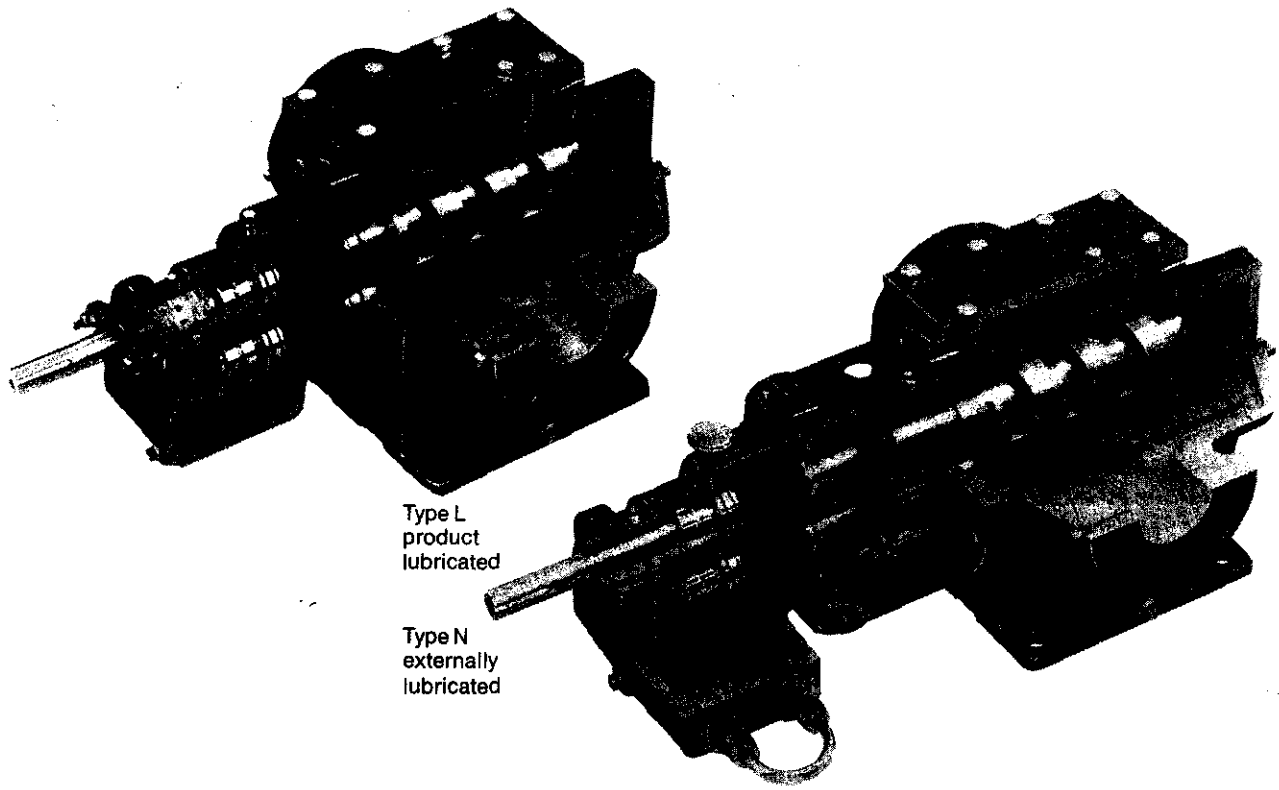
WARREN PUMPS HOUDAILLE
ONE OF THE HOUDAILLE PUMP GROUP

SECTION 2500
PAGE M2500
ISSUE B

INSTALLATION OPERATION MAINTENANCE



Type L product lubricated

Type N externally lubricated

2500 SERIES SCREW PUMP 2501-TYPE L 2502-TYPE N

PLEASE READ THESE INSTRUCTIONS BEFORE INSTALLING PUMP

MEMBERS OF THE HOUDAILLE PUMP GROUP

Warren Pumps, Inc.
Warren, Massachusetts
Peace Dale, Rhode Island
Rockaway, New Jersey

Viking Pump Division
Cedar Falls, Iowa

Houdaille International, Inc.
Alphen a/d Rijn
The Netherlands

CAUTION
IMPORTANT SAFETY NOTICES

This equipment is the responsibility of the equipment owner. Prior to operating the equipment, all necessary steps must be taken by the owner to comply with various federal, state, local and OSHA laws or requirements relating to installation and safe operation.

This pump is not to be operated at speeds, working (discharge) pressures or temperatures higher than, nor used with liquids other than stated in the original order acknowledgement without written permission of Warren Pumps Division, Houdaille Industries, Inc. Refer to the manuals provided by manufacturers of other related equipment for their separate instructions.

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INTRODUCTION

This manual is intended to assist those concerned with installation, operation and maintenance of Warren 2500 Series screw pumps. It is the manufacturer's hope that the following discussions will be clearly and easily understood. Should questions arise that cannot be answered by the material contained in this manual, we suggest that the Warren Service Department be contacted through your local Warren distributor or directly.

SECTION 1 — GENERAL INFORMATION

1-1 DESCRIPTION AND APPLICATION

Warren Series 2500 screw pumps are designed for pumping corrosive and noncorrosive liquids. Capacities to 2400 gpm. Discharge pressures to 500 psi. Viscosities to 100,000 ssu. They are available in stainless steel, cast steel or cast iron construction.

For pumping lubricating liquids, the Series 2501 type L is used, with timing gears and antifriction bearings in the liquid being pumped.

For pumping nonlubricating liquids, the Series 2502, type N is used, with timing gears and antifriction bearings outside the liquid being pumped.

Your Series 2500 pump is a rotary, twin screw, positive displacement pump. The pump consists of two counter rotating shafts located in intersecting body bores.

Each shaft includes a pumping screw, balance piston, timing gear and two bearings. The two shafts are arranged so that the pumping screws are meshed together inside intersecting pump bores.

The fluid pumped enters the unit and travels through suction passages until it reaches the body bore. The fluid is then picked up by the leading tip of the screw. Then, because of the advancing pitch or threading action of the pumping screws, the fluid is trapped in the sealed cavity and moved axially toward the discharge side of the pump. Fluid is discharged first from one screw, then the other, creating a steady, practically pulseless flow of fluid into the system.

The thrust collar located on the discharge side of the pumping screws aids in hydraulically balancing the pump, thus reducing thrust loading on the thrust bearings located at the suction end of the pump.

1-2 DESIGN & CONSTRUCTION

Casing — The casing, consisting of body and heads and, in the 2502 Series, the stuffing box, can be furnished in cast iron, cast steel or stainless steel. The stainless steel body bores are hard surfaced for abrasion and corrosion resistance and to reduce galling. Body is designed for jacketed or unjacketed operation.

Shafts and Screws — Short bearing spans and generous shaft diameters reduce deflection and resulting wear. Pumping screws for each pump size have three standard pitches to meet most pumping conditions. Stainless steel screws are hard surfaced for abrasion and corrosion resistance and to reduce galling.

Bearings — Radial bearings and thrust bearings are heavy duty roller type to handle maximum loads. They are self-flushing. Rear head bearings are carbon sleeve type.

1-3 RECOMMENDED BASIC SAFETY PRACTICES:

1. **Never** work on a pump unless it has been locked out both electrically and hydraulically, from the system (this should be done with an appropriate tag-out system on electrical controllers and on any valves involved.)
2. Be sure proper hoist or crane is used when rigging heavy assemblies for removal, installation, etc.
3. Be sure all liquid fittings are properly tightened to prevent leak hazards to personnel.
4. Be sure the coupling guards and/or belt guards are of an approved type and are properly installed.
5. Be sure relief valves are operating at the correct capacities and pressures.
6. Be sure speed limiting and speed regulating governors are set at the designed speeds and that they are operating properly.
7. Do not operate at higher speeds or pressures than specified without first consulting Warren Pumps Division, Houdaille Industries, Inc. Failure to do so can result in serious personal injury or property damage.

1-4 PRODUCT WARRANTY

1. Warren warrants its products to be free of defects in material and workmanship for a period which ends on the earlier of one year from date of product start-up or eighteen (18) months from date of shipment by Warren. Any part which fails during the warranty period due to defective materials or workmanship will be replaced without charge, F.O.B. Manufacturer's works, provided the party seeking warranty service (a) gives written notice of such defect within the warranty period to his immediate vendor (i.e., the person from whom the party bought the product); (b) obtains instructions from that vendor for the return of defective part(s) for service; and (c) delivers the defective part(s) to that vendor, transportation prepaid, and in accordance with its instructions.

2. Warren's liability for any damage caused by a product which fails due to defective materials or workmanship shall be limited to the replacement or repair (at Warren's option) of the defective part or parts as originally furnished by Warren. Warren shall not be liable for any loss, damage, or expenses directly or indirectly related to the use of its products or from any other cause or for consequential damages (including, without limitation, loss of time, inconvenience, and loss of production). It is expressly understood that Warren is not responsible for damage or injury caused to other products, machinery, buildings, property, or persons by reason of the installation or the use of its products.
3. The warranty shall be null and void if any component of a product has been (a) tampered with, disassembled, repaired or altered (except as may be authorized by Warren in writing); (b) subject to misuse, neglect or accident; or (c) used to pump materials for which it was not designed to handle, which may attack or harm the materials used in construction of the pump, or which may otherwise harm the operation of the pump.
4. This warranty does not cover or apply to (a) the effects of corrosion, abrasion or normal wear; (b) repairs or service adjustments required due to lack of proper maintenance, natural causes or acts of God; or (c) any field expense for service or replacement of parts.
5. This is WARREN'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This document and the warranty contained herein may not be modified and no other warranty, express or implied, shall be made by or on behalf of WARREN unless modified in writing and signed by the President or Vice President of WARREN.

SECTION 2 — RECEIVING, HANDLING AND STORAGE

2-1 RECEIVING

Place the equipment under adequate protection immediately upon receipt. Ordinary packing crates are not suitable for out-of-door storage beyond a 30 day limit including the duration of transport. This may be less if the atmospheric conditions are unfavorable. Contact the manufacturer for specific instructions. Improper storage can damage the equipment which would result in a non-warranty situation.

Special long term storage crating can be supplied upon request, at an additional cost.

Upon receipt of shipment, carefully inspect the pump, driver and individual parts to insure none are missing or damaged. Any damage must be reported promptly to the carrier and to Warren or your Warren distributor. Damage claims must be made at the time of receipt.

2-2 HANDLING

Take care when moving the unit about prior to installation. This is particularly important with large, heavy units. Rough handling and thoughtless selection of points from which to lift large units can cause permanent distortion of the base and/or casing which will affect the close operating clearances of the rotating assembly. Contact of the moving parts can cause a pump failure.

2-3 STORAGE AND PRESERVATION

Units are shipped on skids and suitably boxed or crated to help prevent damage from normal handling. All exterior, unpainted surfaces subject to corrosion are coated with a rust preventive compound. Pump openings are covered with blank flanges or special cups.

A packing list is furnished itemizing the contents of the shipment. When received, check the contents against the packing list. Report any discrepancies to Warren or your Warren distributor immediately.

If pump is not to be installed immediately and operated or if pump is not to be operated for some time after installation, the unit must be cared for as follows:

1. Store in a clean and dry location.
2. Be certain that blank flanges or cups covering pump openings are properly attached.
3. Rotate pump shaft through several turns at least weekly.
4. Recoat all exterior, unpainted surfaces subject to corrosion with a rust inhibiting compound.
5. Fill oil reservoirs completely full of oil.
6. Protect pump and driver with plastic or canvas covering.
7. Fill cast iron or cast iron fitted pumps with oil or a suitable preservative.

SECTION 3 — INSTALLATION

IMPORTANT — The following installation instructions are a guide to assist you in proper installation procedures.

Probably the most important thing that can be done to extend the life and smooth operation of this machine is to plan your installation by following these installation procedures and other good machinery practices.

If questions should arise, contact the Warren Service Department for assistance.

NOTE — Protect your investment. A properly planned and executed installation is necessary for trouble free pump performance.

3-1 LOCATION

The pumps are purchased to deliver a specific capacity at a specific pressure. To accomplish this, the designer must take into consideration the conditions that will exist on the suction and discharge sides of the pump after installation such as suction lift or head and temperature. This information is given to the pump engineer by the purchaser and is based on a preplanned location of the pump in a system. In order for the pump to operate as designed, it must be located in this preplanned location. If, after receipt, another location is considered that might alter the preplanned conditions, it is recommended that Warren engineering be consulted to insure satisfactory operation of your pump.

Locating the pump as near as possible to the source of supply upon installation is recommended. Ideally, the location should be well lit and dry with enough room to perform routine maintenance and space enough for rigging, etc. If you find it necessary to locate the unit in a pit, be sure to make provisions to prevent flooding.

3-2 FOUNDATION

Foundations should be a suitable mass to absorb vibration and provide a rigid support for the unit. Use reinforced concrete as necessary.

A template should be made to position and hold the foundation bolts in place while pouring the concrete. Location and sizes of bolt holes are shown on the certified drawing supplied to the purchaser. Each bolt is installed in a pipe sleeve, the inside diameter of which should be three times the outside diameter of the bolt. The pipe sleeve allows for minor adjustments in bolt spacing after foundation is in place (Fig. 3-2). Two methods commonly used to secure and prevent bolts from turning are:

a. A washer is placed between the bolt head and pipe sleeve with a lug welded to the bolt head (Fig. 3-2).

b. The bolt may be of rod construction, bent 90° below the pipe sleeve.

Stuff waste paper between foundation bolts and sleeves to prevent concrete from entering while foundation is being poured. Foundation bolt must be long enough to allow from ¾" to 1" for grouting under the baseplate (Fig. 3-2). When pump is level, the bolts should extend ¼" through the nuts. Leave top surface of foundations rough for adherence of grout.

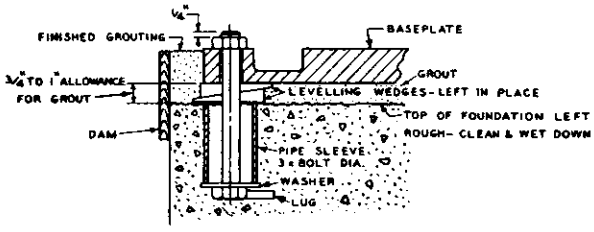


Fig.3-2

3-3 BASEPLATE

1. **Leveling** — Before placing the unit on the foundation, be sure the surface of the foundation is clean and roughed. Place the leveling wedges adjacent to foundation bolts and remove waste paper from pipe sleeves. Clean underside of pump mounting base and lower unit over baseplate bolts and onto wedges. Adjust the wedges to allow for ¾" to 1" of grout, being sure pump flanges are true. This unit has been factory aligned and uneven bearing of wedges can cause misalignment. Snug up, but do not make up hard the foundation bolts. Check coupling alignment and correct as necessary. Avoid baseplate distortion. Level pump with a spirit level.

2. **Grouting** — Build a board dam around the foundation to the desired height for finished grouting (See Fig. 3-2). A mixture of one part portland cement to two parts clean sand with just enough water to mix to a thick creamy consistency should be made for grout. Wet the underside of the baseplate and foundation top, then pour the grout through the holes in the baseplate. Thoroughly puddle the grout during pouring to prevent air pockets and hollow spots. After grout has set sufficiently, remove the board dam and finish off the grout as desired. When grout has hardened, usually in about 48 hours, pull up on foundation bolts.

3-4 PIPING

1. Since the basic pump design incorporates close running clearances between the screws and the body, it is very important that suction side piping be thoroughly cleaned before connecting piping to the pump.

2. After the unit has been installed and secured on its foundation, pipe connections may be made up. See pump outline drawing for location of all

pipe connections, flange sizes, drilling and other notes pertinent to piping. Piping runs should be as short and direct as possible. Use long radius elbows to change direction wherever possible. Discharge piping must be sized to give the required velocity based on the ideal flow condition for the type of fluids being pumped.

3. All major piping must be supported independently of the pump and properly aligned with pump flanges. Piping subject to high temperatures must be fitted with a means of absorbing expansion. Piping strain on the pump may cause distortion resulting in misalignment, vibration or mechanical damage.

4. If the pump is required to operate with a suction lift, the suction system MUST be properly sized and designed. The pump cannot be expected to overcome deficiencies in system design such as long runs of suction piping, possibly undersized and containing many elbows, valves and particularly high points that are above the pump suction. In such cases, cavitation will invariably occur.

5. To check piping alignment of pumps having bolted flanges, insert flange bolts through pipe and pump flange. If bolts are easily moved within the bolt holes and if flange faces are parallel with each other, piping is properly aligned.

3-5 PIPING SYSTEM ACCESSORIES

1. **Suction Strainers** — Warren recommends that suction strainers be installed on the suction side of the pump at least temporarily until the new system is deemed cleansed of foreign material. Strainers or screens should be constructed of 20 mesh wire and equipped with a backing plate. The total mesh opening should be 5 times the cross sectional area of the pipe. If liquid is in excess of 100 SSU viscosity, 6 times the pipe area is recommended. Gauges should be installed on either side of the strainer to indicate when the strainer requires cleaning.

   Generally strainers can be used successfully on all liquids except those of a very high viscosity such as may be found in certain chemical industry applications. In these cases, thorough cleaning of the entire suction system is mandatory.

2. **Check Valves** — If the discharge piping system is subject to a high static head and if the liquid handled will flow easily, a check valve should be installed. This valve will prevent hydraulic shock acting upon the pump and will also prevent reverse rotation of the pump when stopping the unit and most importantly, it permits starting the pump when a sister pump is operating in a common system.

3. **Relief Valves** — Pressure relief valves should be installed between the discharge valve and discharge flange of screw pumps to protect both the pump and piping systems. The valves should be solidly constructed of proper material with ample opening for passage of full discharge capacity, because positive displacement pumps can build up pressure rapidly if the discharge is restricted or shut off. This type of relief valve should lead to the source of supply particularly in pumps that operate unattended.

4. **Vent** — If pump is required to operate with a suction lift, a suitable means for venting the pump should be installed in the discharge piping adjacent to the pump.

3-6 FACTORY ALIGNMENT

Pumps supplied with driver, base and coupling from the factory are aligned (coupling) prior to shipment. However, stresses caused by lifting and transportation often cause minor distortion which will disturb the factory alignment. Check coupling alignment after the baseplate has been leveled but prior to grouting.

If the coupling alignment has been disturbed by improper shimming of the baseplate, correct prior to continuing. After the base has been grouted and the piping connected, make a final pre-startup coupling alignment check. Additionally, a hot alignment check must be made once the pump has been run up to its operating temperature (see Sect. 4, Coupling Alignment, for detailed procedures.)

3-7 DOWELING

After the unit has been running for about one week, the coupling halves must be given a final check for possible misalignment caused by pipe strain or temperature strains. This check must be made immediately after unit is shut down, before it has a chance to cool. If alignment is correct and unless Warren instructs otherwise, the driver must now be doweled on diagonal feet.

NOTE: Normally the pumps are doweled at the factory and the drivers are doweled in the field. The taper pin size for doweling the driver will normally be the same as that of the pump.

SECTION 4 — COUPLING ALIGNMENT

4-1 ALIGNMENT

The flexible coupling supplied with your pump is not designed to operate with excessive misalignment. Reducing misalignment in your coupling installations will increase coupling life and greatly increase operating life of associated equipment such as bearings, packing and seals.

Check the following prior to aligning the pump and driver. Set the coupling gap within tolerances given on the supplied outline drawing. During any work performed on either pump or driver, BE ABSOLUTELY CERTAIN THAT ACCIDENTAL ENERGIZING OF THE SYSTEM WILL NOT OCCUR.

Coupling alignment must be handled in all three planes.

To set side to side alignment.

1. Mount a dial indicator rigidly on the driver half of the coupling and set the indicator button on the rim of the pump half (Fig. 4-1).
2. Facing the driver from the coupling end, set the indicator to zero at the 3 o'clock position. Turn the two coupling halves together and record the reading at the 9 o'clock position. The purpose in turning both halves together is to eliminate the possibility of inaccurate centerline alignment due to coupling runout.
3. The indicator reading will show double the amount of correction required to true the coupling side to side. If the indicator moved in a counter-clockwise direction, the reading is considered negative. If the movement was clockwise, it is considered a positive reading.
4. If the reading was positive, push the motor in the 3 to 9 o'clock direction ½ the total indicator reading. Push the motor towards the starting point (3 o'clock) ½ the indicator reading if it was negative.
5. Return to the 3 o'clock position and reset at zero.
6. Turn the coupling halves together and recheck the alignment. If not quite zero at 9 o'clock, repeat the procedure until a 0-0 reading is obtained in the 3 and 9 o'clock positions.

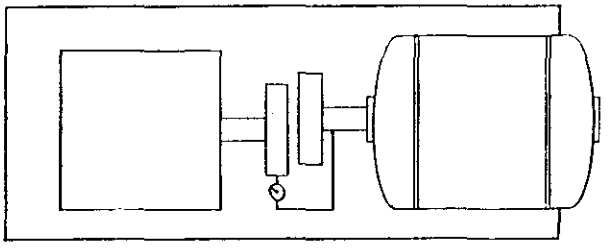


Fig. 4-1 Rim Side to Side

Once side to side alignment is set, face alignment can next be checked. The coupling gap can be accurately checked with either an indicator, set of feeler guages or a wedge. Checking with feeler guages is easiest to accomplish. The indicator can remain set up on the coupling rim and rotation of the coupling is not necessary to determine face alignment when using feeler guages.

1. If the coupling gap is open at the bottom and closed at the top (Fig. 4-2), the front feet of the driver must be shimmed to equalize the gap. Should the top be open in relation to the bottom, the back feet must be shimmed.

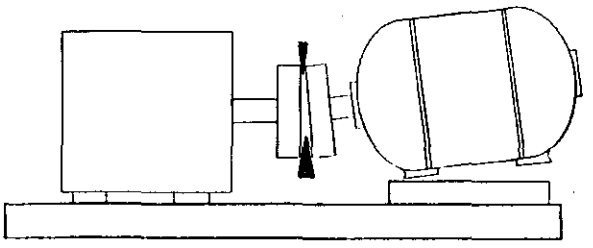


Fig. 4-2 Face Top to Bottom

2. Side to side variance in the coupling gap (Fig. 4-3) is compensated for by moving the back of the driver in the appropriate direction to equalize the gap.

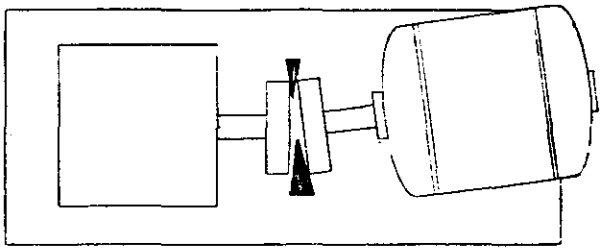


Fig. 4-3 Face Side to Side

Various factors affect the shimming of the driver feet to correct coupling gap. For example, the distance of the driver foot from the coupling will affect the amount of compensation seen when using a shim of specific thickness. In other words, the amount of correction seen using a .020" shim on the front feet of the driver will be different from the amount seen when that same .020" shim is used on the back feet. Each situation is sufficiently unique that the best results are achieved through experimentation.

Once the side to side and face alignment have been corrected, the correction of the vertical alignment may be accomplished.

1. Set the indicator to zero in the 12 o'clock position. (Fig. 4-4).
2. Turn both coupling halves together and take the readings in the 6 o'clock position.
3. If the reading is negative, place shim stock equivalent to half the indicator reading under each of the four driver feet. If the indicator has a positive reading, shims equivalent to ½ the reading must be removed from each of the driver feet.
4. Return to the 12 o'clock position and reset to zero. Turn the coupling halves and check the reading. If the reading is not zero, repeat the preceeding steps until the zero reading is obtained.

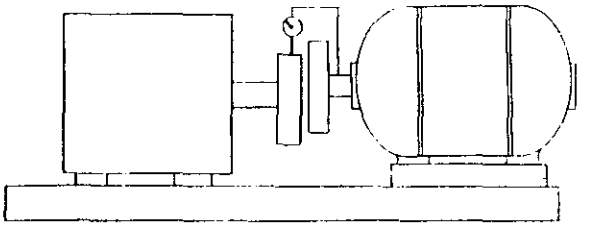


Fig. 4-4 Rim Top to Bottom

Upon completion of the alignment procedure for the third axis, the alignment in the other two axes must be checked.

Setting the vertical alignment may throw the side/side and/or face/face alignment out of tolerance. Due to the affect each axis has on the others, it is often necessary to operate at least one alignment axis approaching the allowable misalignment tolerance of .003".

The importance of checking the alignment once the unit has been piped and run cannot be understated. To insure that dangerous stresses are not imposed on pump or driver during operation, which would reduce operating life and may create hazards to operating personnel, the coupling alignment must be checked with the unit at operating temperature within a week after initial startup.

4-2 THERMAL EXPANSION

When operating units that have a high differential between centerline of driver and centerline of pump or in cases where the operating temperature of driver and pump vary considerably from ambient, the amount of thermal expansion in the pump/driver combination becomes important for proper alignment of the coupling. Failure to take into account thermal expansion when aligning the coupling can result in an extreme reduction in both coupling and bearing life.

The following explanations and worked through example should illustrate the simplicity of these calculations and the necessity that they be made.

The formula itself is expressed as the following:

coefficient of expansion X temperature rise X centerline height.

The coefficient of expansion is a specific figure for each material expressed in millionths of an inch per inch per degree Fahrenheit temperature rise. In the Warren Series 2500 pumps, three materials of construction are used in the pump bodies. These materials are cast iron, cast steel and stainless steel. The coefficient of expansion should be used with the corresponding casing material when making calculations.

A010A (Cast Iron) ..... 6.0 (32-212°F)
B061A (Cast Steel) ..... 6.5 (78-400°F)
B407G (Stainless Steel) ..... 9.4 (70-212°F)

If your operating temperature exceeds the above range listed with its corresponding coefficient, consult Warren.

The second piece of the formula deals with temperature rise and is fairly straight forward. Simply stated, the temperature rise is the difference between ambient and operating temperature (in degree Fahrenheit).

The third piece of the formula, centerline height, is simply the distance (in inches) from the bottom of the pump and driver feet to the center of their respective shafts. Check the supplied outline drawing for pump and driver centerline heights.

The following is a sample calculation using an actual outline and consequently existing centerline differences from a previous pump sale.

Example:
ambient temperature ..... 80°F
pump operating temperature ..... 200°F
pump centerline height ..... 12"
pump material 316SS
motor operating temperature ..... 160°F
motor centerline height ..... 10"
motor material ..... Cast Iron

pump rise due to thermal expansion = coefficient of expansion x temp. rise x centerline height, where
coefficient of expansion is 9.4×10^{-6} in/in/°F
temp. rise is 120°F (200°F — 80°F)
centerline height is 12"
pump rise = $9.4 \times 10^{-6} \times 120 \times 12$
pump rise = .014"

motor rise due to thermal expansion = coefficient of expansion x temp. rise x centerline height, where
coefficient of expansion is 6×10^{-6} in/in/°F
temp. rise is 80°F (160° — 80°F)
centerline height is 10"
motor rise = $6 \times 10^{-6} \times 80 \times 10$
motor rise — .005"

This would result in an additional .009" (.014" — .005") of misalignment when the pump and motor warmed up to operating temperatures. The necessity of making an allowance for thermal expansion is illustrated, as well as the need to check the alignment of the unit while hot. Further the statement should be made that the thermal growth formula is the best method of determining centerline rise without actually checking a hot unit. However, the method is just an approximation and does not account for the influences of piping, casing geometry and hot and cold spots created by circulating air.

In concluding, the following steps should be taken to insure proper coupling alignment during operation.

1. Calculate thermal growth and compensate accordingly when aligning the coupling.

2. Whenever possible allow pump and driver to warm up prior to start up.
3. Check coupling alignment while both pump and driver are hot to insure alignment is correct for the operating conditions.

SECTION 5 — LUBRICATION

5-1 2501 (Type L)

The Warren Series 2501 (Type L) is lubricated by the product being pumped.

5-2 2502 (Type N)

The Warren Series 2502 (Type N) is lubricated in two ways. The carbon sleeve bearings in the rear head are lubricated by the product being pumped. The radial bearings, thrust bearings and timing gears located in the front head are separately lubricated.

Warren recommends the use of high grade non-detergent oils with anti-foaming agents; oxidation and corrosion inhibitors. It is suggested that the oils conform approximately to the following characteristics:

ISO VG	150
Viscosity cST @ 40°C	135-165
SSU @100°F	800
Viscosity index min.	80
Flash Point OC °C	200°C
Gravity °API	28

(These are to guide you and are not rigid specifications). The following oils are satisfactory and fall in the general range of the above specifications:

EXXON	Teresstic 150
MOBIL	DTE Extra Heavy
SHELL	Turbo 150
SUNOCO	Sunvis 775
TEXACO	Regal R&O 150
GULF	Harmony 150 N

IMPORTANT

The oil level should be maintained at the recommended point in the sight glass when the pump is not running, as a false reading can occur while the pump is running. The gear and bearing housing should be thoroughly cleaned and filled with new oil at least once every three months or more often if there are any adverse atmospheric conditions (dust etc.), or other factors which might contaminate or break down the oil.

5-3 COOLING FOR SERIES 2502 (Type N)

The following chart shows the flow requirements for those pumps which require cooling.

TIMING GEAR COOLING REQUIREMENTS

	870 RPM	1150 RPM
025	No Cooler Needed	No Cooler Needed
035	No Cooler Needed	No Cooler Needed
043	No Cooler Needed	½ GPM
053	½ GPM	½ GPM
070	¾ GPM	1½ GPM
100	2 GPM	3½ GPM
	1750 RPM	**3500 RPM**
025	No Cooler Needed	½ GPM
035	½ GPM	1 GPM
043	¾ GPM	
053	1¼ GPM	
070	2½ GPM	
100		

Cooling Water Temperature — 100°F Max.
Max. Pressure in Cooler — 65 PSI.

SECTION 6 — START-UP/OPERATION

6-1 PRE-STARTUP

Pre-startup checks for trouble free initial startup are essential to avoid operational difficulties.

Listed below are several items which should be checked prior to the release of equipment to regular operation:

1. Inspect all piping. Check for leaks and unnecessary piping strain on the equipment. Flush all piping to insure removal of foreign material from the system. Check that all valves and remote control equipment is functional.
2. Check rotating element to see that it turns freely. Jacking may be necessary on large units. If there is any rubbing or binding at this point, do not start the equipment until the cause of this rubbing or binding has been located and corrected.
3. Be sure rotation of driver is correct. Rotation of pump should be C.C.W. when viewed from the coupling end and the motor must be bumped electrically with the coupling disengaged to make this determination.
4. Align coupling halves, lubricate and make up the coupling. See Section 4.
5. Check the oil level. A false reading can sometimes occur when pump is running. Prevent over lubricating your Series 2500 pump. Stop the pump to check for proper oil level. This applies only to Series 2502 pumps as Series 2501 is product lubricated.

6-2 START-UP

1. If pump is jacketed for heating, introduce heating medium and allow pump to heat.
2. Open both suction and discharge valves wide.

   CAUTION: Since this is a positive displacement pump, never operate with the suction or discharge valve closed or partially closed. When pumping hot liquids, open valves slowly to allow all parts to expand evenly.
3. If pump operates with a suction lift, open vent in discharge piping and the body must be filled with liquid prior to initial start-up AFTER installation or overhaul and possibly after lengthy periods of idle time. Once initial prime has been attained, the pump will not require priming on each start-up. If the pump operates under a flooded suction, open the valves and allow the liquid to flood the pump. Rotate pump by hand to permit proper flooding when pumping viscous liquids.
4. Start driver.
5. When your Series 2500 pump has external sealing and lubrication liquid to stuffing box from the discharge of pump, the valve or valves, depending on pumping conditions, should always be throttled to prevent excessive pressure at the gland. This is applicable to pumps equipped with packing or mechanical seals.
6. Adjust gland leakoff as necessary. Do not stop gland leakoff entirely. A constant leakoff is required to provide lubrication for the packing.
7. Open cooling water valve to timing gear housing. See Section 5-3 for flow requirements.

6-3 WHEN PUMP IS RUNNING

1. Check unit for unusual noise or vibration. Any unusual vibration or change in sound should be investigated as it may be the first sign of impending trouble.
2. Check bearing housing temperature. Bearing temperatures can safely rise to approximately 180°F.* Product and/or ambient temperatures should be considered when making judgements as to whether or not the temperatures are excessive.
3. Check gland leakoff on packed pumps. If necessary, adjust packing compression and/or gland seal pressure to achieve a slight, constant leakoff. If excessive leakoff is observed and gland travel is used up, packing rings must be considered worn and should be replaced. (See packing instructions, Section 8-12).
4. On pumps fitted with cooling water to timing gear housing, open valve and regulate so temperature of lube oil is held between 140° and 170°F.

*Bearing temperatures up to 180°F. are normal. Within limits, the stability of the temperature rather than the number of degrees is the best indication of normal operation. A sudden increase in temperature indicates that a bearing problem is developing and a check of the bearing should be made.

Do not attempt to measure temperature by hand. Above 120°F the human hand is worthless in estimating temperature. Use a sensing device to check temperatures.

6-4 TO STOP PUMP

1. Stop driver.
2. Close suction and discharge valves.
3. Close seal line valves.

SECTION 7 — PREVENTIVE MAINTENANCE

Periodic Inspection

7-1 DAILY

1. Check oil level in bearing housing (type N) when the pump is not running.
2. Listen for unusual noise or vibration.
3. Inspect pump for leaks if pump is in use.
4. Check pipe connections and valves for leakage if pump systems are in use.
5. Check stuffing boxes to see if insufficient or excessive leakage exists. If excessive leakage is observed but gland travel is used up, packing rings must be considered as worn and should be replaced. For mechanical seal installation it must be understood that all seals leak to some extent. In most cases the product vaporizes resulting in no observable leakage. However, for some applications, a modest amount of leakage is acceptable. Bearing this in mind, check to see if there is any change in leakage rate which would indicate a seal problem.
6. Adjust flushing cooling liquid as necessary.
7. Make a general survey of the area and note any conditions which could lead to future problems.

7-2 WEEKLY

1. Run idle pumps under power.
2. Check operation of suction and discharge valves.
3. Check all automatic controls and regulators.

7-3 QUARTERLY

1. Check all foundation bolts and hold-down bolts for tightness.
2. Remove half gland and check packing if pump has been left idle for long periods of time. If packing has become hard or otherwise unusable, it should be replaced.
3. Oil should be changed at least every three months or more often if there are any adverse atmospheric conditions (dust, etc.), or other factors which might contaminate or break down the oil.

7-4 ANNUALLY

1. Check existing pump capacity, pressure and power requirements against pump and motor nameplate data. If pressure and capacity have dropped off excessively, the pump should be disassembled and worn parts replaced. See applicable disassembly and reassembly sections in Section 8 — MAINTENANCE. If pump performance is satisfactory, the pump need not be disassembled for inspection.
2. Check alignment of pump and driver coupling hubs preferably after an operating period when pump and driver are still at operating temperature. Correct alignment if necessary and relubricate coupling at this time.

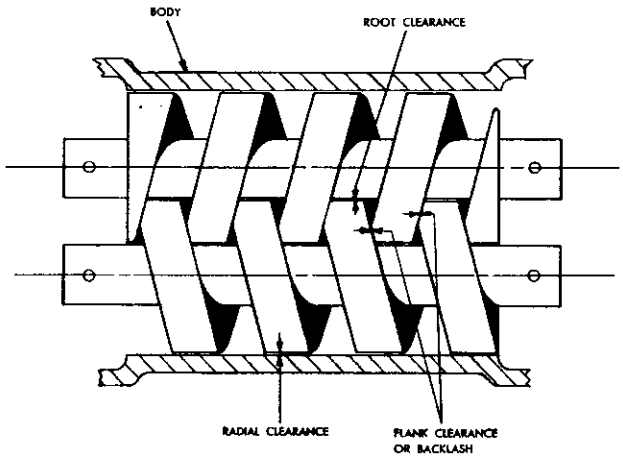
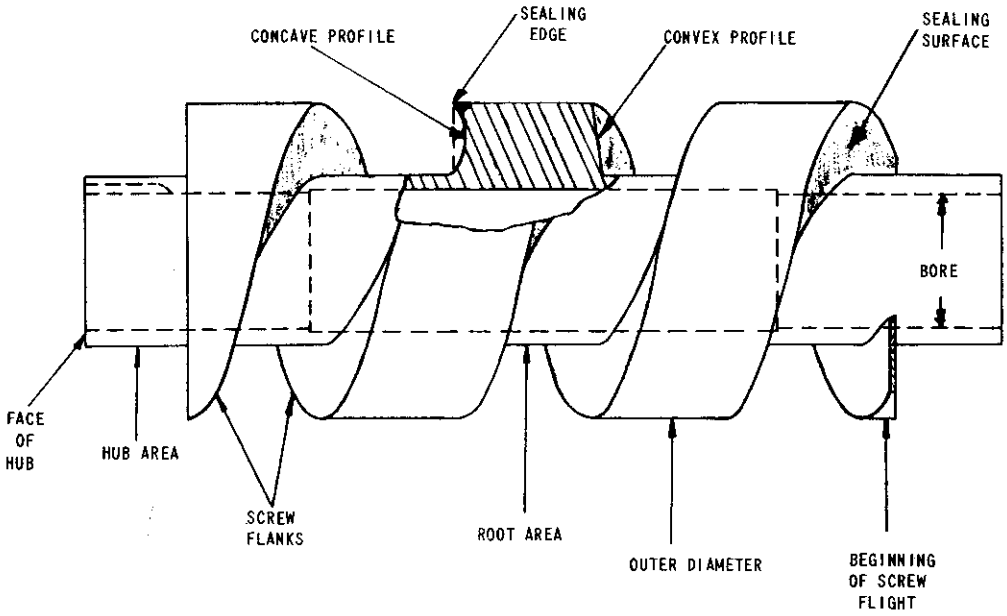


Fig. 7-4a



NOTE - 360° or (1) Turn
Make one complete flight

Fig. 7-4b

SECTION 8 — MAINTENANCE

8-1 DISASSEMBLY (Type L Size 025 — 053) Refer to Dwg. #A-2304

1. Close pump suction and discharge valves. LOCKOUT VALVES WITH APPROVED LOCKOUT SYSTEM.
2. DISCONNECT ALL ELECTRICAL SOURCES AND LOCKOUT WITH APPROVED LOCKOUT SYSTEM.
3. Drain oil from pump.
4. Remove seal piping to stuffing box.
5. Disconnect pump and driver coupling. Remove pump coupling half from pump shaft. Disconnect piping and remove pump if it is preferred to make repairs off site.
6. If the pump is fitted with a mechanical seal, it is necessary to remove the seal prior to continuing with the disassembly. See Section 8-13.
7. If this pump is fitted with packing, you may remove the packing (20), the gland (22), **along** with hardware (27) (41) and the lantern ring (21) now or after disassembly.
8. Remove bolts (4) which secure the front head (6) to the body (1).
9. Insert bolts (4) into the two threaded holes of the front head flange and use these as jacking bolts to remove the front head (6) from the body (1).
10. Loosen setscrews (14) which lock the thrust bearing adjusting sleeve (9) against rotation.
11. Remove the thrust bearing adjusting sleeve (9) from the front head (6) by rotating counterclockwise.
12. Remove "O" Ring (10) from thrust bearing adjusting sleeve (9).
13. Heat and remove inner races of roller bearings (47) from shafts (28) (29).
14. Remove thrust bearing (8) from front head (6) and shafts (28) (29).
15. Remove outer races of the roller bearing from adjusting sleeve (9) and front head (6).
16. Remove rotating assembly from body.
17. Remove timing gears (33) from shafts (28) (29) with a bearing puller.
    NOTE: The gears are secured to the shaft with Loctite #40.
18. Remove timing gear keys (34) from shafts (28) (29).
19. Remove timing gear spacers (35) from shafts (28) (29).
20. Remove bolts (25).
21. Remove rear head cover (24).
22. Remove end float limiting bolt assemblies (63) (64) from rear head cover (24).
23. Remove rear head bolts (4). Use bolts (4) as jacking bolts to remove the rear head (23) as in Step 9.
24. Remove graphite sleeve bearings (7) from rear head (23).
25. Remove and replace gaskets (5) (43) (44) as necessary.
26. To remove screws and/or pistons from shafts, see Section 8-9.

8-2 REASSEMBLY (Type L Size 025 — 053) Refer to Dwg. #A-2304

NOTE: If pistons and/or screws were removed from their shafts, refer to Section 8-10 for instructions on mounting.

1. Install timing gear spacers (35) onto shafts (28) (29).
2. Install timing gear keys (34) into shaft keyways.
3. Install timing gears (33) onto shafts (28) (29) securing them with Loctite #40 (**Caution:** Excess Loctite will collect between the gear spacer and bearing faces preventing proper seating).
4. Install inboard races and roller assemblies of thrust bearings (8) onto shafts (28) (29); seating the races against the faces of the timing gears (33).
5. Heat and install inner races of roller bearings (47) on shafts (28) (29).
6. Install sleeve bearings (7) into rear head (23) with the oil grooves on the vertical centerline as shown on Dwg. A-2304. This bearing is a press fit. Use of the jig shown in Section 9-5 will facilitate its installation. Since these bearings are graphite they must be pressed in carefully. For axial positioning, see Dimension X on Dwg. #A-2304.
7. Install gasket (5) and rear head (23) onto body (1) with bolts (4) aligning with dowel pins (3).
8. Using Loctite #40, install outer race of roller bearings (47) into front head (6) and thrust bearing adjusting sleeve (9). (**Caution:** Do not use excessive amounts of Loctite).
9. Install "O" ring (10) onto thrust bearing adjusting sleeve (9).
   NOTE: If pump is fitted with double mechanical seals, see Section 8-13 prior to continuing assembly.

10. Install thrust bearing adjusting sleeve (9) into front head (6).
11. Install outboard races of thrust bearing (8) into front head (6). The short shaft race will bear against the bottom of its bore. The long shaft race will bear against the end face of the thrust bearing adjusting sleeve (9).
12. Swab the screw bores of the body (1), sleeve bearing (7) and the piston bore in the rear head (23) with oil. Coat the screws, piston and journal areas of the rotor with oil. Mesh the rotors (in proper axial position) and install into the body (1).
13. Install gasket (44) and front head (6) onto body (1) with bolts (4) aligning with dowel pins (3).
14. Install gasket (43) and rear head cover (24) with bolts (25).
15. Install Hydra-Lok nut (64) onto adjusting bolt (63) with its sealing face away from the bolt head. This will place the sealing face against the rear head cover (24) when installed. Install the assembly (63) (64) onto the rear head cover (24). Do not tighten at this time.
16. **FOLLOW THE INSTRUCTIONS FOR ADJUSTING CLEARANCES WHICH ARE FOUND IN SECTION 8-11.**

    NOTE: If the pump is fitted with single or double mechanical seals, see Section 8-13, 2 thru 8.
17. If the pump is fitted with packing, install packing (20) lantern ring, if fitted (21) and secure with gland (22). Install nut (27) and washer (41). Do not overtighten.
18. Reconnect seal piping.

8-3 DISASSEMBLY

(Type L Size 070 — 100) Refer to Dwg. #A-2306

1. Close pump suction and discharge valves. LOCKOUT VALVES WITH APPROVED LOCKOUT SYSTEM.
2. DISCONNECT ALL ELECTRICAL SOURCES AND LOCKOUT WITH APPROVED LOCKOUT SYSTEM.
3. Drain oil from pump.
4. Remove seal piping to stuffing box.
5. Disconnect pump and driver coupling. Remove pump coupling half from shaft. Disconnect piping and remove pump if it is preferred to make repairs off site.
6. If the pump is fitted with a mechanical seal, it is necessary to remove the seal prior to continuing with the disassembly. See Section 8-13.
7. If this pump is fitted with packing, you may remove the packing (20), the gland (22), **along** with hardware (27) (16) and the lantern ring (21) now or after disassembly.
8. Remove bolts (4) which secure the front head (6) to the body (1).
9. Insert bolts (4) into the two threaded holes of the front head flange and use these as jacking bolts to remove the front head (6) from the body (1).
10. Loosen setscrews (14) which lock the thrust bearing adjusting sleeve (9) against rotation.
11. Remove the thrust bearing adjusting sleeve (9) from the front head (6) by rotating counterclockwise.
12. Remove "O" ring (10) from thrust bearing adjusting sleeve (9).
13. Remove thrust bearing (8) from front head (6).
14. Remove outer races of the roller bearing (39) from thrust bearing adjusting sleeve (9) and front head (6).
15. Remove rotating assembly from body.
16. Heat and remove inner races of roller bearings (39) from shafts (28) (29).
17. Remove inboard races and roller assemblies of the thrust bearing (8) from the bearing plate (60).
18. Remove the bearing plates (60) from the shafts (28) (29).
19. Remove timing gears (33) from shafts (28) (29) with a bearing puller.

    NOTE: The gears are secured to the shaft with Loctite #40.
20. Remove timing gear keys (34) from shafts (28) (29).
21. Remove timing gear spacers (35) from shafts (28) (29).
22. Remove bolts (25).
23. Remove rear head cover (24).
24. Remove end float limiting bolt assemblies (63) (64) from rear head cover (24).
25. Remove rear head bolts (4). Use bolts (4) as jacking bolts to remove the rear head (23) as in Step 9.
26. Remove graphite sleeve bearings (7) from rear head (23).
27. Remove and replace gaskets (5) (42) (43) as necessary.
28. To remove screws and/or pistons from shafts, see Section 8-9.

8-4 REASSEMBLY

(Type L Size 070 — 100) Refer to Dwg. #A-2306

NOTE: If piston and/or screws were removed from their shafts, refer to Section 8-10 for instructions on mounting.

1. Install timing gear spacers (35) onto shafts (28) (29).
2. Install timing gear keys (34) into shaft keyways.
3. Install timing gears (33) onto shafts (28) (29) securing them with Loctite #40. (**Caution:** Excess Loctite will collect between the gear spacer and bearing faces preventing proper seating.)
4. Install bearing plates (60) onto shafts (28) (29).
5. Install inboard races and roller assemblies of the thrust bearings (8) onto the bearing plate (60).
6. Heat and install inner races of roller bearings (39) on shafts (28) (29).
7. Install sleeve bearings (7) into rear head (23) with the oil grooves on the vertical centerline as shown on Dwg. A-2306. This bearing is a press fit. Use of the jig shown in Section 9-5 will facilitate its installation. Since these bearings are graphite they must be pressed in carefully. For axial positioning, see Dimension X on Dwg. #A-2306.
8. Install gasket (5) and rear head (23) onto body (1) with bolts (4) aligning with dowel pins (3).
9. Using Loctite #40, install outer race of roller bearings (39) into front head (6) and thrust bearing adjusting sleeve (9). (**Caution:** Do not use excessive amounts of Loctite).
10. Install "O" ring (10) onto thrust bearing adjusting sleeve (9).
    NOTE: If pump is fitted with double mechanical seals, see Section 8-13 prior to continuing assembly.
11. Install thrust bearing adjusting sleeve (9) into front head (6).
12. Install outboard races of thrust bearing (8) into front head (6). The short shaft race will bear against the bottom of its bore. The long shaft race will bear against the end face of the thrust bearing adjusting sleeve (9).
13. Swab the screw bores of the body (1), sleeve bearing (7) and the piston bore in the rear head (23) with oil. Coat the screws, piston and journal areas of the rotor with oil. Mesh the rotors (in proper axial position) and install into the body (1).
14. Install gasket (43) and front head (6) onto body (1) with bolts (4) aligning with dowel pins (3).
15. Install gasket (42) and rear head cover (24) with bolts (25).
16. Install Hydra-Lok nut (64) onto adjusting bolt (63) with its sealing face away from the bolt head. This will place the sealing face against the rear head cover (24) when installed. Install the assembly (63) (64) onto the rear head cover (24). Do not tighten at this time.
17. **FOLLOW THE INSTRUCTIONS FOR ADJUSTING FLANK CLEARANCES WHICH ARE FOUND IN SECTION 8-11.**
    NOTE: If the pump is fitted with single or double mechanical seals, see Section 8-13, 2 thru 8.
18. If the pump is fitted with packing, install packing (20) lantern ring, if fitted (21) and secure with gland (22). Install nut (27) and washer (16). Do not overtighten.
19. Reconnect seal piping.

8-5 DISASSEMBLY

(Type N Size 025 — 053) Refer to Dwg. #A-2305

1. Close pump suction and discharge valves. LOCKOUT VALVES WITH APPROVED LOCKOUT SYSTEM.
2. DISCONNECT ALL ELECTRICAL SOURCES AND LOCKOUT WITH APPROVED LOCKOUT SYSTEM.
3. Drain oil from pump and front head (6).
4. Remove seal piping to stuffing boxes/mechanical seal glands.
5. Disconnect pump and driver coupling. Remove pump coupling half from pump shaft. Disconnect piping and remove pump if it is preferred to make repairs off site.
6. Remove bolts (44).
7. Remove taper pins (80).
8. Insert bolts (44) into the threaded holes of the front head flange and use these as jacking bolts to remove the front head (6) from the stuffing box housing (15) and seal plate (68).
9. Remove front head (6).
10. Loosen set screws (14) which lock the thrust bearing adjusting sleeve (9) against rotation.
11. Remove the thrust bearing adjusting sleeve (9) from the front head (6) by rotating counterclockwise.
12. Remove "O" ring (10) from the thrust bearing adjusting sleeve (9).
13. Remove outer races of thrust bearing (8) from the front head (6).
14. Remove the outer races of the roller bearings (58) from the thrust bearing adjusting sleeve (9) and the front head (6).

15. Heat and remove the inner races of the roller bearings (58) from the shafts (28) (29).
16. Remove roller assembly and inner race of the thrust bearing (8) from the shafts (28) (29).
17. Remove timing gears (33) from the shafts (28) (29) with a bearing puller.

    NOTE: The gears are secured to the shafts with Loctite #40.
18. Remove the timing gear keys (34).
19. Remove the gear spacers (35).
20. Remove the bracket seal plate (68) from the stuffing box housing (15).
21. Remove the oil seal (43) from the bracket seal plate (68).
22. If the pump is fitted with mechanical seals, see Section 8-14 before proceeding with the disassembly.
23. If the pump is packed, loosen gland nuts (27) and swing the gland bolts (26) out of the way.
24. Remove glands (22) (packed pump).
25. Remove the bolts (4) which secure the stuffing box housing (15) to the body (1). The alignment pins (3) remain in the body (1).
26. Insert bolts (4) into the two threaded holes in the flange of the stuffing box housing (15) and use these as jacking bolts to remove the stuffing box housing (15) from the body (1).
27. Remove packing (20) and the lantern ring (if fitted) (21) from the stuffing box housing (15).
28. Carefully remove the rotating assembly from the body (1).
29. Remove bolts (25).
30. Remove rear head cover (24).
31. Remove end float limiting bolt assemblies (75) (76) from rear head cover (24).
32. Remove bolts (4) which secure the rear head (23) to the body (1). The alignment pins (3) remain in the body (1).
33. Insert the bolts (4) into the two threaded holes in the flange of the rear head (23) and use these as jacking bolts to remove the rear head (23) from the body (1).
34. Remove graphite sleeve bearings (7) from rear head (23).
35. Remove and replace gaskets (5) (54) (55) (56) as necessary.
36. To remove screws and/or pistons from shafts, see Section 8-9.

8-6 REASSEMBLY
(Type N Sizes 025 — 053)
Refer to Dwg. #A-2305

NOTE: If pistons and/or screws were removed from their shafts, refer to Section 8-10 for instructions on mounting.

1. Install sleeve bearings (7) into rear head (23) with the oil grooves on the vertical centerline as shown on Dwg. #A-2305. This bearing is a press fit. Use of the jig shown in Section 9-5 will facilitate its installation. Since these bearings are graphite, they must be pressed in carefully. For axial positioning, see Dimension X on Dwg. #A-2305.
2. Install gasket (5) and rear head (23) onto body (1) with bolts (4) aligning with dowel pins (3).
3. Swab the screw bores of the body (1), sleeve bearing (7) and the piston bore in the rear head (23) with oil. Coat the screws, piston and journal areas of the rotor with oil. Mesh the rotors in proper axial position (with the shaft ends even) and install into the body (1).

    NOTE: If the pump is fitted with mechanical seals, see Section 8-14 prior to continuing assembly.
4. Install gasket (55) and stuffing box housing (15) onto the body (1) with bolts (4), aligning with dowel pins (3).
5. Install glands (22) on shafts (28) (29).
6. Install oil seals (43) into bracket seal plate (68).
7. Mount bracket seal plate (68) onto stuffing box housing (15).
8. Install timing gear spacers (35) onto shafts (28) (29).
9. Install timing gear keys (34) into shaft keyways.
10. Install timing gears (33) onto shafts (28) (29) securing them with Loctite #40. **(CAUTION:** Excess Loctite will collect between the gear spacer and bearing faces preventing proper seating).
11. Install inboard races and roller assemblies of thrust bearings (8) onto shafts (28) (29); seating the races against the faces of the timing gears (33).
12. Heat and install inner races of roller bearings (58) on shafts (28) (29).
13. Using Loctite #40, install outer races of roller bearings (58) into the front head (6) and thrust bearing adjusting sleeve (9). **(CAUTION:** Do not use excess amounts of Loctite).
14. Install "O" ring (10) onto thrust bearing adjusting sleeve (9).
15. Install thrust bearing adjusting sleeve (9) into front head (6).

16. Install outboard races of thrust bearing (8) into front head (6). The short shaft race will bear against the bottom of its bore. The long shaft race will bear against the end face of the thrust bearing adjusting sleeve (9).
17. Install gasket (56) and front head (6) onto the bracket seal plate (68) securing with bolts (44) through the bracket seal plate (68) into the stuffing box housing (15). All three pieces (15) (68) (6) are aligned with taper pins (80). **Do not force the taper pins** into their holes. Gently tap them into place.
18. Install oil seal (42) into thrust bearing adjusting sleeve (9).
19. Install gasket (54) and rear head cover (24) with bolts (25).
20. Install Hydra-Lok nut (76) onto adjusting bolt (75) with its sealing face away from the bolt head. This will place the sealing face against the rear head cover (24) when installed. Install the assembly (75) (76) onto the rear head cover (24). Do not tighten at this time.
21. **FOLLOW THE INSTRUCTIONS FOR ADJUSTING CLEARANCES WHICH ARE FOUND IN SECTION 8-11.**

    NOTE: If the pump is fitted with mechanical seals, see Section 8-14, step 7a or 7b.
22. If the pump is fitted with packing, install packing (20), lantern rings, if fitted (21) and secure with gland (22). Install nut (27) and washer (47). Do not overtighten.
23. Reconnect seal piping.

8-7 DISASSEMBLY
(Type N Size 070 — 100)
Refer to Dwg. #A-2307

1. Close pump suction and discharge valves. LOCKOUT WITH APPROVED LOCKOUT SYSTEM.
2. DISCONNECT ALL ELECTRICAL SOURCES AND LOCKOUT WITH APPROVED LOCKOUT SYSTEM.
3. Drain oil from pump and front head (6).
4. Remove seal piping to stuffing boxes/mechanical seal glands.
5. Disconnect pump and driver coupling. Remove pump coupling half from pump shaft. Disconnect piping and remove pump if it is preferred to make repairs off site.
6. Remove bolts (44).
7. Remove taper pins (80).
8. Insert bolts (44) into the threaded holes of the front head flange and use these as jacking bolts to remove the front head (6) from the stuffing box housing (15) and seal plate (68).
9. Remove front head (6).
10. Loosen set screws (14) which lock the thrust bearing adjusting sleeve (9) against rotation.
11. Remove the thrust bearing adjustment sleeve (9) from the front head (6) by rotating counterclockwise.
12. Remove "O" ring (10) from the thrust bearing adjusting sleeve (9).
13. Remove outer races of thrust bearing (8) from the front head (6).
14. Remove the outer races of the roller bearings (56) from the thrust bearing adjusting sleeve (9) and the front head (6).
15. Heat and remove the inner races of the roller bearings (56) from the shafts (28) (29).
16. Remove roller assembly and inner race of the thrust bearing (8) from the bearing plates (74).
17. Remove bearing plates (74) from shafts (28) (29).
18. Remove timing gears (33) from the shafts (28) (29) with a bearing puller.

    NOTE: The gears are secured to the shafts with Loctite #40.
19. Remove the timing gear keys (34).
20. Remove the gear spacers (35).
21. Remove the bracket seal plate (68) from the stuffing box housing (15).
22. Remove the oil seals (43) from the bracket seal plate (68).
23. If the pump is fitted with mechanical seals, see Section 8-14 before proceeding with the disassembly.
24. If the pump is packed, loosen gland nuts (27) and swing the gland bolts (26) out of the way.
25. Remove glands (22) (packed pump).
26. Remove the bolts (4) which secure the stuffing box housing (15) to the body (1). The alignment pins (3) remain in the body (1).
27. Insert bolts (4) into the two threaded holes in the flange of the stuffing box housing (15) and use these as jacking bolts to remove the stuffing box housing (15) from the body (1).
28. Remove packing (20) and the lantern ring (if fitted) (21) from the stuffing box housing (15).
29. Carefully remove the rotating assembly from the body (1).
30. Remove bolts (25).
31. Remove rear head cover (24).
32. Remove end float limiting bolt assemblies (76) (77) from rear head cover (24).

33. Remove bolts (4) which secure the rear head (23) to the body (1). The alignment pins (3) remain in the body (1).

34. Insert the bolts (4) into the two threaded holes in the flange of the rear head (23) and use these as jacking bolts to remove the rear head (23) from the body (1).

35. Remove graphite sleeve bearings (7) from rear head (23).

36. Remove and replace gaskets (5) (53) (54) (55) as necessary.

37. To remove screws and/or pistons from shafts, see Section 8-9.

8-8 REASSEMBLY

(Type N Sizes 070 — 100) Refer to Dwg. #A-2307

NOTE: If pistons and/or screws were removed from their shafts, refer to Section 8-10 for instructions on mounting.

1. Install sleeve bearings (7) into rear head (23) with the oil grooves on the vertical centerline as shown on Dwg. #A-2307. This bearing is a press fit. Use of the jig shown in Section 9-5 will facilitate its installation. Since these bearings are graphite, they must be pressed in carefully. For axial positioning, see Dimension X on Dwg. #A-2307.

2. Install gasket (5) and rear head (23) onto body (1) with bolts (4) aligning with dowel pins (3).

3. Swab the screw bores of the body (1), sleeve bearing (7) and the piston bore in the rear head (23) with oil. Coat the screws, piston and journal areas of the rotor with oil. Mesh the rotors in proper axial position (with the shaft ends even) and install into the body (1).

   NOTE: If the pump is fitted with mechanical seals, see Section 8-14 prior to continuing assembly.

4. Install gasket (54) and stuffing box housing (15) onto the body (1) with bolts (4), aligning with dowel pins (3).

5. Install glands (22) on shafts (28) (29).

6. Install oil seals (43) into bracket seal plate (68).

7. Mount bracket seal plate (68) onto stuffing box housing (15).

8. Install timing gear spacers (35) onto shafts (28) (29).

9. Install timing gear keys (34) into shaft keyways.

10. Install timing gears (33) onto shafts (28) (29) securing them with Loctite #40. (**CAUTION:** Excess Loctite will collect between the gear spacer and bearing faces preventing proper seating).

11. Install bearing plates (74) on shafts (28) (29).

12. Install inboard races and roller assemblies of thrust bearing (8) onto bearing plates (74).

13. Heat and install inner races of roller bearings (56) on shafts (28) (29).

14. Using Loctite #40 install outer races of roller bearings (56) into the front head (6) and thrust bearing adjusting sleeve (9). (**CAUTION:** Do not use excess amounts of Loctite.)

15. Install "O" ring (10) onto thrust bearing adjusting sleeve (9).

16. Install thrust bearing adjusting sleeve (9) into front head (6).

17. Install outboard races of thrust bearing (8) into front head (6). The short shaft race will bear against the bottom of its bore. The long shaft race will bear against the end face of the thrust bearing adjusting sleeve (9).

18. Install gasket (55) and front head (6) onto the bracket seal plate (68) securing with bolts (44) through the bracket seal plate (68) into the stuffing box housing (15). All three pieces (15) (68) (6) are aligned with taper pins (80). **Do not force the taper pins** into their holes. Gently tap them into place.

19. Install oil seal (42) into thrust bearing adjusting sleeve (9).

20. Install gasket (53) and rear head cover (24) with bolts (25).

21. Install Hydra-Lok nut (77) onto adjusting bolt (76) with its sealing face away from the bolt head. This will place the sealing face against the rear head cover (24) when installed. Install the assembly (76) (77) onto the rear head cover (24). Do not tighten at this time.

22. **FOLLOW THE INSTRUCTIONS FOR AD JUSTING CLEARANCES WHICH ARE FOUND IN SECTION 8-11.**

    NOTE: If the pump is fitted with mechanical seals, see Section 8-14, step 7a or 7b.

23. If the pump is fitted with packing, install packing (20), lantern ring, if fitted (21) and secure with gland (22). Install nut (27) and washer (16). Do not overtighten.

24. Reconnect seal piping.

8-9 REMOVAL OF PISTONS AND SCREWS FROM SHAFT

1. Remove groove pins (36) which secure screws (30) to the shafts (28) (29).

2a. Place the rotor assembly in a press supporting it on the discharge end flank of the screw. Press against the end of the shaft. With pressure applied, heat the screw hubs and roots to break

down the adhesive which secures the screws to the shaft (approx. 500°F). Once the adhesive is broken down the screws will slide off the shaft with a moderate pressure.

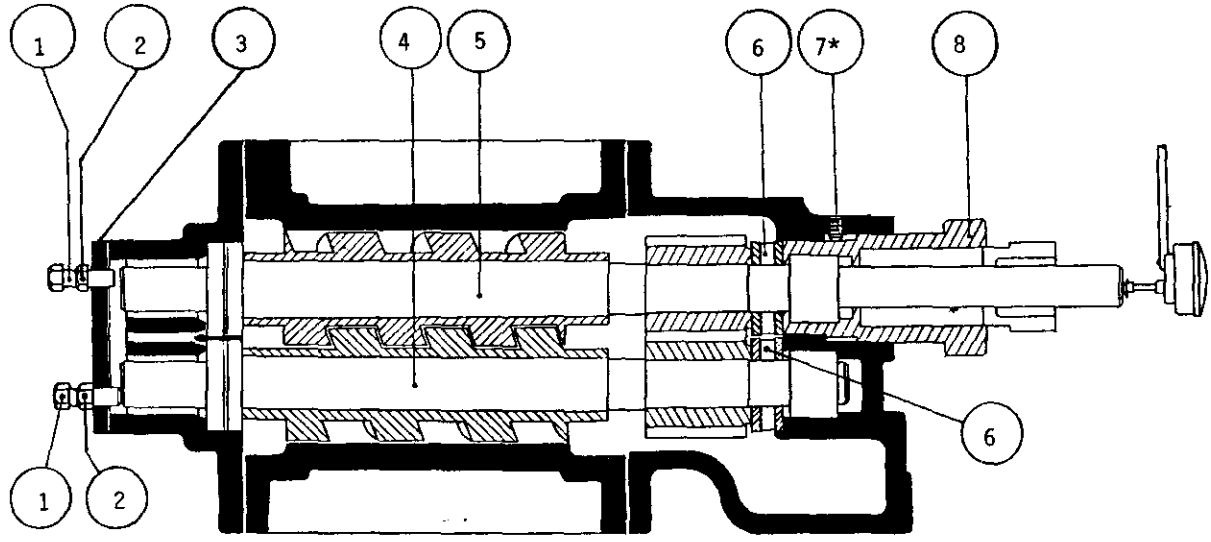
NOTE: The screws are keyed to the shaft at the piston end and it is, therefore, not possible to turn the screw to break it loose.

b. If a press of suitable size is unavailable, construct a horseshoe plate which will rest against the screw flank. Attach threaded rods to the plate and a strongback to the opposite end of the rods. Place a portable hydraulic jack between the end of the shaft and the strongback. Proceed as described above.

3. Remove pistons (31) from shafts (28) (29).
4. Remove key (32).
5. Check shaft runout. Runout must be less than .003".

8-10 MOUNTING OF PISTONS AND SCREWS ONTO SHAFTS

1. Thoroughly deburr and clean shafts (28) (29).
2. Fit piston (31) to shaft. Do not force on.
3. Select proper screw for proper shaft. The screws (30) are numbered. The odd number screw goes on long shaft. If you have more than one set of spare screws, make sure they are matched sequentially, i.e. 1 and 2 are a pair, 3 and 4 are a pair etc. To check screw rotation, the screw should turn counter-clockwise on the long shaft viewing the screw from the coupling end. The long shaft screw has a right hand thread and the short shaft screw has a left hand thread.
4. Remove fitted piston (31) and fit screw to shaft. The screw fits shaft in only one direction. The shaft diameter is stepped. Screw bore has corresponding diameter to mate shaft on both ends.
5. Remove screw (30) from shaft.
6. Fit keys (32) to shaft (28 or 29), to piston (31), to screw bore (30).
7. Clean shafts (28 & 29), pistons (31) and screw bores (30) with Isopropyl Alcohol or other suitable solvent which will not leave a contaminating residue.
8. Install key (32) in shaft (28 & 29).
9. Apply an epoxy adhesive to bore of piston (31). Inspect this piece for nicks and cracks before installation, then install piston (31). (Mix epoxy in accordance with manufacturer's instructions and clean excess with a suitable solvent).
10. Install screw (30) on shaft (28 & 29) using the epoxy adhesive on cast iron screws and Loctite 40 on stainless steel screws. The face of the screw hub (30) must be tight against face of piston (31). Check with .001 feeler guage
11. Install groove pins (36) after adhesive has hardened.



8-11 FLANK CLEARANCE ADJUSTMENT PROCEDURE

Refer to figure 8-11 (the piece numbers used in this section are applicable to figure 8-11 **only**.)

1. Loosen thrust bearing adjusting sleeve setscrew (14).
2. Back off thrust bearing adjusting sleeve (9). Turn counter-clockwise.
3. Tighten lower hex bolt in rear head cover (24) so as to lock the short shaft (29) tightly against the lower thrust bearing (8).

4. Pull on long shaft (5) in the direction of the thrust bearing (6) until the clearance between the upper and lower screw flanks is removed.
5. Place a dial indicator button against the exposed face of the long shaft (5) at the front of the pump.
6. Turn thrust bearing adjusting sleeve (8) clockwise until screw flanks make contact on the opposite side.
7. Record total indicator movement. This will be the total flank clearance. Divide total flank clearance by 2.
8. Repeat Step No. 2.
9. Repeat Step. No. 4.
10. Slowly turn thrust bearing adjusting sleeve (8) clockwise and observe indicator movement. Stop turning when indicator reads ½ of total flank clearance. This now means that the flank clearance will be equal on both sides of the screw flank.

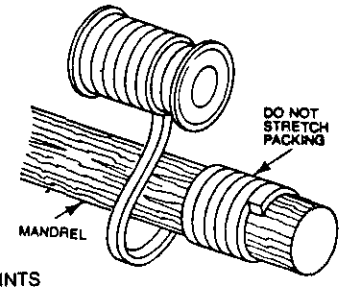
NOTE: Thrust load will be in the direction of the thrust bearings assuring no metal-to-metal contact between the screw flanks.

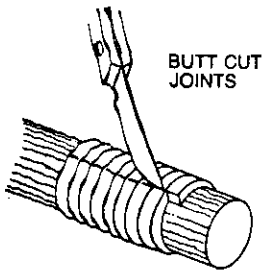
11. Retighten setscrew (7); stake with a prick punch.
12. Backoff lower hex bolt (1) in rear head cover (3) ½ turn. While holding hex bolt (1) in position, tighten Hydra-Lok nut against the face of the rear head cover (3).
13. Tighten upper hex bolt (1) in rear head cover (3) hard-up against shaft (5), then back off ½ turn. While holding hex bolt (1) in position, tighten Hydra-Lok nut against the face of the rear head cover (3).

* The setscrews (7) which lock the thrust bearing adjusting sleeve (8) against rotation is shown on top for the purposes of illustration. In actuality, there are two setscrews which are located on either side.

1

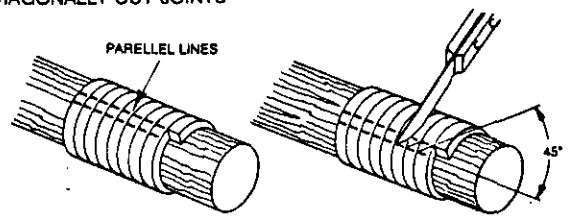
Wrap the packing around the mandrel a sufficient number of times for the amount of rings being made. Hold the packing firmly on the mandrel. DO NOT STRETCH IT.





Cut directly across the packing.

DIAGONALLY CUT JOINTS

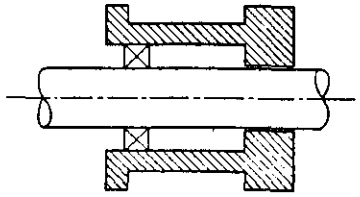


Draw two parallel lines on the packing, then individually cut each ring at a 45° angle.

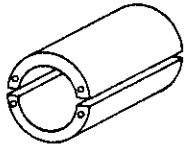
METHOD OF INSTALLATION

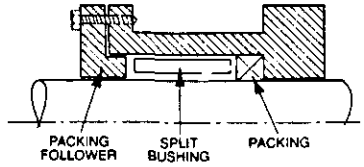
2

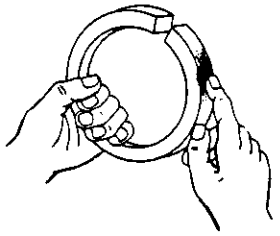
A. Install one ring at a time.
B. Make sure the ring is clean.
C. Where compatible, lubricate lightly on ID and OD with a suitable lubricant.



D. Use split bushings to install each ring.



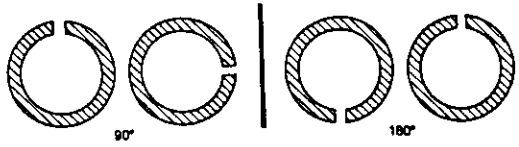




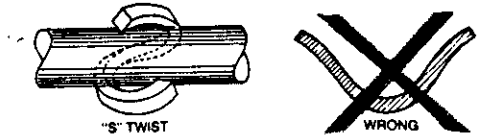
A tamping stick may be used, if split bushings are not available.
DO NOT USE A SCREWDRIVER.

3

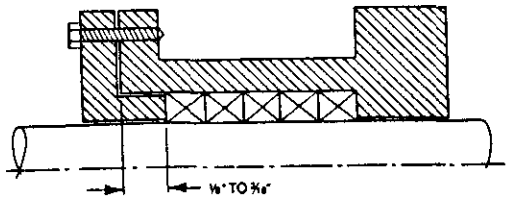
E. Stagger joints 90° apart. If only two rings are used, stagger joints 180° apart.



F. When putting rings around the shaft use an "S" twist. DO NOT BEND OPEN.



G. When the last ring has been installed, there should be enough room to insert the gland follower 1/8" to 3/16".



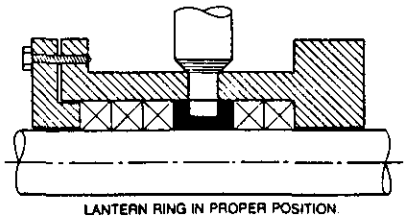
4

H. Take up on the gland bolts with a wrench to seat and form the packing to the stuffing box and shaft. Loosen gland nuts, and let packing expand. Rotate shaft by hand to get running clearance. Then re-tighten gland nuts finger tight only. Again rotate shaft by hand to make sure packing is not too tight.

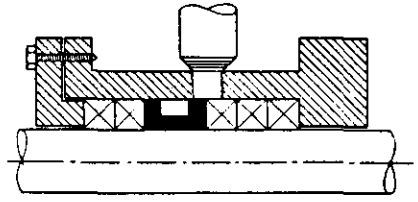
I. Start the pump, allowing the stuffing box to leak freely, then take up on the gland bolts one flat at a time until the desired leakage is obtained, and the pump is running cool.

J. To insure long service life, allow adequate break in time for a set of new packings.

K. If a lantern ring (seal cage, water cage) is provided, make sure the lantern ring is installed under the pipe tap hole.



LANTERN RING IN PROPER POSITION.



LANTERN RING NOT IN PROPER POSITION.

NOTE: If lubrication is not used, remove lantern ring and replace with packing.

8-13 MECHANICAL SEAL INSTALLATION & REMOVAL (Type L) Refer to Dwg. #SK-3178

INSTALLATION

1. If the pump has a double mechanical seal, install the inboard stationary portion of the seal with its "O" ring and ring (59) prior to installing the thrust bearing adjusting sleeve (9). Continue with Step 10 of 8-2 or Step 11 of 8-4 as appropriate.
2. Upon completion of Step 16 of 8-2 or Step 18 of 8-4, install the rotating portion(s) of the mechanical seal (56) onto the shaft. If the pump has a double mechanical seal, make sure that the anti-rotation pin(s) on the inboard seal are inserted into the mating hole(s) of the outboard seal.
3. Install the stationary seal ring into the gland (57).
4. If the pump has a single seal, position the rotating seal assembly so that the set screws line up with the center of the access hole in the thrust bearing adjusting sleeve (9). Tighten the set screws. If the pump has a double mechanical seal, do not tighten the setscrews at this time.
5. Mount the gasket (58) and the pilot ring (61) onto the gland (57).
6. Mount the above on the thrust bearing adjusting sleeve (9) making sure that the gasket and pilot ring remain in their proper positions.
7. Secure the gland with nuts (27) and washers (41).
8. If the pump has a double mechanical seal, tighten the set screws which secure the rotating seal assembly through the access hole.

REMOVAL

1. Remove nuts (27) and washers (41).
2. Remove gland (57).
3. Loosen set screws which secure the rotating assembly of the mechanical seal (56) to the shaft. Access to these set screws is gained by removing pipe plug (11). The shaft must be rotated to loosen **all** set screws. If the pump is fitted with double mechanical seals, **only** the outboard seal is setscrewed to the shaft. The inboard seal is secured against rotation on the shaft by a pin(s) interlocking the two seals.
4. Remove rotating seal(s) from the shaft.
5. Remove gasket (58) and pilot ring (61).
6. Remove stationary seal ring(s) after completion of disassembly.

8-14 MECHANICAL SEAL INSTALLATION AND REMOVAL (Type N) Refer to Dwg. #SK-3179

INSTALLATION

1. If the pump has double mechanical seals, install the inboard stationary portion of the seals with their "O" rings and ring (72) prior to installing the stuffing box housing (15) onto the body (1).
2. Install gasket (55) and stuffing box housing (15) onto the body (1) with the bolts (4), aligning with dowel pins (3).
3. Install the rotating portion of the mechanical seals onto their respective shafts. If the pump is fitted with double mechanical seals slide the rotating portion of the seals into the stuffing box until they seat against the inboard stationary seal ring insuring that the antirotation pins on the inboard seal are inserted into the mating holes of the outboard seal. If the pump is fitted with single mechanical seals, slide the rotating portion of the seals only part way into the stuffing box insuring that they are accessible to be positioned later.
4. Install the stationary portions of the seals with their "O" rings into the glands (70).
5. Mount the gaskets (71) and the pilot ring (73) onto the gland (70).
6. Slide the above onto their respective shafts making sure that the gasket and pilot ring remain in their proper positions. Do **not** secure glands or set the rotating portion of the mechanical seals at this time. Continue with step 6 of 8-6 or 8-8 as appropriate.

7a. **Double Mechanical Seals Only**
Upon completion of step 21 of 8-6 or step 22 of 8-8, secure the glands (70) with nuts and washers. This will properly position the rotating portion of the seals insuring balanced compression of the two seals. Tighten the set screws which secure the rotating seal assemblies through the access hole in the housing.

7b. **Single mechanical Seals Only**
Upon completion of step 21 of 8-6 or step 22 of 8-8 position the rotating portion of the mechanical seals so that the set screws line up with the center of the access hole in the housing. Tighten the set screws which secure the rotating seal assemblies through the access hole in the housing.

8. Continue with step 23 of 8-6 or step 24 of 8-8 as appropriate.

REMOVAL

1. Remove nuts and washers which secure glands.
2. Remove glands (57).
3. Loosen set screws which secure the rotating portion of the mechanical seals to their shafts. Access to these set screws is gained by removing the pipe plugs in the stuffing box housing (15). The shaft must be rotated to loosen **all** set screws. If the pump is fitted with double mechanical seals, **only** the outboard seal is setscrewed to the shaft. The inboard seals are secured against rotation on the shaft by pins interlocking the two seals.
4. Remove rotating portions of the mechanical seals from the shafts.
5. Remove gasket (71) and pilot ring (73).
6. Remove stationary seal rings after completion of disassembly.

9-1 PARTS INFORMATION

	VW025	VW035	VW043	VW053	VW070	VW100
THRUST BEARING	T-602-201 Rollway	T-606 Rollway	T-612 Rollway	T-614 Rollway	T-625 Rollway	40TP-114 Torrington
RADIAL BEARING	MR-16/M1-13 McGill	MR-22/M1-18 McGill	MR-28/M1-24 McGill	MR-28/M1-24 McGill	MR-44/M1-36 McGill	MR-52/M1-44 McGill
Shaft Fit	.00001/.0009 Loose/Tight	.0000/.0010 Loose/Tight	.0000/.0010 Loose/Tight	.0000/.0010 Loose/Tight	.0000/.0014 Loose/Tight	.0000/.0014 Loose/Tight
Housing Fit	.0012/.0000 Loose/Tight	.0012/.0000 Loose/Tight	.0012/.0000 Loose/Tight	.0012/.0000 Loose/Tight	.0013/.0002 Loose/Tight	.0015/.0000 Loose/Tight
SLEEVE BEARING	056D0053/P110A	056C0054/P110A	056D0056/P110A	056C0058/P110A	056C0057/P110A	056C0059/P110A
O.D.	1.315/1.316	1.753/1.754	2.253/2.254	2.253/2.254	3.253/3.254	3.628/3.629
I.D. (before installation)	.947/ .948	1.260/1.261	1.631/1.633	1.760/1.761	2.260/2.261	2.884/2.885
I.D. (after installation)	.943/ .945	1.256/1.258	1.629/1.631	1.756/1.758	2.256/2.258	2.880/2.882
STUFFING BOX OIL SEAL (Type N)	Victor 62286	Victor 62334	Victor 62370	Victor 63247	Victor 62542	Victor 62606
FRONT HEAD OIL SEAL (Type N)	Victor 62238	Victor 49296	National Type 33 1079	Victor 63550	Victor 62193	Victor 49026
"O" RING (THR. BRG. ADJ. SLV.)	2-132	2-227	2-234	2-235	2-155	2-256
PACKING (Type N) TYPE						
SIZE	3/8 sq.x1 7/8 I.D.	3/8 sq.x1 1/2 I.D.	3.8 sq.x1 3/4 I.D.	3/8 sq.x2 I.D.	1/2 sq.x3 I.D.	9/16 sq.x3 1/2 I.D.
No. of RINGS	10	10	10	10	10	10
STUFFING BOX LENGTH	2 11/16	2 11/16	2 3/4	2 11/16	3 9/16	4 1/8
I.D.	1/873/1.875	2.281/2.286	2.531/2.536	2.781/2.786	4.031/4.036	4.656/4.661
SHAFT DIAMETER	1.124/1.125	1.499/1.500	1.749/1.750	1.999/2.000	2.999/3.000	3.499/3.500
LANTERN RING TO END	1 9/16	1 5/8	1 5/8	1 11/16	2 1/16	2 7/16
PACKING (Type L) TYPE						
SIZE	3/8 sq.x3/4 I.D.	3/8 sq.x1 1/16 I.D.	3/8 sq.x1 7/16 I.D.	3/8 sq.x2 3/16 I.D.	1/2 sq.x2 3/16 I.D.	5/8 sq.x2 5/8 I.D.
No. of RINGS	5	5	5	5	5	5
STUFFING BOX LENGTH	2 7/8	2 13/16	2 7/8	2 7/8	3 13/16	4 9/16
I.D.	1.498/1.500	1.827 /1.829	2.187/2.189	2.249/2.251	3.188/3.190	3.875/3.877
SHAFT DIAMETER	.749/ .750	1.0615/1.0625	1.4365/1.4375	1.499/1.500	2.1865/2.1875	2.624/2.625
LANTERN RING TO END	1 5/8	1 9/16	1 5/8	1 5/8	2 1/8	2 1/2
GASKETS PUMP	1/64	1/64	1/64	1/64	1/64	1/64
MECH. SEAL (if fitted)	1/16	1/16	1/16	1/16	1/16	1/16
SHAFT DIAMETER @ COUPLING	.749/.750	1.0615/1.0625	1.4365/1.4375	1.499/1.500	2.1865/2.1875	2.624/2.625
PUMP CLEARANCES (TOTAL) FLANK	.003/.0055	.004/.008	.005/.0095	.006/.012	.008/.016	.010/.022
DIAMETRAL	0035/.0065	.004/.008	.005/.0095	.007/.011	.009/.0135	.011/.015
MAXIMUM TORQUE (in lbs.)	628	1368	2494	3740	6980	17658
ROTOR WK² (LBS./FT²) L	.076	.425	.898	2.87	13.47	10.50
N	.084	.455	.956	2.93	14.50	62.10
WEIGHT (Pump Only) L	130	210	340	510	1170	1870
in lbs. N	150	240	370	550	1210	1970

9-2 MATERIAL SPECIFICATIONS

MATERIAL SPECIFICATIONS

PART	2501 (Type L) CAST IRON	2501 (Type L) CAST STEEL	2502 (Type N) CAST IRON	2502 (Type N) CAST STEEL	2502 (Type N) 316 ST. STL.
BODY	A010A	B061A	A010A	B061A	B407G
SCREWS	A010A	A010A	A010A	A010A	G232U * B407U**
SHAFTS	F060A	F060A	F060A	F060A	G232A
FRONT HEAD	A010A	B061A	A010A	A010A	A010A
REAR HEAD	A010A	B061A	A010A	B061A	B407A
GLANDS	B407A	B407A	B407A	B407A	B407A
TIMING GEARS	F164A	F164A	F164A	F164A	F164A
THRUST COLLAR	A010A	A010A	A010A	A010A	P110A
STUFFING BOX HSG.			A010A	B061A	B407A

* All except VW100
**VW100

WARREN SPEC.	EQUIVALENT ASTM SPEC.
A010A	A48 Class 35
B061A	Mod. 1030 NT 250BHN
B407A	A743 Grade CF-8M
B407G	A743 Grade CF-8M
B407U	A743 Grade CF-8M
F060A	Type 1144
F164A	Type 4140
G232A	A276 Type 316
G232U	A276 Type 316
P110A	High Strength Babbitt Graphite

SUFFIX DESIGNATOR (In-Process Treatment)

A — no in-process treatment
G — Industrial hard chrome
U — METCO 16C hard-surface coating (Cr-Ni-B-Mo)

9-3 APPROXIMATE DIMENSIONS

VW025 — 53 TYPE L & N

All holes in flanges straddle centerlines.

Right hand suction location (as shown) is standard.

Left hand suction location is also available on request.

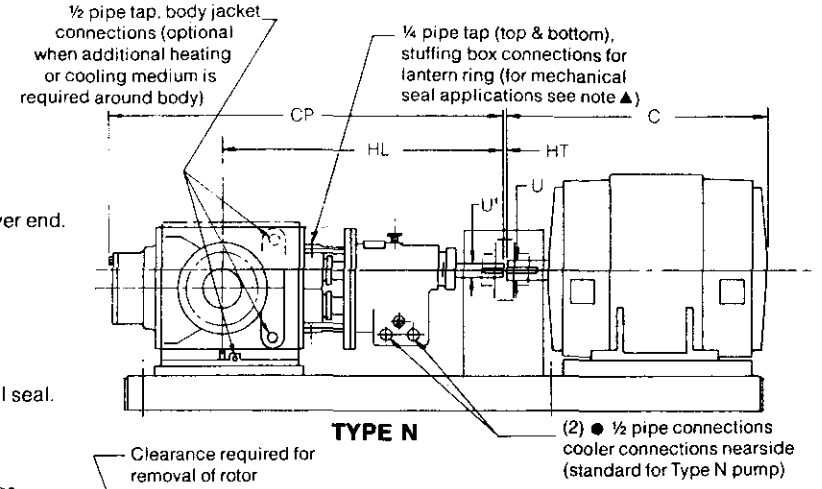
Rotation of pump is counterclockwise viewed from driver end.

All dimensions in inches. Do not use for construction purposes unless certified.

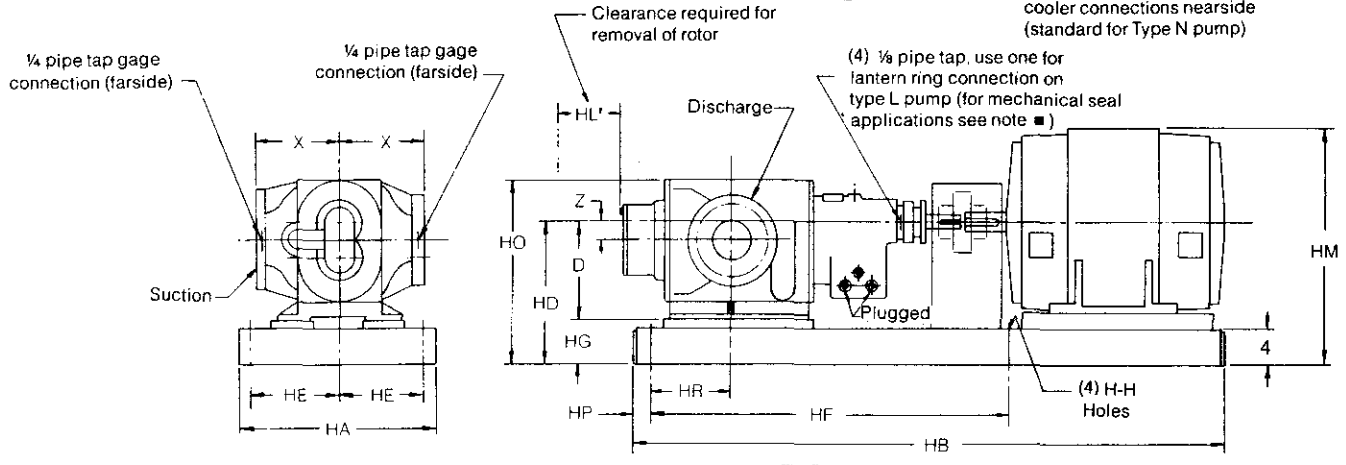
● VWO25 – N & L has (1) ½ NPT nearside & (1) ½ NPT farside.

▲ Use one ¼ pipe tap in each gland for flushing mechanical seal.

■ Use one ⅛ pipe tap in gland for flushing mechanical seal.



TYPE N



TYPE L

PUMP SIZE & TYPE	USAS FLANGES		CP	D	HL	HT	U'	COUPLING KEY SIZE AT PUMP END	X	Z	HL'	PUMP SHAFT EXTENSION @ COUPLING
	DISCHARGE 300#	SUCTION 150#										
VW025-L	2	2½	24½	6½	17⅜	⅛	0.750 0.749	3/16 SQ. x 2"	6½	1	21	2¾
VW025-N	2	2½	28¼		21⅛						24¾	2¾
VW035-L	2½	3	28⅞	8	19		1.0625 1.0615	¼ SQ. x 2"	7½	1 11/32	24½	2⅞
VW035-N	2½	3	33⅞		24						29½	4
VW043-L	3	4	34	9	22⅝		1.4375 1.4365	⅜ SQ. x 3"	8½	1 21/32	29	3¾
VW043-N	3	4	38⅛		26¾						33	4
VW053-L	4	6	38 5/16	10½	25⅞		1.500 1.499	⅜ SQ. x 2"	9½	2	33	4
VW053-N	4	6	42 1/16		29⅝						36¾	4⅜

FLANGE DIMENSIONS –USAS– 150# FLAT FACE					
I.D.	O.D.	B.C.	NO. HOLES	SIZE HOLES	THICK-NESS
2½	7	5½	4	¾	⅞
3	7½	6	4	¾	15/16
4	9	7½	8	¾	15/16
6	11	9½	8	⅞	1

FLANGE DIMENSIONS –USAS– 300# FLAT FACE					
I.D.	O.D.	B.C.	NO. HOLES	SIZE HOLES	THICK-NESS
2	6½	5	8	¾	⅞
2½	7½	5⅞	8	⅞	1
3	8¼	6⅝	8	⅞	1⅛
4	10	7⅞	8	⅞	1¼

9-3 APPROXIMATE DIMENSIONS

MOTOR				UNIT SELECTION							
FRAME NO.	DIMENSIONS			PUMP SIZE & TYPE							
	C*	U	KEYWAY	VW025-L	VW025-N	VW035-L	VW035-N	VW043-L	VW043-N	VW053-L	VW053-N
143T	13 1/2	.875	3/16 x 3/32	A A1	C C1	A A6	C C6				
145T	13 1/2	.875	3/16 x 3/32	A A1	C C1	A A6	C C6				
182T	14 7/16	1.125	1/4 x 1/8	A A2	C C2	A A7	C C7				
184T	15 7/16	1.125	1/4 x 1/8	A A2	C C2	A A7	C C7				
213T	17 3/4	1.375	5/16 x 5/32	A A4	C C4	A A8	C C8				
215T	19 1/4	1.375	5/16 x 5/32	A A4	C C4	A A8	C C8				
254T	23	1.625	3/8 x 3/16	B B1	D D1	B B9	D D9	E E1	G G1	E E9	G G9
256T	24 3/4	1.625	3/8 x 3/16	B B1	D D1	B B9	D D9	E E1	G G1	E E9	G G9
284T	25 3/4	1.875	1/2 x 1/4	B B3	D D3	B B11	D D11	E E3	G G3	E E11	G G11
284TS	24 3/8	1.625	3/8 x 3/16	B B5	D D5	B B13	D D13	E E5	G G5	E E13	G G13
286T	27 1/4	1.875	1/2 x 1/4	B B3	D D3	B B11	D D11	E E3	G G3	E E11	G G11
286TS	25 7/8	1.625	3/8 x 3/16	B B5	D D5	B B13	D D13	E E5	G G5	E E13	G G13
324T	28 13/16	2.125	1/2 x 1/4	B B6	D D6	B B14	D D14	E E6	G G6	E E14	G G14
324TS	27 5/16	1.875	1/2 x 1/4	B B7	D D7	B B15	D D15	E E7	G G7	E E15	G G15
326T	30 5/16	2.125	1/2 x 1/4			B B14	D D14	E E6	G G6	E E14	G G14
326TS	28 13/16	1.875	1/2 x 1/4			B B15	D D15	E E7	G G7	E E15	G G15
364T	32 5/8	2.375	5/8 x 5/16					F F1	H H1	F F7	H H7
364TS	30 1/2	1.875	1/2 x 1/4					F F2	H H2	F F8	H H8
365T	33 5/8	2.375	5/8 x 5/16					F F1	H H1	F F7	H H7
365TS	31 1/2	1.875	1/2 x 1/4					F F2	H H2	F F8	H H8
404T	36 5/8	2.875	3/4 x 3/8					F F4	H H4	F F10	H H10
404TS	33 5/8	2.125	1/2 x 1/4					F F5	H H5	F F11	H H11
405T	38 1/8	2.875	3/4 x 3/8					F F4	H H4	F F10	H H10
405TS	35 1/8	2.125	1/2 x 1/4					F F5	H H5	F F11	H H11

*Varies with type of enclosure and motor manufacturer.

All dimensions in inches. Do not use for construction purposes unless certified.

UNIT NO.	DIMENSIONS										
	MAX. HM*	HB	HF	HA	HD	HE	HG	HO	HR	HH	HP
AA1, AA2, AA4	17	45	27	18	11	7 1/2	4 1/2	14 1/8	8 1/8	15/16	1 1/2
AA6, AA7, AA8	19				12 1/2			16 3/8	7 1/4		
BB1, BB3, BB5, BB6, BB7	21	54	30		12 1/2		6	15 5/8	7 7/8		
BB9, BB11, BB13, BB14, BB15	23				14			17 7/8	7 1/8		
CC1, CC2, CC4	17	50	31		11		4 1/2	14 1/8	8 1/8		
CC6, CC7, CC8	19				12 1/2			16 3/8	7 1/4		
DD1, DD3, DD5, DD6, DD7	21	59	34		12 1/2		6	15 5/8	8 1/4		
DD9, DD11, DD13, DD14, DD15	23				14			17 7/8	7 1/2		
EE1, EE3, EE5, EE6, EE7	23	63	39		13 1/2		4 1/2	17 1/2	11 1/2		
EE9, EE11, EE13, EE14, EE15	25				15			19 3/4	9 1/8		
FF1, FF2, FF4, FF5	26	68	40		14 1/2		5 1/2	18 1/2	11 3/8		
FF7, FF8, FF10, FF11	28				16			20 3/4	9		
GG1, GG3, GG5, GG6, GG7	23	66	43		13 1/2		4 1/2	17 1/2	11 1/4		
GG9, GG11, GG13, GG14, GG15	25				15			19 3/4	8 7/8		
HH1, HH2, HH4, HH5	26	71	44		14 1/2		5 1/2	18 1/2	11 3/8		
HH7, HH8, HH10, HH11	28				16			20 3/4	9		

9-3 APPROXIMATE DIMENSIONS

MOTOR				UNIT SELECTION							
FRAME NO.	DIMENSIONS			PUMP SIZE & TYPE							
	C*	U	KEYWAY	VW025-L	VW025-N	VW035-L	VW035-N	VW043-L	VW043-N	VW053-L	VW053-N
182	13 13/16	.875	3/16 x 3/32	A A3	C C3	A A9	C C9				
184	14 13/16	.875	3/16 x 3/32	A A3	C C3	A A9	C C9				
213	17 1/4	1.125	1/4 x 1/8	A A5	C C5	A A10	C C10				
215	18 3/4	1.125	1/4 x 1/8	A A5	C C5	A A10	C C10				
254U	22 9/16	1.375	5/16 x 5/32	B B2	D D2	B B10	D D10	E E2	G G2	EE10	GG10
256U	24 5/16	1.375	5/16 x 5/32	B B2	D D2	B B10	D D10	E E2	G G2	EE10	GG10
284U	26 1/16	1.625	3/8 x 3/16	B B4	D D4	B B12	D D12	E E4	G G4	EE12	GG12
286U	27 9/16	1.625	3/8 x 3/16	B B4	D D4	B B12	D D12	E E4	G G4	EE12	GG12
324S	26 3/4	1.625	3/8 x 3/16	B B8	D D8	B B16	D D16	E E8	G G8	EE16	GG16
324U	29 1/8	1.875	1/2 x 1/4	B B7	D D7	B B17	D D17	E E7	G G7	EE17	GG17
326S	28 1/4	1.625	3/8 x 3/16	B B8	D D8	B B16	D D16	E E8	G G8	EE16	GG16
326U	30 5/8	1.875	1/2 x 1/4	B B7	D D7	B B17	D D17	E E7	G G7	EE17	GG17
364U	33	2.125	1/2 x 1/4					F F3	H H3	FF9	HH9
364US	30 3/8	1.875	1/2 x 1/4					F F2	H H2	FF8	HH8
365U	34	2.125	1/2 x 1/4					F F3	H H3	FF9	HH9
365US	31 3/8	1.875	1/2 x 1/4					F F2	H H2	FF8	HH8
404U	36 1/2	2.375	5/8 x 5/16					F F6	H H6	FF12	HH12
404US	33 5/8	2.125	1/2 x 1/4					F F5	H H5	FF11	HH11
405U	38	2.375	5/8 x 5/16					F F6	H H6	FF12	HH12
405US	35 1/8	2.125	1/2 x 1/4					F F5	H H5	FF11	HH11

UNIT NO.	DIMENSIONS										
	MAX. HM*	HB	HF	HA	HD	HE	HG	HO	HR	HH	HP
AA3, AA5	17	45	27	18	11	7 1/2	4 1/2	14 1/8	2 5/8	15/16	1 1/2
AA9, AA10	19				12 1/2			16 3/8	1 3/4		
BB2, BB4, BB7, BB8	21	54	30		12 1/2		6	15 5/8	2 3/8		
BB10, BB12, BB16, BB17	23				14			17 7/8	1 5/8		
CC3, CC5	17	50	31		11		4 1/2	14 1/8	2 5/8		
CC9, CC10	19				12 1/2			16 3/8	1 3/4		
DD2, DD4, DD7, DD8	21	59	34		12 1/2		6	15 5/8	2 3/4		
DD10, DD12, DD16, DD17	23				14			17 7/8	2		
EE2, EE4, EE7, EE8	23	63	39		13 1/2		4 1/2	17 1/2	6		
EE10, EE12, EE16, EE17	25				15			19 3/4	3 5/8		
FF2, FF3, FF5, FF6	26	68	40		14 1/2		5 1/2	18 1/2	6		
FF8, FF9, FF11, FF12	28				16			20 3/4	3 5/8		
GG2, GG4, GG7, GG8	23	66	43		13 1/2		4 1/2	17 1/2	6		
GG10, GG12, GG16, GG17	25				15			19 3/4	3 5/8		
HH2, HH3, HH5, HH6	26	71	44		14 1/2		5 1/2	18 1/2	6		
HH8, HH9, HH11, HH12	28				16			20 3/4	3 3/4		

*Varies with type of enclosure and motor manufacturer.

All dimensions in inches. Do not use for construction purposes unless certified.

9-3 APPROXIMATE DIMENSIONS

VW070 — 100 TYPE L & N

All holes in flanges straddle centerlines.

Right hand suction location (as shown) is standard.

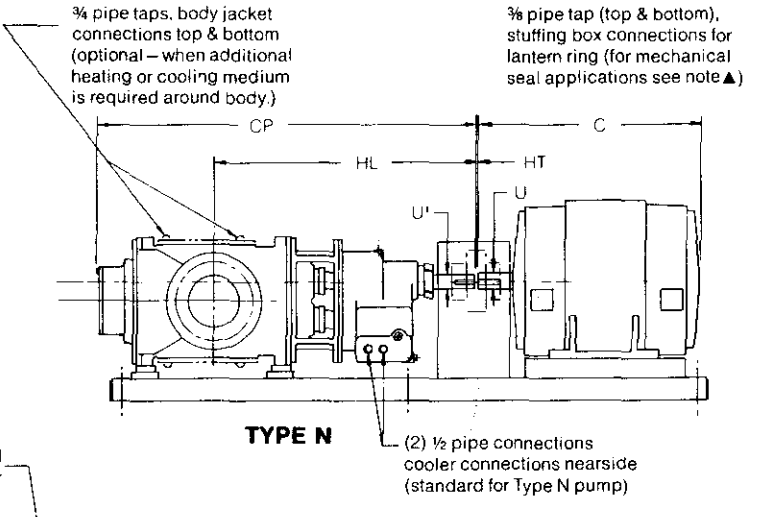
Left hand suction location is also available on request.

Rotation of pumps is counter clockwise viewed from driver end.

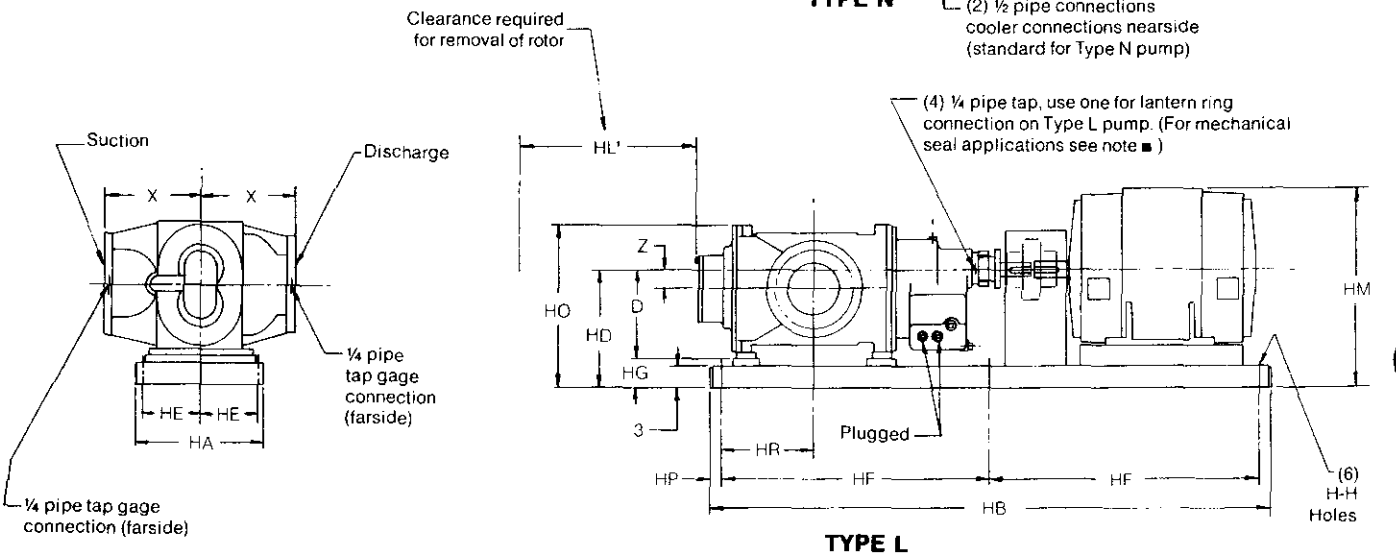
All dimensions in inches. Do not use for construction purposes unless certified.

▲ Use one ⅜ pipe tap in each gland for flushing mechanical seal.

■ Use one ¼ pipe tap in gland for flushing mechanical seal.



TYPE N



TYPE L

PUMP SIZE & TYPE	USAS FLANGES DISCHARGE 300#	USAS FLANGES SUCTION 150#	CP	D	HL	HT	U'	COUPLING KEY SIZE AT PUMP END	X	Z	HL'	PUMP SHAFT EXTENSION @ COUPLING
VW070-L	8	10	52 5/16	12¾	33¼	⅛	2.1875 2.1865	½ SQ. x 3"	15	2 11/16	45	4¾
VW070-N	8	10	57 9/16		38½						50¼	4⅞
VW100-L	10	12	63 11/16	17	40½		2.6250 2.6240	⅝ SQ. x 4"	19	3⅝	56	5 15/16
VW100-N	10	12	70 3/16		47						62½	6

FLANGE DIMENSIONS –USAS– 150# FLAT FACE					
I.D.	O.D.	B.C.	NO. HOLES	SIZE HOLES	THICK-NESS
10	16	14¼	12	1	1 3/16
12	19	17	12	1	1¼

FLANGE DIMENSIONS –USAS– 300# FLAT FACE					
I.D.	O.D.	B.C.	NO. HOLES	SIZE HOLES	THICK-NESS
8	15	13	12	1	1⅝
10	17½	15¼	16	1⅛	1⅞

9-3 APPROXIMATE DIMENSIONS

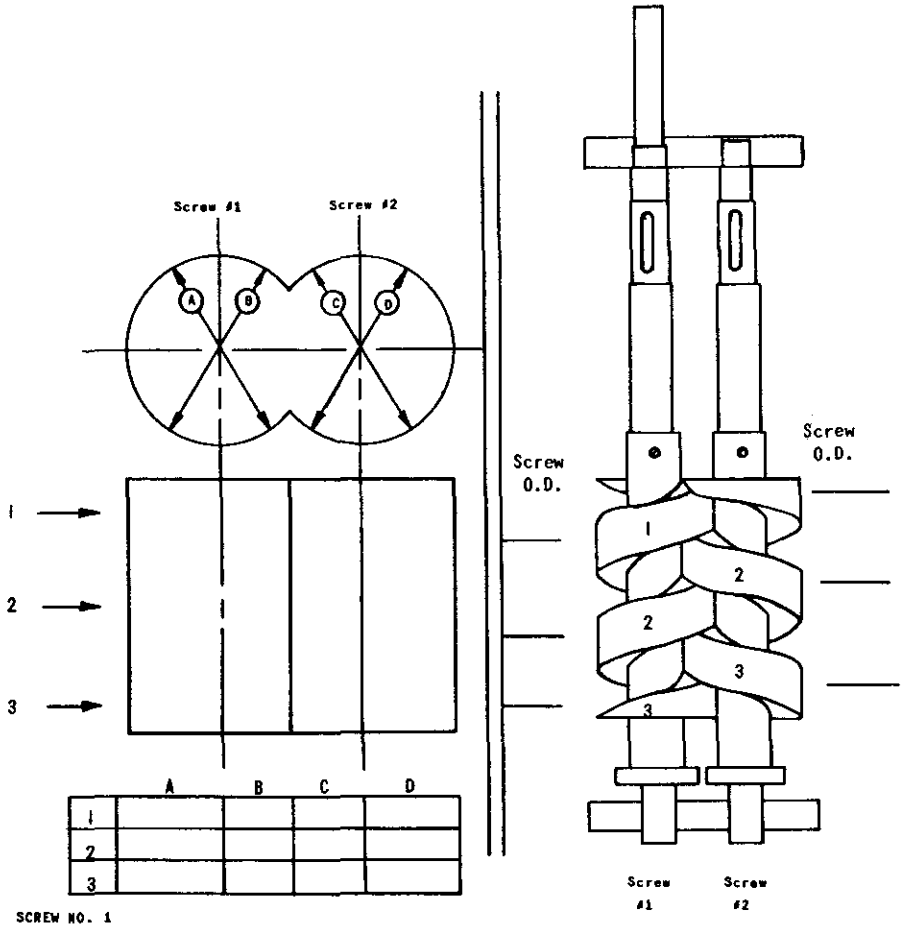
UNIT NO.	DIMENSIONS										
	MAX. HM*	HB	HF	HA	HD	HE	HG	HO	HR	HH	HP
II1, II2, II3, II4, II6, II7, II9	28	78	37½	24	17	10½	4¼	23½	13¾	1	1½
JJ1, JJ3, JJ4	30	89	43								
KK1, KK2, KK3, KK4, KK6, KK7, KK9	28	83	40								
LL1, LL3, LL4	30	95	46								
MM1, MM2, MM4	33	89	43								
NN1, NN3, NN4, NN5	34	97	47		21¼			29¾	17⅜		
OO1, OO2, OO4	33	96	46½								
PP1, PP3, PP4, PP5	34	104	50½								
RR1	34	106	51½								
SS1	34	112	54½								

MOTOR				UNIT SELECTION			
FRAME NO.	DIMENSIONS			PUMP SIZE & TYPE			
	C*	U	KEYWAY	VW070-L	VW070-N	VW100-L	VW100-N
284T	25¾	1.875	½ x ¼	II1	KK1		
284TS	24⅜	1.625	⅜ x 3/16	II2	KK2		
286T	27¼	1.875	½ x ¼	II1	KK1		
286TS	25⅞	1.625	⅜ x 3/16	II2	KK2		
324T	28 13/16	2.125	½ x ¼	II3	KK3		
324TS	27 5/16	1.875	½ x ¼	II4	KK4		
326T	30 5/16	2.125	½ x ¼	II3	KK3		
326TS	28 13/16	1.875	½ x ¼	II4	KK4		
364T	32⅝	2.375	⅝ x 5/16	II6	KK6	MM1	OO1
364TS	30½	1.875	½ x ¼	II7	KK7	MM2	OO2
365T	33⅝	2.375	⅝ x 5/16	II6	KK6	MM1	OO1
365TS	31½	1.875	½ x ¼	II7	KK7	MM2	OO2
404T	36⅝	2.875	¾ x ⅜	JJ1	LL1	NN1	PP1
404TS	33⅝	2.125	½ x ¼	II9	KK9	MM4	OO4
405T	38⅛	2.875	¾ x ⅜	JJ1	LL1	NN1	PP1
405TS	35⅛	2.125	½ x ¼	II9	KK9	MM4	OO4
444T	42⅛	3.375	⅞ x 7/16	JJ3	LL3	NN3	PP3
444TS	38⅜	2.375	⅝ x 5/16	JJ4	LL4	NN4	PP4
445T	44⅛	3.375	⅞ x 7/16	JJ3	LL3	NN3	PP3
445TS	40⅜	2.375	⅝ x 5/16	JJ4	LL4	NN5	PP5
447T	47⅝	3.375	⅞ x 7/16	JJ3	LL3	RR1	SS1
449T	48⅜	3.375	⅞ x 7/16			RR1	SS1

*Varies with type of enclosure and motor manufacturer.

All dimensions in inches. Do not use for construction purposes unless certified.

9-4 MACHINERY RECORD SHEET



	A	B	C	D
1				
2				
3				

SCREW NO. 1

O.D. _____ ACT. _____ REQ'D.

BODY BORE _____ ACT. _____ REQ'D. _____ FINISH

SCREW NO. 2

O.D. _____ ACT. _____ REQ'D.

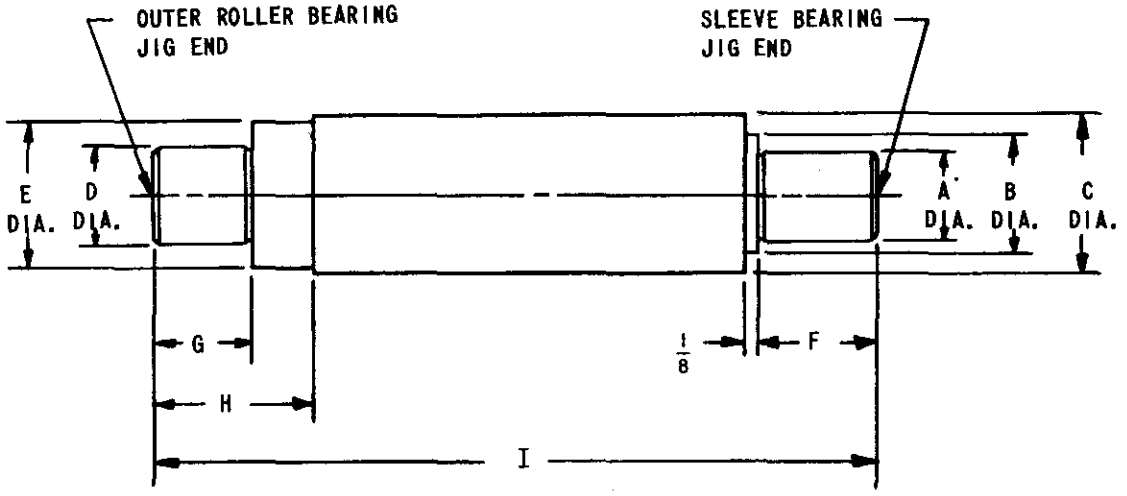
BODY BORE _____ ACT. _____ REQ'D. _____ FINISH

TOTAL FLANK CLEARANCE

SCREWS 1 & 2 _____ ACT. _____ REQ'D.

	Screw #1	Screw #2
RUNOUT	_____	_____

9-5 BEARING INSTALLATION JIG FOR CARBON SLEEVE & ROLLER BEARING



JIG DIMENSIONS

PUMP SIZE	A ±.002	B ±.002	C	D ±.002	E ±.002	F	G	H	I
VW-025	0.934	1.303	1 3/4	0.990	1.490	1 3/4	7/8	1 3/8	7
VW-035	1.247	1.740	2 1/4	1.365	1.865	2 1/4	1 1/8	1 3/4	9
VW-043	1.620	2.240	3	1.740	2.302	2 3/4	1 1/8	1 3/4	10
VW-053	1.747	2.240	3	1.740	2.302	3	1 1/8	1 3/4	10
VW-070	2.247	3.240	4	2.740	3.490	3 3/4	1 5/8	2 1/4	11
VW-100	2.871	3.615	4 1/2	3.240	4.240	4 3/4	1 5/8	2 1/4	12

NOTE - Brass covers should be installed over jig ends when using a hammer or press. Damage to jig ends would result in faulty bearing installations.

SECTION 10 — TROUBLESHOOTING

Symptoms	Possible Cause of Trouble
Pump does not discharge	1-2-3-4-17-18-19-24
Insufficient discharge	2-3-4-5-6-11-14-16-18-19-24
Excessive load on driver	12-14-15-19
Loss of suction (after period of satisfactory operation)	2-4-7-19-24
Hammer, noise, vibration	7-8-9-10-13-19-20-21-22-23-25

1. Pump not primed
2. Suction lift too high
3. Starved or impaired suction
4. Air leaks in suction
5. Insufficient NPSH (hot liquids)
6. Foot valve or strainer too small or plugged
7. Air or gases in liquid
8. Suction velocity too high
9. Abrupt changes of direction in suction piping/velocity too high
10. Insufficient immersion of suction piping
11. Liquid less viscous than specified
12. Liquid more viscous than specified
13. Discharge line obstructed
14. Discharge pressure too high
15. Speed too high
16. Speed too low
17. Incorrect rotation
18. Relief valve improperly set
19. Mechanical defect (inspect pump)
20. Relief valve chatter
21. Improperly supported piping/piping strain
22. Improperly constructed foundation/grouting
23. Cavitation
24. System valves and/or controller operating improperly
25. Mechanical defect (driver)

SECTION 11 — REPLACEMENT PARTS

11-1 GENERAL

Your inventory of spare parts should be based upon the application and the importance of continued operation. The quantity of spares will also vary with number of units in operation with interchangeable parts. The more units you have, the fewer spares per unit will be required. Individual replacement parts or spares can be ordered as needed when down time is not critical.

11-2 ORDERING INSTRUCTIONS

When placing an order for replacement parts, please provide the following information with your order:

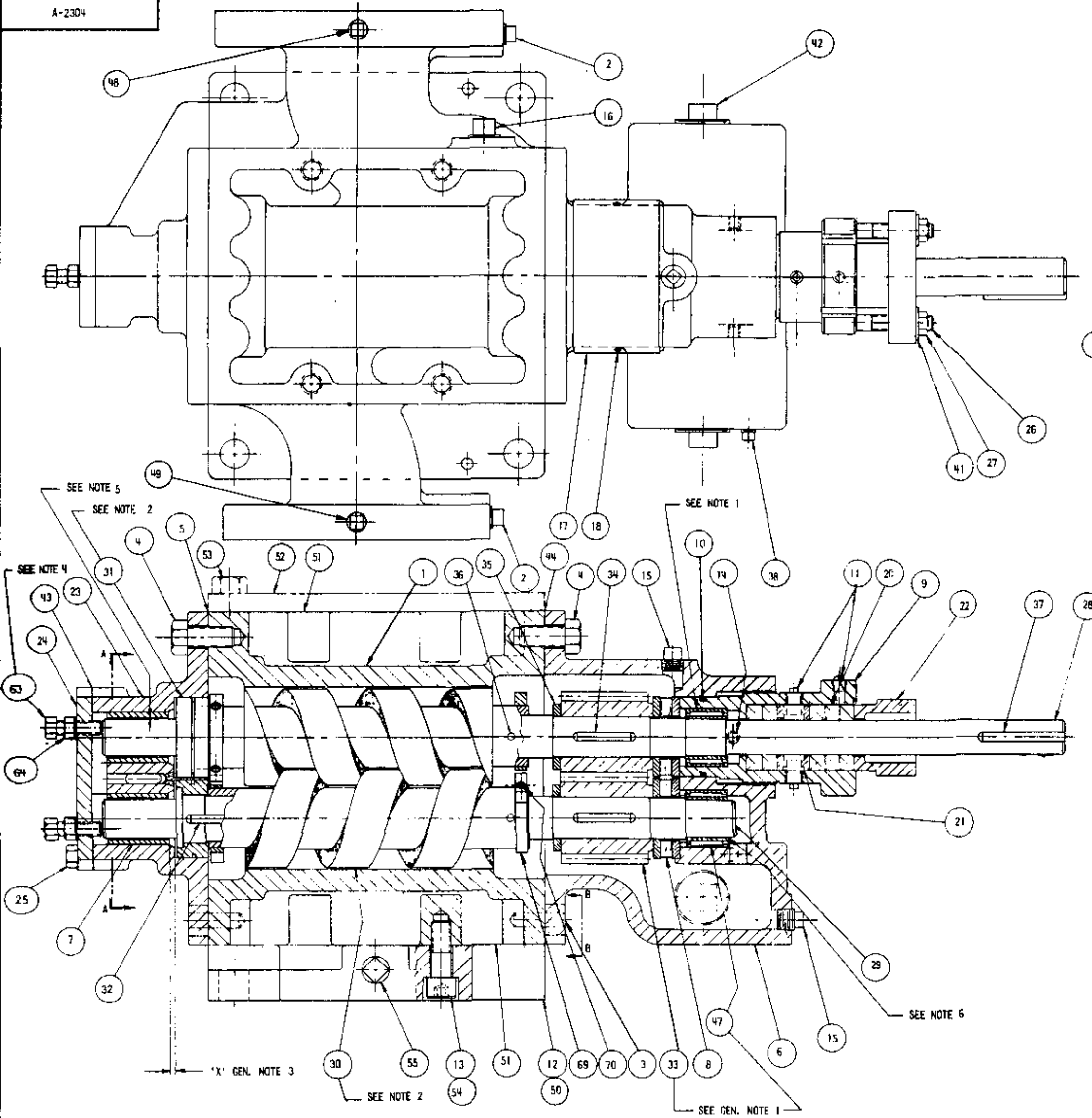
1. Original order number pump was sold on.
2. Serial number of pump. (Example: No. 72345)
3. Type of pump. (Example: Series 2501 VW0258-NFP)
4. Name of part required and part number from drawing (Pc. 58, roller bearing)
5. Quantity required.
6. Purchase order number.
7. Complete shipping and invoicing instructions.

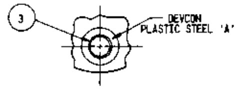
LIST OF PARTS — SERIES 2501 — TYPE L — 025, 035, 043, 053
SECTIONAL ASSEMBLY DWG. A-2304

Item No.	Part	Qty Req'd
1	Body	1
2	Pipe Plug	2
3	Dowel Pin	4
4	Hex Bolt	16
5	Gasket	1
6	Front Head	1
7	Sleeve Bearing	2
8	Thrust Bearing	2
9	Thrust Bearing Adj. Sleeve	1
10	O-Ring	1
11	Pipe Plug	5
12	Mounting Foot	1
13	Cap Screw	4
14	Set Screw	2
15	Pipe Plug	2
16	Pipe Plug	2
17	Nameplate	1
18	Drive Screw	2
20	Packing	5
21	Lantern Ring	1
22	Gland	1
23	Rear Head	1
24	Rear Head Cover	1
25	Hex Bolt	6
26	Stud Bolt	2
27	Hex Nut	2
28	Long Shaft	1
29	Short Shaft	1
30	Screw	2
31	Piston	2
32	Key	2
33	Timing Gear	2
34	Key	2
35	Spacer	2
36	Groove Pin	2
37	Key	1
38	Pipe Plug	1
41	Washer	2
42	Pipe Plug	4
43	Gasket	1
44	Gasket	1
47	Roller Bearing	2
48	Pipe Plug	2
49	Pipe Plug	2
*50	Mounting Foot (Jacket)	1
*51	Gasket	2
*52	Body Jacket Cover	1
*53	Hex Bolt	10
*54	Capscrew	10
*55	Pipe Plug	1
63	Adjusting Bolt	2
64	Hydra-Lok Locknut	2
69	Balancing Disc	4
70	Setscrew	8

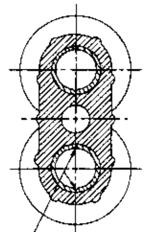
*Optional jacketed body

REVISIONS					
ZONE	LTR	DESCRIPTION	DATE	APPROVED	MICRO FILM
	A	NOTES L & M WERE BACKOFF 1/2 TURN.	2/19/79	EMS	1979
	B	NOTE 8 WAS TO GLUE PC. 68 TO PC. 9 & 6 ALSO REMOVED PC. 67 & ADDED PC'S 69, 70	5/22/79	G.L.	JUL 9 1979
	C	NOTES L & M WERE BACKOFF 1/8 TURN. REMOVED NOTES 5 & 8. ADDED VIEW A-A. VIEW B-B WAS A-A. PC. 14 WAS LOCKNUT. REMOVED PC. 68, 65 & 66.	3/11/83	EMS	AUG 1 0 1983





VIEW B-B
TYPICAL (4) PLACES
SEE NOTE 9



VIEW A-A
POSITION SLEEVE BRG WITH GROOVES ON VERTICAL C_L

GENERAL NOTES

1. USING LOCTITE ADHESIVE #40. ASSEMBLE TIMING GEARS (33) ON SHAFTS, AND OUTER RACE OF ROLLER BRGS. (47) INTO ADJUSTING SLEEVE (9) AND IN FRONT HD. (6).
2. WHEN ASSEMBLING SCREWS (30) AND PISTONS (31) ON SHAFTS USE AN EPOXY ADHESIVE FOR CAST IRON CONSTRUCTION & USE LOCTITE #40 ADHESIVE FOR STAINLESS STEEL CONSTRUCTION.
3. WHEN INSTALLING NEW OR REPLACEMENT SLEEVE BEARINGS SET BEARING TO 'X' DIM'S AS FOLLOWS:
   - VW025 'X' DIM. = 1/8
   - VW035 'X' DIM. = 1/8
   - VW043 'X' DIM. = 1/8
   - VW053 'X' DIM. = 1/8
4. FLANK CLEARANCE ADJUSTMENT PROCEDURE
   - A. LOOSEN THRUST BEARING ADJUSTING SLEEVE SETSCREW (14)
   - B. BACK OFF THRUST BEARING ADJUSTING SLEEVE (9): TURN COUNTERCLOCKWISE.
   - C. TIGHTEN LOWER HEX BOLT (63) IN REAR HEAD COVER (24) SO AS TO LOCK THE SHORT SHAFT (29) TIGHTLY AGAINST THE LOWER THRUST BEARING (8).
   - D. PULL ON LONG SHAFT (28) IN THE DIRECTION OF THE THRUST BEARING (8) UNTIL THE CLEARANCE BETWEEN THE UPPER AND LOWER SCREW FLANKS IS REMOVED.
   - E. PLACE A DIAL INDICATOR BUTTON AGAINST THE EXPOSED FACE OF THE LONG SHAFT (28) AT THE FRONT OF THE PUMP.
   - F. TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE UNTIL SCREW FLANKS MAKE CONTACT ON THE OPPOSITE SIDE.
   - G. RECORD TOTAL INDICATOR MOVEMENT. THIS WILL BE THE TOTAL FLANK CLEARANCE. DIVIDE TOTAL FLANK CLEARANCE BY 2.
   - H. REPEAT STEP NO. B.
   - I. REPEAT STEP NO. D.
   - J. SLOWLY TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE AND OBSERVE INDICATOR MOVEMENT. STOP TURNING WHEN INDICATOR READS 1/2 OF TOTAL FLANK CLEARANCE. THIS NOW MEANS THAT THE FLANK CLEARANCE WILL BE EQUAL ON BOTH SIDES OF THE SCREW THREAD.

     NOTE

     THRUST LOAD WILL BE IN THE DIRECTION OF THE THRUST BEARINGS ASSURING NO METAL-TO-METAL CONTACT BETWEEN THE SCREW FLANKS.
   - K. RETIGHTEN SETSCREW (14) STAKE WITH A PRICK PUNCH
   - L. BACKOFF LOWER HEX BOLT (63) IN REAR HEAD COVER (24) 1/2 TURN.
   - M. TIGHTEN UPPER HEX BOLT (63) IN REAR HEAD COVER (24) HARD-UP AGAINST SHAFT (28): THEN BACK OFF 1/2 TURN.
5.
6. STAKE INNER RACE OF ROLLER BRG. (47) ON SHORT SHAFT (29) ONLY AND AT LOCATION SHOWN.
7. FOR MECHANICAL SEALS SEE SHEET 2.
8.
9. COAT THE DOWEL PIN (3) EXTENDING OUT FROM THE BODY (1) WITH A RELEASING AGENT. MAKE SURE THE MATING HOLE IS CLEAN. FILL THE MATING HOLE WITH DEVCON PLASTIC STEEL 'A' OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES FRACTIONS: DECIMALS: ANGLES:	CONTRACT NO. APPROVED / DATE; CHECKED EMS 1/30/79; DRAWN JG 1/25/79; APPROVED	WARREN PUMPS INC. WARREN, MASS. DRAWING TITLE TYPICAL SECTIONAL ASSEMBLY FOR VW025, 035, 043 & 053 SCREW PUMPS TYPE L SERIES 2501	
		SIZE D	CODE IDENT NO. 63857 · DWG. NO. A-2304 · REV. C
		SCALE: 3/4	SHEET 1 OF 2 SHEETS

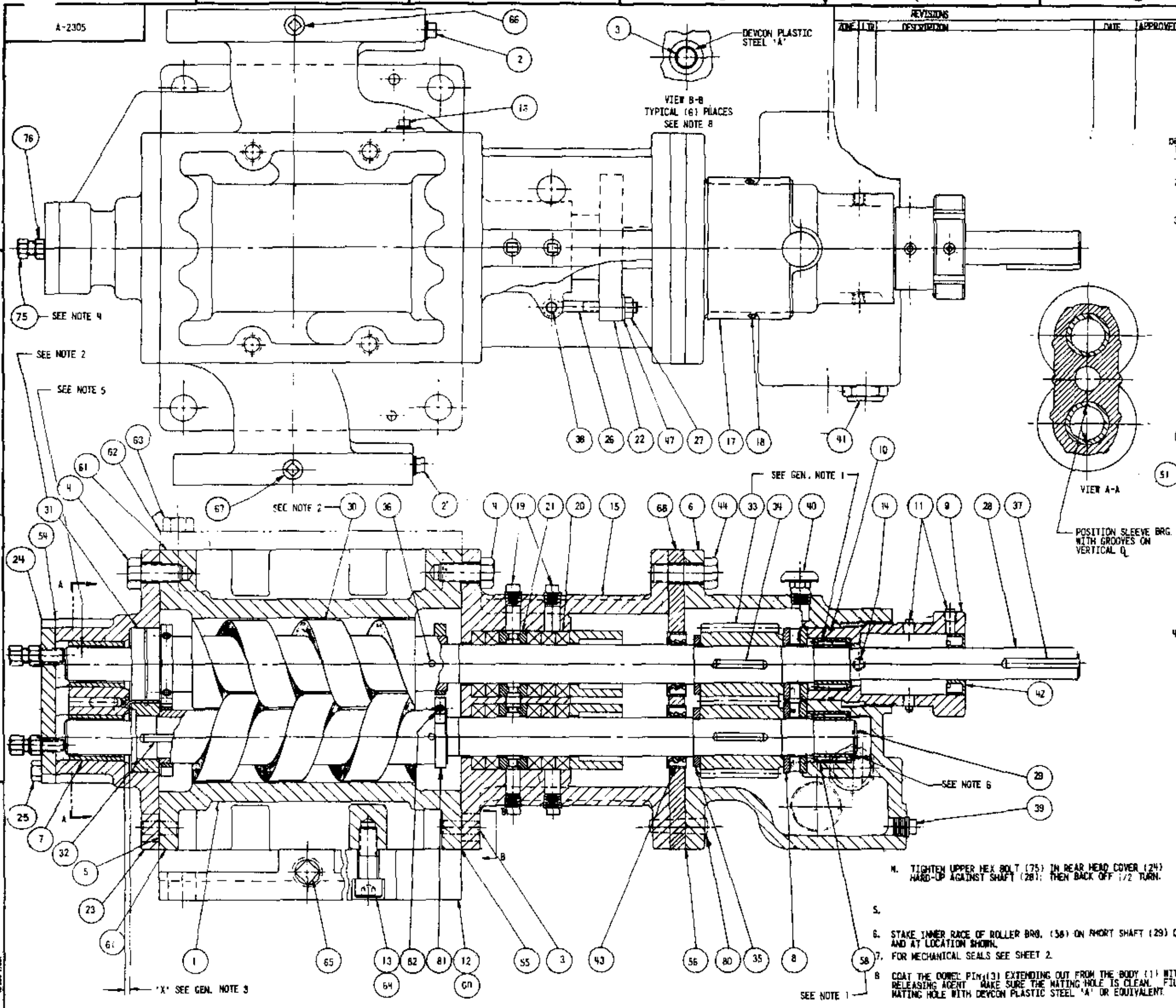
FEB 2 1979

LIST OF PARTS — SERIES 2502 — TYPE N — 025, 035, 043, 053
SECTIONAL ASSEMBLY DWG. A-2305

Item No.	Part	Qty Req'd
1	Body	1
2	Pipe Plug	2
3	Dowel Pin	4
4	Hex Bolt	16
5	Gasket	1
6	Front Head	1
7	Sleeve Bearing	2
8	Thrust Bearing	2
9	Thrust Bearing Adj. Sleeve	1
10	O-Ring	1
11	Pipe Plug	5
12	Mounting Foot	1
13	Cap Screw	4
14	Setscrew	2
15	Stuffing Box Housing	1
16	Pipe Plug	2
17	Name Plate	1
18	Drive Screw	2
19	Pipe Plug	2
20	Packing	10
21	Lantern	2
22	Gland	2
23	Rear Head	1
24	Rear Head Cover	1
25	Hex Bolt	6
26	Gland Swing Bolt	4
27	Hex Nut	4
28	Long Shaft	1
29	Short Shaft	1
30	Screw	2
31	Piston	2
32	Key	2
33	Timing Gear	2
34	Key	2
35	Spacer	2
36	Groove Pin	2
37	Key	1
38	Roll Pin	4
39	Pipe Plug	1
40	Vent & Fill Plug	1
41	Sight Glass	1
42	Oil Seal	1
43	Oil Seal	2
44	Hex Bolt	8
46	Spacer	4
47	Washer	4
48	Oil Cooler	2
49	Hex Plug	4
50	O-Ring	4
51	Female Conn	2
52	Union	2
53	Tubing	1
54	Gasket	1
55	Gasket	1
56	Gasket	1
58	Roller Bearing	2
*60	Mounting Foot (Jacket)	1
*61	Gasket	2
*62	Body Jacket Cover	1
*63	Hex Bolt	10
*64	Capscrew	10
*65	Pipe Plug	1
*66	Pipe Plug	2
68	Bracket Seal Plate	1
75	Adjusting Bolt	2
76	Hydra-Lok Nut	2
80	Taper Pin	2
81	Balancing Disc	4
82	Set Screw	8

*Optional jacketed body

A-2305



ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED	MICRO FILM
	A	NOTES L & M WERE BACKOFF 1/2 TURN.	2/19/79	EMS	FEB 2 2 1979
	B	NOTE 7 WAS TO GLUE PC. 80 TO PC. 9 & 6. ALSO REMOVED PC. 79 & ADDED PC'S 81, 82	5/22/79	G.L.	JUL 9 1979
	C	NOTES L&M WERE BACKOFF 1/8 TURN. DELETED NOTE 5. NOTE 7 WAS GLUE ON THR. BRG. WASHER, ETC., VIEW B-B WAS VIEW A-A. ADDED VIEW A-A REPLACING NOTE 5. PC. 14 WAS LOCKNUT. DELETED PC'S 77 & 78. PC. 80 WAS THR. BRG FABREEKA WASHER.	3/22/83	EMS	AUG 1 6 1983

MAY 2 5 1978

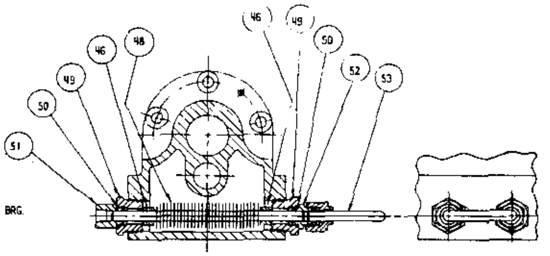
GENERAL NOTES

1. USING LOCTITE ADHESIVE #40, ASSEMBLE TIMING GEARS (33) ON SHAFTS, AND OUTER RACE OF ROLLER BRGS. (58) INTO ADJUSTING SLEEVE (9) AND IN FRONT HD. (6).

2. WHEN ASSEMBLING SCREWS (30) AND PISTONS (31) ON SHAFTS USE AN EPOXY ADHESIVE FOR CAST IRON CONSTRUCTION & USE LOCTITE #40 ADHESIVE FOR STAINLESS STEEL CONSTRUCTION.

3. WHEN INSTALLING NEW OR REPLACEMENT SLEEVE BEARINGS, SET BEARING TO 'X' DIMENSION AS FOLLOWS:

   VW025 'X' DIM. = 1/8
   VW035 'X' DIM. = 1/8
   VW043 'X' DIM. = 1/8
   VW053 'X' DIM. = 1/8



VIEW SHOWING OIL COOLING ARRANGEMENT
NOTE: VW025 FURNISHED WITH (1) ONE
OIL COOLER PC. 48
SCALE 3/8

4. FLANK CLEARANCE ADJUSTMENT PROCEDURE
   A. LOOSEN THRUST BEARING ADJUSTING SLEEVE SETSCREW (14)
   B. BACK OFF THRUST BEARING ADJUSTING SLEEVE (9): TURN COUNTERCLOCKWISE.
   C. TIGHTEN LOWER HEX BOLT (75) IN REAR HEAD COVER (24) SO AS TO LOCK THE SHORT SHAFT (29) TIGHTLY AGAINST THE LOWER THRUST BEARING (8).
   D. PULL ON LONG SHAFT (28) IN THE DIRECTION OF THE THRUST BEARING (8) UNTIL THE CLEARANCE BETWEEN THE UPPER AND LOWER SCREW FLANKS IS REMOVED.
   E. PLACE A DIAL INDICATOR BUTTON AGAINST THE EXPOSED FACE OF THE LONG SHAFT (28) AT THE FRONT OF THE PUMP.
   F. TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE UNTIL SCREW FLANKS MAKE CONTACT ON THE OPPOSITE SIDE.
   G. RECORD TOTAL INDICATOR MOVEMENT. THIS WILL BE THE TOTAL FLANK CLEARANCE. DIVIDE TOTAL FLANK CLEARANCE BY 2.
   H. REPEAT STEP NO. B.
   I. REPEAT STEP NO. D.
   J. SLOWLY TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE AND OBSERVE INDICATOR MOVEMENT. STOP TURNING WHEN INDICATOR READS 1/2 OF TOTAL FLANK CLEARANCE. THIS NOW MEANS THAT THE FLANK CLEARANCE WILL BE EQUAL ON BOTH SIDES OF THE SCREW THREAD.

   NOTE

   THRUST LOAD WILL BE IN THE DIRECTION OF THE THRUST BEARINGS ASSURING NO METAL-TO-METAL CONTACT BETWEEN THE SCREW FLANKS.

   K. RETIGHTEN SETSCREWS (14). STAKE WITH A PRICK PUNCH.
   L. BACKOFF LOWER HEX BOLT (75) IN REAR HEAD COVER (24) 1/2 TURN.
   M. TIGHTEN UPPER HEX BOLT (75) IN REAR HEAD COVER (24) HARD-UP AGAINST SHAFT (28); THEN BACK OFF 1/2 TURN.

5.

6. STAKE INNER RACE OF ROLLER BRG. (58) ON SHORT SHAFT (29) ONLY AND AT LOCATION SHOWN.

7. FOR MECHANICAL SEALS SEE SHEET 2.

8. COAT THE DOWEL PIN (3) EXTENDING OUT FROM THE BODY (1) WITH A RELEASING AGENT. MAKE SURE THE MATING HOLE IS CLEAN. FILL THE MATING HOLE WITH DEVCON PLASTIC STEEL 'A' OR EQUIVALENT.

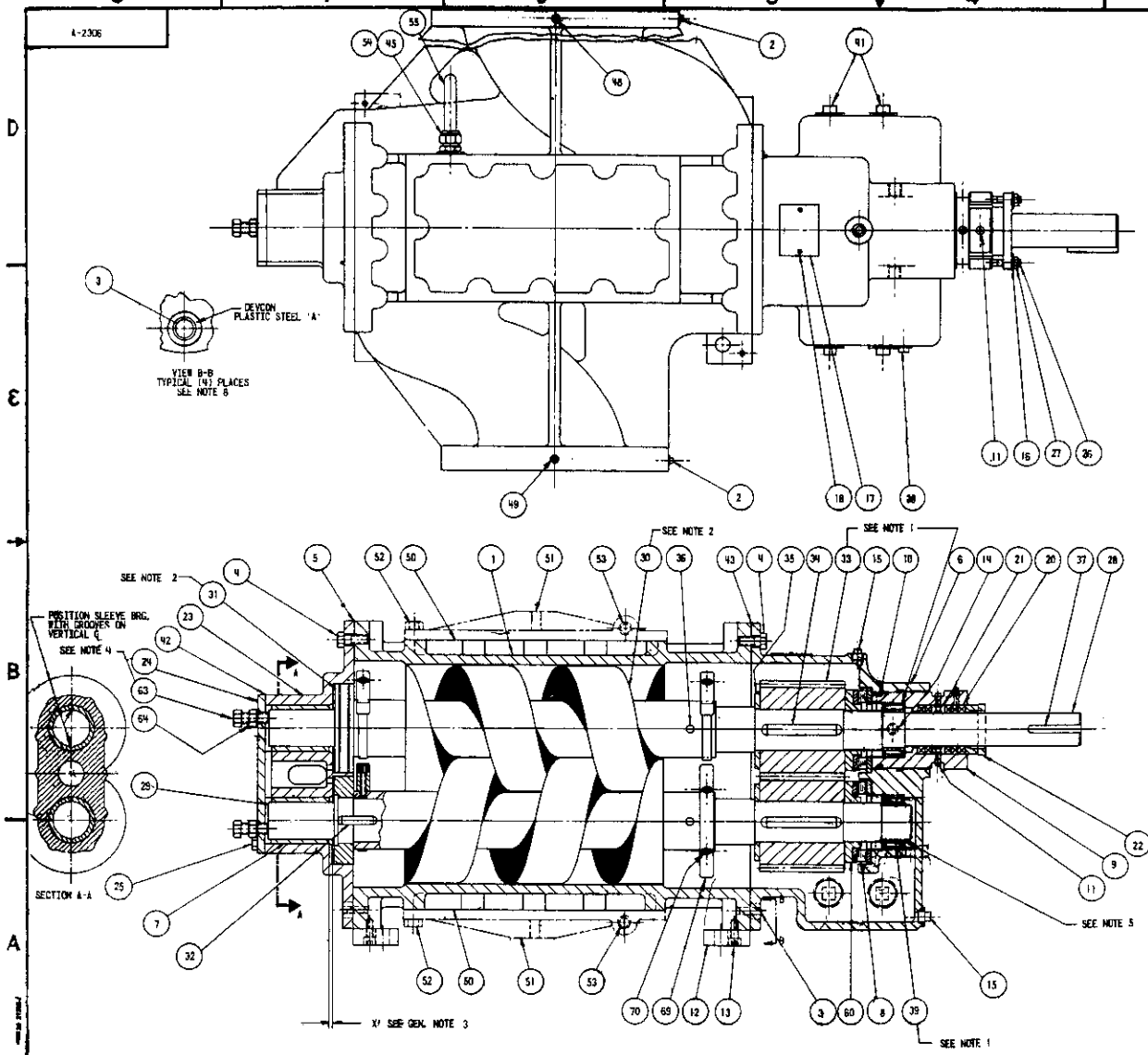
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES FRACTIONS DECIMALS ANGLES	CONTRACT NO.	WARREN PUMPS INC. WARREN MASS.
	APPROVED / DATE; CHECKED EMS 1/30/79; DRAWN TRD 1/25/79; APPROVED	DRAWING TITLE: TYPICAL SECTIONAL ASSEMBLY FOR VW 025, 035, 043 & 053 SCREW PUMPS TYPE N
		SIZE D; CODE IDENT NO. 63857; DWG. NO. A-2305; REV. C
		SCALE: 3/4; SHEET 1 OF 2 SHEETS

FEB 1 1979

LIST OF PARTS — SERIES 2501 — TYPE L — 070, 100
SECTIONAL ASSEMBLY DWG. A-2306

Item No.	Part	Qty Req'd
1	Body	1
2	Pipe Plug	2
3	Dowel Pin	4
4	Hex Bolt	24
5	Gasket	1
6	Front Head	1
7	Sleeve Bearing	2
8	Thrust Bearing	2
9	Thrust Bearing Adj. Sleeve	1
10	O-Ring	1
11	Pipe Plug	5
12	Mounting Foot	2
13	Cap Screw	8
14	Set Screw	2
15	Pipe Plug	2
16	Washer	2
17	Nameplate	1
18	Drive Screw	2
20	Packing	5
21	Lantern Ring	1
22	Gland	1
23	Rear Head	1
24	Rear Head Cover	1
25	Hex Bolt	8
26	Stud Bolt	2
27	Hex Nut	2
28	Long Shaft	1
29	Short Shaft	1
30	Screw	2
31	Piston	2
32	Key	2
33	Timing Gear	2
34	Key	2
35	Spacer	2
36	Groove Pin	2
37	Key	1
38	Pipe Plug	1
39	Roller Bearing	2
41	Pipe Plug	4
42	Gasket	1
43	Gasket	1
48	Pipe Plug	2
49	Pipe Plug	2
*50	Gasket	2
*51	Body Jacket Cover	2
*52	Hex Bolt	32
*53	Pipe Plug	4
60	Bearing Plate	2
63	Adjusting Bolt	2
64	Hydra-Locknut	2
69	Balancing Disc	4
70	Capscrew	8

*Optional jacketed body



REVISIONS					
ZONE	LTR	DESCRIPTION	DATE	APPROVED	MICRO FILM
	A	NOTES L&M WERE BACK OFF 1/2 TURN.	2/19/79	EMS	
	B	NOTE 7 WAS TO GLUE PC. 68 TO PC. 9 & 6. ALSO REMOVED PC. 67 & ADDED PC'S 69. 70	5/22/79	G.L.	
	C	NOTES L & M WERE BACKOFF 1/8 TURN. NOTE 7 WAS REMOVED. PC. 14 WAS LOCKNUT. DELETED PC. 65, 66 & 68	3/22/83	EMS	

GENERAL NOTES:

1. USING LOCTITE ADHESIVE #40. ASSEMBLE TIMING GEARS (33) ON SHAFTS AND OUTER RACE OF ROLLER BEARINGS (39) INTO ADJUSTING SLEEVE (9) AND IN FRONT HEAD (6).
2. WHEN ASSEMBLING SCREWS (30) AND PISTONS (31) ON SHAFTS USE AN EPOXY ADHESIVE FOR CAST IRON CONSTRUCTION & USE LOCTITE #40 ADHESIVE FOR STAINLESS STEEL CONSTRUCTION.
3. WHEN INSTALLING NEW OR REPLACEMENT SLEEVE BEARINGS SET BEARING TO 'X' DIM AS FOLLOWS:
   VM070 'X' DIM. = 1/8
   VM100 'X' DIM. = 1/8
4. FLANK CLEARANCE ADJUSTMENT PROCEDURE
   A. LOOSEN THRUST BEARING ADJUSTING SLEEVE SETSCREW (14)
   B. BACK OFF THRUST BEARING ADJUSTING SLEEVE (9); TURN COUNTERCLOCKWISE.
   C. TIGHTEN LOWER HEX BOLT (63) IN REAR HEAD COVER (24) SO AS TO LOCK THE SHORT SHAFT (29) TIGHTLY AGAINST THE LONGER THRUST BEARING (8).
   D. PULL ON LONG SHAFT (28) IN THE DIRECTION OF THE THRUST BEARING (8) UNTIL THE CLEARANCE BETWEEN THE UPPER AND LOWER SCREW FLANKS IS REMOVED.
   E. PLACE A DIAL INDICATOR BUTTON AGAINST THE EXPOSED FACE OF THE LONG SHAFT (28) AT THE FRONT OF THE PUMP.
   F. TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE UNTIL SCREW FLANKS MAKE CONTACT ON THE OPPOSITE SIDE.
   G. RECORD TOTAL INDICATOR MOVEMENT. THIS WILL BE THE TOTAL FLANK CLEARANCE. DIVIDE TOTAL FLANK CLEARANCE BY 2.
   H. REPEAT STEP NO. B.
   I REPEAT STEP NO. D.
   J. SLOWLY TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE AND OBSERVE INDICATOR MOVEMENT. STOP TURNING WHEN INDICATOR READS 1/2 OF TOTAL FLANK CLEARANCE. THIS NOW MEANS THAT THE FLANK CLEARANCE WILL BE EQUAL ON BOTH SIDES OF THE SCREW THREAD.

   NOTE

   THRUST LOAD WILL BE IN THE DIRECTION OF THE THRUST BEARINGS ASSURING NO METAL-TO-METAL CONTACT BETWEEN THE SCREW FLANKS.

   K. RETIGHTEN SETSCREW (14) STAKE WITH A PRICK PUNCH
   L. BACKOFF LOWER HEX BOLT (63) IN REAR HEAD COVER (24) 1/2 TURN.
   M. TIGHTEN UPPER HEX BOLT (63) IN REAR HEAD COVER (24) HAND-UP AGAINST SHAFT; THEN BACK OFF 1/2 TURN.
5. STAKE INNER RACE OF ROLLER BRG. (39) ON SHORT SHAFT (29) ONLY AND AT LOCATION SHOWN.
6. FOR MECHANICAL SEALS SEE SHEET 2.
7.
8. COAT THE DOWEL PIN (3) EXTENDING OUT FROM THE BODY (1) WITH A RELEASING AGENT. MAKE SURE THE MATING HOLE IS CLEAN. FILL THE MATING HOLE WITH DEVCON PLASTIC STEEL 'A' OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES FRACTIONS DECIMALS ANGLES

CONTRACT NO.

	APPROVED	DATE
CHECKED	DH	7/30/79
DRAWN	MD	7/25/79
APPROVED		

WARREN PUMPS, INC.
SUBSIDIARY OF HOUDAILLE INDUSTRIES, INC.
WARREN, MASS.

DRAWING TITLE SECTIONAL ASSEMBLY NOR VM1706 #VM100 SCREW PUMP - TYPE L

SIZE D | CODE IDENT NO. 49887 | DWG. NO. A-2306 | REV. C

SCALE: 1/4 | SHEET 1 OF 2 SHEETS

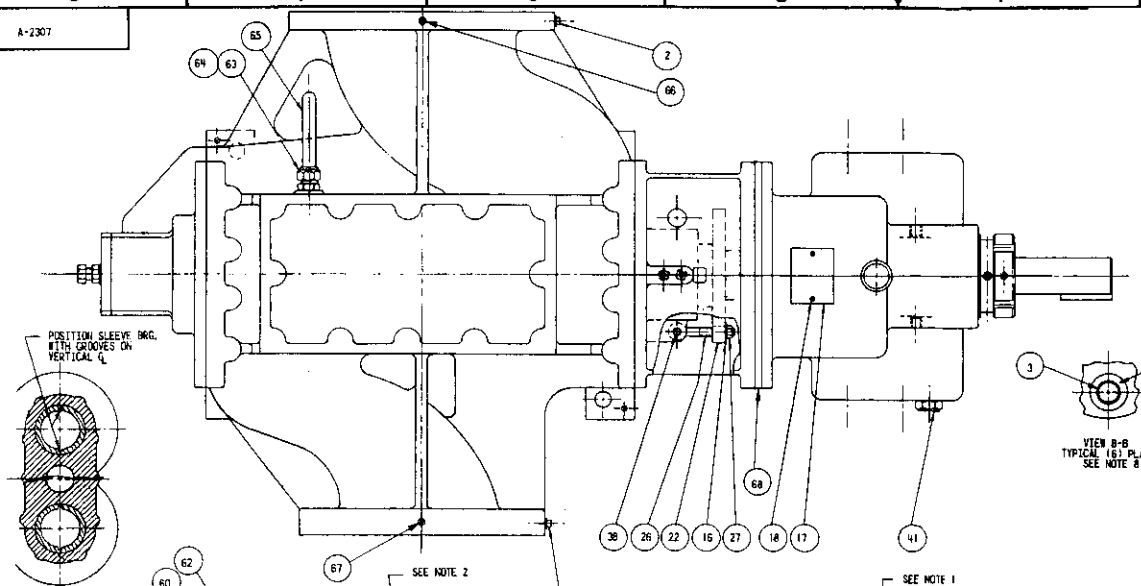
LIST OF PARTS — SERIES 2502 — TYPE N — 070, 100
SECTIONAL ASSEMBLY DWG. A-2307

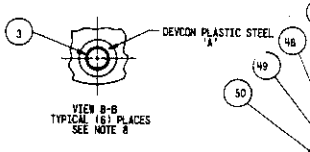
Item No.	Part	Qty Req'd
1	Body	1
2	Pipe Plug	2
3	Dowel Pin	4
4	Hex Bolt	24
5	Gasket	1
6	Front Head	1
7	Sleeve Bearing	2
8	Thrust Bearing	2
9	Thrust Bearing Adj. Sleeve	1
10	O-Ring	1
11	Pipe Plug	5
12	Mounting Foot	2
13	Capscrew	8
14	Setscrew	2
15	Stuffing Box Housing	1
16	Washer	4
17	Nameplate	1
18	Drive Screw	2
19	Pipe Plug	2
20	Packing	10
21	Lantern Ring	2
22	Gland	2
23	Rear Head	1
24	Rear Head Cover	1
25	Hex Bolt	8
26	Gland Swing Bolt	4
27	Hex Nut	4
28	Long Shaft	1
29	Short Shaft	1
30	Screw	2
31	Piston	2
32	Key	2
33	Timing Gear	2
34	Key	2
35	Spacer	2
36	Groove Pin	2
37	Key	1
38	Roll Pin	4
39	Pipe Plug	1
40	Vent & Fill Plug	1
41	Sight Glass	1
42	Oil Seal	1
43	Oil Seal	2
44	Hex Bolt	12
46	Spacer	4
47	Oil Cooler	2
48	Hex Plug	4
49	O-Ring	4
50	Female Conn	2
51	Union	2
52	Tubing	1
53	Gasket	1
54	Gasket	1
55	Gasket	1
56	Roller Bearing	2
*60	Gasket	2
*61	Body Jacket Cover	2
*62	Hex Bolt	32
*63	Pipe Plug	4
*66	Pipe Plug	2
68	Bracket Seal Plate	1
74	Bearing Plate	2
76	Adjusting Bolt	2
77	Hydra-Lok Nut	2
80	Taper Pin	2
82	Balancing Disc	4
83	Capscrew	8

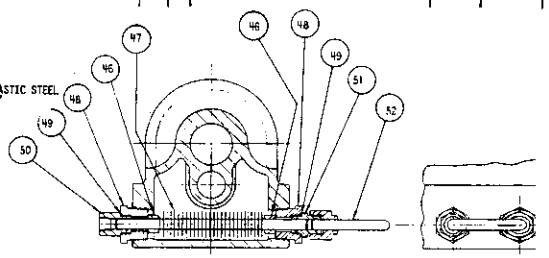
*Optional jacketed body

A-2307

REVISIONS					MICRO FILM
ZONE	LTR	DESCRIPTION	DATE	APPROVED	
	A	NOTES L & M WERE BACKOFF 1/2 TURN.	2/19/79	EMS	FEB 8 1 1979
	B	NOTE 7 WAS TO GLUE PC. 81 TO PC. 9 & 6. ALSO REMOVED PC. 80. & ADDED PC. 82. 83.	7/3/79	G.L.	JUL 1 1979
	C	NOTES L & M WERE BACKOFF 1/8 TURN. DELETED NOTE 7. NOTE 7 WAS GLUE ON THRUST BRG. WASHER ETC.. PC. 14 WAS LOCKNUT. DELETED PC'S 78. 79 & 81. PC. 81 WAS FABREEKA WASHER. ADDED PC. 80	3/22/83	EMS	AUG 1 0 1983







VIEW SHOWING OIL COOLING ARRANGEMENT

GENERAL NOTES:

1. USING LOCTITE ADHESIVE #40, ASSEMBLE TIMING GEARS (33) ON SHAFTS AND OUTER RACE OF ROLLER BEARINGS (56) INTO ADJUSTING SLEEVE (9) AND IN FRONT HEAD (6).
2. WHEN ASSEMBLING SCREWS (30) AND PISTONS (31) ON SHAFTS USE AN EPOXY ADHESIVE. FOR CAST IRON CONSTRUCTION 2 USE LOCTITE #40 ADHESIVE FOR STAINLESS STEEL CONSTRUCTION.
3. WHEN INSTALLING NEW OR REPLACEMENT SLEEVE BEARINGS SET BEARING TO 'X' DIM AS FOLLOWS
   VW070 'X' DIM. = 1/8
   VW100 'X' DIM. = 1/8
4. FLANK CLEARANCE ADJUSTMENT PROCEDURE
   A. LOOSEN THRUST BEARING ADJUSTING SLEEVE SETSCREW (14).
   B. BACK OFF THRUST BEARING ADJUSTING SLEEVE (9). TURN COUNTERCLOCKWISE.
   C. TIGHTEN LOWER HEX BOLT (76) IN REAR HEAD COVER (24) SO AS TO LOCK THE SHORT SHAFT (29) TIGHTLY AGAINST THE LOWER THRUST BEARING (8).
   D. PULL ON LONG SHAFT (28) IN THE DIRECTION OF THE THRUST BEARING (8) UNTIL THE CLEARANCE BETWEEN THE UPPER AND LOWER SCREW FLANKS IS REMOVED.
   E. PLACE A DIAL INDICATOR BUTTON AGAINST THE EXPOSED FACE OF THE LONG SHAFT (28) AT THE FRONT OF THE PUMP.
   F. TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE UNTIL SCREW FLANKS MAKE CONTACT ON THE OPPOSITE SIDE.
   G. RECORD TOTAL INDICATOR MOVEMENT. THIS WILL BE THE TOTAL FLANK CLEARANCE. DIVIDE TOTAL FLANK CLEARANCE BY 2.
   H. REPEAT STEP NO. B.
   I. REPEAT STEP NO. D.
   J. SLOWLY TURN THRUST BEARING ADJUSTING SLEEVE (9) CLOCKWISE AND OBSERVE INDICATOR MOVEMENT. STOP TURNING WHEN INDICATOR READS 1/2 OF TOTAL FLANK CLEARANCE. THIS NOW MEANS THAT THE FLANK CLEARANCE WILL BE EQUAL ON BOTH SIDES OF THE SCREW THREAD.

   NOTE
   THRUST LOAD WILL BE IN THE DIRECTION OF THE THRUST BEARINGS ASSURING NO METAL-TO-METAL CONTACT BETWEEN THE SCREW FLANKS.

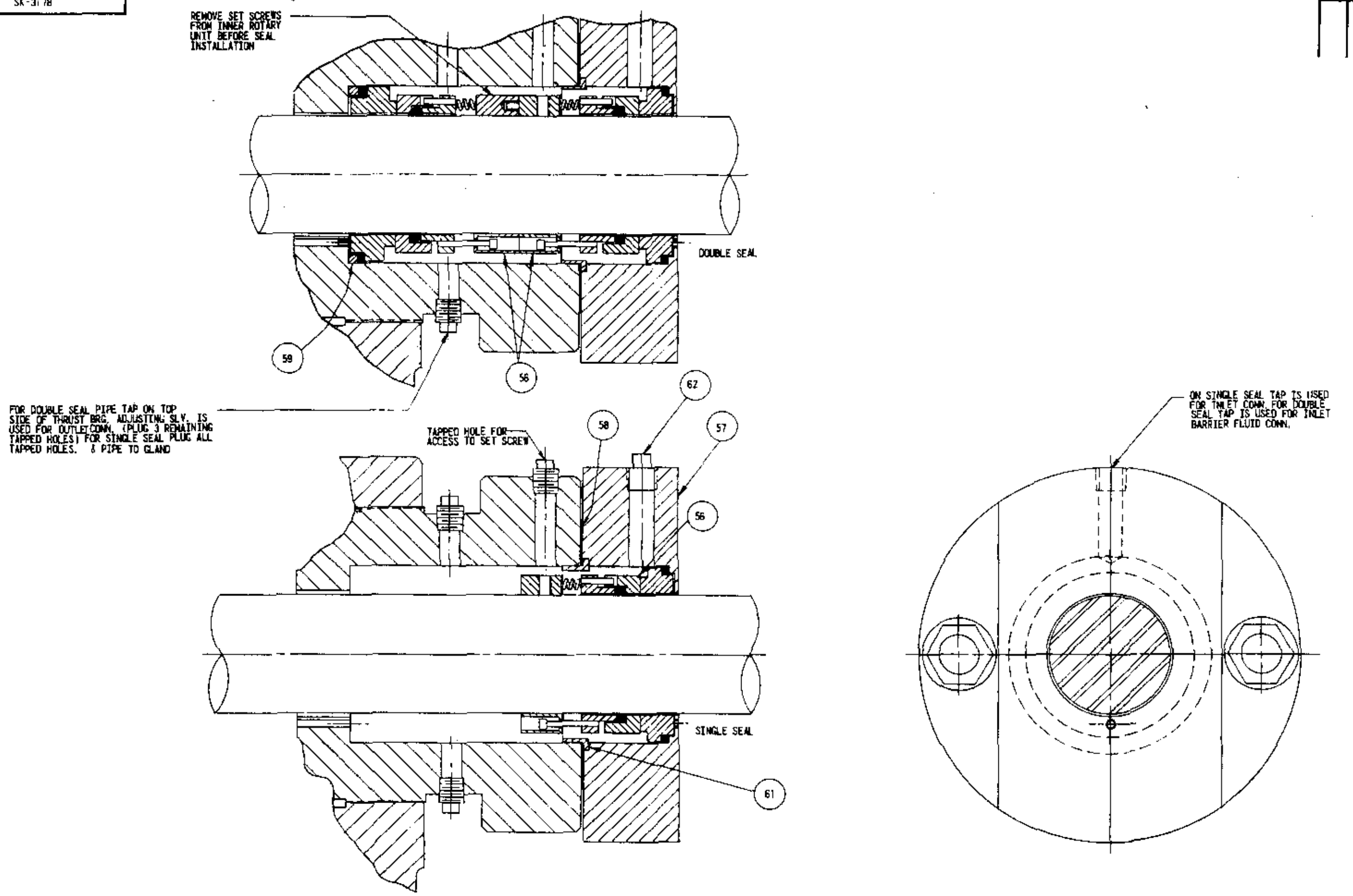
   K. RETIGHTEN SETSCREWS (14) STAKE WITH A PRICK PUNCH
   L. BACKOFF LOWER HEX BOLT (76) IN REAR HEAD COVER (24) 1/2 TURN.
   M. TIGHTEN UPPER HEX BOLT (76) IN REAR HEAD COVER (24) HARD-UP AGAINST SHAFT (28). THEN BACK OFF 1/2 TURN.
5. STAKE INNER RACE OF ROLLER BRG. (56) ON SHORT SHAFT (29) ONLY AND AT LOCATION SHOWN.
6. FOR MECHANICAL SEALS SEE SHEET 2.
7.
8. COAT THE DOWEL PIN (3) EXTENDING OUT FROM THE BODY (1) WITH A RELEASING AGENT. MAKE SURE THE MATING HOLE IS CLEAN. FILL THE MATING HOLE WITH DEVCON PLASTIC STEEL 'A' OR EQUIVALENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES FRACTIONS. DECIMALS. ANGLES:	CONTRACT NO.	WARREN PUMPS, INC. SUBSIDIARY OF HOUDAILLE INDUSTRIES, INC. WARREN, MASS.	
	APPROVED DATE	DRAWING TITLE SECTIONAL ASSEMBLY FOR VW070 & VW100 SCREW PUMP, TYPE M	
	CHECKED GIS 1/30/79		
	DRAWN BD 1/26/79		
	APPROVED	SIZE D	CODE IDENT NO. 63997
		DWG. NO. A-2307	REV C
		SCALE: 1/4	SHEET 1 OF 2 SHEETS

PARTS LISTS

SK-3178 (L)

56	Mechanical Seal
57	Gland
58	Gasket
59	Ring
61	Pilot Ring
62	Pipe Plug



SK-3178

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

MICRO FILM

MECHANICAL SEAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES	CONTRACT NO.		WARREN PUMPS, INC. SUBSIDIARY OF HOUDAILLE INDUSTRIES, INC. WARREN, MASS.
	APPROVED	DATE	DRAWING TITLE TYPICAL SECTIONAL ASS'Y FOR VW SCREW PUMPS TYPE L
	CHECKED EHS	8/24/63	
	DRAWN		
FRACTIONS- DECIMALS- ANGLES-	APPROVED		SIZE D; CODE IDENT NO. 63087; DWG. NO. SK-3178; REV.
			SCALE: NTS; SHEET 1 OF 1 SHEETS

AUG 5 1983

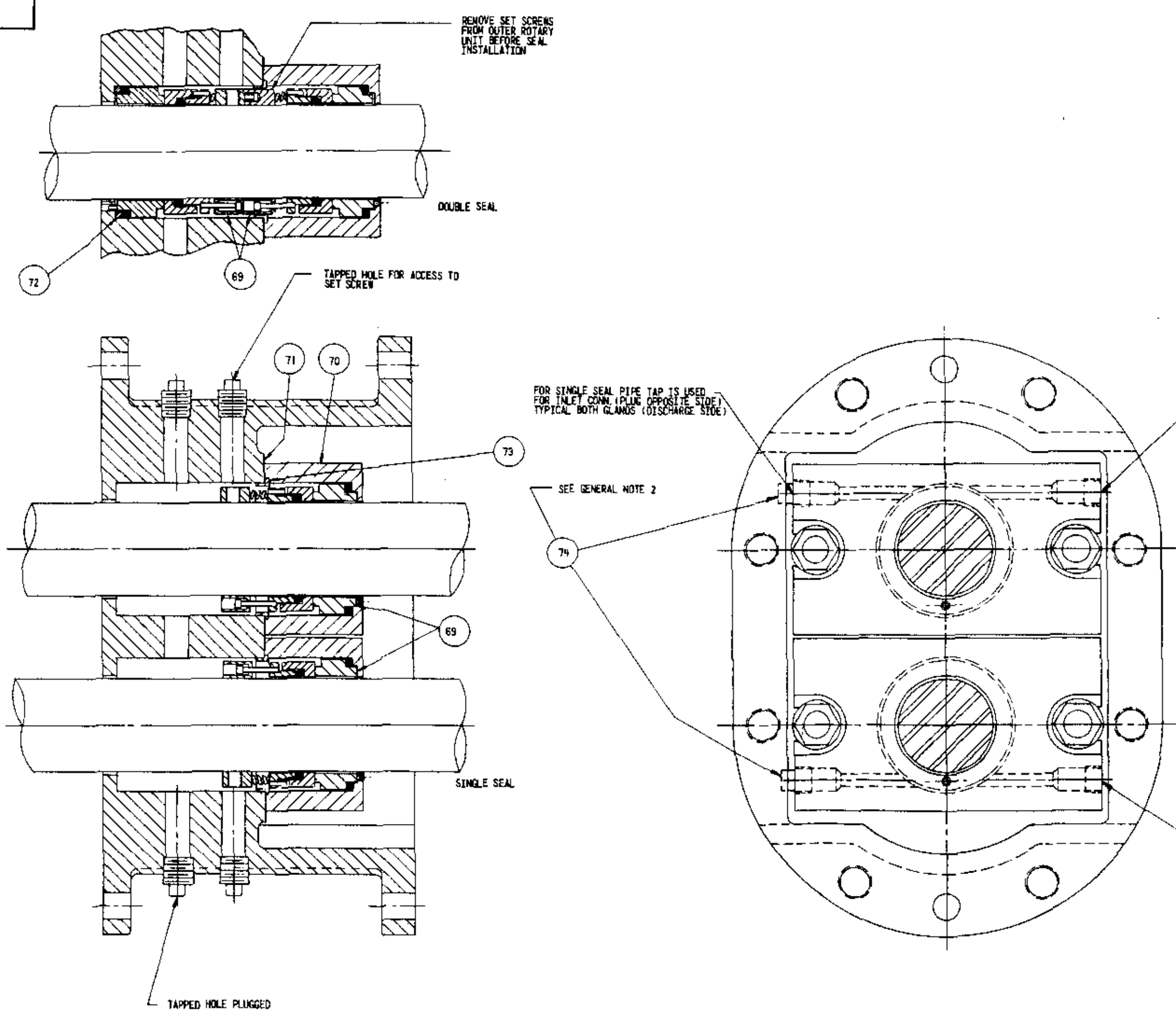
SK-3179 (N)

69	Mechanical Seal
70	Gland
71	Gasket
72	Ring
73	Pilot Ring
74	Pipe Plug
75	Pipe Plug

SK-3179

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

MICRO FILM



GENERAL NOTES:

1. FOR VW025N PIPE TAPS ARE TO BE LOCATED ON DISCHARGE SIDE OF PUMP FOR SINGLE SEALS (INLET CONNS.). FOR DOUBLE SEALS PIPE TAPS ARE TO BE LOCATED ON SUCTION SIDE OF PUMP (OUTLET CONNS.)
2. FOR VW025, 035, 043 AND 053 THE PIPE PLUG IS PC. 74 AS SHOWN. FOR VW070 AND VW100 THE PIPE PLUG IS PC. 75.

MECHANICAL SEAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES
FRACTIONS-
DECIMALS-
ANGLES-

CONTRACT NO.

APPROVED		DATE
CHECKED	EMS	8/25/93
DRAWN	PJC	8/25/93
APPROVED		

WARREN PUMPS, INC.
SUBSIDIARY OF HOUDAILLE INDUSTRIES, INC.
WARREN, MASS.

DRAWING TITLE TYPICAL SECTIONAL ASS'Y FOR VW SCREW PUMPS TYPE N

SIZE	CODE IDENT NO.	DWG. NO.	REV.
D	63857	SK-3179	

SCALE: NTS SHEET 1 OF 1 SHEETS

AUG 2 5 1993

WARREN PUMPS HOUDAILLE

ONE OF THE HOUDAILLE PUMP GROUP

Warren Pumps Division/Houdaille Industries, Inc./Warren, Massachusetts 01083

6/83