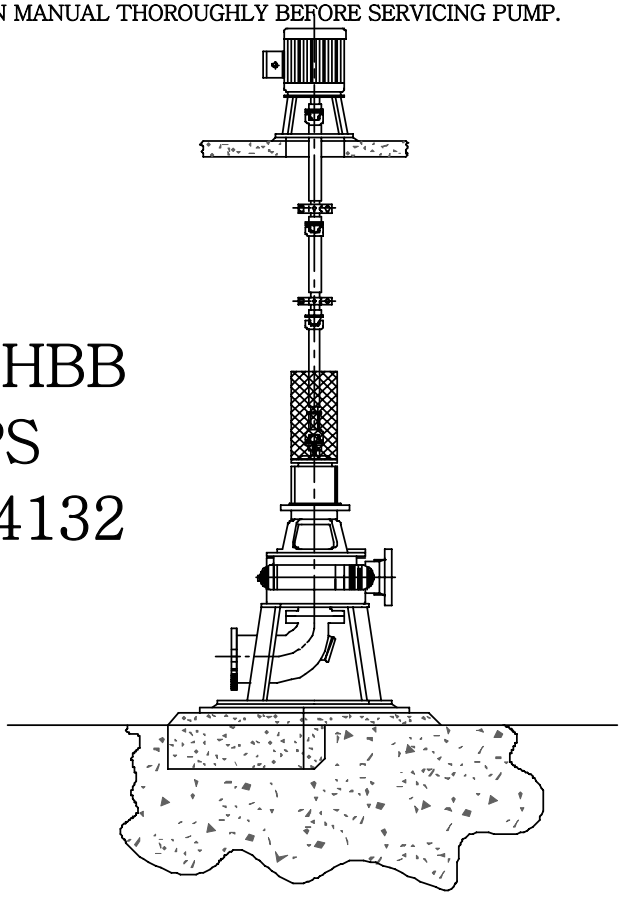
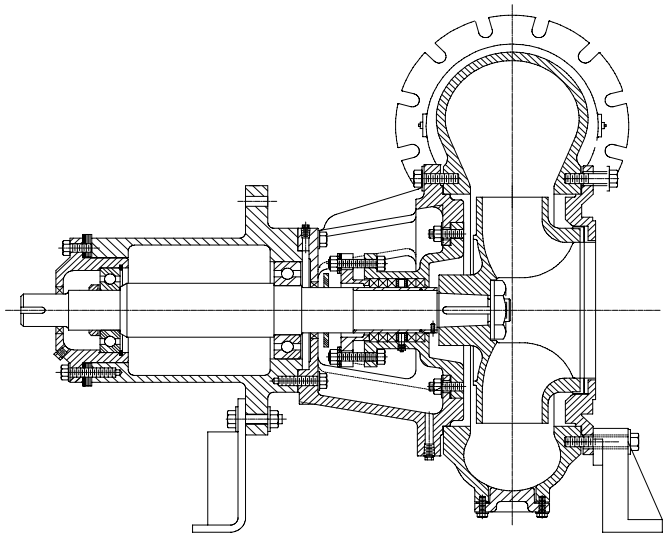
Installation & Maintenance Manual

IMPORTANT

READ THIS ENTIRE INSTRUCTION MANUAL THOROUGHLY BEFORE SERVICING PUMP.



TYPE VOS, VPM and HBB NON-CLOG PUMPS Frames: 44081 thru 64132



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SECTION I. GENERAL INFORMATION

A. PURPOSE AND IMPORTANCE OF MANUAL

CHICAGO PUMP Dry Pit Centrifugal Pumps, when properly installed, given reasonable care and maintenance, and operated near the design capacity and head, will provide years of low cost, efficient pumping service. This manual is intended to give instruction in the proper installation, operation, and maintenance of the pumps. Strict compliance with these instructions will insure reliable performance in wastewater service. Keep this manual handy for ready reference.

READ THIS MANUAL THOROUGHLY BEFORE INSTALLING OR OPERATING PUMP(S).

B. SPECIAL PRECAUTIONS

CHICAGO PUMP cannot be responsible for any damage resulting from failure to comply with these instructions. The pump is not to be operated at conditions nor with liquids other than those stated in the original order acknowledgment without written permission from CHICAGO PUMP COMPANY.

C. RECEIVING INSPECTION - SHORTAGES

Upon receipt of equipment make sure that no damage occurred in transit and that shipment complies with the bill-of-lading and packing memo. Make note of damage or shortages on both receipt and freight bill. Claims should be made to the transportation company within five (5) days.

D. PRESERVATION AND STORAGE

The pumps are shipped with adequate protection for transportation in covered trucks, and for indoor storage at the jobsite for a limited time between receipt and installation. CHICAGO PUMP equipment, if not put into immediate use, should be stored in a cool, clean, and dry indoor location. To prevent rusting, any paint scratches or chips incurred during handling should be touched up prior to storage.

Equipment that is to be stored for one month or more should be covered with plastic to protect it from corrosion. Suction and discharge flanges should also be covered. Exposed shaft ends should be coated with a suitable rust preventative. Packing should be removed from units famished with a stuffing box to prevent pitting of the shaft sleeve. Additionally, the pump rotating assembly must be spun for approximately one minute monthly to insure proper distribution of lubricant. DO NOT add lubricant to the pump bearings while the unit is in storage. Prior to equipment start-up, the pump must be repacked, completely rechecked and re-rotated. If the original packing is no longer useable, replacement sets may be ordered from your CHICAGO PUMP representative.

Refer to specific manufacturer's instructions for storage recommendations for motors, drives, or controls.

E. PROCEDURE FOR ORDERING SPARE PARTS

Parts and service for CHICAGO PUMP Products are available exclusively through the designated sales representative located in your geographical area. When ordering repair parts, please give the full nameplate data from the pump nameplate as described herein, including S.O. Number. Complete nameplate data will insure most rapid handling of your order with the minimum chance of mistake. List each part required using the item number and name of part as shown on the following pages. Be sure to state the quantity of parts required

F. NAMEPLATE IDENTIFICATION

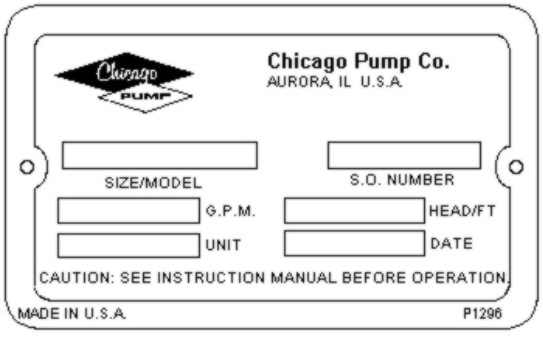
S.O.- The sales order / serial number of the pump. This number must be provided when ordering parts or requesting technical assistance.

T.D.H.- The rated total dynamic head of the pump in feet.

Type-The pump configuration, model, and bearing frame when applicable.

G.P.M.- The rated capacity of the pump in gallons per minute.

Make record of the nameplate information from your pumps in this manual for easy reference.



G. TOOLS REQUIRED

Use only the proper tools when dismantling or repairing any CHICAGO PUMP equipment. Tools required for disassembly and assembly of dry pit pumps are as follows:

Screwdriver	Several Good Blocks of Wood or a Bench
Standard Wrenches	Bearing Puller
Retaining Ring Pliers	Wheel Puller / Bars
Lifting Sling	Bearing Heater
Allen Wrenches	Emery Cloth
Torch	Wooden Mallet

H. RECOMMENDED LUBRICANTS

GREASE	OIL
CITGO Lithium	CITGO Citgard 10W
EP-2	Petro Canada 10W
	Mobil DTE Light

In cases where abnormal conditions exist, such as very high temperatures, it is advisable to consult a lubrication engineer to determine. the proper lubricant to use. If this is not practical, contact your CHICAGO PUMP representative stating your conditions, and alternative recommendations will be provided.

I. RECOMMENDED CLEANING SOLVENT

Safety - Kleen, or any equal grade of non-flammable industrial cleaner.

J. SPARE PARTS RECOMMENDATIONS

The parts list accompanying the cross-section drawing included with this manual denotes items recommended to be carried as spare parts. It is impossible for CHICAGO PUMP to accurately determine the predicted life of any parts subject to wear because of the varying severities of duty exerted on each individual unit manufactured. The list includes parts recommended to be carried for one to five years of operation. It is recommended that the following parts not be reused at re-assembly, even if showing no apparent wear:

Grease seals	Shaft Sleeve (for Packed Pump)
Snap Rings	Thrust Bearing
Packing	Mechanical Seals
Impeller Locknut	Wear Rings (When Furnished)
Radial Bearing	Filter Insert (When Furnished)
Gaskets	
Bearing Locknut & Washer	

SECTION II. INSTALLATION A. PUMP

A. PUMP

1. LOCATION

The following factors must be considered in selecting a location for the pump(s):

a. The pump should be installed as near the liquid to be pumped as possible, with the shortest and most direct suction piping arrangement. The total dynamic suction lift (static elevation plus losses through suction pipe and fittings) should not exceed 15 feet.
b. The pump should be located in a position such that the highest point of the casing is below the minimum level of liquid to be pumped. This condition is referred to as submerged suction.
c. Select a dry place.
d. Select a location that has ample floor space for inspection and repairs.
e. Provide ample floor drains at the pumping unit. For dry pit applications, the use of an automatic sump pump is strongly recommended.
f. NPSH Available must be greater than NPSH Required at all operating points.

2. FOUNDATION

A foundation should consist of a flat, level, substantial surface to provide a permanent, rigid support for the pump base. The foundation must also be solid enough to absorb any normal amount of vibration which may occur. The natural frequency of the support structure must be no less than twice the pump excitation frequency. If a raised foundation is desired, it should be at least six inches greater in length and width than the base of the pump support, and at least deep enough to provide proper embedment for the anchors. A raised foundation should never be superficially poured over a smooth concrete floor, but should be rooted by one of the following means: (a) When the concrete is newly poured, cast a shallow depression in the floor using a box form, (b) leave reinforcement bars protruding above floor level, or (c) gouge out holes in an existing concrete floor.

3. ANCHOR BOLTS

Anchor bolts should be set in pipe sleeves two and one half times larger in diameter than the recommended bolts. The bolts must be accurately placed to correspond with bolt holes in the pump base, as indicated on the dimensional installation drawing. Figure I illustrates the generally accepted method of anchorage. This system traps the bolt for anchorage and allows the bolt to move within the sleeve for alignment purposes. The bolts should be fastened to a template form, usually made of wood, and spaced to conform accurately with pump base anchor bolt holes. The form must be carefully located so that the pump will stand exactly in its specified position with relation to elevation, shaft plumb and pipe connections. The concrete can then be poured.

Before fixing anchor bolts into the form, the top and bottom of the sleeves should be plugged with oakum, as shown. Check that sleeves are held rigidly against square plate, which will permit slight adjustment of the bolts after the concrete has set. This will prevent strains or difficulties arising from slight dimensional discrepancies.

4. SETTING

A. PUMP

Set pump on the foundation over the anchor bolts, but do not tighten down bolts. Raise the pump unit 1" and carefully level for grouting by driving wedges under the pump support or base plate. To level vertical units, place a level on face of pump coupling half and face of discharge flange, and shim the unit as required. Check horizontal units at the suction flange, pump and motor half coupling, and on the base plate near the pump and near the motor.

B. MOTOR SUPPORT

Set the motor support over the floor hole; position the universal shafting to the motor coupling, setting the motor assembly so that it is level and the shafting alignment below can be maintained per UNIVERSAL JOINT / INDUSTRIAL INTERMEDIATE SHAFTING, page 8. After installation of shafting in accordance with those instructions, the unit may be bolted down.

5. ALIGNMENT

A. VERTICAL

On pedestal mounted pumps, the motor supports are indexed (top & bottom) to maintain factory alignment. Coupling alignment should be checked in accordance with the guidelines on page 7 prior to final installation. Refer to flexible shafting instructions, page 8, to determine proper alignment for shaft driven units.

B. HORIZONTAL

Pumps and drivers that are received from the factory with both machines mounted on a common base plate, were accurately aligned before shipment. Units are shipped with coupling halves separated and require coupling realignment at installation. All base plates are flexible to some extent and therefore must not be relied upon to maintain factory alignment. Realignments necessary after the complete unit has been leveled on the foundation, and again after the grout has been set and foundation bolts have been tightened. The alignment must be checked after the unit is piped, and rechecked periodically.

6. GROUTING

Non-shrink grout is generally made up of a mixture of one part pure cement and two parts sand with sufficient water to cause the mixture to flow. A wooden form should be built around the outside of the base of the pump, and the pump base plate or pedestal should be completely filled with grout. This will provide ahead to force the grout into all the cracks and crevices, and prevent the grout from shrinking away from the base as it sets. Before and after the grout has been hardened, the nuts on the foundation bolts should be tested for tightness, and the pump should be checked to see that it has not shifted from its correct position. Alignment of couplings must be checked after any adjustment to the unit.

7. PIPING CONNECTIONS

The suction and discharge pipes must be independently supported near the pump so that no strain will be transmitted to the pump casing. Provisions should also be made for pipe expansion and contraction so that no strain is placed on the pump. A generous, grooved, square hole should be left when running a pipe through a concrete wall, and the pipe should be grouted in only after the pump unit is set and all final connections have been made. If an expansion joint or pipe coupling is to be used between the pump unit and the nearest point of anchor in the piping (i.e. a wall), it is essential that the joint / coupling be axially rigid to offset the pressure increase which would otherwise be exerted on the pump.

Suction and discharge pipe lines must not be smaller in size than the connections on the pump. Piping should be arranged with as few bends as possible, and should be made with long radius elbows when feasible, to reduce the loss of head due to friction.

Consult the factory when handling liquids above 40°C (104°F.)

CAUTION

THE PUMP SHOULD NEVER BE THROTTLED BY THE USE OF A VALVE ON THE SUCTION SIDE OF THE PUMP.

Suction Piping

The suction piping must be kept free of air leaks. Air that remains entrapped in the piping after the pump has been primed and started will eventually be drawn into the pump. This may cause the pump to cavitate or lose its prime. This situation can usually be temporarily remedied by priming and starting the pump several times. This will draw enough air from the entrapped pockets so that the pump will operate properly, but the trouble is likely to reoccur until such a pocket is eliminated.

Some vapor, released by the partial vacuum in the suction pipe occurs naturally in the pumpage. This vapor, added to small amounts of air admitted through minute leaks in the pipe connections, must not be allowed to build-up. Excessive air pockets can be eliminated by following these guidelines:

a. If the pump operates with a suction lift, the suction pipe must slope upward to the pump nozzle and downward to the source of supply. If the suction pipe is installed higher than the pump nozzle, an air pocket will form at the highest point
b. In a horizontal suction line, an eccentric reducer installed flat side up must always be used in lieu of a concentric reducer. Use of a concentric reducer will cause air pockets to form in the top of the reducer and suction line.
c. If a gate valve is used in the suction line, it should be installed with the stem in a horizontal position. Vertical positioning allows air to become trapped in the bonnet of the valve.
   Wet well design should always be in accordance with Hydraulic Institute Standards.
   Consult the factory for anything other than individual piped suction installations.

CAUTION

RESTRICTED FLOW VALVES SHOULD NEVER BE USED ON THE SUCTION SIDE OF THE PUMP. ALL VALVES MUST BE OF A FULL FLOW TYPE.

Discharge Piping

A suitable check valve and gate valve should be installed in the discharge pipe near the pump to protect the pump from reverse flow and excessive back-pressure. The check valve should be placed between the pump and the gate valve. If increasers are used to accommodate larger discharge piping, they should be placed between the check valve and the pump. The selection of discharge pipe size should be made with due reference to friction loss and should never be smaller than the pump discharge size.

At the end of a "pump down cycle" some air may enter the pump and remain trapped by the discharge check valve. To facilitate the expulsion of this trapped air, an automatic air release valve and open vent pipe should be installed from the pump backplate to the wet well.

Alignment must always be rechecked after piping connections have been made.

B. WOOD'S SURE-FLEX® COUPLINGS

The couplings include elastomeric sleeves to compensate for temperature changes during operation. They are NOT to be used to compensate for misalignment of the motor and pump shafts. The following procedures apply to Wood's Sure-Flex® couplings only. When couplings other than these are supplied, please refer to the specific manufacturer's instructions. If questions arise as to the type of coupling supplied with the unit, contact your CHICAGO PUMP representative.

Position the flanges on the shaft to approximately achieve the "Y" dimension (dimension across coupling flanges, outside to outside) shown in Table 1. It is usually best to have an equal length of shaft extending into each flange. Move one flange to its final position and tighten the set screws. Slide the other flange far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth.

Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange. (The "Y" dimension is for reference and not critical.) Secure the flange to the shaft. Different coupling sleeves require different degrees of alignment precision. Locate the alignment values for your sleeve and type in the table.

Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling *without rotating* the coupling. If the maximum offset exceeds the figure shown under "Parallel" in the table, realign the shafts by placing shims underneath the motor.

Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions *without rotating* the coupling. The difference between the maximum and minimum must not exceed the figure shown under "Angular" in the table. If a correction is necessary, be sure to recheck the parallel alignment.

If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

TABLE 1

MAXIMUM RPM AND ALLOWABLE MISALIGNMENT
(Dimensions in Inches)

	Types JE, JN, JES. JNS, E & N			*Type H & HS		
Sleeve Size	Parallel	Angular	Y	Parallel	Angular	Y
3	.010	.035	1.188	...	...	...
4	.010	.043	1.500	...	...	...
5	.015	.056	1.938	...	...	...
6	.015	.070	2.438(1)	.010	.016	2.500
7	.020	.081	2.563	.012	.020	2.625
8	.020	.094	2.938	.015	.025	3.000
9	.025	.109	3.500	.017	.028	3.563
10	.025	.128	4.063	.020	.032	4.125
11	.032	.151	4.875	.022	.037	4.938
12	.032	.175	5.688	.025	.042	5.750
13	.040	.195	6.688	.030	.050	6.688
14	.045	.242	7.750	.035	.060	7.813
16	.062	.330	10.250	...	...	...

*Type H and HS sleeves should not be used as direct replacements for EPDM or Neoprene sleeve.

(1) Value when using 6J flanges is 2.125

C. UNIVERSAL JOINT / INTERMEDIATE INDUSTRIAL SHAFTING

NOTE: The following instructions apply when flexible type shafting with universal joints and spliced slip joint is furnished as intermediate shafting between the pump and motor. If special shafting is supplied, manufacturer's specific instructions will be provided. If questions arise as to the type of shafting supplied with the pump, contact your CHICAGO PUMP representative.

Although universal joints will compensate for considerable misalignment, working angle must be held to within 6° on standard shafting, and 4° on short coupled shafting. An offset of 1/8" to 3/16" per foot of shafting is recommended to provide needle bearing roller action. Use Table 2 to approximate offset and/or working angle.

Table 2

Shafting Length in Feet	1°	2°	3°	4°	5°	6°	7°
	OFFSET IN INCHES						
1	.209	.419	.625	.839	1.049	1.261
2	.418	.838	1.250	1.678	2.098	2.522
3	.627	1.257	1.875	2.517	3.147	3.783
4	.836	1.676	2.500	3.356	4.196	5.044
5	1.045	2.095	3.125	4.195	5.245	6.305
6	1.254	2.514	3.750	5.034	6.294	7.566
7	1.463	2.933	4.375	5.873	7.343	8.827
8	1.672	3.352	5.000	6.712	8.392	10.088
9	1.881	3.771	5.625	7.551	9.441	11.349
10	2.090	4.190	6.250	8.390	10.490	12.610

After the pump and motor support have been set into position, install the companion flanges on the motor shaft and pump shaft. Stock bored flanges are a slip fit over the mating shaft. Align keyways in both the flange and shaft and gently tap on flange. Tighten set screw. Interference or shrink-fits require heating the flange uniformly (preferably submerged in ac oil bath not exceeding 180°C) to expand the bore. Align the keyways in both the shaft and flange, slide flange onto shaft and allow to cool. CAUTION: DO NOT ATTEMPT TO HAMMER AN UNDERSIZED FLANGE ON.

The shaft must be recessed 1/16" below the indexed mounting face of the flange. Once the flanges are installed, set the motor on its support and measure the distance from the motor flange to the pump flange. Compare that distance to the overall shafting dimension shown on the specific installation drawing, and make any necessary adjustments by placing shims under the motor.

If no intermediate guide beings are furnished, the shafting may be bolted directly to the motor and to the pump. Bolt the upper portion of the flexible shafting to the motor making sure that the pilot is firmly seated and bolt holes in flanges line up. Insert bolts or studs, nuts and lockwashers and tighten to the specified torque indicated on Table 3. Insert lower end of flexible shaft slip joint into splined section making sure that yoke and ears are uniformly aligned and bolt holes are in line. Insert bolts or studs, nuts and lockwashers and tighten to torque specified in Table 3.

When multiple sections of shafting are used and intermediate guide bearings are furnished, rigid supports are required for the bearings. The natural frequency of the bearing support must be no less than four times the pump excitation frequency. A plumb line hung from the motor shaft will be helpful in locating the intermediate guide bearings. The distance from the mounting surface of the support to the plumb line should be at least equal to, and preferably greater than, the distance from the center of the bearing to the support mounting surface. Using a phantom vertical center line on the support opposite the plumb line, drill the holes for the guide bearing bolts.

Lay the uppermost "B" section out on a floor, and slide the steady bearing over neck of the "B" stub. To facilitate installation and future removal, it is recommended that light grease be used on the shaft and threads. Install tapered flange onto shaft, followed by retaining nut. Tighten nut until firmly seated against flange and flange is firmly seated against shaft. Nut must be tightened so that there is approximately .001" to .004" diametral interference between bore and shaft. Install cotter pin. Attach universal

end of shafting to motor companion flange so that pilot is firmly seated, yoke and ears are uniformly aligned and bolt holes are lined up. Insert bolts or studs, nuts, and lockwashers and tighten to torque indicated on Table 3. Attach self aligning steady bearing to support beam and secure bearing to "B" stub. Shim if necessary. Repeat above procedure for each additional "B" section as required. Mount lower "A" section as outlined above for single section shafting.

TABLE 3

BOLT SPECIFICATIONS			
Bolt Size	Applicable Shafting Series	Wrench Torque	Grade
3/8"- 24	27, 31, 61, 71	31' #	5
7/16" - 20	37, 41, 81	*4T#*	5
1/2"- 20	48,55	76' #	5
5/8"- 18	88,91	213' #	8
3/4"- 16	95	375' #	8

Note: *Bolts must be tightened in a crisscross pattern and tightened to the specified torque to insure proper mating face contact.*

CAUTION

INTERMEDIATE STEADY BEARINGS SUPPLIED BY CHICAGO PUMP HAVE BEEN PROPERLY SELECTED TO WITHSTAND NORMAL AMOUNTS OF MISALIGNMENT. DO NOT ATTEMPT TO USE ALTERNATIVE BEARINGS WITHOUT WRITTEN APPROVAL FROM CHICAGO PUMP COMPANY.

SECTION III. START-UP AND OPERATION A. PRIMING

A. PRIMING

A CHICAGO PUMP Dry Pit Centrifugal Pump should **never** be started in an unprimed condition. It is absolutely essential that both the casing and suction pipe be completely filled with the liquid to be pumped and void of air or vapor. If the installation does not allow for submerged suction (See Location, page 5) as recommended by CHICAGO PUMP, another suitable priming device is necessary. Units installed with submerged suction should have a vent cock located on the top of the casing. Entrapped air is released through the opened vent cock when liquid enters the pump. The pump must not be started until all air has been exhausted from the casing and suction line. In the event that the pump cannot be primed in this manner, consult the factory.

B. PRE-STARTUP LUBRICATION INSTRUCTIONS

1. Radial and Thrust Bearings

CHICAGO PUMP Dry-Pit centrifugal pumps are equipped with ball bearings, angular contact ball bearings, cylindrical roller or spherical contact roller bearings which have been properly lubricated prior to shipment. No additional lubrication is needed prior to startup. These bearings require but a few ounces of grease per year. For maximum efficiency, bearings should be approximately half full of grease. UNDER NO CIRCUMSTANCES SHOULD A BEARING BE GREASED UNTIL GREASE OOZES OUT OF THE BEARING. Excess grease acts as a dirt catcher and does not in any way lubricate the bearing. An over-greased bearing tends to overheat and in some cases, may overheat to the point where the temper is drawn from the balls or rollers, rendering them soft and causing premature bearing failure. Under normal operating conditions, a bearing requires only 1/2 oz. to 1 oz. of grease every 1500 hours of operation. (Refer to PREVENTATIVE MAINTENANCE SCHEDULE, page 20.) For applications where high temperatures or other unusual conditions exist, consult the factory for special lubrication recommendations.

Some horizontal pumps are equipped with an oil bath lubrication system for the thrust and radial bearings. This system provides a constant supply of fresh oil to the bearings. A drain plug is provided at the low point of the oil chamber to facilitate oil renewal. Maintenance of this system only requires visually checking the oil level at the oil cup or oil plug, and adding oil, if necessary, to a level just below the overflow point. When adding oil remove the oil vent plug in the top of the bearing housing. DO NOT ADD OIL WHILE THE PUMP IS RUNNING. The bearings will retain a considerable amount of oil when rotating. With the pump at rest, the oil collects in the bottom of the chamber, and excess oil will overflow around the shaft and/or out of the oil cup.

The oil should be changed every 3,000 hours of operation. (Refer to PREVENTATIVE MAINTENANCE SCHEDULE, page 20.) Use only a high quality grade of mineral oil with rust and oxidation inhibitors at least equal to Mobil DTE Light. Observe oil level prior to start-up and add if necessary.

2. Flexible Couplings

Factory standard elastomeric jaw type couplings require no lubrication. If non-standard couplings are furnished, refer to the specific manufacturer's lubrication instructions or consult your CHICAGO PUMP representative.

3. Flexible Shafting

Cross and bearing assemblies and sliding splines contain only enough grease to provide protection during storage. Complete lubrication is necessary prior to start-up to avoid premature failure.

a. Cross and bearing assemblies and steady bearings are to be lubricated with a good quality of grease. (See PREVENTATIVE MAINTENANCE SCHEDULE, page 20.) Lubricant MUST appear at all four bearing seals to assure removal of dirt and contaminents. It may be necessary to move drive shaft from side to side while applying grease gun pressure to allow greater clearance on the thrust end of bearing that is not purging.
b. Sliding splines in slip joint must only be lubricated with Texaco Marfac "0" EP or equal grade of long fiber grease. DO NOT use standard grease.

4. Stuffing Box

The shaft stuffing box is packed prior to shipment. The packing is placed in the stuffing box in single rings with the ends butted together. Each ring is cut to the proper length so that the ends come together but do not overlap. Succeeding rings of packing are placed in the stuffing box so that the joints of the rings of packing are staggered. The stuffing box is provided with a lantern or seal ring.

a. Water Seals: On pumps handling liquids with solids, a water seal is used principally to flush the packing and prevent entrance of solids or grit which would score the shaft or shaft sleeve. It also serves to cool and lubricate packing, and in the case of suction lift applications it is required as a seal against entrance of air. Non-Clog pumps are furnished with water seals for external or outside connection to a clear water supply having a pressure approximately 3 to 10 lbs. (7 ft. to 23 ft. head) greater than the pump discharge pressure. If the available pressure is too high (20 pounds or more above the operating head of pump) or if gland leakage is excessive a pressure reducing valve should be used. If available pressure is below operating head of pump, or when required, it is often necessary to employ a small water seal pumping unit. The most economical consumption of sealing water is obtained by installing a solenoid valve in the water seal line, wired with the pump circuit to open automatically when the pump operates.

Note: As a precaution against contamination, State Departments of Health do not permit connecting the water seal line of a sewage pump directly to the city supply.

b. Grease Seals: When water is not available a grease seal is recommended. For grease seals to be effective, a constant pressure of water-proof grease must be maintained on the packing, for which purpose a spring loaded grease cup (see Fig. 2) is usually employed. This spring loaded grease cup is designed for controlled lubrication. The cup has a knurled adjusting screw at the top that permits the operator to decrease or increase the tension on the spring and thus assures a precise regulation of a constant lubricant flow.

The reservoir of the cup is filled with lubricant through the Alemite Fitting located at the cup base. As the lubricant is forced into the reservoir, the cup leather and the pressure spring are elevated until the spring stops at the safety shoulders where the top of the cup slopes inward. The pressure is then extended downward through the cup channel, flushing the packing and refilling it with fresh, clean lubricant. The cup is fitted with a special type tapered valve stem which moves in a tapered delivery channel. As the spring expands by its own tension, the valve stem descends. This combination of tapered stem and tapered channel automatically compensates for the decreasing tension of the spring and an exact uniform pressure of lubricant is effected.

When the spring loaded grease cup is used for this purpose, the cup must be kept loaded at all times with a recomended grease. It is imperative that grease be forced through the packing at a rate of at least 1 oz. per day. For high head pumps (over 100 ft. head) a water seal is required.

Regardless of the type of lubrication system employed, the stuffing box gland should be quite loose when the pump is first put into operation. After the pump has been found to operate properly, the stuffing box gland may be evenly tightened very slowly. Packing should not be pressed too tightly as this may result in burning the packing and scoring the shaft or shaft sleeve. The gland should leak a slow steady weepage of fluid (either outside flush water or pumpage) when the pump is operating. When weepage can no longer be controlled by adjusting the gland, all rings of packing should be replaced. The addition of a single ring to restore gland adjustment is not recommended.

If the pump is to be left idle for a period of one month or more, the packing should be removed. Refer to the "Repairs" section of this manual for packing installation procedure.

5. Mechanical Seal Box

Pumps may be furnished with a mechanical seal. The standard seal arrangement consists of a double mechanical seal (two single seals mounted back to back) and a suitable sealing medium which is introduced into the sealing chamber. Each seal consists of a rotating element and a stationary element. The sealing faces are highly lapped surfaces of materials selected for low coefficient of friction and resistance to corrosion by the liquid being pumped. The faces have a minute running clearance and normally run on a very thin film of liquid. The sealing liquid may be clear water, or if the application permits, filtered liquid taken directly from the pump discharge.

a. Flow Through Clear Water Lubrication

Clear water is injected into the seal box cartridge through a tapped connection at a pressure higher than that which would exist in the box, thereby isolating the sealing faces from the liquid being pumped. If sufficient sealing pressure is not maintained, the pressure within the pump will force open the lower seal and allow the liquid being pumped to enter the box, ruining the seal. A flow of 2 GPM per pump at 5 psi above the shutoff pressure is required for satisfactory seal operation. Consult the typical performance curve to determine shutoff head, or contact your CHICAGO PUMP representative. A solenoid installed in the downstream side of the seal box should open the seal water line at the mechanical seal

before the pump starts. A flow meter or flow indicator installed on the seal water line will verify flow of seal water into the seal box. A pressure reducing valve and needle valve can be used to adjust pressure and flow rate.

b. Closed Loop Filtered Lubrication System

The mechanical seal is lubricated by liquid taken directly from the pump discharge. The liquid enters the seal chamber from the power frame end. The double seal housing should be vented using the petcock prior to starting the pump. This will insure that no air is trapped within the mechanical seal chamber. CAUTION: Never run the mechanical seal dry as damage will result. The liquid used for lubrication must be filtered prior to being used. Therefore, the liquid drained through the petcock should be clean. If sand is present in this liquid the filter insert requires replacement. If the liquid from the petcock is dark in color, check the seal faces and replace entire seal if one or more seal faces are damaged. Liquid leaking out the end of the mechanical seal housing indicates that a re-application of a non-hardening gasket compound must be made.

As the seal is a precision made product, care must be taken in handling. The carbon and ceramic parts should be safeguarded from drops or severe blows. Particular care should be taken to avoid scratching the capped surfaces on the washer and floating seal.

Other

Refer to specific manufacturer's instructions for lubrication recommendations for drives, motors or other accessories.

C. PREPARATION FOR START-UP

Prior to initial start-up of the pump, the following items must be checked:

1. Be sure that all equipment is properly aligned and has been lubricated in accordance with the PRE-STARTUP LUBRICATION INSTRUCTIONS, pages 9 through 11.
2. Turn shaft by hand to see that it rotates freely. If it binds, or turns with difficulty, refer to "Repairs" section of this manual for guidance to remedy the problem.
3. Be sure that discharge pressure gauges and suction compound gauges are properly installed and operating.
4. Verify that current characteristics of voltage and frequency on the driver nameplate coincide with the service provided.
5. Check to see that the direction of rotation is the same as shown by the arrow on the pump and on the installation drawing. To check rotation, quickly turn the power on and off (only long enough to get the shaft spinning). Observe the direction of rotation of the coupling. The motor leads should be marked, and the starter diagram located inside the starter should be marked, so that the connections can be broken and remade with accuracy. It is important that the pump rotates in the direction for which it was designed. If the pump is not rotating in the direction the pump is intended, interchange any two of the motor leads and recheck. As soon as the pump is rotating in the correct direction, mark the leads and diagram as mentioned above. These instructions apply to three phase motors only. Single phase motors cannot be reversed in this manner and are checked at the factory. If rotation reversal is required for single phase motors, consult the factory.
6. Verify that all thermal units are closed and the H-O-A switch (when used) is in the “off” position.
7. Refer to driver and control manuals for specific pre-start instructions.
8. Verify that the gate valve on the discharge line is closed and the suction valve is completely open.

A centrifugal pump, primed and operating at full speed with the discharge valve closed, usually requires less power than when operating at rated head and capacity with the discharge valve open. For this reason CHICAGO PUMP recommends that whenever practical, the discharge gate valve be closed when starting the pump.

To prevent overheating, "shut-off' operation should be limited to five minute periods. Prolonged "shut-off' operation may prove harmful to the structural integrity of the pump mainly because of increased vibration level affecting the bearings and stuffing box or mechanical seal; increased radial thrust and resultant stress in the shafts and bearings; or excessive cavitation and accompanying damage resulting from internal re-circulation.

WARNING

OPERATION OF A CENTRIFUGAL PUMP WITH THE SUCTION VALVE CLOSED AND THE DISCHARGE VALVE OPEN, OR BOTH VALVES CLOSED MAY CAUSE SERIOUS DAMAGE TO THE PUMP. SUCH OPERATION MAY LEAD TO RAPID AND VIOLENT PUMP FAILURE.

D. SEQUENCE FOR INITIAL START-UP

1. Be sure that the discharge valve is closed, suction valve is completely open, and pump is completely primed. Vent pump by opening vent taps in the casing, suction pipe, and stuffing box or mechanical seal.
2. Close the suction vent line and seal / stuffing box vent fitting.
3. Start the pump in accordance with the particular control system being used.
4. Close pump casing discharge vent when all entrapped air is expelled.
5. Slowly open discharge valve until valve is completely opened. This should coincide with stable pump operation at the designed duty. Because Total Dynamic Head (TDH) is a function of several variables and cannot be accurately determined from a single gauge reading, refer to your CHICAGO PUMP representative for suspected discrepancies in actual pump performance. Actual operating head should not be less than the minimum operating head nor greater than the maximum limit shown on the pump performance curve.

During the initial period of operation, check the following items:

- **a.** See that the pump bearings do not overheat due to over or under lubrication. Bearings normally operate at approximately 50° C (122°F).
- **b.** See that there is the desired water weepage from the stuffing box or that lubrication to the mechanical seal is being provided.
- **c.** See that all pipe connections are tight, and that valves are functioning properly.
- **d.** Observe the flexible line shafting, checking for vibration or whipping.
- **e.** Note operation of the automatic control mechanism, observing numerous complete start-stop cycles. See that the liquid level control starts and stops properly as wet basin fills and is then emptied by the pump. Check high and low water level adjustment.

  Observe operation of pump closely for the first day and at frequent regular intervals for the first two weeks. A new machine is frequently stiff or initial control regulation may be incorrect, therefore the unit should be watched closely to note performance. Refer to PREVENTATIVE MAINTENANCE SCHEDULE, page 20, for normal operating inspection procedures and frequencies

E. NORMAL OPERATION

The pump must be operated within 10% of capacity rating of the specified primary (nameplate) duty point. The pump should be checked and maintained in accordance with the PREVENTATIVE MAINTENANCE SCHEDULE, page 20. Additionally, the dry pit area should be cleaned regularly. Amperage readings should be checked to warn of improper phase reversal or a phase out condition. Controls and drivers should be checked in accordance with specific manufacturer's recommendations. On multiple pump systems, Elapsed Time Meters should indicate balanced operation between pumps. The pump should operate without excessive noise or vibration. Pump and motor bearings should not overheat. Weepage from the stuffing / seal box should be controlled per guidelines on page 10 and 11.

F. EMERGENCY OPERATION

In the event of station power failure: Do not allow automatic restart of the pump. Perform SEQUENCE FOR INITIAL START -UP as outlined on this page.
In the event of station flooding; If pump or motor become submerged, units MUST be removed and completely rebuilt by a competent service shop. Refer to Repair Instructions.
In the event of mechanical failures: The unit should be locked out and repair service obtained from a competent service shop. Refer to Repair Instructions.

G. STOPPING PROCEDURE

Turn off power to the pump and allow the pump to coast to a complete stop before restarting. No banging or hammering sounds should be heard during shut-down. If this condition exists, "water hammer" may be occurring in the piping. This system problem may result in severe damage to the pump. It is recommended that a specialized engineer in this field be consulted immediately. The pump must not be operated until this condition is eliminated. Consult your CHICAGO PUMP representative or the factory.

H. EXTENDED SHUT-DOWN PROCEDURE

When shutting down the pump for an extended period, the motor disconnect switch should be opened and locked out. All valves on suction, discharge, and packing lubrication lines must be shut tight. The pump should be completely drained of water by removing vent and drain plugs until all pumpage has run out. When practical, the pump should be flushed to remove any corrosives and/or abrasives. Draining and flushing

protects the pump against sedimentation build-up and damage due to freezing. The pump and bearings should be thoroughly inspected at this time so that all necessary servicing may be done during the inactive period. If the pump is to be out of service for more than one (1) month, CHICAGO PUMP recommends removing the packing from the stuffing box. Shaft must be rotated for one minute monthly to insure proper distribution of lubricant. Re-lubricate the pump in accordance with PRESTART-UP LUBRICATION instructions, page 9, prior to putting the unit back into service.

SECTION IV. GUIDE TO TROUBLE SHOOTING

Discounting the possibility of damage during transit, most field trouble is the result of a faulty installation or misapplication. If the following points are checked, it is likely that the difficulty will be discovered and can be remedied.

A. NO LIQUID DELIVERED

1. Pump is not primed.
2. Speed is too low, check voltage.
3. Discharge head is too high.
4. Suction lift is too high (over 15 ft.)-Check with gauges.
5. Impeller is completely plugged up.
6. Direction of rotation is incorrect.
7. Valve is closed.

B. INSUFFICIENT LIQUID IS DELIVERED

1. Air leaks are present in suction pipe or stuffing box.
2. Speed is too low, check voltage.
3. Discharge head is higher than anticipated.
4. Suction lift is too high (over 15 ft.) - Check with gauges.
5. Impeller is partially plugged.
6. There is not enough positive suction head for handling hot liquids.
7. Mechanical defects:
   Wearing rings worn,
   Impeller damaged,
   Packing defective.
8. Direction of rotation is incorrect.
9. Valve is partially closed.

C. EXCESSIVE POWER CONSUMPTION

1. Speed is too high.
2. System head is lower than anticipated. Pumps deliver too much liquid.
3. Specific gravity of liquid is higher than anticipated. Check viscosity and specific gravity.
4. Mechanical defects:
   Shaft bent,
   Rotating elements binding,
   Stuffing box too tight,
   Wearing rings worn or rubbing.
5. Direction of rotation is incorrect.
6. Power factor is too low, check with wattmeter.

D. PUMP LOSES PRIME AFTER STARTING

1. Leak(s) present in suction line.
2. Water seal is plugged.
3. Suction lift is higher than anticipated (over 15 ft.).
4. Excessive air or vapor is present in liquid.
5. Insufficient NPSH Available.

NOTE: Check the pump speed with a tachometer. If speed is low, check the line voltage.
In cases where checking over the points outlined above does not disclose the trouble and this trouble has developed before the pump has outlived the contract guarantee, CHICAGO PUMP COMPANY will send one of its engineers to make an investigation on the basis of a written agreement that if the trouble proves to be a defect in the unit, no charge will be made for the company's engineer, but if the trouble is due to faulty installation or conditions not in accordance with those for which the pump is guaranteed, then the customer will pay for the engineer's service.

SECTION V. REPAIRS

A. IF PUMP REQUIRES CLEANING:

Removable handhole covers are provided on the pump volute (22). To clean pump, disengage disconnect switch, lock out, close all valves, drain the pumps, remove cleanout cover (55), and remove any solids.

B. TO DISASSEMBLE THE PUMP:

1. Open the electric circuit, lock disconnect switch in "Off' position, close all gate valves on suction, discharge and water seal lines. Drain the pump of water by removing the casing drain plug (16B).
2. Disconnect water seal, vent, grease and drip pocket lines, when present, from the pump.
3. Plug vent line going back to wetwell.
4. Disconnect the bottom end of the lowest shaft section at the pump coupling flange. (See fig. 1.) The bottom or "A" section of universal joint shafting is easily swung aside to permit pump removal. Where more than one shaft section is used, the remaining sections need not be disturbed.
5. Remove power frame nuts (25) separating upper pump assembly from discharge casing (22). Where applicable also remove capscrews and washers (82).
6. Hoist or lift upper pump assembly from discharge casing.
7. Remove impeller locknut (19). If impeller *cannot* be re moved easily, warm the impeller near the shaft with a torch. Pry the impeller carefully and evenly with two large screws on opposite sides of the backplate. Care should be exercised in prying so as not to bend the shaft. Though prying without heating is possible, it is recommended that heat be applied to prevent enlarging the impeller bore. Remove the impeller key.
8. Remove backplate (26) from upper pump assembly. Loosen gland nuts (13), remove packing gland (32) and pick out packing rings (30) and lantern ring (29) carefully noting the number of packing rings used above and below the lantern ring.
9. Remove water slinger (12) and coupling key (1) from shaft.
10. To dismantle the power frame assembly:
    - **a. No. 1 power frame**
        - i. Remove the 2 capscrews and washers (37) that are threaded into the power frame (8).
        - ii. Tighten jackscrews (3), in equal increments, to remove shaft assembly from power frame. It will be necessary to use longer jackscrews than those provided for impeller adjustment to facilitate complete removal of the bearing retainer (36) from the power frame.
        - iii. After the bearing retainer is completely out of the power frame, lift the shaft assembly by the threaded hole in the motor end of the shaft.
        - iv. Remove snap ring (35) from bearing retainer.
        - v. Remove bearing retainer from shaft assembly.
        - vi. Remove bearing locknut and washer (6) and bearing (7).
        - vii. Remove snap ring (10) from shaft and remove bearing (9).
        - viii. Clean all parts in kerosene and remove all burrs from machined surfaces before reassembling pump. Keep ball bearings wrapped in clean, lintless cloth at all times when not in pump. When replacing bearings on shaft, pack clean bearing grease into the bearings with fingers (be sure fingers are free of dirt and / or grit). DO NOT USE A HAMMER TO REMOVE SHAFT ASSEMBLY.
    - **b. No. 2 power frame with two-piece bearing retainer.**
        - i. Remove the 2 capscrews and washers (37) that are threaded into the power frame (8).
        - ii. Remove shaft assembly from power frame by tightening jackscrews (3), in equal increments. It will be necessary to use longer jackscrews than those provided for impeller adjustment to facilitate complete removal of the shaft assembly
        - iii. After the bearing retainer sleeve (85) is completely out of the power frame, lift the shaft assembly by the threaded hole in the motor end of the shaft.
        - iv. Remove capscrews (86) from bearing retainer (84).
        - v. Remove bearing locknut and washer (6) from shaft.
        - vi. Remove bearing set (7) and bearing retainer sleeve as a unit from shaft. Bearing puller should bear on inner race of the bearing set.
        - vii. Pull bearing set out of bearing retainer sleeve.
        - viii. Remove snap ring (10) from shaft and remove bearing (9). Bearing puller should bear on inner race of the bearing.
        - ix. Clean all part in kerosene and remove all burrs from machined surfaces before reassembling pump. Keep ball bearings wrapped in clean, lintless cloth at all times when not in pump. When replacing bearings on shaft, pack clean bearing grease into the bearings with fingers (be sure fingers are free of dirt and/or grit). DO NOT USE A HAMMER TO REMOVE SHAFT ASSEMBLY.

c. No. 2 power frame with one-piece bearing retainer.

i. Remove the 2 capscrews and washers (37) that are threaded into the power frame (8).
ii. Remove bearing retainer (36) from power frame by tightening jackscrews (3), in equal increments. It will be necessary to use longer jackscrews than those furnished for impeller adjustment to facilitate complete removal of the bearing retainer from the power frame.
iii. After the bearing retainer is completely out of the power frame, lift the shaft assembly by the threaded hole in the motor end of the shaft.
iv. Remove snap ring (35) from bearing retainer._
v. Remove bearing retainer from shaft assembly.
vi. Remove bearing locknut and washer (6) and bearing set (7).
vii. Remove snap ring (10) from shaft and remove bearing (9).
viii. Clean all parts in kerosene and remove all burrs from machined surfaces before reassembling pump. Keep ball bearings wrapped in clean, lintless cloth at all times when not in pump. When replacing bearings on shaft, pack clean bearing grease into the bearings with fingers (be sure fingers are free of dirt and/or grit). DO NOT USE A HAMMER TO REMOVE SHAFT ASSEMBLY.

NOTE: Pumps with the No. 2 power frame having the two-piece bearing retainer can have the motor end bearing set removed and replaced without dismantling the entire pump by the following procedure:

1. Perform steps 1 through 4 as above.
2. Remove coupling key (1) from shaft.
3. Remove the 2 capscrews and washers (37) that are threaded into the power frame (8).
4. Remove capscrews (86) from bearing retainer (84).
5. Remove bearing retainer from power frame by tightening jackscrews (3), in equal increments. It will be necessary to use longer jackscrews than those furnished for impeller adjustment to facilitate complete removal of the bearing retainer from the power frame.
6. Remove bearing locknut and washer (6) from shaft.
7. Replace bearing retainer and capscrews (86).
8. Tighten jackscrews (3), in equal increments, to remove bearing retainer, bearing retainer sleeve (85), and bearing set (7) as a unit from shaft.
9. Remove capscrews (86) from bearing retainer.
10. Pull bearing set out of bearing retainer sleeve.
11. When reassembling the bearing, it is mandatory that anew grease seal (38) be installed.

C. TO ASSEMBLE PUMP:

To assemble the pump, reverse the disassembly procedure but take the following precautions:

1. Remove the old packing or mechanical seal assembly as applicable. .
2. Carefully place the bearings onto the shaft being certain of proper orientation. Check the diagrams for assistance.
3. Place water slinger (12) on shaft before assembling packing or mechanical seal housing.
4. Be certain to use impeller key (20).
5. Check all gaskets and grease before using.
6. Before placing sleeve on shaft, clean the shaft with a solvent, and then coat the shaft with Loctite RC680 or equivalent. Sleeve must be placed on shaft prior to mechanical seal assembly.
7. Assemble each individual mechanical seal part carefully in order not to damage mating seal faces. Press old floating seat out of seal housing. Oil outer surface of the seat ring using light oil (not grease), and push the stationary seal face into the cavity of the seal housing, setting it firmly and squarely. Wipe the lapped seal face of the rotating seat clean, and oil face with clean light oil. If seal housing gasket (27) needs replacing, put on a new gasket. Place water slinger and seal housing assembly carefully over shaft, being careful not to strike floating seal with shaft.

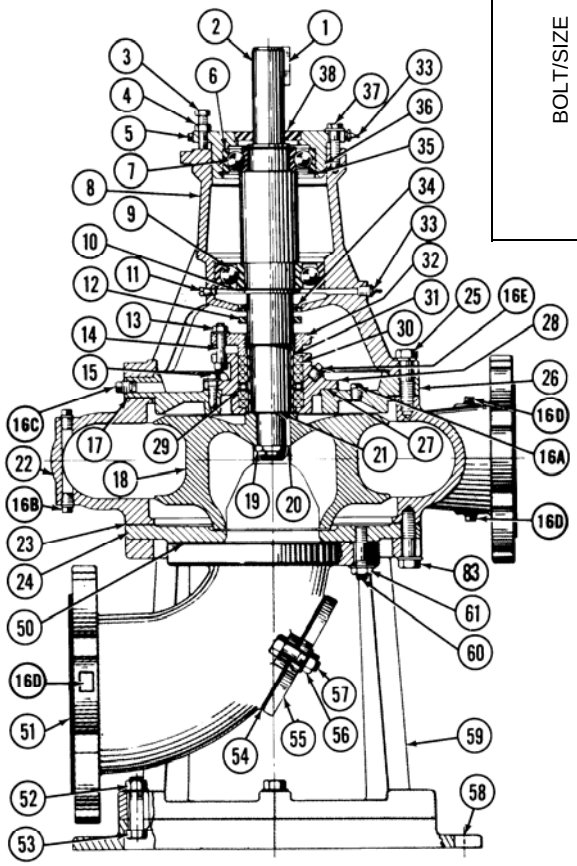
   Oil the surface of the shaft using light oil, not grease. Wipe the face of the sealing face clean and oil with clean light oil. After placing seal housing (40) onto the shaft, put the sealing face and bellows assembly, less the spring, on the shaft. Be certain the seal face is in the proper position with the carbon sealing face toward the motor end. The notches on the edge of the sealing face should mate with the lugs on the retainer. Use a sleeve of proper diameter to slide assembly back as far as it will go. Until slinger and seal housing are back against the power frame. When sliding seal assembly onto shaft, be certain to press only tail sections of bellows and driving band. A smooth sleeve of about 1/32" longer than the shaft sleeve diameter with a wall thickness of about 1/8" is suitable. Place seal spring over shaft and set it properly over the bellows assembly.
8. Assemble seal housing to backplate.
9. Use a non-hardening gasketing compound, Permatex #2 Form-a-gasket or equal (21) prior to

placing impeller on shaft.

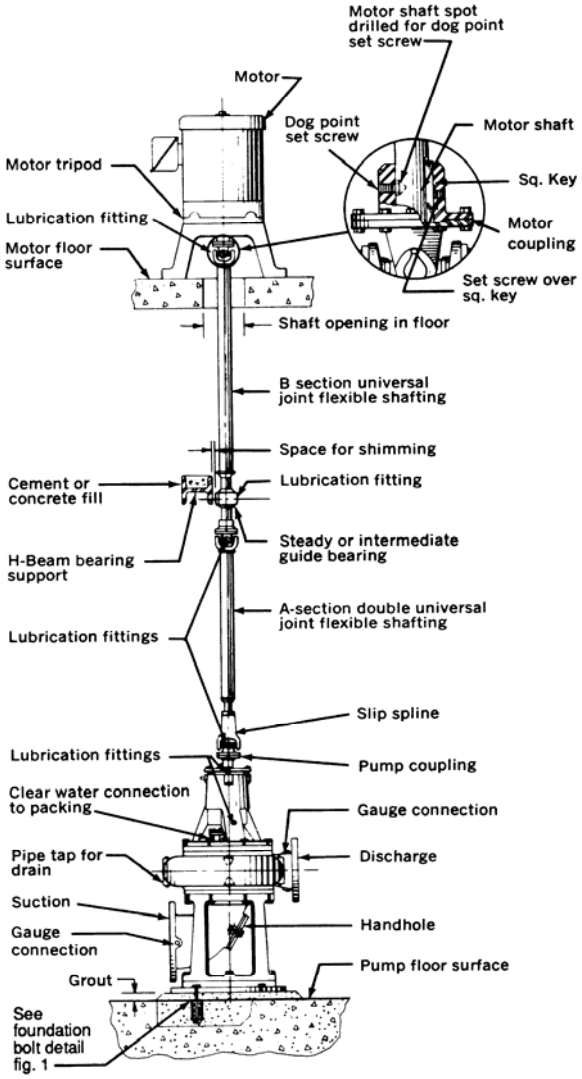
10. Adjust impeller (18) axially with set screws to have a clearance between impeller and suction cover (24) of .005 to .010 inches. When the pump is in a vertical position, loosen cap screws (3) until impeller rubs on suction cover, then tighten cap screws (3) 1/4 to 1/2 turn until the proper clearance is reached. Cap screws should be alternately tightened in equal increments to assure satisfactory impeller clearance. Tighten cap screws (37) to secure bearing retainer (36).

TABLE 4
Recommended Torque Values of
Fasteners in Foot-Pounds

BOLT/SIZE		LOW CARBON STEEL	304 ST'N STL	SILICON BRONZE	316 ST'N STL
	1/4-20	5.4	6.3	5.7	6.6
	5/16 - 18	10.8	11.0	10.3	11.5
	3/8 - 16	17.7	19.7	18.3	20.6
	7/16-14	28.2	31.3	29.1	32.8
	1/2- 13	38.8	43.1	40.0	45.2
	9/16 - 12	51.1	56.8	52.7	59.4
	5/8 - 11	83.3	92.5	85.8	96.7
	3//4 - 10	104.9	127.5	118.0	131.8
	7/8 - 9	159.9	194	178.3	202.5
	1 " - 8	236.0	286.7	265.4	299.6

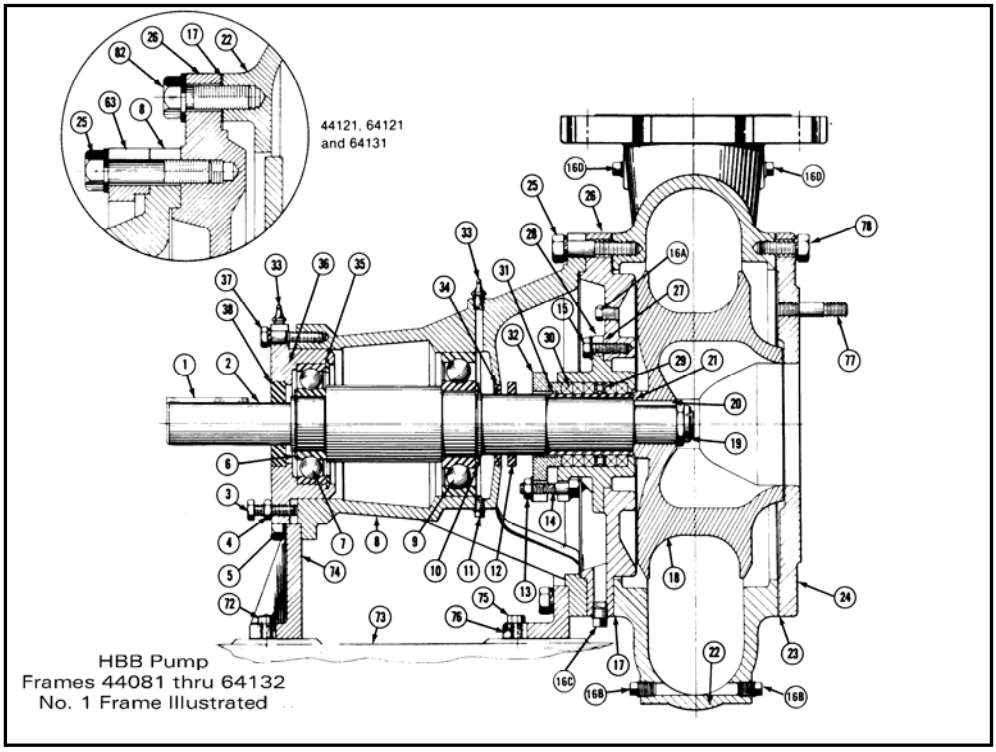


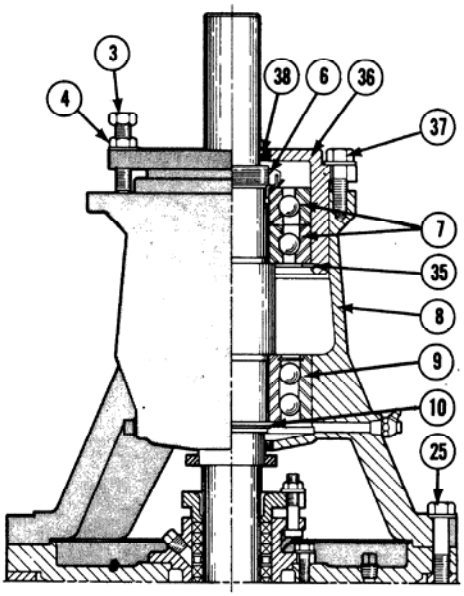
VOS Pump
Frames 44081 thru 64132
No.1 Power Frame Illustrated



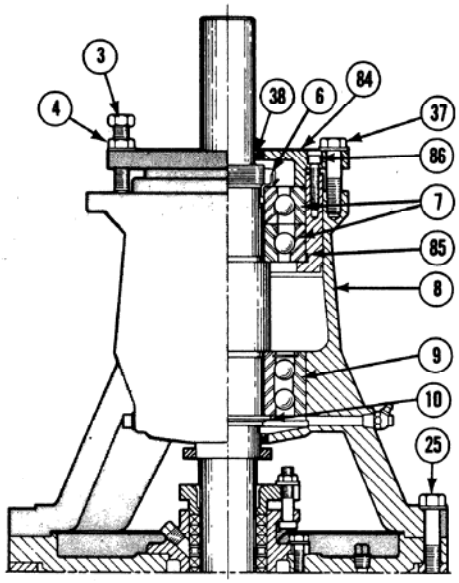
PARTS LIST

1. Coupling Key	*23. Gasket	54. Cleanout Cover Gasket
2. Shaft	24. Suction Cover	55. Cleanout Cover
3. Hex. Head Cap Screw	25. Hex Head Cap Screw and Washer	56. Nut and Washer
4. Nut and Washer	26. Back Plate	57. Hex Head Cap Screw
5. Pipe Plug, Grease Relief	*27. Gasket	58. Floor Plate
*6. Bearing Lock Nut and Washer	28. Packing Housing	59 Pedestal
*7. Ball Bearing (Duplex Pair on No.	29. Lantern Ring	60. Stud
2 Power Frame)	*30. Packing	61. Nut and Washer
8. Power Frame	*31. Shaft Sleeve	62. Hex Head Cap Screw and Washer
*9. Ball Bearing (Double Row on No.	32. Packing Gland	63. Motor Pedestal
2 Power Frame)	33. Alemite Fitting	64. Hex Nut
*10. Snap Ring	*34. Grease Seal	65. Motor Adapter
11. Pipe Plug, Grease Relief	*35. Snap Ring	66. Pump Half Coupling
*12. Water Slinger	36. Bearing Retainer	67. Flexible Insert
13. Gland Nut and Washer	37. Hex Head Cap Screw and Washer	68. Motor Half Coupling
14. Gland Bolt	*38. Grease Seal	69. Coupling Set Screw
15. Hex Head Cap Screw and Washer	39. Lower Seal Housing	70. Hex Head Cap Screw and Washer
16. Pipe Plug	40. Upper Seal Housing	71. Motor
(A). Air Vent	*41. Seal Assembly	72. Hex Head Cap Screw and Washer
(B). Volute Drain	42. Filter Assembly	73. Base Assembly
(C). Seal Drain	*43 Filter Insert	74. Power Frame Foot
(D). Gauge Connections	44. Connector	75. Hex Head Cap Screw and Washer
(E). Water or Grease Seal	45. Elbow	76. Pump Foot
Connection	46. Petcock Assembly	77. Stud
*17. Volute Gasket	47. Tubing	78. Hex Head Cap Screw and Washer
18. Impeller	48. Tubing	82. Hex Head Cap Screw and Washer
19. Lock Nut and Washer	49. Hex Head Cap Screw and Washer	83. Hex Head Cap Screw and Washer
20. Impeller Key	*50. Suction Elbow Gasket	84. Bearing Retainer Cap
21. Non-Hardening Gasket	51. Suction Elbow	85. Bearing Retainer Sleeve
Compound	52. Nut and Washer	86. Socket Head Cap Screw
22. Volute	53. Hex Head Cap Screw	
(*) Recommended Spare Parts List		

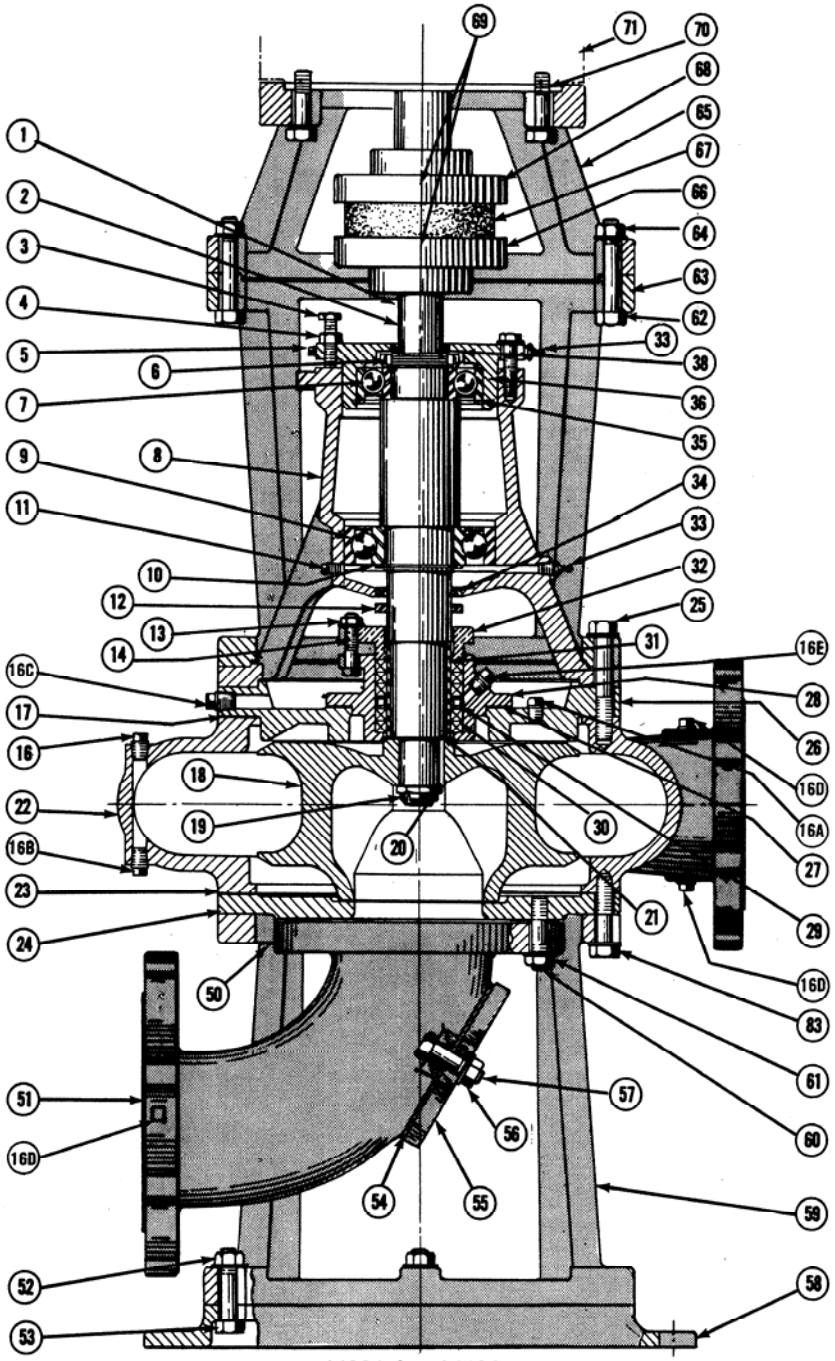




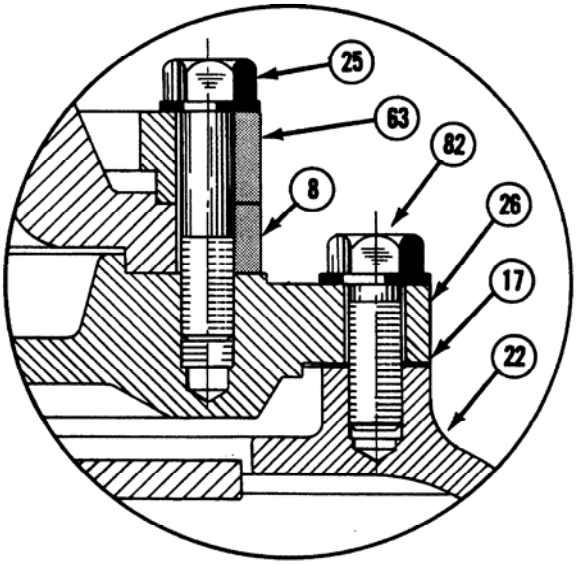
No. 2 Power Frame with
One-Piece Bearing Retainer



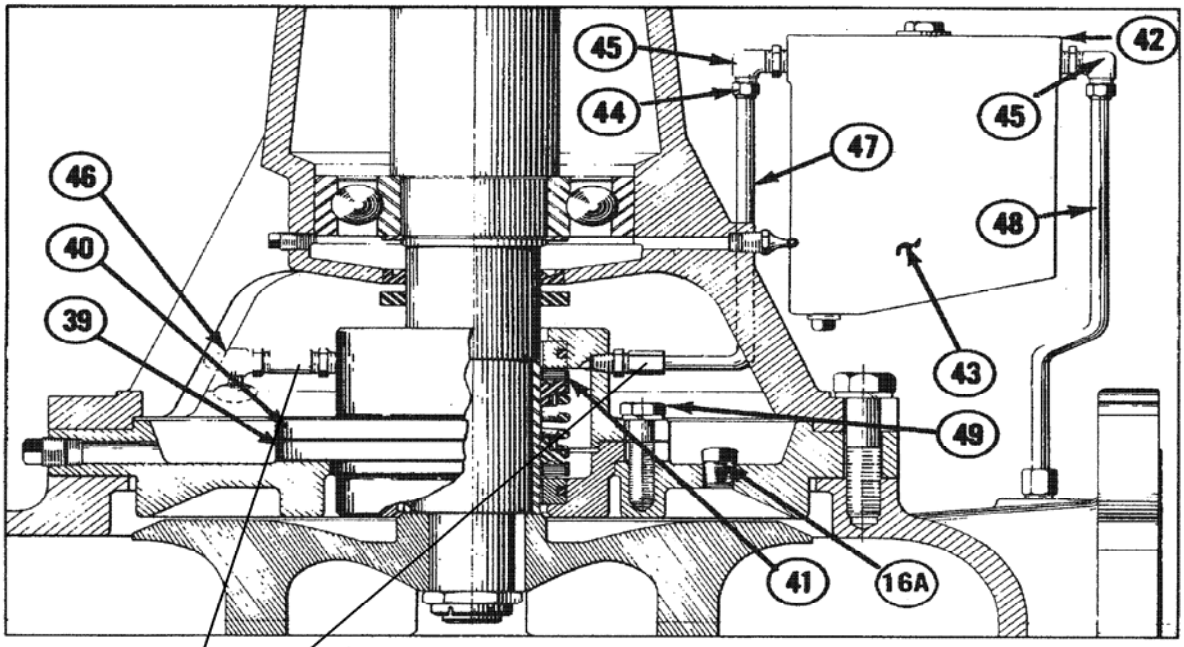
No. 2 Power Frame with
Two-Piece Bearing Retainer



44081 thru 64132
No. 1 Power Frame Illustrated



44121, 64121 and 64131



Mechanical Seal Assembly

Seal Water Supply
Inlet & Outlet

☆ If Applicable	Item to be Lubricated	Recommended Lubricant	Frequency	Method	Remarks
	Pump Bearings: Thrust & Radial (grease lubricated)	Amoco Super Permalube Arco Litholine E2 Shell Alvania EP2, Molyvis ST-200, Mobil Mobilux #2. Texaco Regal AFB2 Unocal UNOBA E2, or equal grade of lithium soap base or EP grease.	Every 1500 hours of operation, or more frequently depending on severity of duty.	Add enough grease to Alemite fittings to maintain bearings 1/2 full. (1/2 to 1 oz)	DO NOT OVERGREASE
	Pump Bearings: Thrust & Radial (oil lubricated)	Mobil DTE Light Shell Turbo 32 Chevron GST 32 Exxon NUT0 32 or equal.	Check oil level prior to start-up. Check level at oil cup or oil plug once a week.	Visually inspect. Manually refill when oil level falls below overflow point of oil cup or oil Plug	Change oil every 3000 hours of operation See page 9
	Packing: (grease lubricated)	Shell Alvania EPRO 71030 or equal ***NOTE:*** If automatic grease lubrication system is used, refer to manufacturer's lubricant recommendations.	3 oz. grease applied every 24 hours of operation	Manually add grease to Alemite fitting, or employ use of an automatic grease lubrication system Visually Inspect for slow steady weepage of pumpage.	See page 10.
	Packing: (flow thru water lubrication)	Clear Water	Check daily for flow.	Visually inspect for slow steady weepage of water	See page 10.
	Mechanical Seal (flow thru water lubrication)	Clear Water	Check daily for flow	Visually inspect flow meter to verify mechanical seal is being lubricated.	See page 10.
	Mechanical Seal (closed loop filter system)	Filtered liquid from Pump discharge	check filter element every 8 weeks	Drain a small amount of liquid thru petcock at seal housing. Inspect for clarity. Replace filter element if necessary.	See page 10.
	Shafting: Steady and Cross Bearings	Same as for pump bearings.	Prior to start-up and every 200 hours of operation	Add grease to fittings until old grease is purged and new grease appears at all ports.	See page 8.
	Shafting: Sliding Splines	Texaco Marfac “O” EP, or equal grade of long fiber grease ONLY.	Prior to start-up and every 200 hours of operation	Add grease to grease fining.	See page 8
★	**General Overall Inspection**		Once a week	Check operation of control system, and that motor comes up to speed properly. Keep interior and exterior of motor and controls free from moisture, oil and dirt.	Refer to special motor manufacturer's instructions for additional recommended maintenance