ARMSTRONG

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INSTALLATION AND OPERATING INSTRUCTIONS

Sump Pumps & Process and Booster Can Pumps

Close Coupled Sump Type Pumps Types A, C, F & VU

Process and Booster Can Type Pumps Types AF, CF, VF & VC

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IMPORTANT NOTE

FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. STUDY THIS INSTRUCTION MANUAL.

The descriptions and instructions included in this manual cover the standard design of the equipment and any common deviations when possible. This book does not cover all design details and variations nor does it provide for every possible contingency which may be encountered. When information cannot be found in this book, contact the nearest representative.

Do not operate this equipment other than in accordance with the instructions contained in this manual. This equipment (or a prototype) has been shop tested and found satisfactory for the conditions for which it was sold.

The following instructions should be read completely before starting to install the pump. This equipment is capable of extended trouble-free operation when properly applied, installed and maintained. These instructions present the basic information and methods required for proper installation and maintenance of turbine pumps of the size and type indicated on the front cover.

Standard practice is to ship close coupled pumps assembled. Where long pump lengths, shipping limitations, handling limitations and headroom limitations prevent complete assembly, we will ship the pump sub-assembled. It is the responsibility of the installer to ask for assistance should it be required to properly assemble and install the pump.

CAUTION: The equipment supplied can cause serious personal injury or death if mishandled and extreme care is not exercised in the operation of the equipment. **NO ONE SHOULD EVER BE ALLOWED NEAR THE SUCTION OR OPEN DISCHARGE OF THE PUMP DURING OPERATION.** A double custody lock should be installed on circuit breaker before anyone should be allowed to do any checking, maintenance or other work on the equipment. If the unit is supplied from the factory with OSHA approved coupling guards they must be kept installed at all times during operation to prevent injury to personnel.

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SECTION 1: GENERAL INFORMATION AND DESCRIPTION

1.1. GENERAL INFORMATION

The length of satisfactory service obtained from the equipment will, in part, depend on proper installation and maintenance. This instruction manual is provided to present the basic information for operating, maintenance and management personnel. Due to the many variations and custom designed units it is impossible to cover every design variation or contingency which may arise, however, the basic information contained herein will answer most questions.

1.2. IDENTIFICATION

Should questions arise concerning the pump, the factory will require the complete serial number. The serial number is stamped on a metal nameplate affixed to the discharge head assembly. The driver will have a separate nameplate attached to it. When requesting information on the driver, both the driver serial number and pump serial number will be required.

1.3. GENERAL DESCRIPTION

The basic components of Close Coupled Pumps are the driver, discharge head assembly, column assembly (when used), and bowl assembly. Refer to Figure 1.1 for the possible variations of your particular unit. The pumps are normally shipped assembled and ready for installation if the total length is less than 30 feet. The drivers, couplings and strainers (when used) are shipped separately to prevent damage.

1.4. DRIVERS

A variety of drivers may be used, however, electric motors are most common. For the purposes of this manual all types of drivers can be grouped into two categories:

1. Hollow shaft drivers where the pump shaft extends through a tube in the center of the rotor and is connected to the driver by a clutch assembly at the top of the driver.

2. Solid shaft drivers where the rotor shaft is solid and projects below the driver mounting base. This type driver requires an adjustable coupling for connecting to the pump.

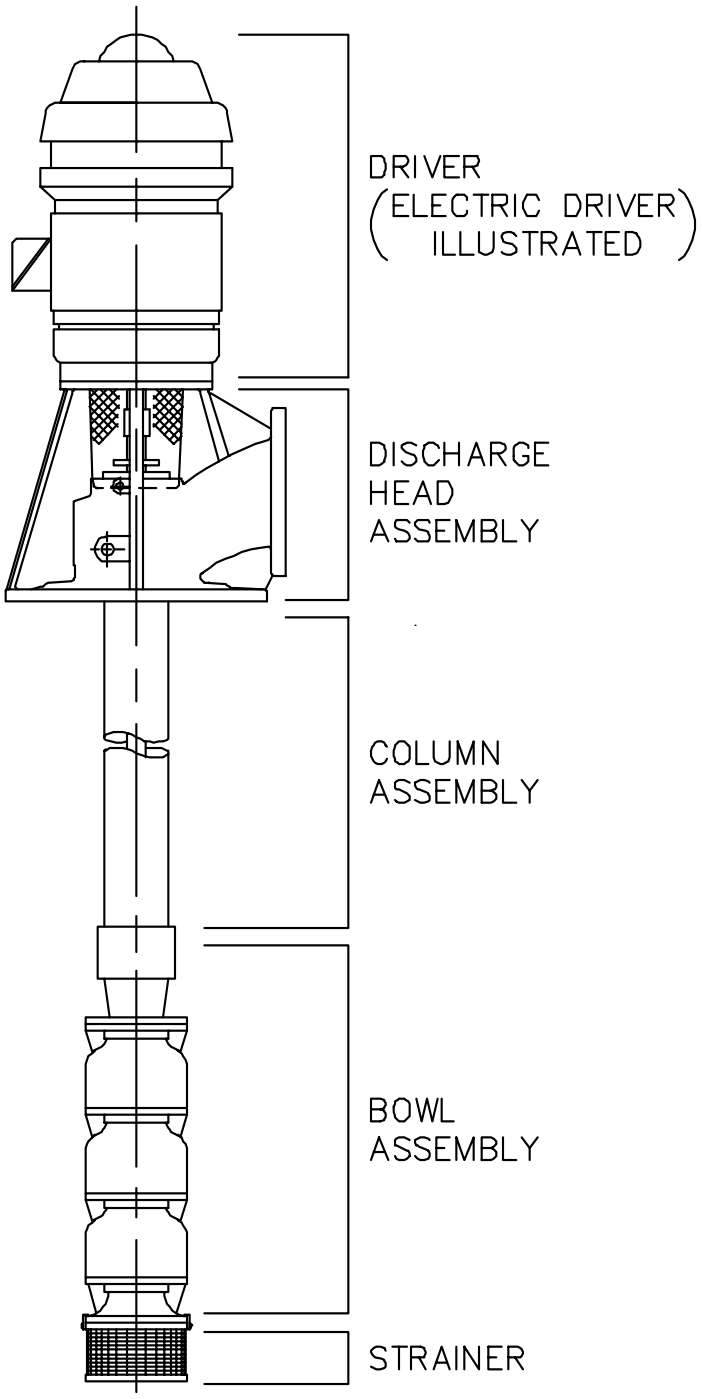

Fig. 1.1 Type "A" Unit

1.5. DISCHARGE HEAD ASSEMBLY

The discharge head supports the driver and bowl assembly as well as providing a discharge connection (the type "VU" discharge connection will be located on one of the column pipe sections below the discharge head). A shaft sealing arrangement is located in the discharge head to seal the rotating shaft where it passes from the stationary housing (liquid chamber). The shaft seal will usually be either a mechanical seal assembly or packing box.

1.6. COLUMN ASSEMBLIES

Column assemblies are of two basic types, either of which may be used on close coupled units:

1. Open lineshaft construction utilizes the liquid being pumped to lubricate the lineshaft bearings.

2. Enclosed lineshaft construction has an enclosing tube around the lineshaft and utilizes oil, grease or injected liquid (usually clean water) to lubricate the lineshaft bearings. (Not used on barrel pumps.)

Column assemblies consist of column pipe, which connects the bowl assembly to the discharge head and carries the pumped liquid to the discharge head; shaft, connecting the bowl shaft to the driver; and may contain bearings if required for the particular unit. Column pipe may be either threaded or flanged.

NOTE: Some units will not require a column assembly, having the bowl assembly connected directly to the discharge head.

1.7. BOWL ASSEMBLIES

The bowl assembly consists of impellers rigidly mounted on the bowl shaft which rotate and impart energy to the fluid, bowls to contain the increased pressure and direct the fluid, suction bell or case which directs the fluid into the first impeller, and bearings located in the suction bell (or case) and each bowl.

A SEPARATE INSTRUCTION MANUAL IS AVAILABLE ON REQUEST WHICH PROVIDES CONSTRUCTION DETAILS AND REPAIR INSTRUCTIONS FOR FLOWAY BOWL ASSEMBLIES.

1.8. SUCTION VESSEL

The suction vessel may consist of a barrel with or without suction fitting, to connect to customers piping arrangement, or a storage tank with suitable opening for mounting the pump. Whatever the arrangement, it must provide adequate support for the unit and a means of supplying the pump with liquid.

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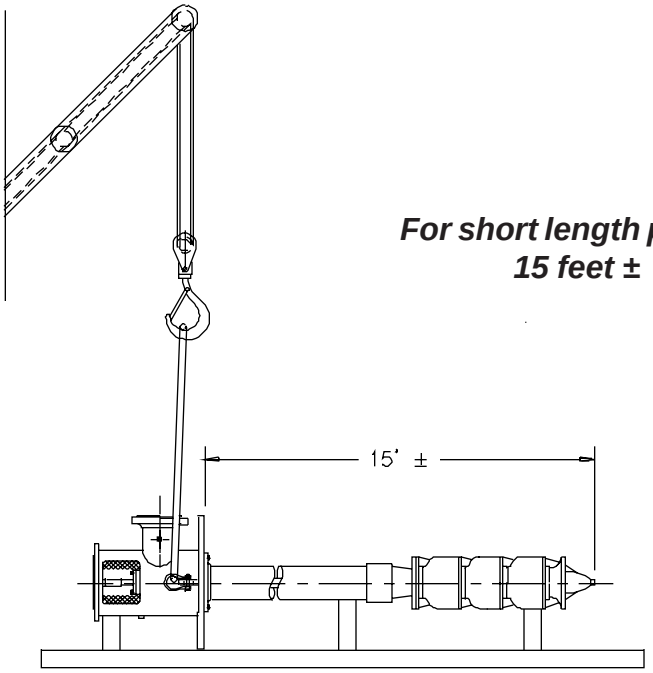
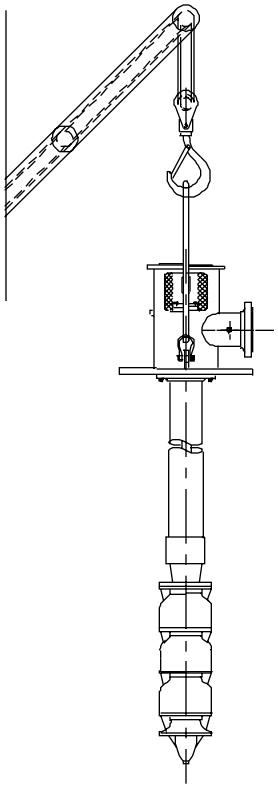
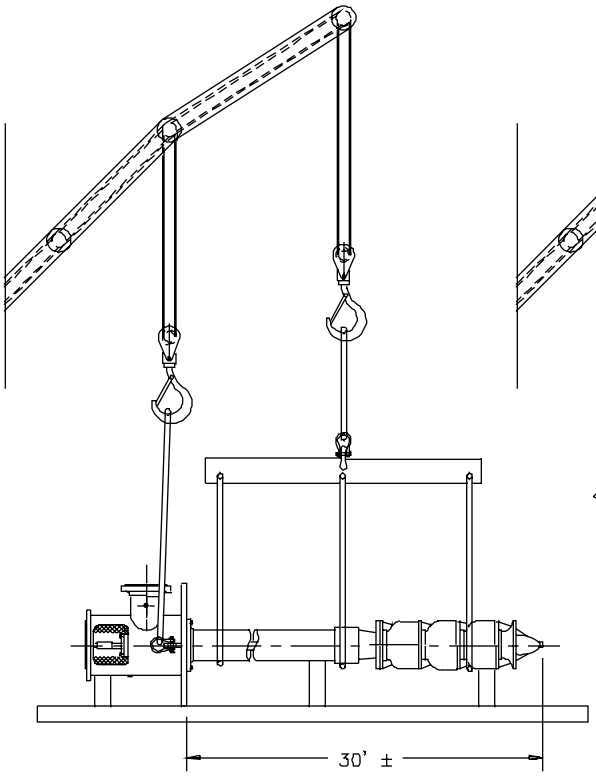
LIFTING PUMPS FROM HORIZONTAL TO VERTICAL POSITION

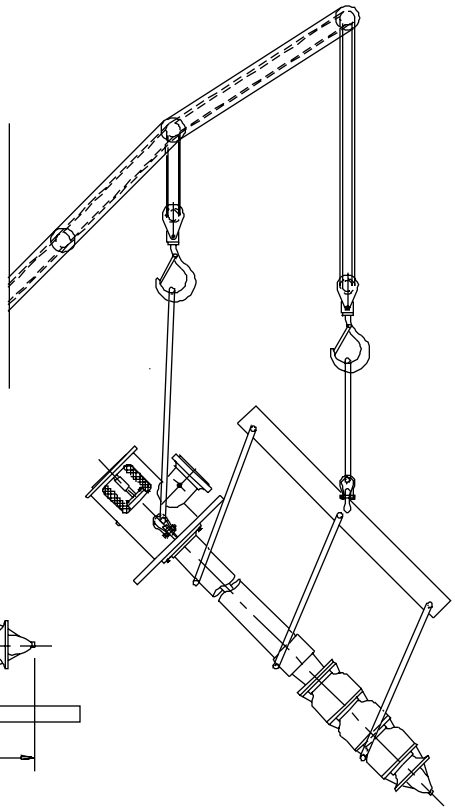


For short length pumps
15 feet ±



For pump lengths
up to 30 feet ±





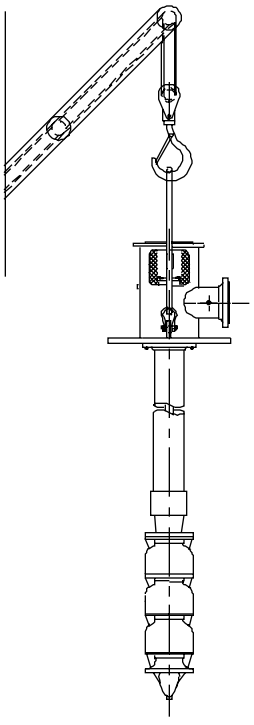


Fig. 1.2

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SECTION 2: PRE-INSTALLATION

2.1. RECEIVING AND UNLOADING

When shipment is received extreme care should be exercised during unloading. Heavy parts should be skidded to the ground if lifting equipment is not available. It is recommended a forklift or crane be used to unload equipment. Do not drop the unit, or any parts, as damage may cause trouble in assembly and operation of the units.

Inspect unit for signs of transit damage before beginning to uncrate or put into storage. If damage is evident the local transporting company agent should be notified before uncrating and a claim filed with the agent.

2.2. STORAGE

If the unit is to be stored prior to installation, carefully select a storage space so the unit will not be subject to excess moisture, extreme weather conditions, corrosive fumes, or other harmful conditions. Carefully inspect the unit and clean any rust spots on machined surfaces with a fine emory cloth and coat with a rust preventative. If the unit is stored for a long period it should be inspected from time to time and cleaned as required. Contact the factory for special long term storage requirements for unit supplied.

2.3. UNCRATING & CLEANING

If unit appears undamaged proceed to uncrate. The pump is normally shipped as a unit from the factory and it is advisable to lift into the vertical position before uncrating. If this is not possible the longer units must be supported at more than one place when raising to the vertical position. See Fig. 1.2.

CAUTION: To prevent deflection of component parts of pump be careful to prevent any weight of pump from resting on suction bell or case when lifting to vertical position. See Fig. 1.2.

Clean all parts of all dirt, packing materials and other foreign matter. Flush the pump inside and outside with clean water or a fluid compatible with pumpage. If pump is for potable water a lightly chlorinated flush may be recommended. Clean all machined surfaces - these are coated with a rust preventative before shipment which must be removed. Remove any rust spots found on the machined surfaces with a fine emory cloth. Clean all threaded connections and any accessory equipment.

NOTE: Parts and accessories may be placed inside shipping containers or attached to skids in individual packages. Inspect all containers, crates and skids for attached parts before discarding.

2.4. INSTALLATION EQUIPMENT AND TOOLS

No installation should be attempted without equipment adequate for the job. The following list covers the principal items required for an installation.

1. Mobile crane capable of hoisting and lowering the weight of the pump or motor. See Fig. 1.2.
2. Cable sling for attaching to the pump and motor lifting eyes. See Fig. 1.2.
3. Ordinary hand tools - end wrenches, socket set, screw drivers, allen wrenches, etc. See Fig. 1.2.
4. Wire brush, scraper and fine emory cloth.
5. Thread sealing compound, light machinery oil and a thread lubricant.
6. Tank or barrel flange gasket and flange bolts and nuts. (Can pumps)

2.5. PRE-INSTALLATION CHECK LIST

The following checks should be made before starting actual installation to assure proper installation and prevent delays:

1. Where more than one unit is received, check the pump serial number against the packing slip to be sure the correct unit is being installed.
2. Check the driver horsepower and speed indicated on the driver nameplate, and the horsepower and speed indicated on the pump nameplate (located on the discharge head) to be sure they agree.

NOTE: A slight difference between the speeds (RPM) shown on the driver and pump nameplates is O.K., however, the difference should not be more than 1% to 2%.

3. With motor driven units be sure the voltage and frequency on the motor nameplate agree with the service available. Also make sure the horsepower and voltage rating of the control panel or starter agrees with horsepower and voltage rating of the motor.
4. Check the depth of the sump against the pump length to be sure there will be no interference.

5. Check bottom of pump. Sleeve-type mechanical seal units shipped completely assembled are supplied with shaft locking plate which must be removed and replaced with pipe plug (plug is required only on grease, packed suction bearings) prior to installation. Refer to Fig. 2.1.

6. Check the proposed liquid level in the sump against the pump length **- the bottom stage of the pump must be submerged at all times.**

7. Clean the sump and piping system before installing the pump.

8. Check the installation equipment to be sure it will safely handle the equipment.

9. Check all pump connections (bolts, nuts, etc.) for tightness. These have been properly tightened before leaving the factory, however, some connections may become loose in transit.

10. On hollow shaft drivers check the clutch size against the shaft size which must go thru the clutch. Sometimes the shaft size coming thru the discharge head is different from the shaft size going thru the driver - be sure you check against the shaft which will go thru the driver.

11. On solid shaft drivers check the motor shaft size against the driver half coupling bore size. Also check all keys.

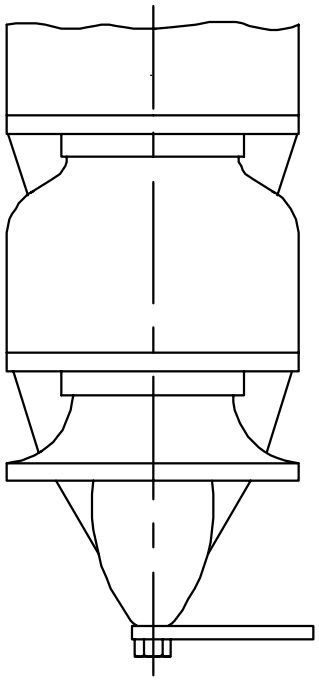

Fig. 2.1 Lock Down Bar

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SECTION 3: INSTALLATION

3.1. GENERAL

This is a precision piece of equipment and should be treated as such. Proper installation is necessary to provide maximum service from the pump. To insure proper alignment three items are very important during installation:

1. All machined mating surfaces (such as the mating flanges of pump and driver) must be clean and free of burrs and nicks. These surfaces should be cleaned thoroughly with scraper, wire brush and emory cloth if necessary and any nicks or burrs removed with a fine file.

2. Exterior strain must not be transmitted to the pump. The most common cause of trouble in this respect is forcing the piping to mate with the pump. It is recommended that flexible connectors be installed in the piping adjacent to the pump when possible. This is especially critical on type "VU" (underground discharge) units where the discharge may be several feet below the supporting structure and a relatively small strain can cause misalignment.

3. All threads should be checked for damage and repaired if necessary. If filing is necessary, remove the part from the pump if possible, or arrange a rag to catch all filings so they do not fall into other parts of the pump. Clean all threads with wire brush and cleaning solvent. Ends of shafts must be cleaned and any burrs removed since alignment depends on the shaft ends butting squarely. Lubricate all screwed connections with a thread lubricant suitable for steel. An anti-galling compound such as "Never-Seez" should be used on stainless and monel mating threads.

CAUTION: Apply thread lubricant sparingly to male shaft threads only when making up shaft connections - excess lubricant should not be allowed to get between the ends of the shaft.

3.2. FOUNDATION

The foundation may consist of any material that will afford permanent, rigid support to the discharge head and will absorb expected stresses that may be encountered in service.

Concrete foundations should have anchor bolts installed in sleeves twice the diameter of the bolt to allow alignment with the holes in the mounting plate as illustrated in Figure 3.1.

3.3. INSTALLING SUCTION BARREL

If a suction barrel has been furnished with the pump it should be mounted on a firm foundation. The suction vessel must provide permanent, rigid support for the pump and motor. Concrete foundations should have anchor bolts installed in sleeves twice the diameter of the bolt to allow alignment with the holes in the mounting plate. Level the pump mounting surface and grout and anchor in place.

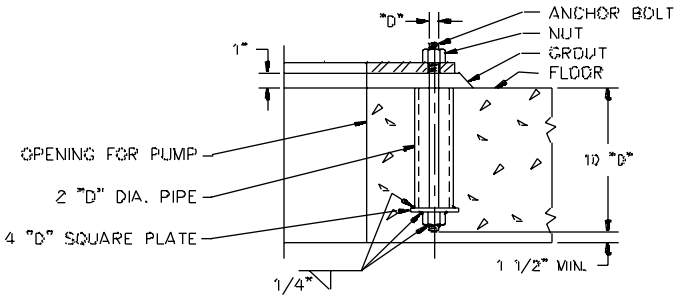


Fig. 3.1 Recommended Anchor Bolt Arrangement

3.4. INSTALLING CLOSE COUPLED PUMPS (TYPES A, C, F &VU)

1. Position lifting equipment so it will center over the foundation opening.

CAUTION: Sump and piping should be thoroughly cleaned of all abrasive particles and loose debris before starting installation, as they can severely damage the pump.

2. If a soleplate is used, level the mounting surface and grout and anchor in place.

3. Clean pump discharge flange.

NOTE: All machined surfaces are coated with rust preventative prior to shipment - this must be completely removed along with any paint overspray or rust which might be on the machined faces. The faces should be scraped and wire brushed first and then fine emory cloth used to remove any stubborn spots.

4. Lift pump, mount strainer if required, and lower slowly into sump. Hand guide the pump as it is lowered and watch for any obstructions or binding of the pump which can be felt thru the hands. Stop lowering unit when still a few inches off foundation.

NOTE: Be particularly careful not to damage any piping which may extend down along the column and/or bowl assembly. This piping (when used) must not be crushed - should it be damaged it must be removed and replaced.

5. Rotate pump until discharge flange faces proper direction for alignment with piping and align anchor bolt holes.

6. Slowly lower pump onto foundation.

7. Install anchor bolts or nuts, but do not tighten.

8. Pipe from discharge piping to pump, shifting the pump slightly on the foundation if required to facilitate alignment.

CAUTION: Exterior stresses should not be transferred to the pump, all piping must be carefully aligned and supported to prevent this.

NOTE: It is strongly recommended that flexible connectors (Dresser Couplings, or equal) be installed in the piping immediately adjacent to the pump.

9. Tighten discharge flange bolting - be sure the flanges mate without forcing.

10. Tighten anchor bolting, and grout if appropriate.

3.5. INSTALLING BOOSTER PUMPS (TYPE AF, CF, VF, VC)

1. Position lifting equipment so it will center over suction vessel mounting flange. See paragraph 3.3.

CAUTION: Suction vessel and piping should be thoroughly cleaned of all abrasive particles and loose debris before installation as they can severely damage the pump.

2. Clean suction vessel mounting flange, oil lightly and position gasket.

NOTE: All machined surfaces are coated with rust preventative prior to shipment - this must be completely removed along with any paint overspray or rust which might be on machined faces. The faces should be scraped and wire brushed first and then fine emory cloth used to remove any stubborn spots.

3. Clean pump mounting flange and oil lightly.

NOTE: A. Type VC booster units have suction nozzles located on discharge head.
B. Type AF, CF & VF booster units have suction nozzles located on suction vessel.

4. Clean pump discharge flange (and suction flange where applicable).

5. Lift pump, mount strainer if required and lower slowly into vessel. Hand guide the pump as it is lowered and watch for any obstructions or binding of the pump which can be felt thru the hands. Stop lowering unit when still a few inches off mounting flange.

NOTE: Be particularly careful not to damage any piping which may extend down along the column and/or bowl assembly. This piping (when used) must not be crushed - should it be damaged it must be removed and replaced.

6. Rotate pump until discharge flange faces proper direction for alignment with piping and align mounting flange bolt holes.

NOTE: Type “VC” Discharge Heads have both suction and discharge flanges, therefore, you must check to be sure the suction piping is connected to the suction side of pump. A flow arrow is located on the side of the suction pipe to help in identification. Figure 3.2 is provided to enable field identification should the flow arrow not be visible.

7. Check the mounting flange gasket to be sure it is in proper position.

8. Hydrocarbon/refinery units are normally supplied with “O” rings in lieu of a gasket.

9. Slowly lower pump onto mounting flange.

10. Install mounting flange bolts or nuts, but do not tighten.

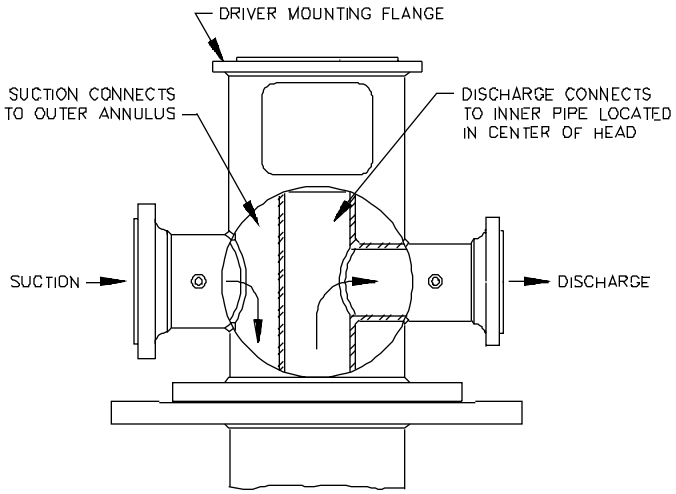


Fig. 3.2 Suction & Discharge Identification - Type "VC" Discharge Head

11. Connect discharge (and suction it applicable), shifting the pump slightly on the mounting flange if required to facilitate alignment. Do not tighten flange bolting.

CAUTION: Exterior stresses should not be transferred to the pump - all piping must be carefully aligned and supported to prevent this.

NOTE: It is strongly recommended that flexible connectors (Dressor Couplings, or equal) be installed in the piping immediately adjacent to the pump.

12. Tighten discharge (and suction, if applicable) flange bolting - be sure the flanges mate without forcing.

13. Tighten mounting flange bolting.

3.6. INSTALLING HOLLOW SHAFT DRIVER

1. Clean driver mounting flange on discharge head and remove any burrs or nicks on the register and mounting face. Oil lightly.

2. Remove driver clutch.

3. Lift driver and clean mounting flange, checking for burrs and nicks.

4. Some electric motors will be supplied with a "lower guide bushing" which is installed at the bottom of the motor to stabilize the shaft at this point. Some motor manufacturers mount this guide bushing before shipping while others will ship the guide bushing with instructions for field mounting. Check the packing slip to see if a guide bushing is required, if so, determine if the bushing is already mounted or not and proceed accordingly. See Fig. 3.3.

5. Raise and center driver over pump.

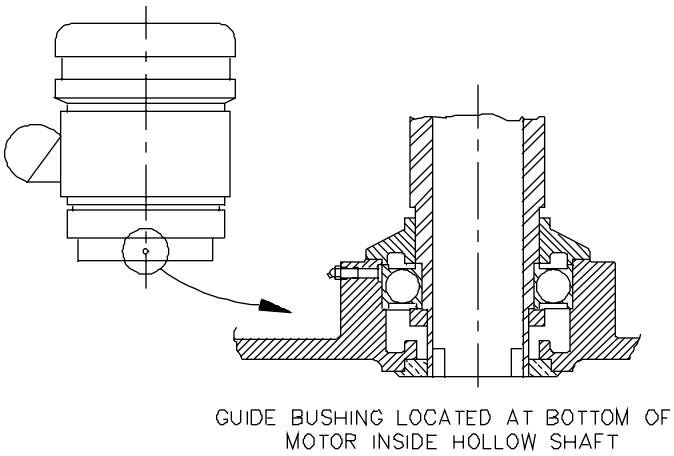


Fig. 3.3 Motor Guide Bushing Location

6. Lower carefully until about 1/4" above mounting flange. Rotate driver until junction box on motor or input shaft on gear drive is in correct position. Align bolt holes and insert bolts.

7. Lower carefully into place making certain that the female register on the driver mates over the male register on the pump.

8. Tighten mounting bolts.

9. Check driver manufacturer's instruction manual for special instructions including lubrication instructions and follow all "start up" directions.

10. **Electric drivers should be checked for rotation at this time. Note: This must be done prior to installation of headshaft.** Make electrical connections and jog motor momentarily to check rotation. DRIVER MUST ROTATE COUNTER CLOCKWISE when looking down at the top end of the motor. **To change the direction of rotation on a three phase motor, interchange any two line leads.**

CAUTION: Reverse rotation with the pump connected can cause extensive damage to the pump - ALWAYS check rotation before connecting driver to pump.

11. Mechanical seal should be installed at this time if the pump is so equipped and the mechanical seal was shipped not installed - see paragraph 3.12 for further details.

NOTE: On units equipped with one piece headshaft (no lineshaft coupling between driver and pump) Steps 12, 13, and 14 will not be applicable.

12. Clean all shaft threads (both ends of head shaft and on top shaft). Try the lineshaft coupling and headshaft nut on their respective threads. These should thread on by hand - if not, clean up threads with fine three cornered file. Check ends of shaft where they will butt inside lineshaft coupling. Ends must be square and clean. Fit gib key to both motor clutch and headshaft. The key must slide smoothly in both keyways.

13. Lubricate top shaft threads and thread (LEFT HAND threads) lineshaft coupling half way onto top shaft.

CAUTION: Apply thread lubricant only to male shaft threads and sparingly to avoid buildup between ends of shaft which could cause misalignment.

14. Lubricate head shaft threads and lower head shaft carefully down thru driver and thread into lineshaft coupling. Shafts must butt against each other.

NOTE: Head shaft should stand centered (long shafts may lean slightly from own weight; however, they can be centered without effort) in the driver hollow shaft - if not check driver mounting flange for improper mounting and reclean shaft ends where coupled inside discharge head.

15. Install clutch on driver being careful that it fits down properly.

16. Install pre-fitted gib key in clutch and shaft.

17. Thread adjusting nut down (RIGHT HAND threads) on shaft until it bears against clutch.

18. See paragraph 3.8 for impeller adjustment.

19. Adjust mechanical seal AFTER adjusting impellers.

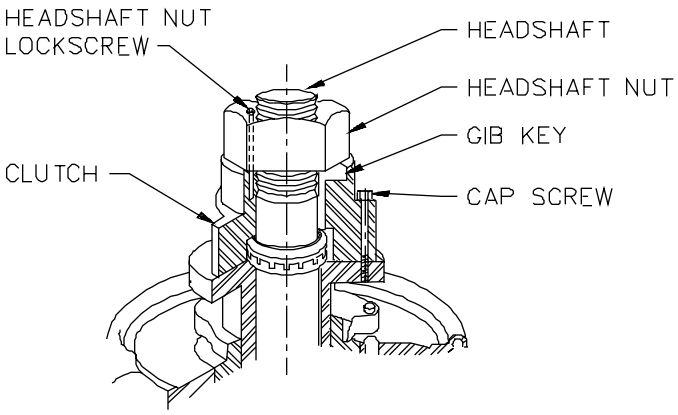


Fig. 3.4 Hollow Shaft Driver Clutch

3.7. INSTALLING SOLID SHAFT DRIVER

1. Clean driver mounting flange on discharge head and remove any burrs or nicks on the register and mounting face. Oil lightly.

2. Clean headshaft threads, lubricate and try adjusting nut. The adjusting nut should run down on the threads by hand.

3. Lift driver and clean mounting flange, checking for burrs and nicks.
   a. Check shaft diameter and projection against coupling and schematic provided.
   b. If dimensions are OK proceed to step 4.
   c. If dimensions are incorrect contact nearest Manufacturers Rep for assistance.

4. Install driver half-coupling on driver shaft (See Figures 3.5 and 7.1 for coupling illustrations):
   a. Place straight key into keyway, be sure the key is up far enough to clear the circular groove cut around the shaft near the end. Key should be hand pressed into groove.
   b. Slide driver half-coupling onto shaft far enough to insert the circular thrust ring into the shaft groove. The coupling should be a tight fit to the driver shaft, but not an interference fit.
   c. Install circular thrust ring in shaft groove - when properly positioned the half-coupling will slip down over the circular key and hold it in position see Figure 3.5.

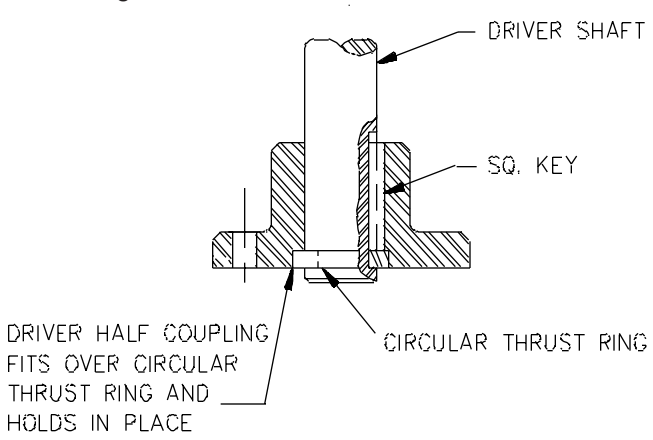


Fig. 3.5 Driver Half-Coupling Correctly Positioned

5. Mechanical seal should be installed at this time if the pump is so equipped and the mechanical seal was shipped not installed - see paragraph 3.12 for further details.

6. Install pump half - coupling on head shaft:
   a. Slide pump half - coupling onto shaft.
   b. Install key and push down to clear threads.
   c. Thread adjusting nut (RIGHT HAND threads) onto shaft until end of shaft is even with top of adjusting nut.

7. Center motor over pump and rotate to align mounting holes.
   Electric motors - rotate to align mounting holes and properly located power conduit box.
   Gear Drives - rotate input shaft into desired position.

8. Lower driver carefully into place making certain that the female register on the driver mates over the male register on the pump.
   a. Check shaft gap between motor and pump shaft against schematic provided.

9. Bolt driver to discharge head.

10. Check driver manufacturer's special instructions including lubrication instructions and follow all "start up" instructions.

11. **Electric drivers should be checked for rotation at this time.** Make electrical connections and jog motor momentarily to check rotation. DRIVER MUST ROTATE COUNTER CLOCKWISE when looking down at top end of motor. To change the direction of rotation on a three phase motor, interchange any two line leads. To change direction of rotation on a two phase motor, interchange the leads of either phase.

CAUTION: Before jogging motor make sure coupling halves are not touching, and that the motor shaft end is sufficiently clear of pump shaft and adjusting nut, and that the driver can rotate freely without rotating the pump. The driver half-coupling must be in proper position as shown in Figure 3.5 so the circular thrust ring will not come out.

CAUTION: Reverse rotation with the pump connected can cause extensive damage to the pump - ALWAYS check rotation before connecting driver to pump.

12. On pumps using the spacer type coupling bolt the spacer to the driver half-coupling.

13. Thread the adjusting nut up until there is 1/8" gap between nut and spacer or driver half-coupling. See Fig. 3.7.

NOTE: Adjusting Nuts on all sizes have drilled holes inside for inserting handle of hex wrench or round bar to facilitate adjustment.

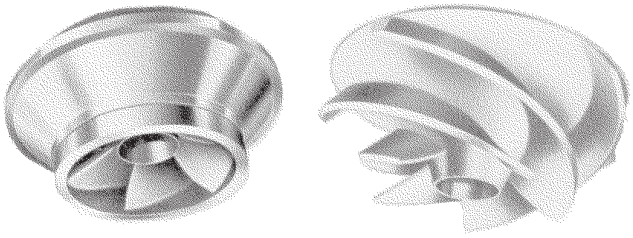
14. See paragraph 3.8 for impeller adjustment.

15. Adjust mechanical seal AFTER adjusting impellers. See paragraph 3.12.

3.8. IMPELLER ADJUSTMENT - GENERAL

Proper impeller adjustment positions the impeller inside the bowl assembly for maximum performance. The impellers must be raised slightly to prevent dragging on the bowl. Impellers are of two basic types "enclosed" and "semi-open" (sometimes called "semi-enclosed") the type impeller will determine proper adjustment. The type of impellers installed in the pump can be determined from the pump nameplate or packing slip. The second letter of the pump type indicates enclosed impellers by "K" and semi-open by "O" thus "DOM" would indicate semi-open impellers while "DKM" would indicate enclosed impellers. See Fig. 3.6.

ENCLOSED IMPELLERS - For proper impeller adjustment refer to pump nameplate on the discharge head.



Enclosed Type Impeller | Semi-Open Type Impeller

Fig. 3.6 Types of Impellers

SEMI-OPEN IMPELLERS - The adjustment of semi-open impellers is more critical than for enclosed impellers. The performance of the pump will vary considerable (see Figure 5.2, Section 5) for a small change in the impeller setting. For maximum performance the impeller must run within a few thousandths of an inch of the bowl seat - the exact shaft adjustment will vary according to variables of each installation; however, for close coupled units as covered by this manual a general rule of .015" plus .005" for each 100 feet of discharge head produced by the pump plus .005" for each 10 feet of column assembly will provide near ideal adjustment. The highest discharge head the unit will be expected to operate against should be used for this adjustment. As an example - a pump designed to operate at 400' discharge head but will also be operated against a closed valve for short periods at which time it will produce 500', therefore 5 x .005" = .025". If the unit has 20' of column assembly - 2 x .005 = .010". The initial adjustment would be .025" + .010" + .015" = .050".

Use the following table for determining how many turns or fraction of turn is necessary for the shaft diameter supplied. For example a 1 11/16" - 10 threads per inch (TDI) shaft will provide .100" per turn of nut. Therefore 1/2 turn of nut would provide the required .050" impeller setting.

LINESHAFT DIAMETER	HEADSHAFT NUT THREADS/INCH	INCHES PER FULL TURN OF ADJ. NUT
1"	14 TPI - R.H.	.071
$1\frac{1}{4}$"	12 TPI - R.H.	.083
$1\frac{1}{2}$"	12 TPI - R.H.	.083
$1\frac{11}{16}$"	10 TPI - R.H.	.100
$1\frac{15}{16}$"	12 TPI - R.H.	.083
$2\frac{1}{4}$"	12 TPI - R.H.	.083
$2\frac{7}{16}$"	12 TPI - R.H.	.083

1. Assembled units ship as follows:
   a. Sleeve type seals (cartridge) are installed in the housing and are supplied with a tag indicating seal is installed.

CAUTION: Locking plate on bottom of pump must be removed and replaced with plug if bottom bearing is grease packed. Product lube bottom bearing does not require suction pipe plug.

   b. Shaft type seals are shipped separately and are not installed in the seal housing. A tag is supplied indicating seal is not installed. No lock down plate is supplied on units with seals not installed.

CAUTION: The impellers must be down against the bowl seat when starting impeller adjustment - all dimensions and instructions given above assume the impellers are initially all the way down. When pumps are subjected to suction pressure the pressure acting against the shaft tends to raise it. If the suction pressure is great enough it can raise the shaft. Make sure the shaft is down when starting to adjust the impellers.

If, after making the above adjustment the pump does not deliver its rated capacity the impellers can be lowered one step at a time until the lowest possible adjustment is achieved without the impellers dragging. On the other hand, if the impellers appear to be dragging after the initial adjustment the unit should be stopped and the impellers raised one step. Dragging impellers will increase the load markedly and can usually be heard and felt as increased vibration.

NOTE: If semi-open impellers are raised and then adjusted down a slight increase in power required will be noted due to the increased delivery of the pump. Do not confuse this with the marked in creased when the impellers are lowered enough to drag.

3.9. IMPELLER ADJUSTMENT - HOLLOW SHAFT DRIVER

Impeller adjustment when using hollow shaft drivers is accomplished at the top of the driver by the following procedure. The driver canopy will have to be removed before beginning.

1. Install headshaft as outlined in paragraph 3.6 if not already in place.

2. Install driver clutch in accordance with driver instruction manual and bolt into place.

3. Install gib key, making sure top of gib key pushes down below top of clutch. To prevent interference with headshaft nut fit gib key to both motor clutch and headshaft. The key must slide smoothly in keyway.

4. Check shaft position - raise shaft slightly by hand and lower until there is a definite feel of metal contacting metal. This indicates the impellers are “on bottom” and is the correct starting position for impeller adjustment.

5. Thread headshaft nut down (RIGHT HAND threads) until impellers are just lifted off their seat and the shaft will rotate freely. When semi-open impellers are used the correct determination of the point where the impellers just barely clear their seat is very important for proper adjustment.

6. Adjust impellers as outlined in paragraph 3.8.

7. Lock headshaft nut with lockscrew inserted down through holes in headshaft nut and threaded into driver clutch.

CAUTION: Always lock headshaft nut before starting driver. Failure to do so could result in damage to the pump and driver.

3.10. IMPELLER ADJUSTMENT - SOLID SHAFT DRIVER

Impeller adjustment when using solid shaft drivers is accomplished in the adjustable flanged coupling located below the driver. The coupling assemblies are adjusted exactly the same. The only difference in design is #1-4 has a separate machined register on driver coupling for alignment and #4HD - #7 utilizes the shaft extension thru driver coupling for alignment to spacer or adjusting nut. Refer to Fig. 3.7 for exact detail of coupling supplied.

3.11. ADJUSTING #1 AND LARGER ADJUSTABLE FLANGED COUPLINGS

1. Assemble coupling on pump and driver as outlined in paragraph 3.7.

2. Back adjusting nut up shaft (threads are RIGHT HAND) until the nut bears firmly against spacer or driver shaft and head shaft will not move down. This will insure that the impellers are all the way down against their seat and in proper position for adjustment.

3. Thread adjusting nut down until the proper impeller adjustment as outlined in paragraph 3.8 can be measured between the adjusting nut and spacer or driver half coupling as shown in Fig. 3.7.

4. Slide pump half-coupling up shaft and align adjusting nut bolt holes with those in pump half coupling. Rotate driver shaft until bolts can be inserted and tightened.

5. Tighten all bolts which will raise impellers to correct operating position.

3.12. MECHANICAL SEAL

Because of the numerous mechanical seal arrangements available separate instruction manuals are written covering installation and operation of the seal. There are, however, comments which apply to all seals.

1. The seal cavity must clean before installing seal.

2. The faces and register of the seal housing and seal housing cover must be clean and free of burrs.

3. The shaft seal is a precision product. Treat it with care. Take particular care not to scratch or chip the lapped faces of the runner or seat.

4. Circulation lines must remain in place and open. Do not remove.

5. Impeller adjustment must be made PRIOR to seal adjustment.

READ THE MECHANICAL SEAL INSTRUCTION MANUAL FURNISHED WITH THIS UNIT.

3.13. PACKING BOXES

Packing boxes are pre-packed at the factory and will be factory installed. Do not tighten the packing gland. See Section 4.3 for further information.

3.14. ENCLOSING TUBE TENSION

The enclosing tube (enclosed line shaft design) tension is preadjusted at the factory before shipping. Additional adjustment will not be required. See assembly instructions (Chapter 6) if assembly or adjustment is required for any reason.

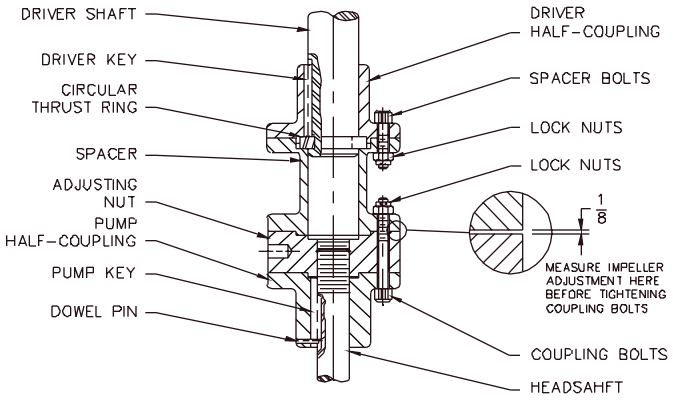


Fig. 3.7 #1 Thru 4 Adjustable Flanged Coupling (Illustrated with Spacer)

SECTION 4: OPERATION

4.1. PRE-STARTING CHECKS

Before starting the pump the following checks should be made:

1. Rotate the pump shaft by hand to make sure the pump is free and the impellers are correctly positioned.

2. Is the shaft adjusting nut properly locked into position?

3. Has the driver been properly lubricated in accordance with the instructions furnished with the driver?

4. Has the driver been checked for proper rotation? If not, the pump must be disconnected from the driver before checking. The driver must rotate COUNTERCLOCKWISE when looking down at the top of the driver.

5. Check all connections to the driver and control equipment.

6. Check that all piping connections are tight.

7. Check all anchor bolts for tightness.

8. Check all bolting and tubing connections for tightness (driver mounting bolts, flanged couplings bolts, seal housing cover bolts, seal piping, etc.)

9. On pumps equipped with packing box make sure the gland nuts are only finger tight - DO NOT tighten packing gland before starting.

10. On pumps equipped with mechanical seals clean fluid should be put into the seal chamber. With pumps under suction pressure this can be accomplished by bleeding all air and vapor out of the seal chamber and allowing the fluid to enter. With pumps not under suction pressure the seal chamber should be flushed liberally with clean fluid to provide initial lubrication. Make sure the mechanical seal is properly adjusted and locked into place.

NOTE: After initial start-up, pre-lubrication of the mechanical seal will usually not be required as enough liquid will remain in the seal chamber for subsequent start up lubrication.

11. On pump equipped with enclosed lineshaft, lubricating fluid must be available and should be allowed to run into the enclosing tube in sufficient quantity to thoroughly lubricate all lineshaft bearings.

4.2. INITIAL STARTING

1. If the discharge line has a valve in it, it should be partially open for initial starting.

2. Start lubrication liquid flow on enclosed lineshaft units.

3. Start the pump and observe the operation. If there is any difficulty, excess noise or vibration, stop the pump immediately and refer to Section 5 for probable cause.

4. Open the discharge valve as desired.

5. Check complete pump and driver for leaks, loose connections or improper operation.

6. If possible, the pump should be left running for approximately 1/2 hour on the initial start-up, this will allow the bearings, packing or seals, and other parts to “run-in” and reduce the possibility of trouble on future starts.

CAUTION: The standard unit is not designed to pump abrasives or debris. If any debris or abrasives are present in discharge liquid and the pumpage does not clear up immediately the unit should be shut down and the source of abrasives and debris eliminated.

4.3. PACKING BOX ADJUSTMENT

On the initial starting it is very important that the packing not be tightened too much. New packing must be “run in” properly to prevent damage to the shaft and shortening of the packing life. See paragraph 5.6 for further information.

The packing box must be allowed to leak for proper operation. The proper amount of leakage can be determined by checking the temperature of the leakage, this should be cool or just lukewarm, NOT HOT, usually 40 to 60 drops per minute will be adequate.

When adjusting the packing gland, bring both nuts down evenly and in small steps until the leakage is reduced as required. The nuts should only be tightened about 1/2 turn at a time at 20 to 30 minute intervals to allow the packing to “run-in”.

Under proper operation a set of packing will last a long time. Occasionally a new ring of packing will need to be added to keep the box full. After adding two or three rings of packing, or when proper adjustment cannot be achieved, the packing box should be cleaned completely of all old packing and repacked.

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5.4. LINESHAFT LUBRICATION

Open lineshaft bearings are lubricated by the pumped fluid and on close coupled units (less than 40' long) will usually not require pre or post lubrication.

Enclosed lineshaft bearings are lubricated by external liquid (usually oil or clean water) which is fed to the tension nut by either a gravity flow or pressure injection system. The gravity flow system utilizing oil is the most common arrangement. The oil reservoir must be kept filled with a good quality light turbine oil (about 150 S.S.U. at operating temperature) and adjusted to feed 5 to 8 drops per minute.

Injection lubrication systems are designed for each installation - injection pressure and quantity of lubricating liquid will vary. Refer to packing slip or separate instruction sheet for requirements when unit is designed for injection lubrication. See Fig. 7.5 for injection lubrication arrangement.

The following turbine oils can be recommended for Enclosed Lineshaft Bearing Lubrication under normal operating conditions.	
MANUFACTURER	TRADE NAME OF OIL
Amoco	Americal Industrial 32
Exxon	Teresstic 32
Mobil Oil Company	DTE light
Conoco	Conoco 32
Shell Oil Company	Tellus 32
Chevron	Chevron GST68
Texaco	Texaco Regal R&O 32
Phillips 66	Magnus 32
Unocal	Unocal Turbine Oil 32
The following turbine oil is suitable for use where FDA approved lubricating oil is required for USDA -Classification H1:	
Chevron	Chevron FM Lubricating Oil 32
Lyondell Petrochemical	ARCO white Oil 32
If none of the above oils is available, an oil with the following specifications should be obtained: Turbine type oil with rust and oxidation inhibitors added. Viscosity 145-175 S.S.U. at 100°F with 90 minimum viscosity index. ISO grade 32. It is recommended that detergent type oils no be used.	

Fig. 4.1 Recommended Lineshaft Oil

PRODUCT CROSS REFERENCE GREASES
FOR PACKING BOXES AND SUCTION BEARINGS

UNION OIL PRODUCTS	GRADES	OTHER SPECS.	ARCO	SHELL	TEXACO	MOBIL	GULF	EXXON	CHEVRON
UNOBA EP GREASE	NLGI #1 & 2	Lithium Soap	Litholine H-EP	Alvania EP	Multifak EP	Moloiux EP	Gulfcrown EP	Beacon EP	Dur-Lith
MP AUTO-MOTIVE GREASE	NLGI #00	GM, Ford, Chrysler, Molybdenum Disulfide & Polyethylene	EP Moly Grease	Super Duty Grease	Marfak All Purpose	Mobile Grease Special	Gulfex Poly	Multi-Purpose Grease	Multi-Motive Grease

Fig. 4.2 Recommended Greases

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SECTION 5: MAINTENANCE

5.1. GENERAL

A periodic inspection is recommended as the best means of preventing breakdown and keeping maintenance costs to a minimum. Maintenance personnel should look over the whole installation with a critical eye each time the pump is inspected - a change in noise level, amplitude of vibration, or performance can be an indication of impending trouble.

Any deviation in performance or operation from what is expected can be traced to some specific cause. Determination of the cause of any change in performance or improper operation is essential to the correction of the trouble - whether the correction is done by the user, the dealer or reported back to the factory.

Variances from initial performance will indicate changing system conditions or wear or impending breakdown of unit.

5.2. PERIODIC INSPECTION

A periodic once a month inspection is suggested for all units. During this inspection the pump and driver should be checked for performance and change in noise or vibration level, loose bolts or piping, dirt and corrosion. Clean and repaint all areas that are rusted or corroded. It is very helpful to develop a vibration trend analysis based upon periodic vibration reading recordings. This will help to determine optimum repair frequency

5.3. PACKING BOX MAINTENANCE

Maintenance of the packing box will consist of greasing the box when required, tightening the packing gland occasionally as the leakage becomes excessive, and installing new packing rings or sets as required.

5.4. GREASING THE PACKING BOX

Under ordinary operation once a month greasing of the packing box will be adequate. A good grade multipurpose of grease such as Chevron Industrial Grease-Medium or Marfak MULTIPURPOSE #2 should be used.

5.5. REPLACING PACKING

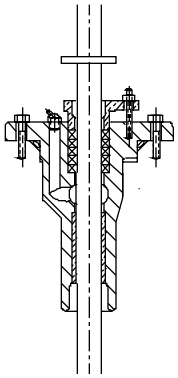
Remove gland and all old packing. If the box contains a lantern ring remove this and all packing below it. Inspect shaft or sleeve for score marks or rough spots. Be sure by -pass holes (if required) are not plugged. Repair or replace badly worn shaft or sleeve. If wear is minor dress down until smooth and concentric. Clean box bore.

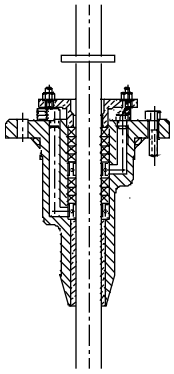
Oil inside and outside of replacement rings lightly and install in box, staggering joints 90°. Be sure to replace lantern ring in proper position when used.

NOTE: Formed replacement packing rings are recommended and are available from the factory.

Replace gland and tighten nuts, making sure gland enters box squarely. Keep the packing under moderate pressure for one minute to allow it to cold flow and adjust itself. Back off on the gland until loose and gland nuts are hand tight before starting the pump.

5.6. START-UP WITH NEW PACKING





STANDARD TYPE BOX

SHAFT SIZE	# PACKING RINGS	PACKING RING SIZE	DEPTH OF BOX	O.D. OF PACKING
3/4	5	5/16	1 23/32	1 3/8
1	5	5/16	1 23/32	1 5/8
1 3/16, 1 1/4	5	3/8	2 1/16	2
1 1/2	5	3/8	2 1/16	2 1/4
1 11/16	5	7/16	2 13/16	2 5/8
1 15/16	6	3/8	2 13/32	2 3/4
2 1/4	6	3/8	2 3/4	3 1/16
2 7/16	6	3/8	4 3/4	3 1/4

Recommended packing: Graphite & oil impregnated metallic babbit foil John Crane #100-M or equal.

HI-PRESSURE TYPE

SHAFT SIZE	# PACKING RINGS	PACKING RING SIZE	DEPTH OF BOX	O.D. OF PACKING
3/4	6	5/16	3 5/8	1 3/8
1	6	5/16	3 5/8	1 5/8
1 3/16, 1 1/4	7	3/8	4 5/8	2
1 1/2	7	3/8	4 5/8	2 1/4
1 11/16	7	7/16	4 7/8	2 5/8
1 15/16	8	3/8	4 7/8	2 11/16
2 1/4	6	1/2	4 3/4	3 1/4
2 7/16	6	1/2	4 3/4	3 1/2
2 11/16	7	1/2	4 1/2	3 3/4

Recommended packing: Graphite impregnated braided acrylic John Crane #1340 or equal.

Fig. 5.1 Standard Packing Dimensions

Check that the bypass line (if used) is connected and packing gland is loose. Start pump and allow to run for 20 to 30 minutes, do not tighten the gland during this “run-in” period even if leakage is excessive. If the leakage continues to be more than normal, adjust as outlined in paragraph 4.3. Should the new packing cause excess heating during “run-in” flush the shaft and packing box area with cold water or shut the pump down and allow to cool if necessary.

5.7. AUXILIARY PACKING BOX MAINTENANCE

Pumps equipped with mechanical seals may also be provided with an auxiliary packing box to restrict leakage should the mechanical seal fail. This packing gland must be left loose since under normal operation the packing will not be cooled and lubricated by the pumpage. This packing box arrangement is designed to help contain leakage past the mechanical seal in the event of a seal failure, it is not designed as a primary seal and should not be used as such.

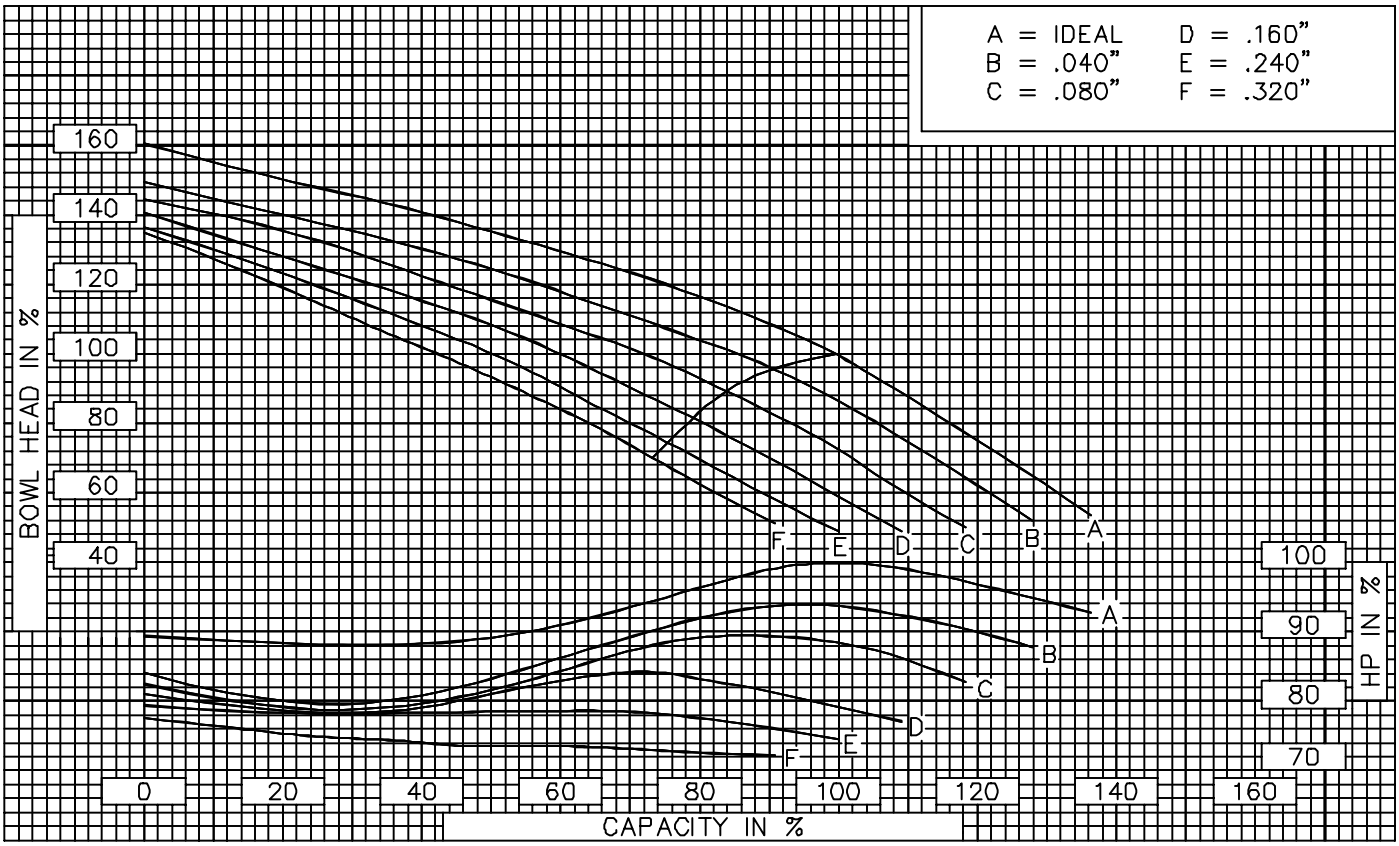
5.8. MECHANICAL SEAL MAINTENANCE

Mechanical Seals should not be readjusted unless there is a reason. Best results will be obtained if the seal is properly set at start up and left that way. If the seal starts to leak after an extended operating period some extra service may be obtained by readjusting, however, it is usually best to plan on replacing the seal at the next maintenance period.

After impeller readjustment, seal leakage may occur due to improper seal adjustment or improper seating of the seal parts. If readjustment of the seal will not correct the problem, refer to the Mechanical Seal Instruction Manual for further information.

5.9. IMPELLER READJUSTMENT

Ordinarily impellers will not require readjustment if properly set at initial installation. Almost no change in performance can be obtained by minor adjustment of enclosed impellers; however, the positioning of semi-open impellers has a definite effect on the performance of the pump. This fact is sometimes used to adjust the output of the pump without valving. Figure 5.2 illustrates the general effect of raising semi-open impellers.



THE ABOVE CHART INDICATES THE APPROXIMATE EFFECT OF RAISING SEMI-OPEN IMPELLERS FROM THEIR IDEAL (A) OPERATING POSITION. RAISING THE IMPELLERS INCREASES THE CLEARANCE BETWEEN IMPELLER AND BOWL SEAT AND REDUCES THE PERFORMANCE ACCORDINGLY. THE CHART IS GENERAL AND WILL NOT BE EXACTLY CORRECT FOR ANY PARTICULAR PUMP MODEL SINCE EACH MODEL WILL REACT DIFFERENTLY. 100% HEAD AND CAPACITY ARE TO TAKEN AS THE HEAD AND CAPACITY OF THE PUMP AT PEAK EFFICIENCY - EXAMPLE: IF A PARTICULAR PUMP DELIVERS 250 GPM AT 50' HEAD AT PEAK EFFICIENCY WHEN THE IMPELLERS ARE PROPERLY ADJUSTED, RAISING THE IMPELLERS .080" WOULD REDUCE THE CAPACITY TO APPROXIMATELY 181 GPM (72 1/2% OF 250 GPM) WHILE MAINTAINING THE 50' HEAD -- OR CONVERSELY, THE PUMP WOULD DELIVER 250 GPM @ 37 1/2' HEAD (75% OF 50'). THE HORSEPOWER WOULD BE ABOUT 91 1/2% OF THE PREVIOUS HORSEPOWER.

Fig. 5.2 Effect of Adjusting Semi-Open Impellers

5.3. TROUBLESHOOTING

CONDITION	PROBABLE CAUSE	REMEDY
Pump will not run.	1. Motor overload protection contacts open. a. Incorrect control box b. Incorrect connections. c. Faulty overloads. d. Low Voltage. e. Ambient temperature of control box or starter too high. 2. Blown fuse, broken or loose electric connections. 3. Defective Motor. 4. Faulty control equipment. 5. Faulty switch. 6. Pump binding.	1. a. Check nameplate for HP and voltage. b. Check wiring diagram furnished with starter. c. Replace. d. Check voltage at pump side of control box. e. Use ambient compensated relays. 2. Check fuses, relays or heater elements for correct size and all electrical connection. 3. Repair or replace. 4. Check all circuits and repair. 5. Repair or replace. 6. Pull master switch, rotate pump by hand to check. Check impeller adjustment or disassemble unit to determine cause.
Pump runs but no water delivered.	1. Line check valve backward. 2. Line check valve stuck. 3. Unit running backwards. 4. Lift too high for pump. 5. Pump not submerged. 6. Excessive amounts of air or gas. 7. Intake strainer or impeller plugged, or pump in mud or sand. 8. Impeller(s) loose on shaft.	1. Reverse check valve. 2. Free the valve. 3. See Section 3.6. 4. Check with performance curve. 5. Lower pump if possible or add fluid to system. 6. Correct conditions. 7. Start & stop pump several times or use line pressure if available to back flush. Pull pump and clean. 8. Pull unit and repair.
Reduced capacity.	1. Bypass open. 2. Lift too high for pump. 3. Motor not coming up to speed. 4. Strainer or impellers partly plugged. 5. Scaled or corroded discharge pipe or leaks anywhere in system. 6. Excessive amounts of air or gas. 7. Excess wear due to abrasives. 8. Impellers not properly adjusted. 9. Impeller(s) loose on shaft.	1. Check bypass valving. 2. Check performance curve. 3. Check voltage while unit is running. 4. Start & stop pump several times or use line pressure if available to back flush. Pull pump and clean. 5. Replace pipe or repair leaks. 6. Correct conditions. 7. Replace worn parts. 8. See Section 3.8. 9. Pull unit and repair.
Motor overloaded.	1. Line voltage not correct. 2. Faulty equipment used to check. 3. Specific gravity higher than design. 4. Operation at point on pump curve other than design. 5. Motor speed too high. 6. Impellers dragging. 7. Pump in bind.	1. Check and correct. 2. Check equipment. 3. Correct specific gravity or re-evaluate system. 4. Check performance curve. 5. Line voltage too high or incorrect frequency. 6. Readjust. 7. Pull master switch, rotate pump by hand to check. Disassemble unit to determine cause.
Pump vibrating excessively and noisy.	1. Unit running backwards. 2. Pump breaking suction and pumping air. 3. Loose fasteners. 4. Badly worn motor or pump bearings. 5. Impeller(s) loose on shaft. 6. Pump & Motor shafts misaligned. 7. Stress due to piping misalignment.	1. See "Initial Starting of Unit" Section 3.6. 2. Lower pump or reduce capacity or increase fluid level. 3. Check all bolts, nuts and retighten. 4. Pull unit and repair. 5. Pull unit and repair. 6. Pull unit and repair. 7. Correct.
Excess wear	1. Abrasives. 2. Pump in bind. 3. Vibration	1. Clean System. 2. Pull master switch, rotate pump by hand to check. Disassemble unit to determine cause. 3. Determine cause and correct.
Corrosion	1. Impurities. 2. Corrosive liquid.	1. Analyze fluid. 2. Change to Corrosion resistant materials.

Fig. 5.3 Troubleshooting Chart

After extended operation the sealing faces between semi-open impellers and the bowl will wear causing a reduction in performance. The pump performance can be brought back up to almost “as new” by proper readjustment of the impellers. See paragraph 3.8 for proper adjustment procedure.

NOTE: All adjustments of the impellers will change the mechanical seal setting. Unless the adjustment is to be very minor it is recommended that the seal be loosened from the shaft until the impeller adjustment is complete and then reset.

5.10. PUMP LUBRICATION

Other than the packing box lubrication outlined in paragraph 5.4 and lineshaft lubrication outlined in paragraph 4.4 the pump will not require further periodic lubrication. The suction bearing on the bowl assembly should be repacked when repairs are made, however, no attempt should be made to repack until repairs to the bowl assembly are necessary.

5.11. DRIVER LUBRICATION

Drivers will require periodic attention. Refer to the driver instruction manual for recommendations.

SECTION 6: REPAIRS

6.1. GENERAL

The repair of vertical turbine pumping units is a job best handled by an experienced pump repair facility. Floway has major pump repair facilities located in Houston, TX and Fresno, CA, where skilled machinists and mechanics can repair and rebuild pumping units to "as new" condition. If end user of pump does not have personnel or facilities to properly repair pump it is strongly recommended that our facilities be utilized.

CAUTION: Always shut-off and lock the driver master power switch before doing any work on the pump driver.

Keep in mind that eventually repairs will have to be made, either to the pump or to the motor. When regular maintenance checks indicate that an overhaul is required, it should not be delayed.

Repairs will consist of removal of the unit and disassembly to the point necessary for replacement of worn parts.

Disassembly should be performed in a clean area with sufficient space to lay out the parts in order of disassembly. Cleanliness throughout repairs is important - remember this is a close tolerance, high speed machine and should be handled as such.

CAUTION: Protect machined surfaces from burrs and scrapes which will cause misalignment on reassembly.

6.2. EQUIPMENT AND TOOLS

Required equipment and tools will be as listed in Section 2 of this manual and in the appropriate Pump Bowl Instruction Manual.

NOTE: If bowl assembly repairs are anticipated, a separate manual is available giving detailed instructions for disassembly and repair. This manual should be read thoroughly before attempting repairs of the bowl assembly. When requesting this manual from the factory the pump model must be given.

6.3. PACKING BOX REPAIRS

Packing box repairs can be effected without removing the completed unit. Packing replacement as outlined in Section 5 can be accomplished without disturbing the pump or driver. The packing box bearing can be replaced if necessary by removing the driver and sliding the packing box off over the shaft.

6.4. MECHANICAL SEAL REPAIRS

Mechanical seal repairs can be effected without removing the complete unit. The mechanical seal assembly can be replaced by removing the spacer and lower half coupling on solid shaft units; on hollow-shaft units the driver shaft and shaft coupling inside the discharge head must be removed or lifted out of the way. Replacement of the bearing located at the bottom of the seal housing will usually require removal of the driver in order to get enough headroom.

6.5. DISASSEMBLY

NOTE: Refer to Section 7 for parts drawings and identification.

1. Disconnect electrical leads from motor.
2. Loosen mechanical seal from shaft.
3. Disconnect pumpshaft from driver:
   a. Hollow Shaft - Remove headshaft nut lockscrew (32), headshaft nut (31), gib key (33) and driver clutch. Unscrew headshaft (30) from shaft coupling (170) inside discharge head and remove.
   b. Solid Shaft - Lower shaft and unbolt driver half-coupling.
4. Remove bolts (23) which attach driver to discharge head.
5. Lift driver off pump and set on wooden supports. With solid shaft drivers be sure supports are high enough to clear shaft and coupling half, which projects beneath the motor.
6. Disconnect discharge (and suction, if applicable) piping from pump.
7. Remove anchor bolt nuts or bolts (402) from mounting flange.
8. Lift pump vertically until pump suction clears foundation, or mounting flange. Remove mounting flange gasket (401) if applicable.
9. Cover opening in foundation.
10. Lower pump and position horizontally on suitable support and in suitable area for disassembly.

NOTE: If more than minor repairs are anticipated it is recommended that the unit be taken to a shop or other clean area with smooth floor and overhead lifting equipment.

11a. Packing box construction - remove slinger (99) and packing gland (85).

11b. Mechanical seal construction - loosen seal cover cap screws (56) and remove seal housing cover (51).

NOTE: With sleeve-mounted mechanical seals, the seal and sleeve assembly should be removed with the cover. See Seal Instruction Manual for further details.

11c. Enclosed lineshaft construction - remove lockscrew (73) and lubrication line (49) and unscrew tension nut assembly (71). Threads are LEFT HAND.

12. Remove cap screws (78) which attach the packing box, tension plate or seal housing to discharge head.

13. Remove packing box (75), tension plate (70) or seal housing (50).

NOTE: If type FF-2 or FF-9 mechanical seal is used the set screws which lock the seal assembly to the shaft must be loosened before removing seal housing.

NOTE: Before proceeding further make sure the discharge head and bowl assembly are supported independently of each other.

14. Disconnect bowl assembly or top column from discharge head. This connection may be flanged or the column pipe or bowl assembly may be threaded into the discharge head. If threaded, the thread will be RIGHT HAND.

15. Remove discharge head (1) being careful not to damage shaft.

Fig. 6.1 Correct Positioning of Wrenches on Shafting

16. Disconnect column pipe (150) (if present) at first joint below top and remove from shaft.

17a. Open Lineshaft Construction - Each time a lineshaft coupling (170) is exposed by removing a length of column pipe the lineshaft (172) and coupling should be removed by holding the coupling and turning the upper lineshaft in a RIGHT HAND direction (line shaft threads are LEFT HAND)

CAUTION: When using wrenches on shafting always place the wrenches on the same side of the shaft as illustrated in Figure 6.1 to avoid excess side strain on the shafting.

17b. Enclosed lineshaft construction - Each time a length of column pipe is removed the enclosing tube (141) and lineshaft (172) must also be disassembled. Locate the joint (see Figure 6.2) and unscrew (LEFT HAND threads) the enclosing tube (141) from the lineshaft bearing (140) (which acts as a bearing for the shaft and also as an enclosing tube coupling). Leave the lineshaft bearing threaded into the enclosing tube not being removed (to support the lineshaft). Slide the enclosing tube up to expose the lineshaft coupling and uncouple as outlined in step 17a above.

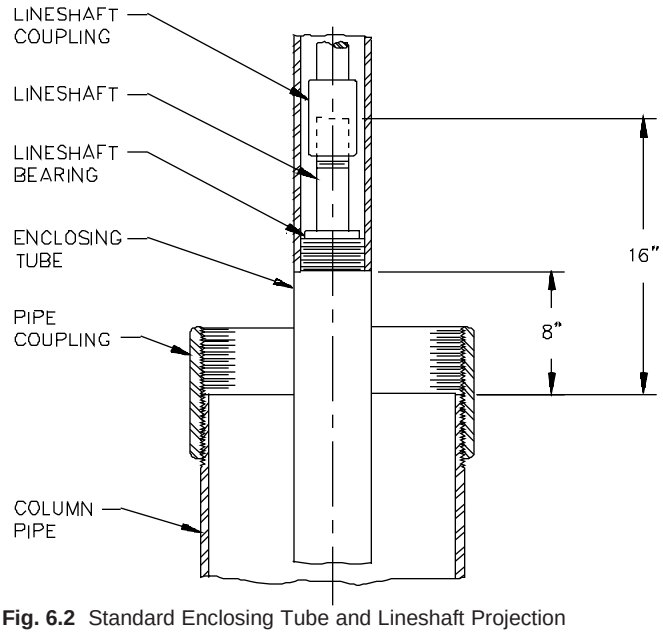


Fig. 6.2 Standard Enclosing Tube and Lineshaft Projection

18. Disconnect each section of column pipe one at a time and remove along with shaft and enclosing tube as applicable until all are removed.

19. Remove bowl assembly to clear area and continue disassembly as outlined in separate "Pump Bowl Instruction Manual".

6.6. INSPECTION AND CLEANING

After disassembly, all components should be thoroughly cleaned and examined for physical defects, wear, corrosion and damage.

Check all bearings bores for total clearance over the shaft diameter. It is recommended that all bearings indicating wear be replaced. The following indicates the maximum allowable diametrical clearance over existing shaft diameter, in which case bearing must be replaced.

FASTENER SIZE	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4
TORQUE (FT. -LB.)	5.4	10	17	27	40	60	84	135
Torque values shown are for standard grade 2 fasteners lubricated with a high stress lubricant (graphite and oil, moly-disulphite, never seez, etc.).								

Fig. 6.3 Torque Values for Standard Fasteners

1" through 1-11/16" shaft - .020" clearance
1-15/16" through 2-7/16" shaft - .025" clearance
2-11/16" through 3-15/16" shaft - .030" clearance

It is recommended that bearings be replaced when pump bowl assembly is disassembled and measured diametrical clearance exceeds standard clearance, indicated in bowl repair manual (new bearings) by .004 maximum.

6.7. REPLACEMENT PARTS

Parts showing signs of damage, cracks or excessive wear should be replaced. Use only genuine Floway parts for replacements. Order replacement parts as indicated in Section 7.

CAUTION: When repairing a pump that has been in service for several years, the physical condition or strength of all parts such as cap screws, bowls, threads, etc., must be carefully checked to be sure these parts can continue to perform their function without failure.

6.8. LUBRICATION

Repack suction bearing as outlined in "Pump Bowl Instruction Manual".

Lubricate all bearings and impeller skirts with clean grease or oil. Thoroughly clean all threaded connections and flanges and coat with thread lubricant and oil or pipe joint compound.

6.9. ASSEMBLY

Assembly of the unit is basically the reverse of disassembly. Before proceeding with assembly, clean thoroughly and check all threads, registers and mating faces for burrs. Clean up with file where required. Lubricate as outlined above. Oil all shafts lightly.

Proceed with assembly in reverse order of disassembly as outlined in paragraph 6.5 above. Figure 6.3 indicates recommended torque values for standard fasteners.

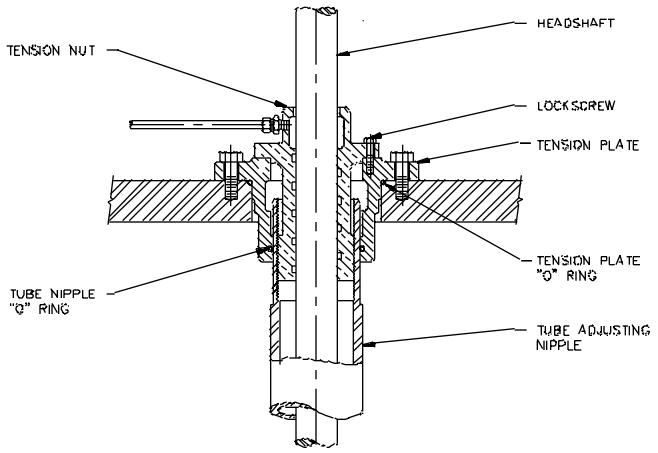


Fig. 6.4 Tension Nut Assembly

CAUTION: Cleanliness and proper lubrication are very important since one small chip, burr or one dry bearing can be cause for redoing the whole job.

6.10. TENSION NUT ASSEMBLY AND ADJUSTMENT
Enclosed lineshaft units use a tension nut at the top of the enclosing tube which must be properly tightened for proper operation. General construction is shown in Figure 6.4.

1. Clean all "O" ring sealing surfaces including groove in tension plate and oil lightly.

2. After assembling discharge head to column, install tension plate (be sure both "O" rings are in place), allowing "O" ring to slide down outside of tube adjusting nipple. Lightly oil outside of tube adjusting nipple prior to installing tension plate.

3. Bolt tension plate into place.

4. Slide tension nut over shaft and thread into inside of tube adjusting nipple (LEFT HAND threads) until tension nut is snug against tension plate. Continue to tighten tension nut until lockscrew slot lines up with FIRST tapped hole in tension plate (1/4 turn maximum).

CAUTION: It is necessary that the enclosing tube have tension on it which is accomplished by tightening the tension nut, however excess tightening will distort or break the tension nut. Do not tighten more than 1/4 turn on close coupled pumps.

5. Install lockscrew and tighten.

6. Proceed with remainder of installation.

ARMSTRONG

SECTION 7: PARTS LIST

7.1. ORDERING PARTS

When ordering spare or replacement parts **the pump serial number** and size and type of pump must be given. This can be found on the nameplate furnished with the unit.

7.2. STOCKING SPARE PARTS

Spare parts to be kept in inventory will vary according to service, field maintenance anticipated, allowable down time and number of units. A minimum inventory of one complete set of bearings, gaskets, “O” rings, and packing (or Mechanical seal) and one spare of each moving part is suggested.

7.3. RETURNING PARTS

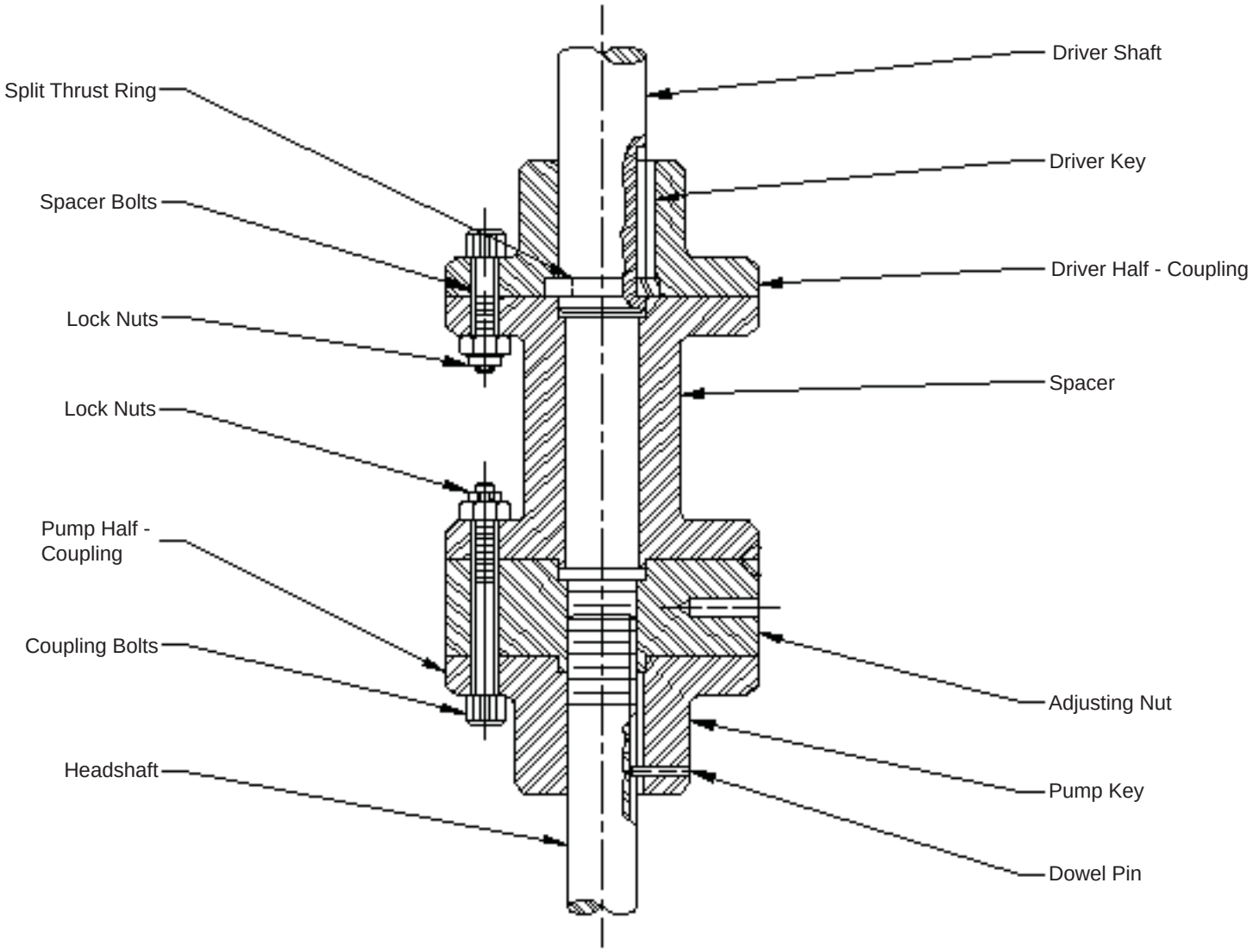
All materials returned to the factory must be accompanied by a Returned Material Authorization (RMA) number. An RMA number can be obtained directly from the factory or through your local Dealer or local District Manager. The RMA Form must be filled in completely and forwarded as directed thereon. Parts being returned under warranty claim must have a complete written report submitted with the RMA Form.

CAUTION: Returned material must be carefully packaged to prevent transit damage - factory cannot assume any responsibility for parts damaged in transit.

ARMSTRONG

PARTS LIST

#4HD AND LARGER
Illustrated with Spacer



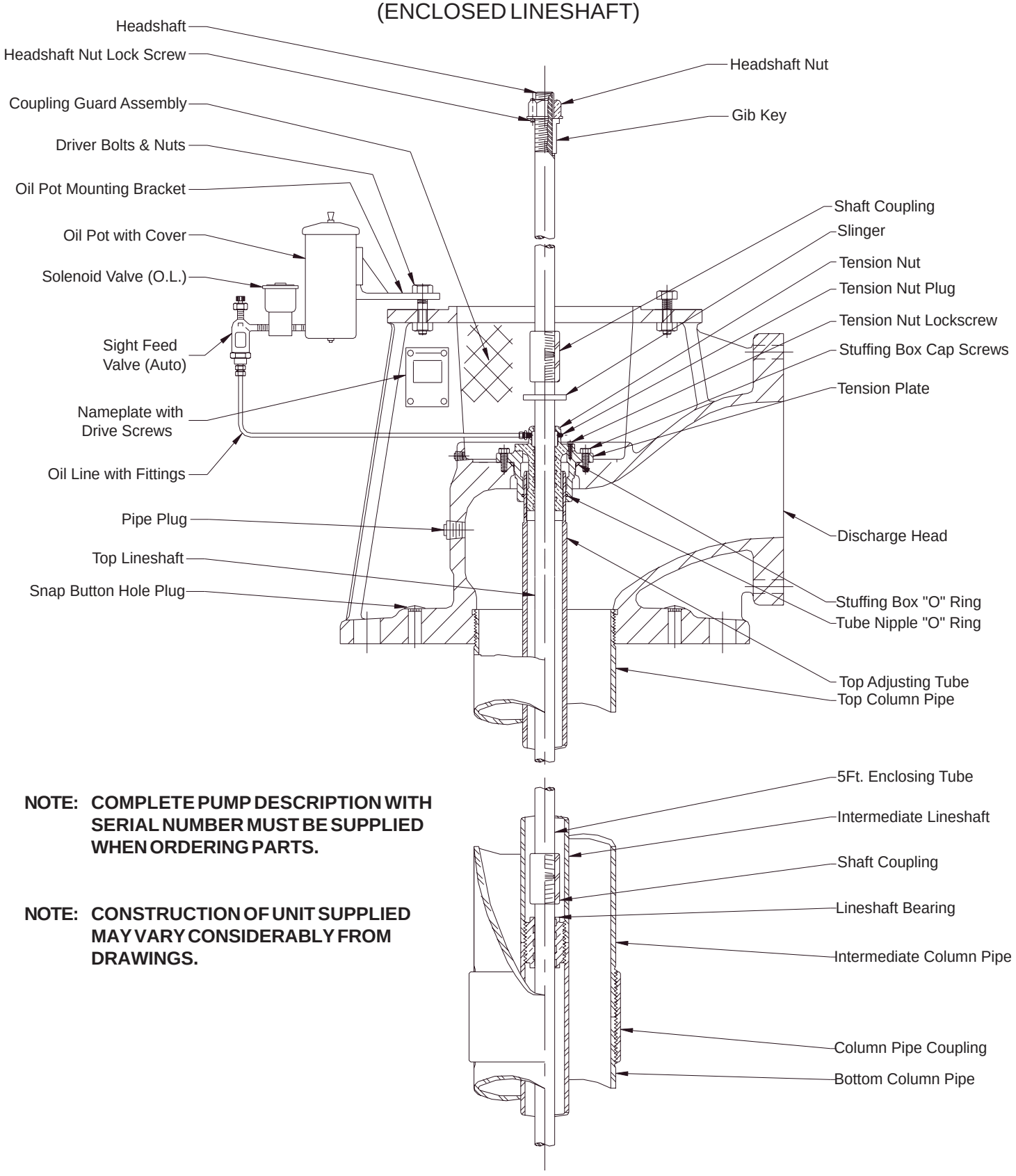
*Construction for coupling assembly less spacer will be identical to that shown except the spacer, spacer bolts and lock nuts will be omitted.

Fig. 7.1 Adjustable Flanged Coupling Parts List

ARMSTRONG

PARTS LIST

TYPE A
(ENCLOSED LINESHAFT)



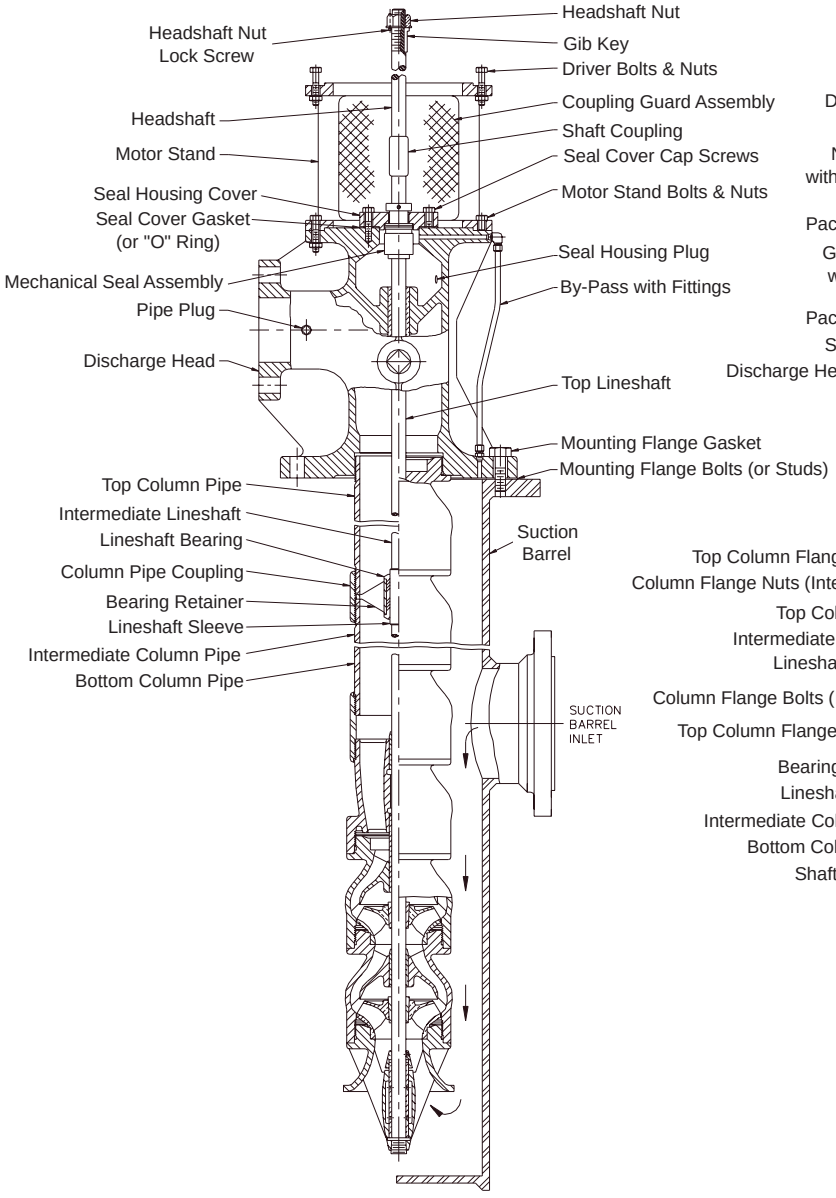
NOTE: COMPLETE PUMP DESCRIPTION WITH SERIAL NUMBER MUST BE SUPPLIED WHEN ORDERING PARTS.

NOTE: CONSTRUCTION OF UNIT SUPPLIED MAY VARY CONSIDERABLY FROM DRAWINGS.

Fig. 7.2 Pump Parts List

PARTS LIST

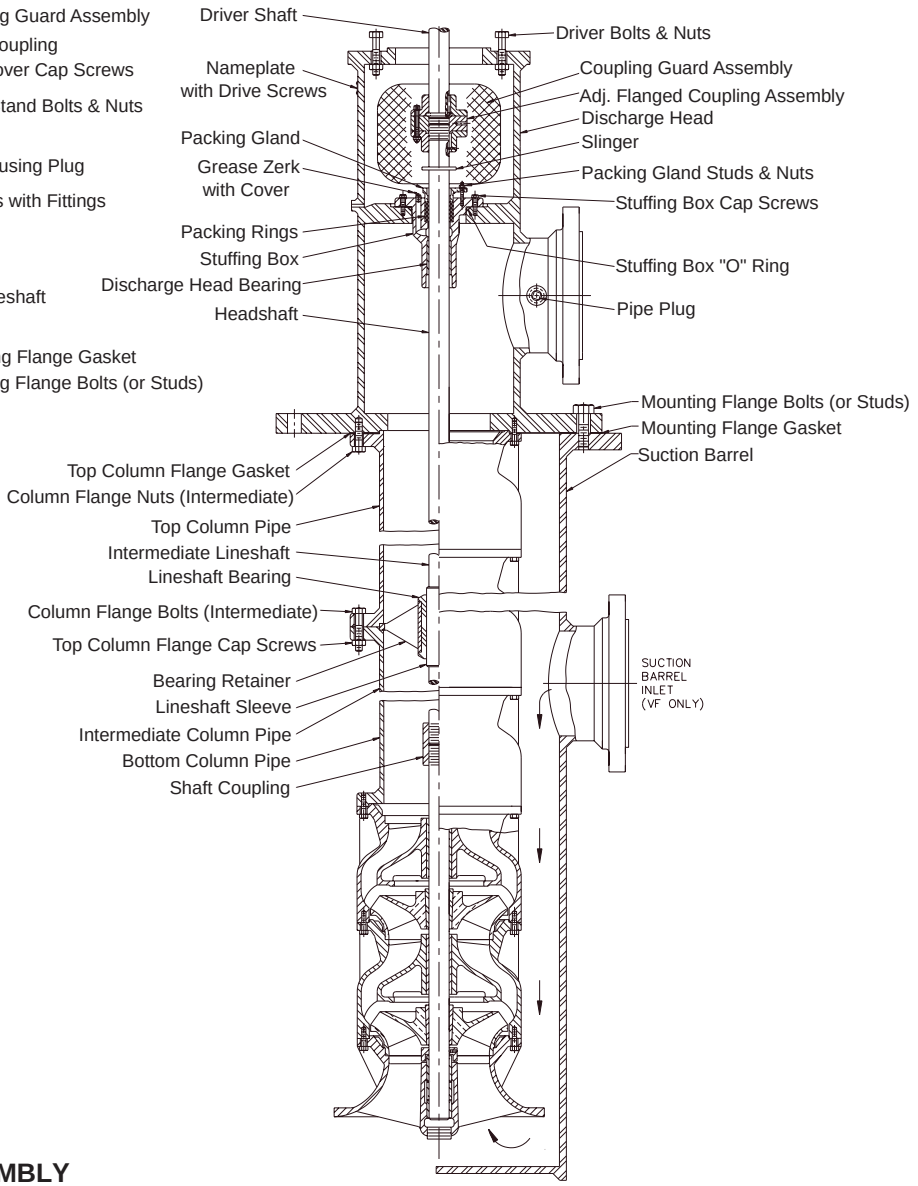
TYPE CF
(OPEN LINESHAFT)
Illustrated with Mechanical Seal
type FF-2S or FF-3



NOTE: SEPARATE INSTRUCTION MANUAL AVAILABLE COVERING BOWL ASSEMBLY CONSTRUCTION AND PARTS LIST.

NOTE: SEPARATE INSTRUCTION MANUAL AVAILABLE COVERING MECHANICAL SEAL CONSTRUCTION AND PARTS LIST.

TYPE F & VF
(OPEN LINESHAFT)
Illustrated with adjustable flanged coupling
(less spacer) and standard packing box



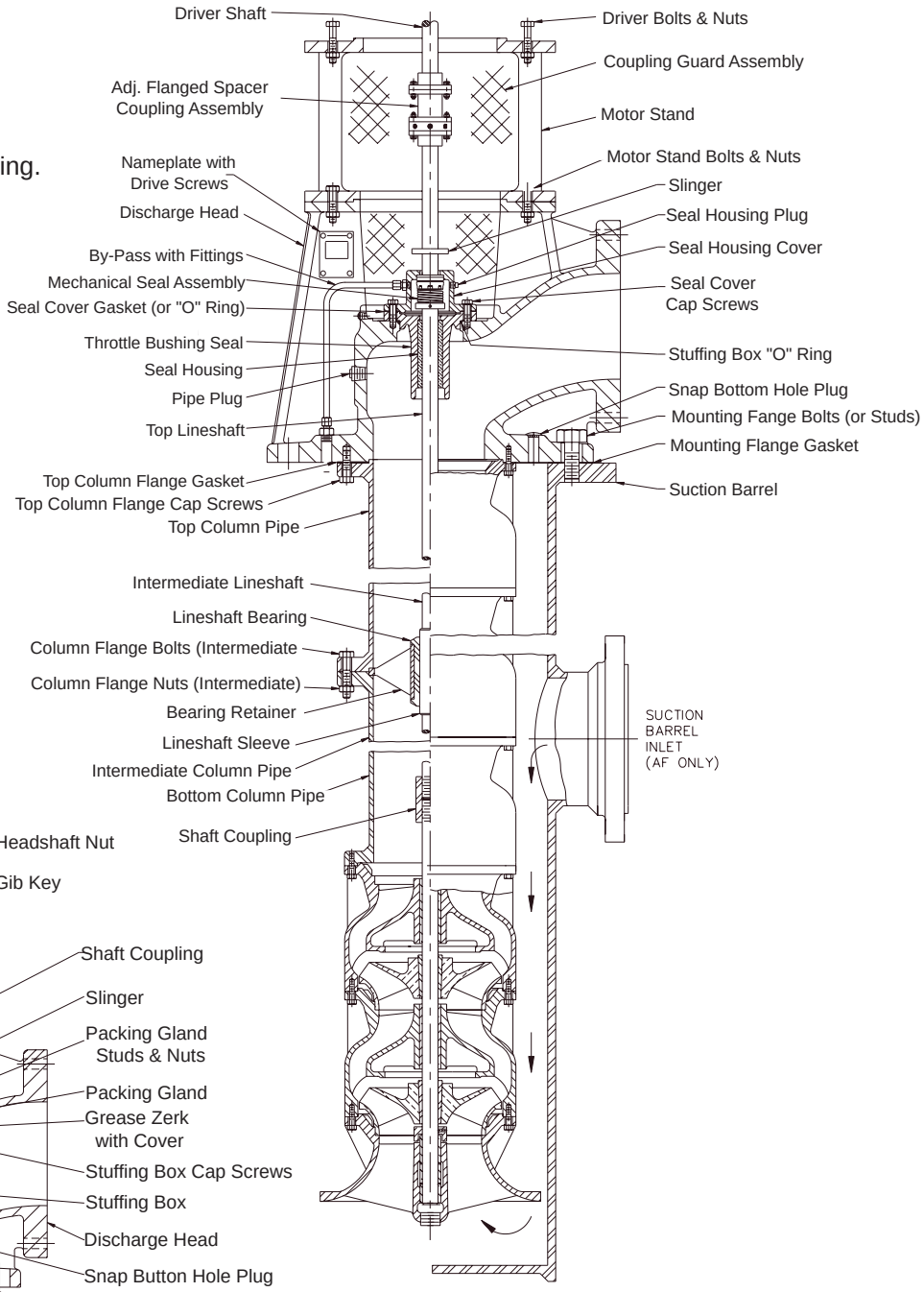
NOTE: CONSTRUCTION OF UNIT SUPPLIED MAY VARY CONSIDERABLY FROM DRAWINGS.

Fig. 7.3 Pump Parts List

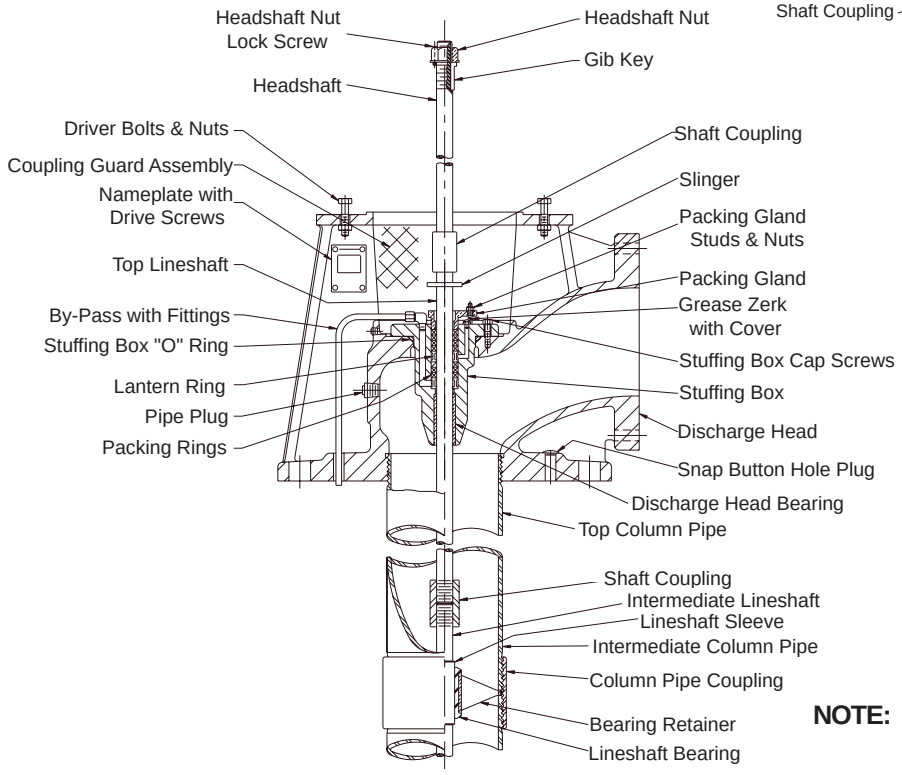
ARMSTRONG

PARTS LIST

TYPE AF
(OPEN LINESHAFT)
Illustrated with motor stand, spacer coupling, FF-2 seal and lower bearing housing.



TYPE A
(OPEN LINESHAFT)
Illustrated with column and hi-pressure packing box.



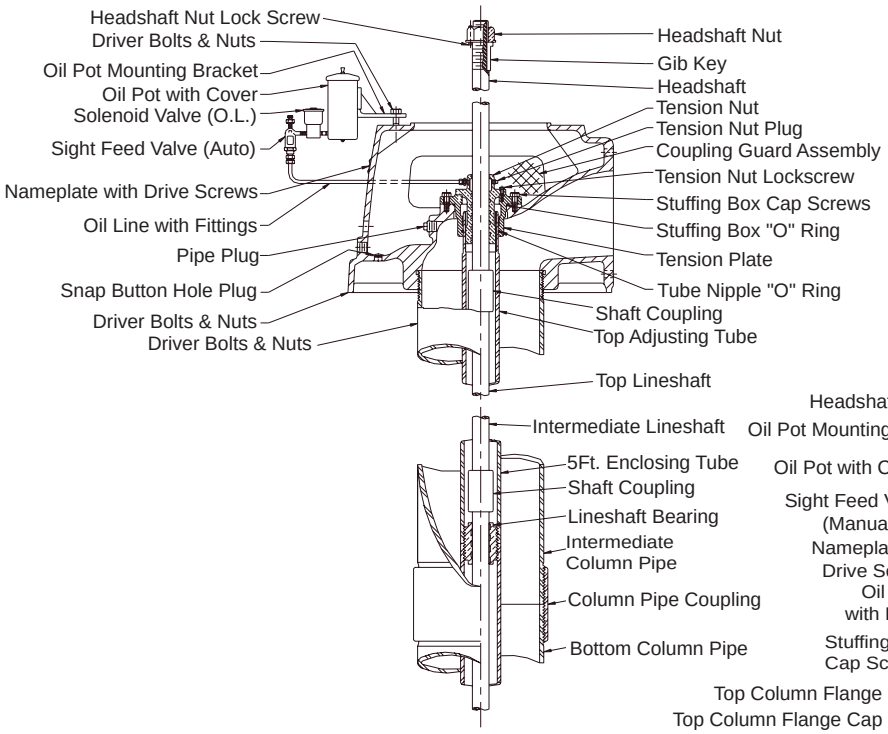
NOTE: SEPARATE INSTRUCTION MANUAL AVAILABLE COVERING BOWL ASSEMBLY CONSTRUCTION AND PARTS LIST.

NOTE: SEPARATE INSTRUCTION MANUAL AVAILABLE COVERING MECHANICAL SEAL CONSTRUCTION AND PARTS LIST.

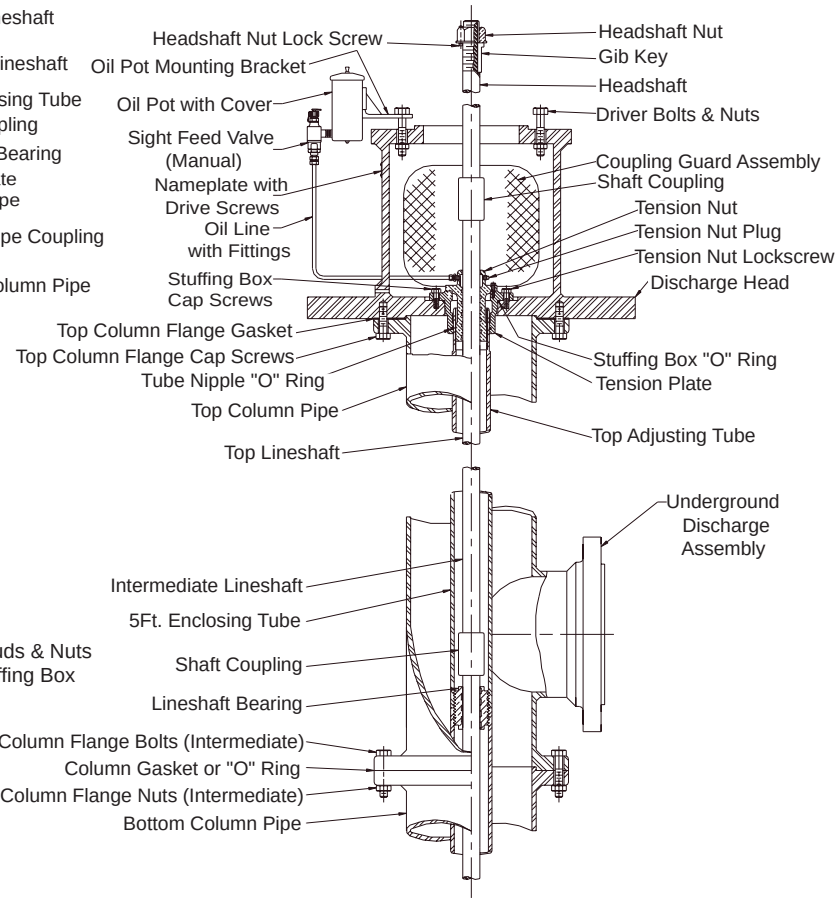
Fig. 7.4 Pump Parts List

PARTS LIST

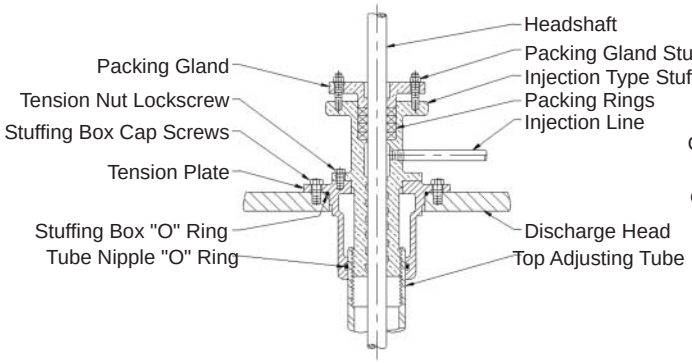
TYPE C
(ENCLOSED LINESHAFT)
Illustrated with automatic operated lubrication.



TYPE VU
(ENCLOSED LINESHAFT)
Illustrated with manually operated lubrication assembly.



INJECTION LUBRICATION ARRANGEMENT



NOTE: COMPLETE PUMP DESCRIPTION WITH SERIAL NUMBER MUST BE SUPPLIED WHEN ORDERING PARTS.

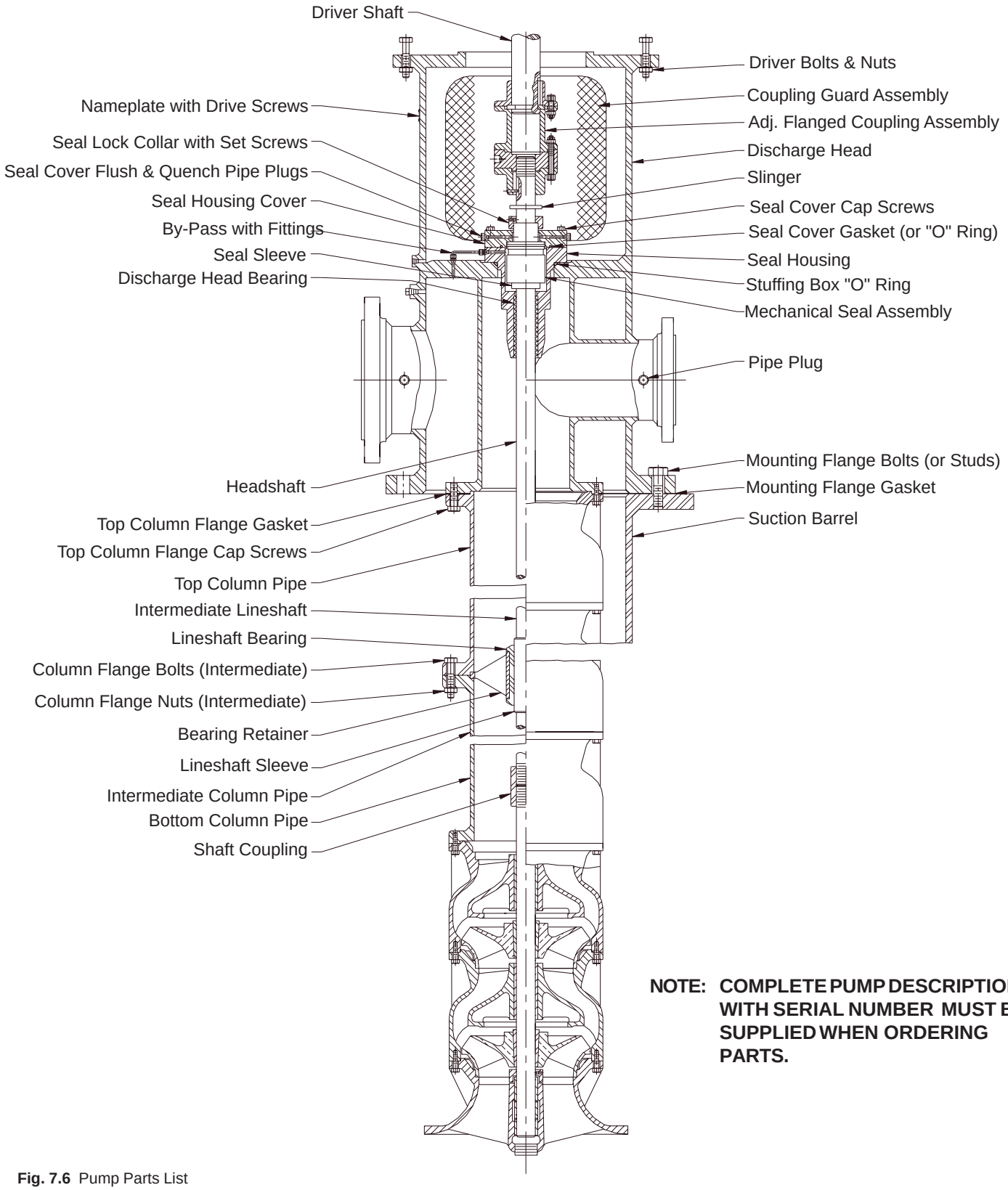
Fig. 7.5 Pump Parts List

ARMSTRONG

PARTS LIST

TYPE VC

Illustrated with adjustable flanged coupling
(with spacer) and mechanical seal.



NOTE: COMPLETE PUMP DESCRIPTION WITH SERIAL NUMBER MUST BE SUPPLIED WHEN ORDERING PARTS.

Fig. 7.6 Pump Parts List

INDEX

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