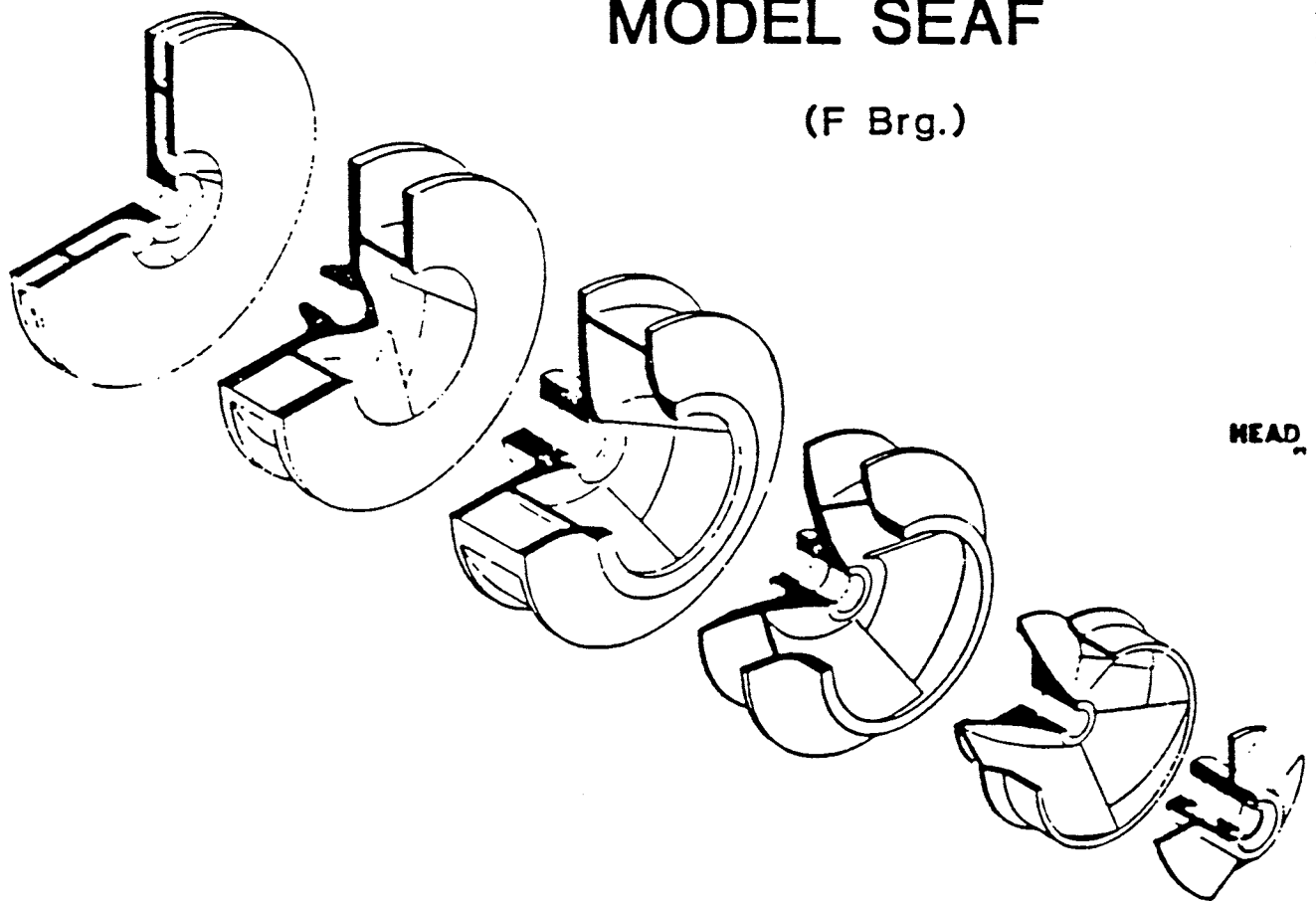




GOULDS PUMPS

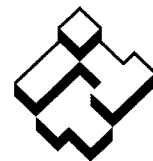
MODEL SEAF

(F Brg.)



HEAD, ft

IMPELLER TYPE



ITT

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:



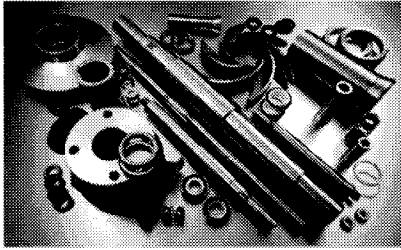
The CE and the Ex designate the ATEX compliance. The code directly below these symbols reads as follows:

- 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.



INSTALLATION AND OPERATING INSTRUCTIONS

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Rev. A - 7/23/79

MORRIS AXIAL FLOW PUMPS

GENERAL

This pump will operate satisfactorily for a long period of time if it is properly installed and given reasonable maintenance.

The following instructions are a general guide and should be used by installation and maintenance personnel and the pump operator. We recommend becoming familiar with these instructions before the pump is installed, started, or disassembled for any reason, to avoid unnecessary lost time and added expense.

LOCATION OF UNIT

When possible the pump should be located in an area that is clean, dry and free from flooding. The area should have sufficient room for maintenance personnel to inspect and, if necessary, work on the unit. The pump should be located with the shortest possible pipe lines and a minimum number of elbows and fittings, which increase the amount of pipe friction.

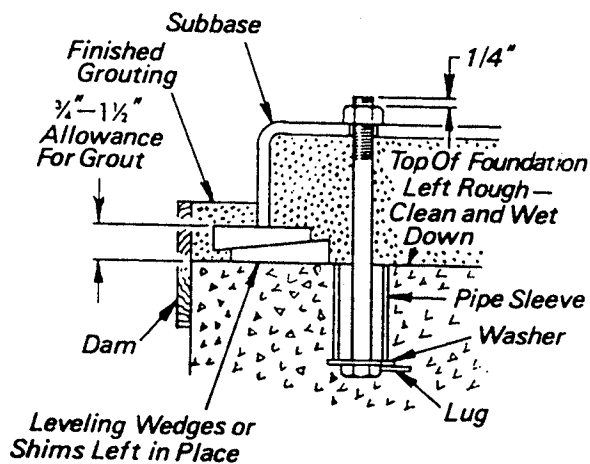
FOUNDATION

The axial flow pumps covered by these instructions may be furnished with a spring supported subbase or a subbase designed to be anchor bolted and grouted to the foundation. The foundation should be substantial enough to provide a permanent and rigid support for the subbase to the degree that there will not be any adverse movement or settling over a long period of time.

Foundations for anchor bolted and grouted subbases are typically concrete with anchor bolts cast in to secure the pump.

When the assembly is cast in concrete, the washer prevents the sleeve and bolt from being pulled. The sleeve I.D. provides an adjustment allowance around the bolt. Anchor bolts should be located in the concrete by a template dimensioned from the pump installation drawing. The top of the sleeve should be temporarily sealed with waste material to prevent concrete from entering during the concrete pouring operation.

INSTALLATION AND OPERATING INSTRUCTIONS



Typical Anchor Bolt

INSTALLING PUMP ON THE FOUNDATION

When the unit is received with the pump and the driver mounted on a subbase, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until all re-alignment operations have been completed. A recommended coupling alignment procedure is included in this instruction section.

For pumps with spring supported subbases, refer to Instruction Section Z-83 rather than the following paragraphs, which are for anchor bolted subbases.

The subbase should be supported on rectangular metal blocks or on metal wedges having a slight taper. There should be one supporting block or wedge on each side of each foundation bolt. A gap of about 3/4" to 1-1/2" should be allowed between the subbase and the foundation for grouting.

Adjust the metal supports or wedges until the shafts of the pump and the driver are level. Check the coupling faces, as well as the suction and discharge flanges of the pump, for horizontal or vertical position by means of a level. Check also for any internal rubbing in the pump. Correct, if necessary, by adjusting the supports or wedges under the subbase as required. In most cases, factory alignment will be regained by shimming under the subbase alone.

GROUTING

When the alignment is correct, the foundation bolts should be tightened evenly, one-half turn past hand tight. The unit can then be grouted to the foundation. The subbase should be completely filled with grout, and it is desirable to grout the leveling pieces or wedges in place.



INSTALLATION AND OPERATING INSTRUCTIONS

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Foundation bolts should not be fully tightened until the grout has hardened.

PIPING

The axial flow pump elbow can be considered as a conventional elbow with one additional requirement; it must maintain its alignment with the pump shaft. When the subbase is anchor bolted and grouted, the shaft does not generally move with the elbow; therefore, excessive loads on the elbow will affect alignment inside the elbow. The piping should be supported independently near the pump to prevent excessive loads on the pump elbow. Expansion joints are usually necessary when the pumpage is at an elevated temperature.

When the pump is furnished with a spring supported subbase the shaft can more easily follow the movement of the elbow, provided the elbow does not undergo distortion from pipe strain. Large strains, and possible problems, will occur if the pipe flange faces are not parallel with the pump flange faces before the flanges are bolted together. The piping should be properly supported to minimize distortion in the elbow from bending.

ALIGNMENT

Pumps and drivers mounted on a common subbase are accurately aligned at the factory before shipment. Because the factory alignment may be altered during shipment and installation, the alignment should be checked and corrected during the installation procedures before the pump is put in operation. The two items of concern are the shaft coupling, if the pump is not V-belt driven, and the shaft in the elbow; at the stuffing box and at the impeller vane path. Alignment corrections are made by altering the subbase supports or by re-positioning components on the base.

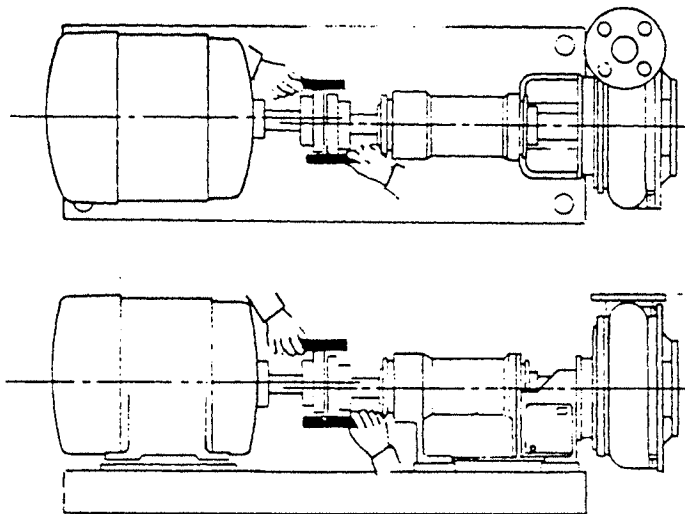
If the alignment is checked during the entire installation procedure, the cause of an alignment change will be more easily determined and corrected.

Before the pipe is connected to the second elbow flange, preferably the flange closest to the impeller, use feeler gauges to measure the clearance at the impeller vane tips. Start at the top of the impeller and rotate the shaft in 90° increments, measuring and recording the clearance of that vane tip at the top, bottom, and both sides. Measure and record the clearance of each of the other vane tips at the top. This record will provide a useful future reference for checking pump alignment and/or wear.



ALIGNING SHAFT COUPLINGS

A check for parallel alignment is made by placing a straight edge across both coupling rims at the top, bottom, and at both sides. The unit will be in parallel alignment when the straight edge rests evenly on the coupling rim at all positions. Allowance may be necessary for temperature changes and for coupling halves that are not of the same outside diameter.



CHECKING PARALLEL ALIGNMENT

NOTE: Care must be taken to have the straight edge parallel to the axis of the shafts.

Angular and parallel misalignment are corrected by means of shims under the driver mounting feet. After each change, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustments already made in another direction. It should not be necessary to adjust the shims under the pump.

The permissible amount of misalignment will vary with the coupling size and type, but in general the operation will be smoother and the coupling life will be improved with minimum misalignment. The exception is universal joint drive shafts which require some misalignment to distribute lubricant in the bearings.

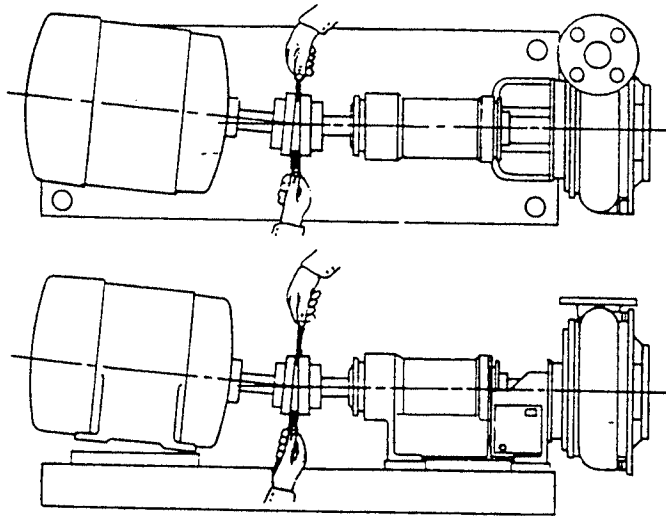


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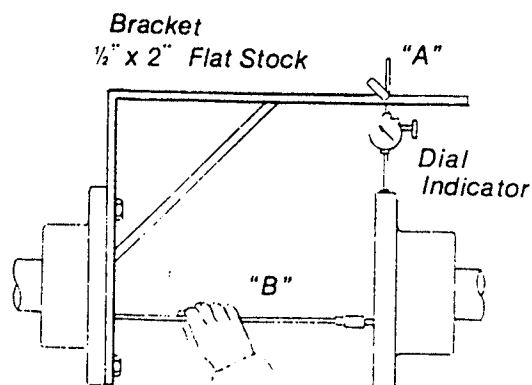
A check for angular alignment is made by inserting the taper gauge or feelers at four points between the coupling faces and comparing the distance between the faces at four points spaced around the coupling. The unit will be in angular alignment when the measurements show that the coupling faces are the same distance apart at all points.



CHECKING ANGULAR ALIGNMENT

ALIGNMENT OF SPACER TYPE COUPLINGS

Where a spacer type coupling is used between the pump and driver, it is not possible to align the couplings of the pump and driver as previously described. To align units with a floating coupling, remove the spacer between the pump and driver. Make a bracket, as shown below, which can be fastened to one of the coupling halves and which is long enough to reach the other coupling half. Fasten this bracket to one coupling half and a dial-type indicator to the bracket arm so that the indicator is in contact with the rim of the other coupling half as shown at "A". Revolve one coupling half by hand so that the indicator moves around the other coupling half.



INSTALLATION AND OPERATING INSTRUCTIONS



After alignment on the coupling rim has been obtained, change the indicator so it bears against the face of the same coupling half and make any necessary adjustments. If the shafts have end play, it is preferable to make this check of face alignment by using inside micrometers as shown at "B".

Change the bracket, fastening it to the other coupling half, and use the indicator, as described above, against the face and rim of the opposite coupling half.

After final alignment is obtained, insert the spacer and bolt the coupling halves.

FACTORS THAT MAY DISTURB ALIGNMENT

The unit should be checked periodically for alignment. If the unit does not stay in alignment after being properly installed, the following are possible causes:

- (1) Settling, seasoning or spring of the foundation.
- (2) Wear of the bearings.
- (3) Pipe strains distorting or shifting the machine.
- (4) Springing of the base plate by heat from an adjacent steam pipe or from a steam turbine.
- (5) Shifting of the building structure due to variable loading or other causes.
- (6) Loose nuts or bolts on the pump or driver assembly.

V-BELT DRIVE

Some axial flow pumps are belt driven by the motor. Excessive belt tension will reduce the bearing life and therefore should be avoided. Under normal operating conditions, the belts should have some droop in the non-tension span as an indication the belts are not excessively tight. The sheaves should be aligned to reduce belt wear from the belt entry and exit at the sheave grooves.



INSTALLATION AND OPERATING INSTRUCTIONS

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PACKING

Initial packing is a good grade of packing for the service intended. Morris endorses no brand and recommends that local packing suppliers of customer's choice be used for supplies and advice. However, as packing is one of the principal routine maintenance operations, the following remarks on techniques are offered.

- (1) Check pump Bill of Material and Assembly Drawing to be sure of the proper packing size, number of rings required, and the location of seal cage (water ring).
- (2) Cut the packing to length either on the shaft or on a mandrel of the same diameter. Either a 45° mitre cut or a properly made butt cut will provide a satisfactory seal. Rings that are too long should be recut to proper size. Rings that are too short should be discarded.
- (3) Pre-form each ring by twisting it 1-1/2 turns in direction of the coil. Insert first ring in the box with the cut on top and carefully, but firmly, tamp it in place. Install remaining rings with cuts staggered at 90° or 120° relative to the first ring. Each ring should be carefully but firmly tamped into place as it is entered into the stuffing box.

Stuffing boxes are fitted with a seal cage (water ring) and in-and-out water connections. Additional stuffing box cooling is provided by water flowing out of the outlet connection; however, it is not necessary for some applications, in which case the outlet can be plugged off. It is important for the packing life to always have the water pressure at the seal cage approximately 10 PSI higher than the pressure inside the pump to keep the pumpage out of the packing.

- (4) Be sure the seal cage (water ring) is in its proper location. If it is not, then the sealing water connections to the box are blanked off by the packing, resulting in no lubrication, burned packing and damage to shaft and possibly bearings.
- (5) Tighten gland nuts finger-tight. Shaft should turn freely.
- (6) Turn on seal water and start pump. The packing has to gradually be run in. The leakage should be excessive at first to provide extra cooling. Gradually reduce the leakage by tightening the gland nuts one flat at a time and allowing several minutes between each retightening. Observe the temperature of the leakage and the stuffing box. If the gland is too tight, seal water cannot lubricate the packing, which will cause the packing to burn and damage the shaft sleeve and perhaps the bearings. Backing off

INSTALLATION AND OPERATING INSTRUCTIONS



the gland nuts does not always increase the leakage enough to prevent the packing failure if the leakage has stopped.

On special order, a water-cooled quench gland can be furnished for pumpage temperatures over 200°. Flexible hoses are included to connect to plant water supply and drain lines for in-and-out flow. If pump is so fitted, quench water must be turned off while packing is being run in so that amount of lubrication water can be observed.

A properly adjusted stuffing box will require, based on shaft sleeve diameter, 3 GPH for 3" diameter, 10 GPH for 6" diameter, 26 GPH for 10" diameter, without considering the possible additional flow through the outlet connection.

The sealing water service should be designed to supply 1/2 GPM for each inch of shaft sleeve diameter. This extra amount will give a reserve flow for running in packing and available flow for the outlet connection, if required. Control of the outlet flow should be made with a valve on the outlet side rather than by throttling the inlet side. Do not lose adequate pressure in the stuffing box because of excessive outlet flow.

Excessive pressure and capacity on seal water service will cause excessive leakage from the back of the box and will also cause abnormal flow around the shaft into the system. In addition to the valve described above, some operators install pressure and flow control units on inlet, and pressure gauge on outlet, connections.

Shaft scoring is usually caused by improper adjustment of gland and seal water allowing slurry to get into the packing and acting as an abrasive, wearing the shaft. If this condition is noted when the shaft is only slightly scored, new packing is soft enough to conform to the shallow grooves. Without proper maintenance, a scored shaft will accelerate wear and cause grooves and ridges to which no packing can conform.

Normal shaft run-out will be under .005" at the stuffing box. If greater than this, the shaft will tend to pound out the packing. The only way to correct this condition is to remove and either straighten or replace the shaft.

STARTING

WARNING!

THIS UNIT MUST NEVER BE USED WITHOUT PRIOR INSTALLATION OF THE SAFETY GUARDS FOR ROTATING PARTS AS PRESCRIBED BY O.S.H.A.



INSTALLATION AND OPERATING INSTRUCTIONS

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Before the unit is started, there are several requirements that must be satisfied.

- (1) The bearings must have suitable lubricant as specified under the heading of BEARING LUBRICATION.
- (2) The pump shaft must turn without any binding or rubbing of the rotating element. There will be some drag in the stuffing box and bearings, but this will be uniform.
- (3) CORRECT ROTATION OF THE DRIVER. The direction of rotation of the driver should always be checked before it is coupled to the pump. Some pumps have impellers that screw on which will unscrew if the pump is started in the wrong direction. This could cause considerable damage.
- (4) Water to the stuffing boxes, glands, or mechanical seals should be turned on before the pump is started.

AFTER STARTING

- (1) Monitor the pump mechanical operation during the first few hours. The bearing temperature should stabilize and the impeller should not start rubbing.
- (2) The unit should be shut down after it has reached normal operating temperature for a coupling alignment check. The hot alignment may be different from the cold alignment.

OPERATION

Most axial flow pumps are in evaporator circulation service, and since the evaporator performance and the amount of product depends on rate of liquid circulation, care should be taken to maintain these pumps in good operating condition.

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

1. Rate of evaporation compared to original design data.
2. Temperature drop across the heat exchanger.
3. Visual inspection of flow in body.
4. Testing the circulating pump

Items 1, 2 and 3 above are covered by the evaporator manufacturer.

INSTALLATION AND OPERATING INSTRUCTIONS



While field conditions preclude absolute accuracy, a check of pump performance will give reasonably close results. This can be done by installing a pressure gauge or mercury manometer at the suction and discharge flanges of the pump, the tap at the discharge flange being on the horizontal centerline of the pump. If gauges are used, the pressure differential times 2.31 divided by the specific gravity of the slurry indicates the TDH against which the pump is actually operating. If manometer is used, then inches of mercury times 1.1333 divided by specific gravity equals TDH.

Check the pump speed and determine GPM (flow rate) from pump curve. This curve will also give efficiency from which HP requirement can be determined. A double check is to take motor electrical readings, convert to HP, figure 90% drive efficiency, then use it against curve to get GPM. It is important to take and record these readings when the equipment is new, so that later readings can be judged on a relative basis.

Some causes of circulation loss:

- (1) Increase in TDH against which pump operates could be caused by:
 - (a) Heat exchanger tubes partially plugged.
 - (b) Too many heat exchanger tubes blanked off.
 - (c) Improperly sized or partially plugged strainer.
- (2) Viscosity of pumpage higher than it should be.
- (3) Pump speed low. V-belt drive may be slipping and operating pump below design speed.
- (4) Impeller installed backward on shaft. This could happen when assembling after repairs. Pump will operate, but at greatly reduced GPM.
- (5) Pump throttled on suction side. Could be caused by rubber lining pulling away from the suction pipe and partially collapsing, by large solids dropping into suction, or by improperly sized or plugged strainer in the suction pipe.
- (6) Pump partially plugged by large solid jammed between two impeller blades. This will also cause rough operation with excessive vibration.
- (7) Incorrect pump rotation. When changing motors for any reason or after any electrical system changes or modifications, always check motors for correct direction of rotation. The



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direction of flow would be reversed if the pump was run backwards.

- (8) Worn pump impeller and/or casing. As the running clearance increases, the pump performance decreases. Compare the clearance with the values noted during the pump installation.

It is not practical to predict performance at any given clearance without running a test at that clearance. On smaller pumps, this effect is magnified, as the percentage of impeller blade area lost from wear and corrosion is higher.

Other pump conditions and possible causes are:

High HP Demand

1. Increased head or viscosity
2. Pump speed too high
3. Specific gravity of slurry higher than normal
4. Packing gland pulled up too tight
5. Impeller rubbing in casing

Noisy or Rough Operation

1. Throttled suction or plugging
2. Impeller rubbing on casing
3. Loose impeller
4. Broken or bent impeller vane
5. Bearings not properly lubricated
6. Bent shaft
7. Impeller out of balance

DISASSEMBLY AND ASSEMBLY OF PUMP

Refer to the Bill of Material and the Assembly Drawing of the pump for proper parts' designation in these instruction.

The order of steps for assembly and disassembly of the liquid end and rotating element is the suggested method. However, any workable sequence to accomplish the desired results can be used.

SPARE PARTS

When ordering spare parts for this pump, always refer to the pump serial number and part number. This will avoid delays in identification. In certain cases where pumps are furnished with special metals, deliveries are quite lengthy. It is therefore advisable to anticipate your requirements several months in advance so that possible long deliveries will not handicap your operation.

HORIZONTAL F TYPE BEARING ASSEMBLY

This bearing assembly uses a separate high-capacity ball thrust bearing with high capacity ball or roller radial bearings. The bearing housing is horizontally split for ease of assembly and disassembly. For special applications, an internal oil wheel and ring are used for lubrication of the bearings.

DESIGNATIONS

The following designations are used for the F bearing assemblies:

- "F" - Two radial ball bearings and one ball thrust bearing.
- "FT" - Two radial ball bearings and tandem ball thrust bearings.
- "FTR" - Same as "FT" but a cylindrical roller radial bearing is used in place of one radial ball bearing for extra capacity.
- "FTS" - Same as "FTR" but a spherical roller radial bearing is used in place of one cylindrical roller radial bearing. This bearing will be oil lubricated only.

CLEARANCE ADJUSTMENT

Axial movement of both housings is made by turning the adjusting screw after the cap screws, which hold the housing to the subbase or bearing frame, have been loosened. The axial adjusting screw is not meant to hold the housing against the axial thrust of the pump; therefore, always make sure the cap screws have been tightened down after a clearance adjustment has been made.

BEARING LUBRICATION AND CARE

OIL LUBRICATION

When the pump is furnished with oil lubrication, a good grade of oil should be used to insure long bearing life. PUMPS FURNISHED FOR OIL LUBRICATION ARE SHIPPED WITHOUT OIL. ADD OIL UNTIL THE LEVEL IS UP TO THE OIL LEVEL LINE BEFORE THE UNIT IS STARTED. If too much oil is added, there will be excessive heat generated in the bearings and there may be leakage from the shaft seals.

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We recommend a commercial oil such as Mobil D.T.E. oil, B.B., Shell Tellus 41 or equal. However, a good grade of non-detergent oil of #30 wgt. is usually satisfactory. The oil should have a minimum viscosity of 100 Sec. Saybolt at the normal operating temperature.

For normal operating conditions, change the oil at least once a year and thoroughly flush the bearings. If the bearing assembly is exposed to dirty or moist conditions, the oil should be changed more often.

GREASE LUBRICATION

When furnished for grease lubrication, this pump was shipped with the bearings hand packed with Mobilux #2 grease, unless otherwise specified by the customer. Other suitable greases are Humble Lidok #2, Texaco Regal Starfak #2, and Shell Alvania #2. If another brand is desired, it should be checked with the supplier for being equivalent to the above.

The bearings have sufficient grease for at least 24 hours of operation after start-up. The bearings will run hotter than normal for the first few hours until the grease is worked out of the ball path and the bearings have "run in". Adding more grease during this period may increase the bearing temperature. After the first regreasing, a small amount of grease should be added at each fitting every 500 hours of operation.

NORMAL BEARING TEMPERATURE

The running temperature for a bearing assembly depends on many factors such as speed, bearing loads, ambient air temperatures, and condition of bearings. Temperatures higher than the human hand can tolerate are very satisfactory for good bearing operation and should not cause any alarm.

For a given speed and loading, the bearing housing temperature will stabilize at some temperature, usually below 200° F., which will be the normal temperature for that installation. Higher temperatures than this normal temperature, without any change in speed or loading, can mean a lubrication difficulty or the approach of a bearing failure.

For the best results, the weight of the oil lubricant should be adjusted for the normal operating temperature as follows:

SECTION X-180

To 150° F. - SAE 20
To 160° F. - SAE 30
To 175° F. - SAE 40
To 190° F. - SAE 50

INSTALLING A BEARING

Long bearing life is quite dependent on careful handling of the bearing when it is out of the housing and during the installation procedure, because dirt and rough handling are prime enemies of precision bearings. Bearings should be pressed, not "hammered" into place. If heat is used to facilitate the installation, a hot oil bath is the best method. Bearings for grease lubrication should be hand-packed with grease to insure adequate lubrication at start-up.

TO DISASSEMBLE THE BEARING ASSEMBLY

1. After the liquid end has been removed in accordance with the instructions for that section, remove the cap screws which secure the bearing housing to the frame #700. If the pump is oil lubricated, drain the oil and remove the fittings that come through the frame.
2. Lift and slide the bearing assembly off the frame.
3. Remove the slingers #2400 & #2402 by loosening the set screws and sliding the slingers off the shaft. Remove the cap screws which fasten the retainers #804 and #904 to the housing and slide the retainers off the end of the shaft.
4. Remove the socket head cap screws which hold the two housing halves together. Carefully lift off the top half and then lift out the shaft with bearings.
5. Remove the bearing locknuts and lockwashers #7300 and #7400. Carefully press the bearings off the shaft, preferably by pushing against the inner races.
6. If the unit is equipped with an oil wheel #823 and oil ring #818, remove the set screws which secure the wheel to the shaft and push the wheel off the shaft.

TO ASSEMBLE THE BEARING ASSEMBLY

1. If the assembly is equipped with the oil wheel and ring, push the oil wheel into position and secure with set screws. Slide the oil ring onto the shaft.
2. Install radial bearing #900 making sure it is against the shaft shoulder. Install the thrust and radial bearings #830 & 800 with spacer #813 between them. Make sure the thrust bearings face in the proper direction according to the assembly drawing, and check the bearings for any notation or identifying marks which may be furnished by the bearing manufacturer for proper orientation.
3. Install the lockwashers and locknuts #7300 & #7400.
4. Place the shaft and bearings into the bottom half of the bearing housing. Carefully lower the top half of the housing into position, using the dowel pins as a guide, and fasten the two halves together with the socket head cap screws.
5. Install the retainers #804 & #904. Check NOTE "A" on the assembly drawing to make sure sufficient shims are used to prevent axial preloading of the radial bearing against the thrust bearing. Slide the slingers into position and secure with set screws. Make sure they do not rub.
6. Place the shaft assembly on the frame and temporarily secure in position until the liquid end is rebuilt and the impeller clearance is set.
7. Install oil fittings if the unit is furnished for oil lubrication, and make sure the bearings have adequate lubricant before the pump is started.

INSPECTION OF BEARINGS

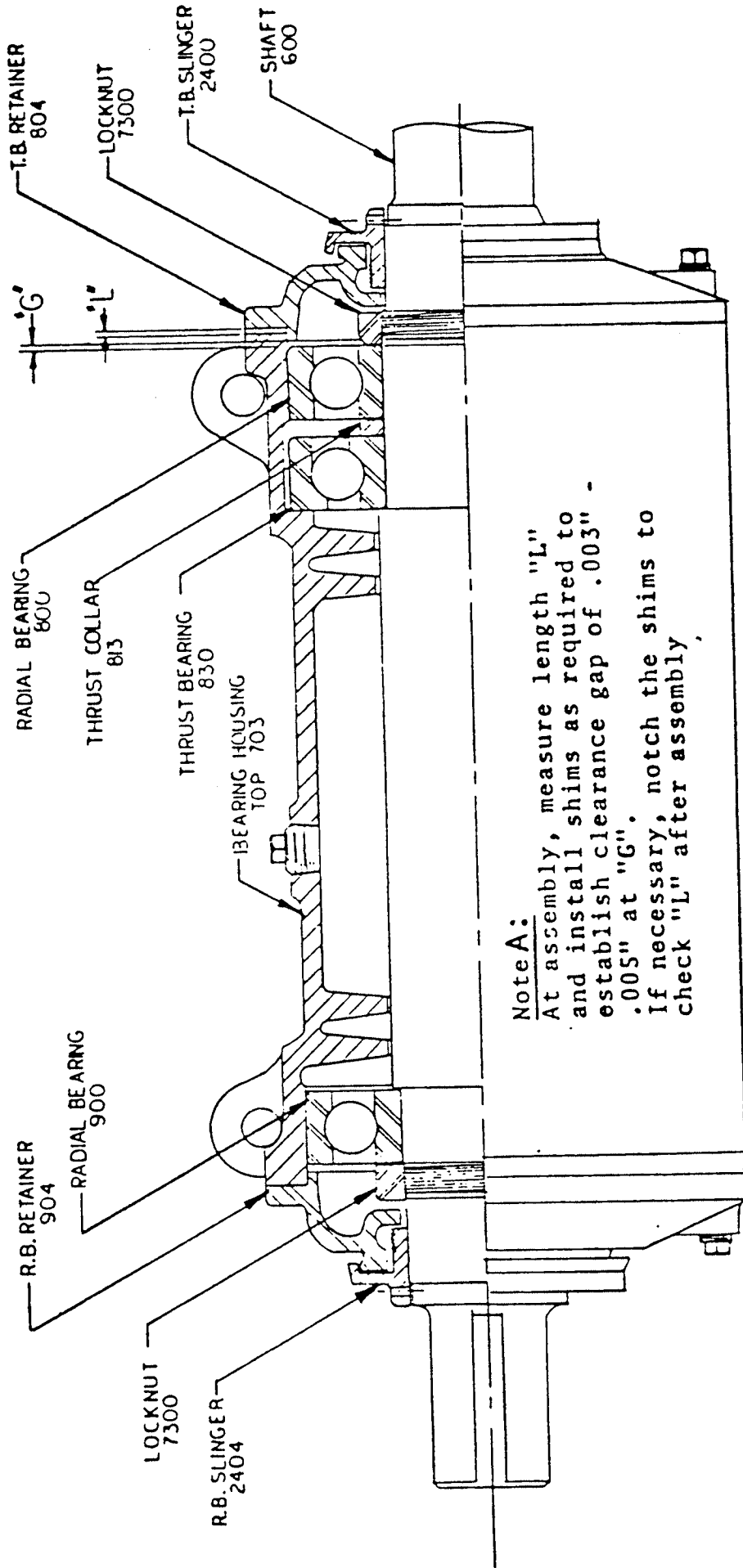
It is possible to inspect the bearings without complete dis-assembly of the pump by doing the following:

1. Block up the coupling end of the pump shaft to prevent

SECTION X-180

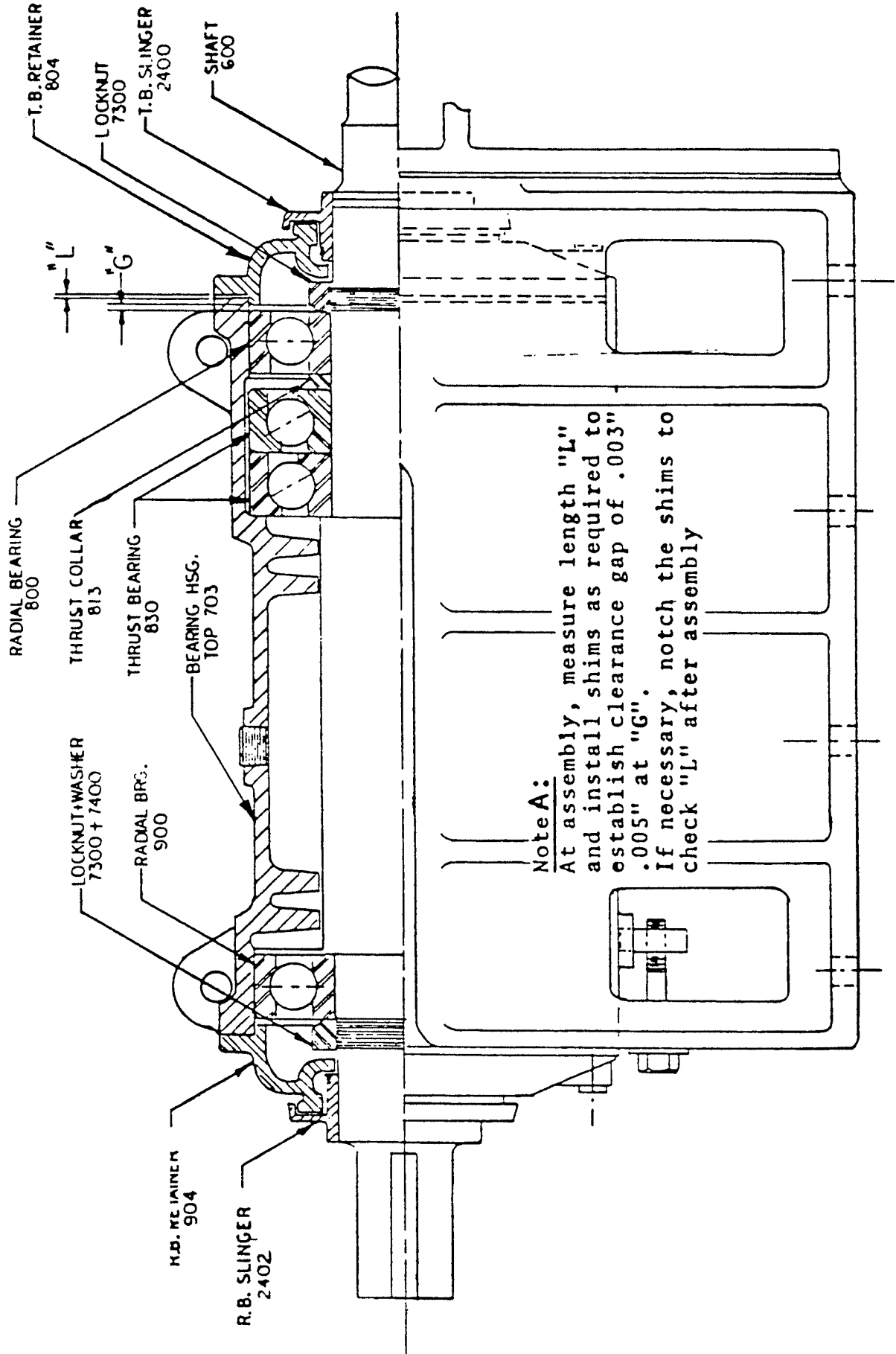
any bending motion.

2. Remove the cap screws which fasten the bearing housing to the frame.
3. Remove the cap screws which fasten the retainers to the upper half of the housing only. Loosen the other retainer cap screws about 2 turns each. After the socket head cap screws which hold the two halves together have been removed, the upper half can be lifted off. The retainers hold the lower housing half in place; therefore, have to remain attached to the lower half.

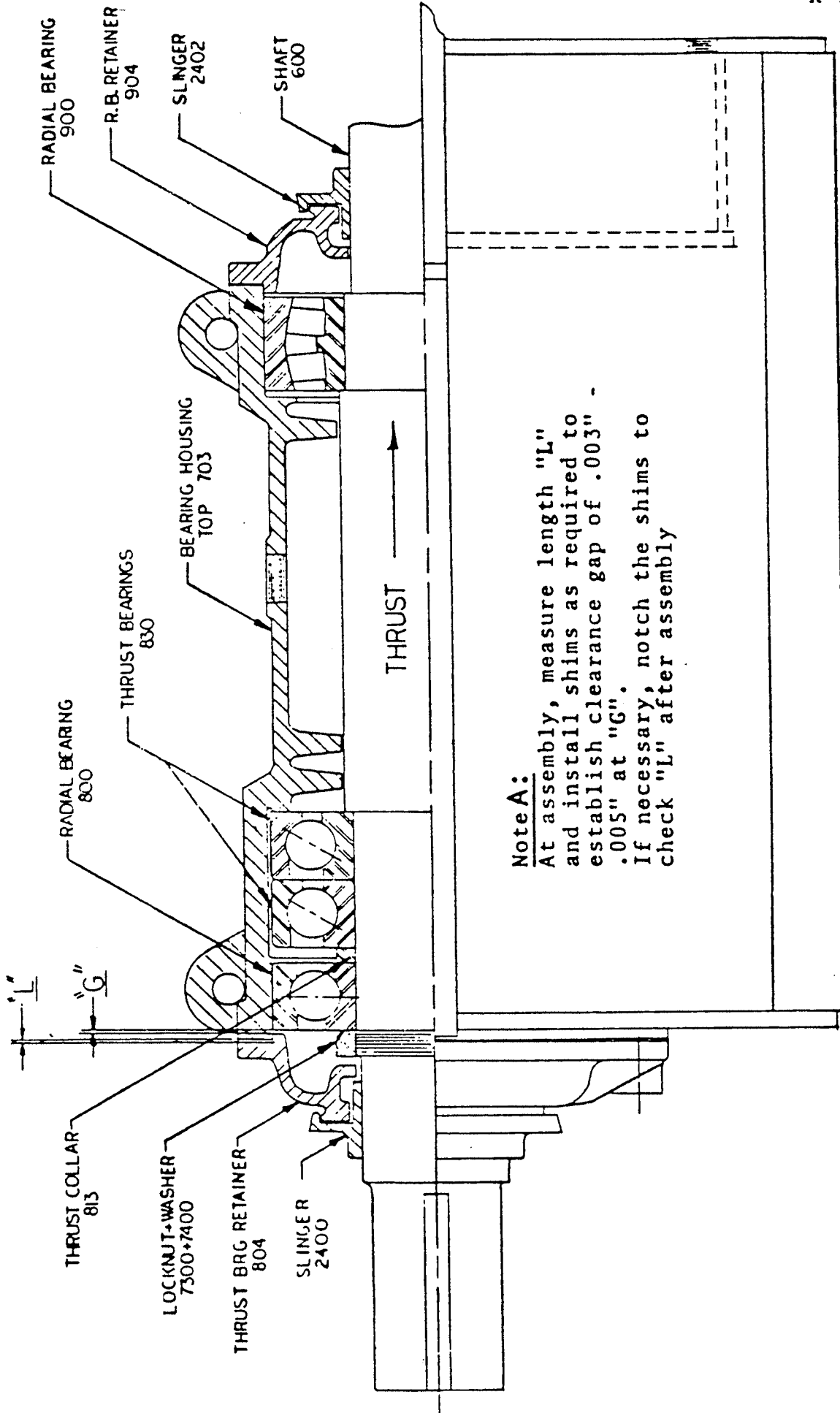


Note A:
 At assembly, measure length "L"
 and install shims as required to
 establish clearance gap of ".003" -
 ".005" at "G".
 If necessary, notch the shims to
 check "L" after assembly.

HORIZONTAL F BEARING ASSEMBLY

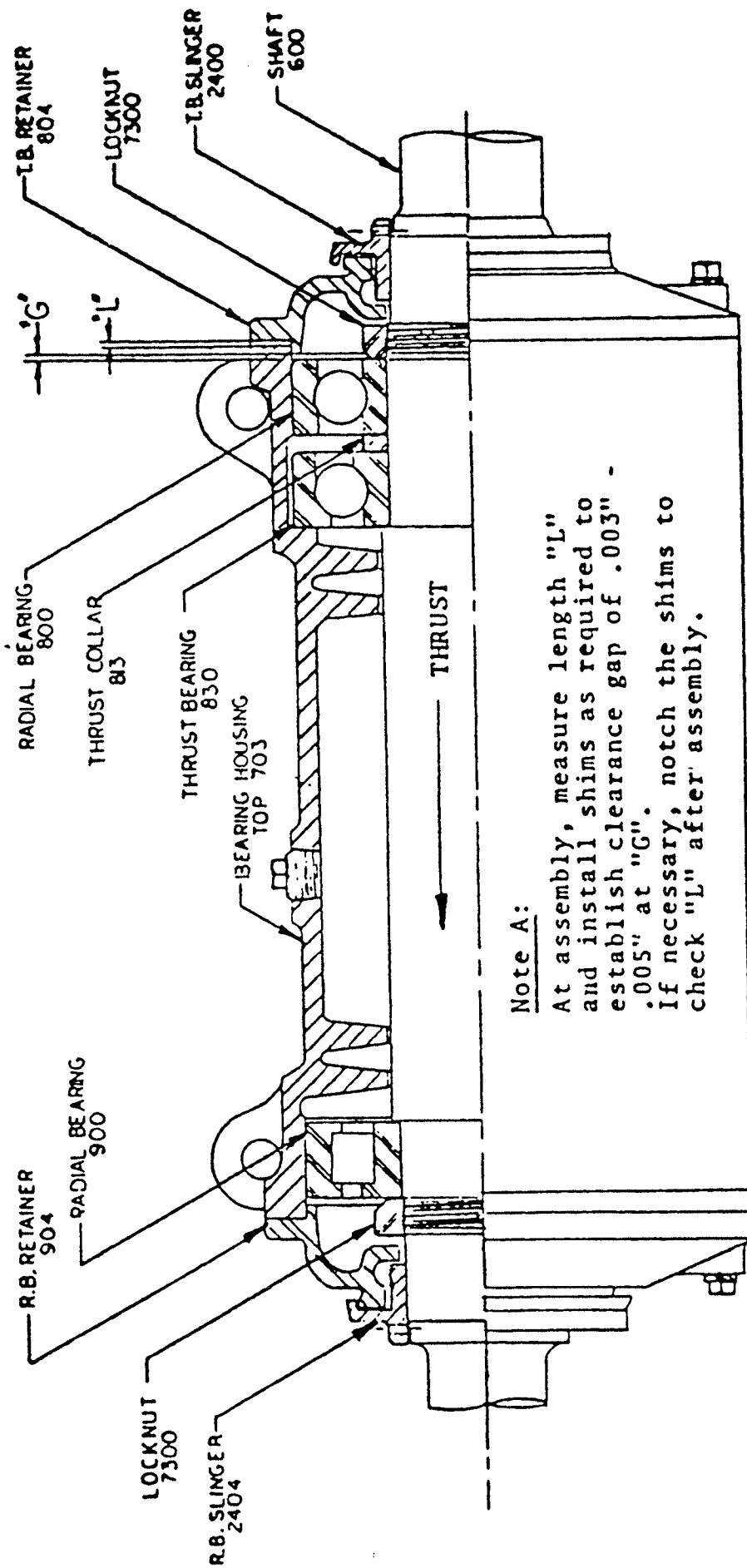


HORIZONTAL "FT" BEARING ASSEMBLY



Note A:
 At assembly, measure length "L" and install shims as required to establish clearance gap of .003" - .005" at "G".
 If necessary, notch the shims to check "L" after assembly

HORIZONTAL "FTS" BEARING ASSEMBLY



Note A:

At assembly, measure length "L" and install shims as required to establish clearance gap of .003" - .005" at "G".
 If necessary, notch the shims to check "L" after assembly.

HORIZONTAL "FR" BEARING ASSEMBLY



INSTALLATION AND OPERATING INSTRUCTIONS

INST. NO. Y-100

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SINGLE ELBOW AXIAL FLOW PUMPS

There are two illustrations at the end of this section for axial flow liquid ends. 24" and smaller cast elbows (#1100) usually have the foot included in the casting. The illustration shows a non-sealed impeller hub and an optional elbow liner (#1111). The other illustration shows a larger cast elbow with separate feet and a sealed impeller hub cavity. Large fabricated elbows are usually supported at the centerline with separate plates at each side. The assembly and disassembly instructions are similar for all SEAF pump liquid ends.

Most of the SEAF pumps have the impeller keyed to the shaft. After the locking device is removed, the impeller can be pulled off the end of the shaft. Some of the SEAF impellers are threaded on the shaft. The threaded-on impeller is removed by turning it in the direction of normal rotation while the shaft is clamped.

The pump assembly drawing and inspection of the shaft end will indicate which method has been used. Removal of any locking devices will expose the end of the shaft and the keyway, if used, will be seen.

IMPELLER LOCKING DEVICES

Most SEAF impellers (#200) are secured to the shaft with a washer (#610) and one or more cap screws (#7704). When a single cap screw is used, it and the washer are prevented from possible turning by set screws (#8002) which have to be removed before the cap screw can be turned.

Locknuts have been used and may be furnished with "duplicate" pumps.

A few pumps have been furnished with threaded-on impellers. These are kept tight by the motor torque and, therefore, may not have any locking devices.

NOTE: When set screws are used to prevent the locking device from turning, it is recommended tightening the locking device and using a drill to "spot" the bottom of the set screw hole. This will give the set screw more holding power to help prevent possible loosening of the parts.

STUFFING BOX WATER PRESSURE

The water pressure to the stuffing box should be 10 - 15 PSI higher than

INSTALLATION AND OPERATING INSTRUCTIONS



the pressure inside the pump at the stuffing box. Depending on the direction of flow, the stuffing box will be on the suction or discharge side of the impeller.

STUFFING BOX WATER CONSUMPTION

The stuffing box water consumption for lubrication of the packing is in the order of a few to several gallons per hour when the packing is properly adjusted and maintained. If the pump is handling hot liquids, some cooling may be required. The water used for cooling will increase the water consumption, but it will not be diluting the pumpage. A second hole in the stuffing box is used as the outlet for the cooling water. Make sure the proper inlet pressure is maintained. If the cooling water does not leave the stuffing box several degrees warmer than the water inlet temperature, the flow rate is excessive and the consumption can be reduced.

SEAL LIQUID END DISASSEMBLY

Disassembly is normally done to fix or replace one or more components of the pump. The most efficient procedure is the one that will require the least amount of time and money to accomplish the required result. The most efficient procedure should be determined before the disassembly is started.

The following procedure is for complete disassembly. Several steps can be omitted for partial disassembly:

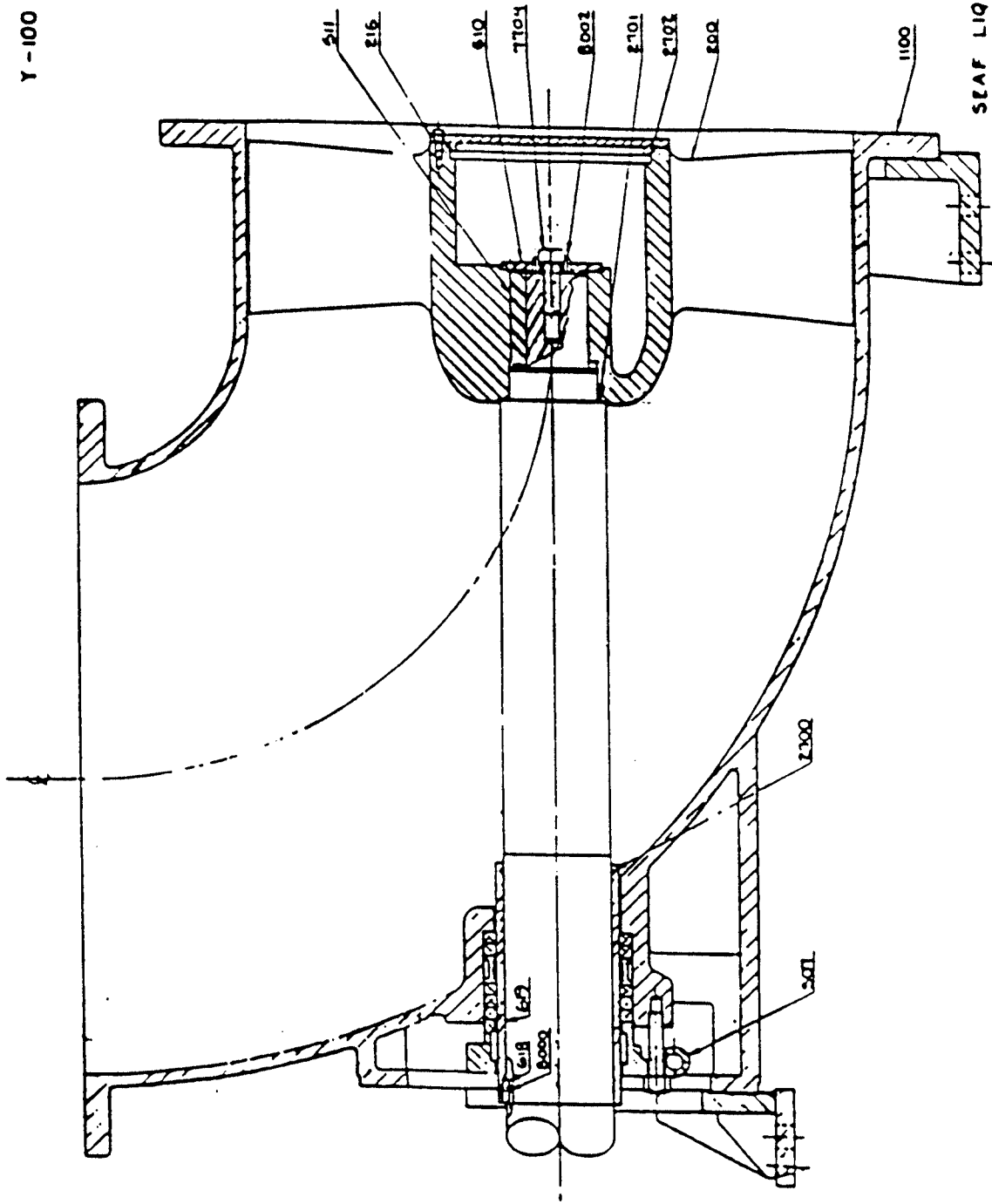
1. Remove all auxiliary water lines to the pump and completely drain the pump and pipe line. Remove the bolts which fasten the pump to the pipe line.
2. Remove the separate casing or guide vane section, if provided.
3. Remove any plates (#216, #610) or locknuts that are attached to the impeller hub or shaft end. Check to see how the impeller is fastened to the shaft. If the impeller is keyed to the shaft it is removed by pulling it off, normally with chains and suitable padding around the vanes near the hub. If there is no keyway, the impeller is threaded on.
4. Remove the cap screws or bolts which fasten the elbow to the subbase and frame. Carefully slide the elbow over the free end of its shaft. (It may be more practical in some cases to leave the elbow in place and slide the shaft with the bearing assembly out of the elbow).
5. Loosen the set screw (#2902) which holds the shaft sleeve (#619) to the shaft and slide the sleeve off the end. The gland (#507) can be removed, as well as the packing and seal cage. (The sleeve can be replaced with the shaft in the elbow, although not as easily).



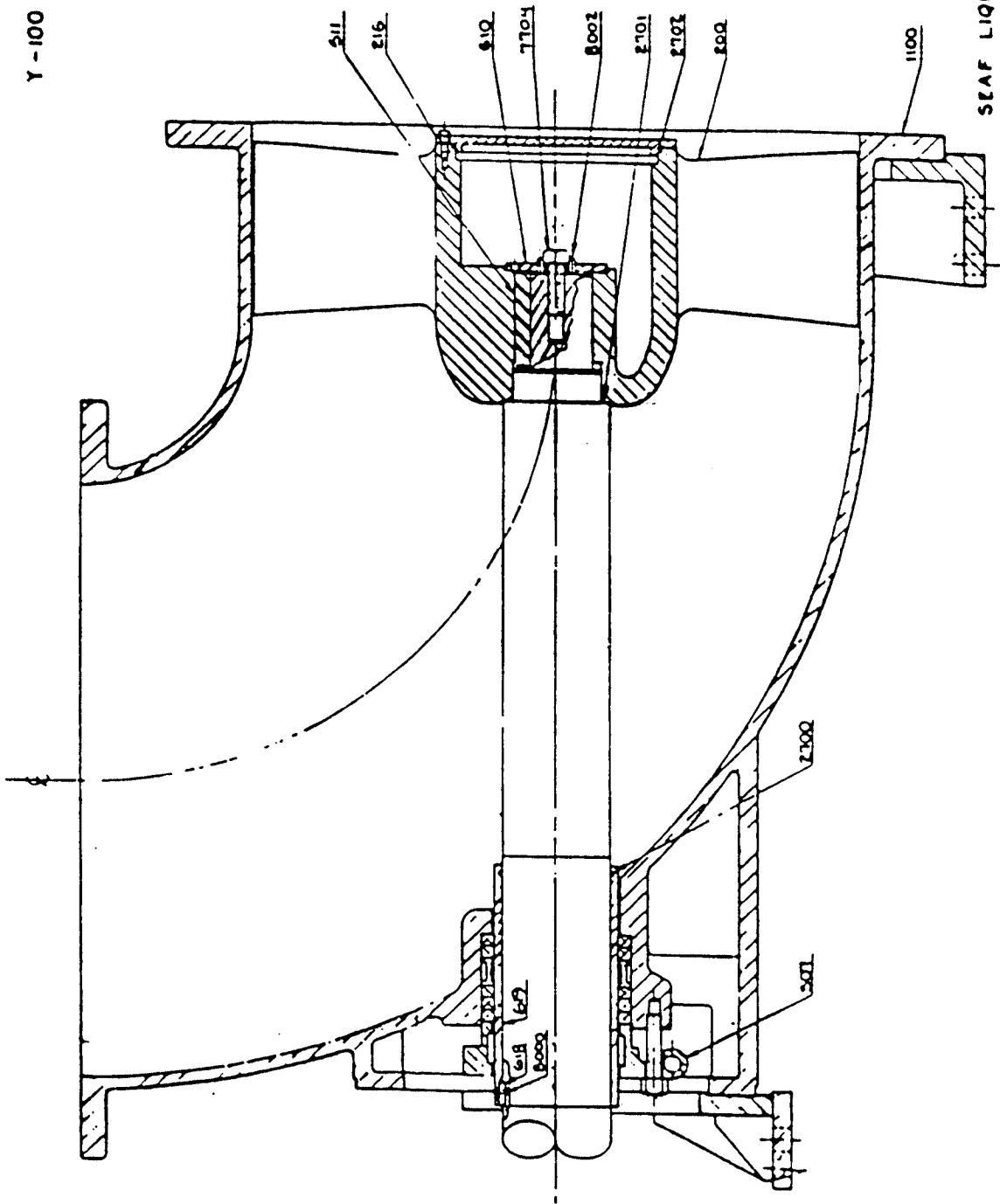
SEAF LIQUID END ASSEMBLY

1. Slide the shaft sleeve (#619) over the shaft, making sure that "O" ring (#2700) is in place as indicated on the assembly drawing. Secure the sleeve with the set screw.
2. Slide seal cage over shaft and sleeve.
3. Carefully slide the elbow over the shaft, into position, and fasten in place.
4. Install the impeller on the shaft. Make sure all gaskets and locking devices are in place. Check the assembly drawing furnished for the pump.
5. Bolt the casing (#100), if furnished, to the elbow.
6. Check the shaft for being centered in the stuffing box and the impeller for reasonably uniform clearance at the vane tips. It may be necessary to re-shim the elbow to obtain satisfactory alignment.
7. Install the packing, seal ring, and gland (#507) in the stuffing box, making sure the packing is not tight until after the pump has been started.
8. Connect all auxiliary water lines to the stuffing box.
9. Make sure the pump turns freely by hand and the impeller is not rubbing.

Y - 100



Y - 100



SEAF LIQUID END



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