

# **AURORA<sup>®</sup>** LAYNE VERTI-LINE SERIES SHORT COUPLED PUMPS

## **INSTALLATION AND MAINTENANCE MANUAL**

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

These instructions are not intended to cover all details or variations in equipment nor to provide for every possible contingency to be met in conjunction with installation, operation, and maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the factory.

 **WARNING** 

High voltage, rotating parts, or falling parts can cause serious or fatal injury. The installation, operation, and maintenance of this equipment should be performed only by qualified personnel familiar with the contents of this manual, the contents of the pump motor manual, the National Electrical Code, local electrical codes, local plumbing codes, local water well codes, and sound practices for electrical and mechanical equipment. Among the many considerations are:

- Observe good safety practices at all times.
- Use proper procedures when handling, lifting, installing, operating, or maintaining the equipment.
- Avoid contact with electrically energized circuits.
- Before initiating maintenance procedures, be sure that all power has been removed from the pump and its accessories.
- Avoid removing, by-passing, or rendering inoperative any safeguards or protective devices.
- Be sure the unit is properly grounded per the instructions in the motor manual and per applicable electrical codes.
- Be sure the equipment is properly enclosed to prevent access by unauthorized personnel who could injure themselves or damage the equipment.
- When making electrical tests, use rubber gloves and rubber soled shoes for protection from possible electrical shock. Perform the tests in a dry location.

 **WARNING** 

**CALIFORNIA PROPOSITION 65 WARNING:**

This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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# SECTION 1

## INTRODUCTION

Efficient performance. Satisfactory operation. Dependable service.

We know these are the things you want from your vertical turbine pump and we've designed it accordingly. We've prepared this booklet to help you assure continuance of these features by implementing a careful and proper installation and maintenance program. If you want further assistance, you might consider contracting for the services of an experienced service representative to supervise your installation and/or startup.

Because of variations in jobsite environments and installation requirements, we've had to be somewhat general. However, we have listed what we believe are the most important guidelines. Your installer must still use sound judgement to adapt the methods we've outlined to the specific site circumstances and pump design features in each particular installation. It is in your interest that he does, since failure to comply with recommended procedures may void your warranty.

If any question should arise during the course of the work, we urge you to see your local representative immediately. Please be able to identify the unit by its serial number. We stamp the number on the nameplate, on the discharge head and on the bowl assembly. See Figures 1 and 2.

Figures 3 and 4 will show you the relationship of all the parts after installation is complete. The nomenclature we've used here will identify the items throughout the instructions. Before starting the installation procedure, please read through the entire process we've described in this book, omitting material not applicable to your particular pump. Study in detail the precautionary directions emphasized in Section 13.

Then, when you do start the work, refer to the instructions for each individual step. After the equipment is in operation, we suggest you keep a manual available at the site for future use in maintenance programs. It can be used in conjunction with the disassembly, assembly and troubleshooting manuals.

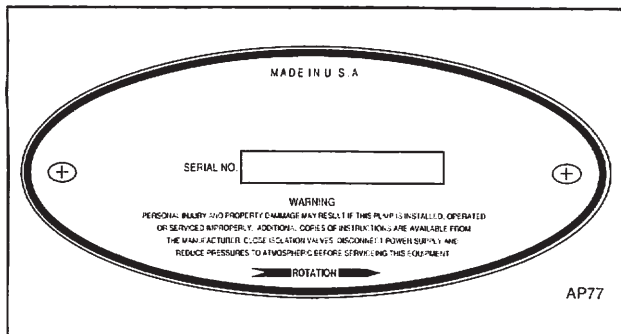


Figure 1. Discharge Head Nameplate

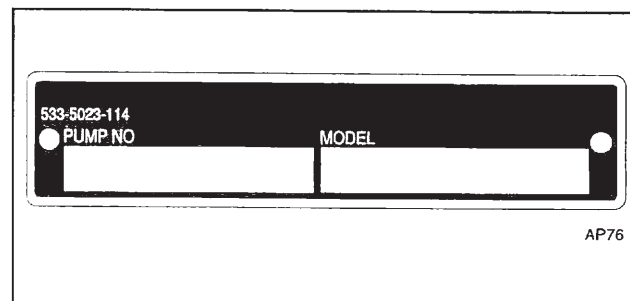


Figure 2. Bowl Assembly Nameplate

## SECTION 2 THE EQUIPMENT

The material and equipment you'll need for installation may vary with the size of pump and the type of job. We'll offer the following suggestions as a guide but you will want to remember the primary tool to be used at all times is SAFETY FIRST.

You can use a portable derrick or tripod, but we recommend either a boom crane of adequate capacity or a properly designed pump setting rig similar to that shown in Figure 3. Whatever you choose, your lifting device must allow the load hook to be raised at least two feet higher than the total length of your assembled pump. Your hook should be of the safety type with a good easy working swivel and you must have sufficient reach to center it over the installation position.

The pump is normally delivered to you in an assembled condition. If you have elected to receive it unassembled due to its size, jobsite head room limitation, or some other compelling reason, Section 9 will guide you thru the required steps to install your pump.

For installation of an assembled unit, we suggest the following miscellaneous tools and material, but you may want to vary them to suit the peculiarities of your individual project:

Lifting equipment. See Figure 3.

Cable sling about 10 feet long of adequate size for job. See Figure 4.

Chain tongs

Medium size pipe wrenches

12 foot length 3/4 inch rope

Ordinary set of mechanics tools. See Figure 5.

Wire brush

Assortment of files

Clean rags

Thread compound — Use anti-galling type for stainless steel parts

Solvent — Gasoline, distillate, or kerosene in recommended containers

Special lubricants as required

Shims and wedges

Non-shrink grouting material



**WARNING**



All combustible materials must be kept in approved safety containers and handled carefully away from any flame, sparks, exhaust, or any other possible source of ignition.

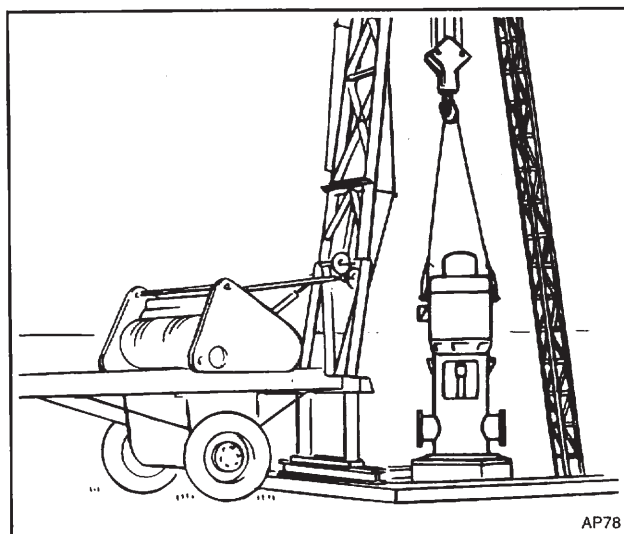


Figure 3. Pump Installation Rig

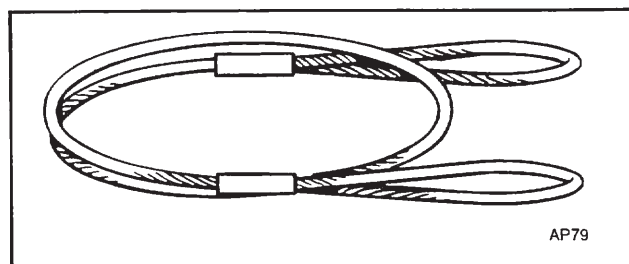


Figure 4. Cable Sling

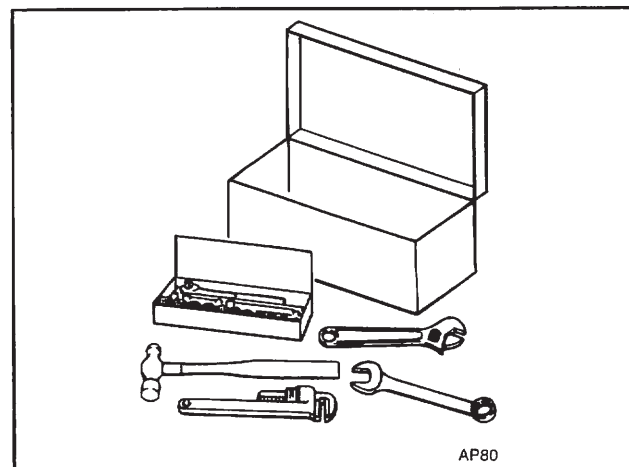


Figure 5. Ordinary Set of Mechanics Tools

## SECTION 3

### RECEIVING THE PUMP

Your pump was inspected on the carrier just prior to leaving the factory. When you receive it at your job site, look it over carefully for any visible damage to parts, skids, boxes, or dunnage. If shafting is crated, open the crate carefully to inspect and make a count but leave the shaft in the box for protection until ready for installation. Take inventory on the truck or during the unload-

ing process. Do not sign for damaged or incomplete shipments unless you take the appropriate exceptions. Report such instances immediately to your representative and to the transportation company involved giving full particulars and confirming all verbal understandings in writing.

## SECTION 4

### UNLOADING THE PUMP

It is important to exercise extreme care in handling and installing all parts. All items are precision machined for proper alignment and, if dropped, banged, sprung, or mistreated in any way, misalignment and malfunction will result. Parts which are too heavy to be lifted from the transporting car or truck should be skidded slowly and carefully to the ground so as to prevent injury. Never unload by dropping parts directly from the carrier to the ground and never use shipping crates for skids.

If jobsite conditions permit, you may be able to install directly from the truck that brought the pump to you. If not, move the components to the installation area and lay them out in a clean and protected area convenient to the work location.

If installation cannot begin within a very few days after delivery, it is a good idea to segregate and identify all components comprising your shipment so they will not be lost in the midst of other equipment arriving at the jobsite. Under these conditions, refer to the Recommendations for Pump Storage in Section 16. Read and follow them carefully because care of the pump during storage and before installation can be as important as maintenance after operation has begun.

Check all parts against your packing list to make sure nothing is missing. It's much better to find out now than during the installation.

## SECTION 5

### THE SUMP

The sump you provide can influence both the mechanical and hydraulic performance of your pump. The intake configuration should be designed to deliver an evenly distributed flow of water to the pump suction since uneven flow patterns tend to create vortices. Vortexing can be submerged and completely invisible, or, it can appear on the surface. It can introduce air into the pump, can increase or decrease power consumption, can influence submergence requirement, and can produce objectionable noise and vibration, among other things.

It's easy to be misled by low calculated average velocities across an intake channel, but keep in mind these figures can often mean absolutely nothing. It's the localized velocities that start the vortex. Actually, vortices are more easily sustained in flows of lower average velocities where a calm slowly moving surface does nothing to interfere with a gradual buildup in vortex size. A more turbulent surface can tend to break up these disturbances before they grow large enough to cause harm.

The Standards of the Hydraulic Institute offers certain guidelines for good pit design and we subscribe to these general principles. However, we recommend you put your sump design questions in the hands of an experienced sump design engineer who can match intake configuration with pump requirements in the plant design phase and make it possible for you to realize optimum performance from each.

Before starting installation, inspect the completed sump carefully. You'll want to make sure it's dimensionally adequate to receive the pump. You'll also want to see that it has been cleared of all trash and debris. Your inspection should include any pipelines or conduits feeding into the pit. It's a good idea to have the basin screened to prevent future entrance of foreign material which can damage or clog the pump, possibly even rendering it inoperative.

If a suction vessel is used, see additional instruction labeled the suction vessel. See Section 6.



## SECTION 6

### THE SUCTION VESSEL

Not applicable for pumps installed in an open sump. See Section 5.

If your pump is a suction cased booster, your suction vessel may have been furnished with the pump or you may have procured it from another source. In either event, the vessel should be lowered into the pit, levelled, and grouted or otherwise secured in place, after which the nuts may be tightened firmly on the vessel anchor bolts. These bolts may be similar to those discussed in Section 7, Mounting Base.

You must set the vessel so that the machined portion of the top flange is level within a maximum of 0.007 inches per linear foot across the flange face. Bolt holes must be located so that the suction and discharge nozzles are in proper orientation for your jobsite piping.

In some installations, concrete is poured around the outside of the vessel after positioning. In other instances, the tank may be set in the ground with a higher water table surrounding. In these or similar situations, you must take proper measures to prevent the barrel from floating out of position. You may use any suitable means, including firm anchoring and bracing, or you may want to fill the vessel itself with water to eliminate its buoyancy.

Velocities and flow patterns in the vessel can be critical to the operation of the pump. If the tank is designed and/or furnished by any source other than the factory, the configuration must be approved by factory authorized engineers before the pump warranty will be validated.

After you've set the vessel, and during the installation of the pump, you must provide protective cover for the machined surface of the barrel flange.

Typical assemblies of this type are illustrated in Figures 6 and 7.

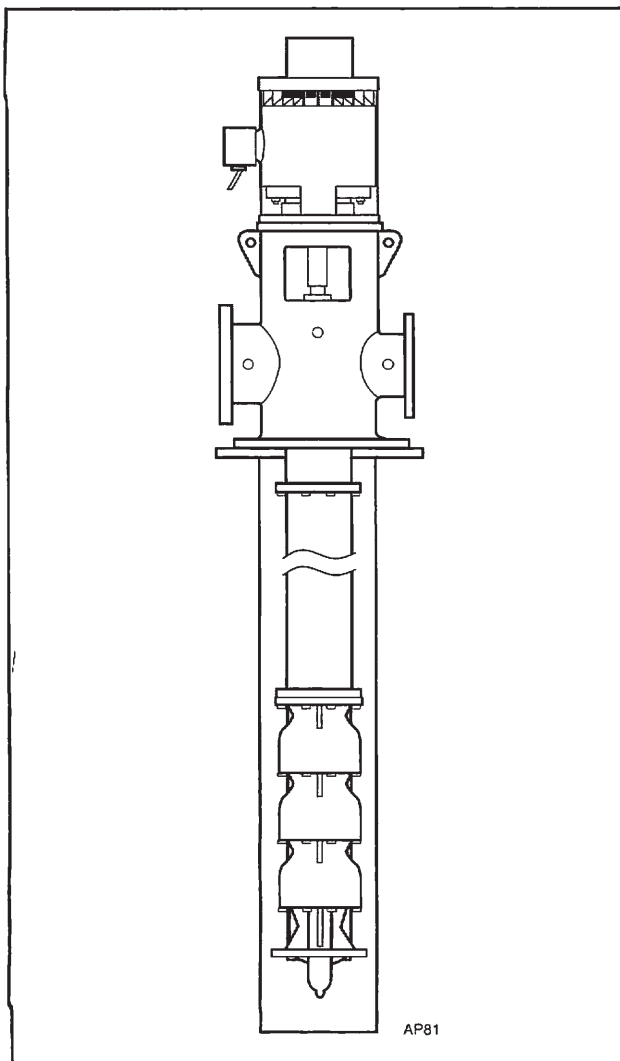


Figure 6. Above Surface Suction Vessel

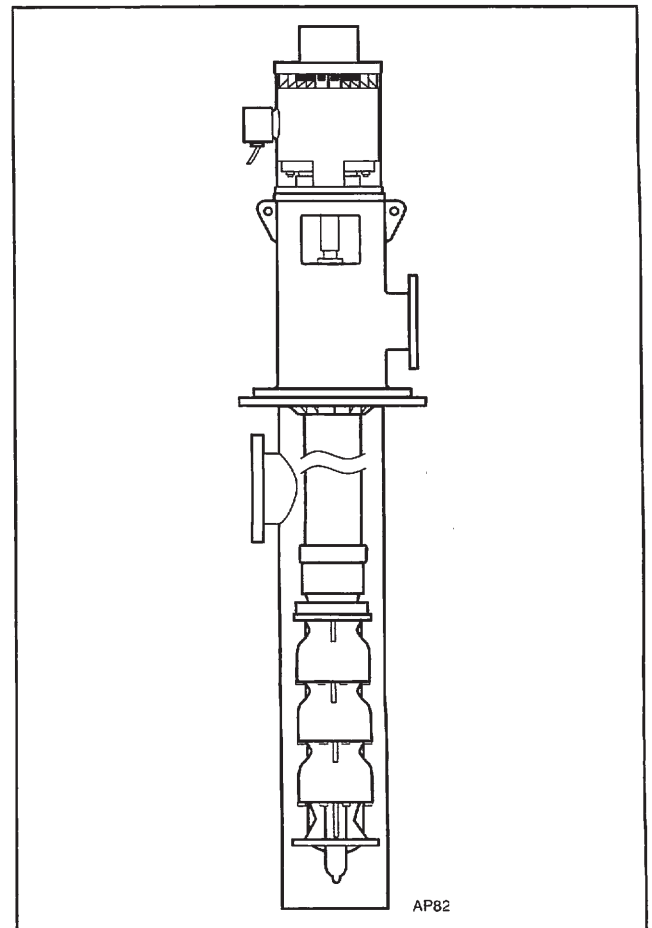


Figure 7. Below Surface Suction Vessel

## SECTION 7

### THE MOUNTING BASE

Your pump requires a foundation suitable for the weight of the entire unit when full of water. While the preferred material is solid reinforced concrete, you can use adequate fabricated steel structures as long as you keep deflections to an absolute minimum. Regardless of material, the mounting structure must be properly engineered, structurally sound and stable, able to withstand and prevent objectionable vibration. You'll need anchor bolts to secure the header base plate to the mounting surface.

With a suction cased pump, the foundation will be under the suction vessel flange, and the pump head will mount directly to the flange as shown in Section 6. You'll want to provide anchor bolts to secure the vessel flange to the mounting base. We prefer the sleeve bolt design shown on the right, in Figure 8 and you probably will too, since it's easy to use. Alternate bolt arrangements are illustrated, however, for your information.

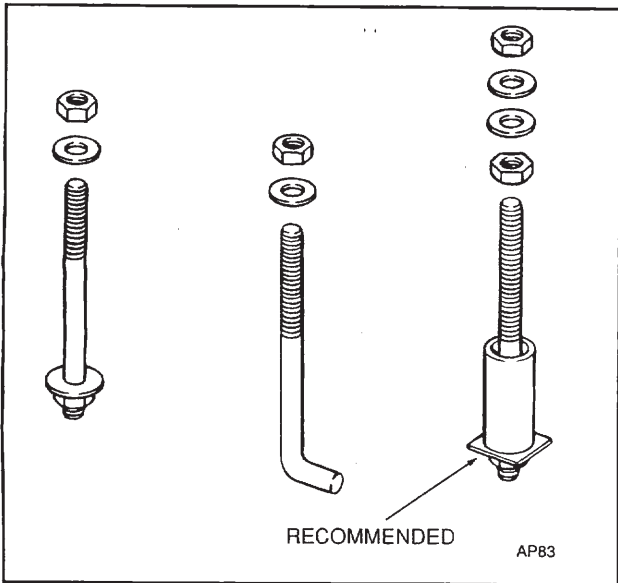


Figure 8. Foundation Anchor Bolts

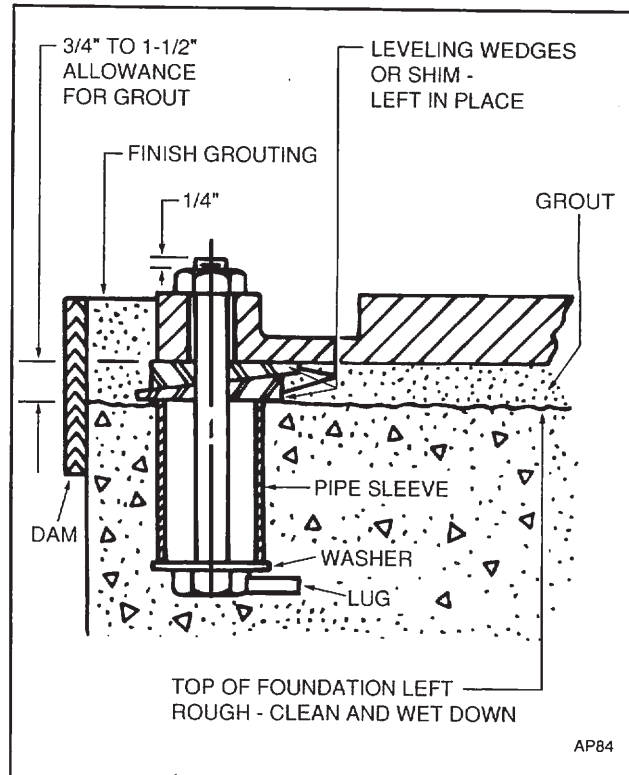


Figure 8A. Typical Foundation Bolt Design

## SECTION 8

### INSTALLING THE PUMP – FACTORY ASSEMBLED UNIT

You're now ready to start actual installation. Clear the work area at and around the mounting position so installers can move freely and with maximum safety. This will also decrease the chances for foreign material or objects to enter the pump as it is lowered into position and secured. If this is a suction cased unit, clean the top flange of the suction vessel and install the gasket or O-ring provided. Examine the vessel and be sure it has been completely cleared of all trash and debris.

During the course of the work, you must never lose sight of the fact that you are handling precision components no matter how awkward they may be to manipulate. All threads should be engaged by hand and checked before tightening. Damage resulting from cross threading or dirt must be repaired with a file before applying force. If not repairable, the part must be replaced so it's clearly worth your while to use the utmost care.

If your pump was shipped not assembled due to its length or space limitations, skip over to the section on assembly of pump components. See Section 9.

With a sling around the lifting trunnions on the discharge head, raise the entire unit as shipped to a vertical position over its mounting base, as shown in Figure 9. Take care to avoid putting any strain on the column or any exposed shafting. Also be careful not to damage the strainer during the lifting operation. Clean the bottom of the pump base and lower the assembly gently into place in its operating position with full contact, base to mounting surface. Assemble base or flange mounting bolts and/or nuts.

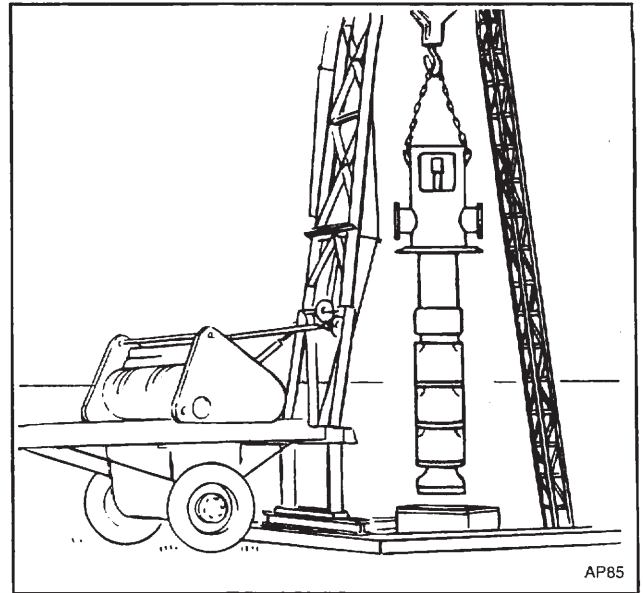


Figure 9. Raising Unit Over Well

Examine the position of the pump. The suction bell must hang the proper distance from the bottom and be unobstructed in any direction. Piping connections must be in the right orientation with respect to jobsite plumbing. When these and all other considerations appear correct, proceed with Section 12.

## SECTION 9

### INSTALLING THE PUMP – UNASSEMBLED UNIT

#### A. UNCRATING AND INSPECTION

Clean an area convenient to the hoist. Uncrate and lay-out all the equipment in the order of installation on clean boards or sawhorses. A physical check of all equipment should be made against the packing list and inspected for obvious damage incurred during shipment. Immediately report any damage to carrier. Check pump shaft for ease of rotation. Shaft should turn freely by hand.

#### B. INSTALLATION EQUIPMENT AND TOOLS

- A portable or permanent derrick of sufficient strength and rigidity to lift the total weight of the pump should be used. A conservative weight of the pump may be obtained from the freight bill. The minimum travel of the derrick should be at least 6' greater than the longest piece of pump equipment. Hoist must have swivel hook.
- One cable sling of sufficient strength to lift entire pump and long enough to clear greatest shaft projection (except for large bowl assemblies).
- One erector sling for lifting driver.
- Dial indicator and stand calibrated in 0.001" divisions.
- Can of machine oil.
- Wire brush, 3-cornered file, flat file and emery cloth.
- Set of mechanic's tools including an assortment of socket wrenches.
- Bucket of solvent - coal oil, etc.
- Machinist's level.
- Steel tape measure.
- Two pipe wrenches of sufficient size to handle shaft couplings and shafting. (Always required for hollow shaft drive.)
- One set of steel clamps to fit the pump bowl (except for large bowl assemblies).
- Two sets of steel clamps to fit the column pipe.

NOTE: One set required if only one section of column is furnished (except for large bowl assemblies).

- Two 4 x 4 timbers or "H" beams (if unit is extra large and heavy), sufficiently long to span installation opening.
- Two "V" blocks for checking shaft if a bent shaft is suspected.
- Two chain tongs of sufficient size to handle column pipe.
- 15' of 3/4" rope. Do not use on large bowl assemblies.
- Thread compound such as Permatex Form-A-Gasket with denatured alcohol thinner.
- Two pipe wrenches of sufficient size to handle shaft enclosing tubing when applicable.
- Sufficient quantity of wedges to level baseplate or head.
- Sufficient quantity of top quality non-shrink grout.
- Anti-sieze compound for stainless to stainless threads.
- For large pump assemblies, at least 3 eye nuts with spacers for lifting equipment.
- A leg sling with safety hooks at least 4 feet long sufficient strength to lift entire pump.
- For large pumps, hanging tool for lifting and assembling shafting, tubing and column.

#### C. SPECIAL PRECAUTIONS

Make certain that no rags, wood scraps, etc. are lodged in any exposed openings. Check pit depth and anchor bolt spacing against pump dimensions. Lift and handle unit carefully to prevent damage caused by excessive strain being applied. Take extra precautions when handling mechanical seal, since this is the most delicate and precision component of the pump assembly.

Do not allow pipe compound, solvent or any petroleum products to get to rubber bearings.

NEVER USE THREAD COMPOUND ON SHAFT JOINTS.

Shaft threads are left hand; column and tubing are right hand.

#### D. PREPARATION AND CLEANING

Clean all threading with wire brush and solvent. Dress threading, if required, with three cornered file.

Clean all shafting and couplings with a rag soaked with solvent. Make certain that all bearings are clean.

If furnished, clean all exposed tubing threads and shaft boxes thoroughly with a rag soaked in solvent and make certain that tubing faces are free of nicks or burrs. Remove protective caps from ends of tubing before starting.

Remove rust preventative from all flange faces with rag and solvent.

Remove stuffing box from discharge head.

Make a physical check of the discharge head or baseplate for proper fit to foundation.

Check pipe ends and mating components to be sure there are no nicks, burrs, etc. The success of a proper pipe joint is dependent on the butt joint of the pipe end.

Check shaft ends for nicks, burrs, etc. The shaft alignment is dependent on the butt joint of the shaft ends.

Check runout on impeller shaft extension by placing indicator dial toward end of shaft and turning shaft slowly making certain that it stays to one side of the uppermost bowl bearing. T.I.R. should not exceed 0.005".

Check and record total bowl lateral or end-play. If prime mover is solid shaft, this information will be required for flanged coupling assembly.

INSTALLATION - REFER TO APPROPRIATE DRAWINGS IN MANUAL

### NOTE

Skip Section E if a separate base plate is not furnished or if pumps have an underground outlet or a suction connection to a header. If either of the two latter cases are true, the base plate should be bolted to the head and treated as if there is no separate baseplate as outlined in Section L.

#### E. BASE PLATE

Accurate baseplate leveling and alignment is the key to proper pump installation and optimum pump operation. Proceed with extreme care. See Figure 10.

Place baseplate over anchor bolts and allow to rest on at least 4 wood or metal spacers about 1/4" thick.

Place a minimum of 8 wedges, two per side, around baseplate and force in until they are tight. Check level of baseplate with a machinist's level and carefully hammer in wedges until plate is level within 0.003 thousands of an inch in all directions. If the elevation of the plate is critical, this should be taken into account prior to and during leveling.

Attach hex nuts to anchor bolts and tighten against base-plate.

Mix up a sufficient quantity of rather dry non-shrink grout. Force as much grout under baseplate as possible. If grout holes are provided, grout can be pressure fed thru the grout holes until all cavities are filled. Grout around the perimeter of the baseplate to hide the wedges. Recheck level of plate then do not disturb until grout has completely set.

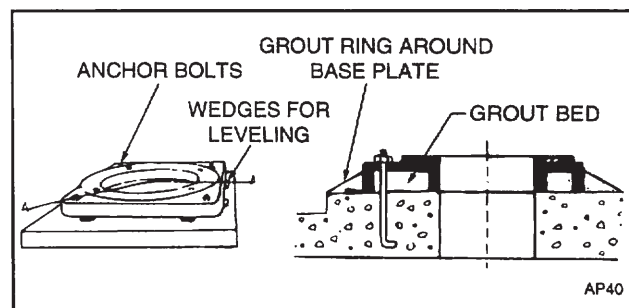


Figure 10. Baseplate Leveling

#### F. PUMP BOWL

Place the two setting beams on the foundation (or baseplate) opening. If a baseplate is used, place cardboard or thin plywood beneath the beams to protect the machined surface.

Secure the proper clamp to the upper end of the bowl beneath a convenient shoulder. Attach the sling to the clamp far enough out on the ears to allow its removal after setting down on beams. See Figure 11.



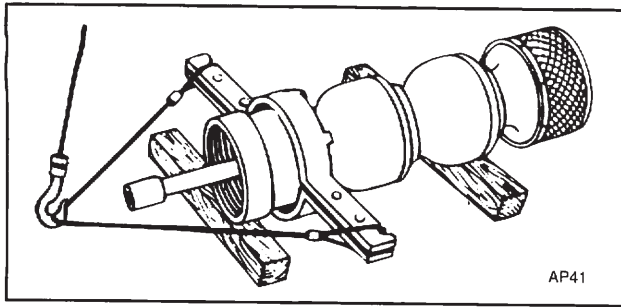


Figure 11. Attaching Lifting Sling

If the bowl is equipped with a strainer, first remove strainer, hoist bowl to vertical position being careful not to drag suction across floor, then reinstall strainer.

If there is any auxiliary piping to the tail bearing, make certain that the bowl portion is assembled to the bowl at this time.

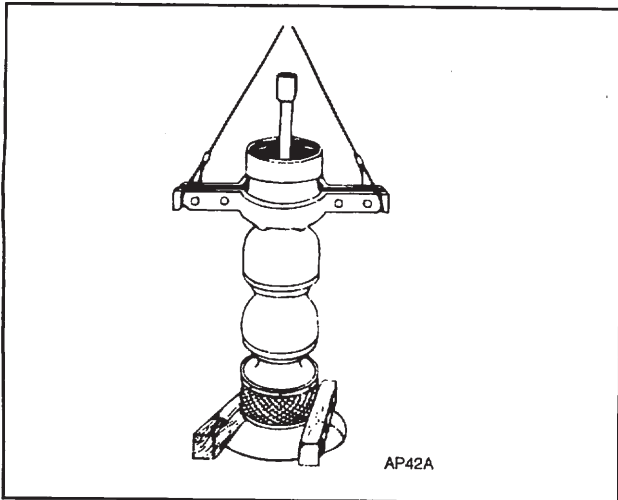


Figure 12. Bowl Ready for Installation

Center bowl over installation opening then carefully lower until the clamp ears are resting squarely on the beams. Remove the sling. See Figures 12 and 13.

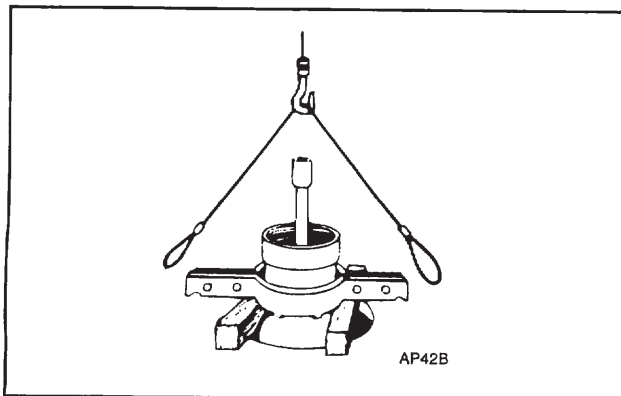


Figure 13. Bowl Lowered In Position

Clean the shaft threads, the discharge threads and butt face or flange face and the tube adapter threads and face if enclosing tubing is furnished. Lightly oil the shaft threads and screw coupling on half way. Place a rag over the coupling to prevent entrance of foreign matter during the next step in assembly.

## G. LARGE BOWL ASSEMBLIES

Place the two setting beams on the foundation (or baseplate) opening. If a baseplate is used, place cardboard or thin plywood beneath the beams to protect the machined surface.

Attach the three spacers and three eye nuts to three studs about 120 degrees apart. Attach 3 legs of the 4 leg sling to eye nuts. See Figure 14.

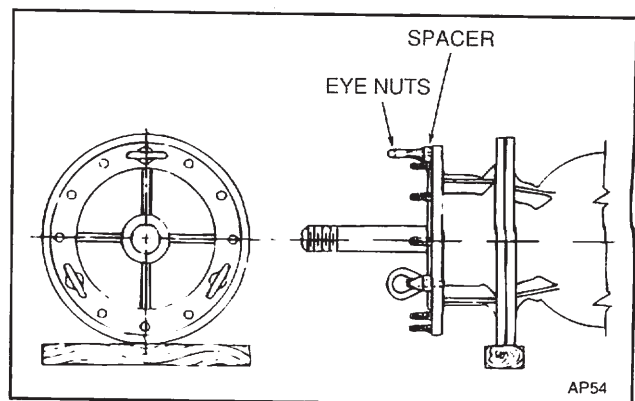


Figure 14. Slings With Eye Nuts

If the bowl is equipped with a strainer, first remove strainer, hoist bowl to vertical position being careful not to drag suction across floor, then reinstall strainer.

If there is any auxiliary piping to the tail bearing, make certain that the bowl portion is assembled to the bowl at this time.

Center bowl over installation opening then carefully lower until the underside of the top flange is resting squarely on the setting beams. Remove sling, eye nuts and spacers.

Clean the shaft threads, the discharge threads and butt face or flange face and the tube adapter threads and face if enclosing tubing is furnished. Lightly oil the shaft threads and screw coupling on half way. Place a rag over the coupling to prevent entrance of foreign matter during the next step in assembly.

## H. COLUMN - OPEN LINE SHAFT

Refer to installation plan to determine correct sequence of column lengths.

Prior to making up threaded column joints, remove the thread protectors and thoroughly clean threads with wire brush and solvent. If necessary, repair any damaged threads with a three cornered file and remove any burrs. **THE PROTECTIVE COATINGS ON THE PARTS IS A RUST PREVENTATIVE AND IS NOT SUITABLE AS A THREAD LUBRICANT. THIS COATING MUST BE CLEANED OFF THREADS.**

Clean all shafting and couplings using a rag soaked with solvent.

Make certain that all bearings are clean (do not use solvent on rubber).

Remove rust preventative from all flange faces with solvent and if necessary, smooth flange face with a flat file.

If tubing is furnished, check the tube ends for nicks, burrs, etc. Sections of tubing which were assembled at the factory should be checked for tightness.

Check the shaft ends for nicks, burrs, etc. The shaft ends at each coupling must butt squarely against each other in order for the shaft to be aligned properly.

Check all loose shafting for straightness using "V" blocks and a dial indicator, as follows: See Figure 15.

Do not attempt to check shaft straightness in direct sunlight.

Place the shaft in "V" blocks as shown in Figure 15. Rotate the shaft and observe the dial indicator. The dial indicator should not vary more than 0.001" times the number of feet to the nearest "V" block. Checks should be made at approximately 2 ft. intervals along the shaft.

If necessary, shaft can be straightened by applying a load on the high side of the shaft at the point on the shaft having the greatest deviation from allowable values.

The shaft must meet the above conditions after all straightening has been performed. Therefore, if straightening is required, the positions checked prior to the straightening operation must be rechecked.

Check the runout of the impeller shaft extension by placing a dial indicator toward the outer end of the shaft and turning the shaft slowly making certain that it stays to one side of the uppermost bowl bearing. The indicator reading should not vary by more than 0.002" as the shaft is turned (0.002 T.I.R.).

Secure pipe clamp immediately beneath column coupling or, if column is flanged, secure clamp about 6" below bottom of flange.

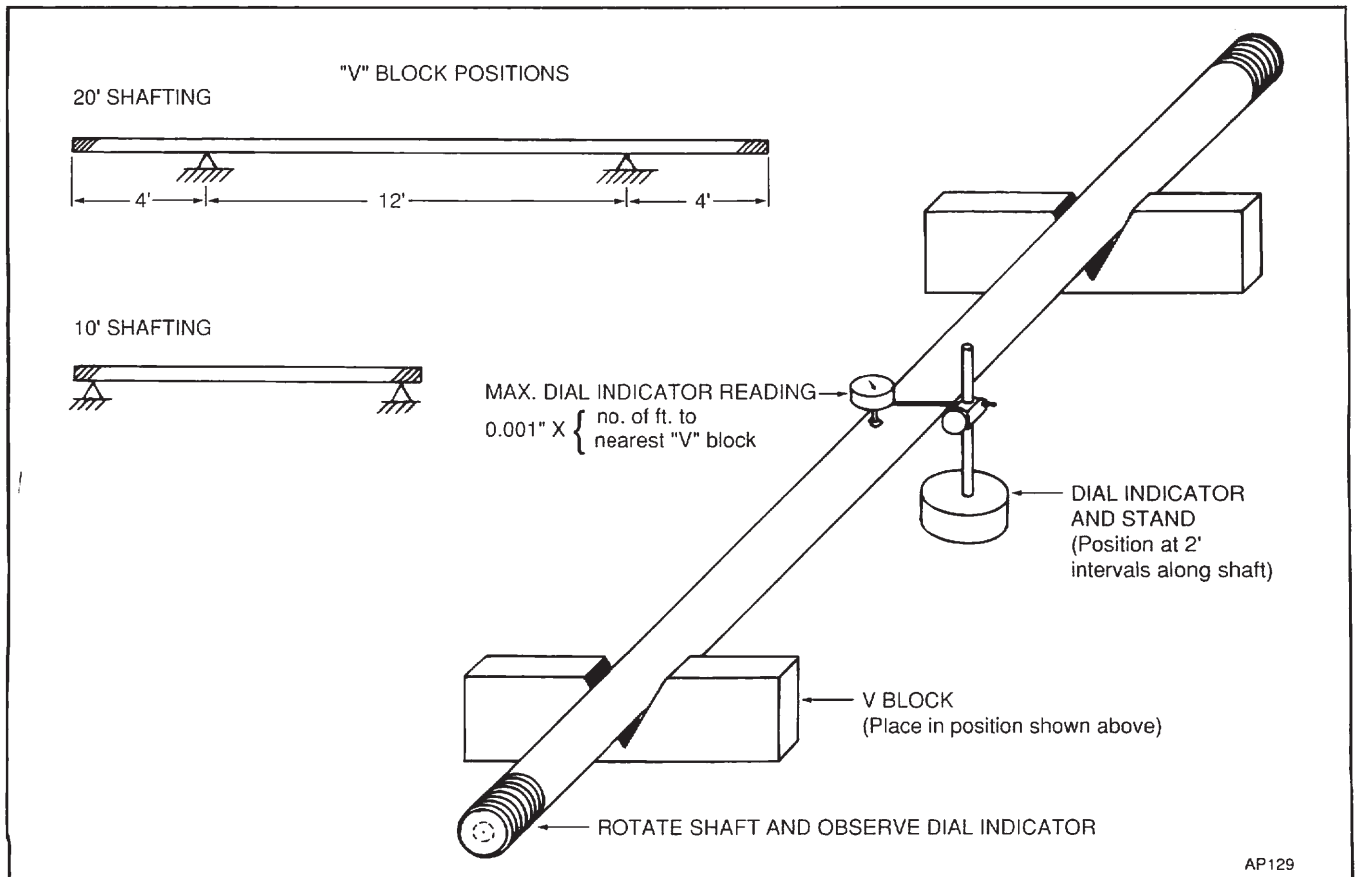


Figure 15. Arrangement for Checking Shaft Straightness

Slide shaft into bottom of column pipe and allow it to protrude approximately 15" below bottom end of pipe. Make certain that shaft sleeve, if furnished, is toward the top of the pipe. Tie a series of half-hitches to the column pipe and to the shaft with the 3/4" rope. Attach the sling to the clamp ears as described in Section F. See Figure 16.

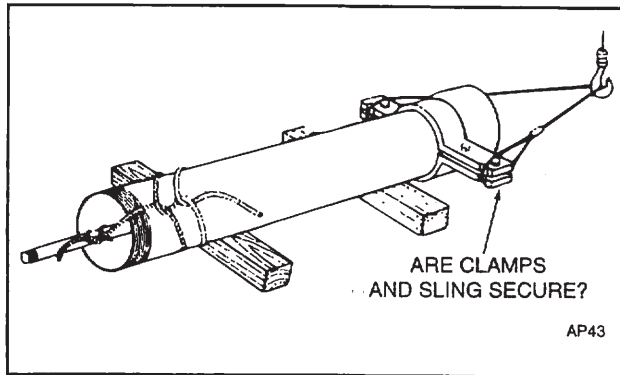


Figure 16. Attaching Lifting Sling

Hoist column to the vertical position taking care not to drag shaft across floor. The shaft should be supported by hand or with a pipe wrench to prevent slippage. Before centering column over bowl, tap side of column to remove any loose matter.

Swing column over bowl, align shaft, remove rag from shaft coupling, lower until shaft contacts coupling then remove rope. Hold coupling and turn shaft (left hand threads) until shaft ends butt. Place one pipe wrench on coupling and one on line shaft and tighten securely. Remove wrench marks from shaft and coupling with a flat file and emery cloth. See Figure 17A.

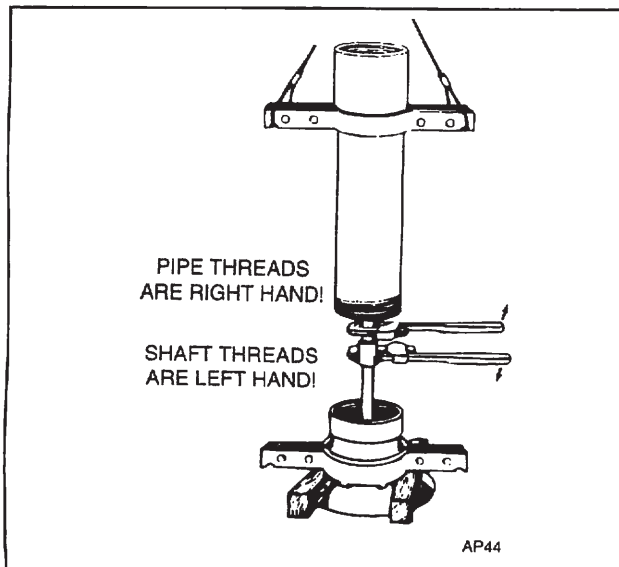


Figure 17A. Tightening Line Shaft

If bowl to column connection is threaded, apply joint compound to pipe threads, lower column making certain that shaft feeds through bearing in upper column coupling (combination type coupling with spider cast integral only) until column engages bowl. Attach chain tongs to bowl and to column. Ease down on hoist and at the same time turn pipe until it seats against mating shoulder in bowl. Tighten pipe into bowl securely. See Figure 17B.

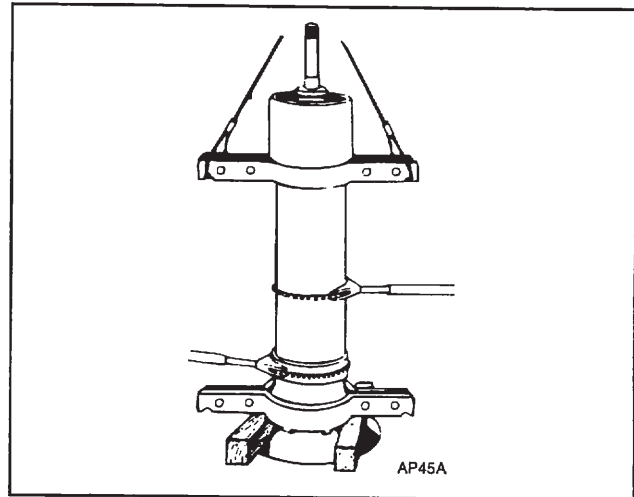


Figure 17B. Assembling Column to Bowl

If bowl to column connection is flanged, spread a thin even film of joint compound on bowl discharge flange. Lower pipe, align studs in bowl with hole in flange, seat column flange against bowl flange, install and tighten hex nuts evenly. See Figure 17C.

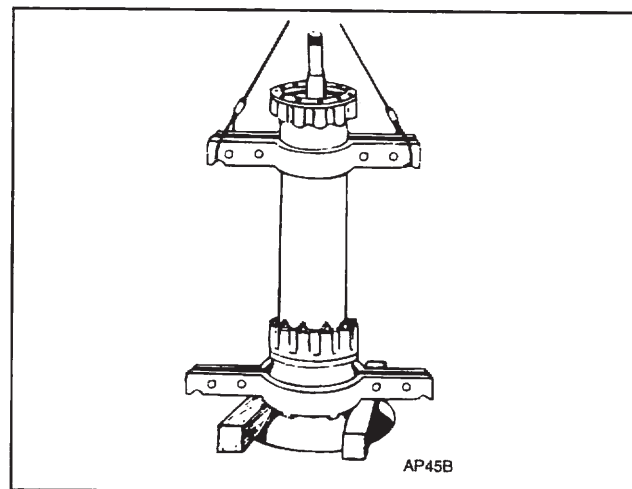


Figure 17C. Column Assembly With Flange Connection

Hoist assembly slightly, remove bowl clamp and slide setting beams out to allow passage of assembly.



If there is any auxiliary piping to the tail bearing being used, that section corresponding to the column section should now be installed. Also if the bowl and column are coated with any special application, any required touch-up work should be done before lowering unit.

Lower assembly, slide beams in close to column, rest clamp ears on beams and remove sling. See Figure 18.

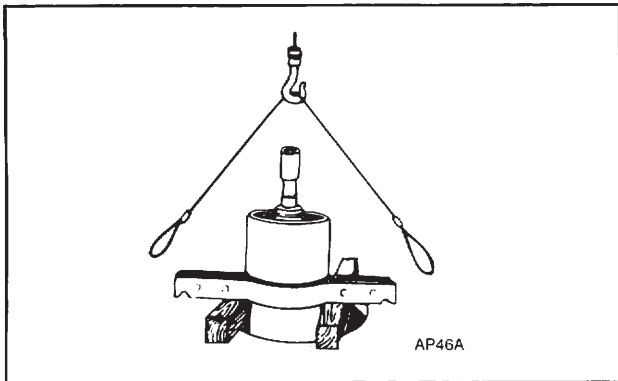


Figure 18. Column and Bowl Lowered in Position

If there is more than one section of column and if the column is threaded and a separate spider is used (sleeve type construction), slip spider over shaft with lock ring up (if used), put spider into coupling until it seats against lower pipe face and tighten.

If column is flanged, clean flange recess and spider ring O.D. and faces thoroughly, slip spider over shaft with lock ring up (if used) and seat into spider recess. See Figure 18A.

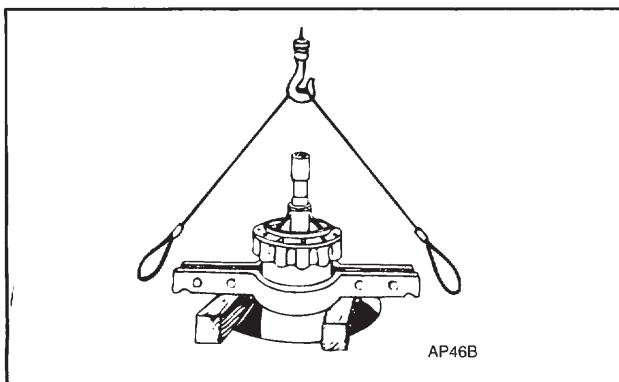


Figure 18A. Installation With Flange Connection

Clean shaft threads and face thoroughly and thread coupling on for half its length. Cover coupling with a rag to prevent entrance of foreign matter.

If there is more than one section of column, repeat the above outlined procedure for each additional section until all column is assembled. Note that on the top column section two lugs are provided and the clamp should be secured directly below and against the bot-

tom of these. Clean the top column flange face (or end of pipe if head connection is threaded) and the shaft projection thoroughly. Do not assemble the shaft coupling to the top piece of shaft.

## I. COLUMN - ENCLOSED LINE SHAFT

Clamp column as described in Section H.

Slide the correct tubing section with shaft into the lower end of the column pipe allowing the tubing to protrude about 9" beyond the pipe end and the shafting to protrude about 9" beyond the tubing end. Note that if tubing is 5" or larger the end with the long turned section should go toward the top end of the pipe. Tie a series of half hitches to the pipe, to the tubing and then to the shaft with the 3/4" rope. Attach the sling to the clamp as described in Section F. See Figure 19.

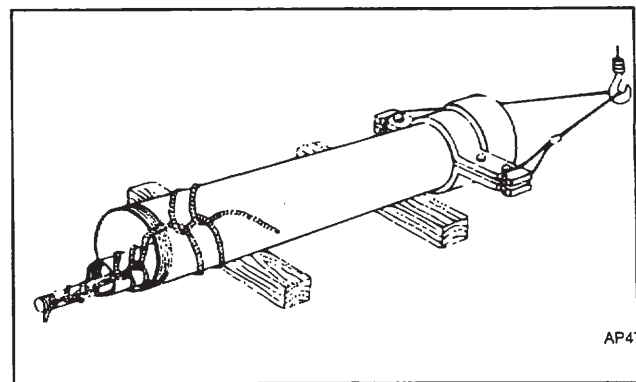


Figure 19. Securing and Slings Column and Shaft

Hoist column to the vertical position taking care not to drag shaft across floor. The shaft and tubing should be supported by hand or with two pipe wrenches to prevent slippage. Before centering column over bowl, tap side of column to remove any loose matter.

Make up shaft joint as described in Section H. See Figure 20.

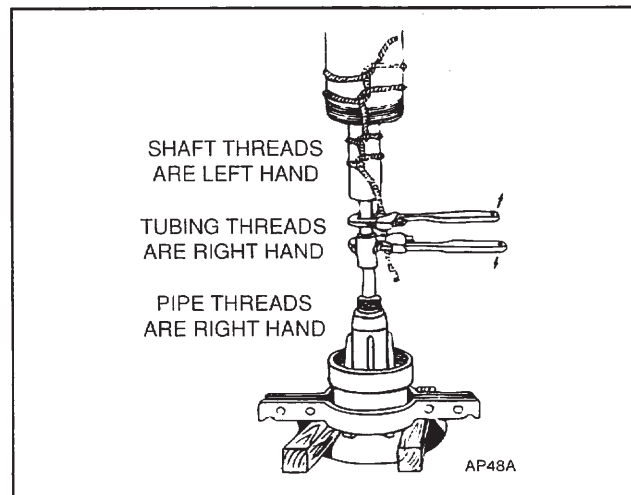


Figure 20. Tightening Line Shaft

Lower assembly until tubing contacts main bearing box, then remove rope. Apply a small amount of joint compound to the upper bearing threads, place one pipe wrench on the main bearing box shoulder (place it on tubing extension on succeeding column joints) and one wrench on the tubing and tighten. If the tubing is coated with any special application, any touch-up required resulting from using the pipe wrench should be done now. See Figure 21.

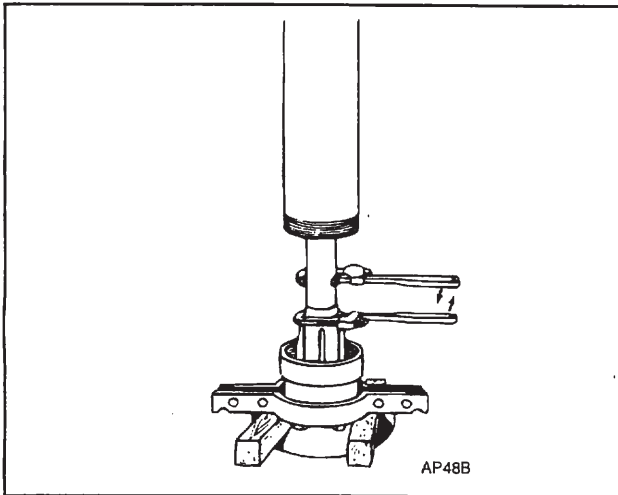


Figure 21. Securing Tubing to Bearing Box

Make up the pipe joint as described in Section H, altering the fifth procedure to include "making certain that shaft and tubing feeds thru the bushing in the upper column coupling".

After the column has been lowered and is resting on the setting beams, pour about a half cup of oil into the tubing, if unit is to be oil lubricated. Apply joint compound to the leading threads of the shaft box (line shaft bearing) oil bore lightly, slide over shaft and thread into tubing for half its length. See Figures 22 and 22A.

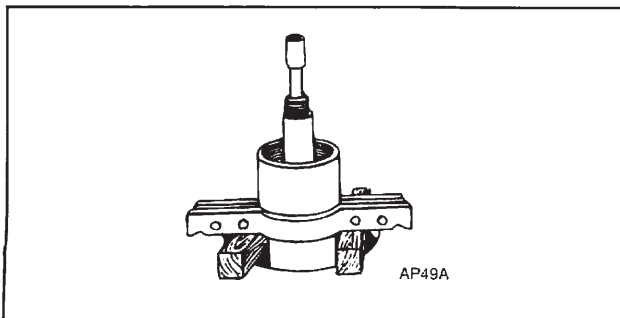


Figure 22. Assembling Tubing to Shaft Box

If the column is threaded but utilizes the sleeve type construction steel coupling and black widow spider and if the setting is deep enough to require a spider, slip the spider over the tubing and force into the pipe about an

inch or two below the top end. Spacing of Black Widow Spiders is generally 20 ft. from the bowl and from the head and 40 ft. in between.

If the column is flanged, clean the recess in the flange, the spider ring faces and O.D. Slide the spider over the tubing and seat in flange recess. If the tubing is 5" or larger, a tapered hub in the spider and a special tapered lock ring may be used in lieu of the normal rubber bushing. The lock ring should be hammered evenly into the hub. See Figure 22A.

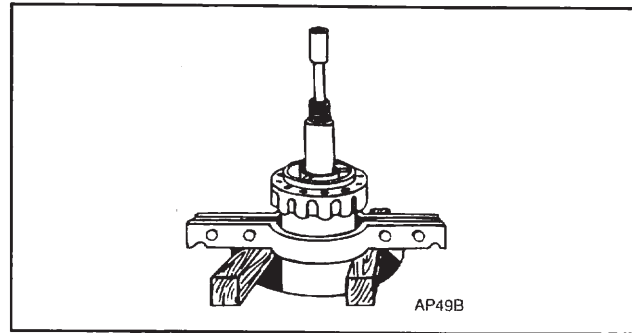


Figure 22A. Assembly with Flange Connection

Continue assembly as outlined in Section H. Prior to assembling each tubing joint, pour about 1/2 cup of oil into tubing if unit is to be oil lubrication. Note that the top end of the top piece of tubing is chamfered and filed smooth on the O.D. and has extra long threads for the Style 60 stuffing box.

## J. COLUMN - OPEN LINE SHAFT

Disregard entire Section H - Open Line Shaft except for procedures four and seven and Figure 16, and disregard any reference to rope in these steps.

Screw hanging tool into line shaft (in end closest to shaft sleeve), slide shaft into top end of column pipe and place pegs of hanging tool into two flange drills 180 degrees apart. Attach three eye nuts to three studs with backing plates about 120 degrees apart. Attach 3 legs of the 4 legs sling to eye nuts. See Figure 23.

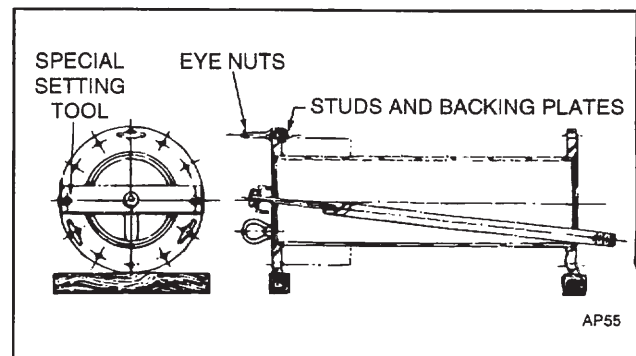


Figure 23. Slings with Eye Nuts

Hoist column to the vertical position taking care not to drag end of shaft across floor. Before centering over bowl, tap side of column to remove any loose matter accumulated inside.

See Section H - Open Line Shaft in Manual for shaft joint assembly. Entire column pipe must turn when threading shaft into coupling unless hanger section of tool is separate from cross member.

Spread a thin layer of joint compound on the bowl flange. Lower pipe, align holes with studs in bowl, seat column flange squarely on bowl flange, install and tighten hex nuts evenly.

Hoist column slightly, slide beams out far enough to allow passage of assembly.

See Section H - Open Line Shaft of Manual.

Lower assembly, slide beams close to column and rest column lugs on beams. Remove sling, eye nuts and studs with backing plates. Remove hanging tool from shaft.

If there is more than one section of column, clean recess in flange and flange face thoroughly, slip spider over shaft with lock ring up (if used) and seat into flange recess.

If there is more than one section of column, clean shaft threads and face thoroughly and thread coupling on for half its length. Cover coupling with a rag to prevent entrance of foreign matter.

Repeat the above outlined procedure for each additional section until all column is assembled. If the top piece of column is short enough, it can remain projected above the setting beams in preparation for head installation. This could simplify head assembly since, if the head base is quite large, it would be difficult to fasten the head to the column due to limited working space if the top piece of column was resting on its own setting lugs.

## K. COLUMN - ENCLOSED LINE SHAFT

Disregard entire Section I - Enclosed Line Shaft except for procedures four and five, Figures 20 and 21, and procedure seven, Figure 31A and disregard any reference to rope in these steps.

Slide shaft into tubing and tubing into column making certain that the tap in end of shaft is toward the top. Assemble hanging tool, screw shaft portion into end of shaft, then screw tubing portion into end of tubing and

place pegs in hanging tool into two flange drills 180 degrees apart. Attach three eye nuts to three studs with backing plates about 120 degrees apart. Attach 3 legs of the 4 leg sling to eye nuts. See Figure 24.

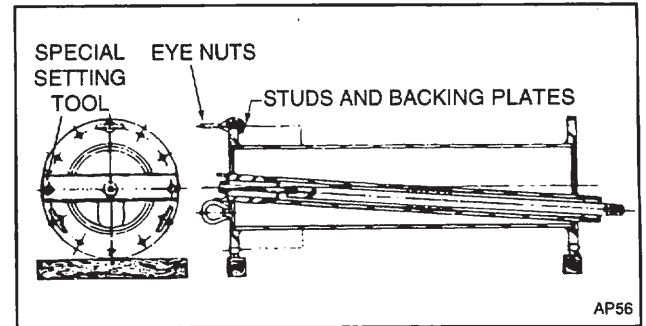


Figure 24. Slings with Eye Nuts

Hoist column to the vertical position taking care not to drag shaft across floor. Before centering column over bowl, tap side of column to remove any loose matter accumulated inside.

See Figure 20, Section I - Enclosed Line Shaft in Manual for shaft joint assembly.

See Figure 21, Section I - Enclosed Line Shaft in Manual for tubing joint assembly.

Follow procedures in Section H for line shaft assembly.

If there is more than one section of column, follow procedures in Section H - Enclosed Line Shaft in Manual.

Repeat the outlined procedure for each additional section until all column joints are assembled. If the top piece of column is short enough, it can remain projected above the setting beams in preparation for head installation. This could simplify head assembly since, if the head base is quite large, it would be difficult to fasten the head to the column due to limited working space if the top piece of column was resting on its own setting lugs.

## L. PUMP HEAD

Wipe a thin layer of joint compound on the top column flange face (or if connection is threaded, on the top column threads). Remove the stuffing box from the head. Clean the flange mounting face (or threads and butt face if head connection is threaded) and the outer machined face of the head thoroughly. Attach sling, hoist head and center over column, align studs with holes in flange, then lower until head is resting squarely on flange. Install hex nuts and tighten. (If there is an underground outlet, orientate the head in relation to the outlet as close as possible to the final position.) See Figure 25.

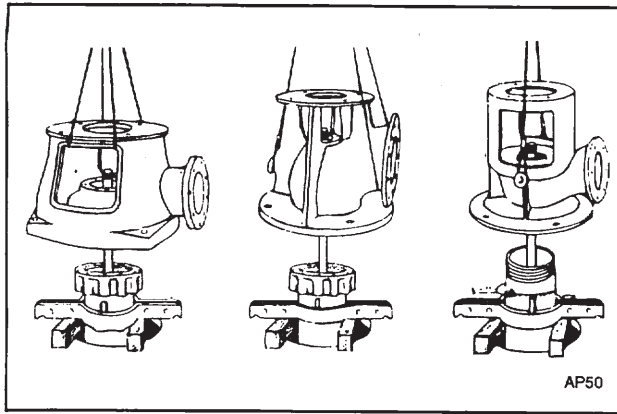


Figure 25. Assembling Pipe Head to Column Pipe

If head connection is threaded, lower head until it contacts pipe, apply a set of chain tongs to the pipe and turn head until pipe seats. To tighten, place a long pipe thru the head windows or into the discharge (being careful not to damage the shaft or tubing) and use as a lever arm. See Figure 25.

If an underground outlet is being used, make certain that it is properly orientated with relation to the head. If the top column flange is of the 3/4" taper/ft. type, it might take considerable force to turn the column within the flange but it can be turned at least one bolt spacing.

If an adjustable top column flange is used, the head can be readily turned to orientate it to the below ground outlet. However, since there is about 4" of adjustment available in this type flange, a measurement should be made from the outlet centerline to the head base and the head turned until the correct dimension is achieved. Back the packing ring off to allow ample working room, fill the chamfer on the lower end of the flange with lam-pwick packing that has been precoated with joint compound. Use a generous amount of packing and wind the packing around in such a manner that it will tighten when the packing ring is screwed into place. Screw the packing ring up against the flange and tighten.

If the adjustable flange is being used in conjunction with enclosing tubing, the top of the tubing should be approximately 7/8" below the stuffing box mounting face of the head after the flange is adjusted.

Hoist head slightly, remove clamp from top piece of column, remove setting beams and clean surface of baseplate or foundations. If there is an auxiliary line to the tail bearing, that portion immediately below and tying into the head should now be installed. Usually the upper piece of pipe is left bland on one end and must be cut to length and threaded at assembly. Properly orientate discharge outlet and align mounting holes with anchor bolts and lower until head is resting squarely on base or foundation.

If head is resting on baseplate, align mounting holes with taps in baseplate, install and tighten capscrews.

If head is resting on foundation, drive wedges under head until proper elevation is achieved. Using a machinist level, check top of head and continue driving wedges until head is level to within 0.003 thousands of an inch. Install and tighten hex nuts to anchor bolts. Grout under the outer perimeter of the head and extend the grout out to hide the wedges. See Figure 10.

If the head is resting on foundation and there is an underground connection, it should first be determined that the outlet in the column properly "meshes" with outlet piping so that no strain will be placed on the pump. Do not make this connection at this time, however. After this is done follow the procedure for leveling and grouting.

The above procedure should also be followed in the same manner if there is a suction connection to a header. It is recommended that a flexible joint of some description be employed between the suction flange and to header to compensate for slight misalignment. If there are no provisions for one, the header flange must be perfectly level in all directions so that no misalignment is transferred to the pump.

## M. STUFFING BOX OR MECHANICAL SEAL

### Packed Box - Open Line Shaft.

- Clean the stuffing box thoroughly, apply joint compound to face, slide over shaft, properly orientate ports to position desired and seat against head. Align mounting holes with tape in head, install and tighten capscrews.
- Refer to stuffing box sectional drawing for packing instructions.

### Mechanical Seal - Open Line Shaft.

- Refer to mechanical seal sectional drawing for complete assembly details.

### Style 60 - Enclosed Line Shaft.

- Refer to Style 60 sectional drawing for complete assembly instructions.

### Style 60 - Enclosed Line Shaft - Force Water Lube.

- Refer to Style 60, force water lube, drawing for complete assembly instructions.

## N. DRIVER AND DRIVE COUPLING - SEE SECTION 10



## SECTION 10

### INSTALLING THE DRIVER

Uncrate the driver but leave it attached to the bottom skid on which it arrived. Move it to a convenient location beside the pump head, keeping it vertical at all times. Set down on firm and level footing.

When ready for installation, raise the driver off its skid to a comfortable working height, lifting it with the lugs provided on the frame.



Stand beside the load as it hangs in the sling, never under it. Inspect and clean the mounting flange and register. If you find any burrs or nicks, set the driver on two beam supports and repair with a file.



Don't work under the load while it's hanging from the hoist. Clean the top of the pump head and inspect it also, making any necessary repairs.

If your pump is equipped with a vertical hollow shaft driver, illustrated in Figure 26, continue right on here with subsection 10A. If you have a solid shaft driver as in Figure 27, skip this portion and be guided by subsection 10B.

#### A. VERTICAL HOLLOW SHAFT

Remove the driver cover capscrews and the canopy itself, as in Figure 28. Remove the drive coupling and any other parts packed in the top for shipment. Place them in a clean, safe place for later use. Cover all openings in the top to prevent anything from dropping into the driver. If this should happen, the object must be retrieved before proceeding.

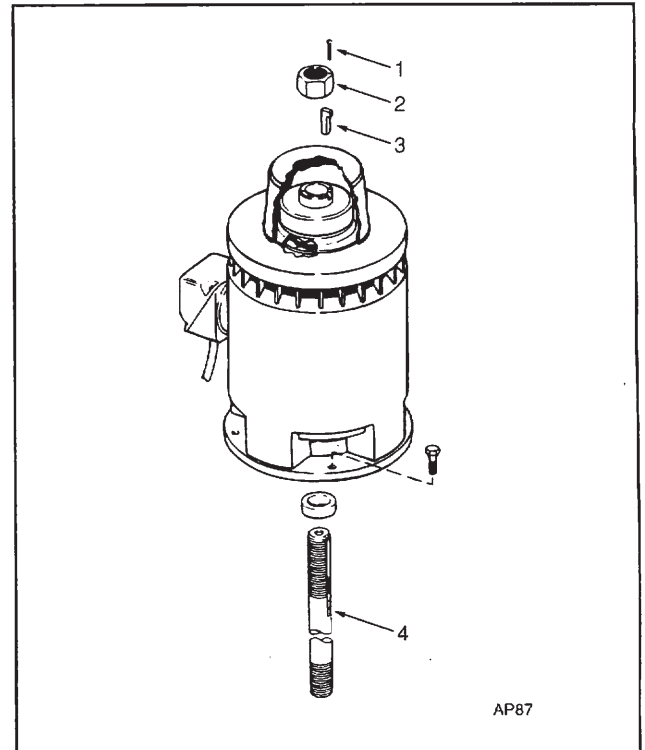


Figure 26. Vertical Hollow Shaft Electric Motor

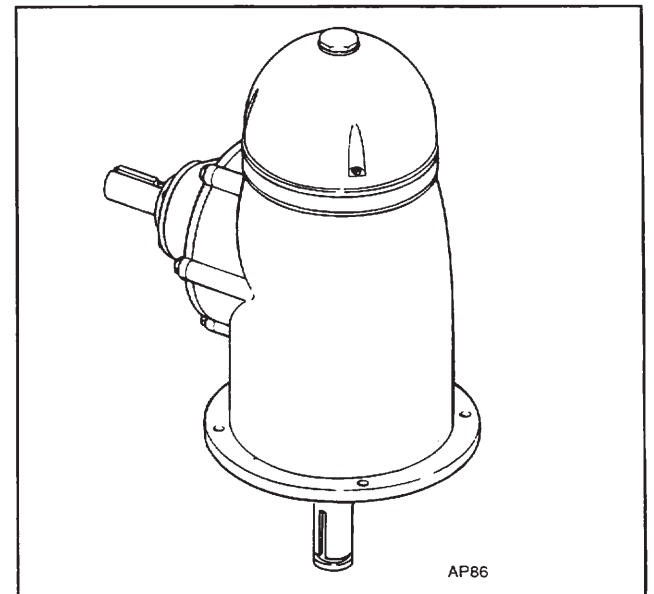


Figure 27. Vertical Solid Shaft Gear Drive

Lower the driver slowly to the head until the register fit is engaged, but with the weight still on the hoist. In the case of an electric motor, swing it around so the junction box is in the desired orientation. If you have a gear drive, as depicted in Figure 28, your positioning criterion is the horizontal input shaft. Align the mounting holes and start the attaching capscrews in by hand. Transfer the weight gently from hoist to head and secure the capscrews, tightening them uniformly.

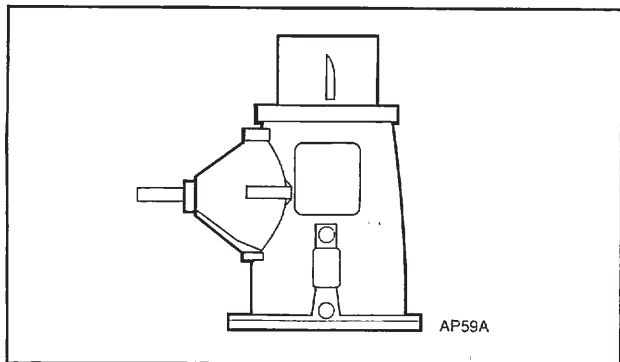


Figure 28. Vertical Hollow Shaft Gear Drive

Please note that the lifting lugs on the driver are for handling the driver only. Never attempt to use these lugs to hoist the pump. The pump must be handled with its own lifting trunnions.

If you have a VHS electric motor, depicted in Figure 26, to deal with, open the main breaker or pump disconnect switch and make a temporary connection between the motor terminals and the leads from the starter panel. Since many electric motors are built as dual voltage machines, it is important that the proper connections be made to suit the voltage of your power source. Therefore, you must check both power characteristic and motor rating for compatibility, then see the motor nameplate for correct wiring hookup.

While scanning the nameplate, determine the type of thrust bearing with which you've been furnished. If it's a spherical roller bearing, proceed with utmost caution as it must never be run at normal speed without an appreciable thrust load. For this reason, when establishing rotation as we're about to do, be very careful to just bump or tap the switch. Never close it fully until the pump is completely operational.

Otherwise, you may now energize the starter panel and buzz start the motor by switching it very quickly on and off, observing for direction of rotation and watching to see that it spins freely and is in apparent balance. Driver shaft must turn counterclockwise when viewed from the top. If rotation is clockwise, kill the power to the starter panel and interchange any two leads on three phase motors. With single phase machines, follow manufacturer's instructions.

After reconnection, energize the starter and again buzz start the motor. When you're sure you have counterclockwise rotation, mark the motor terminals and the leads from the starter box to match. De-energize the starter at the main breaker or pump disconnect switch and make the permanent power connections. Naturally, these connections must be made in accordance with all applicable electrical codes and regulations.

If your pump is equipped with a right angle gear drive, as shown in Figure 28, instead of an electric motor, the rotation check must wait until later when the pump is completely installed and connected to the prime mover. At that time, rotation is verified in a manner similar to that just described with allowances for the type of power equipment. One thing you can do right now is match up the rotation arrows on your gear and your prime mover to determine compatibility, at least as far as the nameplates are concerned.

Your headshaft was probably shipped to you in a separate box. Find it and clean it thoroughly throughout its length, threads, keyway, and end faces. Now, slide it down through the driver hollow shaft without bumping or scraping, keyway end up. If you were furnished with a slinger ring, assemble it to the shaft as the shaft bottom end emerges from the bottom of the driver.

Remove the capscrews securing the packing box or tension nut flange. The shaft coupling may be above or below the packing box/tension nut location. If above, make the connection in the usual manner, mindfull of the left hand threads. If below and in the elbow itself, loosen the packing if any and continue lowering the headshaft through the packing box or tension nut until you encounter the coupling below. If possible, hold the shaft coupling by reaching in through the discharge opening. In any case, start the shaft into the coupling very carefully and snap to a firm butt.

Looking down on the driver, check to see that the headshaft stands in the center of the hollowshaft and that the driver shaft rotates freely by hand. If the shaft stands to one side of the quill, rotate the shaft from below. If the top of the bar moves around the quill, you have a bent shaft or a bad coupling joint. If, however, the shaft remains in the same off center spot during rotation, the problem is with one of the stationary parts, perhaps the column or head assembly or, just as likely, the mounting structure. Wherever it is, it must be rectified before proceeding. If in doubt, call your factory representative.

When all is well, replace the packing box or tension nut flange capscrews, tightening them uniformly and securely. Retrieve the drive coupling and other parts you set aside, together with the pump parts shown in Figure 26.

Table 1. Impeller Lateral Setting

BOWL	LATERAL SETTINGS (IN.)
6 DR, GR	3/16
6 RK, BH	1/4
6 G, AW	3/16
8 DR	1/4
8 PR	1/4
8 RK	1/4
8 UR	1/4
10 RK	7/16
10 U	1/4
10 T, CA	1/4
12 RK	5/16
12 UR	1/4
15 DR	3/8
16 HOH	3/8
22 G	1/4
24 RK	1/2
24 G	1/4
25 RKMC	1/4
25 RKHC	3/8
30 D	1/4
30 G	1/4
32 SK	7/16
36 B	1/4
36 G	1/4
38 H	1/2
42 RK	1/2
44 G	5/8

For pumps not shown use lateral setting of 1/8" for short coupled only (40 ft. max.)

Try the drive key, Item 3, in both headshaft and drive coupling keyways. They should produce a sliding fit. If necessary, dress the key until a free but not loose fit is obtained. Do not file the keyways. Slide the drive coupling over the headshaft, Item 4, into proper position onto its register, firmly seated perfectly flat without cocking. It should slide easily and smoothly without tendency to drag or hang up when lowered or rotated.

Insert the drive key, Item 3. Again it should be a free, but not loose, fit. If necessary dress the key but never the keyways. The top of the key must be below the adjusting nut seat when in place.

Thread the adjusting nut, Item 2, onto the headshaft remembering the left hand threads, and raise the shaft until all its weight is on the nut. This is the breakfree point and may be recognized as that point at which the impeller can first be turned by hand. With a very slight lowering of the shaft, the impellers are felt to drag on the bowl seal rings. Mark the breakfree point, adjusting nut to driver coupling. Set lateral per Table 1. Assemble the lock screw, Item 1.

If your pump is equipped with electric drive, energize the starter and just bump the switch very lightly. With an engine or other type of drive, you must go through the entire first startup procedure, then take the unit barely up to speed and immediately release the power. This will firm up all the shaft joints. However, keep in mind our warning regarding a spherical roller thrust bearing. If your driver came equipped with one, omit this step until you can apply the full thrust of the pump to the bearing.

Deenergize the starter for electric drives. Remove the adjusting nut lock screw and lower the impellers to the original breakfree point as marked. Determine that this has not changed or, if it has, establish a new breakfree point, punch marking the nut and driver coupling for permanent reference. This would conclude your adjustment procedure for startup and early period operation of an electrically driven pump. Replace the lock screw and secure as shown in Figure 29.

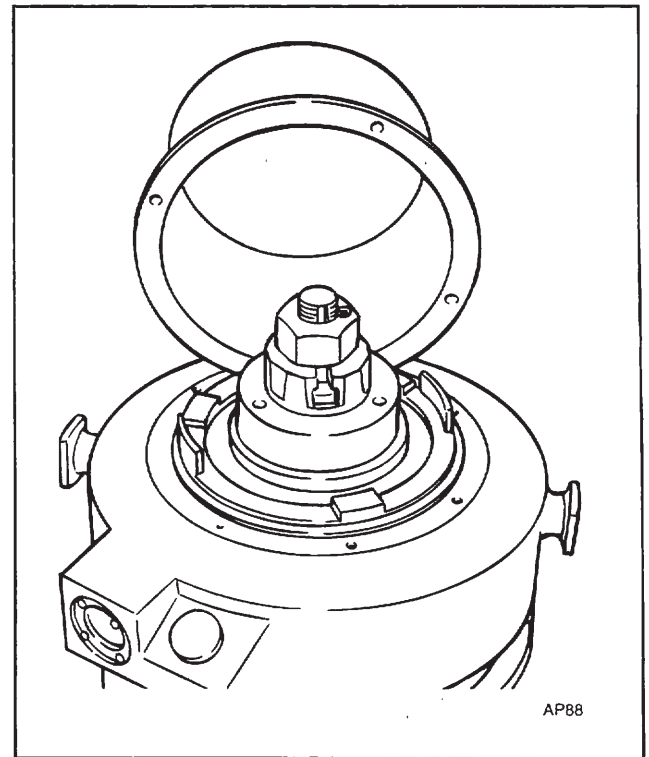


Figure 29. Vertical Hollow Shaft Driver Top

After completing the adjustment procedure, replace the driver canopy and secure the capscrews. Keep it that way all the time that you aren't actually working under the cover. Check driver lubricant and follow directions from manufacturer. If your driver requires provision for coolant flow, take necessary measures as instructed. Do not run equipment until all these considerations have been satisfied. Leave the power circuit open to the starter panel while performing remaining work except when it requires pump operation.

## B. VERTICAL SOLID SHAFT

Lower your vertical solid shaft driver to a firm and stable position atop a pair of beams or blocks placed on the discharge head to provide ample clearance between driver shaft and pump shaft. If you have an electric motor to deal with, secure it firmly against reactive torque with chain or cable restraints. Open the main breaker or pump disconnect switch and make a temporary connection between the motor terminals and the leads from the starter panel. Since many electric motors are built as dual voltage machines, it is important that proper connections be made to suit the voltage of your power source. You must check both power characteristic and motor rating for compatibility, then see the motor nameplate for correct wiring hookup.

While scanning the nameplate, determine the type of thrust bearing with which you've been furnished. If it's a spherical roller bearing, proceed with utmost caution as it must never be run at normal speed without an appreciable thrust load. For this reason, when establishing rotation as we're about to do, be very careful to just bump or tap the switch. Never close it fully until the pump is completely operational.

You may now energize the starter panel and buzz start the motor by switching it very quickly on and off, observing for direction of rotation and watching to see that it spins freely and is in apparent balance. Driver shaft must turn counterclockwise when viewed from the top. If rotation is clockwise, kill the power to the starter panel and interchange any two leads on three phase motors. With single phase machines, follow manufacturer's instructions.

After reconnection, energize the starter and again buzz start the motor. When you're sure you have counterclockwise rotation, mark the motor terminals and the leads from the starter box to match. De-energize the starter at the main breaker or pump disconnect switch.

If your pump is equipped with a right angle gear drive, as shown in Figure 27, instead of an electric motor, the rotation check must wait until later when the pump is completely installed and connected to the prime mover. At that time, rotation is verified in a manner similar to that just described with allowances for the type of power equipment involved. One thing you can do right now is match up the rotation arrows on your gear and your prime mover to determine compatibility, at least as far as nameplates are concerned.

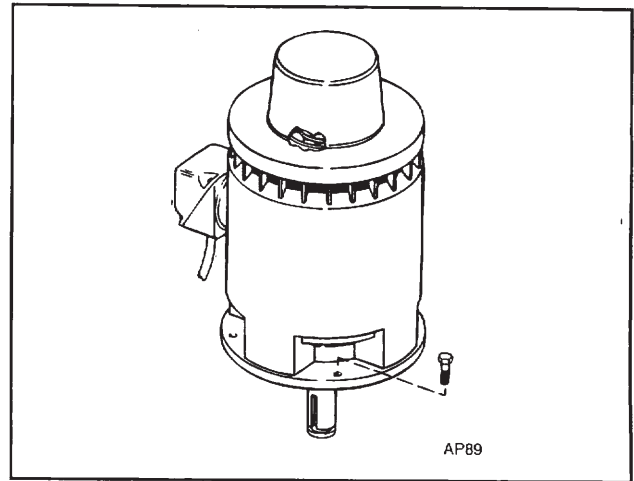


Figure 30. Vertical Solid Shaft Electric Motor

While the driver is still sitting on the blocks, examine the protruding driver shaft for any burrs or nicks. If necessary, repair very cautiously with a small file. Clean the shaft and oil it very lightly. Find the shaft flanged-coupling parts, and clean them all thoroughly.

Try the driver shaft key, in both driver shaft and upper coupling half keyways. You should find a very close sliding fit. If necessary, dress the key but not the keyways until you obtain a free, but not loose, fit. Now try the thrust collar in the shaft groove. It too, should be a very close fit and may be dressed to obtain this if necessary. Try the top half coupling on the shaft.

When you have the proper fits and while the driver still sits on the blocks, insert the key in the shaft keyway and slide the coupling half up on the shaft flange face down. With the flange above the drive shaft ring groove, assemble both halves of the thrust collar in the groove and slide the coupling back down until it rests firmly on the thrust collar, retaining the collar halves in place in the coupling recess. Assemble and tighten setscrew securely.

If your coupling is furnished with a spacer spool, assemble the spacer to the driver coupling half. If parts are matchmarked, install them accordingly. Use only the nuts and bolts shipped with the pump as some couplings are balanced as assemblies. Tighten all flange bolts securely and uniformly throughout the coupling.

Inspect and clean the pump shaft threads, painting lightly with a good thread lubricant. After trying keys and parts as described above, insert key in the pump shaft keyway and slip the pump shaft coupling half well down over shaft, flange face up, leaving shaft threads projecting above coupling. Screw adjusting nut onto



pump shaft with the rimmed end up, turning counterclockwise until pump shaft protrudes through threaded portion of nut by at least two threads. Remove the capscrews securing the packing box or tension nut flange.

Raise the driver just enough to remove the blocks, then lower it slowly to the head until the register fit is engaged but keeping the weight on the hoist. In the case of an electric motor, swing it around so that the junction box is in the desired orientation. If you have a gear drive, as shown in Figure 27, your positioning criterion is the horizontal input shaft. Align the mounting holes and start the attaching capscrews in by hand. Transfer the weight gently from hoist to head and secure the capscrews, tightening them uniformly.

Please note the lifting lugs on the driver are for handling the driver only. Never attempt to use these lugs to hoist the pump. The pump must be handled with its own lifting trunnions.

With the pumpshaft all the way down so the impellers are firmly seated in the bowls, screw the adjusting nut up by turning it clockwise until the face of the driver coupling flange or spacer lower flange, if you have a spacer spool, equals the lateral setting. See Table 1. Pull the pump coupling up and insert flange bolts through both flanges. Assemble the nuts and tighten by hand until they are snug, using a light machine oil on the bolt threads.

Check for shaft alignment at the outer edges of all the flanges. They must meet evenly both at the faces and at the outer circumferences. True alignment can be further verified by using dial indicators on both the driver and the pump shafts. If you cannot obtain an alignment within 0.003 inches T.I.R., call your local factory representative.

When satisfactory alignment is achieved, put all bolts under uniform tension, using a torque wrench. Five hundred inch pounds should be sufficient torque; i.e., a fifty pound pull on a ten inch wrench or the equivalent. Make sure pump shaft key is flush with coupling hub and tighten setscrew securely to lock the key in place.

Now replace the packing box or tension nut flange capscrews. Tighten them uniformly and securely.

## C. STUFFING BOX OR MECHANICAL SEAL

### Packed Box - Open Line Shaft.

- Clean the stuffing box thoroughly, apply joint compound to face, slide over shaft, properly orientate ports to position desired and seat against head. Align mounting holes with tape in head. Install and tighten capscrews.
- Refer to stuffing box sectional drawing for packing instructions.

### Mechanical Seal - Open Line Shaft.

- Refer to mechanical seal sectional drawing for complete assembly details.

### Style 60 - Enclosed Line Shaft.

- Refer to Style 60 sectional drawing for complete assembly instructions.

### Style 60 - Enclosed Line Shaft - Force Water Lube.

- Refer to Style 60, force water lube, drawing for complete assembly instructions.

Make the permanent power connections to the electric motor, if equipped, checking to see that the power circuit to the starter panel is still open. These connections must be made in accordance with all applicable codes and regulations.

Check the driver lubricant and follow manufacturer's directions. If your driver requires provision for coolant flow, take the necessary measures as instructed. Do not attempt to run the equipment until all these considerations have been satisfied. Leave the power circuit open to the starter panel while performing remaining work except when the procedure requires pump operation.

## SECTION 11

### CONNECTING THE PIPING

You will be connecting your pump to your piping of course, since the pump is there to energize your system. Depending on details of installation, you will certainly be joining at the discharge flange and there may be a connection at the suction also. Whatever your particular system is, it must be independently supported. It must not be allowed to impose stresses on the discharge head due to weight, thermal expansion, misalignment, or any other condition.

When bolting the system flange to the pump head discharge flange, determine that the flanges fit face to face and hole to hole before inserting bolts. Do not draw the flanges together with the flange bolts.

Above the floor piping should be installed in such a manner as to eliminate the possibility of the discharge ell (head) being placed in a strain or being thrown out of alignment. See Figure 31.

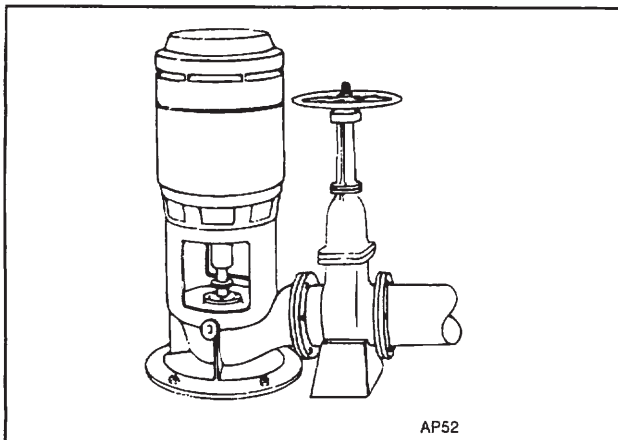


Figure 31. Above the Floor Piping

Below ground discharge connection should be made in such a manner that no strain or misalignment is imposed on the column pipe. Alignment between the pump discharge and the outside should have already been achieved as instructed.

If a flexible joint such as a dresser coupling is to be used, sufficiently strong tie bolts and lugs should be used to span the flexible joint capable of resisting the force created by the discharge pressure at the pump head. None of this force should be imposed on the head. Tension should be taken carefully on these tie bolts so that any amount of forward movement induced to the head will be counteracted during operation so that alignment is maintained during operation. See Figure 32.

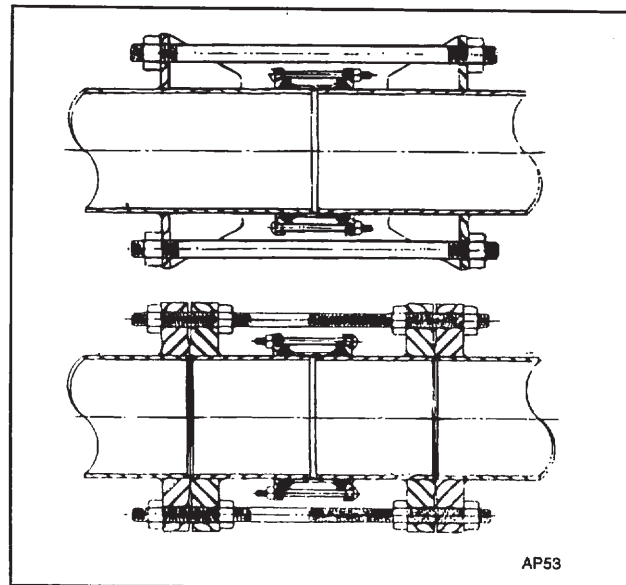


Figure 32. Securing Flexible Joint

On an underground discharge the above procedure can also be used. However, it might be more convenient to construct a simple brace from directly behind the discharge outlet to the pit wall to counteract any forces created by discharge pressure.

Flange faces should be thoroughly clean and free of all nicks or burrs and should be in perfect alignment before tightening bolts.

You may have some small pipes or tubes to accommodate if you are supplying coolant to the driver, for example. In such cases, it is well to protect the small lines from vibration by using a hose connection in strategic locations.

## SECTION 12

### STARTING THE PUMP

Before starting a new pump for the first time, you must establish the status of the following items:

#### A. PRIOR TO START-UP

Perform initial servicing on the driver as recommended by the driver manufacturer. Also perform initial servicing on all auxiliary assemblies if required.

Recheck all fasteners and fittings for tightness.

If air vent is manual, make certain that valve is opened partially but not all the way. If air vent is automatic but equipped with a valve, make certain that valve is opened partially but not all the way.

If there is a control valve on the discharge side of the pump, make certain that it is only partially open.

If unit is oil lubricated, fill lubricator with a good grade SAE 10 viscosity rating, low cold pour point mineral oil. Manually open needle valve and allow about a cup of oil to drain into tubing. RE-FILL LUBRICATOR.

If unit is open line shaft and equipped with pre-lubrication, turn on pre-lubrication some time before start-up and allow it to run a short time after start-up.

If unit is force water lubricated, turn on and regulate flow to 10 to 15 PSI above normal discharge pressure or as instructed on installation or sectional drawing attached. Lubrication should continue during entire pump operational time. If the tail bearing is also lubricated by outside water, pressure need only be about 5 to 10 PSI gauge or as instructed as above. Flow rate of 2 to 5 GPM minimum must be maintained. Some type of flow indicator is recommended.

"Bump" starter again to insure that unit has correct rotation.

Proper water level in sump or sufficient water to keep barrel pull.

#### B. INITIAL START-UP

Energize starter and after pump has come up to speed and all air has been exhausted, regulate control valve to achieve desired pressure.

If the air vent is manual, close off after air is exhausted. If air vent is automatic, determine whether air was exhausted too quickly causing the pump to jerk violently when the valve closed or too slowly and regulate manual valve or throttling device to correct this.

Regulate lubricator to allow about 5 drops per minute for each 50 ft. of setting.

Check all joints for leakage and correct if evident.

Make certain that the driver is operating satisfactorily as to temperature, bearing temperature, etc., as prescribed by the driver manufacturer.

Check for excessive vibration. If this is evident shut down unit immediately and begin checking for cause.

Adjust packing gland, if utilized, to allow some leakage past the packing. After running in for a number of hours, check gland and if it is hot to the touch, loosen until it becomes no more than warm to the touch.

#### C. NORMAL OPERATION AND MAINTENANCE

For normal operation and maintenance of the driver, follow the instructions outlined by the driver manufacturer.

Check the level in the lubricator and refill when it is about 3/4 empty.

If unit requires pre-lubrication, make certain that this process is started in ample time prior to pump start-up to insure that all bearings are properly lubricated.

Apply grease to the stuffing box at the rate of one turn for each 24 hours of operation.

If force water lubrication is employed, this system should be turned on prior to each start-up and proper pressure should be maintained.

Packing gland should seldom require adjustment but in the event that leakage becomes excessive, tighten the gland sufficiently to throttle leakage but not to prevent all leakage. Always adjust the gland with the unit running.

If the tail bearing is pressure grease lubricated apply about one shot of grease for each 24 hours operation.

If unit employs a mechanical seal, no maintenance is required until seal begins to leak or goes out completely. At this time, unit should be shut down, the seal removed and the entire seal or damaged parts replaced.

## SECTION 13

### PRECAUTIONARY INFORMATION

#### A. RESPONSIBILITIES

There are certain areas in which the factory has no control and can therefore accept no liability. For instance, unless supervised by a factory service engineer, responsibility for installation, startup and maintenance rightfully belongs to the Owner and his authorized agents. Similarly, the following shall be the Owner's obligation and responsibility:

Suitability of foundation or mounting structure

Suitability of power characteristics

Security and safety of jobsite and site conditions

Placement and maintenance of all appropriate guards and safety devices

Suitability and performance of system to which pump is applied

The factory cannot be responsible for damages, lost time, or injury resulting from failure to comply with these instructions. The factory's obligations do not cover damage to the pump due to abrasives, gas, or corrosives in the water. They do not cover harm due to starting pump in a reverse rotation mode; neither do they cover performance when parts not furnished by the factory are used in the pump.

If you have any question, please call your factory representative.

#### B. GENERAL PRECAUTIONARY NOTES

Your pump is an engineered assembly of precision parts and must be treated accordingly even though sometimes the components are heavy and awkward to manipulate. Also, because they may be heavy, they must never be handled carelessly. Normal rules of safety and approved methods of practice as associated with the erection of heavy equipment must be observed in any activity related to your pump.

In addition to general acceptable industrial practice, we emphasize the following precautions:

Don't work on pumps, wiring, or any pump or system components without opening energizing circuits such as at main breaker or pump disconnect switch. This will prevent damage or injury due to "surprise" starts actuated by automatic control systems. It will also help prevent other possibilities of injury.

Don't work under a suspended load. Rest the load on positive supports when it's necessary to be underneath.

Don't run a spherical roller thrust bearing except under full thrust load. It can fly apart and cause damage to equipment and injury to personnel.

Don't forget that this equipment contains rotating parts. Use CAUTION when working near such parts to avoid injury. Always replace all guards, covers, shields, and other safety devices before startup.

Don't permit smoking in the vicinity of petroleum base solvents. Store solvents in approved containers.

Don't use lubricants that can contaminate your system and cause damage or injury.

Don't start pump while it is still rotating in reverse direction after having shut down. It is advisable to install a time delay relay on electric drives to prevent this. Non-reverse protection in the driver could also be a solution.

Don't put heavier than recommended heaters in your starter if the pump load begins to trip those furnished originally. These are protective devices. Call your factory representative for assistance.

Don't add oil to driver while running; check levels only when idle. Don't add grease to grease lubricated driver without removing the relief plug.

Don't drop parts into pump during installation or disassembly. Don't drop parts into driver when canopy is off and top is open. Parts must be recovered immediately.



Don't run pump backward. Clockwise operation (looking down at top of pump) under power can unscrew threaded shaft joints. Power requirements of some designs increase when driven backward and can thus create undesirable overloads. In certain areas of the country prone to phase reversal problems, consider phase protection in your power circuit. Note: these problems do not apply to pumps coasting backward due to return flow from system; overspeed is the circumstance to question then.

Don't allow oil, grease, or thread lubricant to contact rubber bearings or tube stabilizers.

Don't pump anything but water unless your pump has been designed for it.

Don't start the pump without proper adjustment.

Don't start a pump in which the shaft appears frozen or locked up. Free the shaft and rotate by hand first.

Don't pull system piping to pump flanges with bolts or capscrews. Install pipelines so that fasteners are used to prevent leakage only.

Don't hang the weight of suction or discharge lines and fittings on pump. Support pipe runs with blocking or concrete saddles according to best piping practice. Use dresser type couplings with thrust ties if necessary whenever possible to eliminate piping strains imposed on pump.

Don't throttle or obstruct the suction of any pump.

Don't tighten shaft packing except in increments. For example, take gland nuts up part of a turn and let pump run five or ten minutes before tightening further. If leakage water is too hot to put on your hand, back gland nuts off a little until water cools, then tighten again. Gland nuts must be adjusted evenly so as to prevent gland from cocking and forcing against shaft.

Don't change pump speed without first checking effect on power, internal pressure, and other conditions. Don't forget that your pump is guaranteed for design conditions only as purchased.

And let us add one more DON'T for the benefit of your pump and your peace of mind:

Don't hesitate to call your factory representative or the factory when you need help or have a question.

## C. OPERATION AT SHUTOFF HEAD

In the usual application of a vertical turbine pumps, no harm will result from operation at conditions of static flow heads. However, not all installations are "usual" and for this reason consideration should be given to any unit which may be subjected to this usage. The following points should therefore be checked and resolved before putting the equipment into operation at or near shutoff heads.

Thrust bearing must be adequate.

Impeller adjustment must allow for much greater thrust load.

If prolonged operation at no flow is contemplated, the problem of heat dissipation may become acute since most of the shutoff horsepower is converted to heat in the available liquid. This can be reduced with an adequate recirculation system.

For high pressure units, stresses at shutoff heads should be investigated. This information may be obtained from your representative upon request.

Certain impeller designs have critical horsepower characteristics at low flow rates. Shutoff horsepower requirements should be reviewed for possible driver overload.

It must be remembered that open lineshaft units depend upon pumped liquid for lubrication. Fluid temperatures, if raised excessively due to lack of flow, may impair lubrication efficiency even to the point of destroying the pump.

To summarize, normal designs will easily accommodate most of the considerations listed above. However, to obtain the best possible application, you must notify the factory at the time of purchase if operation at static flow heads will be a possibility. This precaution must be observed to validate any warranty.

## D. MAINTENANCE HINTS

For pump oil lubrication, use a light turbine oil equivalent to Standard Oil 0. C. Turbine Oil #32 or a good grade of mineral oil with proper additives having a viscosity equal to SAE #10. Always be sure your lubrication system has plenty of oil and is operating any time the pump is running.

Remove the old oil from your driver at least once a year or according to the driver manufacturer's instructions. Flush with kerosene and refill. Follow manufacturer's directions carefully as to method and type of lubricant. Replace self lubricated driver ball bearings in about five years. It is generally less expensive to replace these before they fail.

Replace all shaft packing on open lineshaft pumps after maintenance has required the addition of no more than two rings. Always let packing box leak slightly at top of gland to protect the shaft and add life to your packing.

Be aware of changing conditions in your system. Any change from the original condition or any variation in the system can create an undesirable reaction in the pump as the energizer of the system. If your system head has increased, for example, check your performance curve, your thrust bearing capacity, and other details for the new conditions.

We recommend you consult your factory representative before attempting to remove or repair your pump. If it becomes necessary to work on your equipment, be sure to review all instructions for operation and maintenance. You may want to consider contracting for the services of a trained factory service engineer to guide you.

## SECTION 14

### MISCELLANEOUS ASSEMBLIES

#### A. LUBRICATOR

Install the lubricator and bracket to the discharge head. Refer to the lubricator assembly drawing. Connect the 1/4" copper line from the lubricator to the stuffing box inlet port.

#### B. SUCTION CONNECTION

Alignment between the suction flange and the suction header should have already been achieved per Section L, step 10. If the mounting holes have not yet been aligned, this can be done either by turning the suction flange, if it is not an integral part of the nozzle, or by turning the entire pump and column relative to the top column flange, depending on the type construction employed.

#### C. AIR RELEASE VALVE

Install the air release valve, piping and manual valve, if furnished, to the pump head or just beyond on the discharge piping. It is suggested that if a throttling valve is not furnished, a throttling device be used on the discharge side of the valve to restrict the discharge of air to insure that a cushion of air is available in the discharge head during start-up. Exhausting the air too quickly on a cast iron head can often cause breakage at the water chamber area.

#### D. GAUGES AND MISCELLANEOUS PIPE CONNECTIONS

Connect pressure gauge and snubber, and/or gauge clock, if furnished, to the tap in the discharge flange and, if required in the suction flange. Position dial face to facilitate reading.

Make pre-lube, drain, grease line to tail bearing, etc., pipe connections. Route piping so that it will not interfere with normal maintenance procedure.

#### E. ELECTRICAL CONNECTIONS

All connections to the motor such as main leads, space heater leads, thermocouple leads, etc., should be made in accordance with motor manufacturers specifications.

Make necessary connections to lubricator solenoid.

## SECTION 15

### TROUBLESHOOTING

When properly installed and operating in non-abrasive, non-corrosive water a pump is a relatively long lived piece of machinery, requiring a minimum of attention. However, machinery is subject to wear. The most common causes of improper operation are given below.

These include problems created by wear and other adverse conditions. Note that most of these problems require removal of the pump from the well in order to correct the problem. Contact the factory or your representative for this type service.

CONDITION	PROBABLE CAUSE
Low Capacity or Low Pressure	<ol style="list-style-type: none"> <li>1. Impeller clogged or loose on shaft</li> <li>2. Air or gas in water</li> <li>3. Driver speed slow</li> <li>4. Clogged suction</li> <li>5. Incorrect rotation</li> <li>6. Excessively worn impeller skirts or wear rings</li> <li>7. Insufficient submergence</li> </ol>
Excessive Power Consumption	<ol style="list-style-type: none"> <li>1. Speed too high</li> <li>2. Improper lateral adjustment</li> <li>3. Bad driver thrust bearing</li> <li>4. Pump out of alignment</li> <li>5. Shafting bent</li> <li>6. Head coupling mis-aligned</li> <li>7. Pumping foreign matter</li> </ol>
Vibration	<ol style="list-style-type: none"> <li>1. Bad driver thrust bearing</li> <li>2. Pump out of alignment</li> <li>3. Driver coupling mis-aligned or out of balance</li> <li>4. Shafting bent</li> <li>5. Bearings badly worn or broken</li> <li>6. Improper foundation</li> </ol>
Water in Oil Tubing	<ol style="list-style-type: none"> <li>1. Discharge nozzle relief ports plugged</li> <li>2. Tubing joint leaking</li> <li>3. Shaft seals damaged</li> <li>4. Crack or hole in tubing or leaking at tension box O-ring</li> <li>5. Excessively worn top intermediate and discharge nozzle bearings</li> </ol>



## SECTION 16

### RECOMMENDATIONS FOR PUMP STORAGE

Our pumps are carefully prepared for shipment from the factory. Skids and boxes are intended to mechanical damage from normal handling and preservatives are used to protect critical surfaces from routine conditions of weather and corrosion in transit. Effective life of factory-applied protection, however, can vary widely under different circumstances and should be considered adequate only to secure the equipment during shipment and installation. If installation and operation cannot be effected within a reasonably short time after delivery to jobsite, the product is assumed to be in storage and subject to precautionary procedures as described below.

With common sense as the best guide, store the equipment off the ground in an indoor location where it will not be exposed to excess moisture or humidity, extreme weather conditions, blowing dust corrosive fumes, or other harmful factors. If storage must be outdoors, provide at least a roof shelter and cover all pieces securely with six mil polyethylene sheet or equivalent.

Inspect pump periodically to assure that factory-applied preventives remain intact. With the first sign of deterioration, renew the protective measure in question. If rust spots appear on machined surfaces, clean with fine emery cloth and apply approved rust preventive.

If pump is assembled, it should remain on skids just as delivered. Packing rings and/or mechanical seals if assembled in place should be removed from the pump and stored in a box. If pump is unassembled, inner column joints should be nested inside suction column pipe to save space as well as to provide greater protection. All threads must be covered with wrapping and tape or with suitable caps. Never stack anything on top of column joints.

Electric motors and right angle gear drives must be handled vertically at all times. See individual manufacturer's storage instructions for motors, gears, IC engines, universal shafts, other appurtenances and accessories.

For long term storage, but not to exceed 36 months, the following additional precautions should be observed:

- Air dry hydraulic portion of pump to remove any residual liquid.

- Cover and seal with pressure sensitive waterproof tape all openings into flowstream areas.
- Wrap shaft extension with pressure sensitive waterproof tape.
- Coat rabet fit on driver and pump head with heavy grease, along with any other exposed machined surfaces.
- Completely cover upper part of motor and seal with tape. Consider providing space heaters for motors if stored under damp or humid conditions.
- Fill any external lubrication piping or flush lines with rust preventive.
- Store all parts in a clean dry area with ambient temperature reasonably constant between 40 and 100 degrees F.

Upon removing a pump from any type of storage, proceed as follows:

- Consider contracting with the pump manufacturer for the services of a factory trained field service engineer or technician.
- Remove all covers and tape from openings, drivers, and threads.
- Remove grease and rust preventive from mating fits and running surfaces.
- Clean all threads and mating fits thoroughly.
- Assemble packing and/or mechanical seal if applicable, using appropriate instructions.
- Flush any external lubrication piping to remove rust preventive.
- Follow individual manufacturer's instructions regarding driver and other appurtenances.
- Inspect all visible parts.
- Install pump and start up in accordance with applicable instruction manual.

Occasionally, a pump is stored in its installed position for protracted periods while related equipment is made ready or perhaps simply in seasonal shutdown. In this event, pump and driver shaft must be rotated manually once a week or the unit may be power run every two weeks, using proper startup procedures at each start.

These procedures are offered as a guide to assist users and may not be construed to amend, to extend, or to modify in any way the Pump warranty.

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