

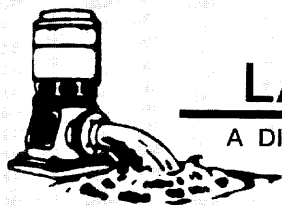
\$5.00

INSTALLATION and OPERATING INSTRUCTIONS

FOR

SHORT COUPLED PUMPS

Read and understand the pump and the electric motor instruction before attempting to install the pump.



LAYNE & BOWLER

A DIVISION OF THE MARLEY COMPANY

INSTALLATION & OPERATING INSTRUCTIONS FOR SHORT COUPLED PUMPS

READ THESE INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING

I. 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.

II. INSTALLATION EQUIPMENT AND TOOLS

1. 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.
2. One cable sling of sufficient strength to lift entire pump and long enough to clear greatest shaft projection.
3. One erector sling for lifting driver.
4. Dial indicator and stand calibrated in .001" divisions.
5. Can of machine oil.
6. Wire brush, 3-cornered file, flat file and emery cloth.
7. Set of mechanic's tools including an assortment of socket wrenches.
8. Bucket of solvent - Coal oil, etc.
9. Machinist's level.
10. Steel tape measure.
11. Two pipe wrenches of sufficient size to handle shaft couplings and shafting. (Always required for hollow shaft drive.)
12. One set of steel clamps to fit the pump bowl.
13. Two sets of steel clamps to fit the column pipe. NOTE: One set required if only one section of column is furnished.
14. Two 4 x 4 timbers or "H" beams (if unit is extra large and heavy), sufficiently long to span installation opening.
15. Two "V" blocks for checking shaft if a bent shaft is suspected.
16. Two chain tongs of sufficient size to handle column pipe.
17. 15' of 3/8" rope.
18. Thread compound such as Permatex Form-A-Gasket with denatured alcohol thinner.
19. Two pipe wrenches of sufficient size to handle shaft enclosing tubing when applicable.
20. Sufficient quantity of wedges to level baseplate or head.
21. Sufficient quantity of top quality non-shrink grout.
22. Anti-seize compound for stainless to stainless threads.

III. SPECIAL PRECAUTIONS

1. 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.
2. Do not allow pipe compound, solvent or any petroleum products to get to rubber bearings.
3. **NEVER USE THREAD COMPOUND ON SHAFT JOINTS.**
4. Shaft threads are left hand; column and tubing are right hand.

IV. PREPARATION AND CLEANING

1. Clean all threading with wire brush and solvent. Dress threading, if required, with three cornered file.
2. Clean all shafting and couplings with a rag soaked with solvent. Make certain that all bearings are clean.
3. 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.
4. Remove rust preventative from all flange faces with rag and solvent.
5. Remove stuffing box from discharge head.

6. Make a physical check of the discharge head or baseplate for proper fit to foundation.
7. 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.
8. Check shaft ends for nicks, burrs, etc. The shaft alignment is dependent on the butt joint of the shaft ends.
9. 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 .005".
10. Check and record total bowl lateral or end-play. If prime mover is solid shaft, this information will be required for flanged coupling assembly.

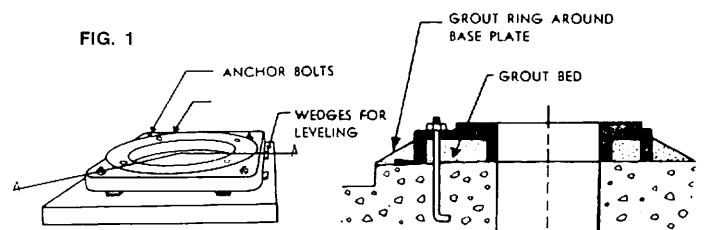
V. INSTALLATION - REFER TO APPROPRIATE DRAWINGS IN MANUAL

NOTE: Skip Section "A" 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 D, Steps 4a, 4b, or 4c".

A. BASE PLATE

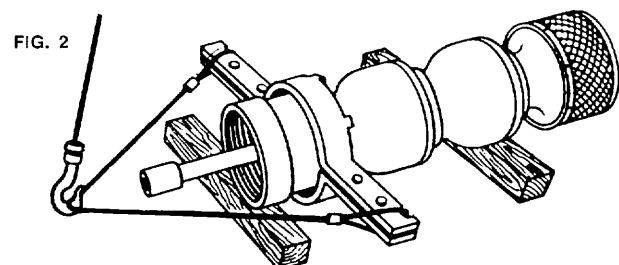
Accurate baseplate leveling and alignment is the key to proper pump installation and optimum pump operation. Proceed with extreme care. See Fig. 1.

1. Place baseplate over anchor bolts and allow to rest on at least 4 wood or metal spacers about 1/2" thick.
2. 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 .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.
3. Attach hex nuts to anchor bolts and tighten against baseplate.
4. 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. Re-check level of plate then **do not disturb until grout has completely set.**



B. PUMP BOWL

1. 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.
2. 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 Fig. 2.



(Continued)

3. 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 re-install strainer. (2)
4. If there is any auxiliary piping to the tail bearing, make certain that the bowl portion is assembled to the bowl at this time.
5. Center bowl over installation opening then carefully lower until the clamp ears are resting squarely on the beams. Remove the sling. See Figs. 3 and 4.

FIG. 3

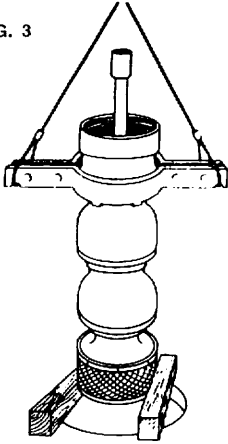
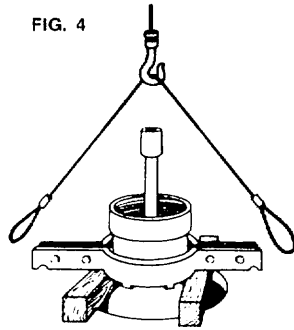


FIG. 4

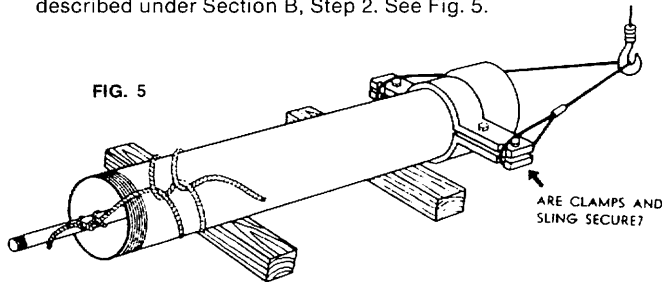


6. Clean the shaft threads, the discharge threads and butt face or flange face and the main bearing box threads and face if enclosing tubing is furnished. Lightly oil the shaft threads and screw coupling on half way. Place a rag over the coupling to prevent entrance of foreign matter during the next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

C. COLUMN - OPEN LINE SHAFT. Refer to installation plan to determine correct sequence of column lengths.

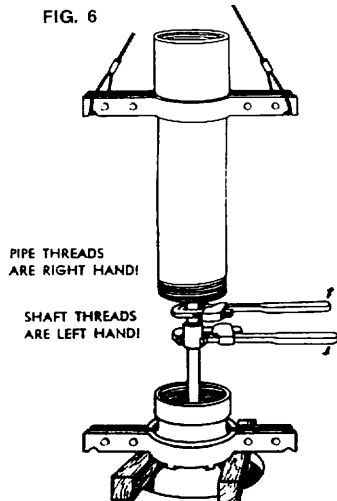
1. Secure pipe clamp immediately beneath column coupling or, if column is flanged, secure clamp about 6" below bottom of flange.
2. Slide shaft into bottom of column pipe and allow it to protrude approximately 15" below bottom end of pipe. Make certain that shaft sleeve, if furnished, is toward the top 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 under Section B, Step 2. See Fig. 5.

FIG. 5



3. 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.

FIG. 6



4. 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 Fig. 6.

5. 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 Fig. 7.

- 5a. 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 and tighten hex nuts evenly. See Fig. 7A.

FIG. 7

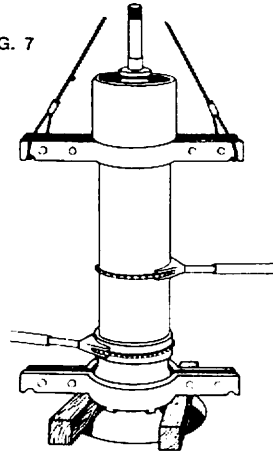
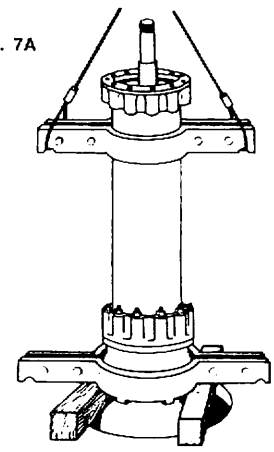


FIG. 7A



6. Hoist assembly slightly, remove bowl clamp and slide setting beams out to allow passage of assembly.
7. 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.
8. Lower assembly, slide beams in close to column, rest clamp ears on beams and remove sling. See Fig. 8.
9. If there is more than one section of column and if the column is threaded and a separate spider is used ("LB" construction), slip spider over shaft with lock ring up (if rubber bearing used), thread spider into coupling until it seats against lower pipe face and tighten. To insure that spider is tightened sufficiently against pipe face, hoist column about one foot, install one set of chain tongs on pipe beneath clamp and one set on coupling and tighten.
- 9a. If column is flanged, clean flange recess and spider ring O.D. and faces thoroughly, slip spider over shaft with lock ring up (if rubber bearings used) and seat into spider recess. See Fig. 8A.
10. 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.

FIG. 8

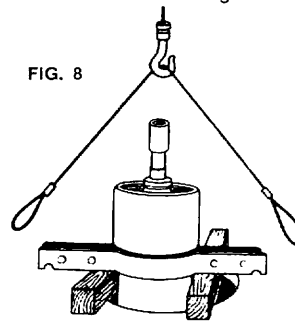
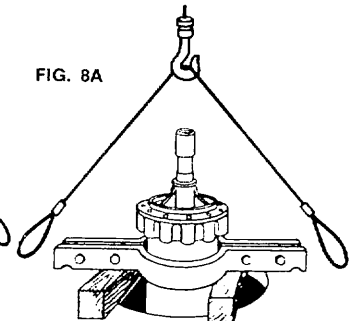


FIG. 8A



11. 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 bottom 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.

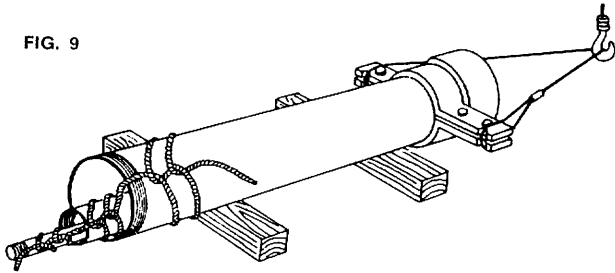
C. COLUMN - ENCLOSED LINE SHAFT

1. Clamp column as described under section "C", Step 1.
2. 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"

(Continued)

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 under "Section B, Step 2". See Fig. 9.

FIG. 9



3. 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.
4. Make up shaft joint as described under "Section C, Step 4". See Fig. 10.
5. 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 Fig. 11.

FIG. 10

SHAFT THREADS
ARE LEFT HAND

TUBING THREADS
ARE RIGHT HAND

PIPE THREADS
ARE RIGHT HAND

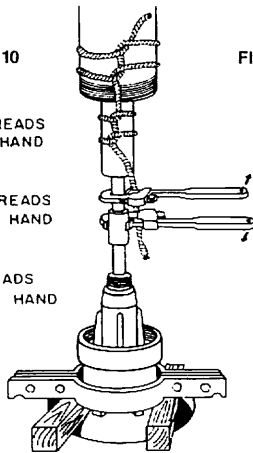
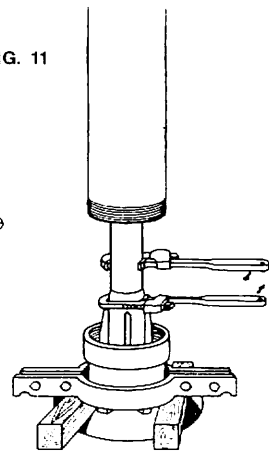


FIG. 11



6. Make up the pipe joint as described under "Section C, Steps 5 thru 8" altering Step 5 to include "making certain that shaft and tubing feeds thru the bushing in the upper column coupling".
7. 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 Figs. 12 & 12A.
8. If the column is threaded but utilizes the "LB" 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.

FIG. 12

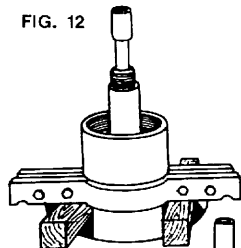
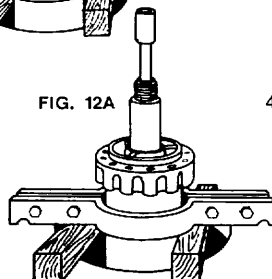


FIG. 12A



- 8a. 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

- (3) tapered hub in the spider and a special tapered lock ring is used in lieu of the normal rubber bushing. The lock ring should be hammered evenly into the hub. See Fig. 12A.
9. Continue assembly as outlined under "Section C, Steps 10 & 11". 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.

D. PUMP HEAD

1. 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 Figs. 13 & 13A.
- 1a. 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 Fig. 13B.

FIG. 13

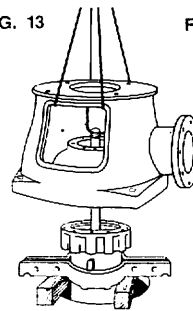


FIG. 13A

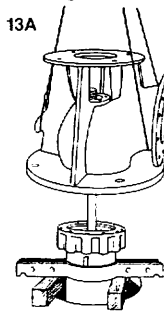
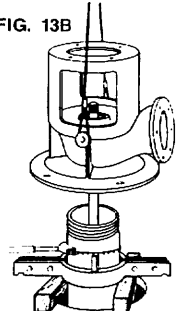


FIG. 13B



2. 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.
- 2a. 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 lampwick 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.
- 2b. If the adjustable flange is being used in conjunction with enclosing tubing, the top of the tubing should be approximately 3/8" below the stuffing box mounting face of the head after the flange is adjusted.
3. 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.
4. If head is resting on baseplate, align mounting holes with taps in baseplate, install and tighten capscrews.
- 4a. 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 .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 Fig. 1.
- 4b. 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 Step 4a for leveling and grouting.

(Continued)

- 4c. Step 4b 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. (4)

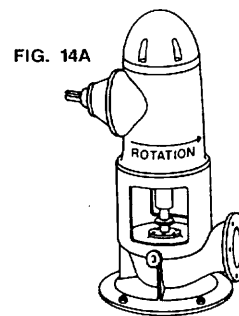
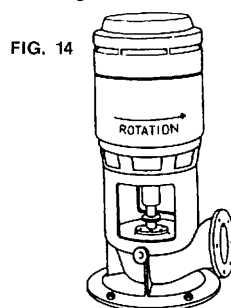
E. STUFFING BOX OR MECHANICAL SEAL

1. Packed Box - Open Line Shaft.
 - a. 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.
 - b. Refer to stuffing box sectional drawing for packing instructions.
2. Mechanical Seal - Open Line Shaft.
 - a. Refer to mechanical seal sectional drawing for complete assembly details.
3. Style 60 - Enclosed Line Shaft.
 - a. Refer to Style 60 sectional drawing for complete assembly instructions.
4. Style 60 - Enclosed Line Shaft - Force Water Lube.
 - a. Refer to Style 60, force water lube, drawing for complete assembly instructions.

F. DRIVER & DRIVE COUPLING

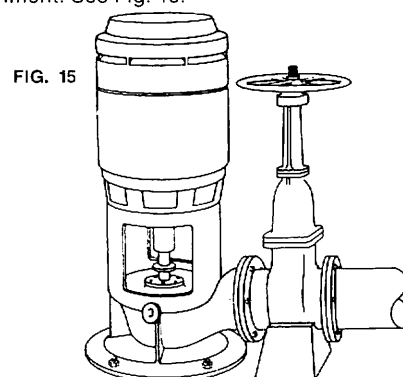
1. Solid Shaft.
 - a. Since a solid shaft driver employs a flanged type coupling, the two must be assembled in conjunction with one another. The assembly instructions can be found with the flanged coupling sectional drawing.
 - b. **If power is not available to the motor, the coupling should not be connected until power is available and correct rotation determined.**
2. Hollow Shaft. **Bolted type coupling should be used.**
 - a. Clean threads and face of line shaft projecting above stuffing box thoroughly, then oil threads lightly. Thread coupling on shaft for half its length. If a threaded flange type coupling is being used, thread it on until it seats against shaft face. Place one pipe wrench on coupling hub and one on shaft and tighten. Place top half coupling on lower half, align match marks, install and tighten capscrews and lock nuts.
 - b. Remove the top cover from the driver. Un-bolt the clutch or coupling from the drive plate and remove the clutch. Install one of the bolts back in one of the driver plate taps. (This is a temporary arrangement and the bolt will be removed before completing assembly.)
 - c. Run a fine flat file over the surface of the motor stand to remove any nicks or burrs. Thoroughly clean with solvent. Wipe a thin layer of light oil over surface. This will help prevent rust and will also facilitate driver shifting during coupling alignment.
 - d. Attach the erector sling to the driver lifting lugs. Hoist driver sufficiently to allow easy access to mounting base, remove nicks and burrs with a fine flat file and thoroughly clean with solvent. If there is insufficient head room to install the drive shaft after placing the driver on the head, lower the drive shaft thru the quill, keyway end up, replace the clutch over the shaft and onto the drive plate. Install the adjusting nut and thread it on (left hand) for 4 or 5 threads, then allow shaft to hang from this adjusting nut.
 - e. Hoist driver sufficiently to clear stand, swing over pump centerline and slowly lower until motor is resting on stand. Properly orientate conduit box, align mounting holes and install BUT DO NOT TIGHTEN capscrews and cut washers.
 - f. Clean the drive shaft thoroughly and dress the threads and keyway with a 3-cornered file if necessary. Lift shaft and carefully lower it through the quill (end with keyway goes toward the top) and allow shaft to contact head coupling. Hold head coupling from turning and turn drive shaft until it seats. If clutch and adjusting nut are installed in Step d, **remove both of these.**
 - g. Make temporary electrical connection to motor, bump starter to determine correct rotation (CCW as viewed from above), mark, then disconnect leads. **If power is not available, do not make final drive shaft connections (Steps i & j) until power is available and correct rotation is determined.**

- h. Place a dial indicator base on the drive plate and using a C-clamp, clamp base to the bolt installed under Step 1. Place dial on shaft and slowly turn rotor. This will, in effect, check the alignment of the driver to the pump centerline. T.I.R. should not exceed .003" - shift driver, unless it is registered to head, until this is accomplished, then tighten mounting screws.
- i. Remove bolt from drive plate, slide clutch over drive shaft, seat against drive plate, install and tighten bolts, if bolted type.
- j. Turn clutch until keyways in shaft and clutch align, install and seat gib key. Thread adjusting nut onto shaft until it seats against top of clutch. Hold the clutch from turning, turn adjusting nut until shaft is pulled to its uppermost position (pump bowl impellers will be in uppermost position) counting the number of complete turns to accomplish this. Back the adjusting nut off exactly half of the total turns found above (this will place impellers in correct running position) align holes in adjusting nuts with taps in clutch, install and tighten fillister head machine screws. Place top cover on driver and secure. See Figs. 14 & 14A.



G. MISC. ASSEMBLIES

1. Lubricator
 - a. 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.
2. Discharge Piping
 - a. 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 Fig. 15.



- b. 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 under "Section D, Step 4b".
- c. 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 Figs. 16 & 16A.

(Continued)

FIG. 16

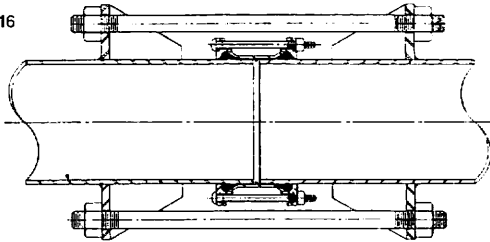
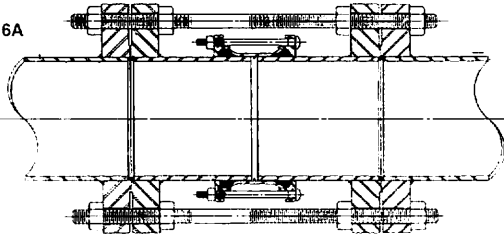


FIG. 16A



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

3. Suction Connection

- a. Alignment between the suction flange and the suction header should have already been achieved per "Section D, Step 4c". 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.

4. Air Release Valve

- a. 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.

5. Gauges and Misc. Pipe Connections

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

6. Electrical Connections

- a. All connections to the motor such as main leads, space heater leads, thermocouple leads, etc., should be made in accordance with motor manufacturers specifications.
- b. Make necessary connections to lubricator solenoid.

VI. STARTING, OPERATION AND MAINTENANCE

A. PRIOR TO START-UP

1. Perform initial servicing on the driver as recommended by the driver manufacturer. Also perform initial servicing on all auxiliary assemblies if required.
2. Recheck all fasteners and fittings for tightness.
3. 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.
4. If there is a control valve on the discharge side of the pump, make certain that it is **only partially open**.
5. If unit is oil lubricated, fill lubricator with a good grade SAE10 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.

(5)

6. 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.
7. 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.
8. "Bump" starter again to insure that unit has correct rotation.

B. INITIAL START-UP

1. Energize starter and after pump has come up to speed and all air has been exhausted, regulate control valve to achieve desired pressure.
2. 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.
3. Regulate lubricator to allow about 5 drops per minute for each 50 ft. of setting.
4. Check all joints for leakage and correct if evident.
5. Make certain that the driver is operating satisfactorily as to temperature, bearing temperature, etc., as prescribed by the driver manufacturer.
6. Check for excessive vibration. If this is evident shut down unit immediately and begin checking for cause.
7. 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

1. For normal operation and maintenance of the driver, follow the instructions outlined by the driver manufacturer.
2. Check the level in the lubricator and refill when it is about ¾ empty.
3. 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.
4. Apply grease to the stuffing box at the rate of one turn for each 24 hours of operation.
5. If force water lubrication is employed, this system should be turned on prior to each start-up and proper pressure should be maintained.
6. 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.
7. If the tail bearing is pressure grease lubricated apply about one shot of grease for each 24 hours operation.
8. 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.

D. DISMANTLING AND ASSEMBLING PUMP BOWLS

Always dismantle from discharge end down and assembly from suction end up.

Layne pump bowl on two or three "V" blocks for proper support.

1. Collet bowls - see separate drawing with instructions for correct procedure.
2. Keyed bowls.
 - a. Remove shaft coupling, remove hex nuts that secure top intermediate to bowl and slide off end of shaft. Discharge nozzle need not be removed from top intermediate unless bearings or seals are to be replaced. Loosen set screw in impeller hub and slide impeller off end of shaft. Remove impeller gib key.
 - b. Repeat Step "a" until all stages have been dismantled. After the bottom intermediate has been removed, the shaft can be removed from the suction nozzle bearing.
 - c. To assemble, place bottom gib key in shaft keyway, slide impeller onto shaft and into position, then lock with set screw. If new shaft is used, it should be countersunk at each impeller set screw position.
 - d. Slide impeller shaft into suction hub, then slide lower intermediate on shaft and attach to suction nozzle.

(Cont.ued)

- e. Assemble all remaining stages as outlined under Steps "c" and "d".⁽⁶⁾

E. BEARING AND WEAR RING REPLACEMENT

1. Metal bearings such as bronze can be readily pressed in with an arbor or screw press. If this is not available, they can be driven in very carefully with a block of wood and hammer although this is not the recommended procedure. Make certain that bearing projections are maintained.
2. Graphite or sintered graphite and metal composition bearings do not possess great tensile or compressive strength and CANNOT BE DRIVEN IN AS METAL BEARINGS CAN. They must be pressed in with an arbor or screw press with a mandrel to fit the bearing properly and pressed in with a slow continuous even motion. They must always be pressed in from the chamfered bore end of the hub to prevent shearing the outer surface. The hub bore and the bearing should be lubricated with water to aid the pressing operation. DO NOT LUBRICATE WITH OIL OR GREASE.
3. If bearings are of Teflon or of a similar plastic material, make certain that locking set screws (if furnished) are removed before pressing bearings out. Lake graphite bearings, plastics are not particularly strong and should, therefore, be pressed in with an arbor or screw press with a properly fit mandrel. If original bearings were locked in, drill and tap bearings at original lock position (or drill and tap bearing and hub at new location), and install locking set screw. It is also recommended that the O.D. of the bearings be roughed up slightly with a file and a good grade neoprene cement be applied to the bearing prior to pressing.
4. Wear rings can be removed by cutting the cross section with a chisel and prying one end inward until it is loose in the bore. To install, make a mandrel to fit the wear rings and press in with an arbor or screw press. In an emergency, the wear rings could be installed by gently and evenly tapping around the top edge with a wood block and hammer but this is not the preferred method.
5. If impeller skirts are equipped with wear rings, first remove the locking set screws securing the rings to the skirts. Cut the wear ring cross section with a chisel and force off. It might be possible to knock off or use a wheel puller for removal without requiring any cutting.
To install, make a mandrel to fit the O.D. of the wear rings and press on flush with the bottom of the impeller skirts. In an emergency, these rings can be installed as described in Step 4. Drill and tap for three ¼" - 20 UNC x ¼" set screws 120° apart at the ring to skirt joint and install stainless steel "Nylok" type set screws.

6. If discharge nozzle seals or klosures must be replaced, make certain they are always installed with their lips pointing down. They are used primarily to keep water out of the enclosing tube more so than to keep the oil in the tube.

F. COMMON CAUSES OF IMPROPER OPERATION

1. Low Capacity or Low Pressure
 - a. Impeller clogged or loose on shaft
 - b. Air or gas in water
 - c. Driver speed slow
 - d. Clogged suction
 - e. Incorrect rotation
 - f. Excessively worn impeller skirts or wear rings
 - g. Insufficient submergence
2. Excessive Power
 - a. Speed too high
 - b. Improper lateral adjustment
 - c. Bad driver thrust bearing
 - d. Pump out of alignment
 - e. Shafting bent
 - f. Head coupling mis-aligned
 - g. Pumping foreign matter
3. Vibration
 - a. Bad driver thrust bearing
 - b. Pump out of alignment
 - c. Head coupling mis-aligned or out of balance
 - d. Shafting bent
 - e. Bearings badly worn or broken
4. Water in Oil Tubing
 - a. Discharge nozzle relief ports plugged
 - b. Tubing joint leaking
 - c. Shaft seals damaged
 - d. Crack or hole in tubing or leaking at tension box O-ring
 - e. Excessively worn top intermediate and discharge nozzle bearings
5. Breaking suction
 - a. Insufficient submergence
 - b. Air or gas in water

WARRANTY

PRODUCTS MANUFACTURED BY SELLER AND SOLD UNDER THIS AGREEMENT ARE WARRANTED FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP FOR ONE YEAR FROM THE DATE OF SHIPMENT TO THE BUYER. GOODS MANUFACTURED BY OTHER THAN SELLER AND SOLD UNDER THIS AGREEMENT ARE WARRANTED ONLY TO THE EXTENT THAT THE MANUFACTURER WARRANTED THEM TO SELLER. SELLER'S OBLIGATION IS LIMITED TO REPAIR OR REPLACEMENT F.O.B. SELLER'S PLANT, WHEN EXAMINATION OF SUCH PRODUCTS SHALL DISCLOSE THEM, TO SELLER'S SATISFACTION, TO HAVE BEEN DEFECTIVE AND BUYER SHALL HAVE NOTIFIED SELLER PROMPTLY OF THE DISCOVERY OF ANY SUCH DEFECT. AT THE SELLER'S OPTION SUCH PRODUCTS SHALL BE RETURNED TO SELLER TRANSPORTATION CHARGES PRE-PAID. THIS WARRANTY DOES NOT APPLY TO ANY PRODUCTS WHICH HAVE BEEN OPENED, DISASSEMBLED, REPAIRED OR ALTERED BY ANYONE OTHER THAN SELLER OR SUBJECTED TO MISUSE OR ABUSE. IN ADDITION TO THE FOREGOING, ALL PRODUCTS FURNISHED HEREUNDER ARE WARRANTED WITH RESPECT TO (A) TITLE, AND (B) IN THE CASE OF STANDARD COMMERCIAL PRODUCTS, NON-INFRINGEMENT; IN EACH CASE TO THE EXTENT PROVIDED BY THE UNIFORM COMMERCIAL CODE. UNLESS OTHERWISE SPECIFICALLY AGREED IN WRITING BY SELLER, THE OBLIGATION OF SELLER IS LIMITED, IN THE CASE OF A MATERIAL BREACH OF THE WARRANTIES SET FORTH IN (A) AND (B) ABOVE, TO THE RETURN OF BUYER'S PURCHASE PRICE OR, AT SELLER'S OPTION IN THE CASE OF INFRINGEMENT, TO THE PROMPT REPLACEMENT OF THE PRODUCTS WITH NON-INFRINGEMENT CONFORMING PRODUCTS. EXCEPT AS ABOVE SPECIFICALLY PROVIDED, SELLER'S LIABILITY TO BUYER SHALL NOT EXCEED THE COST OF CORRECTING DEFECTS IN THE GOODS SOLD AND SELLER SHALL NOT IN ANY EVENT BE LIABLE TO BUYER OR THIRD PARTIES FOR ANY DELAYS OR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE AND NON-INFRINGEMENT.

**ADDENDUM
TO
INSTALLATION & OPERATING INSTRUCTIONS
FOR
EXTRA LARGE SHORT COUPLED UNITS**

USE IN CONJUNCTION WITH SHORT COUPLED INSTALLATION & OPERATING INSTRUCTIONS MANUAL

II. INSTALLATION EQUIPMENT & TOOLS

Delete Items 2, 12, 13, 4" x 4" timbers in Item 14 and Item 17 in Section II of Manual.

Add:

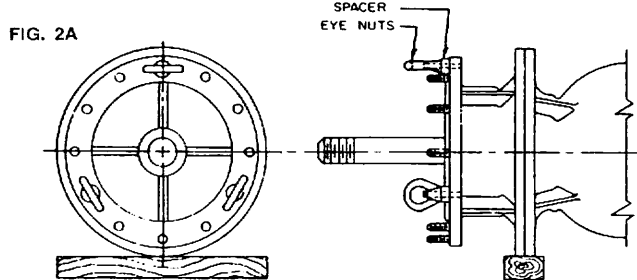
23. Three eye nuts with spacers for hoisting bowl. (By pump manufacturer.)
24. Four leg sling with safety hooks at least 4 feet long of sufficient strength to lift entire pump assembly.
25. Three eye nuts with studs and backing plates for lifting column. (By pump manufacturer.)
26. Special tool for hanging shafting and tubing within column pipe for lifting and assembly. (By pump manufacturer.)

V. INSTALLATION

B. Pump Bowl

Disregard Step 2 & Fig. 2, Step 5 & Figs. 3 & 4 of Section B in Manual.

2. 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 Fig. 2A.

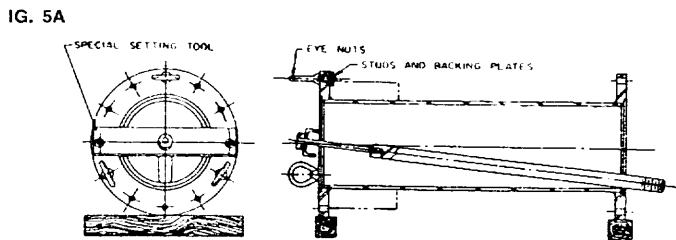


5. Center bowl over installation opening then carefully lower until the underside of the top flange is resting squarely on the setting beams. Remove sling, eye nuts and spacers.

C. COLUMN - OPEN LINE SHAFT

Disregard entire Section C - Open Line Shaft except for Step 4 and Fig. 6 and Step 7, and disregard any reference to rope in these steps.

1. 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 Fig. 5A.



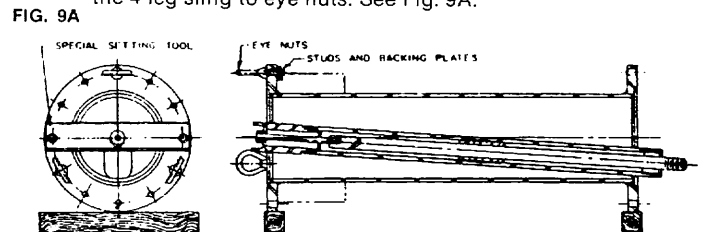
2. Hoist column to the vertical position taking care not to drag end of shaft across floor. Before centering over bowl, tap side of column to remove any loose matter accumulated inside.
3. See Step 4, Section C - Open Line Shaft in Manual for shaft joint assembly. Entire column pipe must turn when threading shaft into coupling unless hanger section of tool is separate from cross member.
4. 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.
5. Hoist column slightly, slide beams out far enough to allow passage of assembly.
6. See Step 7, Section C - Open Line Shaft of Manual.

7. 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.
8. 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 rubber bearing used) and seat into flange recess.
9. 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.
10. 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.

C1. COLUMN - ENCLOSED LINE SHAFT

Disregard entire Section C - Enclosed Line Shaft except for Steps 4 and 5, Figs. 10 and 11, and Step 7, Fig. 12A and disregard any reference to rope in these steps.

1. 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 Fig. 9A.



2. 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.
3. See Step 4 & Fig. 10, Section C - Enclosed Line Shaft in Manual for shaft joint assembly.
4. See Step 5 & Fig. 11, Section C - Enclosed Line Shaft in Manual for tubing joint assembly.
5. Follow Steps 4 thru 7, Section C - Open Line Shaft in Addendum Instructions.
6. If there is more than one section of column, follow Steps 7 & 8A, Section C - Enclosed Line Shaft in Manual.
7. 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.

PIPE AND SHAFT STRETCH (Bowl Lateral Check)

WHEN SELECTING LINE SHAFT SIZE FOR A WELL PUMP, THE DIFFERENCE BETWEEN PIPE AND SHAFT STRETCH DUE TO HYDRAULIC THRUST LOAD MUST BE CHECKED AND COMPARED WITH THE LATERAL AVAILABLE IN THE BOWL ASSEMBLY.

The difference between the pipe stretch and the shaft stretch may be calculated according to the following formula:

$$\frac{HL}{29} [KC_1 - C_2 + C_3 (1 - 1/2 \frac{L}{H})]$$

H = TOTAL DYNAMIC HEAD IN FT./1000

L = COLUMN LENGTH IN FT./1000

K = THRUST FACTOR

C₁, C₂, C₃ = CONSTANTS (SEE BELOW)

COLUMN ASSEMBLY			C ₁	C ₂	C ₃
PIPE	TUBING	SHAFT			
4 *	1 - 1/4	7/8	22.92528	13.54618	9.73156
	1 - 1/2	1	18.11548	12.12963	9.30488
5 *	1 - 1/4	7/8	22.28288	17.90701	11.73232
	1 - 1/2	1	17.52251	16.63626	11.32582
	2	1-3/16	12.91767	14.02244	10.52378
6 *	1 - 1/2	1	17.09141	20.37688	13.14156
	2	1-3/16	12.54031	18.02106	12.37996
	2 - 1/2	1 - 1/2	8.32276	14.86560	11.15224
	2 - 1/2	1-11/16	6.89592	14.86560	11.15224
8 *	1 - 1/2	1	16.72685	30.16048	18.36080
	2	1-3/16	12.21295	27.80047	17.50183
	2 - 1/2	1 - 1/2	8.05194	24.40462	16.07294
	2 - 1/2	1-11/16	6.62510	24.40462	16.07294
	3	1-15/16	5.23780	21.01272	14.88153
10 *	2	1-3/16	11.96645	37.65757	22.74387
	2 - 1/2	1 - 1/2	7.84095	34.16001	21.19790
	2 - 1/2	1-11/16	6.41410	34.16001	21.19790
	3	1-15/16	5.05473	30.69061	19.87294
	3 - 1/2	2-3/16	4.12668	27.91873	18.84972
	3 - 1/2	2-7/16	3.50528	27.91873	18.84972
12 *	2 - 1/2	1 - 1/2	7.58430	37.22428	22.53576
	2 - 1/2	1-11/16	6.15745	37.22428	22.53576
	3	1-15/16	4.82565	34.63953	21.45535
	3 - 1/2	2-3/16	3.96469	32.11403	20.59722
	3 - 1/2	2-7/16	3.34330	32.11403	20.59722

* LAYNE (OR ANSI B58.1) STANDARD WEIGHT PIPE ONLY.

The shaft stretch difference must be added to the required impeller running clearance (0.12 inch constant) and the lateral loss due to assembly (0.06 inch for up to 10 stages and 0.12 inch for over 10 stages). This sum is the total required lateral and must be compared to the lateral available by the bowl assembly as shown on the performance curve.

EXAMPLE: PUMP SETTING: 350 FT.
 COLUMN ASSEMBLY: 1 x 1½ x 5
 RATED CONDITION: 200 GPM AT 528 FT. TDH
 SELECTED BOWL: 8PRHC, 18 STAGE
 THRUST FACTOR: 3.0 @ 200 GPM

C₁ = 17.52251 H = .528
 C₂ = 16.63626 L = .350
 C₃ = 11.32582 K = 3.0

Calculate stretch as follows: (using formula at top of page)

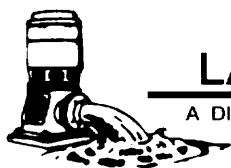
$$\frac{.528 \times .350}{29} [(3.0) (17.52251) - 16.63626 + 11.32582 (1 - \frac{.350}{2 \times .528})] = .2772 \text{ inch Stretch Difference}$$

.2772 inch stretch + .1200 inch Impeller Clearance + .1200 inch Assembly Loss = .5172 inch Total Required Lateral
 Standard available Lateral from Bowl Performance Curve = .5400

**IMPELLER LATERAL SETTING
FOR MAXIMUM PUMP EFFICIENCY**

BOWL	LATERAL SETTINGS (inches)	BOWL	LATERAL SETTINGS (inches)
4 R	1/8	16 HOH	3/8
		16 G	1/8
6 DR	3/16		
6 RK	1/4	17 DRO	1/8
6 G	3/16		
		18 RK	1/8
7 C	1/8		
		19 G	1/8
8 DR	1/4		
8 PR	1/4	24 RK	1/2
8 RK	1/4	24 G	1/4
8 T	1/8		
8 UR	1/4	25 RKMC	1/4
		25 RKHC	3/8
9 B	1/8		
		30 D	1/4
10 RK	7/16	30 G	1/4
10 U	1/4		
10 T	1/4	32 SK	7/16
11 B	1/8	36 B	1/4
		36 G	1/4
12 RK	5/16		
12 T	1/8	38 H	1/2
12 UR	1/4		
		42 RK	1/2
13 C	1/8		
		44 G	5/8
14 T	1/8		
15 C	1/8		
15 DR	3/8		

FOR SHORT COUPLED ONLY (40 FT. MAX.)



LAYNE & BOWLER

A DIVISION OF THE MARLEY COMPANY

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