

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

8100 Series Centrifugal Pumps



a xylem brand

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NOTE

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted engineering practices in the installation, operation, and maintenance of this equipment.

Any further questions, contact AC Fire Pump, (847) 966-3700.

INTRODUCTION

We welcome you as a user of AC Fire Pump. Your pump is a product of careful engineering and skilled workmanship. We believe you have the best pump possible for the service intended. With care and preventative maintenance, our AC Fire Pump will deliver efficient, trouble-free service.

This manual is furnished to acquaint you with some of the practical ways to install, operate, and maintain this pump. Read it completely before doing any work on your unit and keep it handy for future reference.

To maintain this unit at maximum efficiency, follow the recommended installation and servicing procedures outlined in this manual. To guide in the installation of the pump for maximum operating time and minimum downtime, you may contact the AC Fire Pump Network of Sales and Service Representative.

Experienced, factory-trained service personnel offer prompt, efficient service at reasonable rates. These service personnel can find and correct costly errors such as poor grouting, misalignment, pipe stresses transmitted to the pump casing, or improperly sized piping. A service person may be requested through your nearest AC Fire Pump Sales Representatives.

Replacement and spare parts, including special attention to your individual problems, may also be obtained through the AC Fire Pump Representative.

For warranty coverages, refer to your sales contract.

PUMP IDENTIFICATION

There are two identification plates on each pump. The pump rating plate gives identification and rating information. Figure 1 shows an example of a typical Rating Plate.

Permanent records for this pump are referenced by the Serial Number and it must, therefore, be used to order all spare and replacement parts. The last digit indicates the specific pump on orders for more than one pump. For example, if an order called for six pumps, all pumps would have the same first three sets of digits and the last digit will change to identify each of the six. (e.g. 1-21937-1-1, 1-21937-1-2, etc.)

The identification number is a number which the end user of the pump requests to be put on the

rating plate to identify the pump in his operation. (e.g. CWP-11 stands for Chilled Water Pump No. 11)

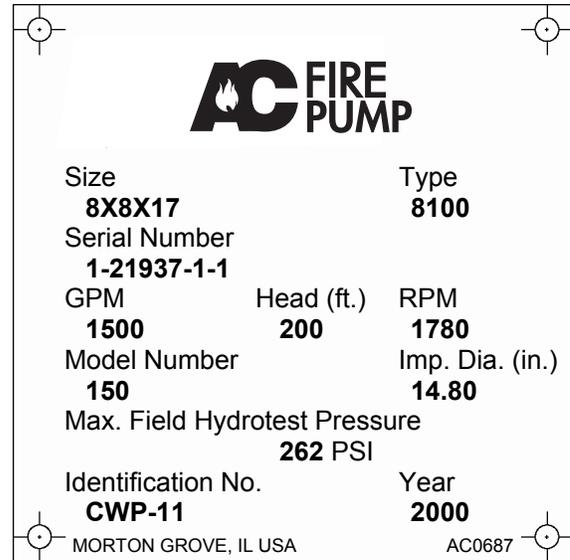


FIGURE 1 – RATING PLATE

The frame plate, shown below, gives information concerning the bearings and their lubrication. The inboard and outboard bearing numbers refer to the bearing manufacturer's numbers.

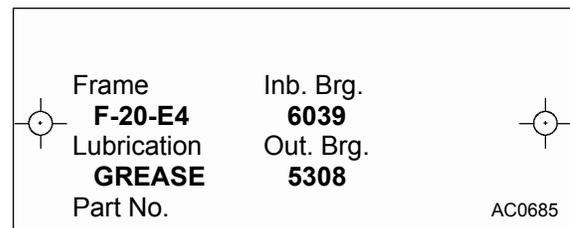


FIGURE 2 – FRAME PLATE

SAFETY INSTRUCTION

The warning and caution decals located on the pump are there for the safety of anyone involved with the installation, operation, and maintenance of the pump. PLEASE READ THE DECALS CAREFULLY.



SAFETY INSTRUCTION

This safety alert symbol will be used in this manual and on the pump safety instruction decals to draw attention to safety related instructions. When used the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.



WARNING:

Do not operate pump at or near zero flow (closed discharge shutoff valve). Explosion could result due to large temperature rise in the fluid being pumped. Failure to follow these instructions could result in property damage, severe personal injury, or death.



WARNING:

If pump is to be used on process fluids above 120°F, pump surface temperatures could be warm enough to cause burns. We recommended pump surfaces be insulated or appropriately guarded. Failure to follow these instructions could result in severe personal injury.

INSTALLATION

RECEIVING THE PUMP

Check the pump for damage immediately upon arrival. (An absolute must!) Prompt reporting of any damage to the carrier's agent, with notations made on the freight bill, will expedite satisfactory adjustment by the carrier.

Pumps and drivers are normally shipped from the factory mounted on a baseplate. Couplings may either be completely assembled or have the coupling hubs mounted on the shafts and the connecting members removed. When the connecting members are removed, they will be packaged in a separate container and shipped with the pump or attached to the baseplate.

LIFTING THE PUMP

The following instructions are for the safe lifting of the Series 8100 pump.

The pump unit should be unloaded and handled by lifting equally at four or more points on the baseplate. The lugs on the upper half casing are designed for lifting the upper half casing only.

Horizontal

1. Bare Pump (Model 100)



WARNING: Falling Objects Hazard

Eyebolts or lifting lugs, if provided, are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Using a nylon sling, chain, or wire rope, hitch around both bearing supports (See Figure 3).

2. Pump, Base, and Driver (Model 150)

Care must be taken to size equipment for unbalanced loads which may exist if the motor is not mounted on the base at the time of lifting. Motor may or may not be mounted at the factory.

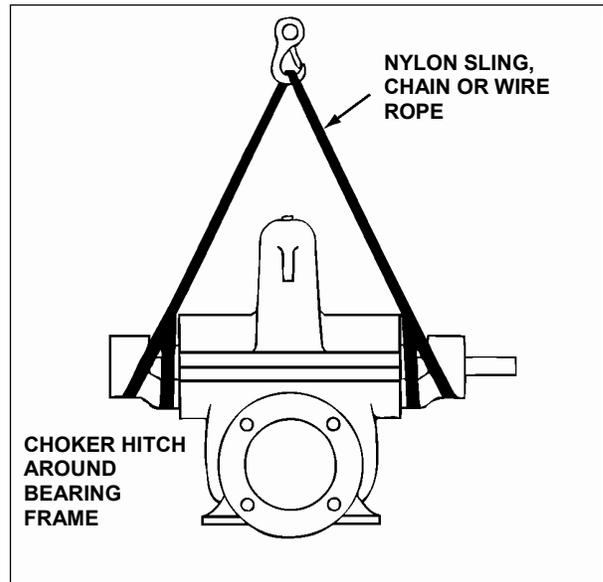


FIGURE 3 – MODEL 100

Pump, base, and driver assemblies where the base length exceeds 100 inches may not be safe to lift as a complete assembly. Damage to the baseplate may occur. If the driver has been mounted on the baseplate at the factory, it is safe to lift the entire assembly. If driver has not been mounted at the factory and the overall baseplate length exceeds 100 inches, do not lift the entire assembly consisting of pump, base, and driver. Instead lift the pump and baseplate to its final location without the driver. Then mount the driver.

Bases supplied with lifting holes:

Large bases are supplied with lifting holes in the sides or the ends of the base (See Figure 4).

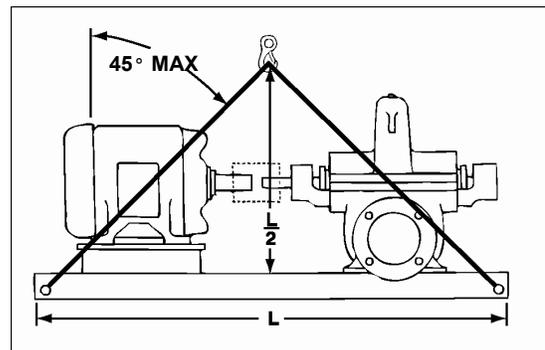


FIGURE 4 – MODEL 150

Using ANSI/OSHA Standard “S” hooks, place the “S” hooks in the holes provided in the four corners of the base. Be sure the points of the hooks do not touch the bottom of the pump base. Attach nylon slings, chains, or wire rope to the “S” hooks. Size the equipment for the load, and so the lift angle will be less than 45° from the vertical.

Bases supplied without lifting holes:

Place one sling around the outboard bearing housing. Place the remaining sling around the back end of the motor as close to the mounting feet as possible. Make sure the sling does not damage the housing cover or conduit box.

Join the free ends of the slings together and place over the lifting hook. Use extreme care when positioning sling under the motor so it cannot slip off (See Figure 5).

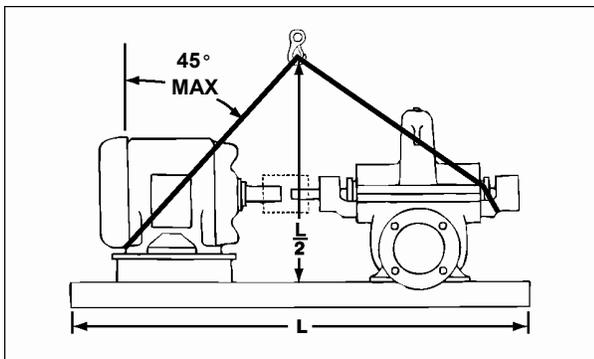


FIGURE 5 – MODEL 150

Vertical

1. Half Pedestal (Model 200)

⚠ WARNING: Falling Objects Hazard
 Eyebolts or lifting lugs, if provided, are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Place nylon sling, chain or wire rope around both flanges. Use a latch hook or standard shackle and end loops.

Be sure the lifting equipment is of sufficient length to keep the lift angle less than 30° from the vertical (See Figure 6).

2. Full Pedestal (Model 300)

Install eyebolts in the three holes provided at the top of the support, being sure to tighten securely. Attach nylon sling, chain

or wire rope using latch hook or standard shackle and end loop.

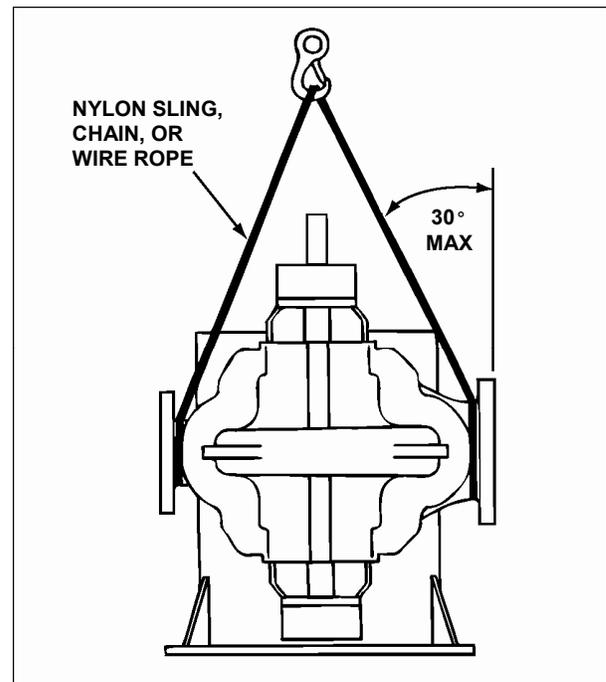


FIGURE 6 – MODEL 200

Be sure to use shoulder eyebolts that are manufactured per ANSI B18.15 and sized to fit the holes provided.

Be sure lifting equipment is of sufficient length to keep the lift angle less than 30° from the vertical (See Figure 7).

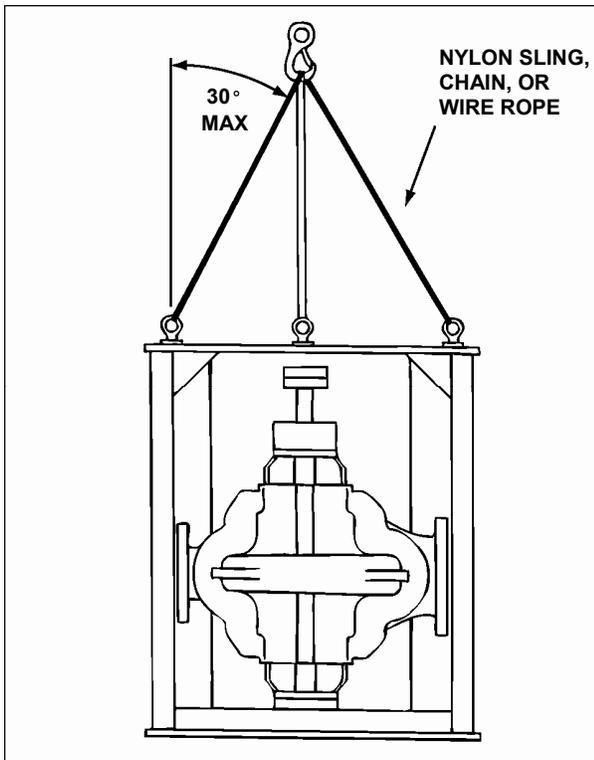


FIGURE 7 – MODEL 300

STORAGE

The following storage procedures apply to the Series 8100 pump only. Other accessories such as motors, steam turbines, gears, etc., must be handled per the respective manufacturer's recommendations.

Temporary

Temporary storage is considered one month or less. If the pump is not installed and operated soon after arrival, store it in a clean, dry place that has slow, moderate changes in ambient temperature. Rotate the shaft periodically to coat the bearings with lubricant and to retard oxidation, corrosion, and to reduce the possibility of false brinelling of the bearings. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventative such as Ashland Oil Tectyl No. 502C.

For oil lubricated bearings, fill the frame completely with oil. Before putting equipment into operation, drain the oil and refill to proper level.

Long Term

Storage longer than one month is considered long term storage. Follow the same procedure for temporary storage with the following addition. Add one half ounce of a corrosion inhibiting concentrated oil such as

Cortec Corp. VCI-329 (for both grease and oil lubricated bearings). Seal all vents and apply a water proof tape around the oil seals in the bearing frame. Remember for pumps with oil lubricated bearings to drain the oil from the frame and refill to the proper level before running the pump.

LOCATION

The pump should be installed as near to the suction supply as possible, with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold.

When installing the pump, consider its location in relation to the system to assure that sufficient Net Positive Suction Head (NPSHA) is available at the pump inlet connection. Available NPSH (NPSHA) must always equal or exceed the required NPSH (NPSHR) of the pump.

The pump must be primed before starting. Whenever possible, the pump should be located below the fluid level to assure priming. This condition provides a positive suction head on the pump. It is also possible to prime the pump by pressurizing the suction vessel.

The pump should be installed with sufficient accessibility for inspection and maintenance. A clear space with ample head room should be allowed for the use of an overhead crane or hoist to lift the unit.

NOTE: Allow a sufficient amount of space to dismantle pump without disturbing the pump suction and discharge piping.

Select a dry place above the floor level wherever possible. Take care to prevent pump from freezing during cold weather when not in operation. Should the possibility of freezing exist during a shut-down period, the pump should be completely drained, and all passages and pockets where liquid might collect should be blown out with compressed air.

Make sure there is a suitable power source available for the pump driver. If motor driven, the electrical characteristics of the power source should be identical to those shown on motor data plate.

FOUNDATION

The pump is built to provide years of service if installed properly and attached to a suitable foundation. A base of concrete weighing 2 ½ to 5 times the weight of the pump is recommended.

The foundation should be poured without interruption to within 1/2 to 1 1/2 inches of the finished height. The top surface of the foundation should be well scored and grooved before the concrete sets; this provides a bonding surface for the grout.

Foundation bolts should be set in concrete as shown in Figure 8. An optional 4-inch long tube around the bolts at the top of the concrete will allow some flexibility in bolt alignment to match the holes in the base plate. Allow enough bolt length for grout, shims, lower base plate flange, nuts and washers. The foundation should be allowed to cure for several days before the base plate is shimmed and grouted.

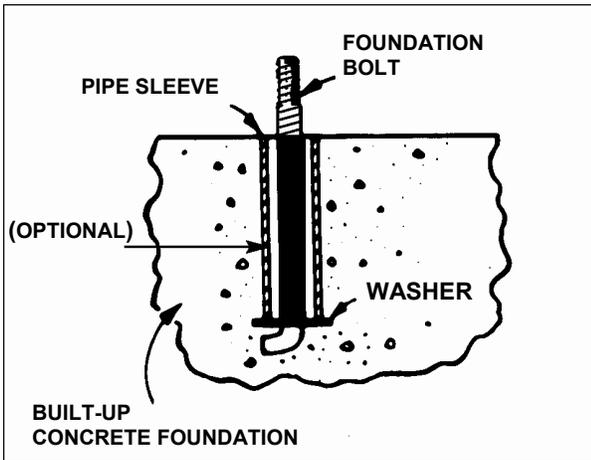


FIGURE 8 – FOUNDATION

BASE PLATE SETTING (BEFORE PIPING)

NOTE: This procedure assumes that a concrete foundation has been prepared with anchor or hold down bolts extending up ready to receive unit. It must be understood that pump and motor have been mounted and rough aligned at the factory. If motor is to be field mounted, consult factory for recommendations. AC Fire Pump CANNOT assume responsibility for final alignment.

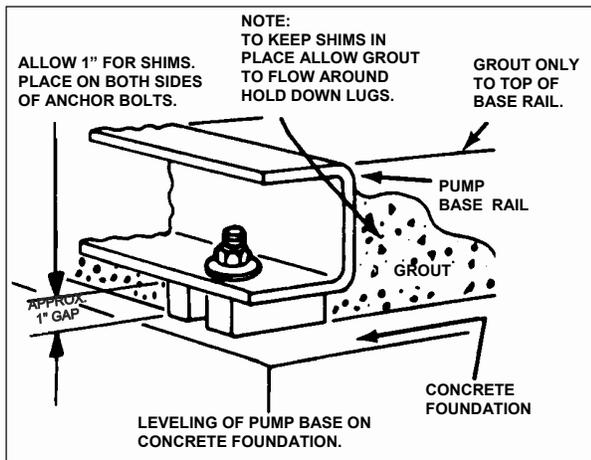


FIGURE 9A – SETTING BASE PLATE AND GROUTING YEAR 2000 STYLE BASE FOR BOTH MOTOR AND ENGINE DRIVEN UNITS

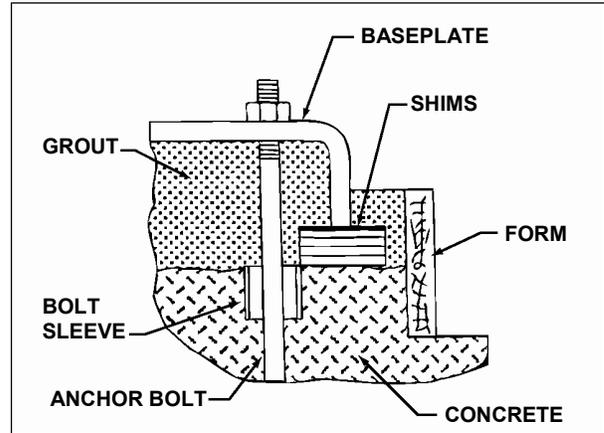


FIGURE 9B – GROUTING PRE-YEAR 2000 STYLE BASE FOR MOTOR DRIVEN UNITS

- Use blocks and shims under base for support at anchor bolts and midway between bolts, to position base approximately 1" above the concrete foundation, with studs extending through holes in the base plate.
- By adding or removing shims under the base, level and plumb the pump shaft and flanges. The base plate does not have to be level.
- Draw anchor nuts tight against base, and observe pump and motor shafts or coupling hubs for alignment. (Temporarily remove coupling guard for checking alignment.)
- If alignment needs improvement, add shims or wedges at appropriate positions under base, so that retightening of anchor nuts will shift shafts into closer alignment. Repeat this procedure until a reasonable alignment is reached.

NOTE: Reasonable alignment is defined as that which is mutually agree upon by pump contractor and the accepting facility (final operator). Final alignment procedures are covered under "Alignment Procedures."

- Check to make sure the piping can be aligned to the pump flanges without placing pipe strain on either flange.
- Pour grout in the base plate completely (See "Grouting Procedure") and allow grout to dry thoroughly before attaching

pipng to pump. (24 hours is sufficient time with approved grouting procedure.)

GROUTING PROCEDURE

Grout compensates for uneven foundation, distributes weight of unit, and prevents shifting. Use an approved, non-shrinking grout, after setting and leveling unit (See Figure 9).

- a. Build strong form around the foundation to contain grout.
- b. Soak top of concrete foundation thoroughly, then remove surface water.
- c. Base plate should be completely filled with grout.
- d. After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary.
- e. Check the alignment after the foundation bolts are tightened.
- f. Approximately 14 days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

ALIGNMENT PROCEDURE

NOTE: A flexible coupling will only compensate for small amounts of misalignment. Permissible misalignment will vary with the make of coupling. Consult coupling manufacturer's data when in doubt.

Allowances are to be made for thermal expansion during cold alignment, so that the coupling will be aligned at operating temperature. In all cases, a coupling must be in alignment for continuous operation. Even though the coupling may be lubricated, misalignment causes excessive wear, vibration, and bearing loads that result in premature bearing failure and ultimate seizing of the pump. Misalignment can be angular, parallel, or a combination of these, and in the horizontal and vertical planes. Final alignment should be made by moving and shimming the motor on the base plate, until the coupling hubs are within the recommended tolerances measured in total run-out. All measurements should be taken with the pump and motor foot bolts tightened. The shaft of sleeve bearing motors should be in the center of its mechanical float.

NOTE: Proper alignment is essential for correct pump operation. This should be performed after base plate has been properly set and grout has

dried thoroughly according to instructions. Final alignment should be made by shimming driver only. Alignment should be made at operating temperatures.



WARNING: Unexpected Start-up Hazard

Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death and property damage.

ANSI/OSHA COUPLER GUARD REMOVAL/INSTALLATION



WARNING: Unexpected Start-up Hazard

Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death and property damage.

NOTE: Do not spread the inner and outer guards more than necessary for guard removal or installation. Over spreading the guards may alter their fit and appearance.

Removal

- a. Remove the two capscrews that hold the outer (motor side) coupler guard to the support bracket(s).
- b. Spread the outer guard and pull it off the inner guard.
- c. Remove the capscrew that holds the inner guard to the support bracket.
- d. Spread the inner guard and pull it over the coupler.

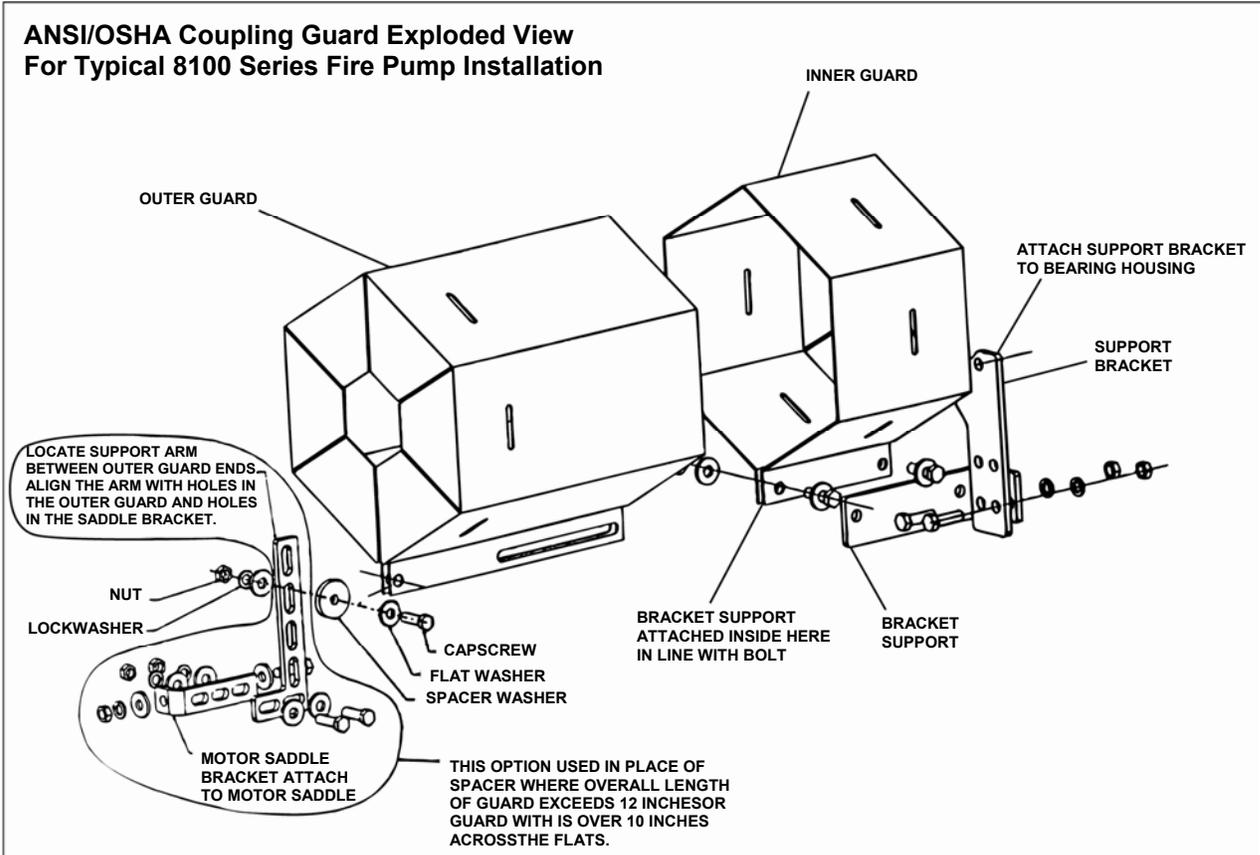
Installation

- a. Check coupler alignment before proceeding. Correct if necessary.
- b. Spread the inner guard and place it over the coupler.
- c. With the inner guard straddling the support bracket, install a capscrew through the hole (or slot) in the support bracket and guard located closest to the pump. Do not tighten the capscrew.
- d. Spread the outer guard and place it over the inner guard.
- e. Install the outer guard capscrews by following the step stated below which pertains to your particular pump:
 - i. *For pumps with a motor saddle support bracket:* Ensure the outer guard is

straddling the support arm, and install but do not tighten the two remaining capscrews.

- ii. *For pumps without a motor saddle support bracket:* Insert the spacer washer between the holes located closest to the motor in the outer guard, and install, but do not tighten, the two remaining capscrews.

- f. Position the outer guard so it is centered around the shaft, and so there is less than a 1/4" of the motor shaft exposed. On guards that utilize a slotted support bracket, the inner guard will have to be positioned so there is only a 1/4" of the pump shaft exposed.
- g. Holding the guard in this position, tighten the three capscrews.



Method 1 – Straight Edge Alignment for Standard Sleeve Type Coupler with Black Rubber Insert

(See Figure 10A)

Proceed with this method only if satisfied that face and outside diameters of the coupling halves are square and concentric with the coupling borers. If this condition does not exist or elastomeric couplings do not make this method convenient, use Method 2.

- 1. Check angular misalignment using a micrometer or caliper. Measure from the outside of one flange to the outside of the opposite flange at four points 90° apart. **DO NOT ROTATE COUPLER.**

Misalignment up to 1/64" per inch of coupler radius is permissible.

- 2. At four points 90° apart (**DO NOT ROTATE COUPLER**), measure the parallel coupler misalignment by laying a straight edge across one coupler half and measuring the gap between the straight edge and opposite coupler half. Up to a 1/64" gap is permissible.

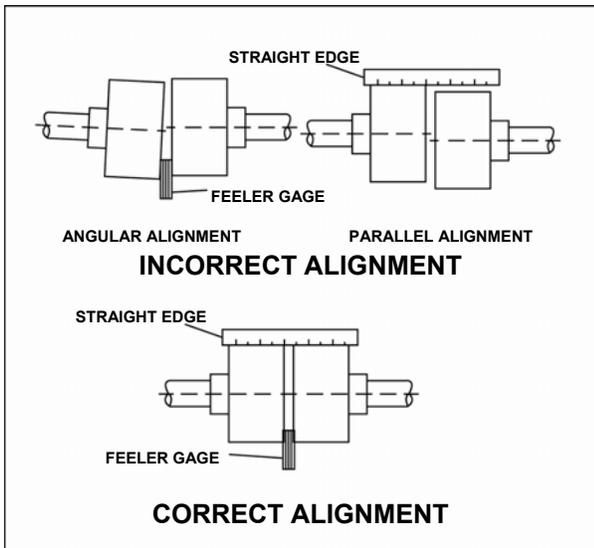


FIGURE 10A – CHECKING ALIGNMENT (METHOD 1)

Method 2 – For Orange Hytel Insert, 3500 RPM Operation, or All Other Coupler Types Except as Noted Below

(See Figure 10B)

- a. Make sure each hub is secured to its respective shaft and that all connecting and/or spacing elements are removed at this time.
- b. The gap between the coupling hubs is set by the manufacturer before the units are shipped. However, this dimension should be checked. (Refer to the coupling manufacturer's specifications supplied with the unit.)
- c. Scribe index lines on coupling halves as shown in Figure 10B.
- d. Mount dial indicator on one hub as shown for parallel alignment. Set dial to zero.
- e. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment (See paragraph i below).
- f. Mount dial indicator on one hub as shown for angular alignment. Set dial to zero.
- g. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment (See paragraph i below).
- h. Assemble coupling. Tighten all bolts and set screw(s). It may be necessary to repeat steps c through f for a final check.

- i. For single element couplings, a satisfactory parallel misalignment is .004"T.I.R., while a satisfactory angular misalignment is .004"T.I.R. per inch of radius R (See Figure 10B).

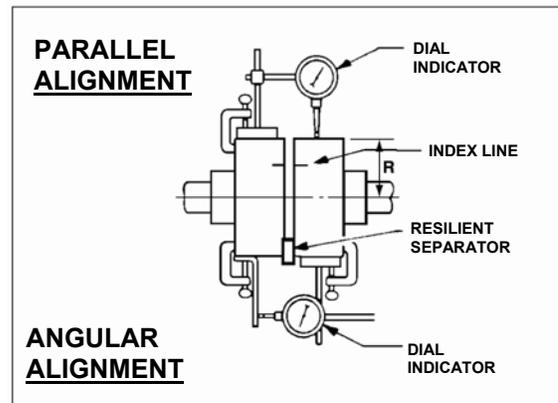


FIGURE 10B – CHECKING ALIGNMENT (METHOD 2)

Grid Couplings

NOTE: The following procedure is intended for mounting and alignment of Rexnord Industries, LLC. and Clarke Fire Protection Products, Inc., Tapered Grid Couplings.

Adequate lubrication is essential for satisfactory operation. Grease supplied by the coupling manufacturer is highly recommended. Other greases to be used should be approved by the coupling manufacturer.

Alignment is shown using a spacer bar and straight edge. Rexnord Industries, LLC. and Clarke Fire Protection Products, Inc. state this practice has been proven for many industrial applications. Superior alignment can be achieved through the use of dial indicators as shown above.

1. Clean all metal parts using non-flammable solvent.
2. Lightly coat seals with coupling vendor supplied grease and place on shafts before mounting shaft hubs.
3. Install keys and mount hubs with flange faces flush with shaft ends or as otherwise specified.
4. Reposition hubs on shafts as required to achieve the required hub gap shown in Figure 10H or otherwise specified. The length of engagement on each shaft

should be roughly equal to the shaft diameter.

5. Tighten setscrews.
6. Bring the pump and motor halves of the coupler into approximate height alignment, by placing equal amounts of shims under all the motor feet.
7. Tighten the motor bolts.
8. Use a spacer bar equal in thickness to the gap specified in Figure 10C. Insert bar, as shown below, to same depth at 90° intervals and measure clearance between bar and hub face with feeler gauges. The difference in minimum and maximum measurements must not exceed the angular installation limits shown in Figure 10H.

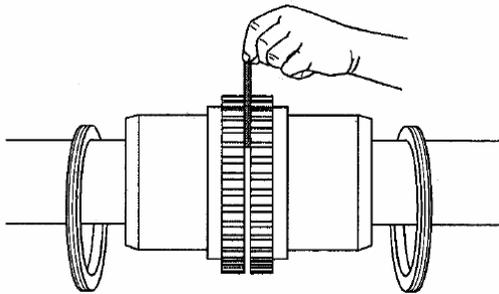


FIGURE 10C – USING SPACER BAR

9. Align so that a straight edge rests (as shown in Figure 10D) on both hubs and also at 90° intervals without rotating the coupler. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Figure 10H.

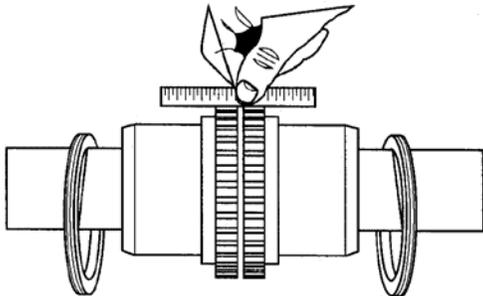


FIGURE 10D – USING STRAIGHT EDGE

10. If adjustment is needed, loosen the motor bolts and add (or remove) an equal amount of shims under each motor foot to align the height. To correct side

misalignment, strike the side of the motor foot with a mallet.

11. Tighten the motor bolts and check again. If a correction is made, re-check alignment in all directions. Repeat this process until the desired result is obtained.
12. Pack gap and grooves with coupling vendor supplied grease before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction as shown below. This will ensure correct grid contact with non-rotating pin in cover halves.
13. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

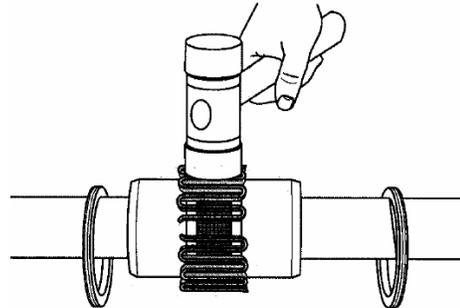


FIGURE 10E – SEATING THE GRID

14. Pack the spaces between and around the grid with as much as coupling vendor supplied grease as possible and wipe off the excess until flush with the top of the grid.
15. Position seals on hubs to line-up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side.

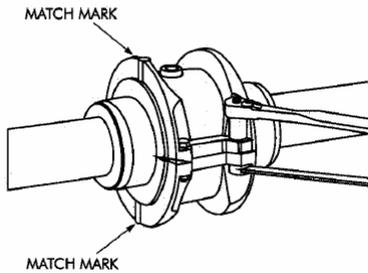
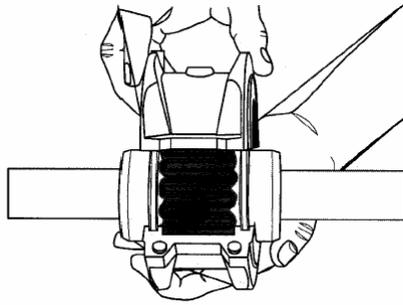


FIGURE 10F – COVER INSTALLATION

16. If the shafts are not horizontal, or coupling is to be used vertically, assemble cover halves with the lug and match mark UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tightening to torque specified in Figure 10H. Ensure

gaskets stay in position during fastener tightening.

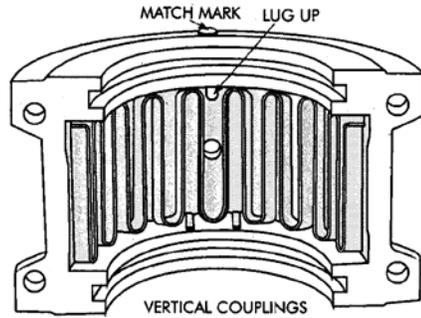


FIGURE 10G – COVER INSTALLATION, VERTICAL POSITION

17. Ensure the lube plugs are installed in the cover.

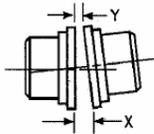


WARNING: Coupling Failure

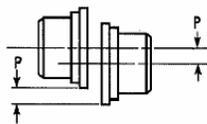
Do not operate coupling without proper lubrication

Failure to follow these instructions could result in serious personal injury or death and property damage.

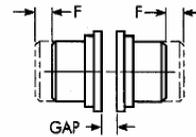
ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT



Size	Installation Limits				Tightening Torque Values		Maximum Allowable RPM	Lube Wt. lb
	Parallel Offset (P)	Angular (x-y)	Hub Gap +/- 10%	End Float Physical Limit (Min) 2xF	Cover Fastener Tightening Torque Values	Flange Type 31 & 35		
	Max Inch	Max Inch	Inch	Inch	In. Series Fasteners (lb*in)	In. Series Fasteners (lb*in)		
1040T	0.006	0.003	0.125	0.211	100	120	3600	0.12
1050T	0.008	0.004	0.125	0.212	200	250	3600	0.15
1060T	0.008	0.005	0.125	0.258	200	440	3600	0.19
1070T	0.008	0.005	0.125	0.259	200	440	1800	0.25
1080T	0.008	0.006	0.125	0.288	200	825	1800	0.38

FIGURE 10H – MISALIGNMENT & FASTENER TORQUE VALUES

Final Alignment

Final alignment cannot be accomplished until the pump has been operated initially for a sufficient length of time to attain operating temperature. When normal operating temperature has been attained, secure the pump to re-check alignment and compensate for temperature accordingly. See Alignment Section.

⚠ WARNING: Rotating Components Hazard

Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

⚠ WARNING: Coupling Failure

Do not operate pump with coupling out of alignment. Ensure final coupling alignment is within the values stated above or according to the coupling manufacturer's instructions. Coupling, pump, or driver failure may occur.

Failure to follow these instructions could result in serious personal injury or death and property damage.

OPTIONAL Alignment Procedure

If desired, the pump and motor feet can be doweled to the base after final alignment is complete. This should not be done until the unit has been run for a sufficient length of time and alignment is within the tolerance. See Doweling Section.

⚠ CAUTION: Extreme Temperature and/or Flying Debris Hazard

Eye protection and gloves required. Failure to follow these instructions could result in property damage and/or moderate personal injury.

NOTE: Pump may have been doweled to base at factory.

DOWELING

Pump units may, if desired, be doweled on diagonally opposite feet. This should not be done until the unit has been run for a sufficient length of time and alignment is within the above alignment tolerance.

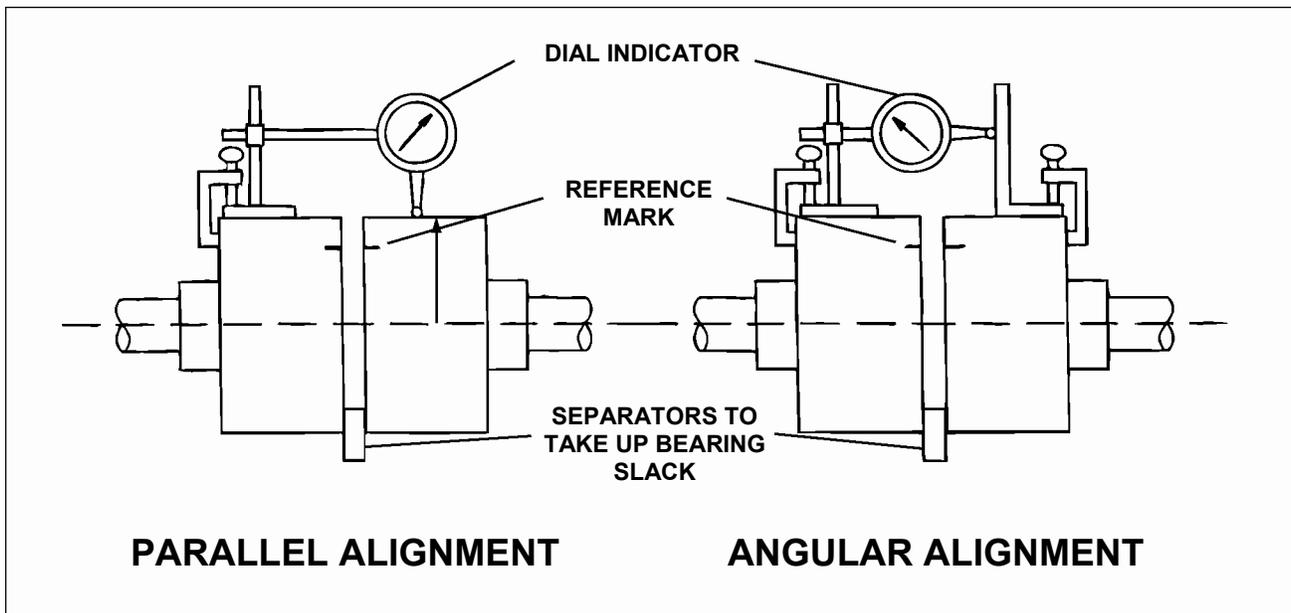


FIGURE 11 – CHECKING ALIGNMENT (METHOD 2)

SUCTION AND DISCHARGE PIPING

The introduction of a pump into a piping system which is not well designed or adjusted may cause strain on the pump, leading to misalignment or even impeller rubbing. Since slight strain may go unnoticed, final alignment should be done with the system full.

Pipe flanges should not impose any strain on the pump. This can be checked by a dial indicator. Any strain must be corrected by adjustments in the piping system.

When installing the pump piping, be sure to observe the following precautions:

Piping should always be run to the pump.

Do not move pump to pipe. This could make final alignment impossible.

Both the suction and discharge piping should be independently anchored near the pump and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at necessary intervals to provide support. When expansion joints are used in the piping system they must be installed beyond the piping supports closest to the pump. Tie bolts and spacer sleeves should be used with expansion joints to prevent pipe strain. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes. When using rubber expansion joints, follow the recommendations of the *Technical Handbook on Rubber Expansion Joints and Flexible Pipe Connectors*. It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction.

Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long radius 90° fittings to decrease friction losses.

Make sure that all piping joints are air-tight.

Where flanged joints are used, assure that inside diameters match properly.

Remove burrs and sharp edges when making up joints.

Do not “spring” piping when making any connections.

Provide for pipe expansion when hot fluids are to be pumped.

Suction Piping

When installing the suction piping, observe the following precautions (See Figure 13).

The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimized and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be directly attributed to improper suction piping systems.

Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening. A minimum of ten (10) pipe diameters between any elbow or tee and the pump should be allowed. If a long suction pipe is required, it should be one or two sizes larger than the suction opening, depending on its length.



CAUTION:

An elbow should not be used directly before the suction of a double suction pump if its plane is parallel to the pump shaft. This can cause an excessive axial load or NPSH problems in the pump due to an uneven flow distribution (See Figure 12). If there is no other choice, the elbow should have straightening vanes to help evenly distribute the flow.

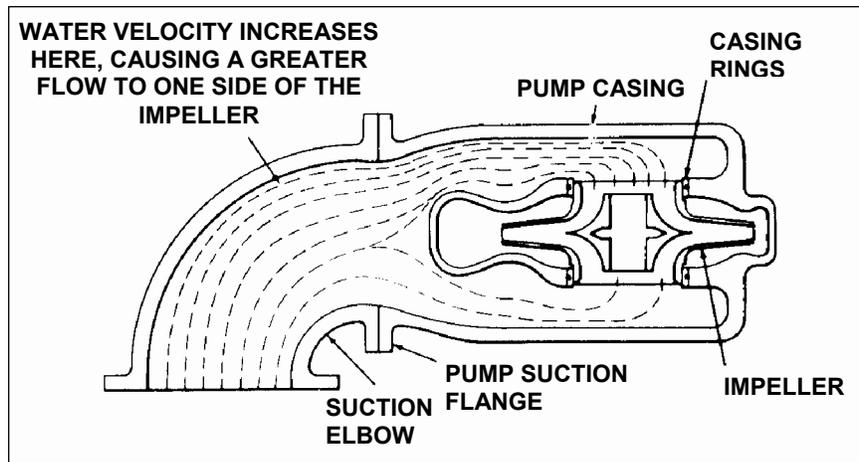


FIGURE 12 – UNBALANCED LOADING OF A DOUBLE SUCTION IMPELLER DUE TO UNEVEN FLOW AROUND AN ELBOW ADJACENT TO THE PUMP

Eccentric reducers should be limited to one pipe size reduction each to avoid excessive turbulence and noise. They should be of the conical type. Contour reducers are not recommended.

When operating on a suction lift, the suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe can become filled with air and prevent proper operation of the pump. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

NOTE: When operating on suction lift never use a concentric reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe.

Figure 13 shows some correct and incorrect suction piping arrangements.

When installing valves in the suction piping, observe the following precautions:

1. If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type, rather than the multiple spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line. See Discharge Piping)

2. When foot valves are used, or where there are other possibilities of “water hammer,” close the discharge valve slowly before shutting down the pump.
3. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets. Globe valves should not be used, particularly where NPSH is critical.
4. The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump for maintenance purposes, and should always be installed in positions to avoid air pockets.

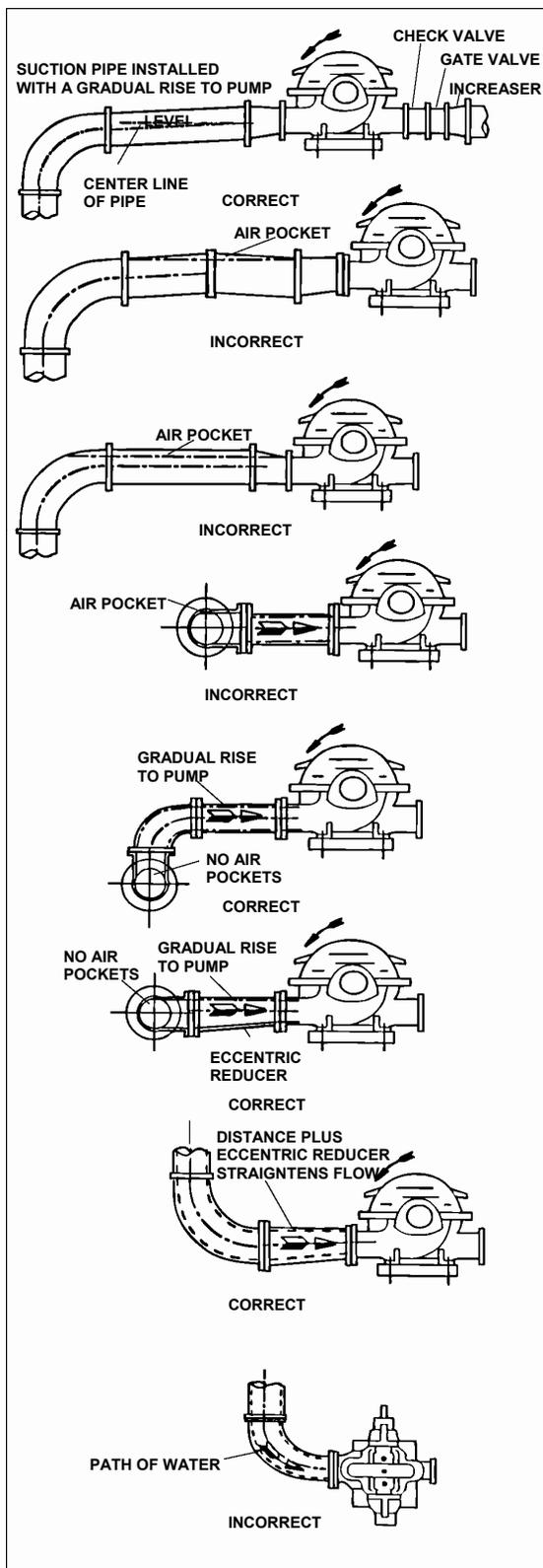


FIGURE 13 – SUCTION PIPING ARRANGMENTS

Discharge Piping

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, the pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain an even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

A slow closing check valve and an isolating gate valve should be installed in the discharge line. The check valve (triple duty valve), placed between pump and gate valve, protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure. The gate valve is used in priming and starting, and when shutting the pump down.

Pressure Gauges

Properly sized pressure gauges should be installed in both the suction and discharge nozzles in the gauge taps provided. The gauges will enable the operator to easily observe the operation of the pump, and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapor binding, or other unstable operation should occur, widely fluctuating discharge pressure will be noted.

STUFFING BOX LUBRICATION

Contaminants in the pumped liquid must not enter the stuffing box. These contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing or mechanical seal deterioration; they can even plug the stuffing box flushing and lubrication system. The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing or seal. It is important to establish the optimum flushing pressure that will keep contaminants from the stuffing box cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing or seal wear may result; and extreme heat may develop in the shaft causing higher bearing temperatures. The most desirable condition, therefore, is to use a seal water pressure 15-20 psig above the maximum stuffing box pressure.

If the pump system pressure conditions vary during the day, packing adjustment becomes

difficult. Consideration should be given to using a mechanical seal. (See Mechanical Seals.)

Packing

Standard pumps are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, inspect the packing before the pump is started.

NOTE: Packing adjustment is covered in the Maintenance section of this manual.

On some applications, it is possible to use internal liquid lubrication (pumped liquid) to lubricate packing. Only when all of the following conditions prevail, can this be done:

1. Liquid is clean, free from sediment and chemical precipitation and is compatible with seal materials.
2. Temperature is above 32°F and below 160°F.
3. Suction pressure is below 75 psig.
4. Lubrication (pumped liquid) has lubricating qualities.
5. Liquid is non-toxic and non-volatile.

When the liquid being pumped contains solids or is otherwise not compatible with packing materials, an outside supply of seal liquid should be furnished. In general, external-injection liquid (from an outside source) is required when any of the above conditions cannot be met.

The standard stuffing box consists of rings of packing (see assembly section for number of rings), a seal cage (optional), and a gland. A shaft sleeve which extends through the box and under the gland is normally provided to protect the shaft.

A tapped hole is supplied in the stuffing box directly over the seal cage to introduce a clean, clear sealing medium. The stuffing box must, at all times, be supplied with sealing liquid at a high enough pressure to keep the box free from foreign matter, which would quickly destroy the packing and score the shaft sleeve.

Only a sufficient volume of sealing liquid to create a definite direction of flow from the stuffing box inward to the pump casing is required, but the pressure is important. Apply seal water at a rate of approximately .25 GPM at a pressure approximately 15 to 20 psig above the suction pressure. (Approximately one (1) drop per second.)

One recommended method to minimize error in regulating flushing water is a "Controlled Pressure System" (Figure 14). It is important to set the pressure reducing valve adjusted to a value slightly exceeding the maximum stuffing box operating pressure (assuming it is reasonably constant). A flow indicating device will detect a failing of the bottom packing rings allowing leakage in the pump.

External sealing liquid should be adjusted to the point where the packing runs only slightly warm, with a very slow drip from the stuffing box. Excess pressure from an external source can be very destructive to packing. More pressure is required, however, for abrasive slurries than for clear liquids. Examination of the leakage will indicate whether to increase or decrease external pressure. If slurry is present in the leakage, increase the pressure until only clear liquid drips from the box. If the drippage is corrosive or harmful to personnel, it should be collected and piped away.

A common error is to open the external piping valve wide and then control the drippage by tightening the packing gland. A combination of both adjustments is essential to arrive at the optimum condition. The life of packing and sleeve depends on careful control more than any other factor.

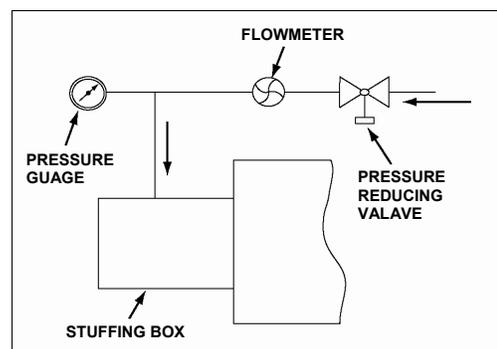


FIGURE 14 – CONTROLLED PRESSURE SYSTEM

Mechanical Seals

Mechanical seals are preferred over packing on some applications because of better sealing qualities and longer serviceability. When a seal is properly installed, it will last longer than packing on similar applications. A mechanical shaft seal is supplied in place of a packed stuffing box when specifically requested. The change from packing to an alternate arrangement may be made in the field by competent service personnel. Conversion parts may be order from your AC Fire Pump Sales Representative.

Just as with packing, the mechanical seal chamber must be supplied, at all times, with a source of clean, clear liquid to flush and lubricate the seal. The most important consideration is to establish the optimum flushing pressure that will keep contaminants from the seal cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive seal wear may result.

When contaminants are present in the system fluid, an external source of clean seal water must be supplied. Supply approximately .25 GPM at a pressure approximately 15 to 20 psig above the suction pressure.

Figure 14 shows the recommended flush system for mechanical seal. Water enters the seal chamber, lubricates the seal face, and exits into the pump itself. Positive flow in the seal water line indicates adequate seal water pressure.

Cartridge Seals

Follow the appropriate lubrication directions for mechanical seals given in this section. Most cartridge seals provide flushing connections on their glands. Use the cartridge seal gland flushing taps (if provided) for your seal water connections instead of the stuffing box tap. The quench taps on the glands (if present) are normally only used in chemical applications. Consult seal manufacturer's literature for more detailed information.

Cyclone Sediment Separators

If the fluid being pumped contains sediment and there is no external, clean water source available to flush the mechanical seals, a cyclone sediment separator can be used to remove most of the sediment from the liquid being pumped so it can be used to flush the seals. The separator is placed in the seal water piping line and removes the sediment to an external drain (normally back to the pump suction line).

OPERATION

PRE-START CHECKS

**WARNING: Unexpected Startup Hazard**

Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

**WARNING: Electrical Shock Hazard**

Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Before the initial start of the pump, make the following inspections:

1. Check alignment between pump and motor. See the section on alignment for alignment requirements.
2. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency on motor nameplate with line circuit.
3. Check suction and discharge piping and pressure gauges for proper operation.
4. Turn rotating element by hand to assure that it rotates freely.
5. Check stuffing box adjustment, lubrication, and piping.
6. Check driver lubrication.
7. Assure that pump bearings are properly lubricated.
8. Assure that coupling is properly lubricated, if required.
9. Assure that pump is full of liquid and all valves are properly set and operational, with the discharge valve closed and the suction valve open. Purge all air from top of casing.
10. Check rotation. Be sure that the driver operates in the direction indicated by the arrow on the pump casing as serious damage can result if pump is operated with incorrect rotation. Check rotation

each time the motor leads have been disconnected.

PRIMING

If the pump is installed with a positive head on the suction, it can be primed by opening the suction valve, and loosening the vent plug on top of the casing (Do not remove), allowing air to be purged from the casing.

If the pump is installed with a suction lift, priming must be done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

**CAUTION:**

Under either condition, the pump must be completely filled with liquid before starting. The pump must not run dry. Serious damage to the pump may result if it is started dry.

Flushing

New and old systems should be flushed to eliminate all foreign matter. Heavy scale, welding splatter and wire or other large foreign matter can clog the pump impeller. This will reduce the capacity of the pump causing cavitation, excessive vibration, and/or damage to close clearance parts (wear rings, seals, sleeves, etc.).

Filling

Vents should be located at the highest point so entrained gases and air can escape. However, if the gases are flammable, toxic, or corrosive they should be vented to an appropriate place to prevent harm to personnel or other parts of the system. Pipe hangers and anchors should be checked to make sure they are properly set to take the additional weight of the pumpage.

All drains should be closed when filling the system. Filing should be done slowly so that excessive velocities do not cause rotation of the pumping elements which may cause damage to the pump or its driver. The adequacy of the anchors and hangers may be checked by mounting a dial indicator off of any rigid structure not tied to the piping and setting the indicator button on the pump flange in the axial direction of the nozzle. If the indicator moves, as the filling proceeds,

the anchors and supports are not adequate or set properly and should be corrected.

STARTING

1. Close drain valves and valve in discharge line.
2. Open fully all valves in the suction line.
3. Slowly turn on seal water to the stuffing box. (If pumped fluid is dirty or if leakage of air is to be prevented, these lines should be always left open.)
4. Prime the pump.

NOTE: If the pump does not prime properly, or loses prime during start-up, it should be shutdown and the condition corrected before the procedure is repeated.

5. Start the pump driver (turbines and engines may require warming up; consult the manufacturer's instructions).
6. When the pump is operating at full speed, open the discharge valve slowly. This should be done promptly after start-up to prevent damage to pump by operating at zero flow.
7. Adjust the liquid seal valves to produce the recommended pressure for either the mechanical seal or packed stuff box.

OPTIONAL CHECKLIST

1. Driver/Pump Rotation: Check rotation each time the motor leads have been disconnected. Be sure that the driver operates in the direction indicated by the arrow on the pump casing. Rough operation and extreme vibration can result if the pump is operated in the wrong direction.
2. Flow: An accurate measurement of flow rate (volume/time) is difficult in the field. Venturi meters, flow nozzles, orifice plates, or timing the draw down in the wet well are all possible methods. Record any reading for future reference.
3. Pressure: Check and record both suction and discharge pressure gauge readings for future reference. Also record voltage, amperage per phase, kilowatts if an indicating wattmeter is available, and pump speed.

4. Temperature: Check and record bearing temperatures using a thermometer. Temperature should not exceed 180°F.
5. Vibration and Sound: The acceptable vibration level of a centrifugal pump depends on the rigidity of the pump and the supporting structure. Recommended values for vibration can vary between .20 ips (inches per second) velocity to .60 ips velocity depending on the operating characteristics and the structure. Refer to the Centrifugal Pump section of the Hydraulic Institute Standards for a complete description and charts on various pumps.

Field sound levels are difficult to measure because of background noise from piping, valves, drivers, gears, etc. Follow recommendations in the Hydraulic Institute Standards.

SHUTDOWN

The following steps will take care of most normal shutdowns of the pump, i.e. maintenance. Make any further adjustments of process piping, valves, etc., as required. If the pump is to be removed from service for an extended period of time, refer to the sections on storage and freeze protection.

1. Shut down the driver. (Consult manufacturer's instructions for special operations.)
2. Close suction and discharge valves.
3. Close seal liquid valves. (If pumped liquid is dirty, or if inleakage is to be prevented, these lines should always be left open, except when the pump is completely drained.)
4. Open drain valves as required.

FREEZE PROTECTION

Pumps that are shut down during freezing conditions should be protected by one of the following methods.

1. Drain the pump; remove all liquid from the casing.
2. Keep fluid moving in the pump and insulate or heat the pump to prevent freezing.

**CAUTION:**

If heat is used to keep the pump from freezing, do not let the temperature rise above 150°F.

FIELD TESTS

A typical performance curve for a specific pump can be obtained from AC Fire Pump. This can be used in conjunction with a field test, if one is required. All AC Fire Pump tests and curves are based on the Hydraulic Institute Standards. Any field test must be conducted according to these Standards.

Unless otherwise specifically agreed, all capacity, head, and efficiencies are based on shop tests when handling clear, cold, fresh water at a temperature not over 85°F.

Appendix "C" (Page 61) contains a field test report sheet and some useful equations which can be used when conducting a field test.

MAINTENANCE

GENERAL MAINTENANCE AND PERIODIC INSPECTION

Operating conditions vary so widely that to recommend one schedule of preventative maintenance for all centrifugal pumps is not possible. Yet, some sort of regular inspection must be planned and followed. We suggest a permanent record be kept of the periodic inspections and maintenance performed on your pump. This recognition of maintenance procedure will keep your pump in good working conditions, and prevent costly breakdowns.

One of the best rules to follow in the proper maintenance of your centrifugal pump is to keep a record of actual operating hours. Then, after a predetermined period of operation has elapsed, the pump should be given a thorough inspection. The length of this operating period will vary with different applications, and can only be determined from experience. New equipment, however, should be examined after a relatively short period of operation. The next inspection period can be lengthened somewhat. This system can be followed until a maximum period of operation is reached which should be considered the operating schedule between inspections.

MAINTENANCE OF FLOOD DAMAGED PUMPS

⚠ WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

The servicing of centrifugal pumps after a flooded condition is a comparatively simple matter under normal conditions.

Bearings are a primary concern on pumping units. First, dismantle the frame, clean and inspect the bearings for any rusted or badly worn surfaces. If bearings are free from rust and wear, reassemble and relubricate them with one of the recommended lubricants. Depending on the length of time the pump has remained in the flooded area, it is unlikely that bearing replacement is necessary; however, in the event that rust or worn surfaces appear, it may be necessary to replace the bearings.

Next, inspect the stuffing box, and clean out any foreign matter that might clog the box. Packing that appears to be worn, or no longer regulates leakage properly should be replaced. Mechanical seals should be cleaned and thoroughly flushed.

Couplings should be dismantled and thoroughly cleaned. Lubricate the coupling with one of the coupling manufacturer's recommended lubricants where required.

BEARING MAINTENANCE BEARING LUBRICATION SCHEDULE

Type of bearing	First lubrication, assembled pumps and replacement bearing frames	First lubrication, replacement bearings	Lubrication interval, pump, polyurea-based grease, operating hours
Grease-lubricated bearings	Not applicable, lubricated before shipment	Hand pack bearings before pressing on the shaft. After bearing frame assembly, follow relube instructions to lube bearings.	<ul style="list-style-type: none"> • 3600 hours, 2 pole • 7200 hours, 4 pole • 50% for severe conditions: dirty, wet and/or above 100°F (38°C) ambient • 50% for bearing frame temperature above 180°F (82°C) • 75% for lithium-based grease

REGREASE THE GREASE-LUBRICATED BEARINGS

It is important to lubricate pumps and motors that require regreasing with the proper grease. See the motor service instructions and nameplate for motor regreasing information. Pumps are to be regreased using the grease types listed below or approved equal. Always keep pump and motor properly lubricated.

NOTICE:
Make sure the grease container, the greasing device, and the fittings are clean. Failure to do so can result in impurities entering the bearing housing when you regrease the bearings.

1. With fully enclosed coupling guards, regrease pump while pump is running.
 - a. With old style open ended guards, stop pump, re-grease, and hand turn shaft before re-starting.
2. Wipe dirt from the grease fittings before greasing.
3. Fill both of the grease cavities through the fittings with the recommended grease. Stop when grease leaks out at shaft.
4. If needed, stop pump and wipe off excess grease.
5. Restart pump.

The bearing temperature usually rises after you regrease due to excess supply of grease. Temperatures return to normal in about two to four operating hours as the pump runs and purges the excess grease from the bearings. Maximum normal bearing housing temperature for polyurea-based grease is 225°F (107°C) and for lithium-based grease 180°F (82°C).

LUBRICATING GREASE REQUIREMENTS

NOTICE:

- Never mix grease of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix lithium-based grease with a polyurea-based grease. This can result in decreased performance.
- Remove the bearings and old grease if you need to change the grease type or consistency. Failure to do so can result in equipment damage or decreased performance.

Specifications – Grease Types

Polyurea-based greases	Lithium-based greases, NLGI 2
Pumps built on or after Dec 1, 2014 use Polyurea-based greases. See date code label and lubrication label on pump or bearing frame indicating polyurea-base grease	Pumps built before Dec 1, 2014 were built with Lithium-based greases, NLGI 2, and do not have lubrication label on pump or bearing frame indicating pump grease type
ExxonMobil Polyrex™ EM	Shell Gadus® S2 V100 2 (was Alvania® RL 2)
Chevron SRI NLGI 2	Chevron Multifak® EP 2
Shell Gadus® S5 T100 2	ExxonMobil Unirex™ N2

Oil Lubrication of Bearings

Oil lubrication on 8100 Series pumps is considered special. Oil lubricated pumps are installed with Trico oilers (See Figure 15). The oilers keep the oil level in the housings constant.

After the pump has been installed, flush the housing to remove dirt, grit, and other impurities that may have entered the bearing housing during shipment or installation. Then refill the housing with proper lubricant. (The housing must be filled using the Trico oiler.) The oil level will be maintained by the Trico oiler. (See the SERVICE section for proper instructions.)

A Mobil Oil, DTE Medium, or equal, meeting the following specification will provide satisfactory lubrication. Similar oils can be furnished by all major oil companies. It is the responsibility of the oil vendor to supply a suitable lubricant.

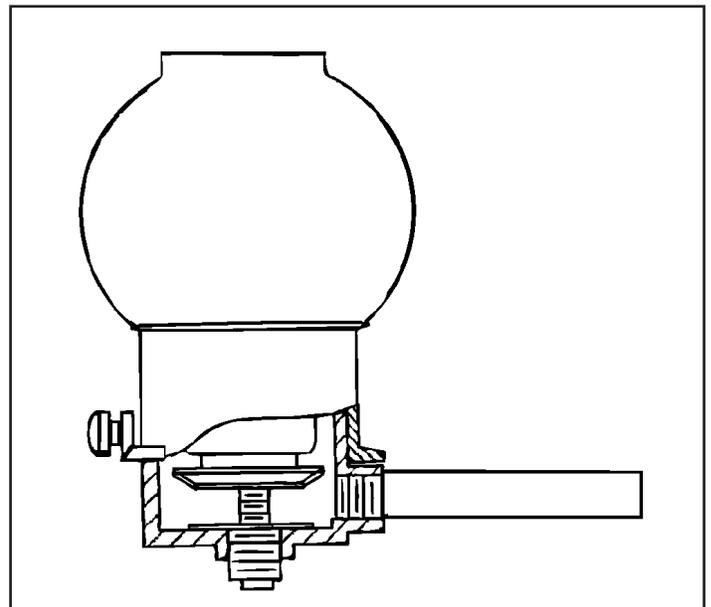


FIGURE 15 – TRICO OILER

(1) Saybolt viscosity at 100°F....	215 SSU-240 SSU
(2) Saybolt viscosity at 210°F.....	49 SSU
(3) Viscosity index, minimum	95
(4) API gravity	28-33
(5) Pour point, maximum.....	+20°F
(6) Flash point, minimum.....	400°F
(7) Additives	Rust & Oxidation inhibitors
(8) ISO viscosity.....	46

NOTE: Oils from different suppliers should not be mixed. Engine oils are not recommended.

The oil should be a non-foaming, well refined, good grade, straight cut, filtered mineral oil. It must be free from water, sediment, resin, soaps, acid and fillers of any kind.

In installations with moderate temperature changes, low humidity, and a clean atmosphere, the oil should be changed after approximately 1000 hours of operation. The oil should be inspected at this time to determine the operating period before the next oil change. Oil change periods may be increased up to 2000-4000 hours based on an 8000 hour year. Check the oil frequently for moisture, dirt, or signs of “breakdown,” especially during the first 1000 hours.

Do not over oil; this causes the bearings to run hot. The maximum desirable bearing housing operating temperature for all ball bearings is 180°F. Should the temperature of the bearing frame exceed 180°F (measured by thermometer) shut down pump to determine the cause.

Coupling Lubrication

Flexible, rubber element type couplings (Wood’s Sure-Flex or Falk Wrap Flex coupling for instance) provide smooth transmission of power. There is no rubbing action of metal against rubber to cause wear. Couplings are not affected by abrasives, dirt, or moisture. This eliminates the need for lubrication or maintenance, and provides clean and quiet performance.

If other type of couplings are used, follow maintenance instructions of coupling manufacturer.

SEAL INFORMATION

Packing (Non-Asbestos)

On packed pumps the packing is installed prior to shipment. All packings used are the highest grade material. Before pump is put

into operation check the condition of packing. If pump is installed within sixty (60) days after shipment the packing will be in good condition with a sufficient supply of lubrication. If pump is stored for a longer period it may be necessary to repack the stuffing box. In all cases, however, we recommend an inspection of the packing before pump is started.

The standard 8100 series pump packing is made from braided acrylic yarn impregnated with graphite.

A soft, well-lubricated packing reduces stuffing box resistance and prevents excessive wear on the shaft or shaft sleeve. Many brands of packing on the market have the desired qualities. Standard packing is YC industry style 608D, or equal.

When a pump with fiber packing is first started it is advisable to have the packing slightly loose without causing an air leak. As the pump runs in, gradually tighten the gland bolts evenly. The gland should never be drawn to the point where packing is compressed too tightly and no leakage occurs. This will cause the packing to burn, score the shaft sleeve and prevent liquid from circulating through the stuffing box cooling the packing. The stuffing box is improperly packed or adjusted if friction in the box prevents turning the rotating element by hand. A properly operated stuffing box should run lukewarm with a slow drip of sealing liquid. After the pump has been in operation for some time, and the packing has been completely run-in, drippage from the stuffing box should be at least 40 to 60 drops per minute. This will indicate proper packing and shaft sleeve lubrication and cooling.

NOTE: Eccentric run-out of the shaft or sleeve through the packing could result in excess leakage that cannot be compensated for. Correction of this defect is very important.

Packing should be checked frequently and replaced as service indicates. Six months might be a reasonable expected life, depending on operating conditions. It is impossible to give any exact predictions. A packing tool should be used to remove all old packing from the stuffing box. Never reuse old and lifeless packing or merely add some new rings. Make sure the stuffing box is thoroughly cleaned before new packing is installed. Also check the condition of the shaft

or sleeve for possible scoring or eccentricity, make replacements where necessary.

New packing (non-asbestos) should be placed carefully into the stuffing box. If molded rings are used, the rings should be opened sideways and the joints pushed into the stuffing box first. The rings are installed one at a time, each ring seated firmly and the joints staggered at about a 90° rotation from each preceding joint.

If coil packing is used, cut one ring to accurate size with either a butt or mitered joint. An accurately cut butt joint is superior to a poor fitting mitered joint. Fit the ring over the shaft to assure proper length. Then remove and cut all other rings to the first sample. When the rings are placed around the shaft a tight joint should be formed. Place the first ring in the bottom of the stuffing box. Then install each succeeding ring, staggering the joints as described above, making sure each ring is firmly seated.

Make sure the seal cage is properly located in the stuffing box under the sealing water inlet. The function of the seal cage is to establish a liquid seal around the shaft, prevent leakage of air through the stuffing box and lubricate the packing. If it is not properly located it serves no purpose.

Mechanical Seals

General instructions for operation of the various mechanical sealing arrangements are included below. It is not feasible to include detailed instructions for all mechanical seals in this booklet because of the almost unlimited number of possible combinations and arrangements. Instead, seal manufacturer's instructions will be included as a separate supplement to this book, where required.

- a. Mechanical seals are precision products and should be treated with care. Use special care when handling seals. Clean oil and clean parts are essential to prevent scratching the finely lapped sealing faces. Even light scratches on these faces could result in leaky seals.
- b. Normally, mechanical seals require no adjustment or maintenance except routine replacement of worn or broken parts.

- c. A mechanical seal which has been used should not be put back into service until the sealing faces have been replaced or relapped. (Relapping is generally economical only in seals two inches in size and above.)

Four important rules which should always be followed for optimum seal life are:

1. Keep the seal faces as clean as possible.
2. Keep the seal as cool as possible.
3. Assure that the seal always has proper lubrication.
4. If seal is lubricated with filtered fluid, clean filter frequently.

MAINTENANCE TIME TABLE

EVERY MONTH	<p>Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 180°F), it may be the result of too much lubricant. If changing the lubricant does not correct the condition, disassembly and inspect the bearings. Lip seals bearing on the shaft may also cause the housing to run hot. Lubricate lip seals to correct.</p>
EVERY 3 MONTHS	<p>Check the oil on oil lubricated units. Check grease lubricated bearings for saponification. This condition is usually caused by the infiltration of water or other fluid past the bearing shaft seals and can be noticed immediately upon inspection, since it gives the grease a whitish color. Wash out the bearings with a clean industrial solvent and replace the grease with the proper type as recommended.</p>
EVERY 6 MONTHS	<p>Check the packing and replace if necessary. Use the grade recommended. Be sure the lantern rings are centered in the stuffing box at the entrance of the stuffing box piping connection.</p> <p>Take vibration readings on the bearing housings. Compare the readings with the last set of readings to check for possible pump component failure (e.g. bearings)</p> <p>Check shaft or shaft sleeve for scoring. Scoring accelerates packing wear.</p> <p>Check alignment of pump and motor. Shim up units if necessary. If misalignment reoccurs frequently, inspect the entire piping system. Unbolt piping at suction and discharge flanges to see if it springs away, thereby indicating strain on the casing. Inspect all piping supports for soundness and effective support of load. Correct as necessary.</p>
EVERY YEAR	<p>Remove the upper half of the casing. Inspect the pump thoroughly for wear, and order replacement parts if necessary.</p> <p>Check wear ring clearances. Replace when clearances become three (3) times their normal clearance or when a significant decrease in discharge pressure for the same flow rate is observed. See Engineering Data Section for standard clearances.</p> <p>Remove any deposit or scaling. Clean out stuffing box piping.</p> <p>Measure total dynamic suction and discharge head as a test of pump performance and pipe condition. Record the figures and compare them with the figures of the last test. This is important, especially where the fluid being pumped tends to form a deposit on internal surfaces. Inspect foot valves and check valves, especially the check valve which safeguards against water hammer when the pump stops. A faulty foot or check valve will reflect also in poor performance of the pump while in operation.</p>

NOTE: *The above time table is based on the assumption that after start-up, the unit had been constantly monitored and such a schedule was found to be consistent with operation, as shown by stable readings. Extreme or unusual applications or conditions should be taken into consideration when establishing the maintenance intervals.*

TROUBLE SHOOTING

Between regular maintenance inspections, be alert for signs of motor or pump trouble. Common symptoms are listed below. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUTDOWN.

CAUSES	CURES
No Liquid Delivered	
1. Lack of prime.	Fill pump and suction pipe completely with liquid.
2. Loss of prime.	Check for leaks in suction pipe joints and fittings; vent casing to remove accumulated air. Check mechanical seal or packing.
3. Suction lift too high (a negative suction gauge reading).	If there is no obstruction at inlet and suction valves are open, check for pipe friction losses. However, static lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, liquid to be pumped must be raised or pump lowered.
4. System static head too high.	Check with factory to see if a larger impeller can be used; otherwise, cut pipe losses or increase speed – or both, as needed. But be careful not to seriously overload driver.
5. Speed too low.	Check whether motor is directly across-the-line and receiving full voltage. Frequency may be too low. Motor may have an open phase.
6. Wrong direction of rotation.	Check motor rotation with directional arrow on pump casing. If rotation is correct with arrow, check the relationship of the impeller with casing. (This will require removing casing upper half.) See Figure 16, page 32.
7. No rotation.	Check power, coupling, line shaft and shaft keys.
8. Impeller loose on shaft.	Check key, locknut and set screws.
9. Impeller completely plugged.	Dismantle pump and clean impeller.
10. System head or required discharge	Check pipe friction losses. Large piping may correct condition. head too high. Check that valves are wide open.
Not Enough Liquid Delivered	
11. Air leaks in suction piping.	If liquid pumped is water or other non-explosive and explosive gas or dust is not present, test flanges for leakage with flame or match. For such liquids as gasoline, suction line can be tested by shutting off or plugging inlet and putting line under pressure. A will indicate a leak with a drop of pressure.
12. Air leaks in stuffing box.	Replace packing and sleeves if appropriate or increase seal lubricant pressure to above atmosphere.
13. Speed too low.	See item 5.
14. Discharge head too high.	See item 10.
15. Suction lift too large.	See item 3.

TROUBLE SHOOTING (cont.)

Causes	Cures
16. Impeller partially plugged.	See item 9.
17. Cavitation; insufficient NPSHA (Net Positive Suction Head Available).	a. Increase positive suction head on pump by lowering pump or increasing suction pipe and fittings size.
	b. Sub-cool suction piping at inlet to lower entering liquid temperature.
	c. Pressurize suction vessel.
18. Defective impeller and/or wear rings.	Inspect impeller and wear rings. Replace if damaged or vane sections badly eroded, or if wear ring clearance is three times normal.
19. Foot valve too small or partially obstructed.	Area through ports of valve should be at least as large as area of suction pipe (preferably 1.5 times). If strainer is used, net clear area should be 3 to 4 times area of suction pipe.
20. Suction inlet not immersed deep enough.	If inlet cannot be lowered or if eddies through which air is sucked persist when it is lowered, chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
21. Wrong direction of rotation.	Symptoms are an overloaded driver and about one third rated capacity from pump. Compare rotation of motor with directional arrow on pump casing. If rotation is correct with arrow, impeller may have to be turned 180°. (See CHANGING ROTATION.)
22. System head too high.	See item 4.
23. Defective mechanical seal.	Repair or replace seal.
Not Enough Pressure	
24. Speed too low.	See item 5.
25. Air leaks in suction piping or stuffing box.	See item 11.
26. Mechanical defects.	See item 18.
27. Vortex at suction inlet.	See item 20.
28. Obstruction in liquid passages.	Check to see if suction and discharge valves are fully open. Dismantle pump and inspect passages and casing. Remove obstruction.
29. Air or gases in liquid.	May be possible to over rate pump to a point where it will provide adequate pressure despite condition. Better provide gas separation chamber on suction line near pump and periodically exhaust accumulated gas. See item 17.

TROUBLE SHOOTING (cont.)

Causes	Cures
Pump Operates For Short Time, Then Stops	
30. Insufficient NPSHA.	See item 17.
31. System head too high.	See items 4 and 10.
Pump Takes Too Much Power	
32. Head lower than rating; thereby pumping too much liquid.	Machine impeller's O.D. to size advised by factory or reduce speed.
33. Cavitation	See item 17.
34. Mechanical defects.	See items 18, 19, 21, and 23.
35. Suction inlet not immersed.	See item 20.
36. Liquid heavier (in either viscosity or specific gravity) than allowed for.	Use larger driver. Consult factory for recommended size. Test liquid for viscosity and specific gravity.
37. Wrong direction of rotation.	See item 6.
38. Stuffing box glands too tight.	Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing.
39. Casing distorted by excessive strains from suction or discharge piping.	Check alignment. Examine pump for rubbing between impeller and casing. Replace damaged parts.
40. Shaft bent due to damage – through shipment, operation, or overhaul.	Check deflection of rotor by turning on bearing journals. Total indicator run-out should not exceed .002" on shaft and .004" on impeller wearing surface.
41. Mechanical failure of critical pump parts.	Check wear rings and impeller for damage. Any irregularity in these parts will cause a drag on shaft.
42. Misalignment.	Realign pump and driver.
43. Speed may be too high.	Check voltage on motor. Check speed versus pump nameplate rating.
44. Electrical defects.	The voltage and frequency of the electrical current may be lower than that for this motor was built, or there may be defects in motor. The motor may not be ventilated properly due to a poor location.
45. Mechanical defects in turbine, engine or other type of drive exclusive of motor.	If trouble cannot be located, consult factory.

SERVICE

DISASSEMBLY AND REASSEMBLY PROCEDURES

The procedures outlined in this section cover the dismantling and reassembly of three different types of 8100 Series pump construction.

- A. 8100 Series pump with packing.
- B. 8100 Series pump with mechanical seals on shaft.
- C. 8100 Series pump with mechanical seals on shaft sleeves.

Each procedure provides the step-by-step instructions for dismantling and then reassembling the pump, depending upon the type of shaft seal used.

When working on the pump, use accepted mechanical practices to avoid unnecessary damage to parts. Check clearances and conditions of parts when pump is dismantled and replace if necessary. Steps should usually be taken to restore impeller and casing ring clearance when it exceeds three times the original clearance.

If your pump has adjustable wear rings, please refer to the instructions on page 48.



CAUTION:

For pumps in the vertical configuration, (Models 200 and 300) please follow the instructions for the disassembly and reassembly of a vertical rotating element on page 49.

CHANGING ROTATION



WARNING: Unexpected Startup Hazard

Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.



WARNING: Electrical Shock Hazard

Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.



WARNING: Rotating Components Hazard

Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

8100 Series centrifugal pumps can be operated clockwise or counterclockwise when viewed from the coupling end of the pump. If you wish to reverse the suction and discharge nozzles; i.e., change rotation, this can be accomplished with the same pump as follows:

1. Remove the impeller from the shaft, turn it 180° and replace it on the shaft. (Follow the disassembly procedures given in this manual.)
2. With the rotating element out of the casing, remove the casing from the base and turn 180°. (Factory bases are drilled for both rotations.)
3. Set the rotating element back in the casing and reassemble the pump.

NOTE: The impeller and casing are in the same relationship to each other as they were originally. The shaft and motor are also in the same relationship to each other as they were originally.

4. Reassemble the pump and realign the coupling as called for in the alignment instructions.
5. The rotation of the motor must be changed by switching the motor leads.

NOTE: Unless the motor rotation is reversed the impeller will run backward.

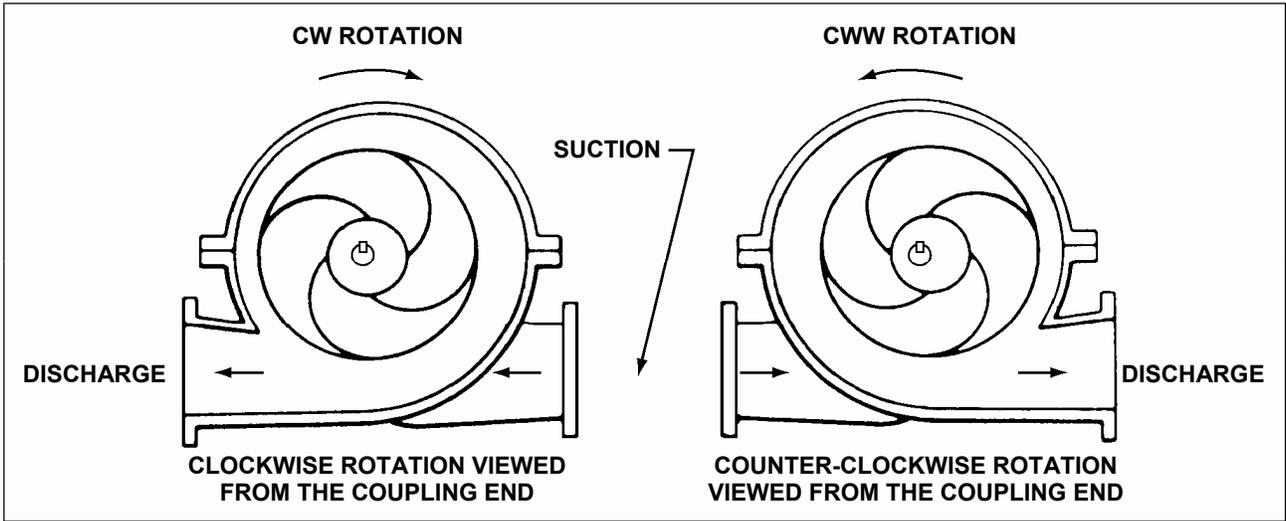


FIGURE 16 – CORRECT RELATIONSHIP OF IMPELLER AND CASING

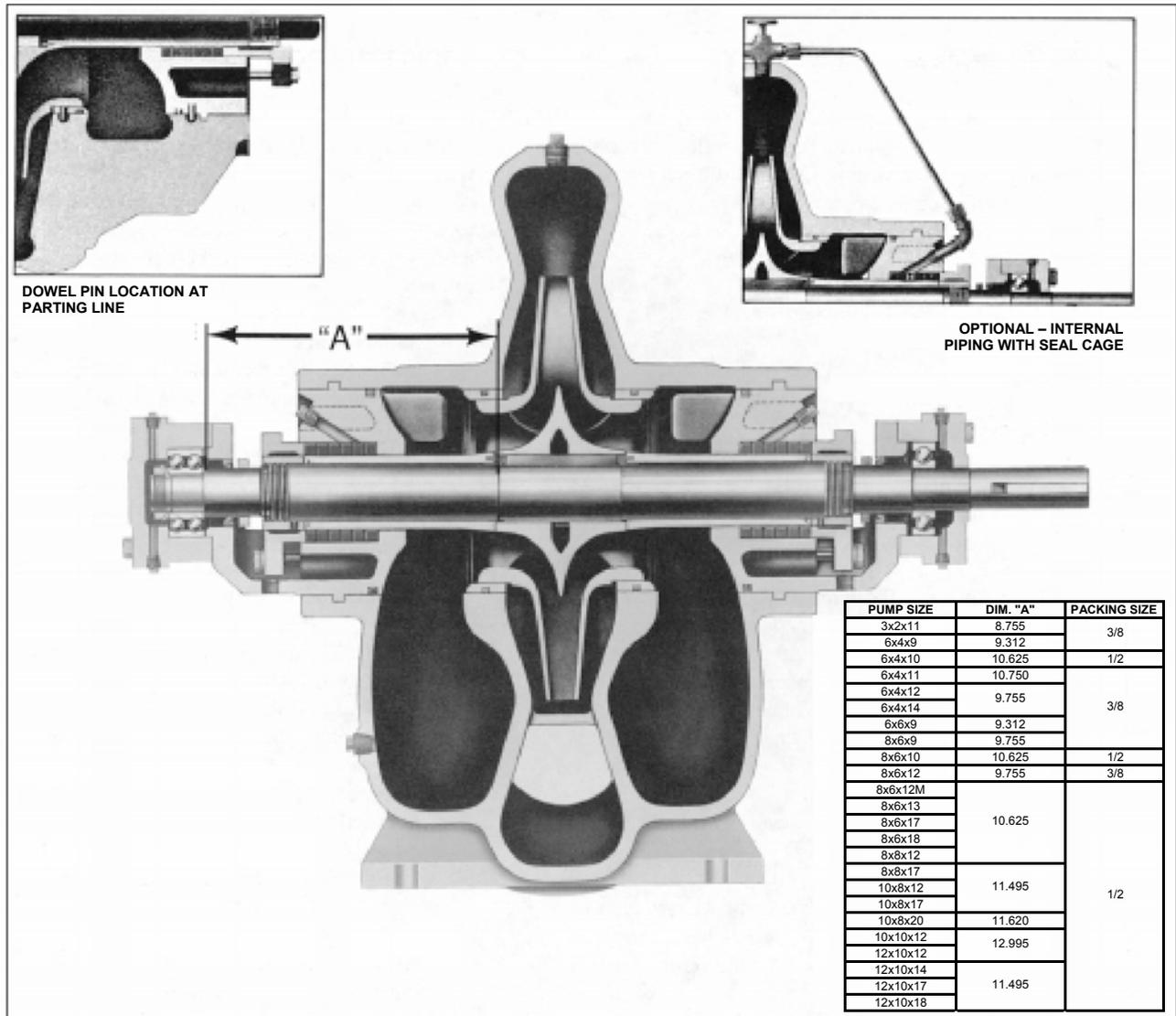


FIGURE 17 – ASSEMBLY SECTION: PUMP WITH PACKING

A. DISMANTLING (PUMP WITH PACKING)

⚠ WARNING: Unexpected Start-up Hazard
Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

(See exploded view on page 57.)

1. Drain the pump by opening vent plug (A, Figure 18) and remove drain plugs (B and C) on the suction and discharge nozzles.
2. Remove all casing main joint cap screws (2-904-1) and dowels (2-916-1). Remove external tubing (0-952-0) if supplied.
3. Insert a screwdriver or pry bar into the slots between the upper and lower casing halves, and separate the halves, lifting off the upper casing half. (**NOTE:** Some casings have jacking screws.)

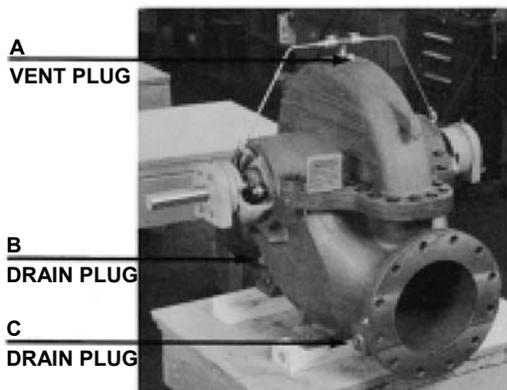


FIGURE 18 – PUMP WITH PACKING

4. Tap the stuffing boxes with a soft-headed hammer to break the seal between the stuffing box and lower casing half, and lift the rotating element out of the lower casing. Rotating element may now be moved to a suitable working location (See Figure 19).

NOTE: A spare rotating element can be installed at this point.

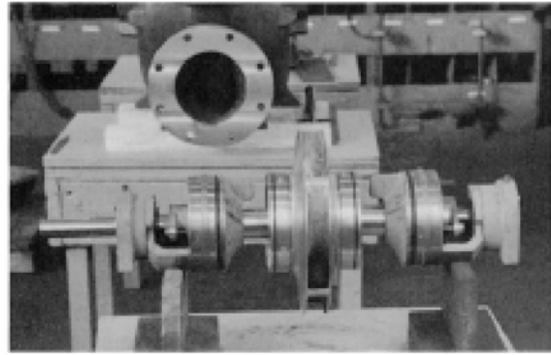


FIGURE 19 – ROTATING ELEMENT (PACKING INSTALLED)

5. Remove four cap screws (3-904-9) from each bearing housing (3-025-3 and -4) and remove the bearing housings from the shaft (3-007-0).
6. Bend back lockwasher tab and remove locknut (3-516-4) and lockwasher (3-517-4) from the outboard end of the shaft and, using a bearing or gear puller, remove the bearing (3-026-4) from the shaft. Remove the inboard end bearing (3-026-3) in the same manner.

NOTE: Locknut and lockwasher are not used on inboard end bearing.

⚠ CAUTION:
DO NOT REUSE THE BALL BEARINGS.

7. Slide both stuffing boxes (3-073-9) off of the shaft, working deflector rings (3-136-9) off the shaft at the same time (See Figure 20).
8. Remove lip seals (3-177-9) from the stuffing boxes.
9. Remove the two gland bolts (1-904-9), gland halves (1-014-9), packing (1-924-9) and, if supplied, seal cage (1-013-9) from each stuffing box. Remove the O-rings (3-914-1) from the stuffing boxes.
10. Remove the two casing rings (3-003-9) from the impeller (4-002-0) and remove O-rings (3-914-2) from each casing ring.

NOTE: Each casing ring on 10x8x20 and 12x10x18 has 2 O-rings (See Figure 21B p. 24).

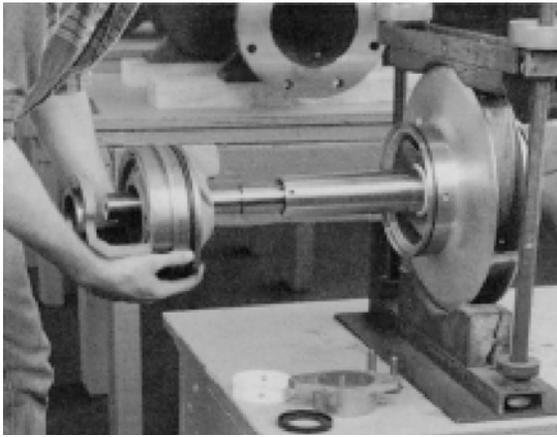


FIGURE 20 – REMOVING STUFFING BOX

11. Loosen set screws (3-902-3) in shaft nuts (3-015-9) and then remove shaft nuts using pin scanner wrench. Remove O-rings (3-914-9) from counterbore in shaft sleeves.

NOTE: Both shaft nuts have right handed threads.

12. To remove the sleeve, hold the shaft vertically and drop it on a block of wood. The impeller weight should force both the impeller and sleeve from the shaft. **NOTE:** There is a silicone adhesive/sealant between the sleeve and the impeller.

13. Remove the other shaft sleeve, nut and sleeve O-ring as described in steps 11 and 12.

NOTE: For impellers with replaceable rings – remove the rings (0-004-0), if necessary, by cutting with a cold chisel (See Figure 21A).

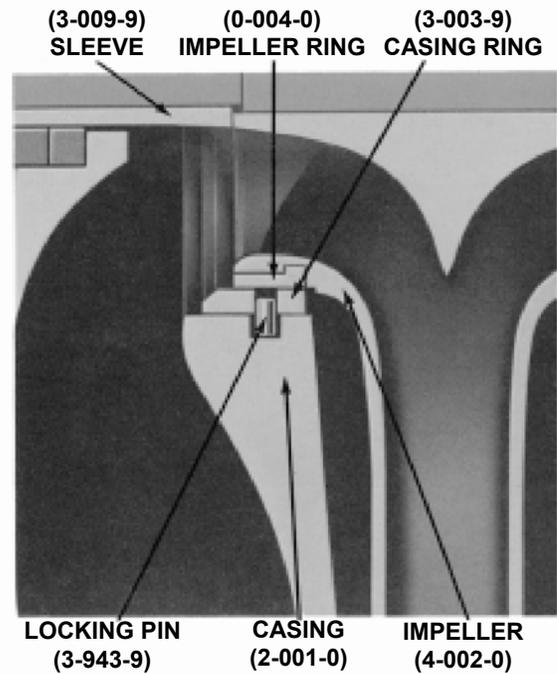


FIGURE 21A – IMPELLER WITH WEAR RINGS

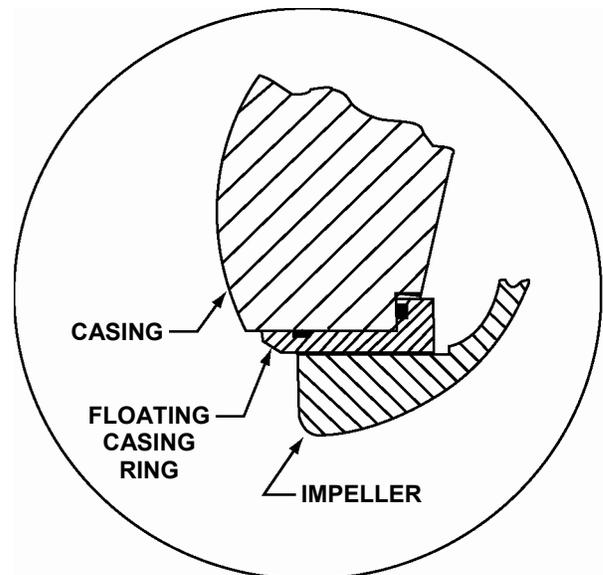


FIGURE 21B – “FLOATING” CASING RING (10X8X20 AND 12X10X18)

14. Remove the impeller key (3-911-1) from the shaft.

ASSEMBLY (PUMP WITH PACKING)

All bearings, O-rings, lip seals, gaskets, impeller rings, and casing wear rings should be replaced with new parts during assembly. All reusable parts should be cleaned of all foreign matter before reassembling. The main casing joint gasket can be made using the upper or lower half as a template. Lay the gasket material on the casing joint. Trim

the gasket, lightly tapping with a ball peen hammer so that it is flush with the inside edges of the casing.

NOTE: Precut casing gaskets (2-153-5 & 6) can be ordered to minimize the amount of trimming.

1. Assemble the impeller key (3-911-1) in the shaft key slot.
2. Check the impeller (4-002-0) and casing to determine the correct relationship (See Figure 16) and locate the impeller on the shaft per dimension "A" given in the table on Figure 17.

NOTE: For impeller with replaceable rings, heat each new ring (0-004-0) (approximately 300°-400°F for bronze) and slide onto the impeller. Using gloves, hold rings against the impeller shoulder until they cool.

3. Starting with the outboard end, apply a 1/4" bead of RTV (DOW CORNING SILICONE SEALANT or equivalent) at the impeller hub face, making sure to fill up the keyway.
4. Slide the sleeve (3-009-9) onto shaft, rotating the sleeve to evenly distribute the sealant applied in step 3. Refer to Optional Method of Installing Packing at the end of this section before mounting sleeve on shaft.



CAUTION:

THE PIN IN EACH SHAFT SLEEVE MUST SEAT IN THE IMPELLER KEY SLOT.

5. Place the sleeve O-ring (3-914-9) onto the shaft, into the sleeve counterbore. Assemble the shaft sleeve nut (3-015-9).
6. Repeat steps 3 through 5 for the inboard shaft sleeve, O-ring and nut. Wipe off excess RTV.
7. Verify that Dimension "A" in Figure 17 on page 32 is maintained, then using a pin scanner wrench and hammer, securely tighten the shaft sleeve nuts. Then, drill a shallow recess in the shaft through the set screw hole in each of the shaft sleeve nuts. Lock each shaft sleeve nut in position with serrated head set screws (3-902-3) (See Figure 22). A low strength sealant, such as Loctite 271, can be used to retain set screws.

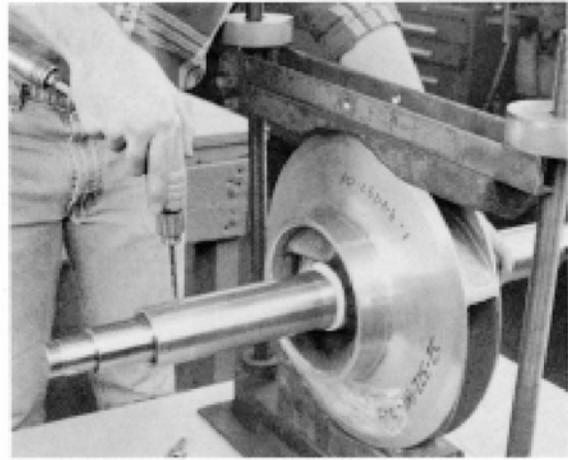


FIGURE 22 – DRILLING SET SCREW RECESS

8. Lubricate and roll an O-ring (3-914-2) into the groove in each casing ring (3-003-9) and slide the casing rings over the impeller (See Figure 23).

NOTE: 10x8x20 and 12x10x18 utilize "Floating" Casing Ring Design. Each ring requires 2 O-rings (See Figure 21B).

9. Press a new lip seal (3-177-9) into each stuffing box. Before installing the seal, lubricate the seal lip with a lightweight oil.

NOTE: Lip seals should seat against machined shoulder in bracket.

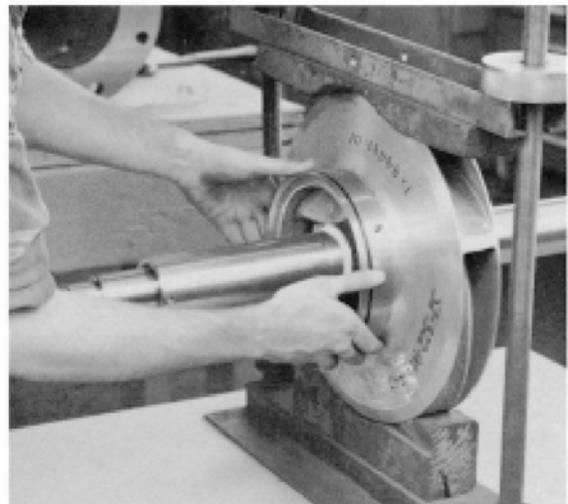


FIGURE 23 – INSTALLING RINGS

NOTE: Seal lip should point away from the bearings (3-026-3 and -4), if the bearings are grease lubricated, and towards the bearings, if the bearings are oil lubricated (See Figure 24).

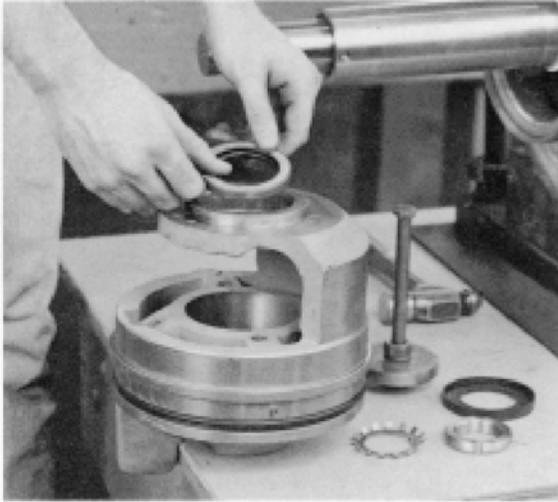


FIGURE 24 – INSTALLING LIP SEAL

10. Lubricate and roll O-ring (3-914-1) into the groove in each stuffing box.
11. Slide outboard stuff box on the shaft so that the shaft end extends through the packing area, but does not enter the lip seal. This will permit installation of deflector (3-136-9).
12. Slide the deflector over the shaft end then carefully push the shaft end through the lip seal and slide the stuffing box fully onto the shaft.



CAUTION:
DO NOT EXCEED 275°F.

13. Heat the ball bearing (3-026-4), using either dry heat or a 10-15% soluble oil and water solution.
14. Using gloves, slide the heated bearing onto the shaft against the shaft shoulder (See Figure 25).

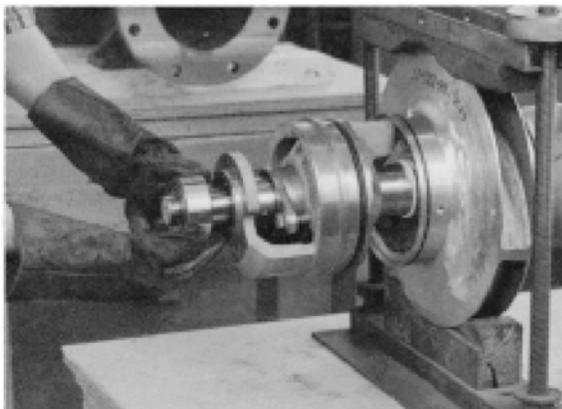


FIGURE 25 – INSTALLING SHAFT BEARING

15. Install lockwasher (3-517-4) and locknut (3-516-4) on the outboard end of the shaft. Make certain locknut is secured and then bend over tabs on lockwasher.
16. Allow the bearing to cool to room temperature. On grease lubricated bearings only, coat the exposed sides with two or three ounces of recommended grease.
17. On grease lubricated bearings, coat the inside of the bearing housing (3-025-4) with grease and slide into place over bearing. Attaching the bearing housing to the stuffing box with four cap screws (3-904-9).
18. Repeat steps 11 through 14, 16 and 17 for the inboard end.

NOTE: A locknut and lockwasher are not installed on the inboard end of the shaft.

19. Clean the gasket surfaces of the casing. Apply Scotch 3M-77 spray adhesive or equivalent to the lower half of the casing.
20. Within one minute of spraying, set the untrimmed gaskets (2-123-5 and -6) in place on the lower half casing, align the holes in the gaskets with the holes in the casing and press the gaskets firmly against the lower half casing face in the area coated by the adhesive.
21. Trim the gaskets flush with the lower casing bores, if this has not been done as yet.



CAUTION:
Machined casing bores must remain sharp at the casing parting line. Gaskets must be flush with bore in order to contact O-rings. Leakage can result around stuff box O-ring if this step is not properly followed.

22. Set the rotating element in the pump casing (2-001-0), assuring correct rotation. Locate both stuffing box tongues in their respective casing grooves. Locate pins (3-943-9) in the stuffing box and the casing wear rings in their respective slots at the casing parting surface. Correct any O-ring bulging (See Figure 26).

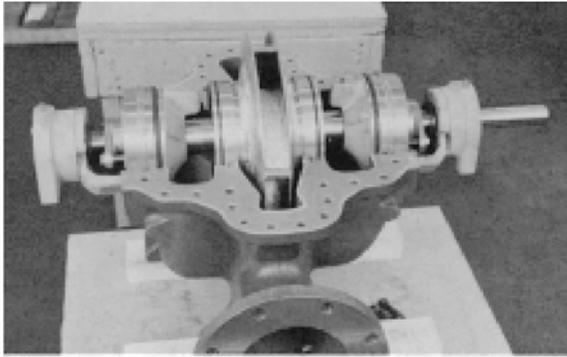


FIGURE 26 – UPPER CASING HALF REMOVED



CAUTION:

Do not cut or damage O-rings when lowering the rotating element into position. When all four anti-rotation pins (3-943-9) are correctly located, there will be some casing ring looseness.

23. Lower the upper half casing (2-001-0) into place using the tapered dowel pins (2-916-1) and install casing main joint bolts (2-904-1). The casing joint bolts should be tightened to the following torques: 140 ft-lb minimum for 5/8"-11 hex head cap screws (Grade 5); 350 ft-lb minimum for 7/8"-9 Ferry Cap Counterbore screws (Grade 8). Bolt torquing pattern is shown in Figure 59.

NOTE: Torque values are essential in obtaining proper gasket compression so no leakage can occur at main joint.

24. Rotate the shaft by hand to assure that it turns smoothly and is free from rubbing or binding.

25. Install seal water piping (0-952-0), if supplied.

26. PACKING (NON ASBESTOS)

Install 12 full rings of packing (6 per stuffing box) so that the ends butt, leaving no gap between the packing and the stuffing box. (Refer to the table in Figure 17 for packing size.) Press the packing to the bottom of the stuffing box. Stagger the joints of each packing ring at least 90 degrees. For 3 adjacent rings, use the 4, 8 and 12 o'clock positions. **NOTE:** The last ring in each box may not be required until after the pump has operated for a period of time.

NOTE: When supplied, the seal cage will replace the third packing ring from the bottom, requiring only 10 rings of packing. The seal cage must be aligned with the seal water inlet when the packing is compressed.

Assemble the glands (1-014-9), washers (0-909-0), and bolts (1-904-9) square with the stuffing box and pull up tight. Then loosen the gland bolts (1-904-0) to permit the packing to expand. Then retighten finger tight. Final adjustment of the gland bolts must be done with the pump running. Allow 30 minutes between adjustments. A good adjustment should allow approximately one (1) drip per second.

OPTIONAL METHOD FOR INSTALLING PACKING (AFTER PUMP DISASSEMBLY)

Place stuffing box (3-073-9) on a table or workbench with the stuffing box opening up. Assemble the packing per step 26 with the shaft sleeve placed in the stuffing box. After completing step 26, remove shaft sleeve and continue to assemble pump per step 4.

The entire assembly may then be placed into position over the sleeve in step 11.

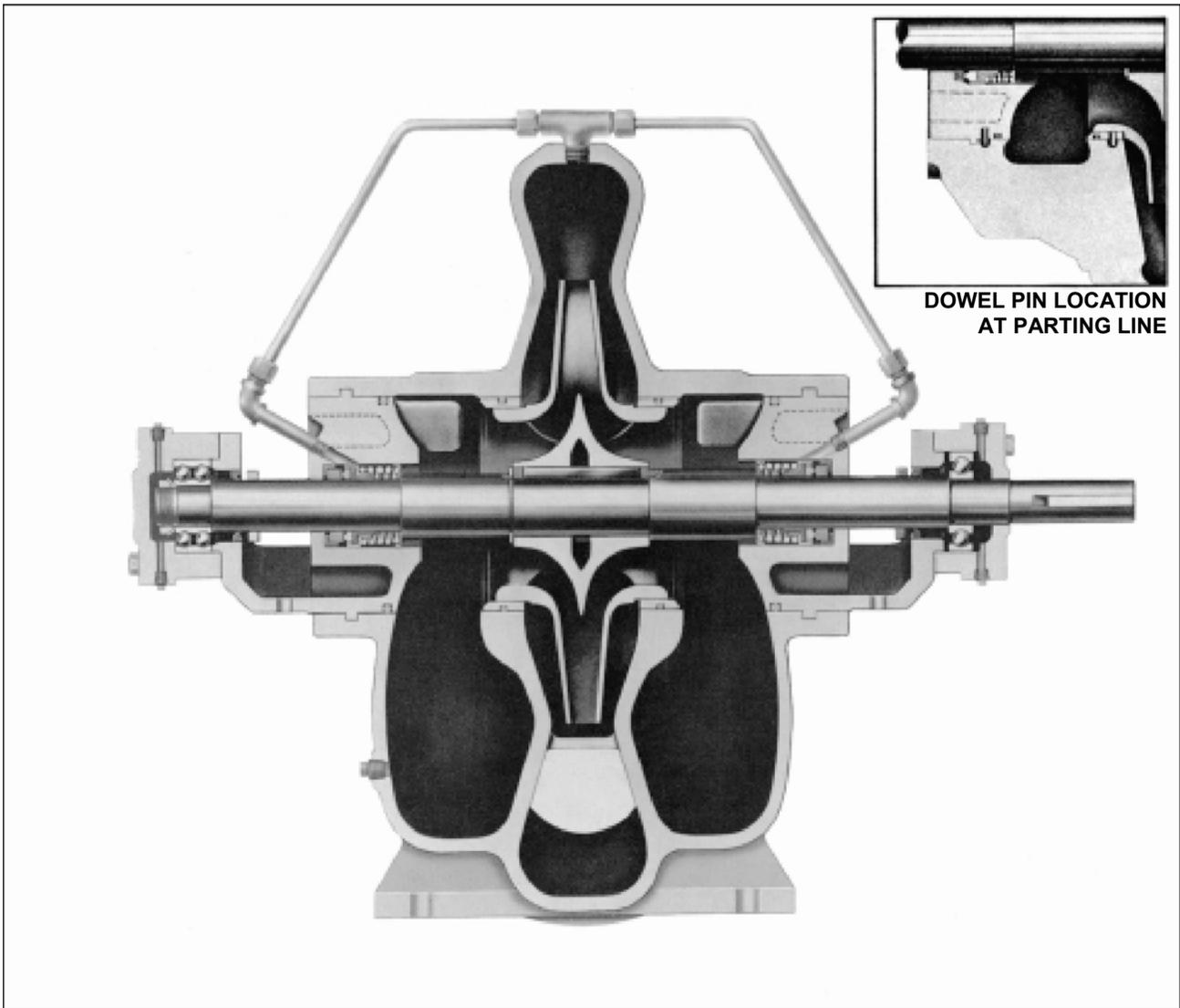


FIGURE 27 – ASSEMBLY SECTION: PUMP WITH MECHANICAL SEALS ON SHAFT

B. DISMANTLING (PUMP WITH MECHANICAL SEALS ON SHAFT)



WARNING: Unexpected Startup Hazard

Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.



CAUTION: Extreme Temperature Hazard

Allow pump temperatures to reach acceptable levels before proceeding. Open drain valve. Do not proceed until liquid stops coming out of drain valve. If liquid does not stop flowing from drain valve, isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from drain valve, leave drain valve open and continue. Remove the drain plug located on the bottom of the pump housing. Do not reinstall plug or close drain valve until reassembly is completed. Failure to follow these instructions could result in property damage and/or moderate personal injury.

**WARNING:**

Prior to working on pump the power source should be disconnected with lockout provisions so power cannot be re-energized to the motor. Close isolating suction and discharge valves. Failure to follow these instructions could result in property damage, severe personal injury, or death.

(See exploded view on page 58.)

1. Drain the pump by opening vent plug (A, Figure 28) and remove drain plugs (B and C) on the suction and discharge nozzles.
2. Remove all casing main joint cap screws (2-904-1) and dowels (2-916-1). Remove external tubing (0-952-0).
3. Insert a screwdriver or pry bar into the slots between the upper and lower casing halves, and separate the halves, lifting off the upper casing half. (NOTE: Some casings have jacking screws.)

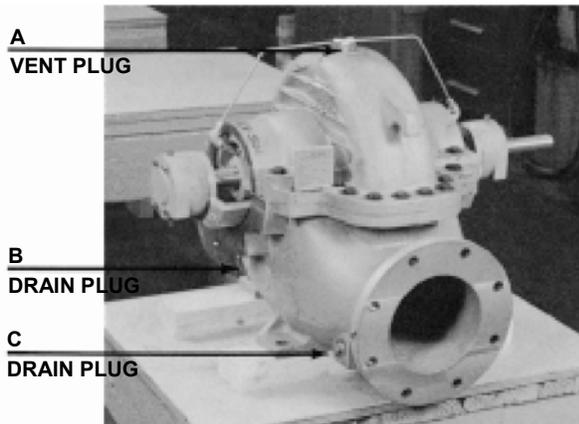


FIGURE 28 – PUMP WITH MECHANICAL SEALS

4. Tap the stuffing boxes with a soft-headed hammer to break the seal between the stuffing box and lower casing half, and lift the rotating element out of the lower casing. Rotating element may now be removed to a suitable location to work on.

NOTE: A spare rotating element can be installed at this point.

5. Remove four cap screws (3-904-9) from each bearing housing (3-025-3 and -4) and remove the bearing housings from the shaft (3-007-0).
6. Bend back lockwasher tab and remove locknut (3-516-4) and lockwasher (3-517-4) from the outboard end of the shaft and, using a puller, remove the bearing (3-026-

4) from the shaft. Remove the inboard end bearing (3-026-3) in the same manner.

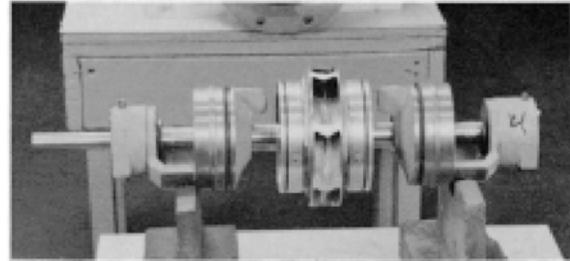


FIGURE 29 – ROTATING ELEMENT

NOTE: Locknut and lockwasher are not used on inboard end bearing.

**CAUTION:**

DO NOT REUSE THE BALL BEARINGS.

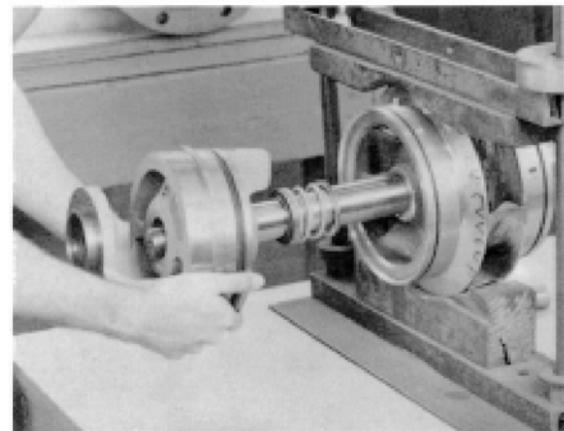


FIGURE 30 – REMOVING STUFF BOX

7. Slide both stuffing boxes (3-073-9) off of the shaft, working deflector rings (3-136-9) off the shaft at the same time (See Figure 30).
8. Remove lip seals (3-177-9) and O-rings (3-914-1) from the stuffing boxes.
9. Drive both mechanical seal seats (3-401-0) from both the stuffing boxes.

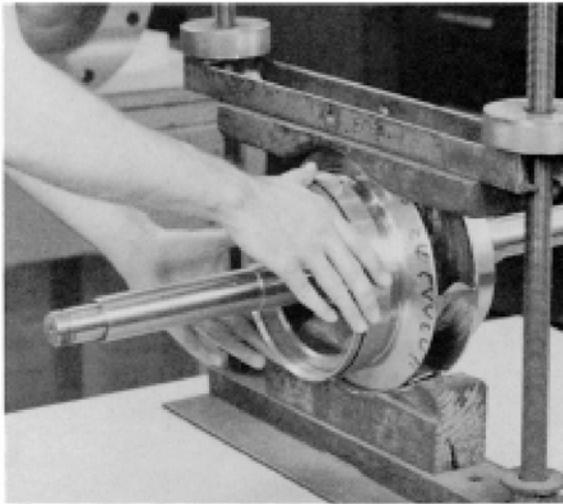


FIGURE 31 – REMOVING CASING RINGS FROM IMPELLER

10. Remove mechanical seal head (3-402-0) from the pump shaft.
11. Remove two casing rings (3-003-9) from the impeller (4-002-0) and remove O-rings (3-914-2) from each casing ring (See Figure 31).
12. Remove the impeller retaining ring (3-915-1) with a retaining ring pliers (Figure 32). Heat the impeller hub on both ends to 350°F maximum, and pull or push the impeller from the shaft. (Instead of heating impeller, you may press impeller off of shaft, if a press is available).

NOTE: Press away from coupling end.

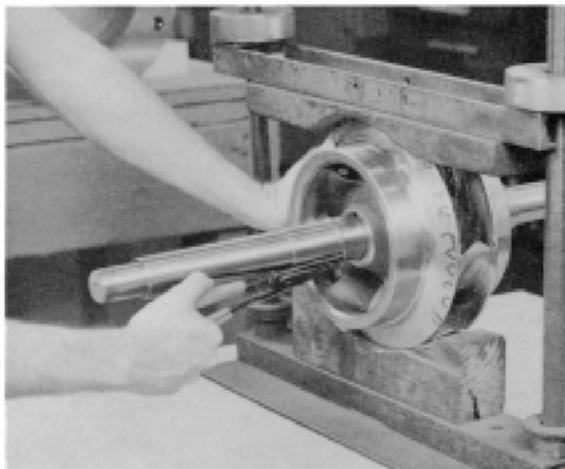


FIGURE 32 – REMOVING IMPELLER FROM RETAINING RINGS

NOTE: For impellers with replaceable rings – remove the rings (0-004-0), if necessary, by cutting with a cold chisel. (See Figure 33)

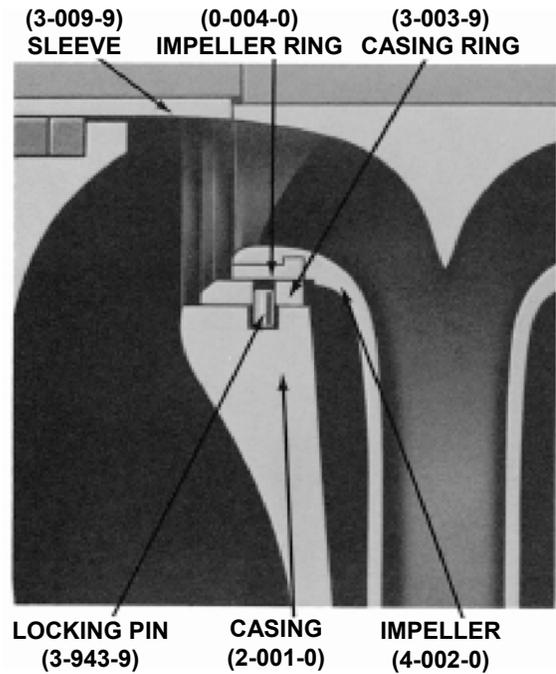


FIGURE 33 –IMPELLER WITH WEAR RINGS

13. Remove the impeller key (3-911-1) from the shaft.

ASSEMBLY (PUMP WITH MECHANICAL SEALS ON SHAFT)

All bearings, O-rings, lip seals, mechanical seals, gaskets, impeller rings, and casing rings should be replaced with new parts during assembly. All reusable parts should be cleaned of all foreign matter before reassembling. The main casing joint gasket can be made using the upper or lower half as a template. Lay the gasket material on the casing joint. Trim the gasket by lightly tapping with a ball peen hammer so that it is flush with the inside edges of the casing.

NOTE: Precut casing gaskets (2-123-5 and -6) can be ordered to minimize the amount of trimming.

1. Assemble the impeller key (3-911-1) in the shaft key slot.
2. Check the impeller (4-002-0) and casing to determine the correct relationship (See Figure 16). Heat the impeller evenly to 300°F maximum to expand the bore. (Impeller may be pressed onto the shaft instead of heating if a suitable press is available, see Figure 34.)

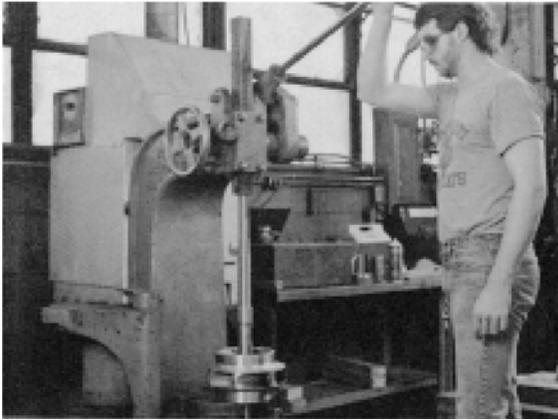


FIGURE 34 – PRESSING IMPELLER ON SHAFT

NOTE: For impeller with replaceable rings, heat each new ring (0-004-0) (approximately 300°F-400°F for bronze) and slide onto the impeller. Using gloves, hold rings against the impeller shoulder until they cool.

3. From the outboard end, using gloves, slide the heated impeller on the shaft (3-007-0) against the shaft shoulder, and install retaining ring (3-915-1).
4. Lubricate and roll an O-ring (3-914-2) into the groove in each casing ring (3-003-9) and slide the casing rings over the impeller.
5. Thoroughly clean the stuffing boxes (3-073-9) to prevent dirt from entering the seal during startup.
6. Press the stationary seats (0-400-0) of the mechanical seals into both stuffing boxes, with the lapped surface facing the impeller. Lightly lubricate the stuffing box bore to ease assembly (See Figure 35).



FIGURE 35 – INSTALLING STATIONARY SEAT

7. Press a new lip seal (3-177-9) into each stuffing box. Before installing the lip seal,

lubricate the seal lip with a lightweight oil.
NOTE: Lip seals should seat against machined shoulder bracket.

NOTE: Seal lip should point away from the bearings (3-026-3 and -4), if the bearings are grease lubricated, and towards the bearings, if the bearings are oil lubricated.

8. Lubricate and roll O-ring (3-914-1) into the groove in each stuffing box.

NOTE: STEPS 9 THROUGH 21 MUST BE COMPLETED WITHIN 10 TO 12 MINUTES TO ASSURE PROPER PLACEMENT OF MECHANICAL SEAL. THE MECHANICAL SEAL USED HAS AN ADHESIVE ON THE INNER DIAMETER OF THE ELASTOMER. THE ROTATING ELEMENT MUST GO INTO THE CASING BEFORE THIS SEALANT BONDS TO SLEEVE.

9. Lightly coat the outboard end of the shaft with STP motor oil treatment or equal and slide the mechanical seal head (0-400-0) onto the shaft (See Figure 36). **NOTE:** Standard mechanical seal for this arrangement is a modified John Crane, Type 21 Mechanical Seal.
10. Slide one of the stuffing boxes on the shaft so that the shaft end extends through the mechanical seal area, but does not enter the lip seal. This will permit installation of deflector (3-136-9).

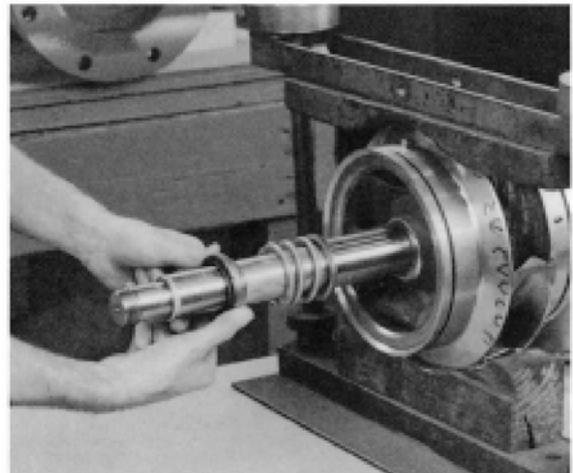


FIGURE 36 – SEAL HEAD INSTALLATION

11. Slide the deflector over the shaft end; then carefully push the shaft end through the lip seal and slide stuffing box fully onto the shaft. COMPRESS THE SEAL SPRING ONLY AS FAR AS REQUIRED TO INSTALL BEARINGS.



CAUTION:
DO NOT EXCEED 275°F.

12. Heat the ball bearing (3-026-4), using either dry heat or a 10-15% soluble oil and water solution.
13. Using gloves, slide the heated bearing onto the shaft against the shaft shoulder (See Figure 37).

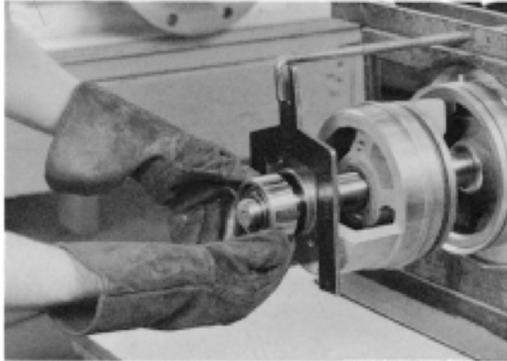


FIGURE 37 – INSTALLING SHAFT BEARING

14. Install lockwasher (3-517-4) and locknut (3-516-4) on the outboard end of the shaft. Make certain locknut is secured and then bend over tabs on lockwasher.
15. Allow the bearing to cool to room temperature. On grease lubricated bearings only, coat the exposed sides with two or three ounces of recommended grease.
16. On grease lubricated bearings, coat the inside of the bearing housing (3-025-4) with grease and slide into place over bearing. Attaching the bearing housing to the stuffing box with four cap screws (3-904-9).

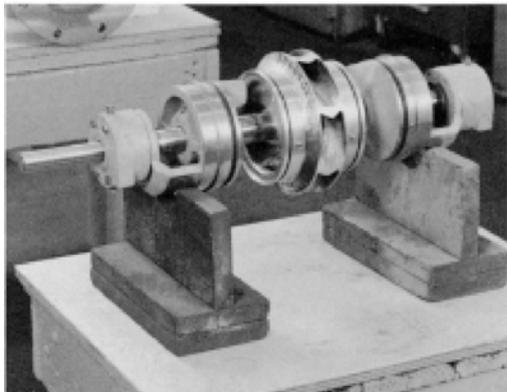


FIGURE 38 – ROTATING ELEMENT

17. Repeat steps 9 through 13, 15 and 16 for the inboard end.

NOTE: A locknut and lockwasher are not installed on the inboard end of the shaft.

18. Clean the gasket surfaces of the casing. Apply Scotch 3M-77 spray adhesive or equivalent to the lower half of the casing.
19. Within one minute of spraying, set the untrimmed gaskets (2-123-5 and -6) in place on the lower half casing, align the holes in the gaskets with the holes in the casing and press the gaskets firmly against the lower half casing face in the area coated by the adhesive.
20. Trim the gaskets flush with the lower casing bores, if this has not been done as yet.



CAUTION:

Machined casing bores must remain sharp at the casing parting line. Gaskets must be flush with bore in order to contact O-rings. Leakage can result around stuffing box O-ring if this step is not properly followed.

21. Set the rotating element in the pump casing (2-001-0), assuring correct rotation. Locate both stuffing box tongues in their respective casing grooves. Locate pins (3-943-9) in the stuffing box and the casing wear rings in their respective slots at the casing parting surface. Correct any O-ring bulging.



CAUTION:

Do not cut or damage O-rings when lowering the rotating element into position. When all four anti-rotation pins (3-943-9) are correctly located, there will be some casing ring looseness.

22. Lower the upper half casing (2-001-0) into place using the tapered dowel pins (2-916-1) and install casing main joint bolts (2-904-1). The casing joint bolts should be tightened to the following torques: 140 ft-lb minimum for 5/8"-11 hex head cap screws (Grade 5); 350 ft-lb minimum for 7/8"-9 Ferry Cap Counterbore screws (Grade 8). Bolt torquing pattern is shown in Figure 59 on page 52.

NOTE: Torque values are essential in obtaining proper gasket compression so no leakage can occur at main joint.

23. Rotate the shaft by hand to assure that it turns smoothly and is free from rubbing or binding.
24. Install seal water piping (0-952-0).

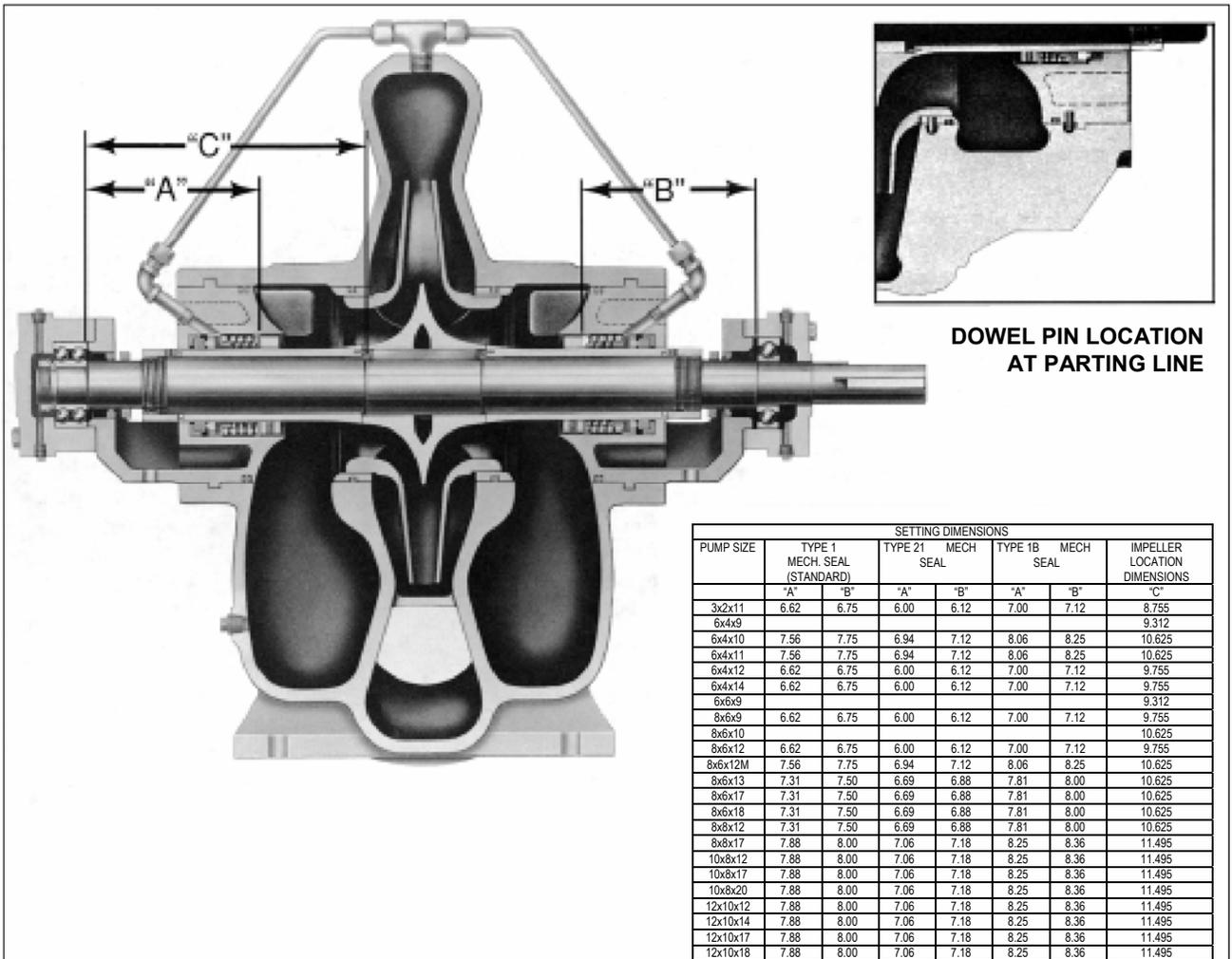


FIGURE 39 – ASSEMBLY SECTION: PUMP WITH MECHANICAL SEALS ON SHAFT SLEEVES

C. DISMANTLING (PUMP WITH MECHANICAL SEALS ON SHAFT SLEEVES)

⚠ WARNING: Unexpected Startup Hazard
 Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ CAUTION: Extreme Temperature Hazard
 Allow pump temperatures to reach acceptable levels before proceeding. Open drain valve. Do not proceed until liquid stops coming out of drain valve. If liquid does not stop flowing from drain valve, isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from drain valve, leave drain valve open and continue. Remove the drain plug located on the bottom of the pump housing. Do not reinstall plug or close drain valve until reassembly is completed. Failure to follow these instructions could result in property damage and/or moderate personal injury.

(See exploded view on page 59.)

1. Drain the pump by opening vent plug (A, Figure 40) and remove drain plugs (B and C) on the suction and discharge nozzles.

- Remove all casing main joint cap screws (2-904-1) and dowels (2-916-1). Remove external tubing (0-952-0) if supplied.
- Insert a screwdriver or pry bar into the slots between the upper and lower casing halves, and separate the halves, lifting off the upper casing half. (NOTE: Some casings have jacking screws.)

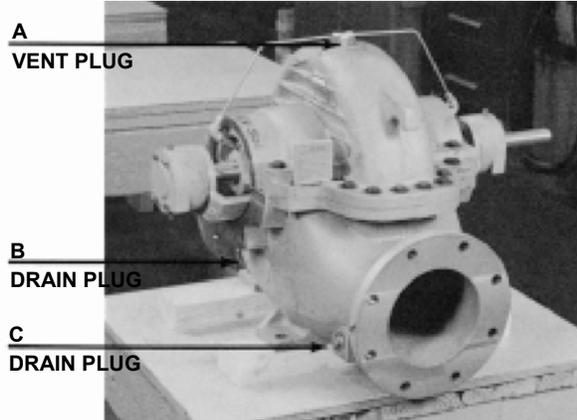


FIGURE 40 – PUMP WITH MECHANICAL SEALS ON SHAFT SLEEVES

- Tap the stuffing boxes with a soft-headed hammer to break the seal between the stuffing box and lower casing half, and lift the rotating element out of the lower casing. Rotating element may now be removed to a suitable location to work on.

NOTE: A spare rotating element can be installed at this point.

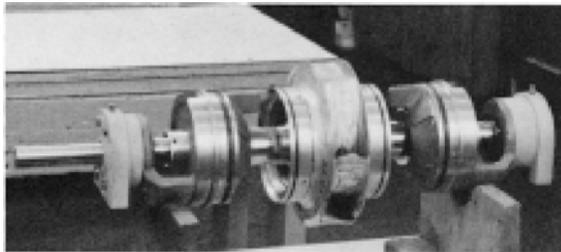


FIGURE 41 – ROTATING ELEMENT

- Remove four cap screws (3-904-9) from each bearing housing (3-025-3 and -4) and remove the bearing housings from the shaft (3-007-0).
- Bend back lockwasher tab and remove locknut (3-516-4) and lockwasher (3-517-4) from the outboard end of the shaft and, using a bearing or gear puller, remove the bearing (3-026-4) from the shaft. Remove the inboard end bearing (3-026-3) in the same manner.

NOTE: Locknut and lockwasher are not used on inboard end bearing.



CAUTION:
DO NOT REUSE THE BALL BEARINGS.

- Slide both stuffing boxes (3-073-9) off of the shaft, working deflector rings (3-136-9) off the shaft at the same time (See Figure 42).

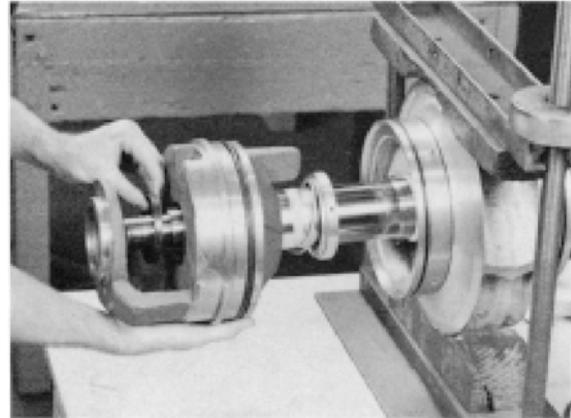


FIGURE 42 – REMOVING STUFF BOX AND DEFLECTOR

- Remove lip seals (3-177-9) and O-rings (3-914-1) from the stuffing boxes.
- Drive both mechanical seal seats (3-401-0) from both the stuffing boxes.
- Remove mechanical seal head (0-400-0) from the pump shaft sleeve. If the set collar (3-421-0) must be removed, scribe a line on the shaft sleeve (3-009-9) flush with the end of the seal (to record mechanical seal location).
- Remove two casing rings (3-003-9) from the impeller (4-002-0) and remove O-rings (3-914-2) from each casing ring (See Figure 43).

NOTE: Each casing ring on 10x8x20 and 12x10x18 has 2 O-rings (See Figure 21B).

- Loosen set screw (3-902-3) in shaft nuts (3-015-9) and then remove sleeve nuts using pin spanner wrench. Remove O-rings (3-914-9) from counterbore in shaft sleeves.

NOTE: Both shaft nuts have right hand threads.

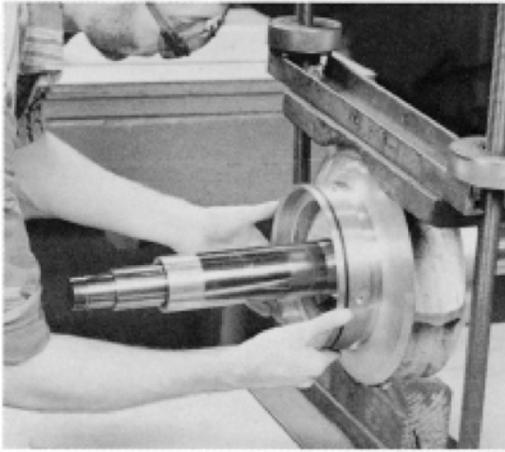


FIGURE 43 – REMOVING CASING RINGS FROM IMPELLER

13. To remove the sleeve, hold the shaft vertically and drop it on a block of wood. The impeller weight should force both the impeller (4-002-0) and sleeve (3-009-9) from the shaft.

NOTE: There is a silicone adhesive/sealant between the sleeve and the impeller.

14. Remove the other seal, shaft sleeve, sleeve O-ring and nut as described in steps 11, 12, and 13.

NOTE: For impellers with replaceable rings – remove the rings (0-004-0), if necessary, by cutting with a cold chisel (See Figure 44).

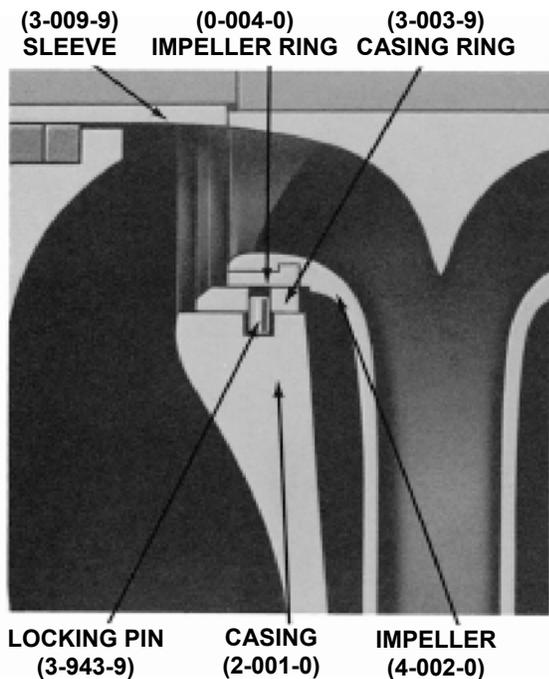


FIGURE 44 – IMPELLER WITH WEAR RINGS

15. Remove the impeller key (3-911-1) from the shaft.

ASSEMBLY (PUMP WITH MECHANICAL SEALS ON SHAFT SLEEVES)

All bearings, O-rings, lip seals, mechanical seals, gaskets, impeller rings, and casing rings should be replaced with new parts during assembly. All reusable parts should be cleaned of all foreign matter before reassembling. The main casing joint gasket can be made using the upper or lower half as a template. Lay the gasket material on the casing joint. Trim the gasket by lightly tapping with a ball peen hammer so that it is flush with the inside edges of the casing.

NOTE: Precut casing gaskets (2-123-5 and -6) can be ordered to minimize the amount of trimming.

1. Assemble the impeller key (3-911-1) in the shaft key slot.
2. Check the impeller (4-002-0) and casing to determine the correct relationship (See Figure 16) and locate the impeller on the shaft per dimension "C" given in the table on Figure 37.

NOTE: For impeller with replaceable rings, heat each new ring (0-004-0) (approximately 300°F-400°F for bronze) and slide onto the impeller. Using gloves, hold rings against the impeller shoulder until they cool.

3. Starting with the outboard end, apply a 1/4" bead of RTV (DOWN CORNING SILICONE SEALANT or equivalent) at the impeller hub face, making sure to fill up the keyway.
4. Slide the sleeve (3-009-9) onto shaft, rotating the sleeve to evenly distribute the sealant applied in step 3.

CAUTION:
THE PIN IN EACH SHAFT SLEEVE MUST SEAT IN THE IMPELLER KEY SLOT.

5. Place the sleeve O-ring (3-914-9) onto the shaft, into the sleeve counterbore. Assemble the shaft sleeve nut (3-015-9).
6. Repeat steps 3 through 5 for the inboard shaft sleeve, O-ring, and nut. Wipe off excess RTV.
7. Verify that dimension "C" in Figure 39 on page 43 is maintained, then using a pin spanner wrench and hammer, securely

tighten the shaft sleeve nuts. Then drill a 3/16" diameter shallow recess in the shaft through the set screw hole in each of the shaft sleeve nuts. Lock each shaft sleeve nut in position with set screws (3-902-3). A low strength sealant, such as Loctite 271, can be used to retain set screws (See Figure 45).

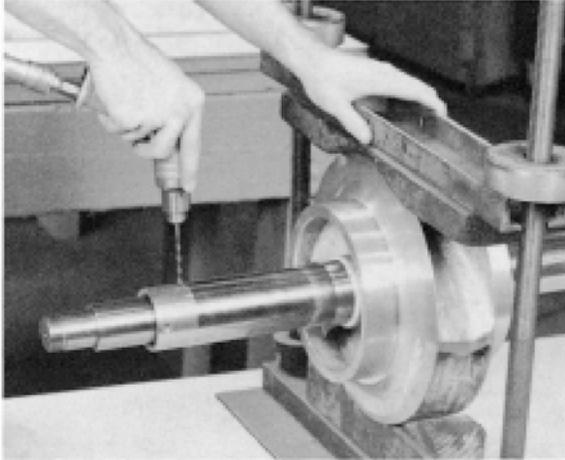


FIGURE 45 – DRILLING SET SCREW RECESS

8. Lubricate and roll an O-ring (3-914-2) into the groove in each casing ring (3-003-9) and slide the casing rings over the impeller.

NOTE: 10x8x20 and 12x10x18 utilize "Floating" Casing Ring Design. Each ring requires 2 O-rings (See Figure 21B).

9. Thoroughly clean the stuffing boxes (3-073-9) to prevent dirt from entering the seal during startup.
10. Press the stationary seats (0-400-0) of the mechanical seals into both stuffing boxes with the lapped surface facing the impeller. Lightly lubricate the stuffing box bore to ease assembly.
11. Press a new lip seal (3-177-9) into each stuffing box. Before installing the lip seal, lubricate the seal lip with a lightweight oil.

NOTE: Lip seals should seat against machined shoulder in bracket.

NOTE: Seal lip should point away from the bearings (3-026-3 and -4), if the bearings are grease lubricated, and towards the bearings, if the bearings are oil lubricated.



FIGURE 46 – INSTALLING LIP SEAL

12. Lubricate and roll O-ring (3-914-1) into the groove in each stuffing box.
13. Obtain the set collar (3-421-9) locating dimension from the table on Figure 37 and scribe the dimension on the shaft sleeve. Install set collar on sleeve per this dimension. (Reference dimensions "A" and "B" on Figure 39.)

NOTE: Each set collar has two set screws. To positively secure each set collar, drill a shallow recess in sleeve through the set screw holes. Retain set screws with a low strength loctite, 271, or equal.

NOTE: Steps 14 through 26 must be completed within 10 to 12 minutes to assure proper placement of mechanical seals. The mechanical seal used has an adhesive on the inner diameter of the elastomer. The rotating element must go into the casing before this sealant bonds to sleeve.

14. Lightly coat the outboard end of the shaft sleeve with STP motor oil treatment or equal and slide the mechanical seal head (0-400-0) onto the shaft sleeve against the set collar.

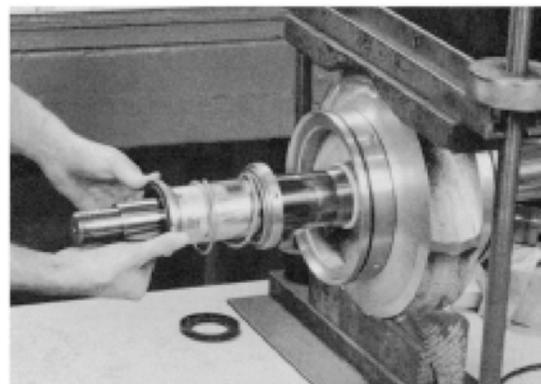


FIGURE 47 – SEAL HEAD INSTALLATION

15. Slide outboard end of stuff box on the shaft so that the shaft end extends through the mechanical seal area, but does not enter the lip seal. This will permit installation of deflector (3-136-9).
16. Slide the deflector over the shaft end; then carefully push the shaft end through the lip seal and slide the stuffing box fully onto the shaft. COMPRESS THE SEAL SPRING ONLY AS FAR AS REQUIRED TO INSTALL BEARINGS.
17. Heat the ball bearing (3-026-4), using either dry heat or a 10-15% soluble oil and water solution.



CAUTION:
DO NOT EXCEED 275°F.

18. Using gloves, slide the heated bearing onto the shaft against the shaft shoulder (See Figure 48).

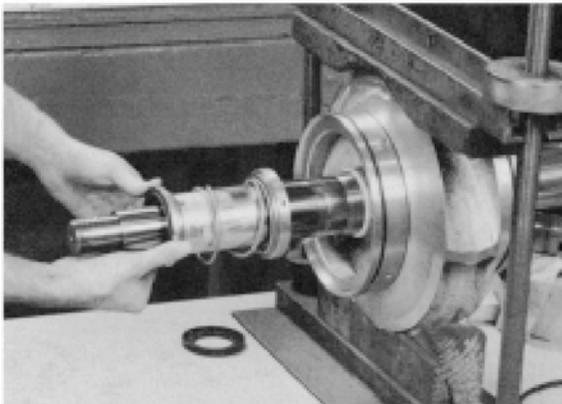


FIGURE 48 – INSTALLING SHAFT BEARING

19. Install lockwasher (3-517-4) and locknut (3-516-4) on the outboard end of the shaft. Make certain locknut is secured and then bend over tabs on lockwasher.
20. Allow the bearing to cool to room temperature. On grease lubricated bearings only, coat the exposed sides with two or three ounces of recommended grease.
21. On grease lubricated bearings, coat the inside of the bearing housing (3-025-4) with grease and slide into place over bearing. Attaching the bearing housing to the stuffing box with four cap screws (3-904-9).
22. Repeat steps 14 through 18, 20 and 21 for the inboard end.

NOTE: A locknut and lockwasher are not installed on the inboard end of the shaft.

23. Clean the gasket surfaces of the casing. Apply Scotch 3M-77 spray adhesive or equivalent to the lower half of the casing.
24. Within one minute of spraying, set the untrimmed gaskets (2-134-5 and -6) in place on the lower half casing, align the holes in the gaskets with the holes in the casing and press the gaskets firmly against the lower half casing face in the area coated by the adhesive.

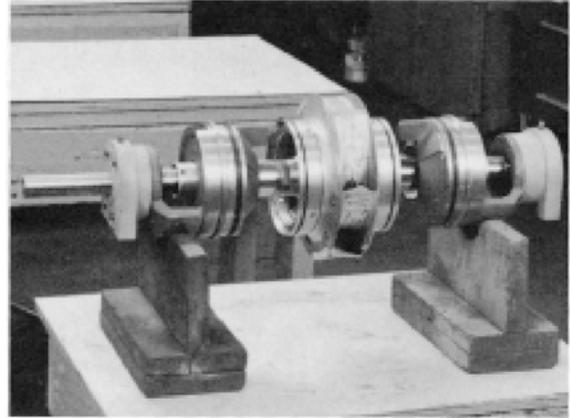


FIGURE 49 – ROTATING ELEMENT

25. Trim the gaskets flush with the lower casing bores, if this has not been done as yet.



CAUTION:
Machined casing bores must remain sharp at the casing parting line. Gaskets must be flush with bore in order to contact O-rings. Leakage can result around stuffing box O-ring if this step is not properly followed.

26. Set the rotating element in the pump casing (2-001-0), assuring correct rotation. Locate both stuffing box tongues in their respective casing grooves. Locate pins (3-943-9) in the stuffing box and the casing wear rings in their respective slots at the casing parting surface. Correct any O-ring bulging (See Figure 50).

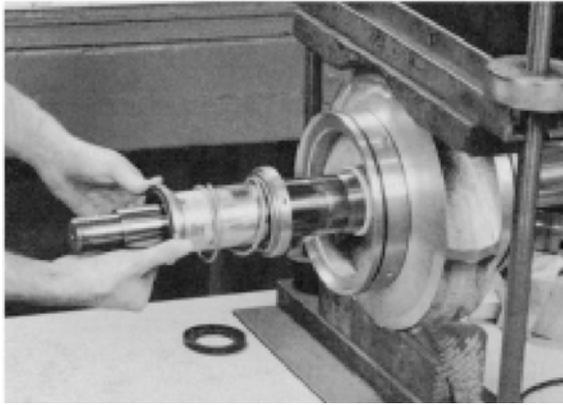


FIGURE 50 – UPPER CASING HALF REMOVED



CAUTION:

Do not cut or damage O-ring when lowering the rotating element into position. When all four anti-rotation pins (3-943-9) are correctly located, there will be some casing ring looseness.

27. Lower the upper half casing (2-001-0) into place using the tapered dowel pins (2-916-1) and install casing main joint bolts (2-904-1). The casing joint bolts should be tightened to the following torques: 140 ft-lb minimum for 5/8"-11 hex head cap screws (Grade 5); 350 ft-lb minimum for 7/8"-9 Ferry Cap Counterbore screws (Grade 8). Bolt torquing pattern is shown in Figure 59.

NOTE: Torque values are essential in obtaining proper gasket compression so no leakage can occur at main joint.

28. Rotate the shaft by hand to assure that it turns smoothly and is free from rubbing or binding.

29. Install seal water piping (0-952-0).

ADJUSTABLE WEAR RINGS

Adjustable rings are an assembly of two threaded rings. The outer, stationary ring is held in the casing by a tongue and groove and an anti-rotation pin in the lower half main joint. The inner, adjustable ring can be moved axially, in either direction, by rotating it. The ring is held in position by a stainless steel locking pin. All rings have clockwise threads.

Adjustment

When the clearance between the impeller wear face and the adjustable wearing ring becomes excessive; i.e., approximately .020" to .030", remove the upper half casing and pull the locking pin.

Rotate the inner rings clockwise to restore .005"-.008" clearance greater than shaft end float between the ring and the impeller. Drill a new hole in the inner ring for the locking pin. This is a blind hole – do not drill through. Replace the locking pin and upper half casing.

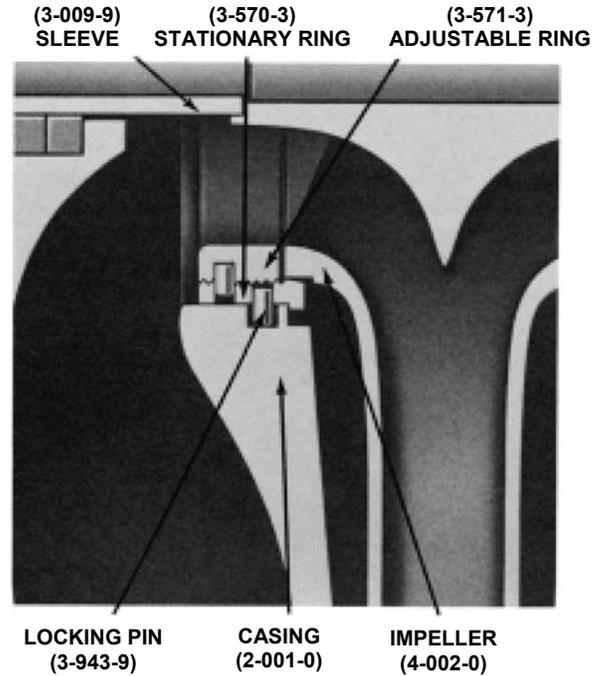


FIGURE 51 – ADJUSTABLE WEAR RINGS

Disassembly and Reassembly

Adjustable rings are removed in the same manner as standard casing rings. They can be separated for cleaning. Adjustable rings are installed in the pump with stationary and the adjustable members assembled but not pinned. Turn the adjustable member counterclockwise to provide maximum impeller clearance and slide over shaft ends. With the rotating element in pump, the rings can be adjusted. Be sure that stationary member has its flange flush against casing lower half.

Move rotating element toward outboard end as far as bearings permit. Screw outboard end adjustable ring toward impeller to obtain .005"-.008" axial impeller clearance. Drill through stationary ring hole into adjustable ring and insert locking pin. Move rotating element toward coupling and set coupling end ring in the same manner.

OIL LUBRICATED BEARINGS

This section describes how to change the oil for oil lubricated bearings. Figure 52 shows a typical oiler assembly.

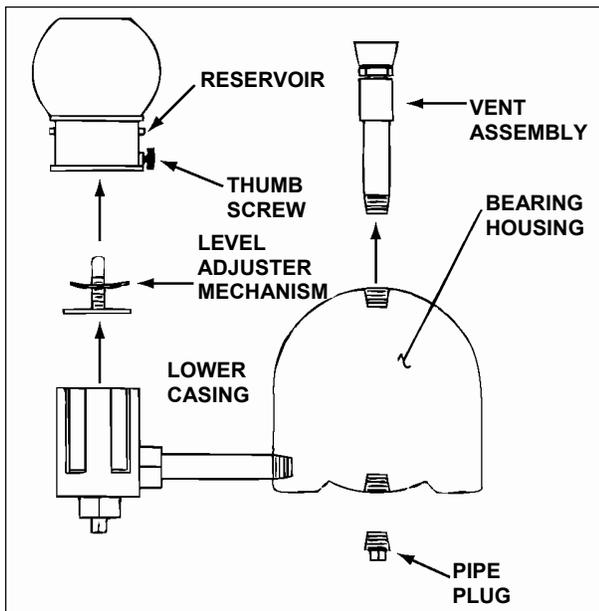


FIGURE 52 – OILER ASSEMBLY

1. Remove the vent assembly from the top of the bearing housing.
2. Remove the pipe plug from the bottom of the bearing housing.
3. Loosen the thumb screw on the side of the oiler. Lift and remove the reservoir.
4. Flush the oiler and bearing housing with a light grade of oil. Flush until all foreign particles have been removed.
5. Screw the pipe plug and vent assembly back into place.
6. Using the predetermined heights from Table 1, set the level adjuster mechanism.
7. Place the level adjuster back in the lower casing.

8100 Pump Size	"A" Dimension	
	Inboard	Outboard
8X8X17, 10X8X12, 10X8X17, 10X10X12, 12X10X12, 12X10X14, 12X10X17, 10X8X20, 12X10X18	1.22	0.53
6X4X10, 8X6X13, 6X4X11, 8X6X10, 8X6X17, 8X6X18, 8X6X12M, 8X8X12	.053	0.56
3X2X11, 6X4X9, 6X4X12, 6X4X14, 6X6X9, 8X6X9, 8X6X12	1.12	1.12

TABLE 1 – LEVEL ADJUSTER HEIGHTS

8. Fill the reservoir with a food grade of filtered mineral oil. Refer to oil lubrication instructions given previously in this manual for type of oil.

NOTE: You must fill through Trico reservoir.

9. Back out the thumb screw on the side of the lower casing so it will not interfere when setting the reservoir in the lower casing.
10. Place thumb over reservoir spout, invert and place reservoir on lower casing while removing thumb. Allow reservoir to empty, filling the bearing housing. Several fillings of the reservoir may be required before the actual level is reached. When the oil level is reached, no more oil will run out of the reservoir.

11. Retighten thumb screw.

After the pump has been started, trial adjustments should be made to the level adjuster mechanism to prevent too high or too low of oil levels. Adjust by repeating steps 6 through 11.

A periodic filling of the reservoir is required. When the oil becomes dirty, repeat steps 1 through 12.

VERTICAL UNITS (MODELS 200, 250, 300)

Upper Casing Half Removal:



WARNING: Falling Objects Hazard

Eyebolts or lifting lugs, if provided, are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, or property damage.

NOTE: If only the upper half casing is to be removed for inspection of the rotating element, it will not be necessary to remove the line shafting or motor.

1. **IMPORTANT: The rotating element must be restrained to the lower half casing or to the pedestal by means of straps.**



WARNING:

Injury may result due to rotating element falling out of lower half casing if the above procedure is not followed.

- Remove the larger of the two pipe plugs from the top of the casing upper half and install an 18" to 24" solid bar threaded at one end into the exposed tapped hole. If a threaded bar is not available, it is permissible to use a standard pipe. NOTE: This bar will be used to stabilize upper half during disassembly of casing upper half (See Figure 53).

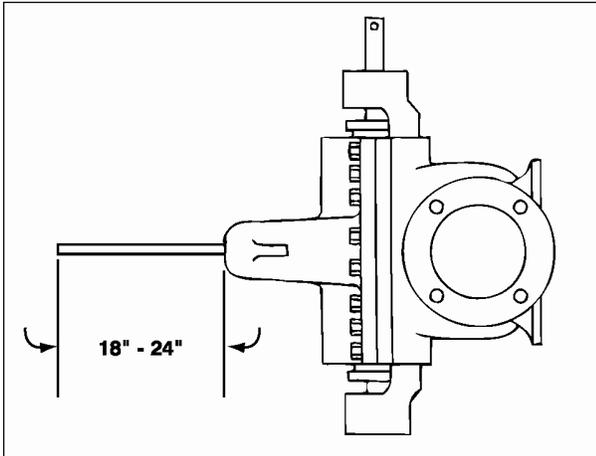


FIGURE 53 – CASING HALF REMOVAL

- Disconnect the seal water lines at the stuff boxes.
- Remove dowel pins and all parting line bolts except for two upper most and two lowest most (See Figure 54).

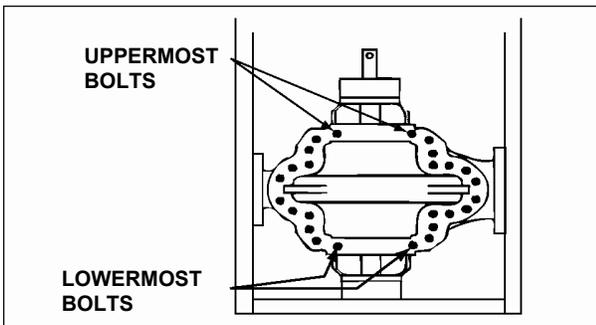


FIGURE 54 – PARTING LINE BOLTS

- Sling around casing upper half ears using nylon sling, pulling slings taught so it is not possible for slings to slip off (See Figure 55).
- Remove two lower most bolts and then one of the two upper most bolts. CAUTION: Maintain downward pressure on the stabilizing rod (end furthest from the pump) during this step.

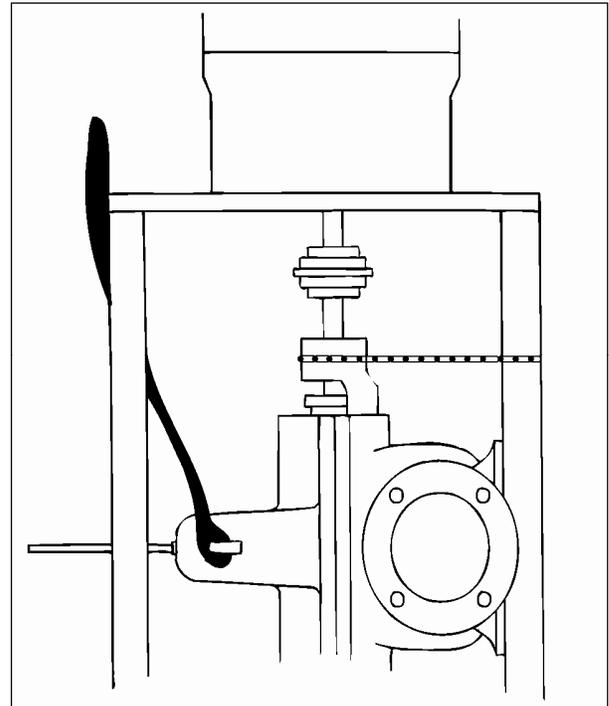


FIGURE 55 – NYLON SLING AROUND UPPER CASING HALF

- While maintaining a downward pressure on the stabilizer bar, loosen the remaining upper most bolt.



WARNING:

Do not remove completely at this point. Failure to follow these instructions could result in property damage, severe personal injury, or death.

- Separate the upper and lower halves by use of a pry bar between the two halves or by the use of jacking screws if the top half is provided with tapped holes.
- When halves separate, slide upper half away from lower half, maintain a downward pressure on the stabilizing rod and slowly remove completely the remaining upper most bolt.
- Balancing the upper half with the stabilizing rod, lower the top half to the ground allowing the upper half to rotate so that its main joint flange sets on the ground (See Figure 56).

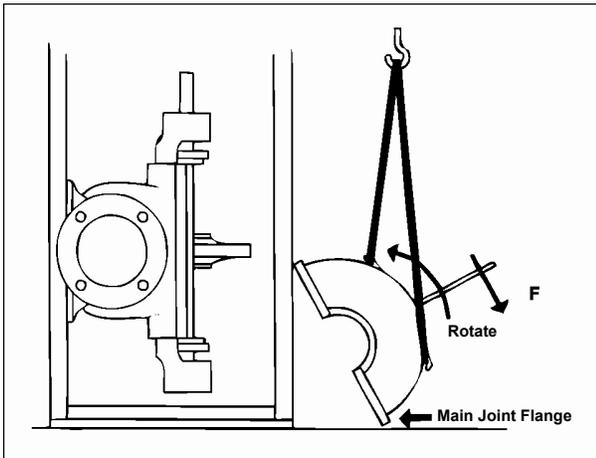


FIGURE 56 – UPPER HALF REMOVAL

11. Rotating element is now ready for inspection or removal. If element is inspected and does not need to be removed then refer to upper half reassembly procedures.

Rotating Element Removal:

- 12. For these procedures it will be necessary to remove the line shafting or motor. Then remove the pump half coupling.
- 13. Thread a long bolt, washer and nut through the hole at the end of the shaft (See Figure 57).

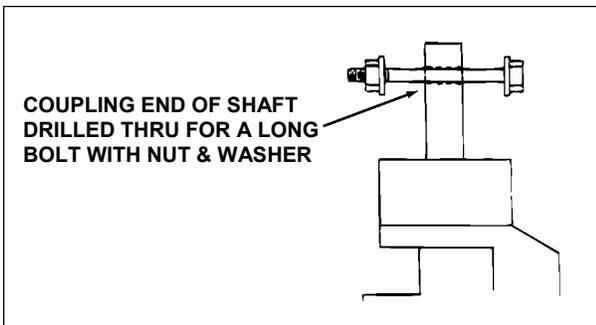


FIGURE 57 – BOLT, NUT AND WASHER ASSEMBLY

- 14. Sling around eye bolt, putting slight amount of tension on sling.
- 15. Remove restraining straps if rotating element is not securely fastened to casing lower half.
- 16. Lightly tapping on inboard and outboard bearing housings, slide rotating element away from lower half.
- 17. Lower rotating element to ground by sliding outboard bearing housing away from pedestal enabling element to be set

on floor with shaft in an horizontal position (See Figure 58).

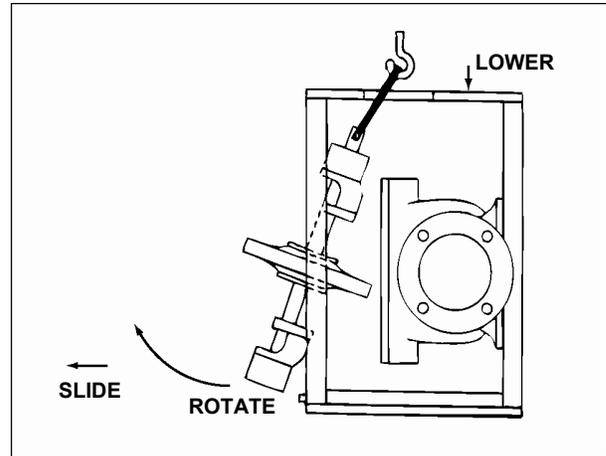


FIGURE 58 – LOWER ROTATING ELEMENT

18. Rotating element can now be serviced following disassembly procedure given previously in this manual.

Reassembly of Rotating Element:

- 19. Inspect main joint gasket and replace if necessary. (Follow replacement instructions in disassembly procedures section.)
- 20. Sling around the bolt in end of pump shaft.
- 21. On full pedestals, the lifting sling must come through hole in top plate of pedestal (See Figure 58).
- 22. When rotating element is off the ground and in the vertical position, align any anti-rotation pins in the casing rings and stuffing boxes for proper orientation in the slots in the casing lower half.
- 23. Moving element towards casing lower half, engage the stuffing box tongue first.
- 24. As the stuffing box tongue begins to go into the respective casing fit, raise the inboard bearing housing into its respective fit.
- 25. When the stuffing box tongues are firmly seated in their respective fits and all the anti-rotation pins are seated in their slots, restrain the rotating element to the lower half.

Replacing Upper Casing Half:

- 26. Sling around lifting ears and with stabilizing rod installed, pick casing upper half off the ground and rotate top half so

that main joint flange is vertical.
(Reference Figure 56 with rotation in
opposite direction shown.)

27. Move upper half towards lower half.
28. Prior to complete engagement of upper half onto lower half, use dowel pins to guide the upper half into its final exact position.
29. Reinstall all main joint bolts, following tightening sequence illustrated in Figure 59. (The number of casing bolts varies with the size of the pump.) Torque bolts 140 ft-lb minimum for 5/8"-11 hex head cap screws (Grade 5); 350 ft-lb minimum for 7/8"-9 Ferry Cap Counterbore screws (Grade 8).

NOTE: Torque values are essential in obtaining proper gasket compression so no leakage can occur at main joint.

30. Rotate shaft making sure it spins free. If the motor or line shafting has been removed it will now be possible to reinstall.

Complete Pump Removal:

Should it be necessary to remove a complete pump, it will be necessary to remove the line shafting or motor, disconnect the pedestal from its anchor bolts, disconnect and remove if necessary sections of the suction and discharge piping, and turn the entire pedestal horizontal enabling complete pump removal from horizontal position.

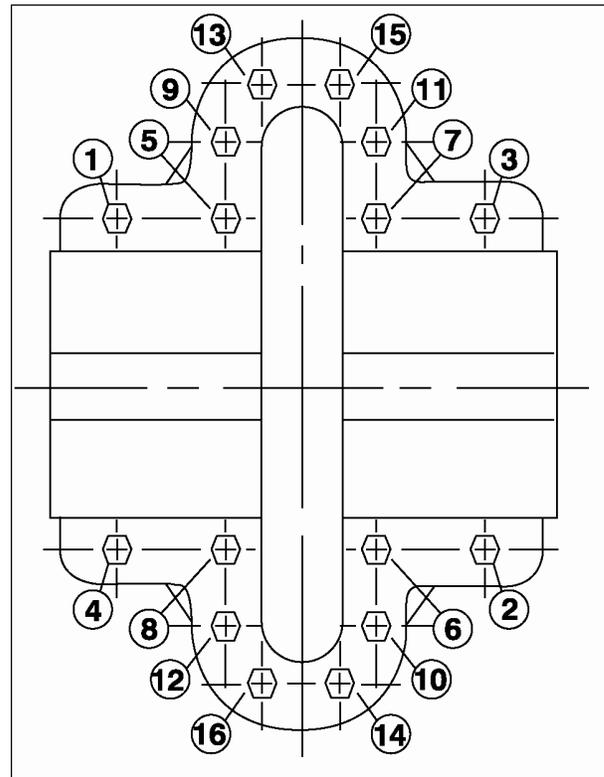


FIGURE 59 – MAIN JOINT BOLTS

INSTRUCTIONS FOR ORDERING PARTS

When ordering parts for 8100 pumps, be sure to furnish the following information to the AC Fire Pump stocking distributor in your area:

- Serial Number
- Pump Size & Type
- Pump Model Number
- Pump Frame Number
- Description of Part
- Catalog Code
- Quantity Required
- Definite Billing and Shipping Instructions
- Date Required

Refer to parts list on page 60 for a complete parts list and recommended spare parts.

Parts should be ordered as far in advance of their need as possible, since circumstances beyond the control of AC Fire Pump may reduce existing stock. All parts are not carried in stock. Some are made for each order. If replacement parts required are to be made of different materials than originally specified, give exact requirements and the reason for changing. Special care in furnishing the above information with the original order for parts will facilitate shipment.

APPENDIX "A" ENGINEERING DATA

Pump Size		3x2x11S	3x2x1L	6x4x9	6x4x10S	6x4x10M	6x4x10L	6x4x10XL	6x4x11	6x4x12S	6x4x12M
CASING DATA (All Dimensions in Inches)											
④ 125# FF Std ASA Flanges ⑥ NOMINAL 175 PSI Working Press.	Max. Suction Pressure	75	75	75	75	75	75	75	75	75	75
	Max. Working Pressure	175	175	175	175	175	175	175	175	175	175
	Max. Hydrostatic Test Pressure	262	262	262	262	262	262	262	262	262	262
	Casing material	Cast I									
⑤ 250# FF ① NOMINAL 280 PSI ⑥ Working Press.	Max. Suction Pressure	200	200	200	200	200	200	200	200	200	200
	Max. Working Pressure	280	280	280	280	280	280	280	280	280	280
	Max. Hydrostatic Test Pressure	420	420	420	420	420	420	420	420	420	420
	Casing material	Ductile I									
⑤ 250# FF ② NOMINAL 400 PSI ③ Working Press. ⑥	Max. Suction Pressure	300	300	300	300	300	300	300	300	300	300
	Max. Working Pressure	400	400	400	400	400	400	400	400	400	400
	Max. Hydrostatic Test Pressure	600	600	600	600	600	600	600	600	600	600
	Casing material	Ductile I									
	Casing Wall Thickness	.375	.375	.50	.50	.50	.50	.50	.50	.44	.44

STUFF BOX DATA (All Dimensions in Inches)												
Packing Dimensions	Bore	2.625	2.625	2.625	3.25	3.25	3.25	3.25	3.25	2.625	2.625	
	Depth	2.56	2.56	2.56	3.50	3.50	3.50	3.50	3.50	2.56	2.56	
	Sleeve O.D.	1.875	1.875	1.875	2.25	2.25	2.25	2.25	2.25	1.875	1.875	
	Packing Size/No. Rings W/O S. Cage	6.375	6.375	6.375	6.50	6.50	6.50	6.50	6.50	6.375	6.375	
	Packing Size/No. Rings W/ S. Cage	5.375	5.375	5.375	5.50	5.50	5.50	5.50	5.50	5.375	5.375	
	Seal Cage Width	.50	.50	.50	.75	.75	.75	.75	.75	.50	.50	
⑦ Mech. Seal On Shaft Dimensions	Bore	2.25	2.25		2.75	2.75	2.75	2.75	2.75	2.25	2.25	
	Depth	2.62	2.62		3.12	3.12	3.12	3.12	3.12	2.62	2.62	
	Mech. Seal Size (Type 21 or 1)	1.38	1.38		1.75	1.75	1.75	1.75	1.75	1.38	1.38	
	⑩ { Balanced Mech. Major Dia.--> Seal Size (Type 1B) Minor Dia.-->		1.50	1.50		1.88	1.88	1.88	1.88	1.88	1.50	1.50
			1.38	1.38		1.75	1.75	1.75	1.75	1.75	1.38	1.38
Mech. Seal On Sleeves Dimensions	Bore	3.00	3.00		3.38	3.38	3.38	3.38	3.38	3.00	3.00	
	Depth	2.56	2.56		2.88	2.88	2.88	2.88	2.88	2.56	2.56	
	Mech. Seal Size (Type 21 or 1)	1.875	1.875		2.25	2.25	2.25	2.25	2.25	1.875	1.875	
	⑩ { Balanced Mech. Major Dia.--> Seal Size (Type 1B) Minor Dia.-->		2.00	2.00		2.38	2.38	2.38	2.38	2.38	2.00	2.00
			1.88	1.88		2.25	2.25	2.25	2.25	2.25	1.88	1.88

IMPELLER DESIGN DATA (All Dimensions in Inches)											
No. of Vanes	6	6	6	6	6	6	6	6	6	6	6
Inlet Area (Sq. Inches)	7.7	9.6	5.9	10.5	15.9	17.8	28.0	19.6	23.1	10.2	
Inlet Velocity per 100 GPM (Ft/Sec)	4.2	3.3	5.4	3.1	2.0	1.8	1.1	1.6	1.4	3.1	
Maximum Diameter	11.0	11.0	9.8	11.0	12.0	11.0	12.3	11.6	12.8	13.7	
Minimum Diameter	5.5	5.5	6.0	5.5	6.5	5.5	6.5	6.5	5.5	7.5	
Maximum Sphere	.25	.38	.44	.34	.50	.62	.37	.70	.40	.50	
WR ^2 for Maximum Diameter (Lbs-Ft^2)	3.6	3.2	2.4	2.6	2.9	2.8	3.2	3.0	3.0	3.0	
⑧ Wear Ring Clearance – Diam. 175# & 280# W.P.	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	
③⑧ Wear Ring Clearance – Diam. 400# W.P.	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	

SHAFT AND BEARING DATA (All Dimensions in Inches)											
Under Sleeve	1.499	1.499	1.499	1.874	1.874	1.874	1.874	1.874	1.499	1.499	
Under Mech. Seal on Shaft Type 21 or Type 1	1.375	1.375		1.750	1.750	1.750	1.750	1.750	1.375	1.375	
Under Mech. Seal on Shaft Type 1B	1.500	1.500		1.875	1.875	1.875	1.875	1.875	1.500	1.500	
At Coupling	1.125	1.125	1.125	1.375	1.375	1.375	1.375	1.375	1.125	1.125	
⑨ Thru Impeller with Packing – Mech. Seal on Sleeve	1.686	1.686	1.687	1.937	1.937	1.937	1.937	1.937	1.686	1.686	
Thru Impeller with Mech. Seal on Shaft	1.689	1.689		1.939	1.939	1.939	1.939	1.939	1.689	1.689	
Shaft Span	Bearing to Bearing Centerline	20.90	20.90	22.00	25.25	25.25	25.25	25.25	25.25	22.90	22.90
Ball Bearings	Inboard	6206	6206	6206	6208	6208	6208	6208	6208	6206	6206
	Outboard	5206	5206	5206	5307	5307	5307	5307	5307	5206	5206
Frame Designation	Packing	F20-A4	F20-A4	F20-G4	F20-B4	F20-B4	F20-B4	F20-B4	F20-B4	F20-C4	F20-C4
	Mech. Seal on Shaft	F20-A5	F20-A5		F20-B5	F20-B5	F20-B5	F20-B5	F20-B5	F20-C5	F20-C5
	Mech. Seal on Shaft Sleeve	F20-A6	F20-A6		F20-B6	F20-B6	F20-B6	F20-B6	F20-B6	F20-C6	F20-C6

- ① With 250# FF flanges and 280# PSIG working pressure refer to pump as M3x2x11S.
- ② With 250# FF flanges and 400# PSIG working pressure refer to pump as H3x2x11S.
- ③ For pumps with 400 PSI working pressure, wear ring clearances are doubled. Derate pump efficiencies by 2 percentage points.
- ④ Flange dimensions are in accordance with ANSI A21.10, AWWA C110 & ANSI B16.1 class 125.
- ⑤ Flange dimensions are in accordance with ANSI B16.1 class 250 except flanges are flat faced, i.e. FF.

- ⑥ The hydrostatic test will be accordance with the latest edition of the Hydraulic Institute Standards, test will maintained for a minimum of 5 minutes.
- ⑦ Type 1 and 21 seals have the same working lengths.
- ⑧ For bronze impellers and casing rings. For diametral clearances for other materials, consult factory.
- ⑨ Impeller is a light press fit on shaft, do not use construction with stainless steel impellers.
- ⑩ Balanced mechanical seals have a major diameter and a minor diameter as listed.

APPENDIX "A" ENGINEERING DATA

Pump Size	6x4x12L	6x4x12XL	6x4x14S	6x4x14L	6x6x9	8x6x9	8x6x10	8x6x12S	8x6x12M	8x6x12L	8x6x12XL
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K

CASING DATA

(All Dimensions in Inches)

④ 125# FF Std ASA Flanges	Max. Suction Pressure	75	75	75	75	75	75	75	75	75	75	75
	Max. Working Pressure	175	175	175	175	175	175	175	175	175	175	175
⑥ NOMINAL 175 PSI Working Press.	Max. Hydrostatic Test Pressure	262	262	262	262	262	262	262	262	262	262	262
	Casing material	Cast I										
⑤ 250# FF NOMINAL 280 PSI	Max. Suction Pressure	200	200	200	200	200	200	200	200	200	200	200
	Max. Working Pressure	280	280	280	280	280	280	280	280	280	280	280
⑥ Working Press.	Max. Hydrostatic Test Pressure	420	420	420	420	420	420	420	420	420	420	420
	Casing material	Ductile I										
② 250# FF NOMINAL 400 PSI	Max. Suction Pressure	300	300	300	300	300	300	300	300	300	300	300
	Max. Working Pressure	400	400	400	400	400	400	400	400	400	400	400
③ Working Press.	Max. Hydrostatic Test Pressure	600	600	600	600	600	600	600	600	600	600	600
	Casing material	Ductile I										
⑥ Casing Wall Thickness		.375	.375	.50	.50	.50	.50	.50	.50	.44	.44	.44

STUFF BOX DATA

(All Dimensions in Inches)

Packing Dimensions	Bore	2.625	2.625	2.625	2.625	2.625	2.625	3.25	2.625	3.25	2.625	2.625	
	Depth	2.56	2.56	2.56	2.56	2.56	2.56	3.50	2.56	3.50	2.56	2.56	
	Sleeve O.D.	1.875	1.875	1.875	1.875	1.875	1.875	2.25	1.875	2.25	1.875	1.875	
	Packing Size/No. Rings W/O S. Cage	6.375	6.375	6.375	6.375	6.375	6.375	6.50	6.375	6.50	6.375	6.375	
	Packing Size/No. Rings W/ S. Cage	5.375	5.375	5.375	5.375	5.375	5.375	5.50	5.375	5.50	5.375	5.375	
	Seal Cage Width	.50	.50	.50	.50	.50	.50	.75	.50	.75	.50	.50	
⑦ Mech. Seal On Shaft Dimensions	Bore	2.25	2.25	2.25	2.25				2.25		2.25	2.25	
	Depth	2.62	2.62	2.62	2.62				2.62		2.62	2.62	
	Mech. Seal Size (Type 21 or 1)	1.38	1.38	1.38	1.38				1.38		1.38	1.38	
	⑩ {	Balanced Mech. Major Dia.-->	1.50	1.50	1.50	1.50				1.50		1.50	1.50
		Seal Size (Type 1B) Minor Dia.-->	1.38	1.38	1.38	1.38				1.38		1.38	1.38
⑦ Mech. Seal On Sleeves Dimensions	Bore	3.00	3.00	3.00	3.00				3.00	3.38	3.00	3.00	
	Depth	2.56	2.56	2.62	2.62				2.62	2.88	2.62	2.62	
	Mech. Seal Size (Type 21 or 1)	1.875	1.875	1.875	1.875				1.875	2.25	1.875	1.875	
	⑩ {	Balanced Mech. Major Dia.-->	2.00	2.00	2.00	2.00				2.00	2.38	2.00	2.00
		Seal Size (Type 1B) Minor Dia.-->	1.88	1.88	1.88	1.88				1.88	2.25	1.88	1.88

IMPELLER DESIGN DATA

(All Dimensions in Inches)

No. of Vanes	6	7	6	6	6	6	5	5	7	7		
Inlet Area (Sq. Inches)	19.1	28.4	19.1	22.9	5.9	12.0	15.2	27.0	20.4	38.9	40.6	
Inlet Velocity per 100 GPM (Ft/Sec)	1.7	1.1	1.7	1.4	5.4	2.7	2.1	1.2	1.6	.83	.79	
Maximum Diameter	12.8	14.0	13.8	13.8	9.8	9.8	10.0	12.8	12.8	12.8	13.7	
Minimum Diameter	6.0	7.0	6.5	7.0	6.5	6.5	7.6	7.0	6.5	7.0	7.0	
Maximum Sphere	.60	.37	.47	.68	.48	.64	.75	.72	.87	1.0	1.0	
WR ^2 for Maximum Diameter (Lbs-Ft^2)	3.1	3.5	7.5	8.0	2.5	2.6	3.1	3.6	3.7	3.8	8.5	
⑧ Wear Ring Clearance – Diam. 175# & 280# W.P.		.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012
	③ ⑧ Wear Ring Clearance – Diam. 400# W.P.	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024

SHAFT AND BEARING DATA

(All Dimensions in Inches)

Under Sleeve	1.499	1.499	1.499	1.499	1.499	1.499	1.874	1.499	1.874	1.499	1.499	
Under Mech. Seal on Shaft Type 21 or Type 1	1.375	1.375	1.375	1.375				1.375		1.375	1.375	
Under Mech. Seal on Shaft Type 1B	1.500	1.500	1.500	1.500				1.500		1.500	1.500	
At Coupling	1.125	1.125	1.125	1.125	1.125	1.125	1.375	1.125	1.375	1.125	1.125	
Thru Impeller with Packing – Mech. Seal on Sleeve	1.686	1.686	1.686	1.686	1.687	1.687	1.937	1.686	1.937	1.686	1.686	
⑨ Thru Impeller with Mech. Seal on Shaft		1.689	1.689	1.689	1.689			1.689		1.689	1.689	
	Shaft Span Bearing to Bearing Centerline	22.90	22.90	22.90	22.90	22.00	25.25	25.25	22.90	25.25	22.90	22.90
Ball Bearings	Inboard	6206	6206	6206	6206	6206	6206	6208	6206	6208	6206	6206
	Outboard	5206	5206	5206	5206	5206	5206	5307	5206	5307	5206	5206
Frame Designation	Packing	F20-C4	F20-C4	F20-C4	F20-C4	F20-G4	F20-H4	F20-I4	F20-C4	F20-B4	F20-C4	F20-C4
	Mech. Seal on Shaft	F20-C5	F20-C5	F20-C5	F20-C5				F20-C5		F20-C5	F20-C5
	Mech. Seal on Shaft Sleeve	F20-C6	F20-C6	F20-C6	F20-C6				F20-C6	F20-B6	F20-C6	F20-C6

- ① With 250# FF flanges and 280# PSIG working pressure refer to pump as M3x2x11S.
- ② With 250# FF flanges and 400# PSIG working pressure refer to pump as H3x2x11S.
- ③ For pumps with 400 PSI working pressure, wear ring clearances are doubled. Derate pump efficiencies by 2 percentage points.
- ④ Flange dimensions are in accordance with ANSI A21.10, AWWA C110 & ANSI B16.1 class 125.
- ⑤ Flange dimensions are in accordance with ANSI B16.1 class 250 except flanges are flat faced, i.e. FF.

- ⑥ The hydrostatic test will be accordance with the latest edition of the Hydraulic Institute Standards, test will maintained for a minimum of 5 minutes.
- ⑦ Type 1 and 21 seals have the same working lengths.
- ⑧ For bronze impellers and casing rings. For diametral clearances for other materials, consult factory.
- ⑩ Impeller is a light press fit on shaft, do not use construction with stainless steel impellers.
- K Not available in mechanical seal on shaft arrangement.

APPENDIX "A" ENGINEERING DATA

Pump Size	8x6x13	8x6x17M	8x6x17L	8x6x18	8x8x12	8x8x17	10x8x12S	10x8x12L	10x8x17S	10x8x17L	10x8x20S
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K

CASING DATA

(All Dimensions in Inches)

④ 125# FF Std ASA Flanges	Max. Suction Pressure	75	75	75	75	75	75	75	75	75	75	75
	Max. Working Pressure	175	175	175	175	175	175	175	175	175	175	175
⑥ NOMINAL 175 PSI Working Press.	Max. Hydrostatic Test Pressure	262	262	262	262	262	262	262	262	262	262	262
	Casing material	Cast I										
⑤ 250# FF NOMINAL 280 PSI	Max. Suction Pressure	200	200	200	200	200	200	200	200	200	200	200
	Max. Working Pressure	280	280	280	280	280	280	280	280	280	280	280
⑥ Working Press.	Max. Hydrostatic Test Pressure	420	420	420	420	420	420	420	420	420	420	420
	Casing material	Ductile I										
② 250# FF NOMINAL 400 PSI	Max. Suction Pressure	300	300	300	300	300	300	300	300	300	300	300
	Max. Working Pressure	400	400	400	400	400	400	400	400	400	400	400
③ Working Press.	Max. Hydrostatic Test Pressure	600	600	600	600	600	600	600	600	600	600	600
	Casing material	Ductile I										
⑥ Casing Wall Thickness		.44	.44	.44	.44	.44	.44	.44	.44	.44	.50	.50

STUFF BOX DATA

(All Dimensions in Inches)

Packing Dimensions	Bore	3.25	3.25	3.25	3.25	3.25	3.75	3.75	3.75	3.75	3.75	3.75	
	Depth	3.50	3.50	3.50	3.50	3.50	3.62	3.62	3.62	3.62	3.62	3.62	
	Sleeve O.D.	2.25	2.25	2.25	2.25	2.25	2.75	2.75	2.75	2.75	2.75	2.75	
	Packing Size/No. Rings W/O S. Cage	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	
	Packing Size/No. Rings W/ S. Cage	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	
	Seal Cage Width	.75	.75	.75	.75	.75	.94	.94	.94	.94	.94	.94	.94
⑦ Mech. Seal On Shaft Dimensions	Bore	2.75	2.75	2.75	2.75	2.75	3.125	3.125	3.125	3.125	3.125		
	Depth	3.00	3.00	3.00	3.00	3.00	3.25	3.25	3.25	3.25	3.25		
	Mech. Seal Size (Type 21 or 1)	1.75	1.75	1.75	1.75	1.75	2.000	2.000	2.000	2.000	2.000		
	⑩ {	Balanced Mech. Major Dia.-->	1.88	1.88	1.88	1.88	1.88	2.12	2.12	2.12	2.12	2.12	
		Seal Size (Type 1B) Minor Dia.-->	1.75	1.75	1.75	1.75	1.75	2.00	2.00	2.00	2.00	2.00	
⑩ {	Bore	3.38	3.38	3.38	3.38	3.38	4.00	4.00	4.00	4.00	4.00	4.00	
	Depth	3.00	3.00	3.00	3.00	3.00	3.12	3.12	3.12	3.12	3.12	3.12	
	Mech. Seal Size (Type 21 or 1)	2.25	2.25	2.25	2.25	2.25	2.75	2.75	2.75	2.75	2.75	2.75	
	⑩ {	Balanced Mech. Major Dia.-->	2.38	2.38	2.38	2.38	2.38	2.88	2.88	2.88	2.88	2.88	2.88
		Seal Size (Type 1B) Minor Dia.-->	2.25	2.25	2.25	2.25	2.25	2.75	2.75	2.75	2.75	2.75	2.75

IMPELLER DESIGN DATA

(All Dimensions in Inches)

No. of Vanes	7	6	6	6	7	7	6	6	7	5	6
Inlet Area (Sq. Inches)	44.4	29.5	38.7	18.3	61.9	40.2	62.9	57.4	57.5	65.4	68.4
Inlet Velocity per 100 GPM (Ft/Sec)	.73	1.09	.83	1.75	.52	.90	.51	.54	.54	.49	.47
Maximum Diameter	12.2	17.0	17.0	17.2	12.8	17.7	12.8	12.8	17.7	17.3	20.2
Minimum Diameter	7.0	10.0	10.0	13.0	8.0	10.0	8.0	8.5	10.0	12.0	12.0
Maximum Sphere	1.0	.47	.50	.70	1.13	.98	1.4	1.47	.97	1.16	.53
WR ^2 for Maximum Diameter (Lbs-Ft^2)	5.3	16.5	18.0	18.0	8.1	17.0	9.8	11.2	20.7	22.4	21.7
⑧ Wear Ring Clearance – Diam. 175# & 280# W.P.	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012
⑧ Wear Ring Clearance – Diam. 400# W.P.	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024

SHAFT AND BEARING DATA

(All Dimensions in Inches)

Under Sleeve	1.874	1.874	1.874	1.874	1.874	2.374	2.374	2.374	2.374	2.374	2.374
Under Mech. Seal on Shaft Type 21 or Type 1	1.750	1.750	1.750	1.750	1.750	2.000	2.000	2.000	2.000	2.000	
Under Mech. Seal on Shaft Type 1B	1.875	1.875	1.875	1.875	1.875	2.125	2.125	2.125	2.125	2.125	
At Coupling	1.375	1.375	1.375	1.375	1.375	1.625	1.625	1.625	1.625	1.625	1.625
Thru Impeller with Packing – Mech. Seal on Sleeve	1.937	1.937	1.937	1.937	1.937	2.437	2.437	2.437	2.437	2.437	2.437
⑨ Thru Impeller with Mech. Seal on Shaft	1.939	1.939	1.939	1.939	1.939	2.439	2.439	2.439	2.439	2.439	2.439
	Bearing to Bearing Centerline	27.25	27.25	27.25	27.25	27.25	29.90	29.90	29.90	29.90	29.90
Ball Bearings	Inboard	6208	6208	6208	6208	6208	6309	6309	6309	6309	6309
	Outboard	5307	5307	5307	5307	5307	5308	5308	5308	5308	5308
Frame Designation	Packing	F20-D4	F20-D4	F20-D4	F20-D4	F20-D4	F20-E4	F20-E4	F20-E4	F20-E4	F20-E4
	Mech. Seal on Shaft	F20-D5	F20-D5	F20-D5	F20-D5	F20-D5	F20-E5	F20-E5	F20-E5	F20-E5	F20-E5
	Mech. Seal on Shaft Sleeve	F20-D6	F20-D6	F20-D6	F20-D6	F20-D6	F20-E6	F20-E6	F20-E6	F20-E6	F20-E6

- ① With 250# FF flanges and 280# PSIG working pressure refer to pump as M3x2x11S.
- ② With 250# FF flanges and 400# PSIG working pressure refer to pump as H3x2x11S.
- ③ For pumps with 400 PSI working pressure, wear ring clearances are doubled. Derate pump efficiencies by 2 percentage points.
- ④ Flange dimensions are in accordance with ANSI A21.10, AWWA C110 & ANSI B16.1 class 125.
- ⑤ Flange dimensions are in accordance with ANSI B16.1 class 250 except flanges are flat faced, i.e. FF.

- ⑥ The hydrostatic test will be accordance with the latest edition of the Hydraulic Institute Standards, test will maintained for a minimum of 5 minutes.
- ⑦ Type 1 and 21 seals have the same working lengths.
- ⑧ For bronze impellers and casing rings. For diametral clearances for other materials, consult factory.
- ⑩ Impeller is a light press fit on shaft, do not use construction with stainless steel impellers.
- K Not available in mechanical seal on shaft arrangement.

APPENDIX "A" ENGINEERING DATA

Pump Size	10x8x20L	10x10x12	12x10x12	12x10x12XL	12x10x14	12x10x17	12x10x18
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K

CASING DATA

(All Dimensions in Inches)

④ ⑥	125# FF Std ASA Flanges	Max. Suction Pressure	75	75	75	75	75	75	75
		Max. Working Pressure	175	175	175	175	175	175	175
⑥	NOMINAL 175 PSI Working Press.	Max. Hydrostatic Test Pressure	262	262	262	262	262	262	262
		Casing material	Cast I						
⑤ ⑥	250# FF NOMINAL 280 PSI Working Press.	Max. Suction Pressure	200	200	200	200	200	200	200
		Max. Working Pressure	280	280	280	280	280	280	280
⑥		Max. Hydrostatic Test Pressure	420	420	420	420	420	420	420
		Casing material	Ductile I						
⑤ ⑥	250# FF NOMINAL 400 PSI Working Press.	Max. Suction Pressure	300	300	300	300	300	300	300
		Max. Working Pressure	400	400	400	400	400	400	400
⑥		Max. Hydrostatic Test Pressure	600	600	600	600	600	600	600
		Casing material	Ductile I						
		Casing Wall Thickness	.62	.44	.44	.56	.56	.56	.56

STUFF BOX DATA

(All Dimensions in Inches)

Packing Dimensions	Bore	3.75	3.25	3.25	3.25	.375	3.75	3.75
	Depth	3.62	3.50	3.50	3.50	3.62	3.62	3.62
	Sleeve O.D.	2.75	2.25	2.25	2.25	2.75	2.75	2.75
	Packing Size/No. Rings W/O S. Cage	6.50	6.50	6.50	6.50	6.50	6.50	6.50
	Packing Size/No. Rings W/ S. Cage	5.50	5.50	5.50	5.50	5.50	5.50	5.50
	Seal Cage Width	.94	.75	.75	.75	.94	.94	.94
⑦ ⑩	Mech. Seal On Shaft Dimensions	Bore		2.75	2.75	2.75	3.125	3.125
		Depth		3.00	3.00	3.00	3.25	3.25
		Mech. Seal Size (Type 21 or 1)		1.75	1.75	1.75	2.000	2.000
		Balanced Mech. Major Dia.-->	1.88		1.88	1.88	1.88	2.12
		Seal Size (Type 1B) Major Dia.-->	1.75		1.75	1.75	1.75	2.00
⑩	Mech. Seal On Sleeves Dimensions	Bore	4.00	3.38	3.38	3.38	4.00	4.00
		Depth	3.12	3.00	3.00	3.00	3.12	3.12
		Mech. Seal Size (Type 21 or 1)	2.75	2.25	2.25	2.25	2.75	2.75
		Balanced Mech. Major Dia.-->	2.88	2.38	2.38	2.38	2.88	2.88
		Seal Size (Type 1B) Major Dia.-->	2.75	2.25	2.25	2.25	2.75	2.75

IMPELLER DESIGN DATA

(All Dimensions in Inches)

No. of Vanes	6	6	6	6	6	7	8
Inlet Area (Sq. Inches)	74.0	86.4	77.2	87.3	93.6	86.4	53.4
Inlet Velocity per 100 GPM (Ft/Sec)	.43	.37	.42	.37	.34	.37	.60
Maximum Diameter	20.2	12.8	12.8	13.8	14.0	17.5	18.0
Minimum Diameter	12.0	9.3	8.7	8.7	10.0	10.0	12.5
Maximum Sphere	.72	1.54	1.12	1.56	1.62	1.36	.90
WR ^2 for Maximum Diameter (Lbs-Ft^2)	22.5	11.7	11.7	15.5	18.0	22.3	24.2
③ ③	Wear Ring Clearance – Diam. 175# & 280# W.P.	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012	.010-.012
	Wear Ring Clearance – Diam. 400# W.P.	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024	.020-.024

SHAFT AND BEARING DATA

(All Dimensions in Inches)

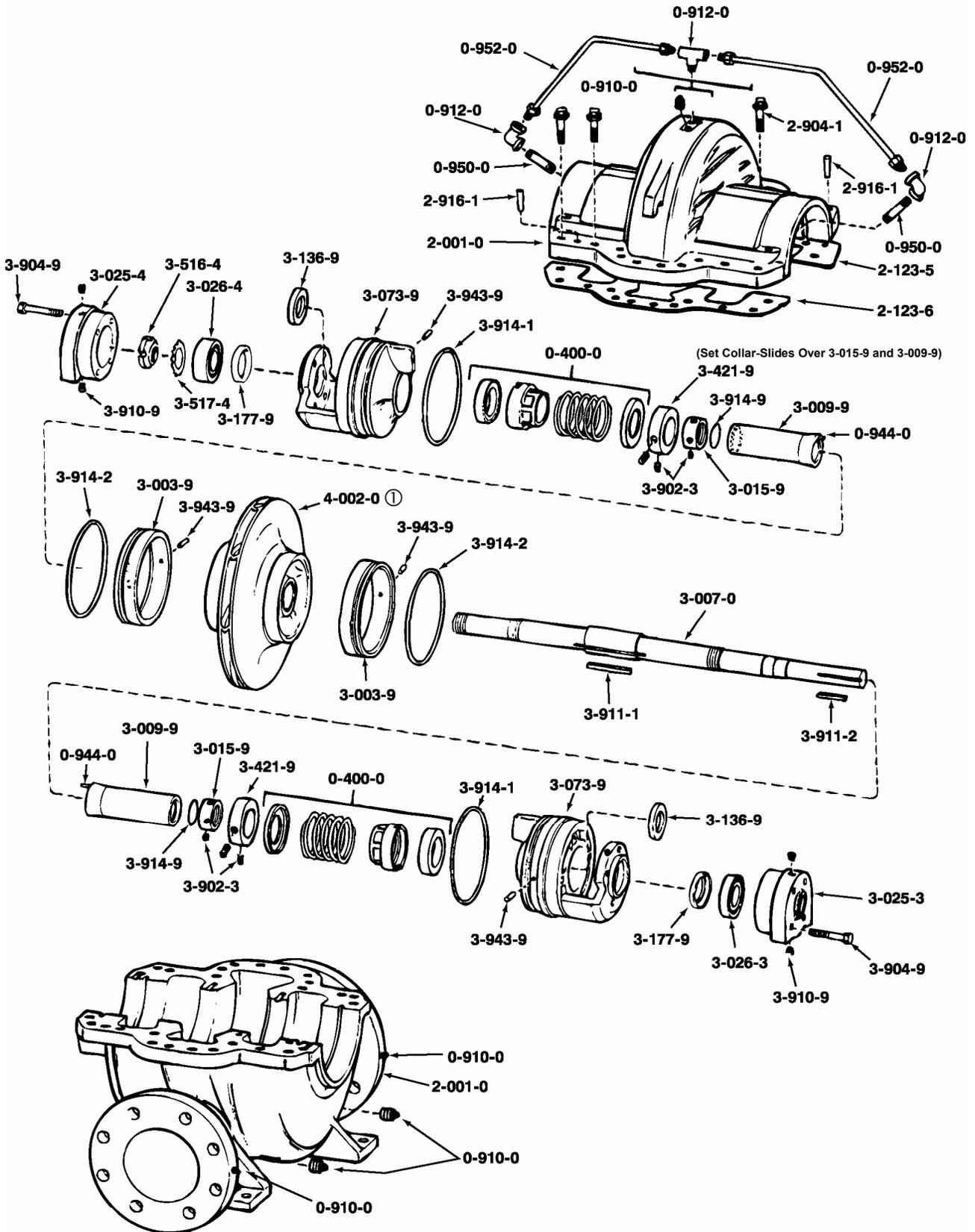
Under Sleeve	2.374	2.374	2.374	2.374	2.374	2.374	2.374
Under Mech. Seal on Shaft Type 21 or Type 1		2.000	2.000	2.000	2.000	2.000	
Under Mech. Seal on Shaft Type 1B		2.125	2.125	2.125	2.125	2.125	
At Coupling	1.625	1.625	1.625	1.625	1.625	1.625	1.625
Thru Impeller with Packing – Mech. Seal on Sleeve	2.437	2.437	2.437	2.437	2.437	2.437	2.437
⑩	Thru Impeller with Mech. Seal on Shaft		2.439	2.439	2.439	2.439	2.439
		Shaft Span	29.90	32.90	32.90	32.90	29.90
Ball Bearings	Inboard	6309	6309	6309	6309	6309	6309
	Outboard	5308	5308	5308	5308	5308	5308
Frame Designation	Packing	F20-E4	F20-F4	F20-F4	F20-F4	F20-E4	F20-E4
	Mech. Seal on Shaft		F20-F5	F20-F5	F20-F5	F20-E5	F20-E5
	Mech. Seal on Shaft Sleeve	F20-E6	F20-F6	F20-F6	F20-F6	F20-E6	F20-E6

- ① With 250# FF flanges and 280# PSIG working pressure refer to pump as M3x2x11S.
- ② With 250# FF flanges and 400# PSIG working pressure refer to pump as H3x2x11S.
- ③ For pumps with 400 PSI working pressure, wear ring clearances are doubled. Derate pump efficiencies by 2 percentage points.
- ④ Flange dimensions are in accordance with ANSI A21.10, AWWA C110 & ANSI B16.1 class 125.
- ⑤ Flange dimensions are in accordance with ANSI B16.1 class 250 except flanges are flat faced, i.e. FF.

- ⑥ The hydrostatic test will be accordance with the latest edition of the Hydraulic Institute Standards, test will maintained for a minimum of 5 minutes.
- ⑦ Type 1 and 21 seals have the same working lengths.
- ⑧ For bronze impellers and casing rings. For diametral clearances for other materials, consult factory.
- ⑩ Impeller is a light press fit on shaft, do not use construction with stainless steel impellers.
- K Not available in mechanical seal on shaft arrangement.

APPENDIX "B"

EXPLOSION VIEW: MECHANICAL SEALS ON SHAFT SLEEVES



APPENDIX “B”

REPLACEMENT PARTS LIST

Part Number	Part Name	Quantity		
		Packing	Mech. Seal on Sleeve	Mech. Seal on Shaft
0-400-0*	Mechanical Seal		2	2
0-910-0	Pipe Plug (Casing)	5	5	5
0-912-0	Pipe Fitting	3 (optional)	3	3
0-944-0	Spirol Pin (Shaft Sleeve)	2	2	
0-950-0	Pipe Nipple	2 (optional)	2	2
0-952-0	Tubing & Connectors	2 (optional)	2	2
1-013-9	Seal Cage	2 (optional)		
1-014-9	Gland, Packing	2		
1-904-9	Cap Screw (Gland)	4		
1-924-9*	Packing	12 Rings		
2-001-0	Casing, Lower Half	1	1	1
2-001-0	Casing, Upper Half	1	1	1
2-123-5*	Gasket, Casing (Suction)	1	1	1
2-123-6*	Gasket, Casing (Discharge)	1	1	1
2-904-1	Cap Screw (Casing)	Varies w/pump size	Varies w/pump size	Varies w/pump size
2-916-1	Taper Pin	2	2	2
3-003-9*	Casing Ring	2	2	2
3-007-0	Shaft	1	1	1
3-009-9*	Shaft Sleeve	2	2	
3-015-9	Nut, Shaft Sleeve	2	2	
3-025-3	Housing, Inboard Bearing	1	1	1
3-025-4	Housing, Outboard Bearing	1	1	1
3-026-3*	Bearing, Inboard	1	1	1
3-026-4*	Bearing, Outboard	1	1	12
3-073-9	Stuffing Box	2	2	2
3-136-9	Deflector	2	2	2
3-177-9*	Lip Seal	2	2	
3-421-9	Set Collar		2	1
3-516-4	Locknut	1	1	1
3-517-4	Lockwasher	1	1	
3-902-3	Set Screw	2	6	8
3-904-9	Cap Screw (Bearing Housing)	8	8	4
3-910-9	Pipe Plug (Bearing Housing)	4	4	1
3-911-1	Impeller Key	1	1	1
3-911-2	Coupling Key	1	1	
3-914-1*	O-Ring (Stuffing Box)	2	2	2
3-914-2*	O-Ring (Casing Ring)	2	2	2
3-914-9*	O-Ring (Shaft Sleeve)	2	2	
3-915-1*	Retaining Ring (Impeller)			1
3-943-9	Spirol Pin	4	4	4
4-002-0	Impeller	1	1	1

* Recommended spare parts.

APPENDIX "C" FIELD TEST REPORT

Field Test Report

Pump Size _____ Pump Type _____ Date _____
 Pump Serial No. _____ Imp. Dia. (in.) _____ Head _____ RPM _____
 RATING: GPM _____ Suction gage connection pipe size _____ in.
 Discharge gage connection pipe size _____ in.
 Discharge gage elevation corr. _____ ft.
 Suction gage elevation corr. _____ ft.
 MOTOR:** Rated HP _____ Volts _____ S.F. _____ in. Hg x 1.13 = _____ ft. water
 F. L. Amps _____ F.L. Eff. _____ P.F. _____ Liquid pumped _____ S.G. _____
 Phase _____ Liquid temperature _____ °F
 Liquid vapor pressure _____ psi x 2.31 = _____ ft. water

P O I N T	Disch. Press. Gage (psi) (ft.)	Suct. Press. Gage (psi) (ft.)	Velocity Head (ft.)		Total Dynamic Head (TDH ₂)	Flow		Motor Volts	Motor Amps			Avg. Amps.	Pump BHP ₂ (calc'd)	Pump Eff (calc'd)	Affinity Law Corrections			Calc'd N P S H R*
			Disc.	Suct.		g _n	g ₁		leg 1	leg 2	leg 3				RPM ₂	TDH ₁	GPM ₁	
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

*NPSHR taken from manufacturer's price book curve.
 **Motor information taken off motor nameplate.
 See sheet 2 of 2 for useful formulas.

Type of flow measurement device: _____
 Readings taken by: _____

Comments: _____

1 of 2

APPENDIX "C" FIELD TEST REPORT

USEFUL FORMULAS

- 1) Head (ft.) = $\frac{\text{Pressure (psig.)} \times 2.31}{\text{S.G.}}$ S.G. = specific gravity ; S.G. of water = 1.0 at 70°F
- 2) TDH (ft.) = Total Dynamic Head (ft.) = (Disch. pressure gauge reading - Suct. pressure gauge reading) +
(Discharge velocity head - Suction velocity head) +
(Elevation correction to disch. gauge - Elevation correction to suct. gauge)
- 3) PUMP INPUT HP (BHP) - calculated:

Single Phase Motor	Three Phase Motor
$\text{BHP} = \frac{\text{Amps} \times \text{Volts} \times \eta_m \times \text{p.f.}}{746}$	$\text{BHP} = \frac{\text{Avg. Amps} \times \text{Volts} \times 1.732 \times \eta_m \times \text{p.f.}}{746}$

where η_m = motor efficiency, p.f. = motor power factor, Avg. Amps = $\frac{\text{leg 1} + \text{leg 2} + \text{leg 3}}{3}$

- 4) Pump Efficiency (η_p):

$$\eta_p = \frac{\text{GPM} \times \text{TDH}}{3960 \times \text{BHP}}$$

- 5) Affinity Laws for correcting GPM, TDH, and BHP for speed (RPM):

$$\frac{\text{GPM}_1}{\text{GPM}_2} = \frac{\text{RPM}_1}{\text{RPM}_2} \quad \text{or} \quad \text{GPM}_1 = \text{GPM}_2 \times \frac{\text{RPM}_1}{\text{RPM}_2}$$

$$\frac{\text{TDH}_1}{\text{TDH}_2} = \left(\frac{\text{RPM}_1}{\text{RPM}_2} \right)^2 \quad \text{or} \quad \text{TDH}_1 = \text{TDH}_2 \times \left(\frac{\text{RPM}_1}{\text{RPM}_2} \right)^2$$

$$\frac{\text{BHP}_1}{\text{BHP}_2} = \left(\frac{\text{RPM}_1}{\text{RPM}_2} \right)^3 \quad \text{or} \quad \text{BHP}_1 = \text{BHP}_2 \times \left(\frac{\text{RPM}_1}{\text{RPM}_2} \right)^3$$

- 6) NPSHA DETERMINATION:

NPSHA = Net Positive Suction Head Available

NPSHA = (Atmospheric pressure - Vapor pressure of liquid + Total suction head)

Total Suction Head = (Suction pressure gauge reading + Suction velocity head + Elevation correction to suction gauge)

NOTE: NPSHA must always be greater than NPSHR (NPSHA > NPSHR) for the pump to operate without concern of cavitation.

NPSHR refers to Net Positive Suction Head Required by pump. This is a published value obtained from the Pump Manufacturer's curve.

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- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

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