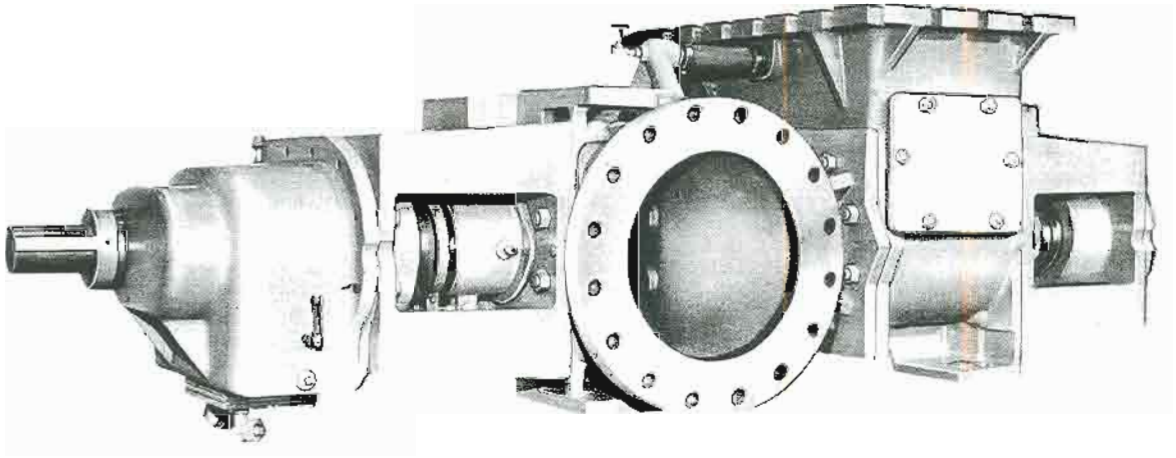
INSTALLATION

OPERATION

MAINTENANCE



HIGH DENSITY STOCK PUMPS - SERIES 2601

No. 11 / No. 125 / No. 138

PLEASE READ THESE INSTRUCTIONS BEFORE INSTALLING PUMP

Imo Industries Inc.

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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 Inc. Refer to the manuals provided by manufacturers of other 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 2601 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 you contact Warren Pumps.

SECTION 1 — GENERAL INFORMATION

The Warren Series 2601 High Density Stock Pump is a positive displacement screw pump specifically designed for pumping high density paper stock.

Basically the pump consists of two counter-rotating shafts located in intersecting body bores. Each shaft includes a suction feeder screw, a pumping screw, a timing gear and various sleeves, seals and bearings.

Casing — The pump body is composed of three separable parts; the front casing (discharge section), rear casing (suction section) and the main body (pressure generation section). The pressure generating section, containing the body bores, can be replaced independently of the front and rear casing. The pressure generation section of the three-piece body is designed to be rotated 180° to compensate for pump bore wear. An added advantage of the three-piece body is that the discharge nozzle can be positioned on either the right or left side of the discharge section. The suction section has two large cleanout holes.

Rotating Element — This element consists of two pumping screws and two auxiliary feeders mounted on the same shafts. The shafts are protected from packing wear by hardened shaft sleeves which are keyed and extend under the oil seals. Stainless steel is used throughout.

Fabricated Bearing Brackets — The bearing brackets are fabricated from steel rather than machined from a casting. This fabrication allows the use of stainless steel in the area that is in contact with the stock, while the rest of the bracket is standard steel. The fabricated brackets have large areas for access to the glands and stuffing boxes for easier packing maintenance.

Air Bleed — Patented air bleed device removes air from stock before it enters discharge area. This eliminates pulsations on refiner feed and long line transfer applications.

1-1 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 material or workmanship will be replaced without charge, F.O.B. Warren plant, 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 or business entity 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 limitations, 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, or persons by reason of the installation or use of its procucts.
3. The said 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 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. The said 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. The said warranty is WARREN'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH ARE HEREBY DISCLAIMED, INCLUDING IN-PARTICULAR ALL WARRANTIES OF MERCHANT-ABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This document and 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 General Manager of WARREN.

SECTION 2 — RECEIVING, HANDLING AND STORAGE

2-1 Receiving

The equipment should be placed under adequate protection immediately upon receipt.

Special long term storage crating can be supplied upon request.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to Warren Pumps. 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 these units may cause permanent damage.

2-3 Storage and Preservation

Units are shipped on skids and suitably boxed or crated to 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.

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 Pumps.

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

1. Select a clean dry storage location.
2. Be certain that blank flanges 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 compound.
5. Fill oil reservoirs completely full of oil.
6. Protect pump and driver with a plastic or canvas covering.

SECTION 3 — INSTALLATION

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

Probably the most important thing you can do to enhance 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 pump should be located so that the stock is able to free fall into the suction chute. This means you should avoid any type of bends or angles in the chute. This will prevent the stock from bridging in the chute.

Provide ample space around the pump to permit routine work. The overhead should be fitted with pads from which lifting devices may be hung. Allow sufficient room to facilitate front pullout of the rotating assembly. Allow 35" from the outboard end of the jackshaft for this purpose.

CAUTION — Since baseplate leveling is done after bolts are installed, it is better to have bolts too long and then cut to proper length.

3-2 Construction of Poured Concrete Foundations

Foundations should be a suitable mass to provide a rigid support for the unit. Use reinforcing steel 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 outline 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 between foundation bolts and sleeves to prevent concrete from entering while foundation is being poured. Foundation bolts 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 foundation rough for adherence of grout.

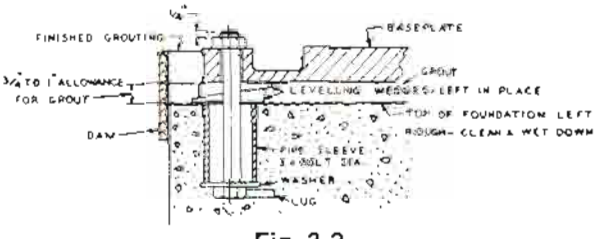


Fig. 3-2

3-3 Baseplate

1. Leveling — Move pump next to foundation. The surface of the foundation should be thoroughly cleaned and roughed. Set leveling wedges (fig. 3-2) adjacent to foundation bolts and remove waste from pipe sleeves. Lift pump from skids and clean underside of baseplate. Lower pump over foundation bolts onto wedges. Adjust wedges to allow ¾" to 1" of grout, being sure pump flanges are plumb. Care must be taken at all times to prevent damage or distortion of the pump. A spirit level placed on the machined suction flange may be used to insure that the pump is level end to end and side to side.

2. Grouting in the Baseplate — Build a board dam around the foundatioin 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. General — Piping runs should be as direct as possible. Use long radius fittings to change piping direction. Discharge piping should be adequately supported and properly anchored (within 5 ft.) with allowance for thermal expansion. Piping should not be supported by the pump flanges nor should piping stresses be transmitted to the pump. When connecting piping to the pump, flanges should line up squarely so that it is not necessary to spring piping into place with flange bolts.

2. Suction Chute — There are several points that should be considered concerning design of the suction chute:

   Configuration — The suction chute must be straight. Angles or slopes in the suction chute tend to block the free fall of stock and slug feed the pump. If the pump is fed in this manner, it will pump in a like manner causing fluctuations in discharge pressure and motor amperage. If it occurs, this type of operation will not affect the pump but it is not consistent with good system operation. The suction chute should not be tapered towards the pump or otherwise constructed as the stock may tend to bridge the chute preventing further feeding. The inner walls of the suction chute should present a smooth surface. Projections into the chute and jagged welds also must be avoided to prevent bridging.

   Strength — The suction chute design must incorporate sufficient strength to contain 100% capacity of stock and water. Should the pump stop for any reason without a corresponding shutdown of the washer or decker, the suction chute will be quickly filled. Also, by designing sufficient strength into the chute, it may be used as a surge area to compensate for load fluctuations.

3. Discharge Piping — Discharge piping for high consistency stock pumping requires specific data. Generally, avoid short radius fittings and avoid low spots in the line which will not flush or drain. Inclusion of a discharge valve for use when the pump is not operating is desirable. The discharge system should also include a valve located adjacent to the pump that can be opened to drain the discharge line.

   Considerable thought must be given to the proper sizing of the discharge line. The Series 2601 generally requires smaller diameter discharge piping and should be sized to create a minimum velocity of 0.5 feet per second and a maximum of 2 feet per second. This is in contrast to other thick stock pump manufacturers and results in reduced material and installation costs. Warren can assist you in proper pipe size selection.

4. Flushing and Dilution — It is recommended that a combination flushing and dilution line be installed in the pump suction chute as it is necessary to flush the piping and pump of any high consistency stock prior to shutdown to prevent plugging due to dewatered stock. (Power required to move extremely high consistency stock through a long transfer line may be beyond the capabilities of the driver). The flushing and dilution line may also be used for stock dilution during start-up until the pump is handling normal load and the system has been leveled out.

5. Stuffing Box Flushing Water — High Density pump stuffing boxes require the injection of clean water for flushing and lubrication of the packing rings.

   Flushing water should be supplied at 15-20 psi at the suction end and 15-20 psi above pump discharge pressure at the discharge end. Flow rate should be 1-2 gpm.

6. Air Bleed System — Flushing connections are provided for the air bleed system to provide 2-3 G.P.M. flow at about 50 P.S.I. minimum. This flow is required to dilute stock carried over into the bleed system and flush it back to the pump suction. These connections are shown on the certified outline drawing provided with the pump.

3-5 Protective Devices

1. Shear Pin Coupling — Warren Series 2601 High Density Stock pumps are furnished with a standard shear pin coupling. The shear pin is sized for each application to offer protection against motor overload and pump damage due to foreign material entering the pump. Shear pin sizes can be determined from the formula in Section 9-4.

2. Ammeter — It is suggested that an indicating ammeter be installed near the operator's station so the operator will have an indication of pump loading during pump operation. The ammeter will provide an immediate indication of any change in stock consistency, blockage in the pump, broken shear pin or driver failure.

3. Rupture Disc — On high pressure pipe line transfer, it is suggested that a pressure relief device (rupture disc) be installed adjacent to the pump discharge to protect the pipeline from excessive pressure.

4. Airpax Zero Speed Monitor —
   a. General — The Airpax zero speed switch is designed for general industrial service and is particularly adaptable to Warren's High Density pumps. Switches are enclosed in a J.I.C. box, Nema types 3 & 12 and have flange mounts to affix to remote locations. Each zero speed switch comes equipped with a pick-up and cable assembly. The pick-up is positioned to align with three socket head cap screws which affix the bearing adjusting sleeves to the end of the pump shaft. There is a 1/16" gap between the pick-up and the head of the cap screws.

   b. Pick-Up Installation and Setting — (see fig. 3-5.4)

   1. Turn shaft until cap screw is in line with 5/8 — 18 drilled hole in rear head.

   2. At coupling end, bar shaft towards rear head so that rotor position will be in normal operating position pertaining to axial thrust to set proper gap for pick-up.

   3. Screw pick-up into tapped hole in the rear head until contact is made with head of cap screw.

   4. Back off pick-up 1 1/8 turns to obtain 1/16" gap between nose of magnetic pick-up and cap screw.

   5. Apply Permatex or silicone rubber to threads and tighten jam nut (CAUTION: do not change pick-up gap while tightening jam nut).

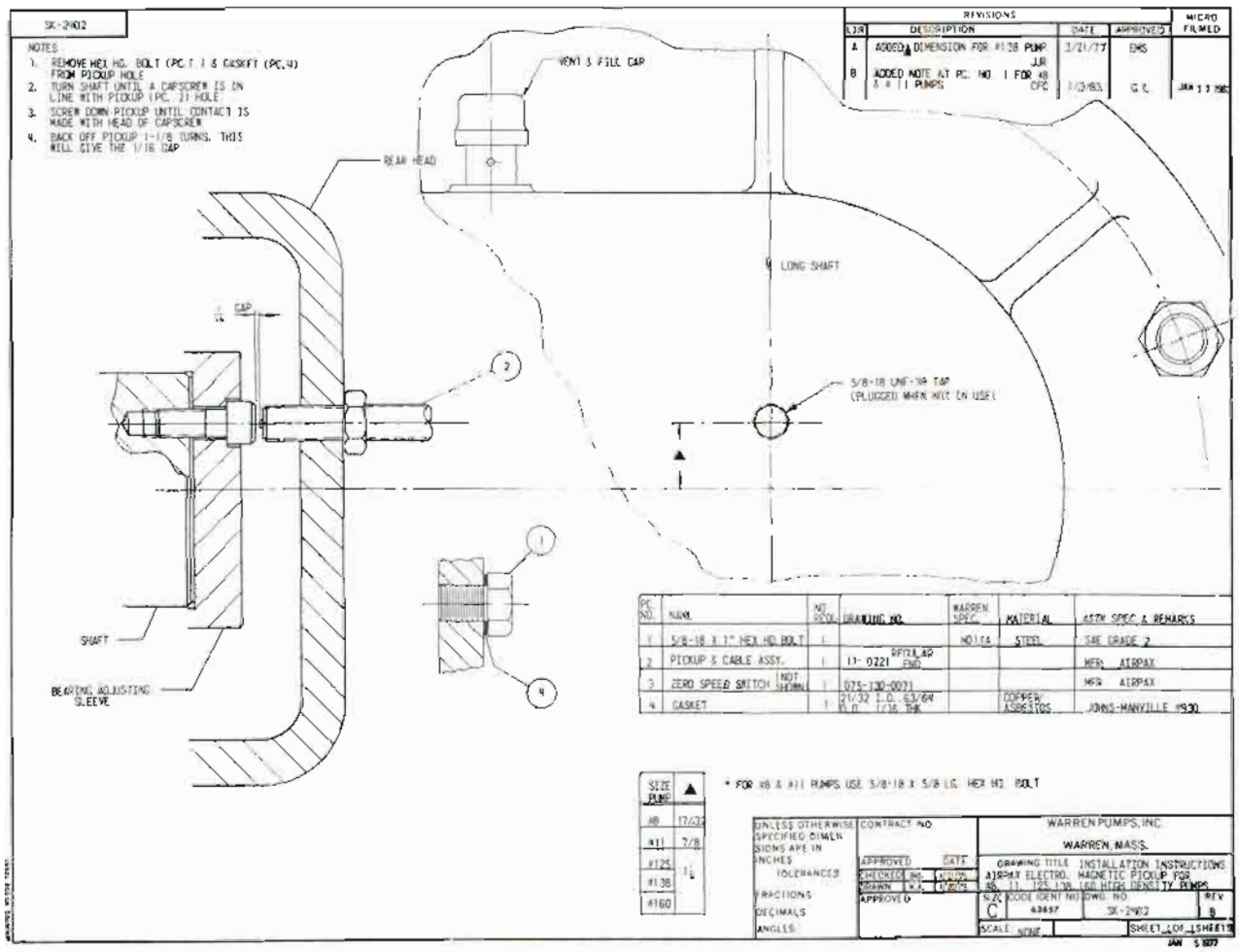


Fig. 3-5.4

SECTION 4 — COUPLING ALIGNMENT

4-1 Alignment

Special care must be followed to provide some coupling misalignment. This will provide for proper motion of the coupling's universal portion, allowing the needles in the bearings to rotate slightly and be lubricated. There should be a minimum of ¼" misalignment. Maximums are given in Sect. 9-4.

Most drive arrangements are equipped with belt drives. Ultra "V" type belts are generally used.

The following manufacturer's recommendations should be followed:

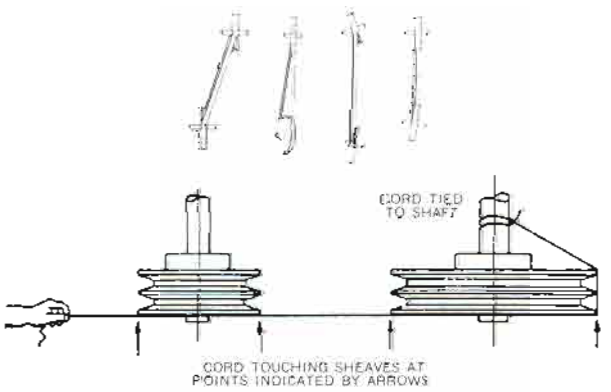
Although alignment is not as critical in V-belt drives as in others, proper alignment is essential to long belt and sheave life.

First, make sure that drive shafts are parallel. The most common cause of misalignment are nonparallel shafts and improperly located sheaves. Where shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. As a result, these belts wear out faster, requiring the entire set to be replaced before it has given maximum service. If misalignment is in the sheave, belts will enter and leave the grooves at an angle, causing excessive belt cover and sheave wear.

Shaft alignment can be checked by measuring the distance between the shafts at three or more locations. If the distances are equal, then the shafts will be parallel.

To check the location of the sheaves on the shafts, a straightedge or a piece of string can be used. If the sheaves are properly lined up, the string will touch them at the points indicated by the arrows in the accompanying sketch. Rotating each sheave a half revolution will determine whether the sheave is wobbly or the drive shaft is bent. Correct any misalignment.

With sheaves aligned, tighten motor hold down and/or pillow block bearing and cap screws evenly and progressively. Apply the recommended torque to cap screws as listed.



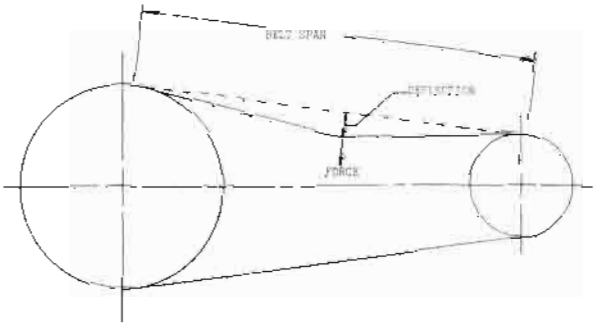
4-2 Tensioning

Proper V-drive tension is that which is sufficient to overcome slipping under maximum peak load. This could be either at the start or during the work cycle. The amount of peak load will vary depending upon the character of the driven machine or drive system. To increase total tension, merely increase the center distance. This simple method applies to Prime Mover conventional and/or narrow Ultra-V belts. It applies to drives with one belt or any number of belts.

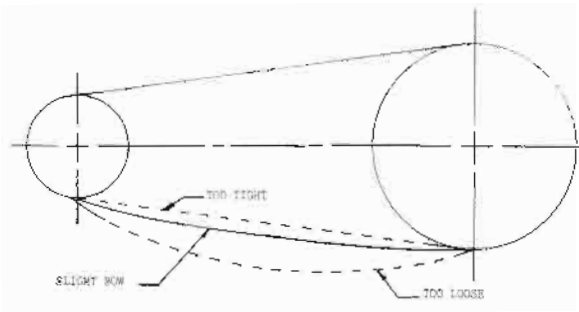
Complete instructions follow for both methods of properly tensioning a V-belt drive. We have included the force deflection method as it applies to T. B. WOOD'S — B. F. GOODRICH belts. Caution should be used when applying these values to other brands. Also, the values listed here do not apply to existing drives designed from old catalogs.

a. Method 1 — Ultra V — This method should be used only for tensioning drives on which the grade of belts, rated belt capacity, service factor, design horsepower, etc., are known. If the drive has been designed in strict accordance with the procedures, instructions and horsepower ratings in T. B. WOOD'S or B. F. GOODRICH current catalogs, the force deflection valves are valid.

Stop the drive and measure the belt span. Using a spring scale, apply a perpendicular force to any ONE of the belts at the mid point of the span. Measure the force required to deflect any one of the belts 1/64" for every inch of span length. For example, the deflection for a 32 inch span would be 1/64" multiplied by 32, or ½".



b. Method 2 — Conventional — Before attempting to tension any drive, it is imperative that the sheaves be properly installed and aligned. The V-belts should be placed over the sheaves and in the grooves without forcing them over the sides of the grooves.



Step 1: With all belts in their proper grooves adjust the centers to take up all slack and until the belts are fairly taut.

Step 2: Start the drive and continue to adjust until the belts have only a slight bow on the slack side of the drive while operating under load. See Sketch.

Step 3: After a few days operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight "bow" in the slack side.

The drive is now properly tensioned and should operate satisfactorily with only an occasional readjustment to compensate for belt and groove wear.

If the prime mover is an "across-the-line" start motor, a peak load is usually generated on startup. Test the drive by starting it under load. If the belts squeal, continue to apply tension until the squeal disappears.

If these procedures are not followed, a drop off in pump capacity due to belt slippage and finally belt burnout.

Always use the proper quantity of belts and buy and use belts in matched sets.

SECTION 5 — LUBRICATION

5-1 Bearing and Timing Gear Lubrication

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
SUS @ 100°F	800
Viscosity Index Min.	80
Flash Point OC °C	200°C
Gravity °API	28

NOTE: (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
TEXACO	Regal R & O 150
GULF	Harmony 150N

The operating oil level should be maintained approximately midway in the oil level sight glasses located in the gear and bearing housings. The oil level should be established when the pump is **stopped** as a false reading can occur when the pump is running. Special care must be taken with the timing gear housing as the oil level is maintained at the extreme lower part of the timing gears.

5-2 Coupling Lubrication

The shear pin coupling must be filled with grease. Any good ball bearing grease such as Exxon Unirex N2 is satisfactory for the coupling. Greasing interval depends upon the pump environment. Unusually moist or dusty locations would require more frequent applications. Consider six month periods as the greasing interval for normal installations.

5-3 Cooling Mediums

Cooling water is recommended for the No. 125 and 138 timing gear housing. Cooling water flow would be dependent upon many factors therefore, the amount required for a particular pump would necessarily be decided by experimentation. It is recommended that the gear case lube oil temperature be held between 120° and 160°F. Except in cases of unusual circumstances, thrust end lube oil temperature should not exceed 180°F.

SECTION 6 — START-UP/OPERATION

6-1 Pre-Start-up

Pre-start-up checks for trouble free initial start-up 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. Check motor for correct rotation. Do this with the drive belts off the motor sheave or with the universal coupling disconnected. Before replacing the drive belts or reconnecting the coupling, accomplish the following items.

2. Since a construction site is generally dusty, etc., it is recommended that the timing gear and thrust bearing housings be flushed and refilled to the proper levels with clean oil. See "Lubrication".
3. Install a screen in the suction chute just above the pump inspection doors. The screen mesh should be ⅛" or smaller. Simply wedge the screen against the sides of the suction chute using pieces of wood cut to fit tightly. Remove drain plug from the bottom of the pump suction also.
4. Flush the system ahead of the pump thoroughly permitting the flushing water to fall through the suction chute. Leave both pump inspection doors off for flushing water to drain. Also flush through all of the permanent flushing and dilution lines into the pump suction. After all of the flushing has been completed, remove the screen from the suction chute.
5. Go over the bottom of the pump suction carefully and completely to remove weld beads or scale that may have passed through the screen.
6. Replace the drain plug and the metal inspection door.
7. Open flushing water valves to the air bleed system to ascertain that the bleed lines are open and sufficient water (2-3 G.P.M.) is available at about 50 P.S.I.G. mimimum.
8. Adjust stuffing box seal water as outlined in Section 3.
9. Adjust packing glands with seal water turned on to obtain a moderate leakage (60 drops/minute) from the packing glands.
10. Turn the rotor through several rotations by hand.
11. Replace the drive belts or reconnect the universal coupling.
12. With all of the above steps completed, the unit is now ready for operation.

6-2 Start-Up

1. Check oil levels in both bearing housings. Add or drain as necessary.
2. Open flush water valves in the air bleed system.
3. Open valves in the stuffing box flushing water system.
4. Open valves in lube oil cooling water system (No. 125 & 138 units only).
5. Open all valves on the discharge side of the pump.
6. Start the pump. Note: Water entering the pumps through the air bleed system and suction end glands is sufficient for operation of the pump.
7. Start stock off the washer or decker into the pump.

6-3 Pump In Operation

1. Discharge pressure and motor amperage is affected by:
   a. Amount of stock being pumped (TPD)
   b. Consistency of stock being pumped.
2. Pump capacity is determined by pump speed.
3. If desired, the pump will easily pump water for line flushing purposes.

6-4 Securing

1. Stop flow of stock to the pump.
2. Open dilution water to pump and allow pump to operate pumping water for a sufficient length of time to move the stock out of the discharge line. This will prevent dewatering of the stock in the discharge piping and the pump.
3. Secure dilution water.
4. Stop pump.
5. If static head on pump is greater than 60 feet, stop pump leaving bleed water on to pump bores. Close discharge valve, drain discharge line, drain suction — then shut off bleed water.
6. Secure valves supplying water to the air bleed device, stuffing box flushing water, and the lube oil cooler.

6-5 Start-Up After Forced Shutdown

If the pump is unexpectedly shut down the following procedure may be used to get the unit back into operation as quickly as possible.

A Shear Pin Failure

1. If installed, close the pump discharge valve as quickly as possible to prevent the stock from dewatering.
2. Open pump inspection door and remove the drain plug from the pump suction, then flush stock out of the suction area.
3. Remove shear pin in the universal coupling.
4. Turn the pump backwards. This should dislodge any foreign material and back it into the pump suction where it can be removed.
5. Replace the shear pin in the universal coupling.
6. Replace the pump inspection door,
7. Open dilution water valve to allow water to flow into the pump suction.
8. Open the discharge line drain valve and start the pump.

9. If a discharge valve is installed open this valve and close the drain valve. The water pressure developed by the pump should be sufficient to start the stock in the line moving. If there is a high discharge head working against the pump, it may be necessary to partially drain the discharge line before the pump will start.

B Start Up After Power Failure

The start-up procedure in this case is the same as outlined under Shear Pin Failure except eliminate steps 3, 4 and 5 as they will not apply.

C Start-Up After Stock Back-Up

Start-up with dilution water. Gradually shut dilution water as suction chute clears.

SECTION 7 — PREVENTIVE MAINTENANCE

7-1 Periodic Inspection

Following are periodic inspection procedures which, if carried out conscientiously, should contribute to longer intervals between shutdowns.

Daily

1. Check oil level in bearing housings.
2. Check stuffing boxes to see if excessive leakage exists. If excessive leakage is observed but gland travel is used up, packing rings must be considered to be worn and should be replaced. If gland travel is not used up, adjust packing to approximately 60 drops/minute.
3. Adjust stuffing box flushing water flow to provide sufficient flushing and cooling water as specified previously.
4. Check and adjust as necessary cooling water to timing gear housing (No. 125 and 138 High Density ONLY).
5. Check and adjust flow of water as necessary for proper operation of air bleed system.
6. Visually inspect piping, driver coupling, V-belts and associated equipment for proper operation.
7. Record average amperage, discharge pressure, consistency and tonnage daily. This record is useful in determining pipeline buildup of pitch or other composition which may tend to reduce the effective discharge pipe diameter.

Weekly

1. Run idle pump under power and dilution water.
2. Check proper operation of automatic controls and regulators.
3. Inspect V-belt tension. Adjust as necessary.

Quarterly

1. Check all foundation bolts and hold down bolts for tightness.
2. Check alignment of V-belts since wear, vibration and constant temperature changes may cause serious misalignment.

Annually

1. Check existing pump capacity and power requirements against pump nameplate data. A Warren High Density Stock Pump is a positive displacement pump. With a constant system and stock consistency, pump wear is indicated when capacity is off or if sufficient pressure cannot be developed. If capacity is off, or if pump will not develop sufficient discharge pressure, pump should be disassembled and worn parts replaced. (This is meant only as a guide and the exact time for disassembly and inspection is left to the discretion of the customer). If pump performance is satisfactory, the pump need not be disassembled for inspection. It may, however, be desirable to check the amount of wear taken place within the pump. By removing the inspection covers at either side of the pump suction, feeler gages can be inserted between screw outside diameter and the body bores. In addition, the flank clearances or clearance between the sides of the meshed screws can be checked in the same manner.
2. If capacity is off, it is possible to increase this by a slight speed increase of the pump. Contact your Warren representative for details.

SECTION 8 — MAINTENANCE

Part numbers shown inside ( ) refer to part numbers on sectional assembly drawing located at the rear of this manual.

8-1 To Remove Rotor From Body (Refer to Sectional Assembly Drawing)

1. Isolate pump hydraulically and driver electrically.
2. Drain oil from front head (80) and rear cover (101). Pipe plugs are provided for this purpose.
3. Disconnect cooling water tubing from inlet and outlet connections located on front head (80). Size No. 125 and 138 only.

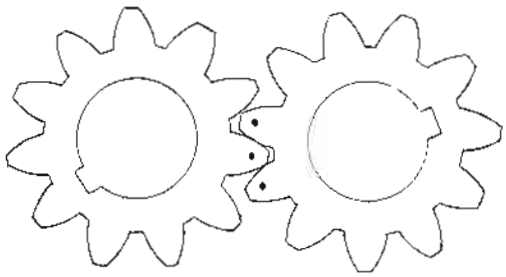
4. Disconnect flexible coupling, then remove jackshaft and jackshaft bearing supports from baseplate.
5. Remove rear head (101) from rear bearing bracket (50).
6. Remove thrust bearing adjusting sleeve lockscrew (39).
7. Remove thrust bearing locknuts and lockwashers (38 & 37) from adjusting sleeves (35).
8. Pull thrust bearings (34) and adjusting sleeves (35) from the shafts and rear bearing brackets. There are three ways to accomplish this:

   a. The thrust bearings may be removed by use of the hydraulic bearing puller which can be made using the drawings in Section 9-6. To use the device simply insert an "O" ring in its groove and thread device onto the adjusting sleeve in place of the locknut. Attach a hydraulic pump to port provided and apply pressure.

   b. Remove the entire rear bracket with the bearings intact. To do this, loosen or remove the packing gland first and slide the checkseals along as the bracket is removed. the bearing can then be pressed out from the inside.

   c. After disassembling the front of pump, pull the rotor out of the bearings and then proceed as in b.

9. Make sure the checkseals (140) are free to slide.
10. Remove pump half coupling hub from long shaft (14).
11. Remove coupling key (49).
12. Remove checkseal (139) from the drive shaft.
13. Remove front head (80) from front bearing bracket (51). Oil seal (93) and outer races and rollers of front head roller bearings (40) will come off with the front head.
14. Remove set screws (47) from locknuts (46 & 48). Remove bearing locknuts (46 & 48) from timing gear end of shafts.
15. Remove inner races of roller bearings (40) from shafts. They may be removed by applying heat to expand the races or they may be removed by pulling the timing gears. (See step 9.)
16. Remove gear and bearing spacers (41).
17. Remove timing gears (42) from the shafts. This is most easily accomplished by inserting threaded rods into the tapped holes in the face of the gears drawing the gears off one at a time with a strongback arrangement. Match mark outboard end of gears and mark to identify long shaft gear. See sketch.



18. Remove timing gear keys (43) from shafts. Mark one key to indicate which shaft it was removed from.
19. Remove gear and bearing spacers (44).
20. Remove split glands (65) from the shafts.
21. Check that checkseals (140) are free to move on the shafts. Remove front bearing bracket (51).
22. Remove the rotor from the body and separate.
23. The inner races of the roller bearings (45) may be removed by pulling the shaft sleeves (58) inboard of them utilizing the puller slots provided or by heating them and removing them individually.
24. Separate the pumping rotors.
25. If required, outer roller bearings races (40) (45) may be removed from the front head or front bearing brackets as follows:

    a. Race (40) for the long shaft, push race out through the shaft hole. For the short shaft, remove plugs (72) and push race out with a drift.

    b. Race (45). Race is cored to accept an inside puller or push bearings out from the back side.

26. Remove oil seals (69) and (93) as necessary for replacement.

8-2 Replacement or Reversal of the Body

If it becomes necessary, due to wear, to replace or reverse the body follow this procedure:

1. Unbolt and remove front casing (12).
2. Remove the air bleed assembly.
3. Remove dowel pins (11) and unbolt.

NOTE: The dowels are symetrically placed, therefore, it is possible to rotate the body. In addition, there are ports for the air bleed system top and bottom to enable the body to be rotated 180°. The dowels are precision drilled so that a replacement will fit exactly.

8-3 Installation and Timing of Replacement Timing Gears

Replacement timing gears are furnished as a matched set. One of the replacement gears includes a timing gear keyway pre-cut at the factory. The remaining gear does not have a pre-cut keyway. This keyway must be located and cut in the field.

1. If the rear bearing bracket (50) had been removed in disassembly, it should be reinstalled. Replace the gasket (108) oil seals (69) and stuffing box bushing (31) if removed. Align the bracket to the pump with the two dowel pins (96). Install and tighten nuts.
2. Wipe body bores clean and swab with light lube oil. Install shaft sleeves (58 & 52) and inner races of roller bearings (45).
3. Mesh the pumping screws. Insert screws into body from the discharge end. The long shaft (14) is to be inserted in the left bore when viewed from the drive end. As the shafts past through the rear bearing bracket, install checkseals (140).
4. Replace gasket (108) front bearing bracket to front casing (12). Install oil seals (69), stuffing box bushings (31) if removed, outer race of bearings (45) as applicable.
5. Replace front bearing bracket (51). As the shafts penetrate the stuffing boxes, install checkseal (140). Align the bracket to the body with the two dowel pins (96), then install and tighten all nuts.
6. Install thrust bearing assemblies, thrust bearings (34) and adjusting sleeve (35) as follows:

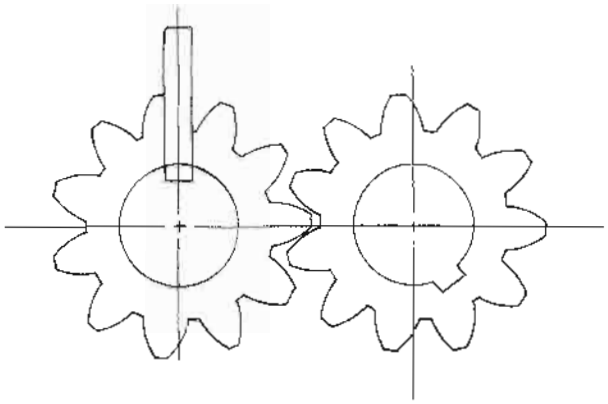
   a. Obtain three pieces of threaded rod 8" to 10" long and thread into the three holes in the end of each shaft.

   b. Install one thrust bearing assembly over the rods and start onto the shaft.

   c. Place a nut on each of the rods. Tighten these nuts evenly to push the bearing assembly into place.

   d. Install the second thrust bearing assembly in the same manner.
7. Place a straightedge across the outside race of the thrust bearings. The straightedge must contact both bearings evenly. If necessary, hold one shaft stationary and turn the other to move the thrust bearing either ahead or back so as to make the bearings flush with each other.
8. Install timing gear key (43) in long shaft keyway only. Do not install short shaft timing gear key.
9. Fit timing gear (42) to shafts individually so that the gears are a slip fit for approximately 30% of their length and then a tap fit for the ramaining 70%.

   CAUTION: The fit should only be loose enough to work with. Excessive clearance must be avoided.
10. Install timing gears on lightly oiled shafts. Push gears onto the shafts until the long shaft key is about one-half covered by the timing gear.
11. Apply bluing to the inside face of the short shaft timing gear over the keyway area.
12. Grind one end of the short shaft timing gear key flat then stand the key vertically in the shaft keyway so that the edge extends up across the timing gear face. It is **very** important that the key is fitted tightly and squarely in the keyway. See Sketch.



13. Lock the short shaft then turn the long shaft in the direction of rotation until you can feel flank contact. Turn the short shaft gear to bring the drive side of the long shaft gear in contact with the driven side of the short shaft gear. This removes gear backlash.
14. Using a sharp scribe, scribe a short line up one side of the gear face using the vertical key as a guide.
15. Turn the long shaft in the opposite direction until again you can feel flank contact. Remove backlash as described in item 13.
16. Scribe another short line up the other side of the gear face using the vertical key as a guide.
17. Turn the long shaft again in the direction of rotation until the vertical key splits the distance between the two scribe marks. Be sure that the thrust bearings are still aligned. Recheck 7.
18. Scribe a line on both sides of the vertical key. Make these lines longer to differentiate them from the previous lines. These two lines indicate where the keyway is to be cut.
19. Match mark the timing gears at their point of mesh.
20. Remove the timing gear from the shaft and cut the keyway in the blank gear.

CAUTION: 1. Be very careful to cut the keyway accurately between the scribed lines and also be careful to cut the keyway square with the gear face.

2. It may be necessary to add shims (100) to compensate for inherent inaccuracies in cutting the keyway. The shims will move the respective shaft axially with respect with the other shaft.

8-4 Reassembly and Installation of Rotors

1. Replace gasket (108) for rear bearing bracket (50) to rear casing (3). Use 1/64" thick material. Install oil seals (69) and stuffing box bushings (31).
2. Replace rear bearing bracket (50). Align this part to the body with the two dowel pins (96). Then install and tighten all nuts.
3. Before installing the rotors, body bores should be wiped clean, then swabbed with light lube oil. This will aid installation and prevent scoring as the rotor is slid in.
4. Mesh the long and short shaft pumping screws. Then determine the total flank clearance between the meshed screws. Record this clearance for later reference. Install shaft sleeves (52 & 58) and seal with RTV silicone sealant on the inboard end of the sleeve and key (32). Heat the inner bearing races with an induction type heater or in an oil bath to expand the races sufficiently for installation (45).
5. Lift the meshed rotor and carefully insert into the body (1) from the discharge end.

   NOTE: It will be necessary to install two checkseals (140) when the shafts have penetrated the rear bearing bracket stuffing boxes and before the shafts enter the oil seals.

6. Replace gasket (108) (front bearing bracket (51) to body). Use 1/64" thick material. Install oil seals (69), stuffing box bushings (31), outer race of bearings (45) as applicable.
7. Replace front bearing bracket (51). As the shafts penetrate the stuffing boxes, install checkseal (140). Align the bracket to the body with the two dowel pins (96), then install and tighten all nuts.
8. Install thrust bearing assemblies, thrust bearings (34) and adjusting sleeves (35) as follows:

   a. Obtain three pieces of threaded rod 8" to 10" long and thread into the three holes located in the end of each shaft. Replace necessary shims against shaft sleeve shoulder.

   b. Install one thrust bearing assembly over the rods and start onto the shaft.

   c. Place a nut on each of the rods. Tighten these nuts evenly to push the bearing assembly into place.

   d. Install the second thrust bearing assembly in the same manner.

   e. Insure that the adjusting sleeves are hard up against the ends of the shaft sleeve, then replace and tighten adjusting sleeve cap screws (39).

9. Install gear and bearing spacers (44). If original spacers are being used, be sure they are returned to their original position.
10. Check that the timing gear keys (43) are free of nicks or burrs, then install in their keyways.
11. Mesh timing gears together (42) at the match marks.
12. Install timing gears approximately half way over the timing gear keys. Be sure each gear is installed on the proper shaft.
13. Return to the thrust end and lay a straightedge across the outer thrust bearing races. Thrust bearings must be flush. If necessary bump one shaft to bring the bearings flush.

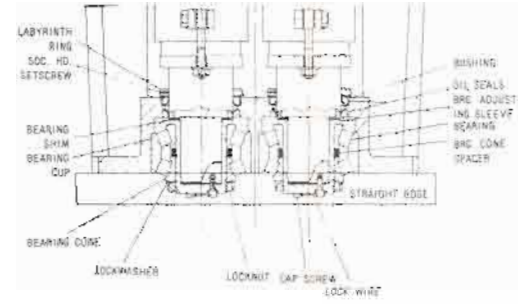


Fig. 8-7.13

14. Turn rotors by hand so that the end flight of the short shaft screw overlaps the end flight of the long shaft screw when observing through the suction chute. Check flank clearance between meshed pumping screws. Existing clearance should be one-half the total flank clearance (±.005") as determined in step 4. If existing clearance is other than this, it will be necessary to adjust the clearance as follows:

   a. If existing flank clearance is less than one-half the total clearance, remove the long shaft thrust bearing and adjusting sleeve.

   b. If existing flank clearance is more than one-half the total clearance, remove the short shaft thrust bearing and adjusting sleeve.

   c. Select a shim or shims of sufficient thickness to make up the difference between the existing clearance and the clearance needed. Cut these shims to the same outside diameter as the end of the shaft sleeve and the inside diameter to shaft diameter plus 1/16".

   d. Install shims and adjusting sleeve. For location see Fig. 8-7.13.

   e. Repeat step 13.

15. Push timing gears all the way onto the shafts.
16. Install outboard gear and bearing spacers (41).
17. Install front head roller bearing inner races (40).
18. Replace and tighten roller bearing locknuts (46 & 48). Tighten locknuts firmly to insure all bearing rings are securely locked. Secure the locknut with setscrew (47).
19. Turn pump by hand. Rotor must turn freely at this point.
20. Replace rear cover gasket (99) and rear cover (101).
21. Replace front head gasket (99). Install the outer races of the front head bearings (40) as applicable. Replace front head (80).
22. Replace front head oil seal (93) and front head checkseal (139).
23. Install pump packing and glands (59 & 65).
24. Add lubricant.
25. Grease seals using grease fitting (71).

9-1 Parts Information

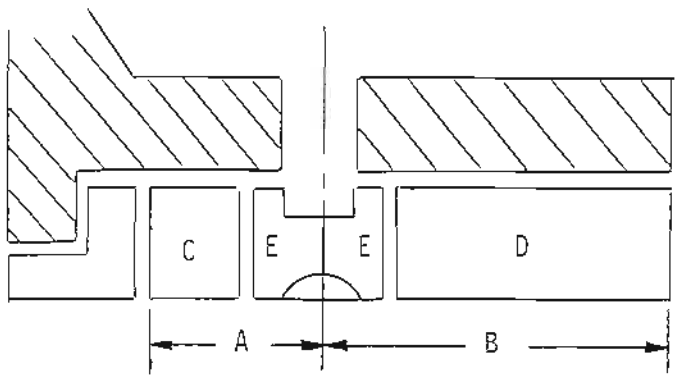
PUMP SIZE		#11	#125	#138	#160
Shaft Diameter at Coupling		3.5000/3.4995	4.0000/3.9995	4.5000/4.4990	4.5000/4.4990
Sleeve Diameter at Stuffing Box		5.000/5.003	5.875/5.878	6.250/6.253	6.630/6.620
Inboard Radial Bearing		Rollway E5220B MUC5220	Rollway E5224B MUC5224	Rollway E5226B MUC5226	Rollway E5226B MUC5226
Outboard Radial Bearing		Rollway E5219B MUC5219	Rollway E5222B MUC5222	Rollway E5224B MUC5224	Rollway E5224B MUC5224
Thrust Bearing		Timken 023Z0071	Timken 023Z0080	Timken 023Z0080	Timken 023Z0084
Bearing Span		72¼	76½	92⁵⁄₃₂	100¹⁵⁄₁₆
Packing	No. Rings Stuffing Box	5	5	5	7
	Size	⅝ SQ.	⅝ SQ.	¾ SQ.	¾ SQ.
	Type	John Crane Style C-59	John Crane Style C-59	John Crane Style C-59	John Crane Style C-59
Maximum Diameter Sphere Size		2½	2⅝	3¼	3¾
Screw to Body Clearance (Total)		.038-.043	.038-.043	.038-.043	
Flank Clearance (Total)		.020-.032	.020-.032	.020-.032	
Body Components Gaskets		1/64"	1/64"	1/64"	

9-2 Material Specifications

PART	MATERIAL	WARREN SPEC	EQUIVALENT ASTM
Body	Stainless Steel	B407G	A743 Gr. CF-8M
Screws	Stainless Steel	B407U	A743 Gr. CF-8M
Feeders	Stainless Steel	B407A	A743 Gr. CF-8M
Shafts	Stainless Steel	G261A	A276 Type 316L
Shaft Sleeves	Coated Stainless Steel	B407U	A743 Gr. CF-8M
Stuffing Boxes	Stainless Steel	B407A	A743 Gr. CF-8M
Glands	Stainless Steel	B407A	A743 Gr. CF-8M
Timing Gears	Hardened Steel	F120D	A322 Gr. 8620

Note: Body bores, screws and shaft sleeves have hard overlays for abrasion resistance.

9-3 Pump Packing



	11 H.D. (Mark 2)	125 H.D. (Mark 2)	138 H.D.
A	1½"	2"	1⅞"
B	3⅞"	3⅞"	4⅞"
C No. of Turns	2 turns — 41/64"	2 turns — 41/64"	2 turns — 49/64"
D No. of Turns	4 turns — 41/64"	5 turns — 41/64"	5 turns — 49/64"
E	1¼"	1¼"	1¼"

NOTE: ¾ sq. packing may be used in place of 49/64"
⅝ sq. packing may be used in place of 41/64"

9-4 Shear Pin Coupling Data

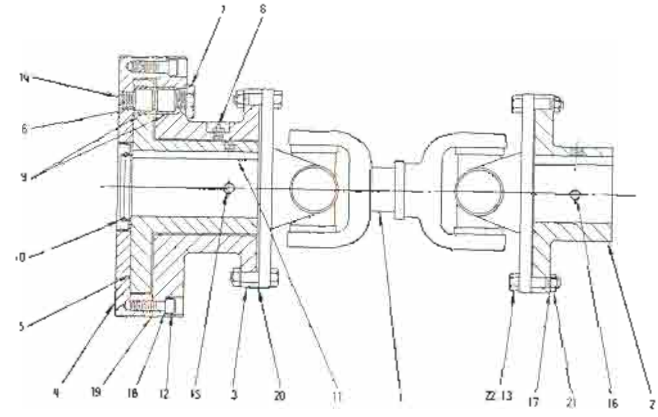
GENERAL NOTES

1. Maximum permissible parallel misalignment
   For the No. 125 Cplg is 5/16".
   For the No. 138 Cplg is 3/4".
2. Shear pin material — Steel (AISI 1215 Cold drawn)
   Average shearing stress — 40,000 psi.
3. To determine ultimate horsepower capacity of shear pin:

$$HP = \frac{\text{Torque x RPM}}{63025}$$

   Size shear pin for 1.5 times motor horsepower.
4. There should be a minimum of 1/4" misalignment.

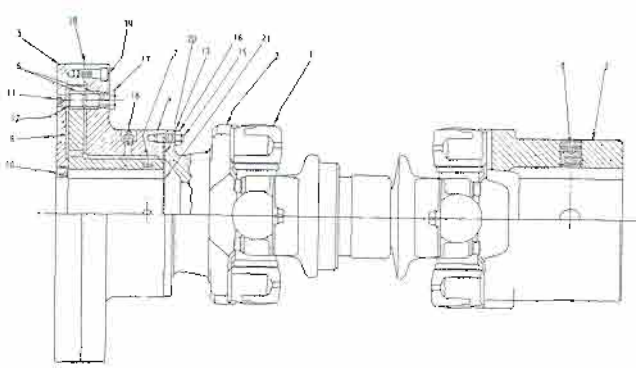
No. 11 High Density



Item No.	Part No.	Description	Qty. Req'd.
1	009500255-1	Universal Joint	1
2	016400006A422A1	Coupling Hub Pump Half	1
3	005100063A010A1	Coupling Cover (Rear)	1
4	005200019A010A1	Coupling Cover (Front)	1
5	016400009A422A1	Coupling Hub Jackshaft	1
6	See Table	Shear Pin	2
7	007600032F051A1	Hexhead Plug	2
8	213100004R002A1	Lube Fitting	1
9	007500280R003A1	Bushing	4
10	217610026-1	Oil Seal	1
11	067700072F021A1	Key	1
12	205100238N022A1	Cap Screws	8
13	200000078N022A1	Hex Bolt	20
14	207700003R002A1	Pipe Plug	2
15	206700241N022A1	Set Screw	2
16	206700244N022A1	Set Screw	2
17	203800006R002A1	Lockwasher	24
18	203800005R002A1	Lockwasher	8
19	016300203P002A1	Gasket	1
20	016300204R022A1	Gasket	1
21	201400006N071A1	Hexnut	24
22	200000077N022A1	Hexbolt	4
	621900002-1	Cplg. Assm. Less Pins	

	Item No.	Part No.	Torque	Qty. Req'd.
Shear Pin Item 6 2601 Series #11	A	011200021F051A1	7,700	2
	B	20	13,750	2
	C	11	21,400	2
	D	10	30,900	2
	E	12	42,000	2
	F	24	55,000	2

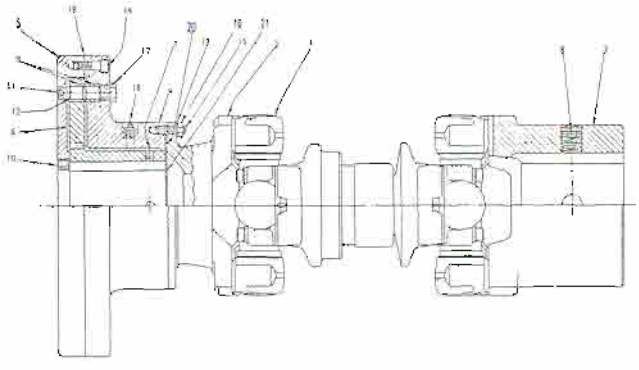
No. 125 High Density



Item No.	Part No.	Description	Qty. Req'd.
1	009500251-1	Dbl. Universal Joint	1
2	016400041R002A1	Flange Coupling	1
3	016400028R002A1	Coupling Hub Pump	1
4	005100119A010A1	Coupling Cover Rear	1
5	005200029A010A1	Coupling Cover Front	1
6	016400027A414A1	Coupling Hub Jackshaft	1
7	206700241N022A1	¼x⅜ Set Screw	2
8	206700481N022A1	⅛x1 Set Screw	2
9	007500280R003A1	Bushing	2
10	217610027-1	Oil Seal	1
11	207700003R002A1	Pipe Plug	1
12	See Table	Shear Pin	1
13	203800005R002A1	Lockwasher	20
14	205100238N022A1	Cap Screw	8
15	204400065N024A1	Stud	12
16	201400005N022A1	Hex Plug	12
17	207700003R002A1	Pipe Plug	1
18	213100004R002A1	Grease Fitting	1
19	016300090R022A1	Gasket	1
20	016300091R022A1	Gasket	1
21	005800076L050A1	Seal Plate	1
	621900001-1	Coupling Assm. Less Pin	1

	Item No.	Part No.	Torque	Qty. Req'd.
Shear Pin Item 12 2601 Series #125	A	011200021F051A1	6,050	1
	B	20	10,800	1
	C	11	16,800	1
	D	10	24,300	1
	E	12	33,000	1
	F	24	43,200	1
	G	25	48,760	1
	H	26	54,627	1

No. 138 High Density



Item No.	Part No.	Description	Qty. Req'd.
1	009500259-1	Double Universal Joint	1
2	016400031R019A1	Flange Coupling	1
3	016400040R002A1	Coupling Hub Pump	1
4	005100135A010A1	Coupling Rear Cover	1
5	005200029A010A1	Coupling Front Cover	1
6	016400027A010A1	Coupling Hub Jackshaft	1
7	206700241N022A1	Soc. Hd. Set Screw	2
8	206700481N022A1	Soc. Head Set Screw	2
9	007500280R003A1	Bushing	4
10	217610027-1	Oil Seal	1
11	207700003R002A1	Soc. Head Pipe Plug	2
12	See Table	Shear Pin	
13	203900008R002A1	Lockwasher	8
14	205100238N022A1	Soc. Head Capscrew	8
15	204400158N024A1	Stud	8
16	201400007N022A1	Hex Nut	8
17	208100002R002A1	Hex Pipe Plug	1
18	213100004R002A1	Lube Fitting	1
19	016300090R022A1	Gasket	1
20	016300122R022A1	Gasket	1
21	005800079L050A1	Sealing Plate	1
	621900003-1	Cplg. Assm Less Pin	

	Item No.	Part No.	Torque	Qty. Req'd.
Shear Pin Item 12 2601 Series #138	A	011200011F051A1	33,600	2
	B	10	48,600	2
	C	12	66,000	2
	D	24	86,007	2
	E	25	97,445	2
	F	26	109,156	2

9-5 Bearing Puller for Adjusting Sleeve

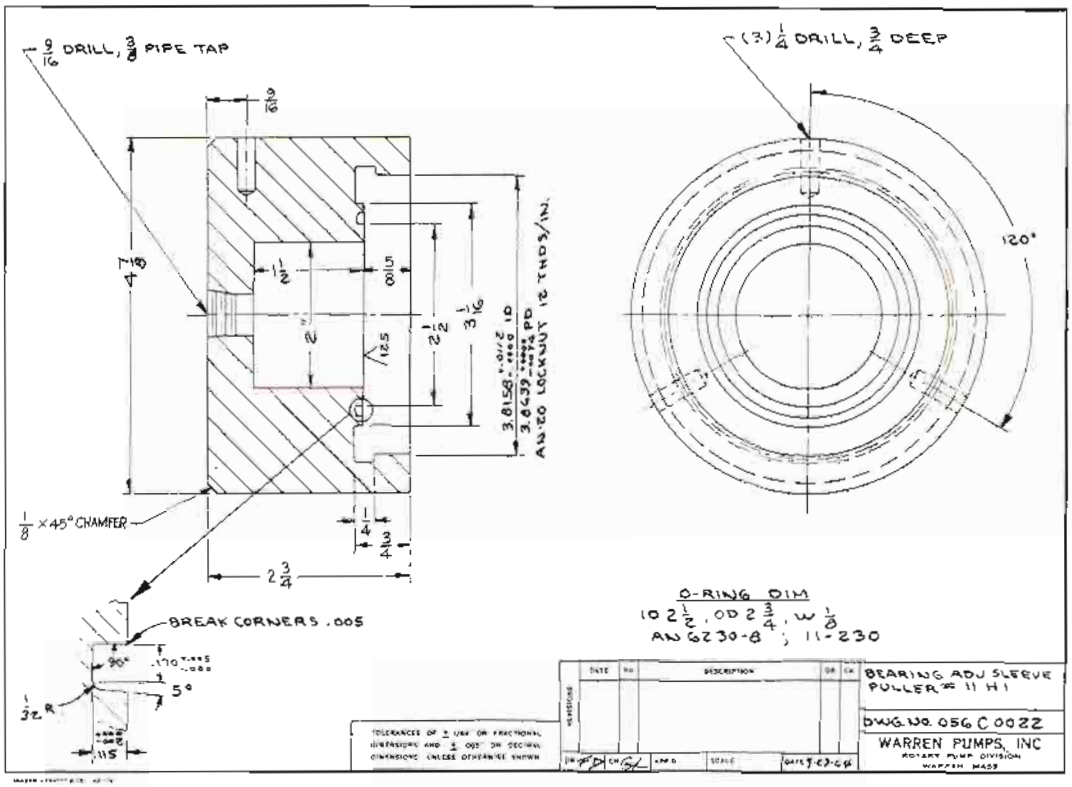


Fig. 6A

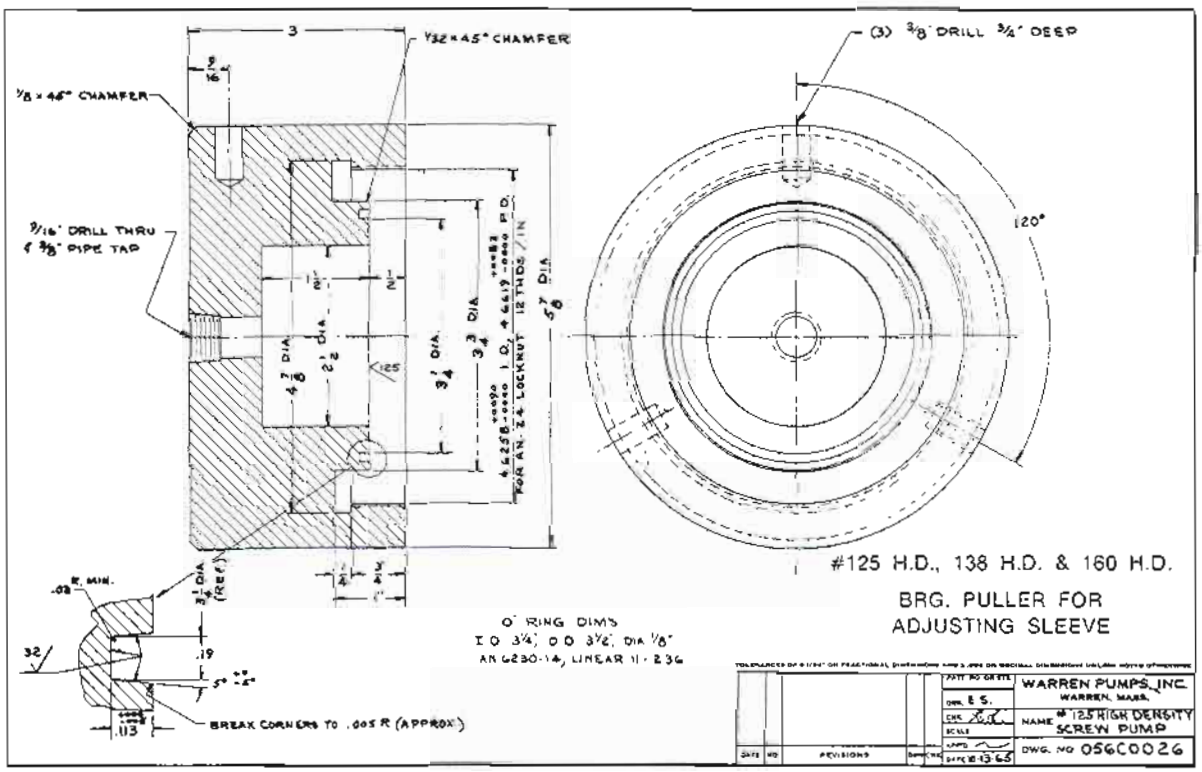


Fig. 6B

SECTION 10 — TROUBLESHOOTING

Trouble	Cause of Trouble
10-1 Pump Does Not Discharge:	1. Clogged suction 2. Incorrect rotation
10-2 Insufficient Discharge:	1. Speed too low 2. Belts too loose 3. Starved or impaired suction line 4. Mechanical defect (inspect pump)
10-3 Excessive Load on Driver:	1. Speed too high 2. Total discharge head higher than specified 3. Discharge line obstructed 4. Mechanical defect (inspect pump) 5. Defective discharge gauge 6. Belts too tight
10-4 Hammer, Noise, Vibration:	1. Excess stock temperature from mixer, above 180°F 2. Bearings improperly fitted 3. Abrupt changes of direction in suction line 4. Mechanical defect (inspect pump) 5. Improperly supported piping and/or piping strain 6. Problems in foundation or grouting 7. Defective motor bearings
10-5 Pump Stops:	1. Belts incorrectly tightened 2. Tripped out on zero speed switch 3. Foreign material in pumping element

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 quality of spares will also vary with the 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. Serial number of pump. (Example: No. 73245).
2. Type of pump (Example: No. 125 High Density).
3. Name of part required and part number from drawing (Example: Long Shaft — No. 14).
4. Quantity required.
5. Purchase order number.
6. Complete shipping and invoicing instructions.

SECTION 12 — SAFETY PRECAUTIONS

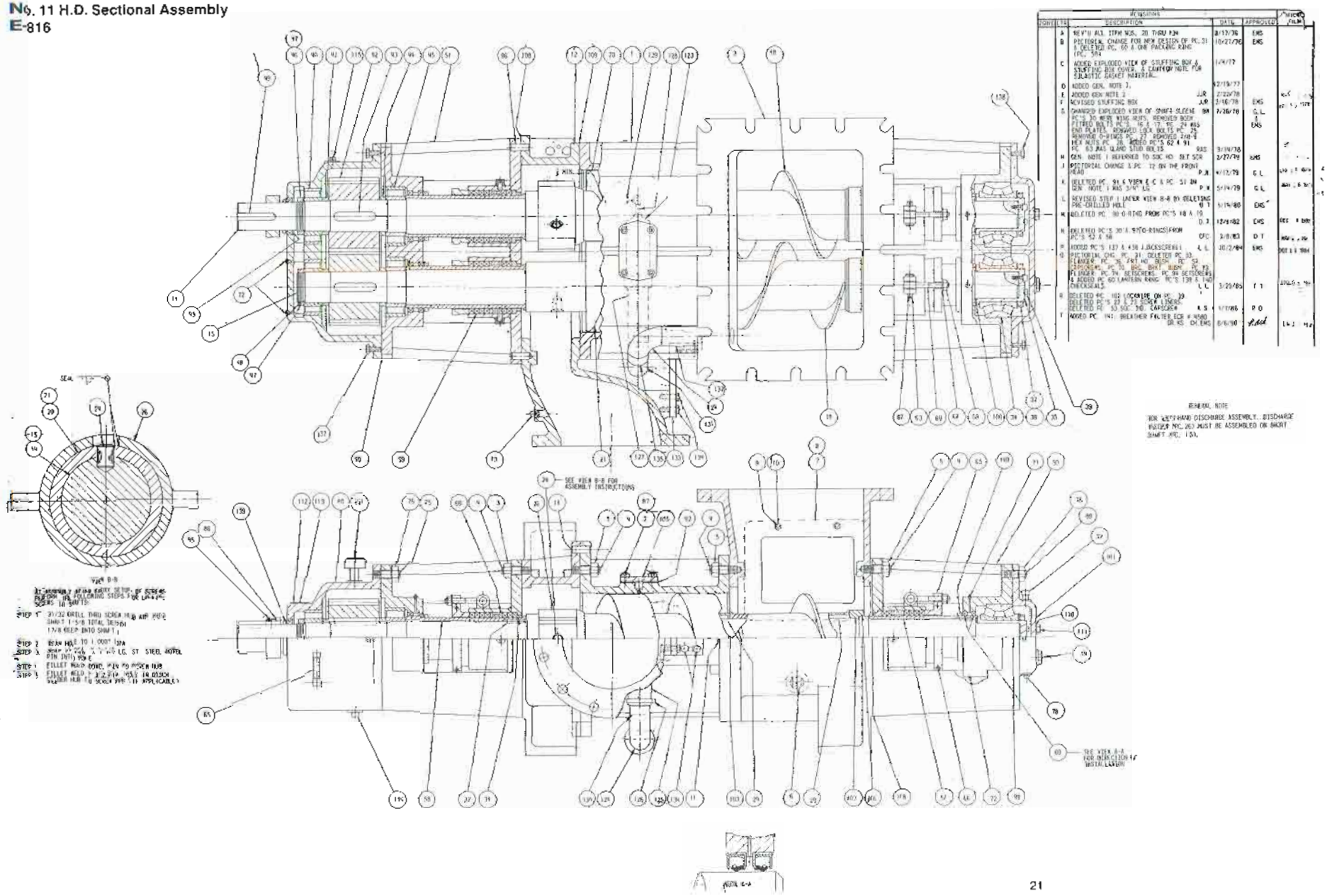
Recommended basic safety practices to help prevent serious personal injury:

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 all liquid fittings are properly tightened to prevent leak hazards to personnel.
3. Be sure coupling guards are properly installed.
4. Do not operate at higher speeds, temperatures or pressures than specified without first consulting Warren Pumps. Failure to do so could result in serious personal injury or property damage.
5. Do not operate in liquids other than specified without first consulting Warren Pumps. Many parts are available in several different materials for different chemical environments. Your pump's materials were chosen for a specific application. Operating in different conditions may result in serious personal injury or property damage, and will void your warranty.

PARTS LIST — WARREN 2601 SERIES HIGH DENSITY STOCK PUMP

Part No.	Part
1.	Body
2.	Stud
3.	Rear Casing
4.	Stud
5.	Hex Nut
6.	Pipe Plug
7.	Handhole Cover
8.	Gasket
9.	Stud
10.	Hex Nut
11.	Dowel Pin
12.	Front Casing
13.	Pipe Plug
14.	Long Shaft
15.	Short Shaft
18.	Feeder (Long Shaft)
19.	Feeder (Short Shaft)
20.	Screw (Long Shaft)
21.	Screw (Short Shaft)
24.	Dowel Pin
26.	Discharge Feeder
29.	Key
31.	Stuffing Box Bushing
32.	Shaft Sleeve Key
34.	Thrust Bearing Assembly
35.	Thrust Bearing Adjusting Sleeve
37.	Lockwasher
38.	Locknut
39.	Socket Head Capscrew
40.	Bearing
41.	Spacer
42.	Timing Gear
43.	Timing Gear Key
44.	Spacer
45.	Bearing
46.	Locknut
47.	Serscrew
48.	Locknut
49.	Coupling Key
50.	Rear Bearing Bracket
51.	Front Bearing Bracket
52.	Shaft
58.	Shaft Sleeve
59.	Packing
60.	Lantern Ring
62.	Cotter Pin
63.	Clevis Pin
64.	Gland Swing Bolt
65.	Gland (Split)
66.	Socket Head Cap Screw
67.	Washer
68.	Hex Nut
69.	Oil Seal
71.	Grease Fittings
72.	Square Head Pipe Plug
75.	Stud
76.	Hex Nut
77.	Vent Plug
78.	Pipe Plug
79.	Sight Glass
80.	Front Head
81.	Heat Exchanger
82.	Cover
83.	Square Head Pipe Plug
84.	Stud
85.	Sight Gage
86.	Shaft Collar
87.	Hex Nut
88.	Hex Nut
89.	Stud
92.	Gasket
93.	Oil Seal
95.	Socket Head Setscrew
96.	Dowel Pin
98.	Gasket
99.	Gasket
100.	Shim
101.	Rear Cover
103.	Gasket
104.	90° Street Elbow
105.	Cover
106.	O-Ring
107.	Shaft Collar
108.	Gasket
109.	Gasket
110.	Gasket
111.	Hex Nut
112.	Name Plate
113.	Drive Screw
114.	Pipe Plug
115.	Pipe Plug
116-122	Air Bleed System
136.	Gasket
137.	Hex Head Bolt
138.	Hex Head Bolt
139.	Checkseal
140.	Checkseal
141.	Filter, Breather

No. 11 H.D. Sectional Assembly
E-816

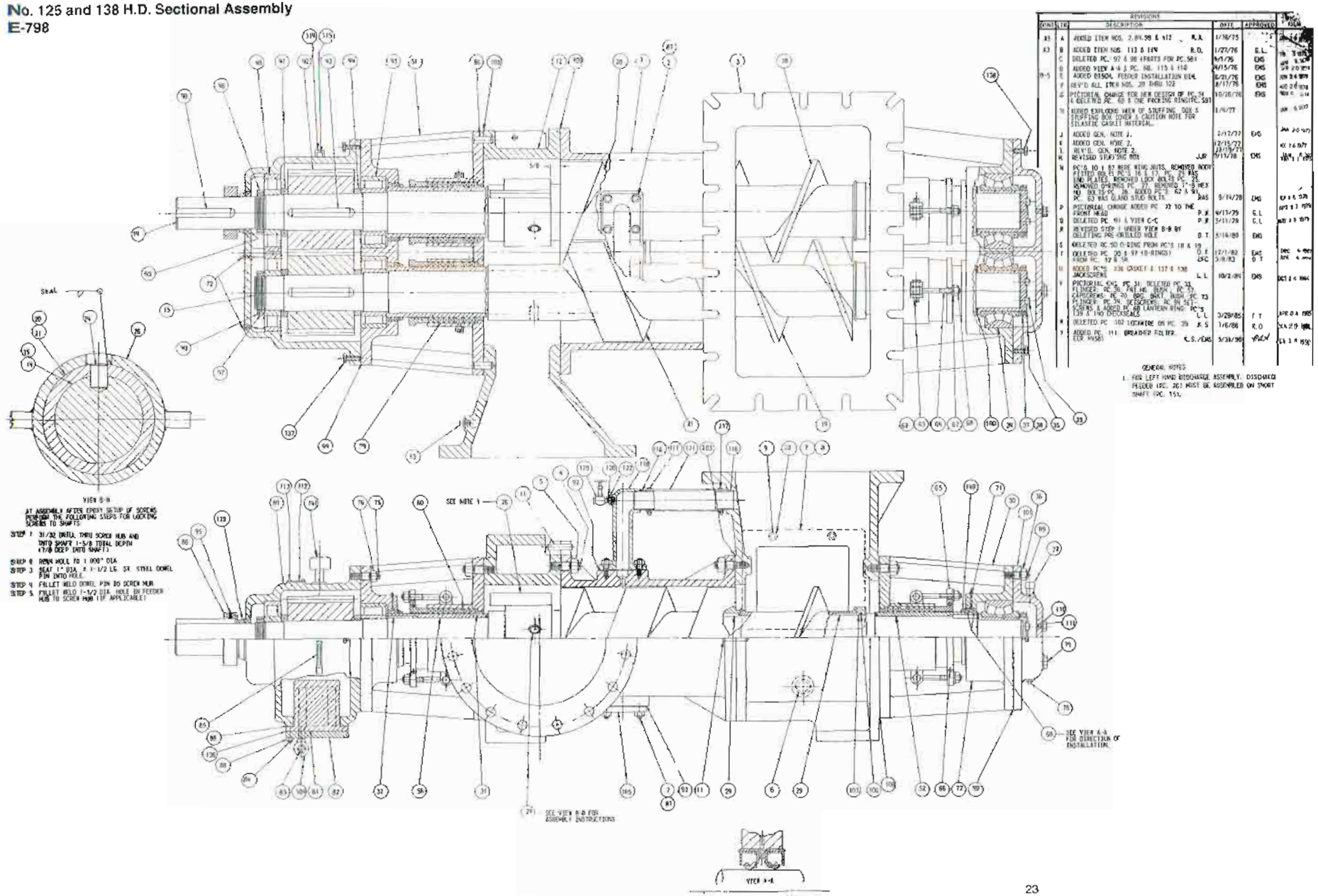


PARTS LIST — WARREN 2601 SERIES HIGH DENSITY STOCK PUMP

Part No.	Part
1.	Body
2.	Stud
3.	Rear Casing
4.	Stud
5.	Hex Nut
6.	Pipe Plug
7.	Handhole Cover
8.	Gasket
9.	Stud
10.	Hex Nut
11.	Dowel Pin
12.	Front Casing
13.	Pipe Plug
14.	Long Shaft
15.	Short Shaft
18.	Feeder (Long Shaft)
19.	Feeder (Short Shaft)
20.	Screw (Long Shaft)
21.	Screw (Short Shaft)
24.	Dowel Pin
26.	Discharge Feeder
29.	Key
31.	Stuffing Box Bushing
32.	Shaft Sleeve Key
34.	Thrust Bearing Assembly
35.	Thrust Bearing Adjusting Sleeve
37.	Lockwasher
38.	Locknut
39.	Socket Head Capscrew
40.	Bearing
41.	Spacer
42.	Timing Gear
43.	Timing Gear Key
44.	Spacer
45.	Bearing
46.	Locknut
47.	Serscrew
48.	Locknut
49.	Coupling Key
50.	Rear Bearing Bracket
51.	Front Bearing Bracket
52.	Shaft
58.	Shaft Sleeve
59.	Packing
60.	Lantern Ring
62.	Cotter Pin
63.	Clevis Pin
64.	Gland Swing Bolt
65.	Gland (Split)

Part No.	Part
66.	Socket Head Cap Screw
67.	Washer
68.	Hex Nut
69.	Oil Seal
71.	Grease Fittings
72.	Square Head Pipe Plug
75.	Stud
76.	Hex Nut
77.	Vent Plug
78.	Pipe Plug
79.	Sight Glass
80.	Front Head
81.	Heat Exchanger
82.	Cover
83.	Square Head Pipe Plug
84.	Stud
85.	Sight Gage
86.	Shaft Collar
87.	Hex Nut
88.	Hex Nut
89.	Stud
92.	Gasket
93.	Oil Seal
95.	Socket Head Setscrew
96.	Dowel Pin
98.	Gasket
99.	Gasket
100.	Shim
101.	Rear Cover
103.	Gasket
104.	90° Street Elbow
105.	Cover
106.	O-Ring
107.	Shaft Collar
108.	Gasket
109.	Gasket
110.	Gasket
111.	Hex Nut
112.	Name Plate
113.	Drive Screw
114.	Pipe Plug
115.	Pipe Plug
116-122	Air Bleed System
136.	Gasket
137.	Hex Head Bolt
138.	Hex Head Bolt
139.	Checkseal
140.	Checkseal
141.	Filter, Breather

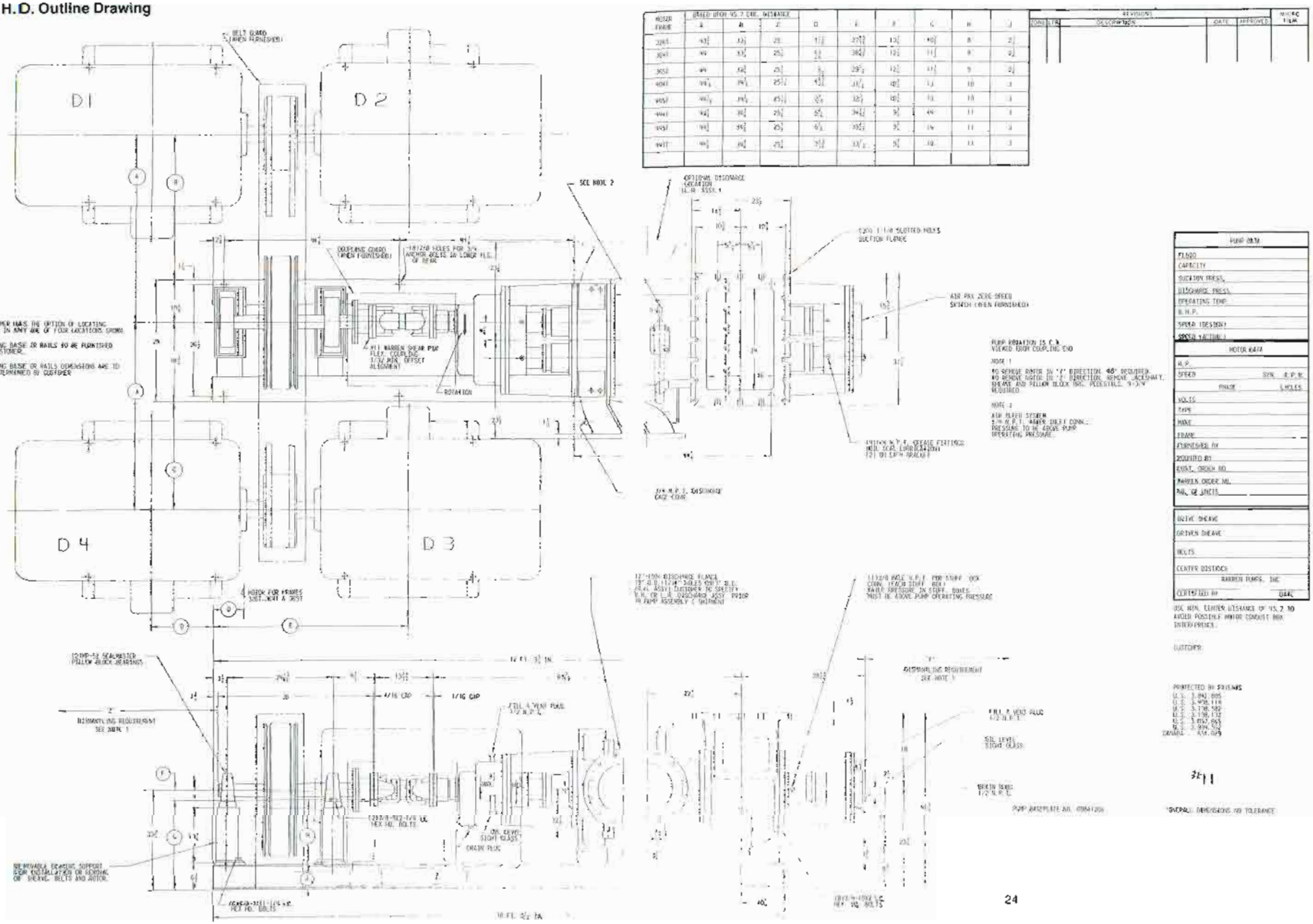
No. 125 and 138 H.D. Sectional Assembly
E-798



ZONE	LTR	DESCRIPTION	DATE	APPROVED
X5	A	ADDED ITEM NOS. 2,89,98 & 112 R.A.	1/30/75	
X3	B	ADDED ITEM NOS. 113 & 114 R.D.	1/27/76	G.L.
	C	DELETED PC. 97 & 98 4PARTS FOR PC.561	4/1/76	EMS
	D	ADDED VIEW A-A & PC. NO. 115 & 116	4/15/76	EMS
9-5	E	ADDED 03504, FEEDER INSTALLATION DWG.	6/21/76	EMS
	F	REV'D ALL ITEM NOS. 20 THRU 102	8/17/76	EMS
	G	PICTORIAL CHANGE FOR NEW DESIGN OF PC.74 & DELETED PC. 68 & ONE PACKING RINGPC.591	10/26/76	EMS
	H	ADDED EXPLODED VIEW OF STUFFING BOX,S STUFFING BOX COVER & CAUTION NOTE FOR SILASTIC GASKET MATERIAL.	1/6/77	
	J	ADDED GEN. NOTE 3.	2/12/77	EMS
	K	ADDED GEN. NOTE 2.	12/15/77	
	L	REV'D. GEN. NOTE 2.	12/19/77	
	M	REVISED STUFFING BOX JUR	9/11/78	EMS
	N	PC'S 10 & 82 WERE RING JOINTS, REMOVED BODY FITTED BOLTS PC'S 14 & 17 PC. 79 WAS END PLATES, REMOVED LOCK BOLTS PC. 23, REMOVED O-RINGS PC. 77, REMOVED 1"-8 HEX HD. BOLTS PC. 26, ADDED PC'S 82 & 91, PC. 83 WAS GLAND STUD BOLTS. DAS	9/14/78	EMS
	P	PICTORIAL CHANGE ADDED PC. 22 TO THE FRONT HEAD P.R.	4/17/79	G.L.
	Q	DELETED PC. 101 & VIEW C-C P.R.	5/11/79	G.L.
	R	REVISED STEP 1 UNDER VIEW B-B BY DELETING PRE-DRILLED HOLE D.T.	5/14/80	EMS
	S	DELETED PC. 50 O-RING FROM PC'S 18 & 19		
	T	DELETED PC. 25 & 97 (O-RINGS) FROM PC. 57 & 58 D.E. GFC	12/1/82 5/8/83	EMS D T
	U	ADDED PC'S 136 GASKET & 137 & 138 JACKSCREWS L.L.	10/2/84	EMS
	V	PICTORIAL CHG. PC. 31 DELETED PC. 32 FLINGER, PC. 56 PKT.HD. BOX & PC. 57 CAPSCREWS, PC. 20 BRG. SHAFT BUSH. PC. 73 FLINGER, PC. 74 SETSCREWS, PC. 94 SET-SCREWS & ADDED PC. 60 LANTERN RING, PC'S 138 & 140 DISCHARGES L.L.	3/29/85	T T
	W	DELETED PC. 102 LOCKWIRE ON PC. 39 R.S.	1/6/86	R.O.
	Y	ADDED PC. 141 BREATHER FILLER EGG WASHER C.S./EMS	5/30/90	

GENERAL NOTES
1. FOR LEFT HAND DISCHARGE ASSEMBLY, DISCHARGE FEEDER (PC. 20) MUST BE ASSEMBLED ON SHORT SHAFT (PC. 15).

No. 11 H.D. Outline Drawing
E-817



MOTOR FRAME	DRIVEN UTOH 165.2 DIM. INDICATE A	A1	Z	D	E	F	G	H	J
326T	43 1/2	33 1/2	25	11/2	29 1/2	13 1/2	14 1/2	8	2
364T	49	33 1/2	25 1/2	5/8	38 1/2	12 1/2	11	9	2 1/2
365T	49	34 1/2	25 1/2	5/8	29 1/2	12 1/2	11 1/2	9	2 1/2
404T	54 1/2	39 1/2	25 1/2	7/8	31 1/4	12 1/2	13	10	3
405T	55 1/2	39 1/2	25 1/2	7/8	32 1/2	12 1/2	13	10	3
444T	59 1/2	39 1/2	25 1/2	7/8	34 1/2	9 1/2	14	11	3
445T	59 1/2	39 1/2	25 1/2	7/8	35 1/2	9 1/2	14	11	3
447T	59 1/2	39 1/2	25 1/2	7/8	37 1/2	9 1/2	14	11	3

REVISIONS				MADE FOR
ZONE LTR	DESCRIPTION	DATE	APPROVED	

PUMP DATA	
FLANGE	
CAPACITY	
SUCTION PRESS.	
DISCHARGE PRESS.	
OPERATING TEMP.	
B.H.P.	
SPEED (DESIGN)	
SPEED (ACTUAL)	

MOTOR DATA	
H.P.	
SPEED	SYN. R.P.M.
PHASE	CYCLES
VOLTS	
TYPE	
MAKE	
FRAME	
FURNISHED BY	
ACQUIRED BY	
EXIST. ORDER NO.	
WARREN ORDER NO.	
NO. OF UNITS	

DRIVE SHEAVE	
DRIVEN SHEAVE	
BELTS	
CENTER DISTANCE	

WARREN PUMPS, INC.

CERTIFIED BY _____ DATE _____

USE MIN. CENTER DISTANCE OF 45.2.10 AVOID POSSIBLE MOTOR CONDUIT BOX INTERFERENCE.

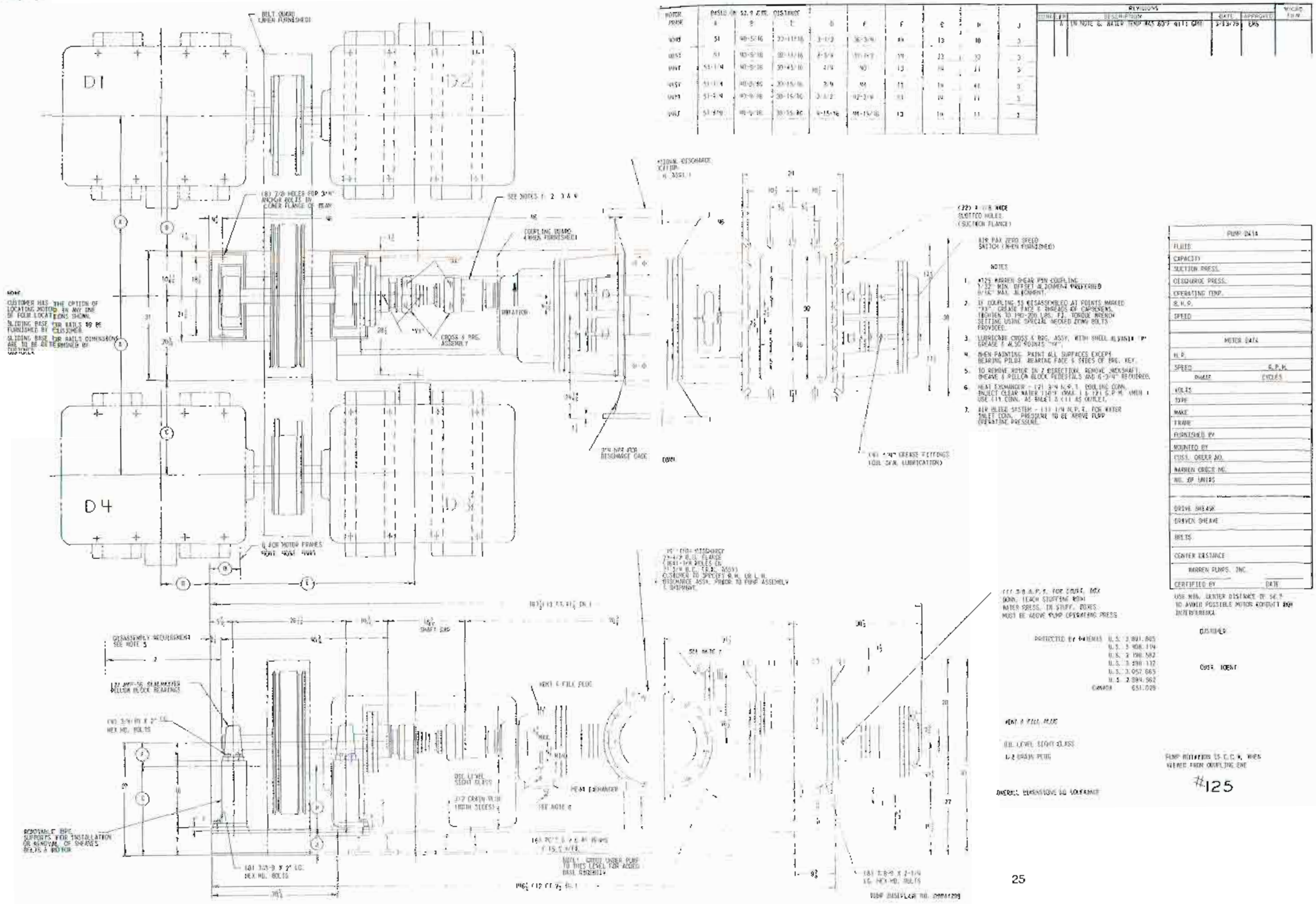
CUSTOMER

PROTECTED BY FOLLOWS
U.S. 3,042,885
U.S. 3,420,118
U.S. 3,138,582
U.S. 3,198,132
U.S. 3,057,863
U.S. 3,399,524
DRAWING - KM-029

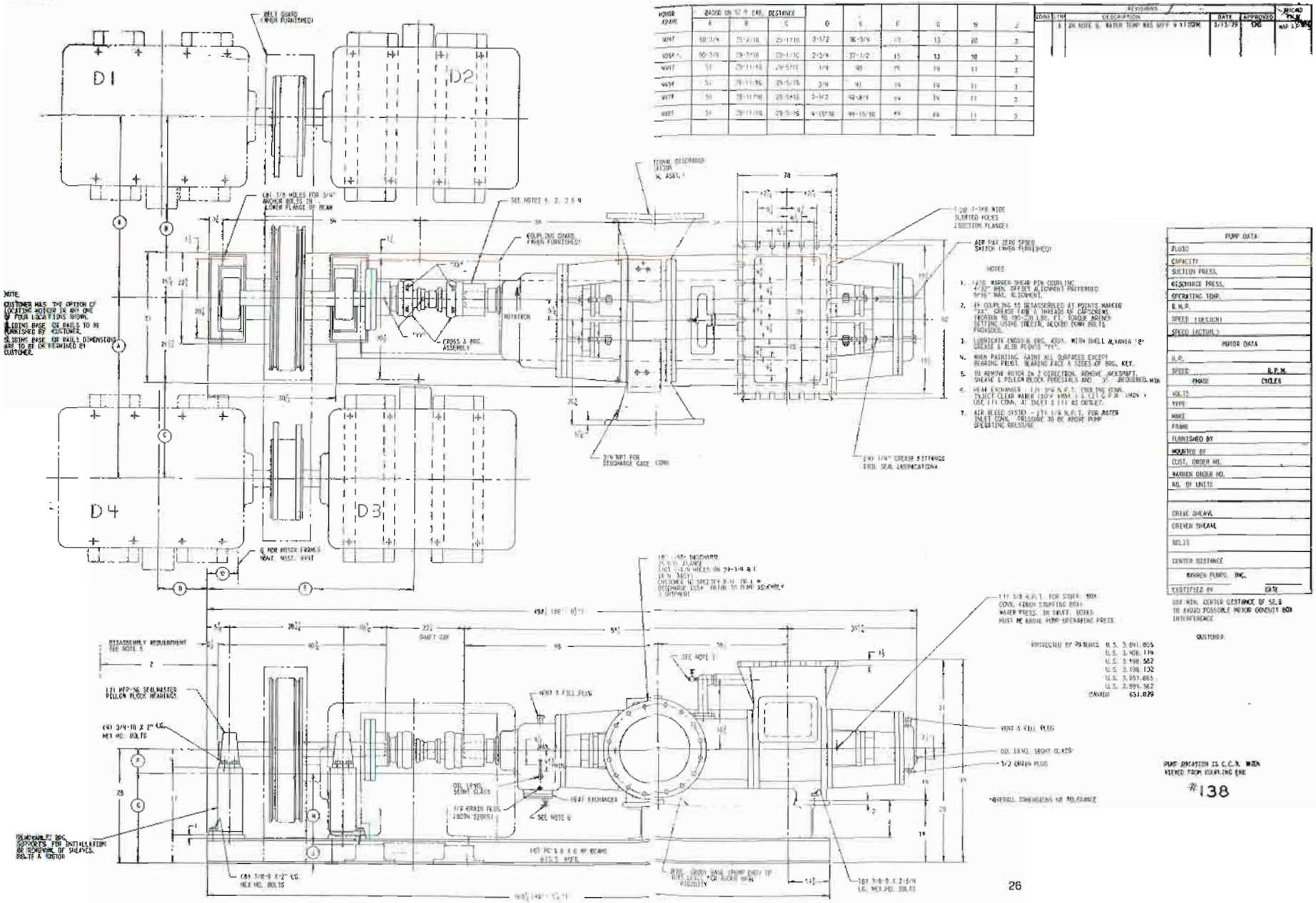
32 11

*OVERALL DIMENSIONS NO TOLERANCE

No. 125 H.D. Outline Drawing
E-815



No. 138 H.D. Outline Drawing
E-818



MOTOR FRAME	BASED ON 52.8 CNTR. DISTANCE A	B	C	D	E	F	G	W	Z
56HT	50-3/4	23-9/16	25-11/16	3-1/2	36-3/4	13	13	10	3
56FR	50-3/4	23-7/16	25-11/16	2-3/4	37-1/2	15	13	10	3
444T	51	25-11/16	25-5/16	1/4	38	15	14	11	3
445T	51	25-11/16	25-5/16	3/4	41	15	14	11	3
447T	51	25-11/16	25-5/16	3-1/2	42-3/4	14	14	11	3
449T	51	25-11/16	25-5/16	4-13/16	44-15/16	14	14	11	3

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED	MICRO FILM
	A	IN NOTE 6, WATER TEMP WAS 60°F & 1.5 PSIG	3/13/79	CHK	MAR 15 '79

Imo Industries Inc.

Warren Pumps Inc.
Bridges Avenue
Warren, MA 01083-0969
413-436-7711
FAX: 413-436-5605
Telex: 955456