservoirs in bearing housings are filled when oil remains visible in the bottle. Several fillings of the bottle will be required. Never fill through the oil vent or the oiler housing without use of the bottle.
- b. Alignment
Check alignment as described in I-F.
- c. Stuffing Box
On pumps with packed boxes, check to be sure gland nuts are finger tight only.
- d. Stuffing Box Lubrication/Cooling
Check to be sure that any required auxiliary piping is installed and functioning. If cooling and/or flushing from an outside source is being used, establish these flows.

I. Disassembly of Pump and Rotating Element

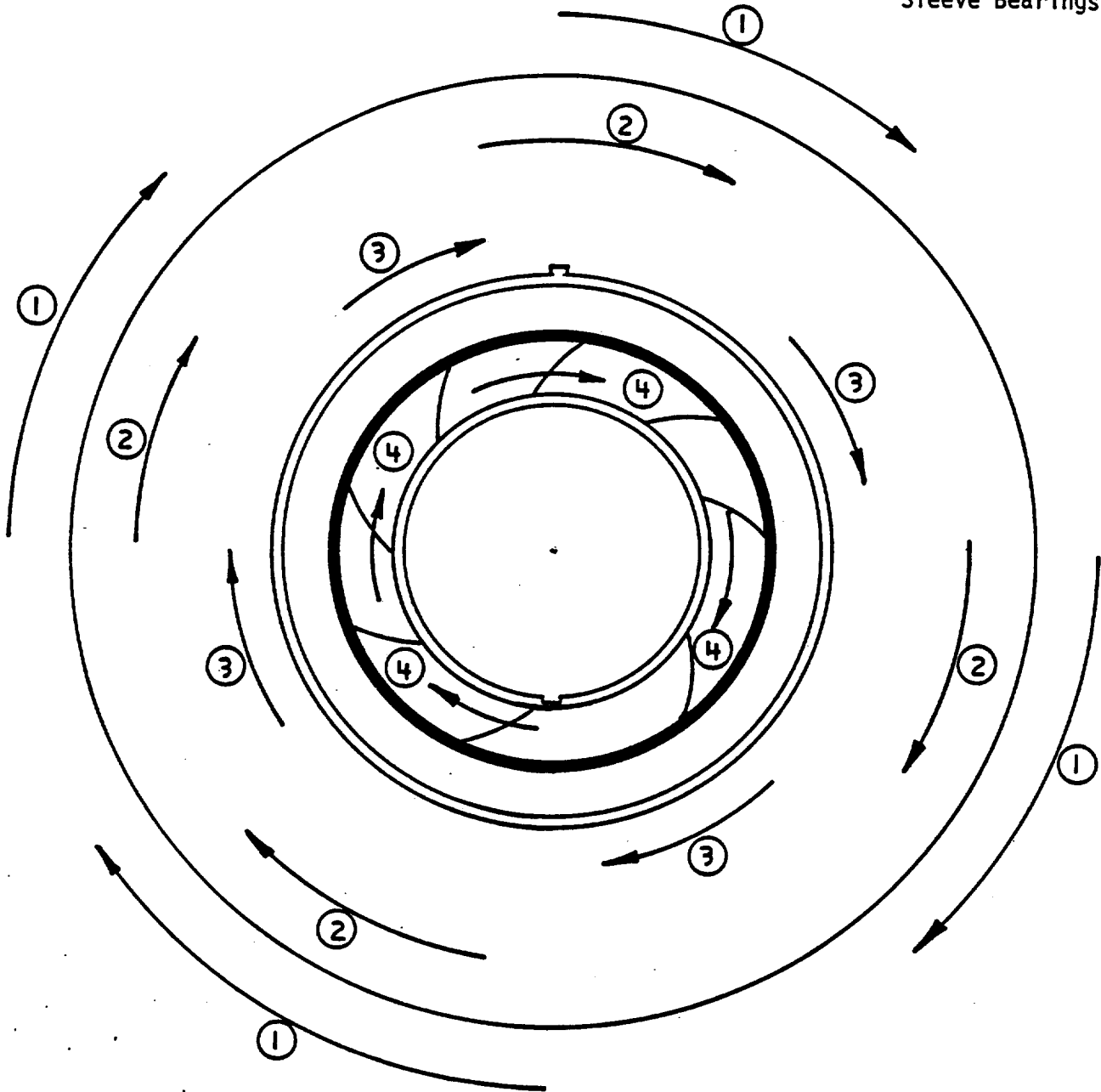
HAVE SPARE PARTS AVAILABLE

- A. 1. Lock out power supply to motor if unit is motor driven.
- 2. Close and lock steam inlet and exhaust valves if unit is turbine driven.
- B. Close and lock pump suction, discharge and any bypass or recirculation valves.
- C. Uncouple the pump from its driver.
- D. 1. If the pump has mechanical seals, loosen and remove all seal gland bolts.
Pull seal glands away from pump stuffing box flange. Refer to seal manufactures instructions for details.
- 2. If pump has packed stuffing box, loosen and remove all stuffing box screws.
- E. Loosen and remove all casing cap nuts and flat washers. BE SURE TO REMOVE THESE FROM THE BOTTOM HALF CASING. Remove the casing dowel pins.
- F. Rig a chain hoist with matched straps or cables over the pump center line and rig straps or cables to lifting lugs at top of casing. With a light strain on chain hoist, screw casing jack screws in until the casing halves separate. Slowly lift upper half casing, being careful not to tear gasket, until it clears all pump parts. Set upper half casing down away from pump on blocks and re-rig it to turn over.
- G. Loosen set screws of deflector rings (123) and (123A). Clean shaft behind deflectors, slide deflectors (123) and (123A) away from bearing housings.
- H. Remove the coupling-end cover screws (371C). Slide coupling-end bearing cover (119A) away from coupling end bearing housing. Do not damage gasket (360).
- I. Loosen and remove thrust bearing end cover screws (371C). Remove thrust bearing end cover (109A) and gasket (360C). Do not damage gasket (360C).
- J. Loosen and remove thrust bearing housing screws (370C). Remove thrust bearing housing (134D) and gasket (360). Do not damage gasket (360).
- K. Loosen and remove upper half bearing housing screws and dowel pins from upper half bearing housings (343) and (343A). Remove upper half bearing housings (343)

and (343A).

- L. Remove the upper half journal bearings (115) and (120). Identify them and place them in a clean protected area. If possible, rig a chain fall and a sling or strap on the shaft between bearings housing and stuffing box to take a light strain. A small pry bar can also be used. This will take the weight off the lower half journal bearings (116) and (121), and allow them to roll out easily. Do not damage oil rings (114). Place lower journal bearings with uppers in clean protected area.
- M. Rig a chain fall and straps or slings over center of element. Locate straps or slings on shaft so that element does not bind up in fits when removed. Remove rotating element and transport to work area for further disassembly.
- N. Remove split packing gland (107) and packing rings (106) if supplied.
- O. Remove thrust bearing oil ring (114B). Bend out "tang" of thrust bearing lock washer (382). Loosen and remove thrust bearing lock nut (136) and lock washer (382). Remove oil ring sleeve (323). Remove thrust bearing collar (443B). Set up bearing puller and remove thrust bearing (112A). Remove thrust bearing spacer (237). Remove oil rings (114). Remove inner deflector (123).
- P. Remove coupling parts from shaft. It may be necessary to heat the coupling. Remove outer deflector (123A), coupling-end end cover (119A) with gasket (360). Remove oil rings (114) and inner deflector (123).
- Q. For pumps with mechanical seal:
1. Remove seal gland and seal parts. Refer to seal manufacturers instructions for details.
 2. Remove water jackets (220J)
 3. Loosen and remove shaft nut (130). On counterclockwise rotation pumps, this nut has LEFT HAND threads.
 4. Loosen and remove shaft nut (124). On clockwise rotation pumps, this nut has Left Hand threads.
- R. For pumps with packed stuffing boxes:
1. Remove lantern ring (105) if supplied.

2. Remove stuffing boxes (220J).
 3. Loosen and remove shaft sleeve (130). On counterclockwise pumps this sleeve has Left Hand threads.
 4. Loosen and remove shaft sleeve (124). On clockwise rotation pumps, this sleeve has Left Hand threads.
- S. Remove pressure reducing bushing (129), pressure reducing sleeve (128) and pressure reducing sleeve key (178D).
- T. Prepare the shaft for impeller removal. CLEAN AND POLISH ALL exposed areas of the shaft between impellers. Beginning from either end, proceed as follows:
1. Coat the cleaned exposed shaft behind the first impeller with a high temperature anti-seize compound.
 2. Set up an oxygen acetylene or equivalent torch with a large "Rose-Bud" type tip. Heat the first impeller to be removed as shown in Fig. 1. Tap the impeller toward the center of the shaft far enough to remove the split retaining ring (361F). With the split ring removed, give the impeller another quick heat and tap it off its fit away from center of shaft. Do not use metal hammers directly on impellers. Remove the impeller key (178C).
 3. The remainder of the impellers are removed in the same manner. Caution is advised to not allow the shaft to get too hot. This will require excessive heat to expand the impellers. Periodically cool the shaft with cold water or other coolant.

HEATING PROCEEDUREModel 3300
Disassembly of Pump and
Rotating Element
Sleeve Bearings

- 1 BEGIN HEAT AT OUTSIDE DIAMETER. MOVE FLAME SLOWLY AROUND. DO NOT LET IT SIT IN ONE PLACE.
- 2 SLOWLY BRING FLAME TOWARD HUB AREA. KEEP FLAME MOVING AT ALL TIMES.
- 4 GIVE FINAL QUICK HEAT TO HUB AREA. KEEP FLAME MOVING AT ALL TIMES.

SECTION 10

Model 3300
Inspection of
Sleeve Bearings

II. Inspection of Parts and Preparation for Reassembly

A. Inspect shaft for damage:

1. All impeller fits must be clean and smooth. Polish impeller fits with a fine emery paper. Small gall marks and scratches can be removed with a fine honing stone. Replace the shaft if damage to impeller fits is severe.
2. Bearing journal areas and thrust bearing fit must be clean and smooth. Polish with a fine emery paper. Small scratches can be removed with a fine honing stone. Replace the shaft if damage is severe.
3. Pressure reducing sleeve (128) fit must also be clean and smooth, particularly in O-ring seat area.
4. Inspect all other shaft fits and shoulders for damage. Clean and polish them as necessary.
5. Check shaft key ways and shaft keys (178C) (178B) (178D) for damage. Renew keys as necessary. Be sure new keys fit their key ways properly before reassembly.

B. Check Shaft for run out:

1. Set shaft in machined "V" blocks located at bearing journals. A small piece of inverted crocus cloth can be used as a bearing liner for this. A few drops of oil will make shaft easier to turn in "V" blocks. Balance rollers can also be used.
2. Mount a dial indicator to read on shaft and slowly turn shaft. Maximum allowable run out is .002". Straighten or replace shaft if run out exceeds .002".

C. Inspect impellers for damage.

1. Impeller bores must be clean and smooth. Gall marks, scratches and burrs will interfere with reinstallation. Remove burrs and scratch marks with fine emery paper. Gall marks can be removed with a small honing stone. Replace impeller (s) if damage to bores is severe.

D. Inspect all impeller and casing wearing rings for damage and wear. Factory wearing ring clearances are listed in Figure 4. Replace wearing rings if excessively worn

1/6/81 or damaged.

SECTION 10

- E. Inspect pressure reducing sleeve (128) and pressure reducing bushing (129) for damage and wear. Pressure reducing sleeve to bushing Factory clearances are listed in Figure 2. Excessive clearance may result in increased stuffing box pressure.
- F. Inspect shaft sleeves on packed pumps for excessive wear. Replace if worn excessively.
- G. Inspect journal bearing (115) (116) and (120) (121) for damage. If babbitt material is damaged, the journal bearing to shaft contact must be checked.
1. Put a thin film of "PRUSSIAN BLUE" on shaft journal.
 2. Gently place lower half journal bearing on the shaft and with slight pressure, roll it back and forth across the shaft journal.
 3. Remove lower half journal and inspect the babbitt. Scrape off the high areas as indicated by the "PRUSSIAN BLUE".
 4. The upper journal bearings can be scraped as needed to remove high spots in babbitt material.
- H. When journal bearings are renewed, lower journal bearing (115) and (120) to shaft contact should be checked with "PRUSSIAN BLUE". Recommended minimum journal bearing to shaft contact is 70%.
- I. Ball thrust bearings (112A) should be renewed regardless of their condition. If none are available, clean them thoroughly in an oil base solvent (kerosene). Be sure that they spin freely. Replace thrust bearings if any doubt exists.
- J. Inspect all bearing housing gaskets (360) and (360C). If damaged or torn, renew them with compatible gasket material of the same thickness.
- K. Inspect oil rings (114) and (114B). They must not be egg shaped or distorted. Replace oil rings if damaged.
- L. Inspect thrust bearing collar (443B) and anti-rotation pin. Replace collar and/or pin if damaged. Check collar fit to outer race of thrust bearing (112A). It should be a light tap fit.
- M. Inspect all O-rings (412R), (412H), (497) for cracks or breaks. Replace O-rings as necessary.
- N. Inspect casing center bushing assembly (155) for damage or wear. Check running clearance of assembled bushing to center impeller hub wearing rings (203A).
Factory clearance is listed in Figure 4.

MODEL 3300

GOULDS' STANDARD MIN. CLEARANCE

Bore Diameter of Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.499				.016			.010			.010	.010	
4.500 to 4.999					.016			.010			.010	.010
5.000 to 5.999	.017								.010			.010
6.000 to 6.999		.018										.010
7.000 to 7.999			.019									

API 610 NON-GALLING MIN. CLEARANCE

Bore Diameter Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.999				.016			.016			.016	.016	
4.500 to 4.999					.016			.016			.016	.016
5.000 to 5.999	.017								.017			.017
6.000 to 6.999		.018										
7.000 to 7.999			.019									

FIGURE 2

SECTION 10

Model 3300
Inspection of Parts
Sleeve Bearings

- O. Inspect mechanical seals if supplied. Refer to seal manufacturers instructions for details.
- P. Inspect coupling parts for damage. Refer to coupling manufacturers instructions for details.
- Q. Inspect and clean inner deflectors (123); coupling-end deflector (123A); thrust bearing spacer (237); thrust oil ring sleeve (323); thrust bearing lock washer (382) and thrust bearing lock nut (136). Replace any or all of these parts as necessary.
- R. Inspect upper and lower half casing for damage. Clean all wearing ring, stuffing box or jacket, pressure reducing bushing and center casing bushing fits thoroughly. Do not use any highly abrasive tools. Use fine emery paper and solvent. Wire brushes and metal scrappers should not be used to clean the machined bores. Be sure the parting flanges are clean and free of all old gasket material. Inspect them for damage such as hammer blows or chisel marks. Remove damage with a honing stone. Excessive damage to machined bores or parting flanges should be repaired.

Model 3300

III Reassembly of Rotating Element and Pump

- A. All impellers have a .0015" to .003" shrink fit to their respective shaft fits.

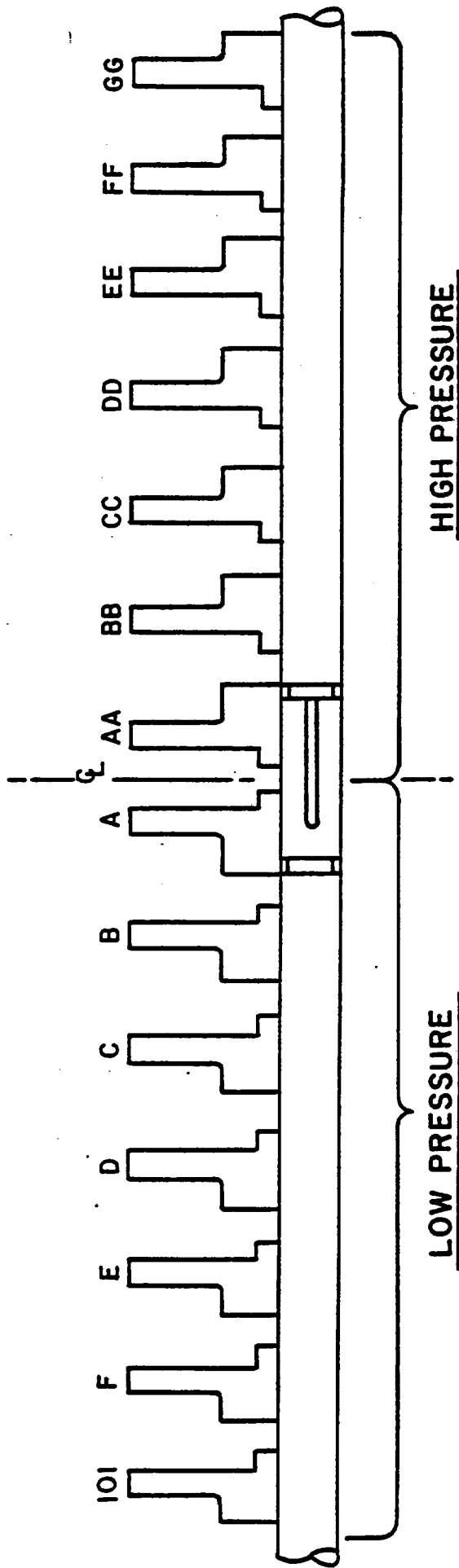
To accomplish installation, each impeller must be heated to approximately 450°F. (Do not exceed 500°F). A "temp-stick" or pyrometer can be used to measure the temperature.

- B. Before beginning impeller installation, the low pressure (suction) side of the shaft must be located. Note that the center impeller key way in the shaft is closed on one end. The closed end of the center impeller key way faces the low pressure (suction) side of the shaft. Impeller installation should begin with the (A) impeller. Fig. 3. It also has a closed key way. All other impellers have full key ways.

1. Install the center impeller key (178B) in shaft and coat center impeller shaft fit with a high temperature anti-seize compound. Install suction casing wearing ring (164) on impeller (A) prior to heating impeller. Heat impeller (A) as shown in Fig. 2. (Impeller (A) has closed key way.) Slide it on its fit from low pressure (suction) end of shaft until the split ring groove is completely exposed. Using two 90° angled tip #3 snap ring pliers to hold both halves of split ring (361F) together, install the split ring halves in the split ring groove and hold them. Push impeller (A) back toward low pressure (suction) end of the shaft over split ring (361F) halves until it is firmly seated against split ring shoulder.
2. Install casing wearing ring (164) on impeller (AA) prior to heating impeller (AA). Heat and install impeller (AA) from opposite end (high pressure) of shaft (122). Slide it on its fit until the split ring groove is completely exposed. Install the split ring using the two angled tip snap ring pliers. Push impeller (AA) back toward high pressure end of the shaft over the split ring. Be sure impeller seats firmly against split ring shoulder.
3. Continue installing impellers WITH CASING WEARING RINGS (164), (127), CASING HUB RINGS (144), AND IMPELLER KEYS (178C) in this manner following impeller location sequence in Fig. 1.

MODEL 3300 FIGURE 3

IMPELLER SEQUENCE



PUMP SIZE	LOW PRESSURE	HIGH PRESSURE
3" 4 STAGE	101, A	AA, BB
3" 5 STAGE	101, B, A	AA, BB
3" 6 STAGE	101, B, A	AA, BB, CC
3" 7 STAGE	101, C, B, A	AA, BB, CC
3" 8 STAGE	101, C, B, A	AA, BB, CC, DD
3" 9 STAGE	101, D, C, B, A	AA, BB, CC, DD
3" 10 STAGE	101, D, C, B, A	AA, BB, CC, DD, EE
3" 11 STAGE	101, E, D, C, B, A	AA, BB, CC, DD, EE
3" 12 STAGE	101, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 13 STAGE	101, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 14 STAGE	101, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF, GG

CAUTION

It may be necessary to cool the shaft
after each impeller is installed.

- C. Install pressure reducing sleeve key (178D) and pressure reducing sleeve (128).

For Pumps With Mechanical Seals

- D. 1. Install shaft nut O-ring (497) over thrust end shaft nut threads. Seat O-ring (497) against face of pressure reducing sleeve (128). Install second shaft nut O-ring (497) in machined groove of shaft nut (130).
2. Lubricate O-rings (497) and install shaft nut (130). On counterclockwise rotation pumps, shaft nut (130) has left hand threads. Tighten shaft nut (130) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.
3. Install shaft nut O-ring (497) over coupling end shaft nut threads. Seat O-ring against shaft shoulder. Install second O-ring (497) in machined groove of shaft nut (124).
4. Lubricate O-rings (497) and install shaft nut (124). On clockwise rotation pumps, shaft nut (124) has left hand threads. Tighten shaft nut (124) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.

For Pumps With Packed Stuffing Boxes

- E. 1. Install shaft sleeve O-ring (497) over thrust end shaft sleeve threads. Seat O-ring (497) against face of pressure reducing sleeve (128). Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (130).
2. Lubricate O-rings (497) and install shaft sleeve (130). With pumps that have counterclockwise rotation, shaft sleeve (130) has left hand threads. Tighten shaft sleeve (130) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
3. Install shaft sleeve O-ring (497) over coupling end shaft sleeve threads. Seat O-ring against shaft shoulder. Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (124)

4. Lubricate O-rings (497) and install shaft sleeve (124). With pumps that have clockwise rotation, shaft sleeve (124) has left hand threads. Tighten shaft sleeve (124) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
- F. Install pressure reducing bushing O-ring (412R) in machined groove of pressure reducing bushing (129). Install pressure reducing bushing (129) on pressure reducing sleeve (128).
- G. Install water jacket O-rings (412H) in machined grooves of water jackets (220J) or stuffing box (220J). Install water jackets or stuffing boxes on shaft.
- H.
 1. Mechanical seals if used must now be installed before proceeding. Refer to seal manufacturers instructions for seal setting and installation procedures.
 2. Lantern rings (105) if used must now be installed before proceeding.

For Pumps with Sleeve Journal Bearings and Ball Type Thrust Bearing

- I. Install inner deflector rings (123) on shaft (122).
- J. Install two oil rings (114) on each end of shaft.
- K. Install thrust bearing spacer (237). Install Duplex thrust bearing (112A). Bearings are installed back to back. Install oil ring sleeve (323). Install thrust bearing lock washer (382) and lock nut (136). Tighten lock nut (136) firmly and set one tang of lock washer (382) in lock nut groove. Install thrust bearing collar (443B) over thrust bearings (112A). This piece has a light "tap" fit. Do not damage it at installation.
- L. Install the case center bushing (155). Make sure halves of center bushing align properly.
- M. Install bearing housing gasket (360), coupling-end end cover (119A), and coupling-end outer deflector (123A). Install coupling parts. Refer to coupling manufacturers instructions for details.
- N. With the casings fits and bearing housings clean, the rotating element can be installed. Rig a sling or strap at each end of the shaft between the water jacket/stuffing box and bearing housing areas. (It may be necessary to apply a spreader between the straps to prevent binding of the water jackets/stuffing boxes when the element is lifted.)

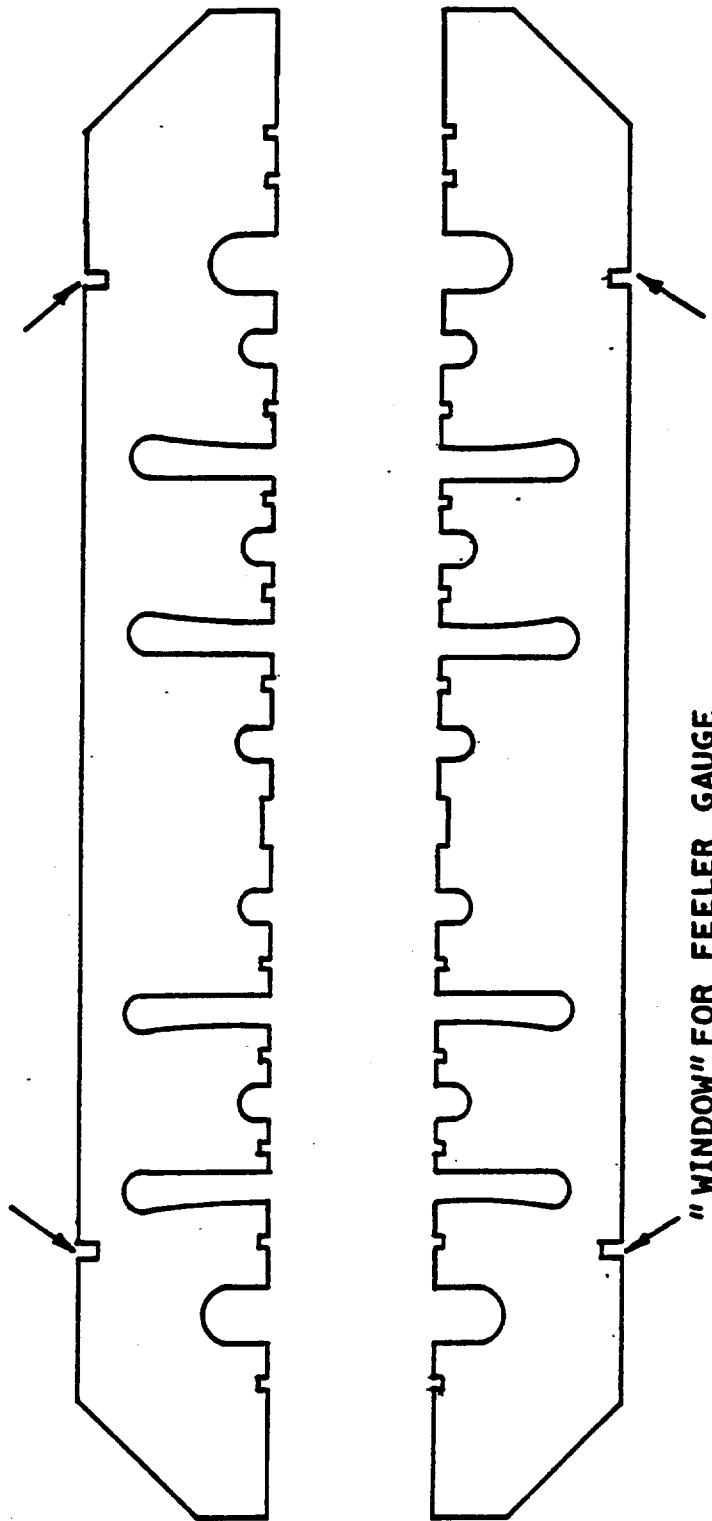
- Lubricate the water jacket/stuffing box (412H) and the pressure reducing bushing O-ring (412R) with a liberal amount of O-ring lubricant, (Parker Lube or equivalent). Also, lubricate the O-ring fits in the lower half casing with a liberal amount of O-ring lubricant.
- O. Center and level the rotating element over the lower half casing and slowly lower it. Be sure that all casing wearing rings (164), (127), casing hub wearing rings (144), water jackets (220J) or stuffing box (220J), pressure reducing bushing (129) and center casing bushing (155) enter their fits evenly. Do not damage pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Be sure water deflectors (123) do not hang up on bearing housings (344A) (344) and do not allow oil rings (114) to be damaged.
- P. Hold the oil rings (114) so that the lower half bearings (116) (121) can be rolled into their fits in the bearing housings (344) and (344A). Pour a small amount of light turbine oil on the shaft journals and roll the lower half bearings (116) and (121) in place. Position the oil rings (114) over the shaft journals.
- Q. Make a new casing gasket using 1/64" compressed asbestos gasket material. The upper half casing can be used as a pattern. Do not use a metal hammer when forming the gasket at any of the wearing ring, pressure reducing bushing, or water jacket or stuffing box fits. Do not cut the gasket flush to the ends of the stuffing boxes. Let it overhang these areas by 1/2" to 1". This is most important on pumps with mechanical seals.
- R. If a torque wrench is available, proceed as follows:
1. Install the new gasket on the lower half casing. Make sure it fits snug to all machined fits.
 2. Install the upper half casing. Use a liberal amount of O-ring lubricant on pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Install and set casing dowel pins. Be sure dowel pin jack nuts are free and do not interfere with dowels.
 3. Install all the casing nuts and tighten them evenly using a criss-cross pattern starting from the center and working towards the ends. Torque the casing nuts to

.1750 foot pounds nominal torque.

4. Trim excess gasket from stuffing box areas.
- S. If torque wrench is not available, proceed as follows:
1. Check the thickness of the new casing gasket with a micrometer and record it for later use. Install the new gasket on the lower half casing. Make sure it fits snug to all machined fits.
 2. Cut four small "windows" in the gasket as shown in Figure 4. These "windows" are used in conjunction with a feeler gauge to insure even compression of the gasket.
 3. Install the upper half casing. Use a liberal amount of O-ring lubricant on pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Install and set the casing dowel pins. Be sure dowel pin jack nuts are free and do not interfere with dowels.
 4. Install the casing nuts and tighten them evenly using a criss-cross pattern starting from the center and working towards the ends.
 5. While tightening, periodically insert a feeler gauge in each of the four "windows". Tighten the nuts until the gasket is compressed .003" to .004". Refer to original gasket thickness recorded in Step S.1.
 6. Trim excess gasket from stuffing box areas.
- T. With upper half casing tight, the "bearing lift" must be checked. Roll out ONE of the lower half journal bearings (116) or (121), NOT BOTH. Mount a dial indicator on the bearing housing and set the dial to read on the shaft journal at TOP DEAD CENTER. Using a pry bar, gently move the shaft up and down. Read the dial indicator and record the total travel. Roll in the lower half journal bearing (116) or (121). Do not damage oil rings (114). Reset dial indicator on the shaft journal and again move the shaft up and down. The reading obtained is subtracted from the first reading and the difference is the "bearing lift". Then record this reading and do the same at the opposite end. The bearing housings were set at the factory so that the bearings set the shaft .002" lower than dead center. New, worn or rebuilt bearing and damaged or lost bearing housing dowel pins may cause the "bearing lift" to change. To correct this, the bearing

MODEL 3300 FIGURE 4

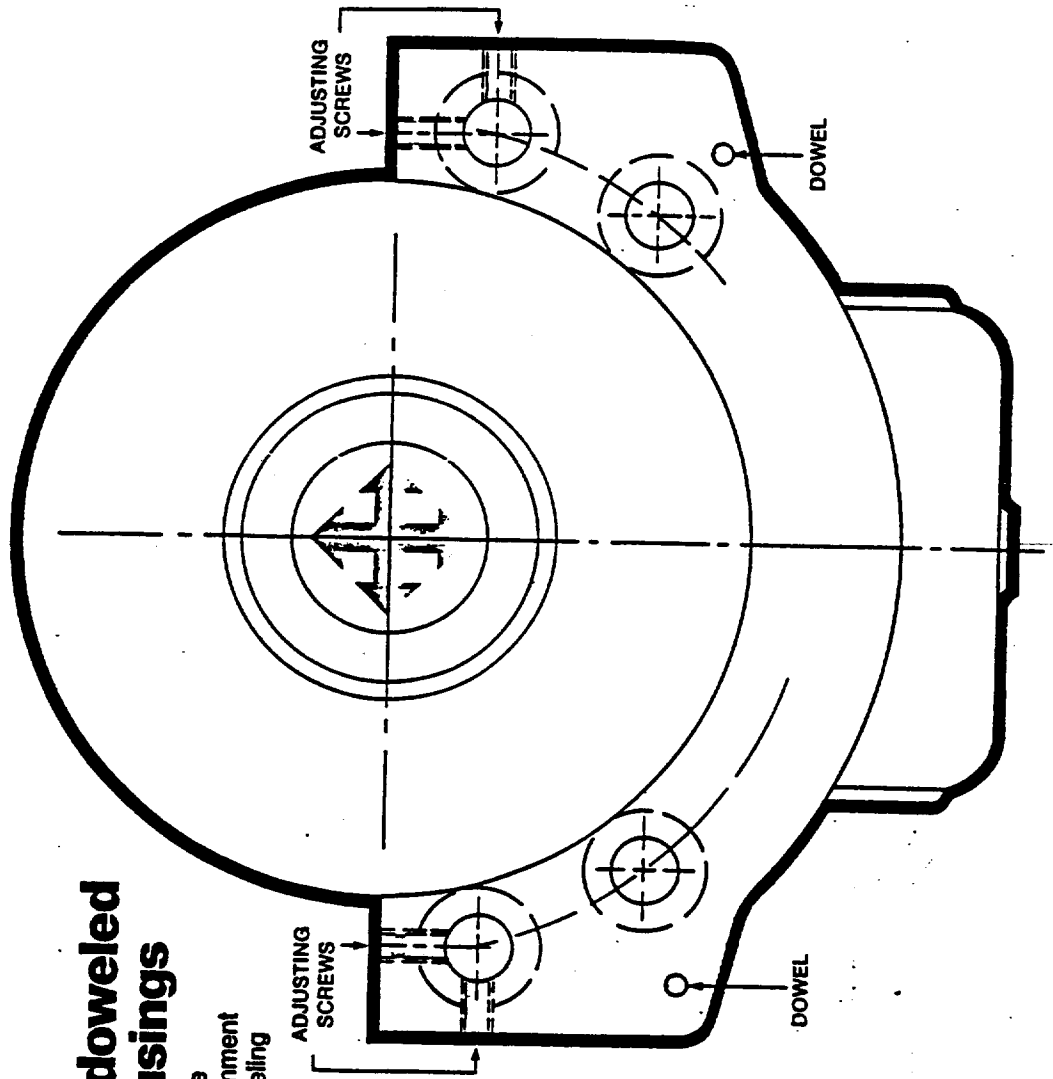
CASING GASKET



Reassembly of Rotating Element and Pump
Sleeve Bearings

housing(s) must be relocated. To do this, remove the lower bearing housing (344) (344A) dowel pins, relax and snug the lower bearing housing cap screws. Adjust the bearing housing jack screws as necessary to obtain the required bearing lift. The bearing housing jack screws are located at the bearing housing corners. See Fig. 5. When one housing is moved, it will effect the "bearing lift" of the opposite end. Both ends must be checked after each move. With the "bearing lift" satisfied, the element must turn free. If it does not, further internal investigation is required. When this operation is complete, the bearing housings must be redoweled.

- U. Install upper half bearing journals (115) and (120). Install and tighten upper half bearing housing (343A) and (343). Install and tighten thrust bearing housing (134D) with gasket (360). Install thrust sleeve oil ring (114B). Install and tighten thrust bearing end cover (109A) with gasket(s) (360C). Be sure anti-rotating pin in thrust bearing collar (443B) enters groove in end cover (109A).
- V. Check thrust bearing end play. Mount dial indicator to read on end of shaft at coupling end. Push the element inboard and "zero" the dial indicator. Push the element outboard and read the dial indicator. Recommended end play of the thrust bearing is .003" to .008". To obtain proper end play, add or remove gaskets (360C) at thrust end cover (109A). Set and lock deflectors (123) and (123A) about .030" away from bearing housings.
- W. 1. Tighten mechanical seal glands if supplied. Refer to seal manufacturers instructions for details.
2. Install shaft packing if supplied. Packing should be installed with the splits of the rings set at 90° intervals.
- X. Check alignment between driver and pump. Correct alignment as necessary. Refer to Section 9.I.F. for alignment procedures.



Bolted and doweled bearing housings

Alignment set screws are provided for precise alignment of rotating element. Doweling maintains the alignment.

Figure 5

SECTION 10

IV Procedure for installing new or substitute bearing housings:

- A. Assemble pump less mechanical seal when supplied and with the new or substitute bearing housing.
- B. Install and snug lightly all bearing housing to casing nuts.
- C. Check shaft to stuffing box for centralization using an inside calliper or other suitable measuring tool at each end of the pump. Relocate the bearing housings with the bearing housing adjusting screws as needed until both ends of the shaft are centralized in the stuffing box bore.
- D. Tighten the bearing housing to casing nuts firmly. When tightened recheck to insure that the shaft to stuffing box bore centralization has held and that the element turns free by hand. If the element does not turn free by hand further internal investigation of the cause must be initiated. Refer to Section 11B for assistance.
- E. Drill through the dowel pin pilot holes in new bearing housings or the original dowel pin holes in the substitute bearing housings and into the casing. Ream out the newly drilled pilot holes with a reamer that will provide a smooth hole in both the bearing housing and the casing. Obtain the new dowel pins of a suitable size and install them.

SECTION 10

I. Disassembly of Pump and Rotating Element

HAVE SPARE PARTS AVAILABLE

- A. 1. Lock out power supply to motor if unit is motor driven.
2. Close and lock steam inlet and exhaust valves if unit is turbine driven.
- B. Close and lock pump suction, discharge and any bypass or recirculation valves.
- C. Uncouple the pump from its driver.
- D. 1. If the pump has mechanical seals, loosen and remove all seal gland to casing screws. Pull seal glands away from pump stuffing box flange. Refer to seal manufacturer's instructions for details.
2. If pump has packed stuffing box, loosen and remove all stuffing box water jacket (220J) to casing screws.
- E. Loosen and remove all casings cap nuts and flat washers. BE SURE TO REMOVE THESE FROM THE BOTTOM HALF CASING. Remove the casing dowel pins. Do not damage dowel pin jacking nut threads.
- F. Rig a chain hoist with matched straps or cables over the pump center line and rig straps or cables to lifting lugs at top of casing. With a light strain on chain hoist, screw casing jack screws in until the casing halves separate. Slowly lift upper half casing, being careful not to tear gasket, until it clears all pump parts. Set upper half casing down away from pump on blocks and re-rig it to turn over.
- G. Remove coupling parts from pump shaft. It may be necessary to heat the coupling hub. Refer to coupling manufacturer's instructions for assistance.

- H. Loosen set screws of deflector rings (123) and (123A). Clean shaft behind deflectors. Remove deflector (123A) from coupling end of shaft and slide deflectors (123) away from end-covers (160A).
- I. Loosen and remove screws (371C) that secure the end-covers (119A) (160A) and (109A) to bearing housings (134A). Slide end-covers (160A) away from bearing housings and remove end-covers (109A) and (119A). Do not damage end-cover gaskets (360A) and (360).
- J. Remove oil rings (114).
- K. Remove bearing housing dowel pins. Do not damage dowel pin jacking nut threads. Loosen and remove all bearing housing to casing hold down nuts. Remove bearing housings (134A) from both ends of pump.
- L. Rig a chain fall and straps or slings over center of element. Locate straps or slings on shaft so that element does not bind up in fits when being removed. Remove rotating element and transport to work area for further disassembly.
- M. Depress the tang in bearing lock washer (382A) at coupling end bearing. Loosen and remove coupling end bearing lock nut (136) and washer (382A). Remove oil ring sleeve (324).
- N. Remove coupling end bearing (168A) from shaft fit using a suitable puller to pull on the inner race of the bearing. Remove end-cover (160A) and gasket (360A).
- O. Depress the tang in bearing lock washer (382) at thrust end bearing. Loosen and remove thrust end bearing lock nut (136) and washer (382). Remove oil ring sleeve (323).

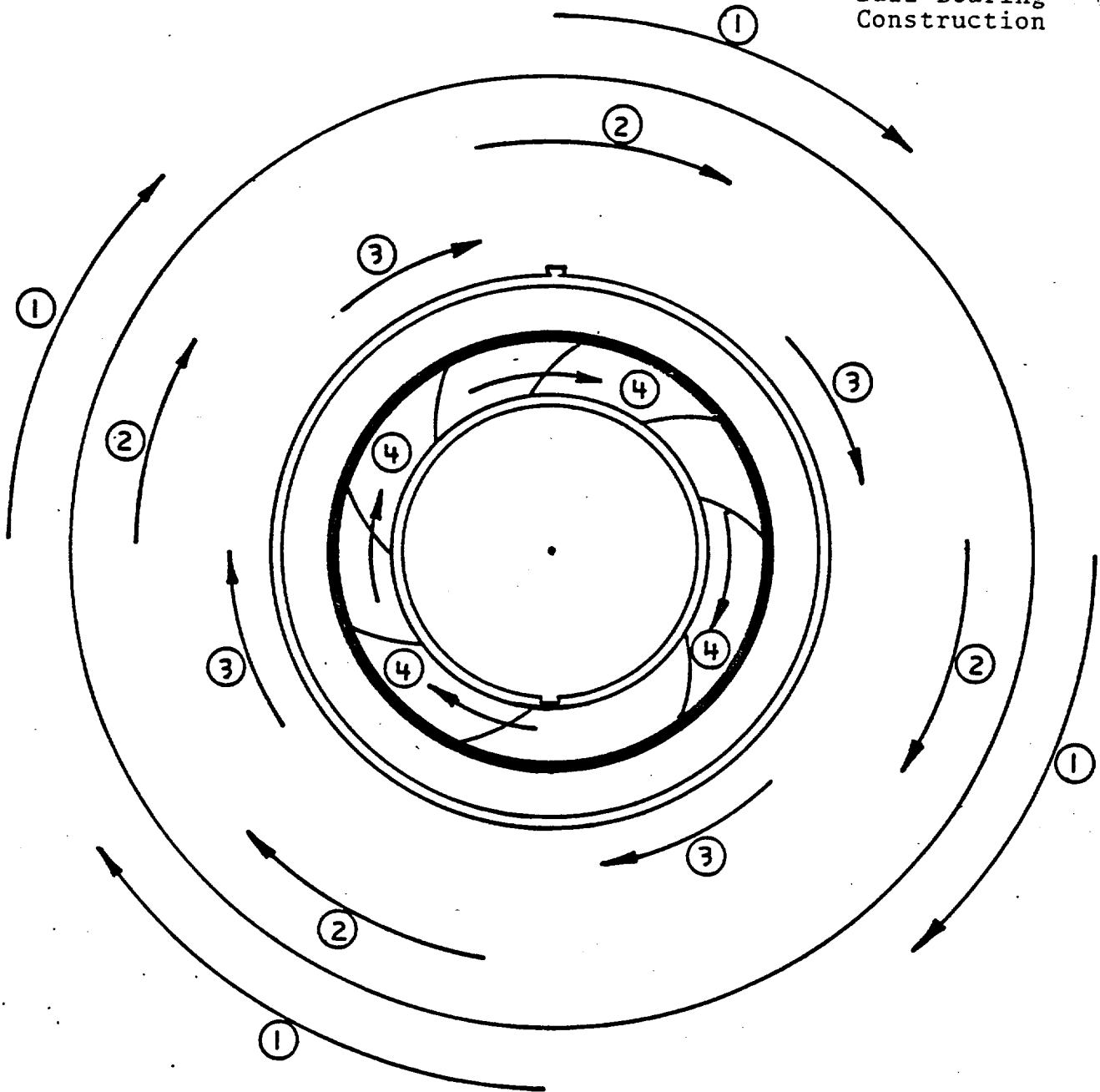
- P. It is not possible to install a puller on thrust bearing inner race until duplex bearing is partially removed. To remove the thrust bearing (112A) begin by pulling on the outer race of the duplex bearing until enough room is available behind end-cover (160A) to pull on the inner race. While pulling on the outer race it is recommended to continuously turn the puller/bearing to prevent damaging the races. Pulling on the inner race must begin when the outer most half of the duplex bearing is not more than half way off its fit. Serious damage to the bearings may occur if the above procedure is not followed.
- Q. Remove end-covers (160A) and end-cover gaskets (360A). Remove deflectors (123).
- R. For pumps with mechanical seals:
1. Remove seal gland and seal parts. Refer to seal manufacturers instructions for details.
 2. Remove water jackets (220J).
 3. Loosen and remove shaft nut (130). This nut has LEFT HAND threads.
 4. Loosen and remove shaft nut (124).
- S. For pumps with packed stuffing boxes:
1. Remove lantern ring (105) if supplied.
 2. Remove stuffing boxes (220J).
 3. Loosen and remove shaft sleeve (130). This sleeve has LEFT HAND threads.
 4. Loosen and remove shaft sleeve (124).
- T. Remove pressure reducing bushing (129), pressure reducing sleeve (128) and pressure reducing sleeve key (178D).

- U. Prepare the shaft for impeller removal. CLEAN AND POLISH ALL exposed areas of the shaft between impellers. Beginning from either end, proceed as follows:
1. Coat the cleaned exposed shaft behind the first impeller with a high temperature anti-sieze compound.
 2. Set up an oxygen acetylene or equivalent torch with a large "Rose-Bud" type tip. Heat the first impeller to be removed as shown in Fig. 1. Tap the impeller toward the center of the shaft far enough to remove the split retaining ring (361F). With the split ring removed, give the impeller another quick heat and tap it off its fit away from center of shaft. Do not use metal hammers directly on impellers. Remove the impeller key (178C).
 3. The remainder of the impellers are removed in the same manner. Caution is advised to not allow the shaft to get too hot. This will require excessive heat to expand the impellers. Periodically cool the shaft with cold water or other coolant.

MODEL 3300 FIGURE 1

HEATING PROCEEDURE

Page 5
Model 3300
Disassembly of Pump
and Rotating Element
Ball Bearing
Construction



- 1 BEGIN HEAT AT OUTSIDE DIAMETER. MOVE FLAME SLOWLY AROUND. DO NOT LET IT SIT IN ONE PLACE.
- 2 SLOWLY BRING FLAME TOWARD HUB AREA. KEEP FLAME MOVING AT ALL TIMES.
- 4 GIVE FINAL QUICK HEAT TO HUB AREA. KEEP FLAME MOVING AT ALL TIMES.

II. Inspection of Parts and Preparation for Reassembly

A. Inspect shaft for damage:

1. All impeller fits must be clean and smooth. Polish impeller fits with a fine emery paper. Small gall marks and scratches can be removed with a fine honing stone. Replace the shaft if damage to impeller fits is severe.
2. Bearing journal fits must be clean and smooth. Polish with fine emery paper. Check journal diameters to insure they provide a .0002" to .0004" interference fit to the inner races of the bearings. Small scratches can be removed with a fine honing stone. Replace shaft if necessary.
3. Pressure reducing sleeve (128) fit must also be clean and smooth, particularly in O-ring seat area.
4. Inspect all other shaft fits and shoulders for damage. Clean and polish them as necessary.
5. Check shaft key ways and shaft keys (178C) (178B) (178D) for damage. Renew keys as necessary. Be sure new keys fit their key ways properly before reassembly.

B. Check shaft for run out:

1. Set shaft in machined "V" blocks located at bearing journals. A small piece of inverted crocus cloth can be used as a bearing liner for this. A few drops of oil will make shaft easier to turn in "V" blocks. Balance rollers can also be used.
2. Mount a dial indicator to read on shaft and slowly turn shaft. Maximum allowable run out is .002". Straighten or replace shaft if run out exceeds .002".

- C. Inspect impellers for damage.
 - 1. Impeller bores must be clean and smooth. Gall marks, scratches and burrs will interfere with reinstallation. Remove burrs and scratch marks with fine emery paper. Gall marks can be removed with a small honing stone. Replace impeller (s) if damage to bores is severe.
- D. Inspect all impeller and casing wearing rings for damage and wear. Factory wearing ring clearances are listed in Figure 4. Replace wearing rings if excessively worn or damaged.
- E. Inspect pressure reducing sleeve (128) and pressure reducing bushing (129) for damage and wear. Pressure reducing sleeve to bushing factory clearances are listed in Figure 2. Excessive clearance may result in increased stuffing box pressure.
- F. Inspect shaft sleeves on packed pumps for excessive wear. Replace if worn excessively.
- G. Inspect ball bearings for damage. Ball bearings can be checked for visible wear by slowly turning the races and watching for pits or worn areas on the balls or raceways. The bearings can also be checked by holding the inner race and spinning the outer race. If any rasping noises are emitted or the bearing "catches" it should be replaced. If any wear or other visible damage is apparent, replace the bearing.
- H. Inspect all O-rings (412R), (412H), (497) for cracks or breaks. Replace O-rings as necessary.
- I. Inspect casing center bushing assembly (155) for damage or wear. Check running clearance of assembled bushing to center

impeller hub wearing rings (203A). Factory clearance is listed in Figure 4.

- J. Inspect mechanical seals if supplied. Refer to seal manufacturer's instructions for details.
- K. Inspect coupling parts for damage. Refer to coupling manufacturers instructions for details.
- L. Inspect and clean inner deflectors (123); coupling-end deflector (123)A, Replace any or all of these parts as necessary.
- M. Inspect upper and lower half casing for damage. Clean all wearing ring, stuffing box or jacket, pressure reducing bushing and center casing bushing fits thoroughly. Do not use any highly abrasive tools. Use fine emery paper and solvent. Wire brushes and metal scrapers should not be used to clean the machine bores. Be sure the parting flanges are clean and free of all old gasket material. Inspect them for damage such as hammer blows or chisel marks. Remove damage with a honing stone. Excessive damage to machine bores or parting flanges should be repaired.

MODEL 3300

GOULDS' STANDARD MIN. CLEARANCE

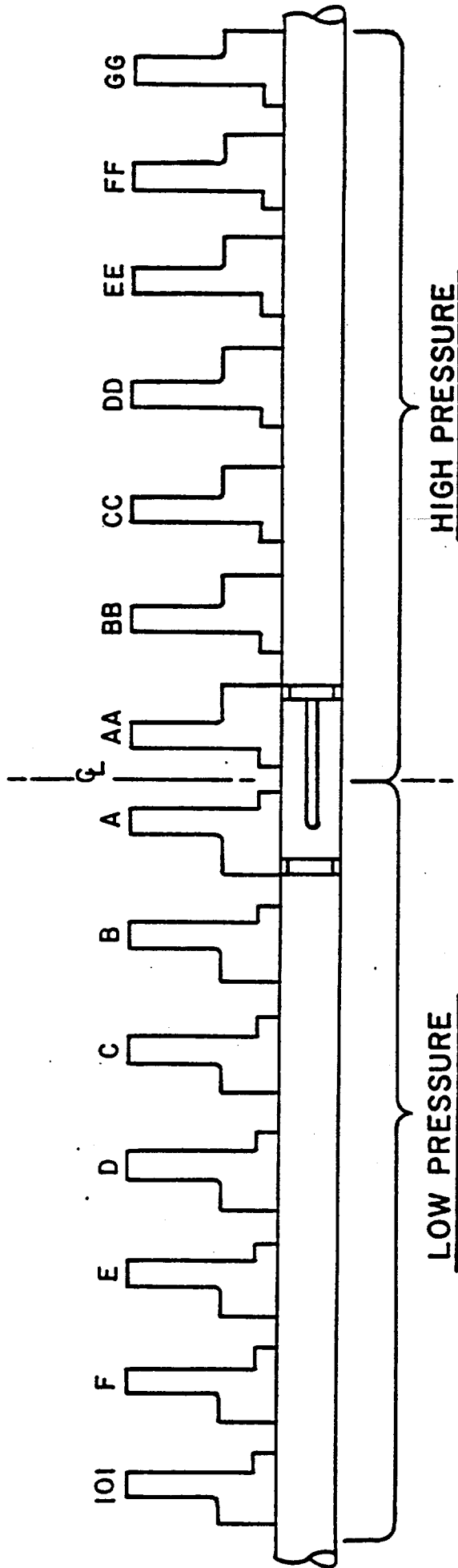
Bore Diameter of Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.499				.016			.010			.010	.010	
4.500 to 4.999					.016			.010			.010	.010
5.000 to 5.999	.017					.017			.010			.010
6.000 to 6.999		.018										
7.000 to 7.999			.019									

API 610 NON-GALLING MIN. CLEARANCE

Bore Diameter Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.999				.016			.016			.016	.016	
4.500 to 4.999					.016			.016			.016	.016
5.000 to 5.999	.017					.017			.017			.017
6.000 to 6.999		.018										
7.000 to 7.999			.019									

FIGURE 2

MODEL 3300 FIGURE 3
IMPELLER SEQUENCE



PUMP SIZE	LOW PRESSURE	HIGH PRESSURE
3" 4 STAGE	101, A	AA, BB
3" 5 STAGE	101, B, A	AA, BB
3" 6 STAGE	101, B, A	AA, BB, CC
3" 7 STAGE	101, C, B, A	AA, BB, CC
3" 8 STAGE	101, C, B, A	AA, BB, CC, DD
3" 9 STAGE	101, D, C, B, A	AA, BB, CC, DD
3" 10 STAGE	101, D, C, B, A	AA, BB, CC, DD, EE
3" 11 STAGE	101, E, D, C, B, A	AA, BB, CC, DD, EE
3" 12 STAGE	101, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 13 STAGE	101, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 14 STAGE	101, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF, GG

Model 3300

III. Reassembly of Rotating Element and Pump

- A. All impellers have a .0015" to .003" shrink fit to their respective shaft fits. To accomplish installation, each impeller must be heated to approximately 450°F, (Do not exceed 500°F). A "temp-stick" or pyrometer can be used to measure the temperature.
- B. Before beginning impeller installation, the low pressure (suction) side of the shaft must be located. Note that the center impeller key way in the shaft is closed on one end. The closed end of the center impeller key way faces the low pressure (suction) side of the shaft. Impeller installation should begin with the (A) impeller. Fig. 3. It also has a closed key way. All other impellers have full key ways.
 1. Install the center impeller key (178B) in shaft and coat center impeller shaft fit with a high temperature anti-sieze compound. Install suction casing wearing ring (164) on impeller (A) prior to heating impeller. Heat impeller (A) as shown in Fig. 2. (Impeller (A) has closed key way). Slide it on its fit from low pressure (suction) end of shaft until the split ring groove is completely exposed. Using two 90° angled tip #3 snap ring pliers to hold both halves of split ring (361F) together, install the split ring halves in the split ring groove and hold them. Push impeller (A) back toward low pressure (suction) end of the shaft over split ring (361F) halves until it is firmly seated against split ring shoulder.

2. Install casing wearing ring (164) on impeller (AA) prior to heating impeller (AA), Heat and install impeller (AA) from opposite end (high pressure) of shaft (122). Slide it on its fit until the split ring groove is completely exposed. Install the split ring using the two angled tip snap ring pliers. Push impeller (AA) back toward high pressure end of the shaft over the split ring. Be sure impeller seats firmly against split ring shoulder.
3. Continue installing impellers WITH CASING WEARING RINGS (164), (127) CASING HUB RINGS (144), AND IMPELLER KEYS (178C) in this manner following impeller location sequence in Fig. 1.

CAUTION

It may be necessary to cool the
shaft after each impeller is installed.

- C. Install pressure reducing sleeve key (178D) and pressure reducing sleeve (128).

For Pumps with Mechanical Seals

- D. 1. Install shaft nut O-ring (497) over thrust end shaft nut threads. Seat O-ring (497) against face of pressure reducing sleeve (128). Install second shaft nut O-ring (497) in machine groove of shaft nut (130).
2. Lubricate O-rings (497) and install shaft nut (130). Shaft nut (130) has left hand threads. Tighten shaft nut (130) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.
3. Install shaft nut O-ring (497) over coupling end shaft nut threads. Seat O-ring against shaft shoulder. Install

second O-ring (497) in machined groove of shaft nut (124).

4. Lubricate O-rings (497) and install shaft nut (124). Tighten shaft nut (124) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.

For Pumps with Packed Stuffing Box

- E. 1. Install shaft sleeve O-ring (497) over thrust end shaft sleeve threads. Seat O-ring against face of pressure reducing sleeve (128). Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (130).
2. Lubricate O-rings (497) and install shaft sleeve (130). Shaft sleeve (139) has left hand threads. Tighten shaft sleeve (130) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
3. Install shaft sleeve O-ring (497) over coupling end shaft sleeve threads. Seat O-ring against shaft shoulder. Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (124).
4. Lubricate O-rings (497) and install shaft sleeve (124). Shaft sleeve (124) has left hand threads. Tighten shaft sleeve (124) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
- F. Install pressure reducing bushing O-ring (412R) in machined groove of pressure reducing bushing (129). Install pressure reducing bushing (129) on pressure reducing sleeve (128).
- G. Install water jacket O-rings (412H) in machined grooves of water jackets (220J) or stuffing box (220J). Install water jackets or stuffing boxes on shaft.
- H. 1. Mechanical seals if used must now be installed before

proceeding. Refer to seal manufacturers instructions for seal setting and installation procedures.

2. Lantern rings (105) if used must now be installed before proceeding.
- I. Install inner deflectors (123) on each of shaft (122). Install end-covers (160A) with gaskets (360A) on each end of shaft.

Bearing Installation

The bearings can be installed in one or two ways; they can be pressed on or heated. When pressing or tapping apply force to inner races only. If bearings are heated do not use an open flame. A temperature control oven or standard bearing heater can be used. DO NOT EXCEED 200°F.

- J. Install thrust bearing spacer (237) on shaft (122). Position thrust bearing halves (112A) in a BACK TO BACK configuration on shaft and press or tap on shaft fit until firmly seated against thrust bearing spacer (237). If bearings were heated, allow to cool before proceeding.
- K. Install thrust end oil ring sleeve (323), bearing lock washer (382) and lock nut (136). Tighten lock nut (136) firmly using a hook type spanner wrench. Check bearings to insure that they are not clamped too tightly.

Insure that one of the lock washer "tang" are aligns with one of the slots in the lock nut. Set the "tang" firmly with a pin punch. If a lock washer "tang" does not align, tighten the lock nut more - do not loosen.
- L. Position the coupling end bearing (168A) on shaft (122) and press

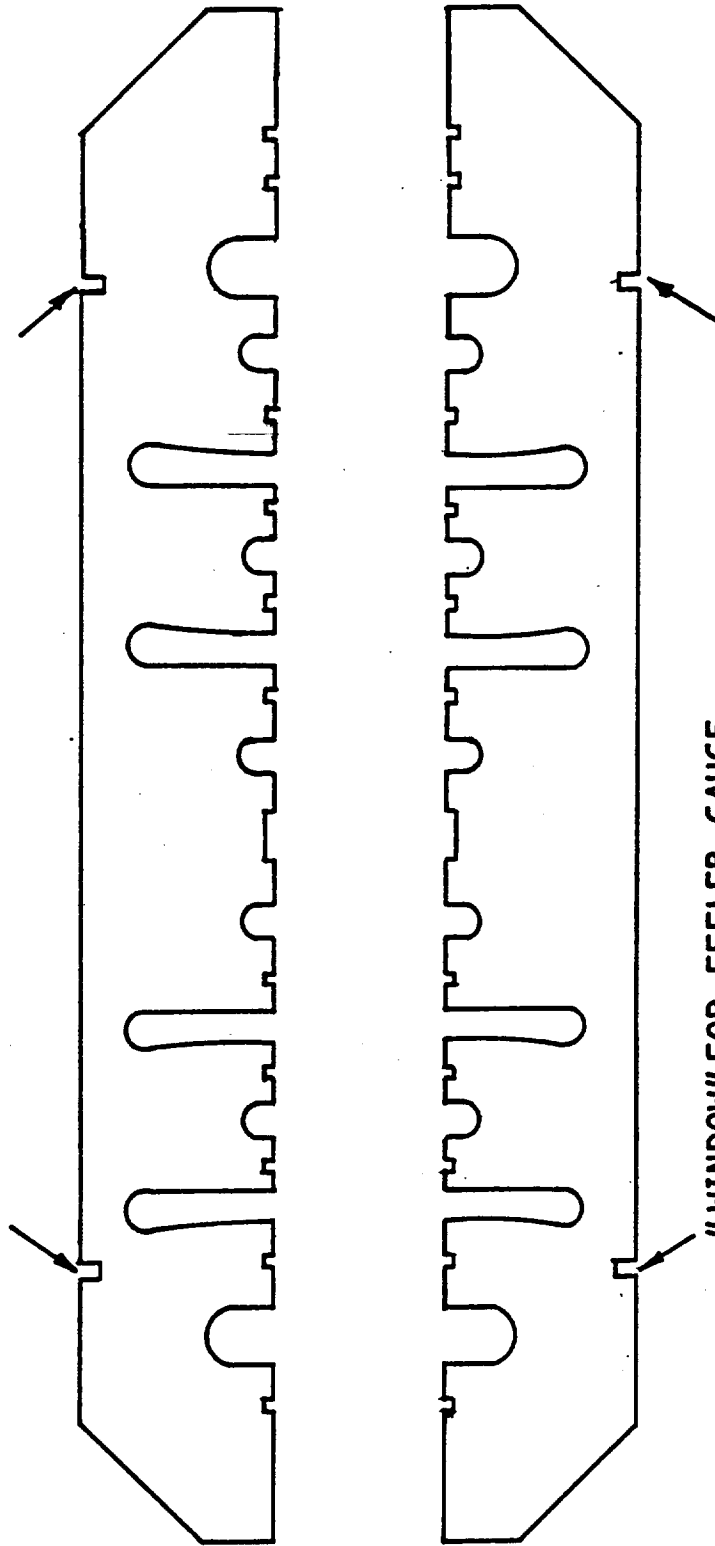
- or tap on shaft fit until firmly seated against shoulder. If bearing was heated allow to cool before proceeding.
- M. Install coupling end oil ring sleeve (324), bearing lock washer (382A) and bearing lock nut (136). Tighten lock nut firmly using a hook type spanner wrench. Insure that one of the lock washer "tang" aligns with one of the slots in the lock nut. Set the "tang" firmly with a pin punch. If a lock washer "tang" does not align, tighten the lock nut more - do not loosen.
- N. With the casing fits and bearing housing clean, the rotating element can be installed. Rig a sling or strap at each end of the shaft between the water jacket/stuffing box and bearing housing areas. (It may be necessary to apply a spreader between the straps to prevent binding of the water jacket/stuffing boxes when the element is lifted). Lubricate the water jacket/stuffing box (412H) and the pressure reducing bushing O-ring (412R) with a liberal amount of O-ring lubricant (Parker Lube or equivalent). Also lubricate the O-ring fits in the lower half casing with a liberal amount of O-ring lubricant.
- O. Center and level the rotating element over the lower half casing and slowly lower it. Be sure that all casing wearing rings (164) (127), casing hub wearing rings (144), water jackets (220J) or stuffing box (220J), pressure reducing bushing (129) and center casing bushing (155) enter their fits evenly. Do not damage pressure reducing bushing O-ring (412R) and water jacket/stuffing box O-rings (412H).
- P. Install thrust bearing housing (132) over thrust bearing (112H) and bearing housing studs. This is a slide fit. Do not use excessive force as damage to the bearings will occur.

Position end-cover gasket (360A) on flange of end-cover (160A) so that oil return passages line up. Secure end-cover with gasket to bearing housing with screws (317C). INSURE THE WORD "TOP" IS ALIGNED WITH THE OIL HOLE COVER (113B) IN THE BEARING HOUSING.

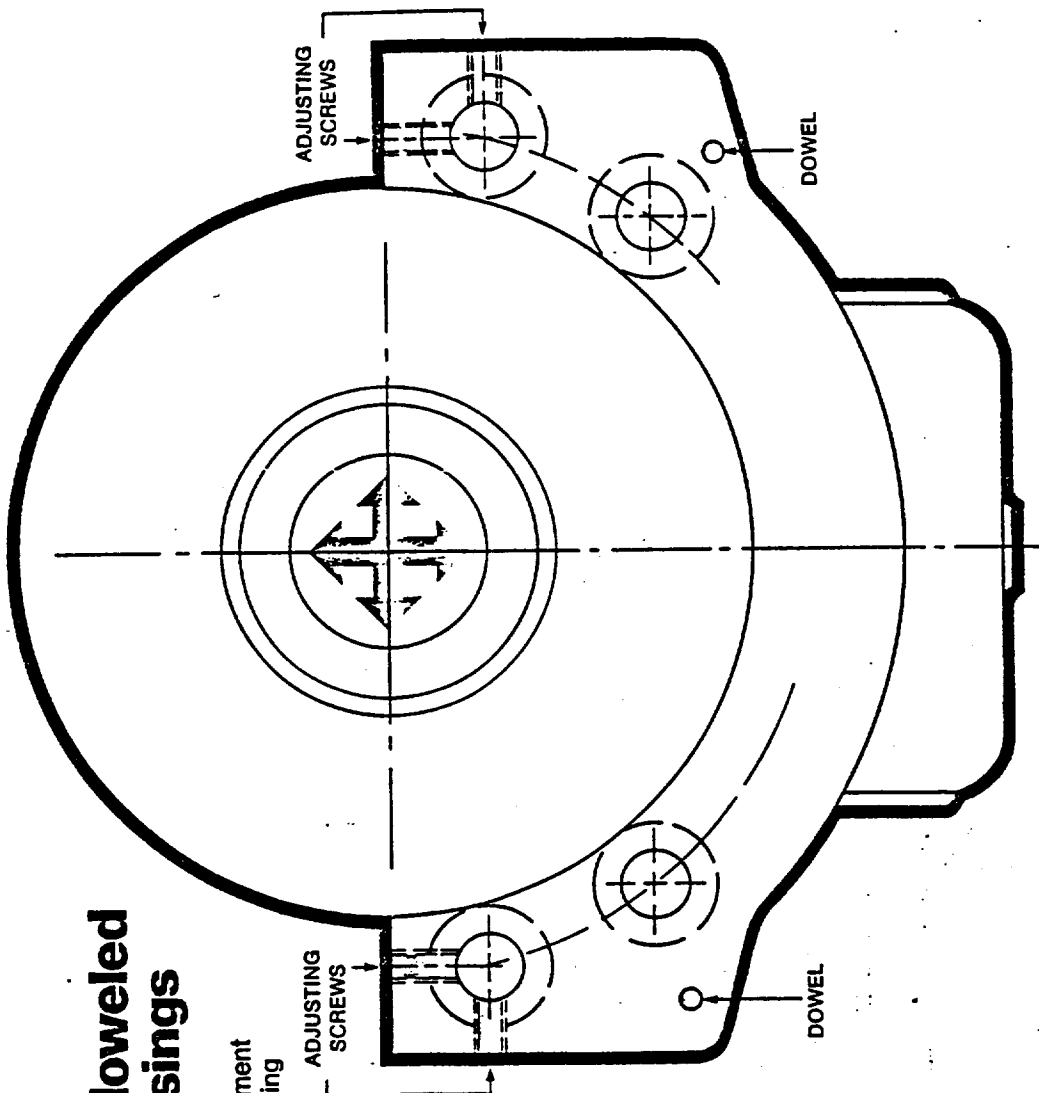
- Q. Install oil ring (114) on oil ring sleeve (323). Position end-cover gasket (360) on end-cover (109A). Secure end-cover (109A) to bearing housing (134A) with screws (371C). INSURE THE WORD "TOP" IS ALIGNED WITH THE OIL HOLE COVER (113B) IN THE BEARING HOUSING. Install outer shaft deflector (123A) on coupling end of shaft.
- R. If torque wrench is not available, proceed as follows:
1. Check the thickness of the new casing gasket with a micrometer and record it for later use. Install the new gasket on the lower half casing. Make sure it fits snug to all machined fits.
 2. Cut four small "windows" in the gasket as shown in Figure 4. These "windows" are used in conjunction with a feeler gauge to insure even compression of the gasket.
 3. Install the upper half casing. Use a liberal amount of O-ring lubricant on pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Install and set the casing dowel pins. Be sure dowel pin jack nuts are free and do not interfere with dowels.
 4. Install the casing nuts and tighten them evenly using a criss-cross pattern starting from the center and working towards the ends.

MODEL 3300 FIGURE 4

CASING GASKET



5. While tightening, periodically insert a feeler gauge in each of the four "windows". Tighten the nuts until the gasket is compressed .003" to .004". Refer to original gasket thickness recorded in Step R.1.
6. Trim excess gasket from stuffing box areas.
- S. Rough align bearing housing dowel pin holes of both bearing housings by adjusting screws (Fig. 5). When dowel pin holes are aligned insert dowel pins and tap gently until firmly seated. Install and tighten firmly the nuts that hold the bearing housings to the casing.
- T. Turn the element by hand one or two complete revolutions to see if it turns free. If a rub is felt or if the element is unusually hard to turn, further investigation is required. Refer to Section 10 IV for assistance. When installing new or substitute bearing housings refer to Section 10 IV for procedure.
- U. Check thrust bearing end play. End play should be .003" to .008". Mounting a dial indicator to read on a flat surface of the element, pry the element back and forth. If the end play is less than .003" install an additional gasket between the thrust bearing end-cover (109A) and thrust bearing housing (134A). If the end play is more than .008", reduce the thickness of the gasket between the thrust bearing end-cover (109A) and the thrust bearing housing (134A).
- V. Install and tighten the screws that hold the stuffing box water jacket (220J) to the casing.
- W. Tighten mechanical seal glands if supplied. Refer to seal manufacturers instructions for details.



Bolted and doweled bearing housings

Alignment set screws are provided for precise alignment of rotating element. Doweling maintains the alignment.

Figure 5

- X. Install shaft packing if supplied. Packing should be installed with the splits of the rings set at at least 90° intervals. Insure that the lantern rings are properly positioned.
- Y. Set the shaft deflectors (123A) and (123) to about 1/32" away from the bearing housings.
- Z. Check alignment between driver and pump. Correct alignment if necessary. Refer to Section 9.1.F for alignment procedures.

SECTION 10

Disassembly of Pump and Rotating Element

I. Disassembly of Pump and Rotating Element

HAVE SPARE PARTS AVAILABLE

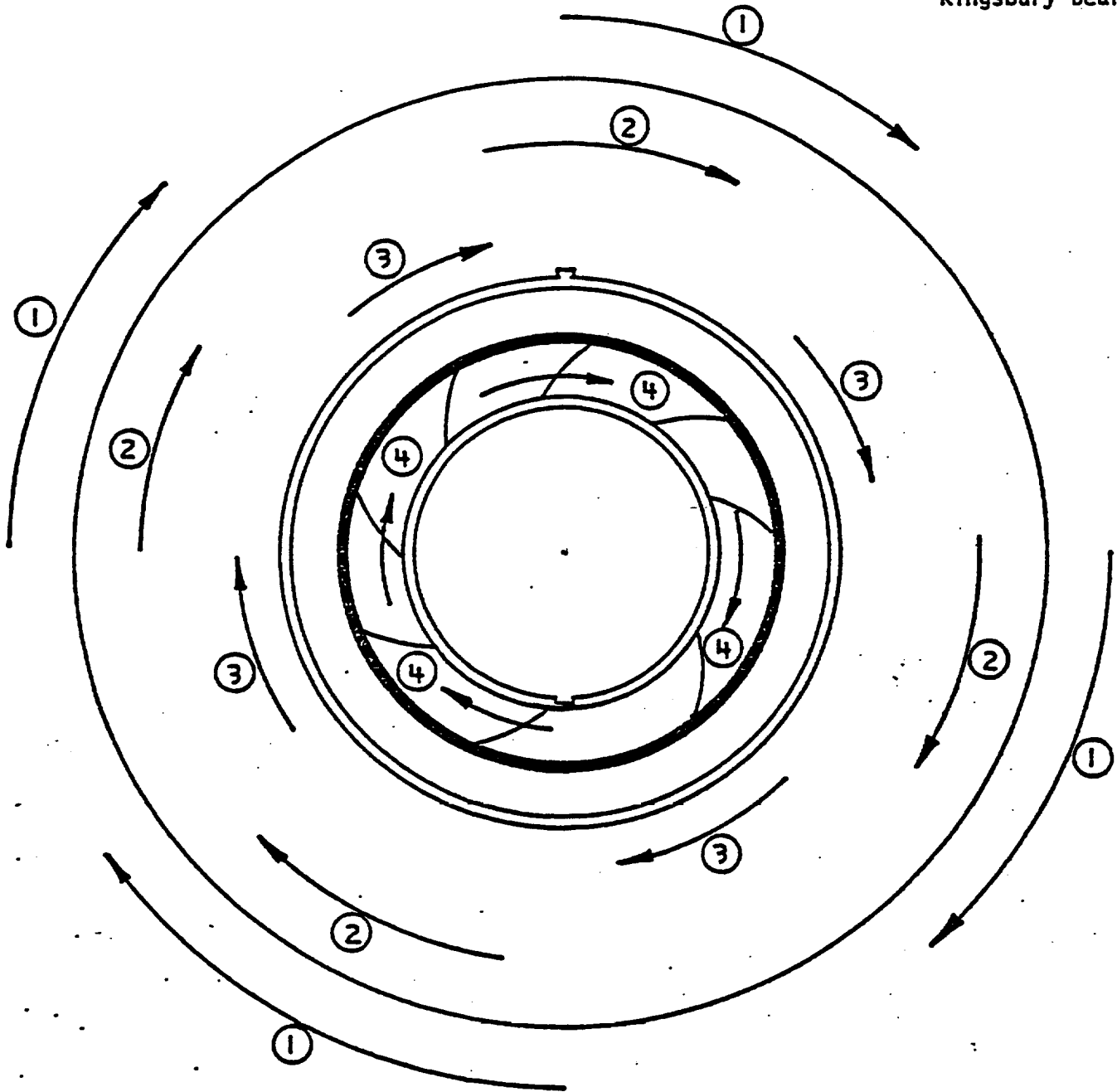
- A. 1. Lock out power supply to motor if unit is motor driven.
2. Close and lock steam inlet and exhaust valves if unit is turbine driven.
- B. Close and lock pump suction, discharge and any bypass or recirculation valves.
- C. Uncouple the pump from its driver.
- D. 1. If the pump has mechanical seals, loosen and remove all seal gland bolts. Pull seal glands away from pump stuffing box flange. Refer to seal manufacturer's instructions for details.
2. If pump has packed stuffing box, loosen and remove all stuffing box screws.
- E. Loosen and remove all casing cap nuts and flat washers. BE SURE TO REMOVE THESE FROM THE BOTTOM HALF CASING. Remove the casing dowel pins.
- F. Rig a chain hoist with matched straps or cables over the pump center line and rig straps or cables to lifting lugs at top of casing. With a light strain on chain hoist, screw casing jack screws in until the casing halves separate. Slowly lift upper half casing, being careful not to tear gasket, until it clears all pump parts. Set upper half casing down away from pump on blocks and re-rig it to turn over.
- G. Loosen set screws of deflector rings (123) and (123A). Clean shaft behind deflectors, slide deflectors (123) and (123A) away from bearing housings.
REFER TO SECTION 8 FOR DETAILED ASSISTANCE ON DISASSEMBLY OF THE KINGSBURY THRUST BEARING.
- H. Loosen and remove the thrust bearing housing end cover screws. Remove the thrust bearing housing end cover with shimming gasket when used. Shimming gasket will be reused at reassembly.
- I. Loosen and remove the upper half thrust-end bearing housing screws and dowel pins. Remove the upper half thrust-end bearing housing. Do not damage the bearing housing vent tube. It is not necessary to remove or disturb lower half bearing housing.

- J. Remove the Kingsbury thrust shoes and base ring assemblies. Do not mix the thrust shoes or base ring parts. Protect the babbited surfaces of the thrust shoes from damage.
- K. Loosen and remove the upper half coupling-end bearing housing screws and dowel pins. Remove the upper half coupling end bearing housing. It is not necessary to remove or disturb the lower half bearing housing.
- L. Remove the upper half journal bearing shells. Identify them and place them in a clean protected area. If possible, rig a chain fall and a sling or a strap on the shaft between bearings housing and stuffing box to take a light strain. A small pry bar can also be used. This will take the weight off the lower half journal bearing shells, and allow them to roll out easily. Place lower journal bearings with uppers in clean protected area.
- M. Rig a chain fall and straps or slings over center of element. Locate straps or slings on shaft so that element does not bind up in fits when removed. Protect the thrust bearing circulator to prevent damage. Remove rotating element and transport to work area for further disassembly.
- N. Remove split packing gland (107) and packing rings (106) if supplied.
- O. Loosen the set screws that lock the thrust collar nut in place. Loosen and remove the thrust collar nut (Left Hand Thread) and outboard seal ring.
- P. Remove the thrust collar and key with circulator. Do not damage circulator. Remove inbound seal ring.
- Q. Remove coupling parts from shaft. It may be necessary to heat the coupling. Remove outer deflector (123A), coupling-end end cover (119A) with gasket (360). Remove oil rings (114) and inner deflector (123).
- R. For pumps with mechanical seal:
 - 1. Remove seal gland and seal parts. Refer to seal manufacturers instructions for details.
 - 2. Remove water jackets (220J).

3. Loosen and remove shaft nut (130). On counterclockwise rotation pumps, this nut has LEFT HAND threads.
 4. Loosen and remove shaft nut (124). On clockwise rotation pumps, this nut has Left Hand threads.
- S. For pumps with packed stuffing boxes:
1. Remove lantern ring (105) if supplied.
 2. Remove stuffing boxes (220J).
 3. Loosen and remove shaft sleeve (130). On counterclockwise pumps this sleeve has Left Hand threads.
 4. Loosen and remove shaft sleeve (124). On clockwise rotation pumps, this sleeve has Left Hand threads.
- T. Remove pressure reducing bushing (129), pressure reducing sleeve (128) and pressure reducing sleeve key (178D).
- U. Prepare the shaft for impeller removal. CLEAN AND POLISH ALL exposed areas of the shaft between impellers. Beginning from either end, proceed as follows:
1. Coat the cleaned exposed shaft behind the first impeller with a high temperature anti-seize compound.
 2. Set up an oxygen acetylene or equivalent torch with a large "Rose-Bud" type tip. Heat the first impeller to be removed as shown in Fig. 1. Tap the impeller toward the center of the shaft far enough to remove the split retaining ring (361F). With the split ring removed, give the impeller another quick heat and tap it off its fit away from center of shaft. Do not use metal hammers directly on impellers. Remove the impeller key (178C).
 3. The remainder of the impellers are removed in the same manner. Caution is advised to not allow the shaft to get too hot. This will require excessive heat to expand the impellers. Periodically cool the shaft with cold water or other coolant.

HEATING PROCEEDURE

Model 3300
Disassembly of Pump and
Rotating Element
Kingsbury Bearings



- 1 BEGIN HEAT AT OUTSIDE DIAMETER. MOVE FLAME SLOWLY AROUND. DO NOT LET IT SIT IN ONE PLACE.
- 2 SLOWLY BRING FLAME TOWARD HUB AREA. KEEP FLAME MOVING AT ALL TIMES.
- 4 GIVE FINAL QUICK HEAT TO HUB AREA. KEEP FLAME MOVING AT ALL TIMES.

II. Inspection of Parts and Preparation for Reassembly

A. Inspect shaft for damage:

1. All impeller fits must be clean and smooth. Polish impeller fits with a fine emery paper. Small gall marks and scratches can be removed with a fine honing stone. Replace the shaft if damage to impeller fits is severe.
2. Bearing journal areas and thrust bearing fit must be clean and smooth. Polish with a fine emery paper. Small scratches can be removed with a fine honing stone. Replace the shaft if damage is severe.
3. Pressure reducing sleeve (128) fit must also be clean and smooth, particularly in O-ring seat area.
4. Inspect all other shaft fits and shoulders for damage. Clean and polish them as necessary.
5. Check shaft key ways and shaft keys (178C) (178B) (178D) for damage. Renew keys as necessary. Be sure new keys fit their key ways properly before reassembly.

B. Check Shaft for run out:

1. Set shaft in machined "V" blocks located at bearing journals. A small piece of inverted crocus cloth can be used as a bearing liner for this. A few drops of oil will make shaft easier to turn in "V" blocks. Balance rollers can also be used.
2. Mount a dial indicator to read on shaft and slowly turn shaft. Maximum allowable run out is .002". Straighten or replace shaft if run out exceeds .002".

C. Inspect impellers for damage.

1. Impeller bores must be clean and smooth. Gall marks, scratches and burrs will interfere with reinstallation. Remove burrs and scratch marks with fine emery paper. Gall marks can be removed with a small honing stone. Replace impeller (s) if damage to bores is severe.

- D. Inspect all impeller and casing wearing rings for damage and wear. Factory wearing ring clearances are listed in Figure 4. Replace wearing rings if excessively worn or damaged.
- E. Inspect pressure reducing sleeve (128) and pressure reducing bushing (129) for damage and wear. Pressure reducing sleeve to bushing factory clearances are listed in Figure 2. Excessive clearance may result in increased stuffing box pressure.
- F. Inspect shaft sleeves on packed pumps for excessive wear. Replace if worn excessively.
- G. Inspect journal bearing (115) (116) and (120) (121) for damage. If babbit material is damaged, the journal bearing to shaft contact must be checked.
1. Put a thin film of "PRUSSIAN BLUE" on shaft journal.
 2. Gently place lower half journal bearing on the shaft and with slight pressure, roll it back and forth across the shaft journal.
 3. Remove lower half journal and inspect the babbit. Scrape off the high areas as indicated by the "PRUSSIAN BLUE".
 4. The upper journal bearings can be scraped as needed to remove high spots in babbit material.
- H. When journal bearings are renewed, lower journal bearing (115) and (120) to shaft contact should be checked with "PRUSSIAN BLUE". Recommended minimum journal bearing to shaft contact is 70%.
- I. Inspect all Kingsbury thrust bearing parts. Refer to Section 8 for details.
- J. Inspect all O-rings (412R), (412H), (497) for cracks or breaks. Replace O-rings as necessary.
- K. Inspect casing center bushing assembly (155) for damage or wear. Check running clearance of assembled bushing to center impeller hub wearing rings (203A). Factory clearance is listed in Figure 4.
- L. Inspect mechanical seals if supplied. Refer to seal manufacturer's instructions for details.

- M. Inspect coupling parts for damage. Refer to coupling manufacturers instructions for details.
- N. Inspect and clean inner deflectors (123); coupling-end deflector (123)A. Replace any or all of these parts as necessary.
- O. Inspect upper and lower half casing for damage. Clean all wearing ring, stuffing box or jacket, pressure reducing bushing and center casing bushing fits thoroughly. Do not use any highly abrasive tools. Use fine emery paper and solvent. Wire brushes and metal scrappers should not be used to clean the machine bores. Be sure the parting flanges are clean and free of all old gasket material. Inspect them for damage such as hammer blows or chisel marks. Remove damage with a honing stone. Excessive damage to machine bores or parting flanges should be repaired..

MODEL 3300

GOULDS' STANDARD MIN. CLEARANCE

Bore Diameter of Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.499				.016			.010			.010	.010	
4.500 to 4.999					.016			.010			.010	.010
5.000 to 5.999	.017								.010			.010
6.000 to 6.999		.018										
7.000 to 7.999			.019									

API 610 NON-GALLING MIN. CLEARANCE

Bore Diameter Outer Part at Running Clearance	SERIES SUCTION RING Items 202A/164			SERIES HUB RING Items 203/144			CENTER BUSHING Items 202A/155			BREAKDOWN BUSHING Items 128/129		
	3"	4"	6"	3"	4"	6"	3"	4"	6"	3"	4"	6"
4.000 to 4.999				.016			.016			.016	.016	
4.500 to 4.999					.016			.016			.016	.016
5.000 to 5.999	.017								.017			.017
6.000 to 6.999		.018										
7.000 to 7.999			.019									

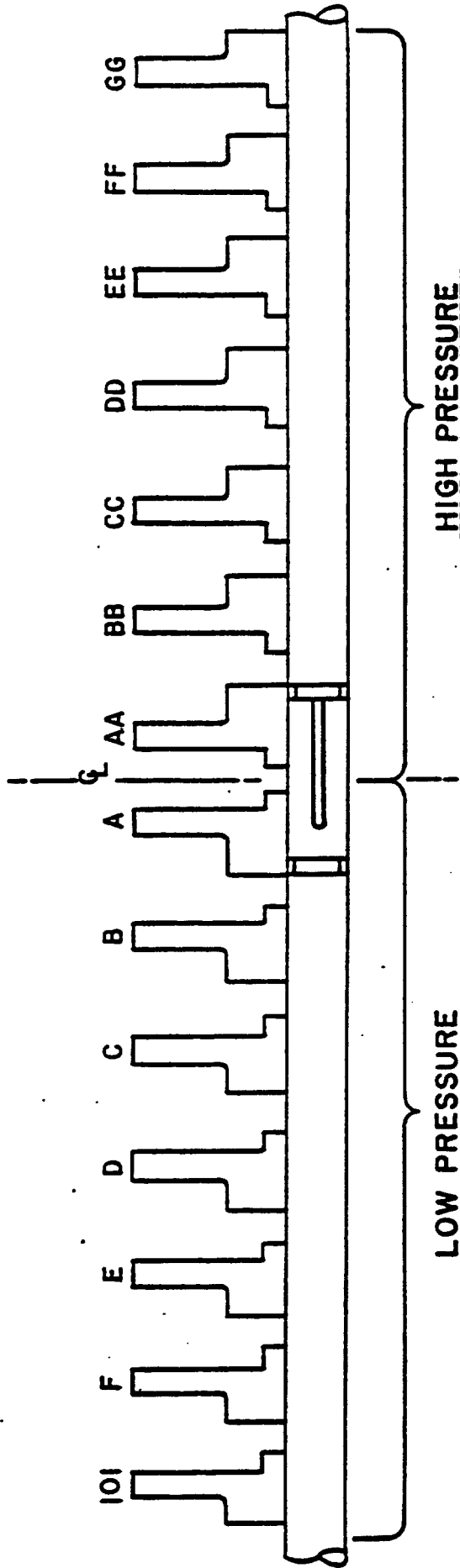
FIGURE 2

Model 3300

III. Reassembly of Rotating Element and Pump

- A. All impellers have a .0015" to .003" shrink fit to their respective shaft fits. To accomplish installation, each impeller must be heated to approximately 450⁰F. (Do not exceed 500⁰F). A "temp-stick" or pyrometer can be used to measure the temperature.
- B. Before beginning impeller installation, the low pressure (suction) side of the shaft must be located. Note that the center impeller key way in the shaft is closed on one end. The closed end of the center impeller key way faces the low pressure (suction) side of the shaft. Impeller installation should begin with the (A) impeller. Fig. 3. It also has a closed key way. All other impellers have full key ways.
1. Install the center impeller key (178B) in shaft and coat center impeller shaft fit with a high temperature anti-seize compound. Install suction casing wearing ring (164) on impeller (A) prior to heating impeller. Heat impeller (A) as shown in Fig. 2. (Impeller (A) has closed key way). Slide it on its fit from low pressure (suction) end of shaft until the split ring groove is completely exposed. Using two 90⁰ angled tip #3 snap ring pliers to hold both halves of split ring (361F) together, install the split ring halves in the split ring groove and hold them. Push impeller (A) back toward low pressure (suction) end of the shaft over split ring (361F) halves until it is firmly seated against split ring shoulder.
 2. Install casing wearing ring (164) on impeller (AA) prior to heating impeller (AA). Heat and install impeller (AA) from opposite end (high pressure) of shaft (122). Slide it on its fit until the split ring groove is completely exposed. Install the split ring using the two angled tip snap ring pliers. Push impeller (AA) back toward high pressure end of the shaft over the split ring. Be sure impeller seats firmly against split ring shoulder.
 3. Continue installing impellers WITH CASING WEARING RINGS (164), (127), CASING HUB RINGS (144), AND IMPELLER KEYS (178C) in this manner following impeller location sequence in Fig. 1.

MODEL 3300 FIGURE 3
IMPELLER SEQUENCE



PUMP SIZE	LOW PRESSURE	HIGH PRESSURE
3" 4 STAGE	10I, A	AA, BB
3" 5 STAGE	10I, B, A	AA, BB
3" 6 STAGE	10I, B, A	AA, BB, CC
3" 7 STAGE	10I, C, B, A	AA, BB, CC
3" 8 STAGE	10I, C, B, A	AA, BB, CC, DD
3" 9 STAGE	10I, D, C, B, A	AA, BB, CC, DD
3" 10 STAGE	10I, D, C, B, A	AA, BB, CC, DD, EE
3" 11 STAGE	10I, E, D, C, B, A	AA, BB, CC, DD, EE
3" 12 STAGE	10I, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 13 STAGE	10I, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF
3" 14 STAGE	10I, F, E, D, C, B, A	AA, BB, CC, DD, EE, FF, GG

CAUTION

It may be necessary to cool the
shaft after each impeller is installed.

C. Install pressure reducing sleeve key (1780) and pressure reducing sleeve (128).

For Pumps With Mechanical Seals

- D. 1. Install shaft nut O-ring (497) over thrust end shaft nut threads. Seat O-ring (497) against face of pressure reducing sleeve (128). Install second shaft nut O-ring (497) in machine groove of shaft nut (130).
2. Lubricate O-rings (497) and install shaft nut (130). On counterclockwise rotation pumps, shaft nut (130) has left hand threads. Tighten shaft nut (130) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.
3. Install shaft nut O-ring (497) over coupling end shaft nut threads. Seat O-ring against shaft shoulder. Install second O-ring (497) in machined groove of shaft nut (124).
4. Lubricate O-rings (497) and install shaft nut (124). On clockwise rotation pumps, shaft nut (124) has left hand threads. Tighten shaft nut (124) firmly using pin type spanner wrench. Be sure O-ring enters fit in end of shaft nut.

For Pumps With Packed Stuffing Boxes

- E. 1. Install shaft sleeve O-ring (497) over thrust end shaft sleeve threads. Seat O-ring (497) against face of pressure reducing sleeve (128). Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (130).
2. Lubricate O-rings (497) and install shaft sleeve (130). With pumps that have counterclockwise rotation, shaft sleeve (130) has left hand threads. Tighten shaft sleeve (130) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
3. Install shaft sleeve O-ring (497) over coupling end shaft sleeve threads. Seat O-ring against shaft shoulder. Install second shaft sleeve O-ring (497) in machined groove of shaft sleeve (124).

4. Lubricate O-rings (497) and install shaft sleeve (124). With pumps that have clockwise rotation, shaft sleeve (124) has left hand threads. Tighten shaft sleeve (124) firmly using pin type spanner wrench. Be sure O-ring (497) enters fit in end of shaft sleeve.
- F. Install pressure reducing bushing O-ring (412R) in machined groove of pressure reducing bushing (129). Install pressure reducing bushing (129) on pressure reducing sleeve (128).
- G. Install water jacket O-rings (412H) in machined grooves of water jackets (220J) or stuffing box (220J). Install water jackets or stuffing boxes on shaft.
- H.
 1. Mechanical seals if used must now be installed before proceeding. Refer to seal manufacturers instructions for seal setting and installation procedures.
 2. Lantern rings (105) if used must now be installed before proceeding.

For Pumps with Sleeve Journal Bearings and Kingsbury Thrust Bearing

- I. Install inner deflector rings (123) on shaft (122).
- J. Install thrust bearings inboard seal ring. Install thrust collar key and thrust collar with circulator. Install thrust collar nut with outboard seal ring. Tighten thrust collar nut firmly and tighten set screws. Install outer deflector on coupling end of shaft.
- K. Install the case center bushing (155). Make sure halves of center bushing align properly.
- L. Install coupling parts. Refer to coupling manufacturers instructions for details.
- M. With the casing fits and bearing housings clean, the rotating element can be installed. Rig a sling or strap at each end of the shaft between the water jacket/stuffing box and bearing housing areas. (It may be necessary to apply a spreader between the straps to prevent binding of the water jackets/stuffing boxes when the element is lifted.) Lubricate the water jacket/stuffing box (412H) and the pressure reducing bushing O-ring (412R) with a liberal amount of O-ring lubricant, (Parker Lube or equivalent). Also, lubricate the O-ring fits in the lower half casing with a liberal amount of O-ring lubricant.

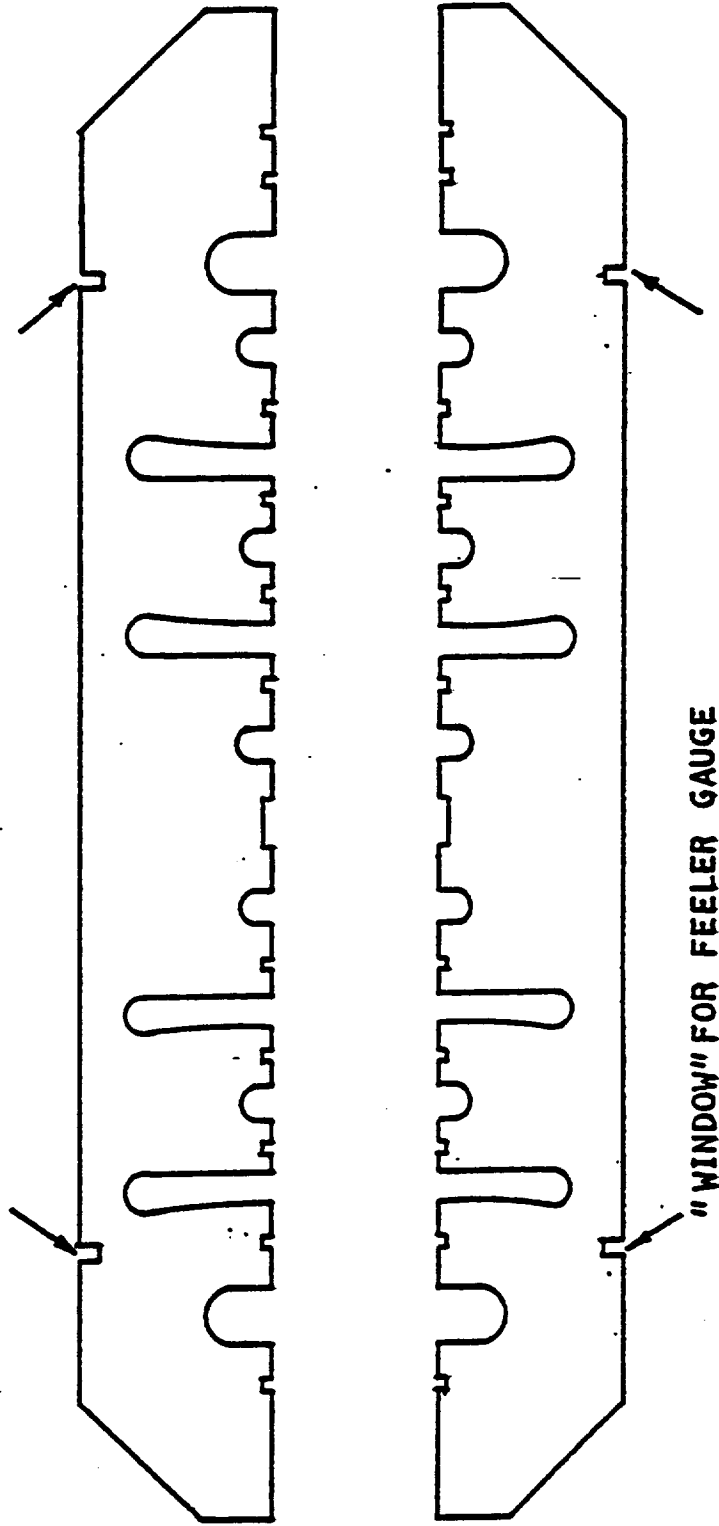
- N. Center and level the rotating element over the lower half casing and slowly lower it. Be sure that all casing wearing rings (164), (127), casing hub wearing rings (144), water jackets (220J) or stuffing box (220J), pressure reducing bushing (129) and center casing bushing (155) enter their fits evenly. Do not damage pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Be sure water deflectors (123) do not hang up on bearing housings and do not allow thrust bearing circulator ring to be damaged.
- O. Pour a small amount of light turbine oil on the shaft journals and roll the lower half bearing shells in place.
- P. Make a new casing gasket using 1/64" compressed asbestos gasket material. The upper half casing can be used as a pattern. Do not use a metal hammer when forming the gasket at any of the wearing rings, pressure reducing bushing, or water jacket or stuffing box fits. Do not cut the gasket flush to the ends of the stuffing boxes. Let it overhang these areas by 1/2" to 1". This is most important on pumps with mechanical seals.
- Q. If a torque wrench is available, proceed as follows:
1. Install the new gasket on the lower half casing. Make sure it fits snug to all machined fits.
 2. Install the upper half casing. Use a liberal amount of O-ring lubricant on pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Install and set casing dowel pins. Be sure dowel pin jack nuts are free and do not interfere with dowels.
 3. Install all the casing nuts and tighten them evenly using a criss-cross pattern starting from the center and working towards the ends. Torque the casing nuts to 1750 foot pounds nominal torque.
 4. Trim excess gasket from stuffing box areas.
- R. If torque wrench is not available, proceed as follows:
1. Check the thickness of the new casing gasket with a micrometer and record it for later use. Install the new gasket on the lower half casing. Make sure it fits snug to all machined fits.

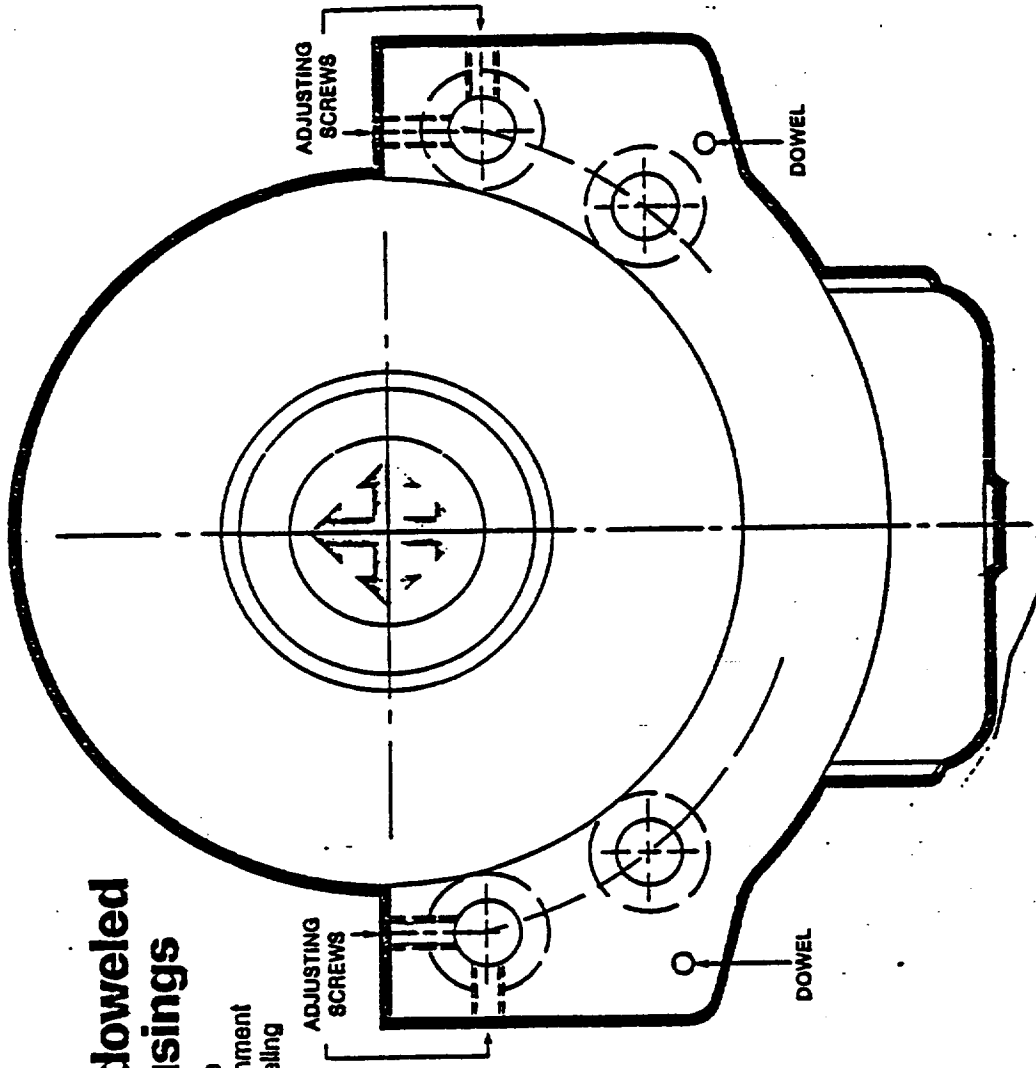
2. Cut four small "windows" in the gasket as shown in Figure 4. These "windows" are used in conjunction with a feeler gauge to insure even compression of the gasket.
 3. Install the upper half casing. Use a liberal amount of O-ring lubricant on pressure reducing bushing O-ring (412R) and water jacket or stuffing box O-rings (412H). Install and set the casing dowel pins. Be sure dowel pin jack nuts are free and do not interfere with dowels.
 4. Install the casing nuts and tighten them evenly using a criss-cross pattern starting from the center and working towards the ends.
 5. While tightening, periodically insert a feeler gauge in each of the four "windows". Tighten the nuts until the gasket is compressed .003" to .004". Refer to original gasket thickness recorded in Step R.1.
 6. Trim excess gasket from stuffing box areas.
- S. With upper casing tight, the "bearing lift" must be checked. Roll out ONE of the lower half journal bearing shells, NOT BOTH. Mount a dial indicator on the bearing housing and set the dial to read on the shaft journal at TOP DEAD CENTER. Using a pry bar, gently move the shaft up and down. Read the dial indicator and record the total travel. Roll in the lower half journal bearing shell. Reset dial indicator on the shaft journal and again move the shaft up and down. The reading obtained is subtracted from the first reading and the difference is the "bearing lift". Then record this reading and do the same at the opposite end. The bearing housings were set at the factory so that the bearings set the shaft .002" lower than dead center. New, worn or rebuilt bearing and damaged or lost bearing housing dowel pins may cause the "bearing lift" to change. To correct this, the bearing housing(s) must be relocated. To do this, relax and snug the lower bearing housing cap screws. Adjust the bearing housing jack screws as necessary to obtain the required bearing lift. The bearing housing jack screws are located at the bearing housing corners. See Fig. 5. When one housing is moved, it will

effect the "bearing lift" of the opposite end. Both ends must be checked after each move. With the "bearing lift" satisfied, the element must turn free. If it does not, further internal investigation is required. When this operation is complete, the bearing housings must be redoweled.

- T. Install upper half bearing journal shells. Install the Kingsbury Thrust bearing base ring assemblies. Do not damage seal rings, Install the thrust shoes. Pour a liberal amount of oil over these parts. Refer to Section 8 for details.
- U. Install upper half bearing housings. Install Dowel pins and tighten screws. Be sure dowel pins are not bent or damaged. Renew them as necessary.
- V. Install and tighten thrust bearing housing end cover with shimming gasket if required.
- W. Check thrust bearing end play. End play should be .012"-.014". The end play can be adjusted by changing thickness of shimming gasket between thrust bearing end cover and housing. Refer to Section 8 for assistance.
- X.
 1. Tighten mechanical seal glands if supplied. Refer to seal manufacturers instructions for details.
 2. Install shaft packing if supplied. Packing should be installed with the splits of the rings set at 90° intervals.
- Y. Check alignment between driver and pump. Correct alignment as necessary. Refer to Section 9.I.F for alignment procedures.

MODEL 3300 FIGURE 4
CASING GASKET





Bolted and doweled bearing housings

Alignment set screws are provided for precise alignment of rotating element. Doweling maintains the alignment.

Figure 5

SECTION 11
TROUBLE SHOOTING

<u>Problem</u>	<u>Possible Causes & Corrections</u>
A. No liquid delivered, not enough liquid delivered or not enough pressure	1,2,3,4,5,6,7,8,9,10,11,12,13,14,18
B. Pump works a while and then quits	4,5,7,8,9,11,12,20
C. Pump takes too much power	6,13,14,15,16,21,22,23,24,30
D. Pump is noisy or vibrates	15,16,17,28,30
E. Pump leaks excessively at stuffing box	15,16,17,29,30
F. High bearing temperature	8,24,25,26,27
G. Stuffing box overheating	8,24,25
H. Element turns hard or has a rub	31,32,33,34,35,36,37,38

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 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 long may cause excessive friction losses). Check with vacuum or compound gage.
5. Impeller 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. Stuffing box packing or seal worn allowing leakage of air into pump casing - Check packing or seal and replace as required. Check for proper lubrication.
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 clearance too great - Check for proper clearance.
14. Impeller damaged - Inspect and replace as required.
15. Rotating parts bind - Check internal wearing parts for proper clearances.
16. Shaft bent - straighten or replace as required.
17. Coupling or pump and driver misaligned - Check alignment and realign if required.
18. Impeller diameter too small - Consult factory for proper impeller diameter.
19. Improper pressure gauge location - Check correct position and discharge nozzle or pipe.
20. Casing gasket damaged - Check gaskets and replace as required.
21. Speed too high - Check motor winding voltage or steam pressure received by turbines.
22. Head lower than rating; pumps too much liquid - Consult factory. Install throttle valve, cut impeller.
23. Liquid heavier than anticipated - Check specific gravity and viscosity.

Stuffing box not properly packed (insufficient packing, not properly inserted or run in, packing too tight) - Check packing and repack stuffing box.

Incorrect packing or mechanical seal - Consult the factory.

Damaged mechanical seal - Inspect and replace as required. Consult factory.

Shaft sleeve scored - Remachine or replace as required.

Cavitation - Increase NPSH available. Consult factory.

Pump capacity too low - Consult factory for minimum continuous flow.

Improper bearing lubrication or bearings worn out - Inspect and replace as required.

Proper setting of thrust bearing end play.

Bent or distorted bearing housing dowel pins.

Improper running clearances between wearing rings and/or center bushing and pressure breakdown bushing areas.

Shaft deflectors set properly.

Excessive pipe strain on pump casing.

Excessive runout on shaft or impeller rings.

Dirt between impeller and case wearing rings. Dirt in casing ring, casing center bushing, and/or pressure breakdown bushing casing fits.

Packing too tight or mechanical seals not properly adjusted.