Form SPAD-187
March, 1994

CLASS HOC
Model 2

Cradle Mounted Centrifugal Pumps

Instructions for
INSTALLATION-OPERATION & MAINTENANCE

Note: It is important that the entire contents of this booklet be studied before installation.

Ingersoll-Dresser Pumps

Table of Contents

I. Introduction

This manual contains instructions for the installation, operation and maintenance of your Ingersoll-Dresser Pump Company Class HOC2 centrifugal pump. This information is provided to insure the long life and safe operation of this pump, therefore, read this manual before installation or operation and keep it in a safe place for future reference. The instructions in this manual are intended for personnel with a general training in the operations and maintenance of centrifugal pumps.

A. Safety-General

This pump has been designed to provide safe and reliable service. However, it is both a pressure vessel and a piece of rotating machinery. Therefore, the operator(s) must exercise good judgment and proper safety practices to avoid damage to the equipment, surrounding areas, and to prevent personal injury. It must be understood that the information contained in this manual does not relieve operating and maintenance personnel of the responsibility of exercising normal good judgment in operation and care of this pump and its components. The safety department at this pump location must establish a safety program based on a thorough analysis of industrial hazards. This program should be reviewed before the installation and operation of this pump.

In addition to the hazards of rotating equipment and pressure vessels, considerations must be given to hazards of electrical power, hot oil, high pressure and temperature liquids, toxic liquids and gases, and flammable liquids and gases. Proper installation and care of protective guards, shutdown devices and over-pressure protection equipment should also be an essential part of any safety program.

Also essential are special precautionary measures to prevent the possibility of applying power to the equipment at any time that maintenance work is in process. In addition, the prevention of rotation due to reverse flow should not be overlooked.

In general, all personnel should be guided by all the basic rules of safety associated with the equipment and the process.

B. Safety Procedures

In this manual the words **WARNING, CAUTION,** and **NOTE** will be found. The definitions of these words are as follows:

WARNING:—An operating procedure, practice, etc. which, if not correctly followed, could result in personal injury or loss of life.

CAUTION:—An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of equipment.

NOTE:—An operating procedure, condition, etc. which is essential to highlight.

Ingersoll-Dresser Pump Company will not be liable for any delay, damage or injury caused by the failure to comply with the procedures in this manual. This pump must not be operated at pressures, temperatures or speeds higher than stated on the original order, or used with liquids not previously approved without written permission of Ingersoll-Dresser Pump Company.

C. Check Upon Arrival

The complete pump unit should be inspected immediately upon arrival, and any irregularities arising due to shipment reported to the carrier.

Care must be taken during unpacking to avoid damage to the equipment. A copy of this instruction manual and instructions for various other components will be included in the shipment.

Inspect all packaging to avoid discarding these instructions and other pump parts and accessories which may be packed inside shipping containers or attached to skids in individual packages.

D. Handling

Use care when moving pumps. **DO NOT lift pumps or pumping units by eyebolts (when provided).** The pump eyebolt is designed only for removing the back pull-out assembly and the motor eyebolt only for moving the motor. An assembled pump should be lifted using a sling under the suction nozzle and the bearing housing. Complete pump, driver and motor units should be hoisted using slings beneath the bedplate under both the pump and driver. Make certain that the equipment used to lift the pump or pumping unit is capable of supporting the weights encountered.

E. Storage and Preservation

The standard domestic shipping and preservation protection is suitable for the period of shipment (in covered trucks) and installation.

The equipment is also protected for a short period of covered storage at the jobsite before installation. If the pump is not to be installed at once, special precautions must be taken. One method is to apply special protection before shipment, but this additional packaging must then be removed before installation. Therefore application of special protection in the field is suggested. As a minimum the pump must be stored in a dry, clean place. The unit should be stored in an approximately level position with no strains applied. Flange covers should be left in place. It is recommended to flush the pump and bearing housing with a suitable rust preventative. Contact your local Ingersoll-Dresser Pump Company representative for any additional recommendations. The individual manufacturers of other components should be contacted for their recommendations for long term storage.

F. Pump Groupings

Class HOC2 pumps are grouped according to seal size and bearing systems. Reference is made throughout this manual to Group I,2, or 3 pumps. Listed below are the pumps belonging to each group.

Group I Pumps	Group 2 Pumps		Group 3 Pumps
1½x1x6 HOC	3x2x6 HOC	3x2x10 HOC	8x6x13 HOC
3x1½x6 HOC	3x1½x8 HOC	4x3x10 HOC	10x8x13 HOC
1½x1x8 HOC	3x2x8 HOC	4x3x10L HOC	8x6x15 HOC
	4x3x8 HOC	6x4x10 HOC	10x8x15 HOC
	4x3x8L HOC	3x1½x13 HOC	
	2x1x10 HOC	3x2x13 HOC	
	3x1½x10 HOC	4x3x13 HOC	
		6x4x13 HOC	

II. INSTALLATION

NOTE: The design of piping systems, foundations and other areas of system design is the responsibility of others. Ingersoll-Dresser Pump Company data and comments are offered as an aid, but Ingersoll-Dresser Pump Company cannot assume responsibility for the design and operation.

It is recommended that the customer consult a specialist skilled in the design of foundations, piping, sumps and related systems so as to supplement and interpret Ingersoll-Dresser Pump Company information and ensure a successful installation.

A. Checklist

1. Cleaning the pump
2. Location
3. Foundation
4. Field Mounting of Driver
5. Leveling
6. Grouting
7. Piping
8. Preliminary Alignment
9. Check Rotation
10. Coupling and Guard
11. Stuffing Box
12. Auxiliary Piping

B. Cleaning the Pump

Before putting the pump into operation, the liquid end of the pump should be flushed out with water to remove any rust preventative as well as any foreign matter which may have accumulated during shipment, storage, or installation.

If the pump has been in storage for more than six months, it should be disassembled, inspected and cleaned, as required, before putting it into service.

C. Location

Install the pump in an accessible place, as close as possible to the source of the liquid to be pumped. Allow space for inspection and maintenance, and sufficient floor space and head room for the required crane or hoist service.

Consideration must be given to the environment when pumps are driven by an electric motor. Proper ventilation is necessary, and extremes of dampness and/or heat should be avoided.

D. Foundation

The foundation should be sufficiently rigid and substantial enough to absorb any pump vibration and to permanently support the entire pumping unit. Bedplate mounted pumps are normally grouted in on a reinforced concrete foundation which is strong enough to support 1½ times the weight of the unit (including driver). The foundation bolts should be installed in a fashion similar to that shown in Figure I at the locations and size shown on the certified General Arrangement Drawing, but it suggested that the foundation bolts not be set rigidly until the equipment arrives.

For optional stilt-mounted or spring-loaded baseplates the installation should be in accordance with the General Arrangement Drawing.

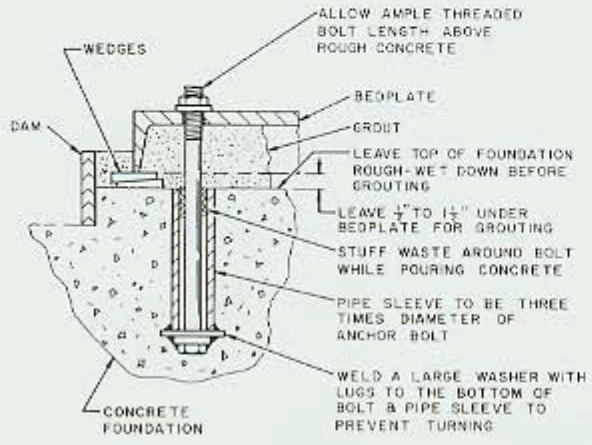


Figure 1

E. Field Mounting of Drivers

Important: Check driver shaft run-out.

During the assembly of the pump at the factory the run-out of the rotating parts is checked.

Before the pump and driver are aligned as a unit the driver coupling run-out must be checked. Broken shafts sometimes result because of the failure in the field to check the driver shaft run-out.

NOTE: On units supplied from the factory less driver, but with metallic bedplate, it is required that the driver support be welded in place,in the field, once proper shaft spacing is obtained.

F. Leveling

1. Check that the pump shaft is centered from side to side with the bedplate and tighten the pump hold down bolts.

2. Place the unit on the foundation and level the baseplate by driving wedges, or shimming, at at least four points, two under the pump and two under the driver (Figure 2). Use a machinist's level on the discharge nozzle and plumb the suction nozzle to determine levelness. The bedplate should be between .50" (12mm) and 1.50" (38mm) above the foundation.

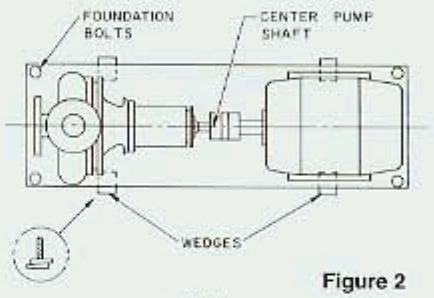
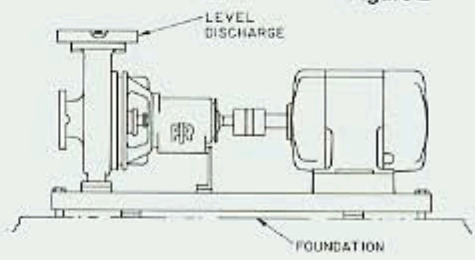


Figure 2



3. Tighten the foundation bolts so that they are snug and recheck levelness. Adjust wedges if necessary to maintain flatness.

4. Check to be sure the baseplate is not distorted and that accurate coupling alignment can be acheived within the limits of movement and/or by shimming the driver.

G. Grouting

NOTE: Do not grout until the unit has been properly leveled.

Build a dam around the bedplate and pour the grout through the ends, on channel bedplates, or through the grout holes on steel and non-metallic bedplates. It is essential that the area under the bedplate be completely grouted with no voids or air pockets. After the grout has hardened (48 to 72 hours), remove the dam and also the wedges, if desired. The holes left by the wedges may be filled with grout.

H. Piping

After the unit has been mounted, connect the suction and discharge piping. Proper piping design is critical to the proper operation and long life of any pump. Do not use the pump as a piping support. All piping should be supported independently of the pump, and care should be taken when making up fittings, etc. to avoid placing a strain on the pump. Reference to the guidelines in the "HYDRAULIC INSTITUTE STANDARDS" should be made before designing or installing piping. Both the suction and discharge piping should be as short and as straight as possible in order to reduce friction losses. Straight length of pipe at least five to ten diameters long should be attached to the pump suction and discharge before any elbows are used.

Refer to the nozzle loading chart (page 6) for maximum allowable nozzle loads.

CAUTION: Provision must be made to support suction and discharge piping to the pump to prevent excessive nozzle loads and maintain pump-driver alignment.

CAUTION: Never strain the pump by using force to draw piping to the pump flanges.

Suction Piping

1. Only clear, cold liquids can be pumped with a suction lift.

2. Arrange the length and size of suction pipe so that the maximum suction lift, including all losses, will not exceed the NPSH requirements of the pump. (See page 13.)

3. Hot liquids must flow to the pump under sufficient positive head to prevent vaporization at the impeller inlet.

4. Keep the suction pipe short and direct.

5. Use a suction pipe at least one size larger than the pump suction nozzle.

6. Keep the suction pipe free of air pockets.

a. When the pump operates with a suction lift, the suction pipe should slope upward to the pump nozzle from the source of supply.

b. Horizontal suction pipes should have a gradual rise. Do not install any part or section of a horizontal suction pipe higher than the pump suction nozzle.

c. Whenever another pipe or other obstruction requires bending from the natural slope, run the suction pipe under the obstruction rather than above it.

d. The pipe reducer at the pump suction nozzle must be of the eccentric type to prevent air pockets in the suction line.

e. Gate valves should never be necessary in a suction pipe under suction lift; however, when they are used, air pockets can be eliminated by turning the valve stem in a horizontal or bottom direction. When used, their size should be equal to that of the largest pipe used in the suction line.

7. Horizontal elbows in the suction line should be at a lower elevation than the pump nozzle. Never install a horizontal elbow next to the pump. Where possible have a vertical elbow lead into the pipe reducer next to the pump.

Discharge Piping

Use discharge piping one size larger than the pump discharge nozzle. It is good practice to install a gate valve and a check valve in the discharge line. The installation of the check valve prevents back flow which may damage the pump on shut down. (Ingersoll-Dresser Pump Company will not be responsible for damages resulting from failure to install a check valve.)

NOTE: If quick-closing valves are installed in the discharge piping system, protection MUST be provided to ensure that no surge or water-hammer is transmitted to the pump.

Suction Screen (Strainer)

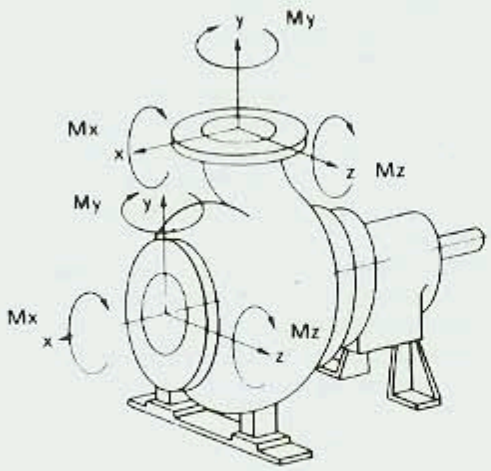
When starting precision units of this type it is particularly important to protect the running fits from abrasive matter present in new piping.

A screen should be placed in the suction line as close to the suction nozzle as possible. The strainer must have a net area at least three times the area of the suction pipe.

A differential gauge can be used to monitor the strainer and allow the pump to be shut down before the debris blocks the strainer such that the pump is damaged. At this point the strainer should be cleaned and reinstalled, when the scale and dirt have been removed from the system as shown by no further changes in pressure or pressure drops across the screen the strainer may be removed.

The strainer should be used for at least 24 hours under normal temperature conditions before removal.

Pump Nozzle Loading
(For Fully-Grouted Metallic Bedplates Only)



Values given are for forces or moments acting alone at the suction or discharge flange. In combination forces and moments must be reduced so that:

$$\frac{Fxd}{Fxd_{max}} + \frac{Fyd}{Fyd_{max}} + \frac{Fzd}{Fzd_{max}} + \frac{Mxd}{Mxd_{max}} + \frac{Myd}{Myd_{max}} + \frac{Mzd}{Mzd_{max}} \leq$$

$$\frac{Fxs}{Fxs_{max}} + \frac{Fys}{Fys_{max}} + \frac{Fzs}{Fzs_{max}} + \frac{Mxs}{Mxs_{max}} + \frac{Mys}{Mys_{max}} + \frac{Mzs}{Mzs_{max}} \leq 1.0$$

PUMP		Forces-Lbs.			Moments-Ft. Lbs.		
		Fx	Fy	Fz	Mx	My	Mz
1½ x 1 x 6	Suction	810	500	500	380	690	690
	Disch.	100	300	180	320	400	320
3 x 1½ x 6	Suction	870	520	520	380	690	790
	Disch.	120	400	220	340	420	350
3 x 2 x 6	Suction	740	450	680	610	730	730
	Disch.	250	800	400	390	460	380
1½ x 1 x 8	Suction	810	510	500	380	730	720
	Disch.	90	300	180	330	400	330
3 x 1½ x 8	Suction	890	560	550	950	700	790
	Disch.	180	600	400	500	440	360
3 x 2 x 8	Suction	1000	580	620	610	1000	1000
	Disch.	330	700	350	620	730	610
4 x 3 x 8 4 x 3 x 8L	Suction	880	530	800	700	980	890
	Disch.	310	870	500	700	880	730
2 x 1 x 10	Suction	1000	730	730	610	1200	1200
	Disch.	530	850	530	610	160	1000
3 x 1½ x 10	Suction	930	590	570	650	1090	1090
	Disch.	380	610	400	500	790	540
3 x 2 x 10	Suction	900	560	580	700	1040	1040
	Disch.	370	640	400	600	800	660
4 x 3 x 10 4 x 3 x 10L	Suction	900	570	800	800	910	910
	Disch.	310	820	500	700	890	730
6 x 4 x 10	Suction	700	600	800	800	930	920
	Disch.	370	900	500	700	900	750
3 x 1½ x 13	Suction	820	520	510	650	920	910
	Disch.	340	540	400	500	800	660
3 x 2 x 13	Suction	950	600	600	700	1180	640
	Disch.	400	920	400	600	1330	880
4 x 3 x 13	Suction	970	600	700	650	1180	700
	Disch.	400	820	500	650	1470	800
6 x 4 x 13	Suction	1210	770	770	910	1180	1570
	Disch.	320	900	500	930	1130	930
8 x 6 x 13	Suction	1170	2510	2500	2410	1250	1250
	Disch.	810	1310	810	2410	1250	2500
10 x 8 x 13	Suction	1170	2420	2410	2410	1250	1500
	Disch.	970	1560	970	2410	1250	3000
8 x 6 x 15	Suction	1170	2380	2370	2410	1250	1500
	Disch.	540	870	530	2410	1250	3000
10 x 8 x 15	Suction	1170	2110	2100	2410	1250	1600
	Disch.	780	1260	780	2410	1250	3250

I. Preliminary Alignment

Correct alignment of the pump and driver is of the utmost importance. Pump-Driver combinations are aligned at the factory, but bedplates may be distorted in shipment, and misalignment may occur due to unequal tightening of foundation bolts or pipe strain. It is therefore essential that alignment be checked, as listed below, before the pump is put in service.

1. Check that the pump shaft is level and parallel to the bedplate. Use the cradle foot adjustment screw(s) and/or shims as necessary.

2. Check that the foundation and pump hold-down bolts are tight.

3. Connect the suction and discharge piping as described in Section II.H PIPING.

4. Check for binding by rotating the pump by hand.

5. With most couplings it is more convenient to check alignment with the hubs installed on the shaft, therefore install the hubs.

6. Check OFFSET alignment by laying a straight edge across the coupling halves at 90 degree intervals and measure misalignment with a feeler gage. For the pre-startup alignment the vertical offset alignment must be adjusted to allow for the expansion due to temperature of the pump and driver:

Vertical Cold Alignment Settings

Pumped Fluid Temp.	Set Driver Shaft
Up to 200 deg F	.005" (.12mm) below pump shaft
200 to 250 deg F	equal to pump shaft
Above 250 deg F	.005" (.12mm) above pump shaft

CAUTION: Do not adjust the pump or bearing housing foot to obtain alignment.

Move the Driver from side to side or remove shims from under the DRIVER FEET until the OFFSET alignment is within .002" (.05mm) TIR of the recommended vertical cold alignment and .002" (.05mm) TIR side to side as shown in Figure 3. Maintain the correct distance between shafts.

7. Check ANGULAR misalignment using an inside micrometer, feeler gage or calipers and measure the coupling separation at 90 degree intervals on the outer diameter of the faces on the coupling hubs. Move the Driver and shim as necessary until ANGULAR alignment is within .002" (.05mm) TIR as shown in Figure 4.

8. Recheck OFFSET alignment. Continue to move the DRIVER and adjust the DRIVER SHIMS until both OFFSET and ANGULAR alignment are within the above limits.

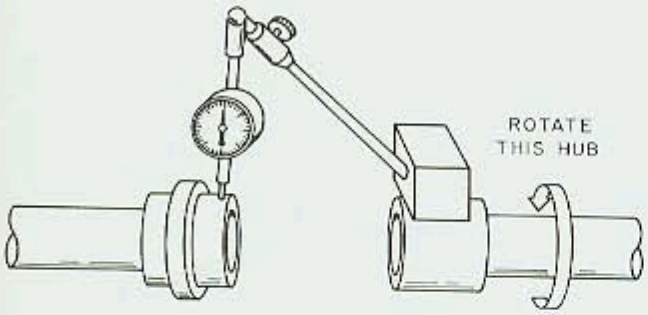


Figure 3

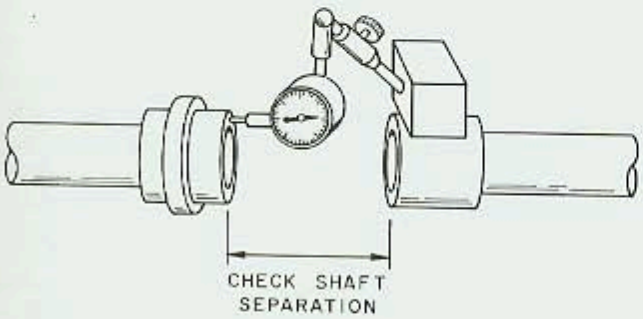


Figure 4

J. Check Rotation

CAUTION: Check driver rotation. Serious damage to the pump can result if it is rotated in the wrong direction. The correct rotation is cast in the pump casing.

K. Coupling and Guard

1. Connect the coupling per the manufacturer's instructions.
2. Install the coupling guard.

WARNING: This pump must not be operated unless an approved coupling guard is in place. Failure to observe this warning could result in personal injury to operating personnel.

L. Stuffing Box

Packing

If packing is used, it should in general be the softest that can be employed in the service in which the pump is operating. Ingersoll-Dresser Pump Company supplies standard packing as follows:

TFE IMPREGNATED SYNTHETIC FIBERS—For Acids, Caustic, General Petroleum, Water, and General Service.

TEFLON—For liquids which must not be contaminated.

Under normal service conditions, the stuffing box taps are plugged and the packing lubricated by leakage of the liquid through the packing.

If severe conditions necessitate, the packing may be lubricated by clear liquid, or grease injected into the stuffing box.

A special smothering gland may be substituted for the conventional gland for quenching leakage of toxic vapors or steam through a packed box. This gland must be connected to a source of quenching liquid, usually clear water, at low pressure and low flow.

Pumps using packing must be packed before the unit is put into service. A complete set of packing cut to proper lengths is included with other loose parts in the shipping crate. Packing is to be installed in the following manner.

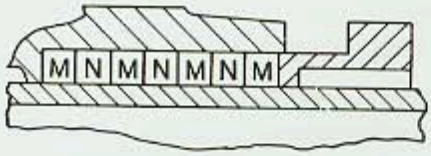
Soft Packing

1. Remove the gland and thoroughly clean the stuffing box and shaft.
2. Insert two rings into the stuffing box by twisting the rings sideways, placing them over the shaft and pushing them firmly into the bottom of the box and stagger the joints 90 degrees on succeeding rings. Insert the seal cage and make certain it falls in relative alignment with the lubricating hole in the stuffing box. Insert remaining rings of packing to fill the stuffing box.
3. After the last ring is in place, replace the gland, and draw up the nuts evenly until snug; then back off the nuts and tighten them again with the fingers only. This will permit the slight amount of leakage necessary to properly lubricate the packing.

NOTE: Packing glands must never be tightened to the point where leakage from the packing is stopped. A small amount of leakage is required for lubrication of the packing. Shutting off leakage flow from the packing will result in burned packing and scored shaft sleeves.

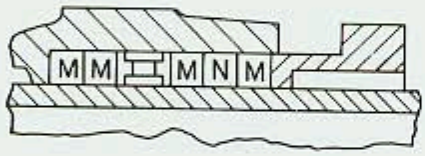
Metallic Packing

1. Remove the gland and thoroughly clean the stuffing box and shaft.
2. Dip each ring in heavy cylinder oil and insert two rings ahead of the seal cage. Lightly caulk each ring and stagger the joints of succeeding rings. Insert the seal cage and make certain it falls in relative alignment with the lubricating hole in the stuffing box. Insert remaining rings of packing after the seal cage, as necessary, to fill the stuffing box. Pack the box in accordance with Figure 5.
3. After the last ring of packing is installed, replace the gland and draw up the nuts evenly and snug.



PACKED SOLID

PUMPS WITH
ODD NUMBER OF RINGS



WITH SEAL CAGE

PUMPS WITH
ODD NUMBER OF RINGS

① FIRST AND LAST RINGS ARE ALWAYS [M]

② [M] = METALLIC PACKING
[N] = NON-ASBESTOS PACKING

Figure 5

NOTE: Only clean cool pumpage should be injected into the seal cage. If the pumpage is dirty or hot an external source must be utilized, unless the bypass is equipped with proper separator, filter, and/or cooling system, which must be piped into the stuffing box connection.

Mechanical Seals

On pumps supplied with mechanical seals a variety of manufactures types and styles are available for the different types of service and application. When mechanical seals are supplied they have been installed and adjusted before the pump was shipped.

Single Seals

All seals must not be run dry or in abrasives. A variety of seal piping plans designed to suit certain pumping conditions and liquids are available, refer to the General Arrangement Drawing for details on any required connections that need to be made before operation of the pump.

Double Seals

All double seals require external lubrication under all conditions. In all cases, make certain the temperature of the liquid injection into the seal gland does not exceed 115 degrees F and that its pressure is 15 to 20 PSI greater than the stuffing box pressure. Refer to stuffing box pressure chart, Figure 6, for exact values. Injection liquid should be free of dissolved solids.

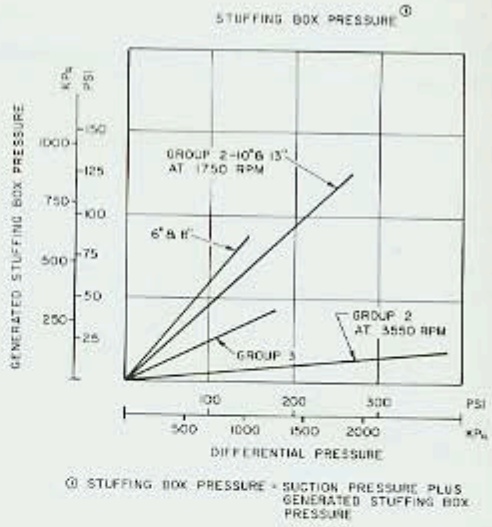


Figure 6

Stuffing Box Cooling

The seal chamber should be cooled when pumpage temperatures exceed mechanical seal temperature limits. A cooled jacketed stuffing box with plan 11 seal flushing will reduce seal chamber temperature approximately 100 degrees F. The cooling jacket with a dead ended seal chamber (no flush into the seal) will reduce the temperatures as shown on Figure 7. To provide greater cooling (150 degrees F) with a continual flush a separate flush line and heat exchanger should be used. The cooling jacket should be used in conjunction with all cooling systems. Refer to the General Arrangement Drawing for size and location of required connections.

NOTE: Cooling jacket must be vented when not in use.

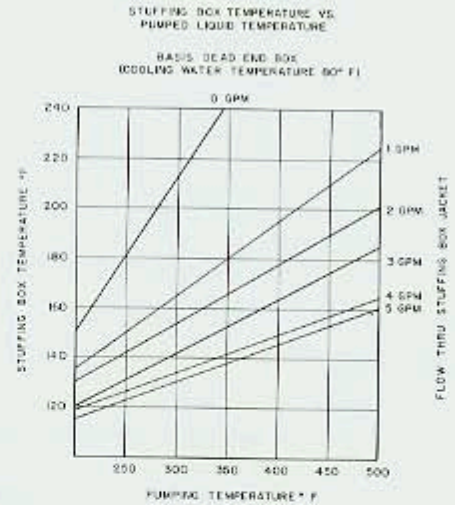


Figure 7

M. Auxiliary Piping

Depending upon the service in which the pump is used, it may be necessary to make lubricating and/or cooling, heating or smothering liquid line connections to the pump. Refer to the General Arrangement Drawing for orientation of auxiliary connections.

III. Pre-Starting Checks and Operation

A. Checklist

1. LUBRICATION:
   DRIVER
   PUMP
2. IMPELLER RUNNING CLEARANCE
3. ON-THE-BENCH IMPELLER SETTING
4. STARTING THE PUMP
5. OPERATING CHECKS
6. TROUBLE CHART
7. TECHNICAL DATA:
   THROTTLING-MINIMUM FLOW
   NET POSITIVE SUCTION HEAD (NPSH)
   PARALLEL OPERATION
   CHANGING PUMP SPEED
   EFFECTS OF VISCOSITY
   EFFECTS OF SPECIFIC GRAVITY

B. Lubrication

Driver

Prepare the driver for operation as instructed by the driver manufacturer. After wiring, make certain the direction of shaft rotation corresponds to that indicated by the directional arrow on the pump casing. This must be done with coupling disconnected.

WARNING: The driver rotation must be checked before making up coupling. Actual damage to the equipment and personal injury could result from operating the unit with wrong rotation.

When the pump is motor-driven see that the voltage and frequency on the motor and control nameplate correspond with the line voltage. Check all connections to the motor and control with the wiring diagram.

All ball bearing motors that have grease fittings and plugs near the bearing are to be lubricated in accordance with motor manufacturer lubrication instructions.

Pump

When oil lubricated bearings are furnished, the pumps are shipped with the bearing housings empty of oil.

A good quality mineral oil which is non-detergent, and has anti-rust and anti-oxidant additives should be used to fill the bearing housing. The grade of oil should be ISO VG100 (between SAE grade 30 and 40). Typical good oils include Gulf Harmony 100 and Mobil DTE Heavy.

The pump is fitted with a constant-level oiler so that the oil will be maintained at the proper level. For the correct oil level to be maintained, the oiler must be locked at the elevation corresponding to the oil level mark on the bearing housing. A vent is furnished for venting the housing. The oil capacity of the bearing housing needed to give the correct oil elevation is given in Table 1.

Remove transparent oil reservoir from the oiler. Remove the vent cap, fill the bearing housing through the vent connection until the oil level in the oiler cup reaches the middle of the oil level bar on the bearing housing. Fill the transparent oil reservoir and install. Slowly raise the reservoir, locking it in place when the first air bubble enters.

Refer to figure 8.

WARNING: Operation of the unit without proper lubrication can result in overheating of the bearings, bearing failures, pump seizures, and actual breakup of the equipment exposing operating personnel to personal injury.

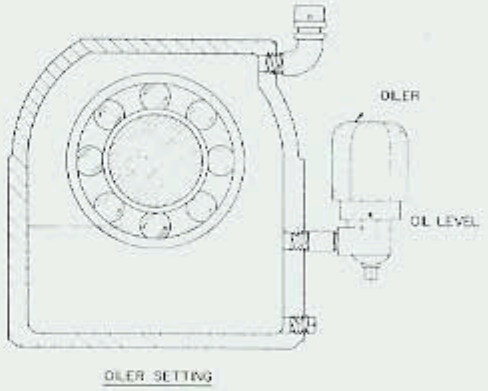


Figure 8

Oil is always subject to gradual deterioration from use and contamination from dirt and moisture. In time, the accumulated sludge will be harmful to the bearing and cause premature wear. For this reason, draining and flushing are necessary at regular intervals. Refer to instructions under "MAINTENANCE" section of this book.

Oil Mist Lubrication

There are two methods of oil mist lubrication:

One method is called Pure Mist (Dry Sump). In this method the bearing housing is empty of oil. The oil mist is introduced into optional connections provided when specified outboard of the bearings and allowed to pass thru the bearings and out the bearing housing drain, which must be kept open. Provisions must be made to remove the oil which accumulates at the drain from the oil mist. Refer to figure 9.

The other method is a Purge Mist (Wet Sump) system.

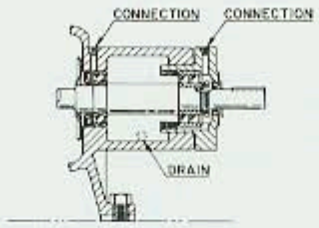
In this method the bearing housing is filled with oil as in normal lubricated construction (complete with constant level oiler). Oil Mist is introduced into the bearing housing thru the vent connection to provide an oil mist environment for the exposed bearing surfaces.

Due to the contact lip seals used at the ends of the bearing housing additional piping and bearing housing modifications are required and it is suggested to consult with others (such as Alemite) before installing or operating a Purge Mist (Wet Sump) system.

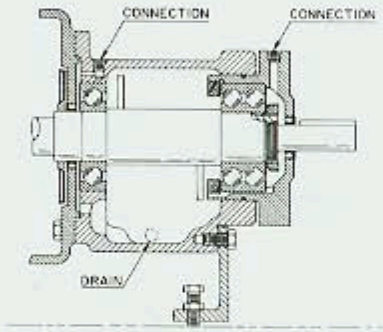
With both methods it is suggested to fill the bearing housing with oil to the top and drain just before operation and to run the oil mist system for several hours before starting the pump. This soaks the bearing housing with oil which reduces the amount of time required to establish oil mist equilibrium in the bearing housing which is required for proper operation.

Table 1
APPROXIMATE OIL CAPACITIES

Group 1 Pumps	Group 2 Pumps	Group 3 Pumps
1.0 Pints	3.0 Pints	7.0 Pints



GROUP 1 – OIL-MIST CRADLE



GROUP 2 – OIL-MIST CRADLE

Figure 9

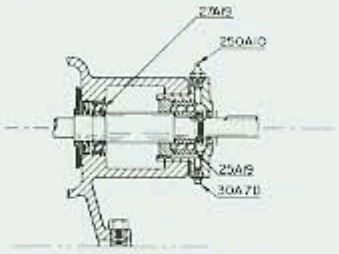
Std. Grease Lubricated Bearings

When standard grease lubricated bearings are furnished, the radial bearing (Part 27A19) is a double shielded, factory-packed grease bearing, and needs no attention for the life of the bearing. The thrust bearing (Part 25A19) is of re-greasable design. The bearing is greased at the factory, but it is suggested to re-grease the bearing before starting the unit so as to insure proper lubrication. Refer to grease lubrication instructions on page 15 and Figure 10 below.

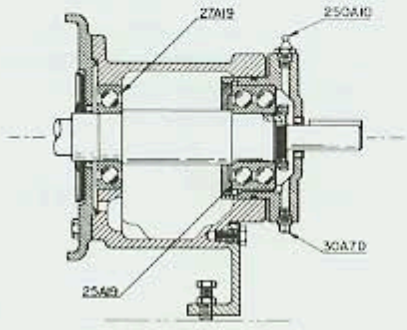
A moisture-resistant, lithium-base grease of number 2 consistency should be used. Typical good greases include: Texaco Premium RB, Chevron SRI #2, and Esso Ronex MP.

Greased-For-Life Bearings

When greased-for-life bearing construction is furnished, there will be no lubrication fittings furnished on the pumps. No further attention needs to be paid to the bearings.



GROUP 1 - GREASE LUBE CRADLE



GROUP 2 - GREASE LUBE CRADLE

Figure 10

C. Impeller Running Clearance

NOTE: Numbers in parentheses are illustration numbers which correspond to the appropriate cross-section drawing or exploded-view drawing in section VI.

To set running clearances between the impeller and casing, follow this procedure:

(A) Loosen jam nuts (23A4) and capscrews (36A2) on the bearing end cover (0573).

(B) Move the bearing end cover and shaft assembly forward by tightening (sequentially) the bolts (35A2B) in the bearing end cover until the impeller contacts the casing. (By rotating the shaft every so often while tightening the bolts, it can be determined when the impeller contacts the casing.)

(C) Tighten (by hand) the capscrews (36A2) until they rest snugly against the face of the bearing housing. (Do not force).

(D) Loosen the bolts (35A2B) one full turn each.

(E) Tighten each of the capscrews (36A2) 2 flats for Group 1 and Group 2 pumps, or 3 flats for Group 3 pumps.

(F) Tighten the jam nuts (23A4) against the bearing end cover.

(G) Tighten the bolts (35A2B).

(H) Rotate shaft by hand thru at least one complete revolution to make sure there are no rubs or binds. With feeler gages, check to make sure that the gap between the bearing end cover and the face of the bearing housing is equal all around within .003".

NOTE: An addition procedure should be followed to ascertain that the proper impeller running clearance is obtained.

After step (C), measure (with feeler gage) the gap between the bearing end cover and the face of the bearing housing. To this measurement, add .014" for Group 1 pumps, .016" for Group 2 pumps, and .024" for Group 3 pumps. This should equal the gap measured after step (E).

The optimum impeller running clearance for Group 1 and 2 pumps is .010" to .012", and .020" to .023" for Group 3 pumps. Since the rotor could have up to .002" axial end play the settings listed above will result in running clearance within optimum.

D. On-The-Bench Setting of Impeller Running Clearances

Depending on user preference it is sometimes desired to "pre-set" the impeller-to-casing running clearance while the pump rotor is in the shop being worked on. This allows the mechanical seals to be properly positioned and set in the shop, so no field adjustments have to be made. The assembled, pre-adjusted cradle assembly may then be taken to the pump site and installed in the casing which has been left in the line.

This procedure will result in pre-set impeller clearances within .010" of optimum. This will not affect mechanical seal settings when final, field setting of impeller clearance is done.

The following table gives the dimension from the bare gasket surface of the stuffing box cover to the face of the impeller. This procedure does not apply to the Group 2 6x4x13 pump and all Group 3 pumps.

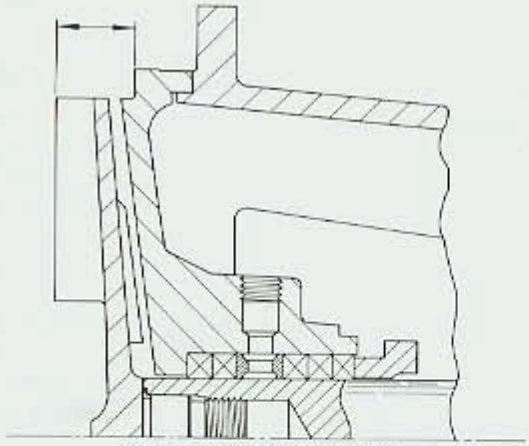


Figure 11

Pump Size	Setting
1½ x 1 x 6	.733
3 x 1½ x 6	.873
1½ x 1 x 8	.776
3 x 2 x 6	1.109
3 x 1½ x 8	.867
3 x 2 x 8	.952
4 x 3 x 8	1.143
4 x 3 x 8L	1.363
2 x 1 x 10	.680
3 x 1½ x 10	1.019
3 x 2 x 10	1.086
4 x 3 x 10	1.201
4 x 3 x 10L	1.502
6 x 4 x 10	2.152
3 x 1½ x 13	1.067
3 x 2 x 13	1.172
4 x 3 x 13	1.294

E. Starting the Pump

After all pre-starting checks have been performed, the pump is ready to start. Observe the following procedure to put the pump into operation.

1. Rotate the pump by hand through at least one complete revolution to see that all parts are free. It is possible that pipe strains or extreme rough handling during shipment may have caused binding. If so, the piping should be disconnected and source of pipe strain found and eliminated. Bolts holding the pump casing, supporting head and suction pipe should be loosened and the parts shifted until the binding is eliminated. Re-check coupling alignment.

2. Prime the pump. This may be accomplished by using a foot valve in the suction pipe and filling the suction line and casing with fluid. Pumps operating under a suction lift may be primed by an ejector or exhaustor placed on the discharge piping. The unit is self venting.

CAUTION: Before starting or while operating the pump, the casing and suction line must be completely filled with the liquid being pumped. The rotating parts depend on this liquid for lubrication and the pump may seize if operated without liquid.

3. Investigate the source of liquid supply, and see that the discharge line is properly arranged to handle the liquid pumped. When starting the pump for the first time, and always when there is no pressure in the discharge line, close the gate valve in the discharge line.

4. If the stuffing box is externally lubricated, open the seal valve to allow liquid to flow into the box. If an external seal and/or water-cooled casing cover and/or smothering gland is used, taps should be connected to a cool liquid source of sufficient pressure to provide an adequate flow. Pipe tap requirements are indicated on the pump general arrangement drawing.

If the stuffing box is grease sealed, inject grease until resistance is felt.

5. If the pump is to handle hot liquid, open the suction valve to allow a very slight flow of liquid into the pump casing, thereby heating the pump slowly and evenly. Open the suction valve wide before starting.

CAUTION: When pump is handling heavy viscous liquid, the viscosity of the liquid must allow it to be pumped easily. Liquid may have to be heated prior to starting the pump.

6. Start the driver. Bring pump up to speed quickly so interal parts receive lubrication.

7. As soon as the pump is up to rated speed, open the discharge valve slowly to avoid abrupt changes in velocity and surging in the suction line. Do not operate the pump against a closed discharge valve for any length of time or the liquid in the pump will be heated until it vaporizes. This will cause the pump to seize or lose suction.

8. With pumps that are packed it is important to keep the gland as loose as possible without undue leakage, for packing lubrication. A normal leakage rate is between 20-30 drops/minute. A tight gland will cause excessive packing and shaft sleeve wear, and also increase power consumption.

9. After the unit has operated for a short time, all pressure bolting should be gone over for tightness. Also check coupling alignment and impeller running clearance.

F. Operating Checks

WARNING: In the interest of operator safety the unit must not be operated above the nameplate conditions. Such operation could result in unit failure causing injury to operating personnel. Consult instruction book for proper operation and maintenance of the pump and its supporting components.

1. Check frequently to make certain lubricating liquid flow to the stuffing box, jacketed stuffing box cover (if used) is adequate.

2. Make certain that liquid is always being discharged from the pump. If not, the pump may seize. A discharge pressure gauge is the best method to check whether or not liquid is being pumped. If the gauge should drop to zero or register abnormal pressure, shut down the pump immediately and determine the cause.

3. If your pump is equipped with a packed box, a slight amount of leakage through the packing is required to cool and lubricate the packing. Adjust the gland for proper leakage of 20-30 drops per minute.

4. Bearings will run at a constant temperature, depending on the air temperature at the location (normal operating temperature will be 140 to 180 degrees F based on 80 degree ambient temperature). Check the oil level and refill the constant-level oiler, when used as required. If bearing temperature exceeds 200 degree F, the pump should be shut down and the cause of the overheating located.

WARNING: Operation of the unit without proper lubrication can result in overheating of the bearings, bearing failures, pump seizures and actual breakup of the equipment exposing operating personnel to personal injury.

WARNING: The unit must not be operated unless coupling guard is in place. Failure to observe this warning could result in personal injury to operating personnel.

G. Throttling the Pump

If conditions require operating the pump at reduced capacity, this must be done by throttling (or partly closing) the discharge valve. Never throttle the suction line.

CAUTION: When operating for some time at reduced capacity, much of the pump horsepower will go into the liquid in the form of heat. A bypass must be provided under these conditions to prevent the liquid in the pump from becoming hot enough to vaporize.

Always maintain sufficient flow through the pump to prevent flashing of the liquid passing through the pump. At low flows, a large proportion of the horsepower input is absorbed by the liquid as heat, and the flow must be maintained at a point sufficient to keep the temperature rise thru the pump within a safe limit.

CAUTION: Damage to pump may result from prolonged operations at reduced capacities.

In addition to heat rise considerations for minimum flow, there is also a minimum flow requirement for mechanical protection of the pump. Damage to the pump may occur at reduced capacities due to increased hydraulic thrust loads. These higher loads cause increased vibration and shaft deflection, and decreased mechanical seal and bearing life.

Also encountered at low flows is the damage which could be done by erosive swirl. At low flows, much of the pumped liquid is recirculated through the pump. This can result in localized damage to the pump by erosive action, particularly when pumping light slurries or "dirty" liquids.

Both heat rise and mechanical protection must be considered when determining correct minimum flow. HOC Pumps have been designed to operate at low flows without problems due to hydraulic thrust; however, the table on page 13 lists minimum flows required for satisfactory operation and pump life. The figures listed are percent flow of the best efficiency point of the impeller diameter required for the application.

H. Stopping the Pump

1. If the packing or mechanical seal is lubricated from an external source, do not shut off the lubricating liquid supply until after the unit is shut down.
2. If a check valve is installed in the discharge line, the pump may be shut down by merely stopping the driver. If a check valve is not installed in the discharge line, shut down the pump by closing the discharge valve, after which the driver is to be stopped immediately.
3. It is good practice to close the suction valve if the pump is to be shut down for an extended period of time.
4. When the pump is idle and there is a possibility of freezing the casing plug should be removed and the casing drained.
5. If pumps are on hot service and are put on standby, keep cooling liquid on.

I. Trouble Chart

TROUBLE CHART

If any of the following troubles are encountered, they may be due to the causes listed below

No Liquid Delivered:
1. Pump not primed.
2. Speed too low-check voltage and frequency.
3. Air leak in suction or stuffing box.
4. Discharge head too high.
5. Suction lift too high.
6. Impeller or discharge line plugged up.
7. Wrong direction of rotation.
8. Discharge valve closed.

Not Enough Liquid Delivered:
1. Air leaks in suction or stuffing box.
2. Speed too low-check voltage and frequency.
3. Suction lift too high.
4. Impeller or discharge line partially plugged.
5. Not enough suction head for hot liquid.
6. Total head too high.
7. Pump defects:
   a. Excessive impeller running clearance.
   b. Damaged or clogged impeller or casing.
8. Suction not submerged.
9. Wrong direction of rotation.

Not Enough Pressure:
1. Speed too low-check voltage and frequency.
2. Wrong direction of rotation.
3. Air or gas in liquid.
4. Leaks in suction.
5. Pumps defects:
   a. Excessive impeller running clearance.
   b. Impeller diameter too small.
   c. Damaged or clogged impeller or casing.

Pump Works for a While, Then Loses Suction:
1. Leaky suction line.
2. Liquid seal plugged.
3. Suction lift too high.
4. Air or gas in liquid.
5. Air leaks in suction or at stuffing box.
6. End of suction line uncovered.

TROUBLE CHART (continued)

Motor Runs Hot:
1. Pump taking too much power.
   a. Speed too high.
   b. Head lower than rating allowing pump to handle too much liquid.
   c. Liquid heavier and more viscous than rating.
   d. Pump defects:
      1. Excess impeller running clearance.
      2. Stuffing boxes too tight.
      3. Rotor binding.
2. Electrical defects:
   a. Voltage and frequency lower than rating.
   b. Defects in motor.

Vibration:
1. Starved suction:
   a. Gas or vapor in the liquid.
   b. Available NPSH not sufficient.
   c. Inlet to suction line not sufficiently submerged.
   d. Gas or vapor pocket in suction line.
2. Misalignment.
3. Worn or loose bearings.
4. Rotor out of balance.
5. Shaft bent.
6. Impeller plugged or damaged.

Stuffing Boxes Overheat:
1. Packing too tight.
2. Packing not sufficiently lubricated.
3. Wrong grade of packing.
4. Box not properly packed.

Bearings Overheat:
1. Oil level too low.
2. Improper or poor grade of oil.
3. Dirt or water in bearings.
4. Misalignment.

Bearings Wear Rapidly:
1. Misalignment.
2. Shaft bent.
3. Vibration.
4. Lack of lubrication.
5. Bearing improperly installed.
6. Moisture in oil.
7. Dirt in bearings.

J. Technical Data

Minimum Flow for Mechanical Protection

Refer to "Throttling the Pump" section on page 12 for explanation on use of chart.

Pump Size	Min. Flow (%)	Pump Size	Min. Flow (%)
1½ x 1 x 6	10	4 x 3 x 10	25
3 x 1½ x 6	10	4 x 3 x 10L	25
3 x 2 x 6	10	6 x 4 x 10	25
1½ x 1 x 8	10	3 x 1½ x 13	15
3 x 1½ x 8	10	3 x 2 x 13	20
3 x 2 x 8	10	4 x 3 x 13	25
4 x 3 x 8	20	6 x 4 x 13	25
4 x 3 x 8L	20	8 x 6 x 13	25
2 x 1 x 10	10	10 x 8 x 13	30
3 x 1½ x 10	10	8 x 6 x 15	25
3 x 2 x 10	15	10 x 8 x 15	30

Net Positive Suction Head (NPSH)

Any liquid, hot or cold, must be pushed into the impeller of the pump by some absolute pressure, such as the atmosphere or the vessel pressure from which the pump takes its suction.

The head in feet of liquid necessary to maintain the required flow into the pump is called the Net Positive Suction Head. This value, more commonly called NPSH, is measured above the vapor pressure of the liquid at the pumping temperature.

NPSH is commonly expressed in two ways: the NPSH required by the pump, and shown on the pump curve, is the head needed to cover the losses in the pump suction: the NPSH available is that inherent in the system, taking into account friction loss in suction piping, valves, fittings, etc. In all cases, the NPSH available, measured above vapor pressure, must exceed the NPSH required in order to push the liquid into the pump.

Changing Pump Speed

Changing the speed of a centrifugal pump affects the capacity, total head, NPSH required and the brake horsepower. In general the capacity will vary in a direct ratio with the speed, whereas the total head and NPSH required will vary as the ratio of the speed squared. The brake horsepower will vary as the ratio of the speed cubed.

Effects of Viscosity

The pump is designed to deliver rated capacity at rated head for a liquid with a particular viscosity. When the pump is handling heavy viscous liquid, the viscosity of the liquid must allow it to be pumped easily. Liquid may have to be heated prior to starting of pump.

When contemplating operation at some viscosity other than that for which the pump was originally designed, the changed conditions should be referred to the nearest Ingersoll-Dresser Pump Company Branch Office for their recommendations.

Effects of Specific Gravity

The capacity and total head in feet of liquid developed by a centrifugal pump are fixed for every point on the curve and are always the same for the same speed. Neither capacity nor total head will be affected by a change in the specific gravity of the liquid pumped. However, since the discharge pressure in PSI(pounds per square inch) and the brake horsepower required to drive the pump are functions of the specific gravity of the liquid, both will be affected in direct proportion by any change in specific gravity.

Therefore, an increase in specific gravity will raise the discharge pressure and is dangerous, as it might overload the pump's driver, or exceed the pump casing allowable pressure.

IV. Maintenance

WARNING: Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of operating rotating equipment. Such action could result in injury to operating personnel.

Before attempting any inspection or repair on the pump the driver controls must be in the "off" position, locked and tagged to prevent injury to personnel performing service on the pump.

A. Preventive Maintenance

Ingersoll-Dresser Pump Company pumps are ruggedly constructed, and with proper care will give years of satisfactory service. It is recommended that operating personnel become familiar with "Operating Checks" described previously in this book, and that these checks be made as a matter of routine.

Periodically, depending upon your service schedule, the unit should be dismantled, and all internal parts and passages cleaned and inspected for wear.

Foreign matter found in any pump should be removed, and all excessively worn parts replaced.

Ingersoll-Dresser Pump Company assumes no responsibility or liability for damages caused by the use and failure of the pump which has been fitted with spare or repair parts not of Ingersoll-Dresser Pump Company manufacture. Only genuine parts from Ingersoll-Dresser Pump Company or an authorized distributor should be used.

The following is a list of normal maintenance procedures that might be performed between major overhauls.

B. Replacing Packing

When packing becomes worn to the extent that leakage cannot be controlled within desirable units, it is advisable to re-pack the stuffing box.

Remove the nuts securing the gland, and remove or pull gland back out of the way. With the aid of a hook, pull the packing and seal cage(if used) from the stuffing box.

Thoroughly clean the stuffing box, and inspect the shaft sleeve before re-packing. Leakage may be due to a worn sleeve requiring replacement.

Refer to previous instructions in "Stuffing Box" on page 7.

C. Replacement of Mechanical Seal

Mechanical seals should be checked, particularly during the first hours of operation. Minor leakage through the seal usually stops after a short time; however,if it continues, stop the pump and examine the seal. Excessive leakage past a mechanical seal usually indicates worn or broken parts, which require replacement.

To replace a mechanical seal, the pump must be dismantled (See Disassembly). The stationary part of a seal must be removed from the gland and replaced by a new part.

Remove the gland gasket, thoroughly clean the gland and replace the gasket.

Remove seal from shaft sleeve and inspect sleeve (if furnished).

To re-set new inside or double seals, pre-assemble the pump rotor complete less seal and gland. Adjust rotor per the "on-the-bench" impeller clearance instructions on page 10. Scribe the shaft sleeve or shaft(if sleeveless)at the location of the face of the stuffing box.

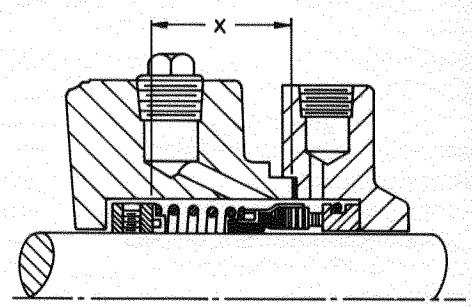
Remove impeller and stuffing box cover, and mark dimension(see appropriate "X" dimension in "Seal Types and Settings" section) on the shaft sleeve (or shaft). Locate seal at this position, but do not snugly tighten set screws until shaft sleeve is installed on shaft. Install gland, then shaft sleeve with seal. Tighten seal set screws. Reassemble rest of rotor.

Outside seals are set by completely building the rotor (including seal and gland), and adjusting rotor per instructions. Set and secure seal per appropriate "X" dimension.

For seals other than those shown, refer to seal drawings supplied with unit.

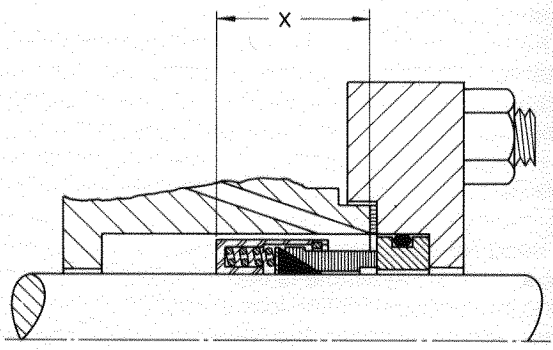
D. Seal Types and Settings

With John Crane Type 1 with plain glands (no flush tap connection located on the gland), the setting is automatic since the seal is located against a shoulder on the sleeve. For other types of seals set seal per "X" below or refer to seal drawing included with unit.



Crane Type 1

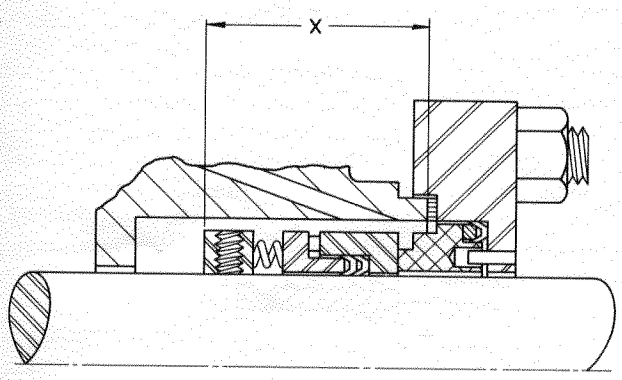
Seal Size	1⅛	1⅞	2⅛	2⅜
"X"	1.12	1.56	1.56	2.00



"X" Dim for Crane Seals

Seal Size	Gland Style	9T "x"	9BT "x"
1⅛	Plain	.94	1.31
	Flush	.50	.88
1⅞	Plain	1.31	1.69
	Flush	.81	1.19
2⅛	Plain	1.69	2.06
	Flush	1.19	1.38
2⅜	Plain	1.62	2.00
	Flush	1.19	1.56

NOTE: Maximum Gland Nut Torque:
5ft-lbs Group 1
10ft-lbs Group 2
12ft-lbs Group 3



"X" Dim for Dura Seals

Seal Size	Gland Style	RO/RO-TT *"x"	PT/PTO "x"	CRO-P "x"
1⅛	Plain	1.66	1.84	1.41
	Flush	1.22	1.41	.97
1⅞	Plain	1.81	2.06	1.62
	Flush	1.31	1.56	1.12
2⅛	Plain	1.59	2.12	1.41
	Flush	1.09	1.62	.91
2⅜	Plain	1.53	2.12	1.34
	Flush	1.09	1.69	.91

*Basis RO/RO-TT seals with .25" long springs. If replacement seals have .50" long springs add .25" to "x" dim.

E. Bearing Lubrication

On pumps furnished with oil-lubricated bearings, check the bottle on the constant-level oiler periodically to be sure there is an adequate supply of oil.

The oil in the bearing housing should be changed every 1000 hours, or sooner if the operating conditions or pump environment dictates. Before filling with new oil, flush the bearing housing with a hot, light oil, rotating the pump shaft by hand to remove dirt and contaminants.

Refill the bearing housing through the vent connection, using a good quality mineral oil which is non-detergent, and has anti-rust and anti-oxidant additives. The grade of oil should be ISO VG 100 (between SAE grade 30 and 40). Typical good oils include: Gulf Harmony 100 and Mobil DTE Heavy.

Refer to previous instructions under "Lubrication" on Page 9 for proper setting of the constant-level oiler.

Pumps furnished with grease lubricated bearings require re-greasing of the thrust bearing (Part 25A19) at 4000 hours intervals. A moisture-resistant, lithium-based grease of number 2 consistency should be used. Typical good grease include: Texaco premium RB, Chevron SRI#2, and Esso Ronex MP.

Grease should be added while the pump is running. Since over-lubrication is as harmful as under-lubrication, the plug in the bottom of the bearing end cover should be removed when adding grease. Let the pump run awhile with the plug removed to allow excess grease to be expelled.

Periodically, the bearings should be thoroughly cleaned to remove old grease and contaminents. This generally can be done at the time the pump is torn down for major overhauls.

The radial bearing (Part 27A19) is factory-sealed and lubricated-for-life, and needs no further attention.

F. Overhaul Instructions

The back withdrawal feature of the pump enables the complete unit to be dismantled without disturbing the pump casing and piping.

Shut off valves controlling fluid flow to and from the pump. Drain casing. Drain bearing housing.

Disconnect any seal piping, and any cooling services that might be supplied to either the stuffing box cover or cradle.

WARNING: Before attempting to disassemble pump, pump must be isolated from system, drained of liquid and cooled, if pump is handling hot liquid.

Again make certain the driver control is in the off position, locked, and tagged.

When pump is handling "caustic" liquid, extreme care must be taken to ensure safety of personnel when attempting to drain pump. Protective devices of suitable protective materials must be worn when draining pump.

G. Disassembly

Remove coupling spacer piece.

Remove bolts from main casing flange.

By use of jacking screws the complete rotating unit can now be withdrawn from the casing.

Remove gland nuts and withdraw gland onto shaft. If the unit has a packed box, remove packing and lantern ring.

Secure shaft and unscrew impeller counter-clockwise when looking into the impeller. Be careful not to damage the surface of the impeller.

Remove bolts holding the support head to the stuffing box cover and withdraw stuffing box cover.

Remove shaft sleeve (if supplied), seal and flinger.

To dismantle shaft assembly, remove bolts holding the end cover to the bearing housing.

The complete shaft assembly can now be withdrawn.

To remove the thrust bearing unscrew locknut (NOTE: LOCKNUT IS LEFT HAND THREADED) and withdraw end cover. The bearing can then be removed after removing bearing locknut and washer.

The dismantling of the support head from the bearing housing should not generally be necessary.

H. Cleaning and Inspection

Discard all gaskets, O-rings, packing, and lip seals since new parts are recommended for re-assembly.

Ingersoll-Dresser Pump Company assumes no responsibility or liability for damages caused by the use and failure of the pump which has been fitted with spare or repair parts not of Ingersoll-Dresser Pump Company manufacture. Only genuine parts from Ingersoll-Dresser Pump Company or an authorized distributor should be used.

All parts must be clean before reassembly. This is especially important at O-ring grooves, threads, radial fit contact areas, and gasket surfaces.

Wash all parts in solvent and dry with compressed air or lint free cloths. Carry out the inspection procedure described below.

Inspect the impeller vanes and back ribs for wear, erosion, burrs, or scoring. Large nicks and deep pitting will unbalance the impeller and may cause vibration and excessive wear, on other parts of the pump. Check and clean the impeller threads and O-ring seating surface.

Check surface of shaft sleeve (if supplied) for scoring and scratches, particularly on packed box units.

Make certain that the sleeve end is clean where the O-ring and impeller are located.

The stuffing box bore must be inspected and thoroughly cleaned. Make certain that there are no deep scratches. If necessary, clean the gland studs.

Check also the seal cage and seal flush openings, making sure that all foreign matter has been removed from the threads and drilled passages. Examine the radial fit for burrs, etc.

Check shaft for straightness (on rollers positioned at bearing diameters). Shaft runout should be no more than .001″. Check that surfaces are free from scores, wear and corrosion. The shoulder against the impeller and shaft sleeve should be carefully checked. Impeller threads should be clean and undamaged. On the opposite end, the keyway should be undamaged, and the key should fit snugly.

Inspect surface of gland that contacts packing to be sure that it is clean and smooth. On mechanical seal glands, remove old gasket material and check inside diameter of glands.

Inspect casing thoroughly, removing all burrs and foreign matter. Check hydraulic passages for cleanliness, particularly behind the splitter in the volute area (on pumps so equiped).

I. Pump Reassembly

CAUTION: It is important that, if bearing replacement is required, the new bearings installed be of the brand and construction as specified in this section. Despite manufacturers' claims, there is a difference in load-carrying capacity and life characteristics between different brands of manufacturers.

Only FAG, New Departure, or MRC are approved as suppliers of double row bearings for this pump.

Assemble the double row bearing on the shaft so that the filling slots of the bearing faces the impeller end of the shaft. Refer to Figure 12.

The bearing end cover must be free of fins or burrs. Make sure of proper bore finish and that the shoulder at the bottom of the bore is clean and undamaged.

Insert bearing (assembled on shaft) into the bearing end cover, making sure it is firmly bottomed against shoulder. The bearing should be .000″ to .002″ loose fit on the outer race when fitted into the bearing end cover.

Re-install the locknut (NOTE: LOCKNUT IS THREADED LEFT HANDED) into the bearing end cover. Refer to Figure 13.

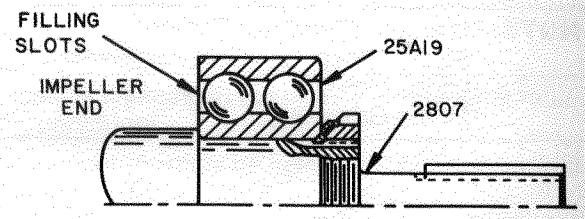


Figure 12

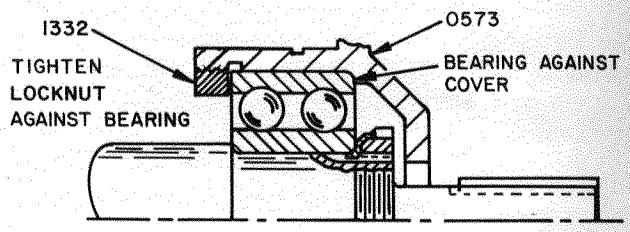


Figure 13

For the optional duplex bearing,install the bearings back to back. Insert duplex bearings into bearing end cover.Re-install the locknut into the bearing end cover (NOTE: LOCKNUT IS THREADED LEFT HANDED). Tighten the locknut against the bearing and then back off such that a .005″ feeler gage fits between the bearing and locknut at at least three places. Then tighten setscrew thru end cover into locknut to prevent it from loosening. Refer to Figure 14.

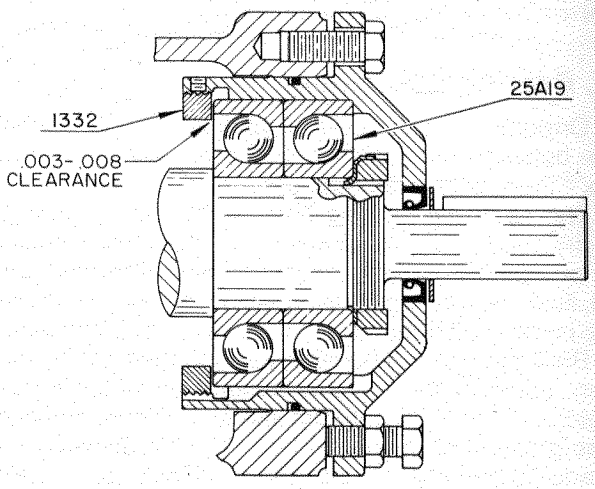


Figure 14

Position O-ring on outside of bearing end cover making certain that it is not twisted and then position shaft assembly into bearing housing. Check shaft end play which should be .003″ or less (.008 on duplex bearings).

Bolts holding bearing housing to end cover should be finger tightened. Assemble and install bolts and jamnuts.

If the support head had been removed, place gasket into position and bolt on support head.

Replace lip seals in support head and bearing end cover.

Position flingers shaft.

Position seal stationary face in gland (Mechanical Seal only) and place gland on shaft.

Place shaft sleeve(if provided) on shaft. Position mechanical seal. (See "Replacement of Mechanical Seal" Page 14).

Assemble stuffing box cover and support head.

Position O-ring and screw on impeller. Take care that O-ring does not get torn.

Check complete rotating assembly per Figure 15 before installing in casing. If dial indicator readings exceed limits shown, individual components will need to be checked out to find cause of excessive readings.

Position main gasket and bolt on pump casing.

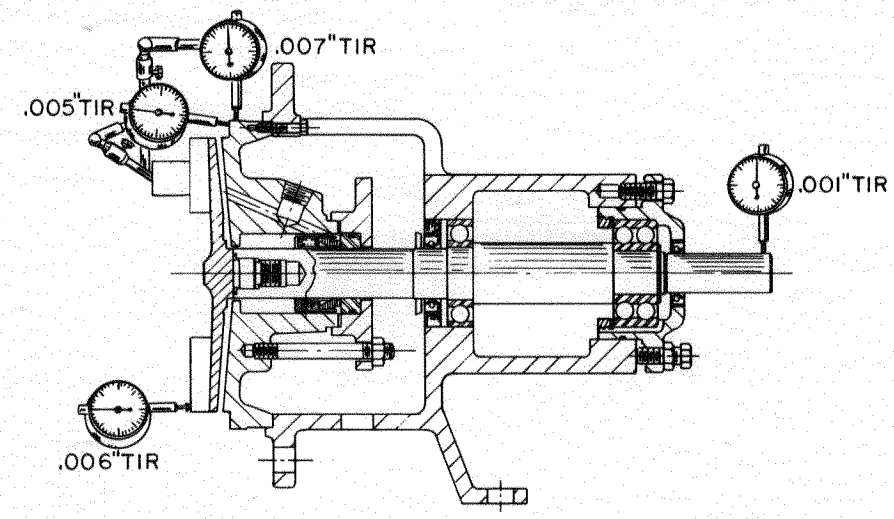
Bolt on gland (mechanical seal version) or pack stuffing box (see "Stuffing Box" Page 7).

Set impeller running clearance (See "Impeller Running Clearance" Page 10).

Use the following table for recommended torque values (unless instructed otherwise in this book).

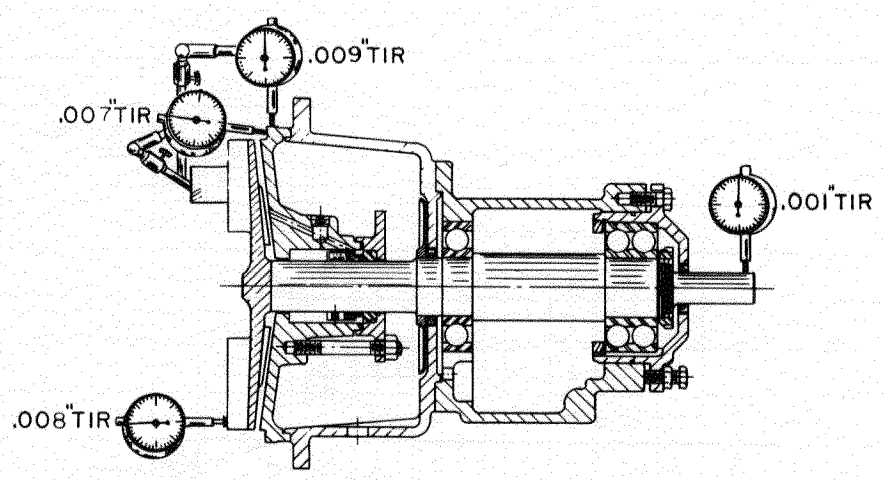
Fastener Size:	¼	⅜	½ **Studs**	½ **Bolts**	¾
Torque (Foot-Pounds)	4	12	45	30	100

NOTE: Torque values are based on well-lubricated threads. Twice as much torque might have to be applied if unlubricated fasteners are used.



COMPLETE ROTATING ASSEMBLY

GROUP I



COMPLETE ROTATING ASSEMBLY

GROUP 283

Figure 15

V. Ordering Instructions

BY GIVING COMPLETE INFORMATION YOU WILL ENABLE US TO FILL YOUR ORDER CORRECTLY AND AVOID UNNECESSARY DELAYS

A. How to Order Replacement Parts

When ordering replacement parts, please specify:

1. The SIZE & TYPE and SERIAL NUMBER as stamped on the PUMP nameplate. (The size is the numerical prefix to the Type.)
2. The FORM NUMBER of this booklet. Form SPAD-187.
3. The QUANTITY.
4. The PART NUMBER AND DESCRIPTION exactly as listed.

EXAMPLE

4 X 3 X 8 HOC Serial No. 0587-5001
Form SPAD-187 1-Casing-2469 1-Impeller-1129

B. How to Select Recommended Spares

Each Parts List shows the parts which are included in each of the following three classes of recommended spares:

CLASS 1—MINIMUM—Suggested for Domestic Service when pump is handling clean noncorrosive liquids and where interruptions in service are not important.

CLASS 2—AVERAGE—Suggested for Domestic Service when pump is handling abrasive or corrosive liquids and where some interruptions in continuity of service are are not objectionable.

CLASS 3—MAXIMUM—Suggested for Export, Marine, or Domestic Service where interruptions in service are objectionable.

Our sales Representative in your area will gladly review the class of spares best suited to meet your requirements.

When ordering recommended spares, please follow the procedure as outlined for replacement parts.

HOC2 Interchangeability

	Group 1			Group 2															Group 3			
	1.5 x 1 x 6	3 x 1.5 x 6	1.5 x 1 x 8	3 x 2 x 6	3 x 1.5 x 8	3 x 2 x 8	4 x 3 x 8	4 x 3 x 8L	2 x 1 x 10	3 x 1.5 x 10	3 x 2 x 10	4 x 3 x 10	4 x 3 x 10L	6 x 4 x 10	3 x 1.5 x 13	3 x 2 x 13	4 x 3 x 13	6 x 4 x 13	8 x 6 x 13	10 x 8 x 13	8 x 6 x 15	10 x 8 x 15
Casing	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Casing Cover	1	1	2	3	4	4	4	4	5	5	5	5	5	5	6	6	6	7	8	8	9	9
Main Gasket	1	1	2	1	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6	6
Impeller	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Support Head				1	2	2	2	2	3	3	3	3	3	3	4	4	4	5	6	6	7	7
Shaft Sleeve	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Gland	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Flinger	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	4	4	4	4
Brg Housing	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Shaft	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Brg End Cover	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Radial Brg	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Thrust Brg	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Imp O-Ring	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Lip Seal-Pump End	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Lip Seal-Cplg End	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3

Engineering Information

	Pump Size		1.5 x 1 x 6	3 x 1.5 x 6	1.5 x 1 x 8	3 x 2 x 6	3 x 1.5 x 8	3 x 2 x 8	4 x 3 x 8	4 x 3 x 8L	2 x 1 x 10	3 x 1.5 x 10	3 x 2 x 10	4 x 3 x 10	4 x 3 x 10L	6 x 4 x 10	3 x 1.5 x 13	3 x 2 x 13	4 x 3 x 13	6 x 4 x 13	8 x 6 x 13	10 x 8 x 13	8 x 6 x 15	10 x 8 x 15
	Group:		1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
PUMP DATA	Suction Flange		1.5	3	1.5	3	3	3	4	4	2	3	3	4	4	6	3	3	4	6	8	10	8	10
	Discharge Flange		1	1.5	1	2	1.5	2	3	3	1	1.5	2	3	3	4	1.5	2	3	4	6	8	6	8
	Max. Imp. Dia.	3550 RPM	6.25	6.25	8.00	6.25	8.50	8.50	8.50	8.00	9.88	10.75	10.75	10.75	9.75	8.00	12.25	12.00	10.00	N/A	N/A	N/A	N/A	N/A
		1750 RPM	6.25	6.25	8.00	6.25	8.50	8.50	8.50	8.50	9.88	10.75	10.75	10.75	10.75	10.75	13.25	13.25	13.25	13.00	13.25	13.25	15.00	15.00
	Imp. Eye Area (Sq In)		2.76	4.68	3.14	6.51	4.91	6.47	11.79	11.84	3.54	7.06	8.61	12.56	12.56	23.75	7.07	8.30	15.07	28.27	50.20	58.50	50.20	65.50
	Max. Sphere Size		.39	.53	.46	.57	.50	.59	.78	.81	.23	.48	.58	.70	.91	1.02	.49	.57	.87	1.00	1.00	1.12	.94	1.25
	Wr Sq. (Less Motor) Ft-Lbs Sq		.10	.11	.30	.14	.38	.46	.52	.55	.95	1.10	1.10	1.30	1.35	1.80	2.60	2.90	3.20	4.50	6.00	8.10	10.20	12.00
CASING DATA	Imp. Clearance—Front		.010	.010	.010	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.015	.020	.020	.020	.020
	Casing Thickness		.32	.32	.32	.32	.32	.32	.35	.35	.35	.35	.38	.38	.38	.44	.44	.44	.44	.44	.56	.56	.56	.56
	Corrosion Allowance		.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
	Aux Connections (NPT)	Drain	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
		Disch. Gage	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38
		Suct. Gage	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38
SUFFING BOX DATA	Sleeve O.D.		1.125	1.125	1.125	1.875	1.875	1.875	1.875	1.875	1.875	1.875	1.875	1.875	1.875	1.875*	1.875	1.875	1.875*	1.875	2.375	2.375	2.375	2.375
	Stuffing Box Bore		1.750	1.750	1.750	2.625	2.625	2.625	2.625	2.625	2.625	2.625	2.625	2.625	2.625	2.625**	2.625	2.625	2.625**	2.625	3.250	3.250	3.250	3.250
	Depth of Box		2.06	2.06	2.06	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	3.56	3.56	3.56	3.56
	Dist. to 1st Obstruction		1.91	1.91	1.91	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	3.69	3.69	3.69	3.69
	Packing Size (Sq)		.31	.31	.31	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.44	.44	.44	.44
	Packing Arrangement		2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	3-C-3	3-C-3	3-C-3	3-C-3
	Width of Seal Cage		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.75	.75	.75	.75
	Box & Gland Conn. (NPT)		.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38
SHAFT AND BEARING DATA	Diameter at Impeller		.62	.62	.62	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.62	1.62	1.62	1.62
	Diameter Under Sleeve		.88	.88	.88	1.62	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.56	2.56	2.56	2.56
	Diameter at I.B. BRG		1.18	1.18	1.18	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.56	2.56	2.56	2.56
	Diameter at O.B. BRG		.98	.98	.98	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.56	2.56	2.56	2.56
	Diameter between Bearings		1.31	1.31	1.31	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	3.00	3.00	3.00	3.00
	Bearing Span		4.00	4.00	4.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	9.88	9.88	9.88	9.88
	Diameter at Coupling		.88	.88	.88	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12***	1.12	1.12	1.12***	1.12	2.38	2.38	2.38	2.38
	Bearing Number—Inboard		206	206	206	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	313	313	313	313
	Bearing Number—Outboard		5305	5305	5305	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5311	5313	5313	5313	5313
	Impeller Overhand		5.81	5.97	6.44	8.00	7.65	7.62	7.75	7.92	7.84	7.75	7.84	7.94	8.12	8.50	7.75	8.00	8.00	8.03	10.38	10.56	10.38	10.56
	1st Critical Speed		12175	11364	6226	17523	15625	13992	13393	13273	13393	11943	11943	10965	10845	10653	9817	9282	10417	7353	7211	6168	6356	5823
	Oil Capacity (Pints)		1.0	1.0	1.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	7.0	7.0	7.0	7.0

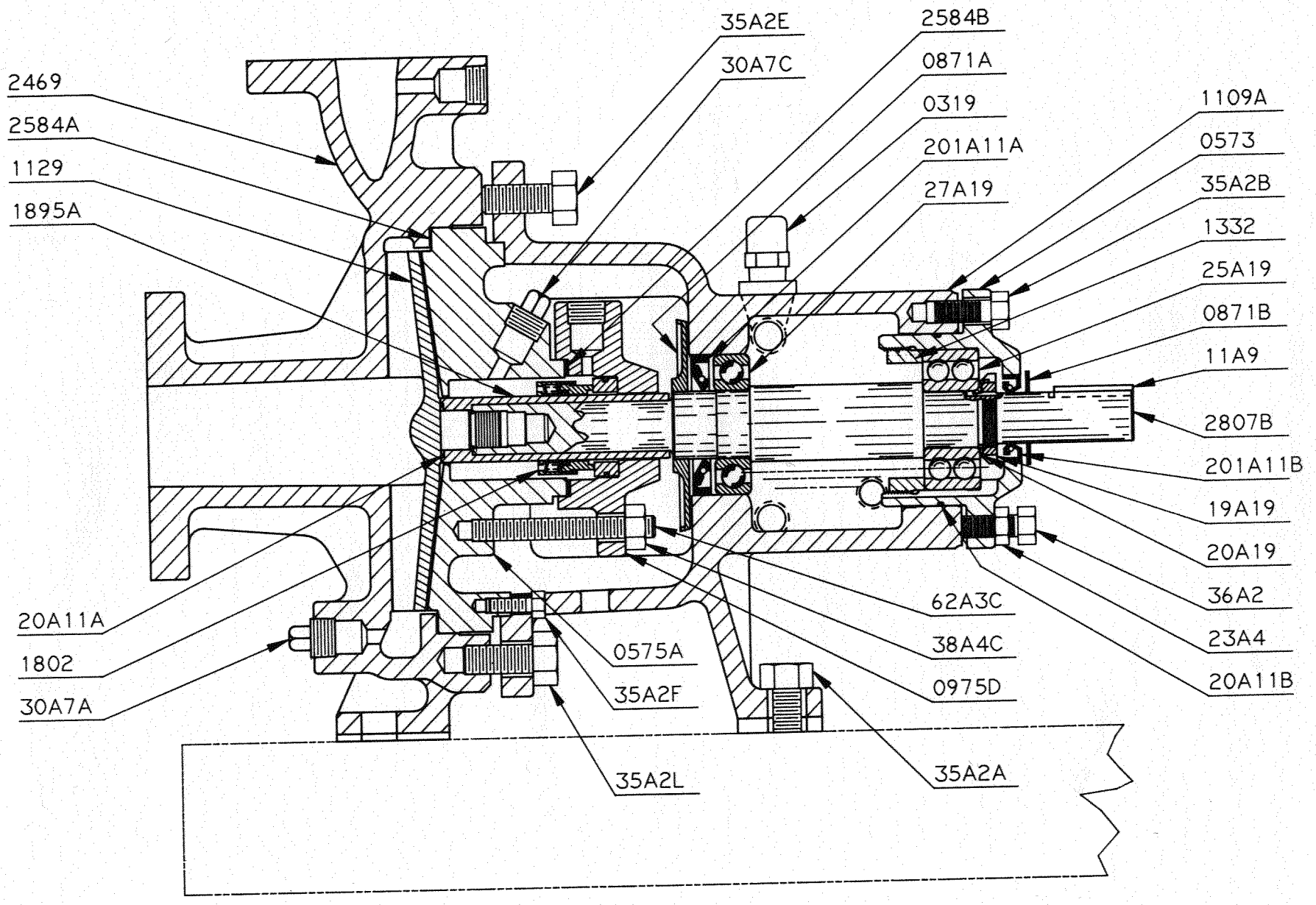
*6x4x10 & 4x3x13—2.12 at 3550 RPM
**6x4x10 & 4x3x13—2.94 at 3550 RPM
***6x4x10 & 4x3x13—1.62 at 3550 RPM

All Dimensions in Inches (Unless Otherwise Specified)

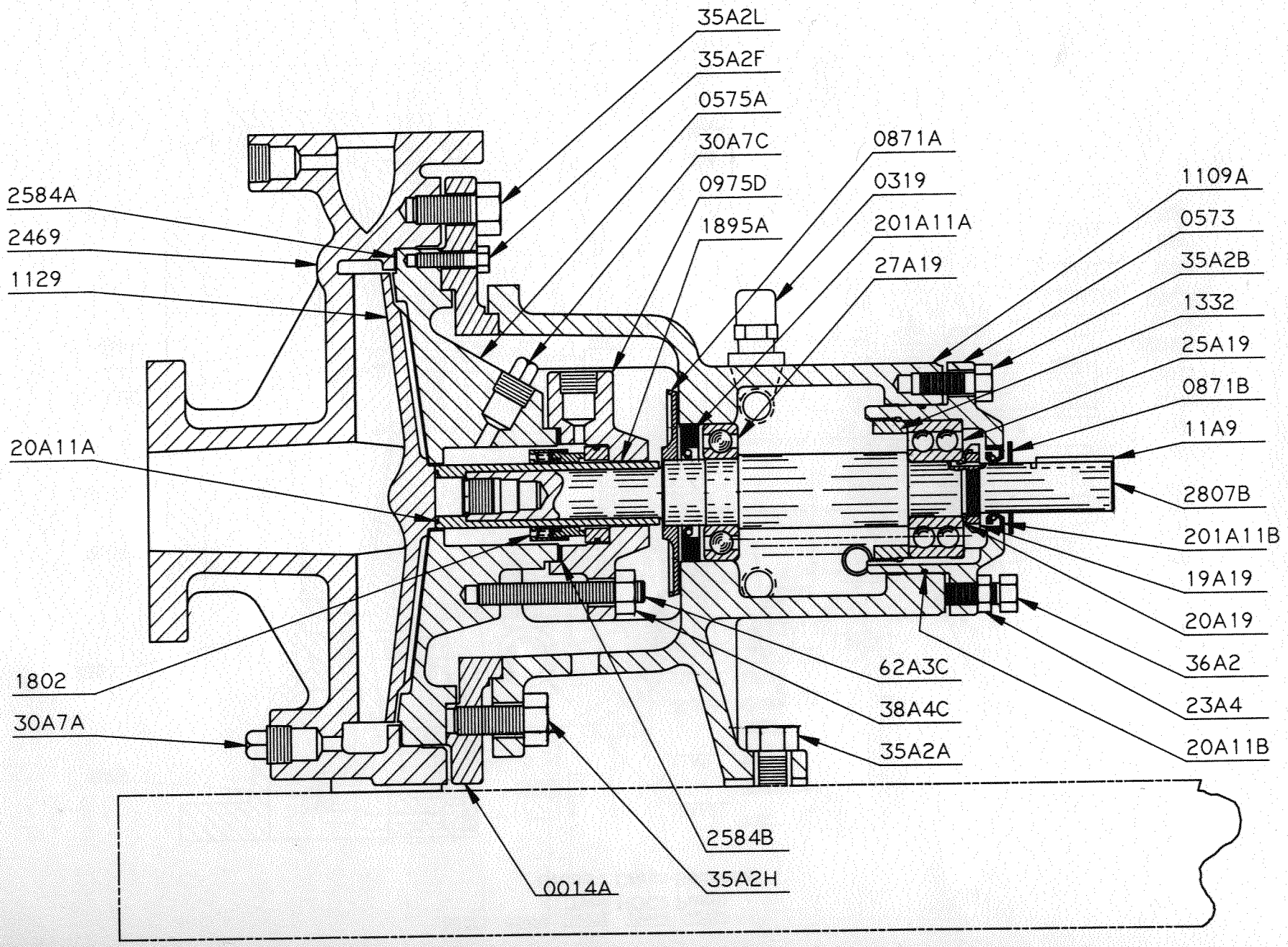
BHP Limits

Group	BHP/100 RPM	3550	2900	1750	1450	1180	970	880
Group 1	.57	20	16.5	10	8	7	5.5	4
Group 2	3.66	130	110	65	53	43	35.5	32
Group 2A	4.22	150	122	75	61	50	41	37
Group 3	12.36			220	179	146	120	109

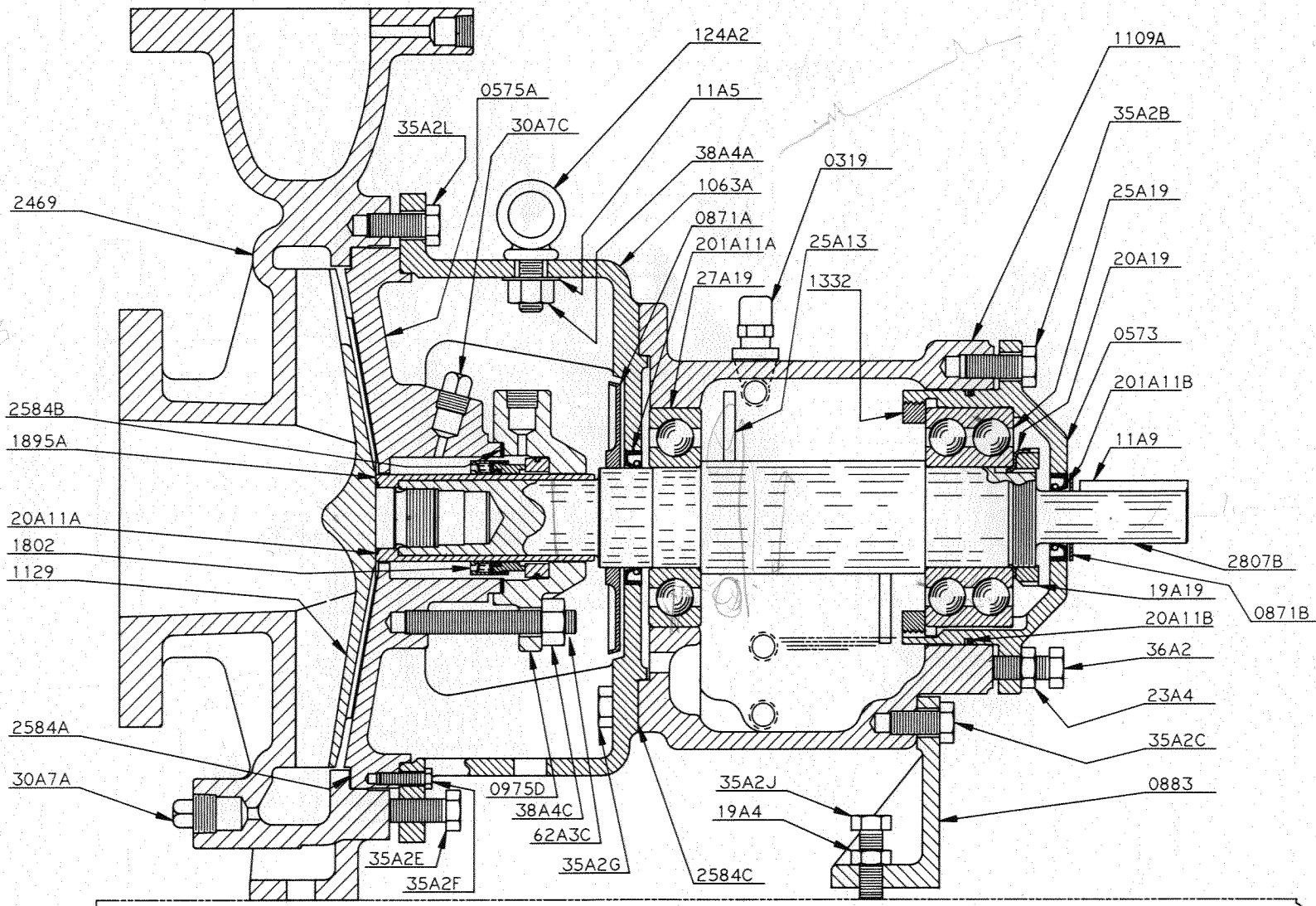
Type HOC2 Pump
Group 1 Cross-Sectional



Type HOC2 Pump
1½ × 1 × 8 Cross-Sectional

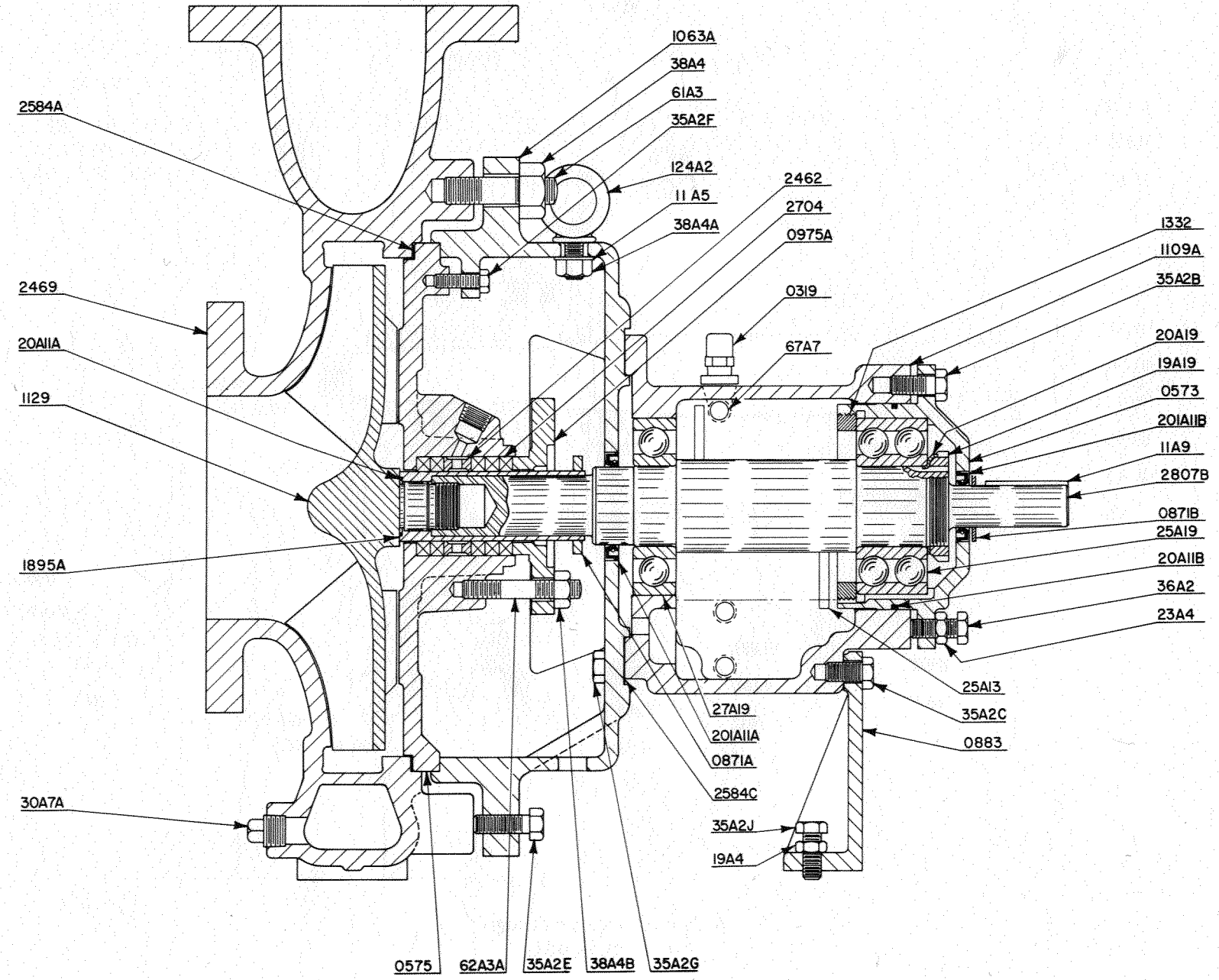


Type HOC2 Pump
Group 2 Cross-Sectional

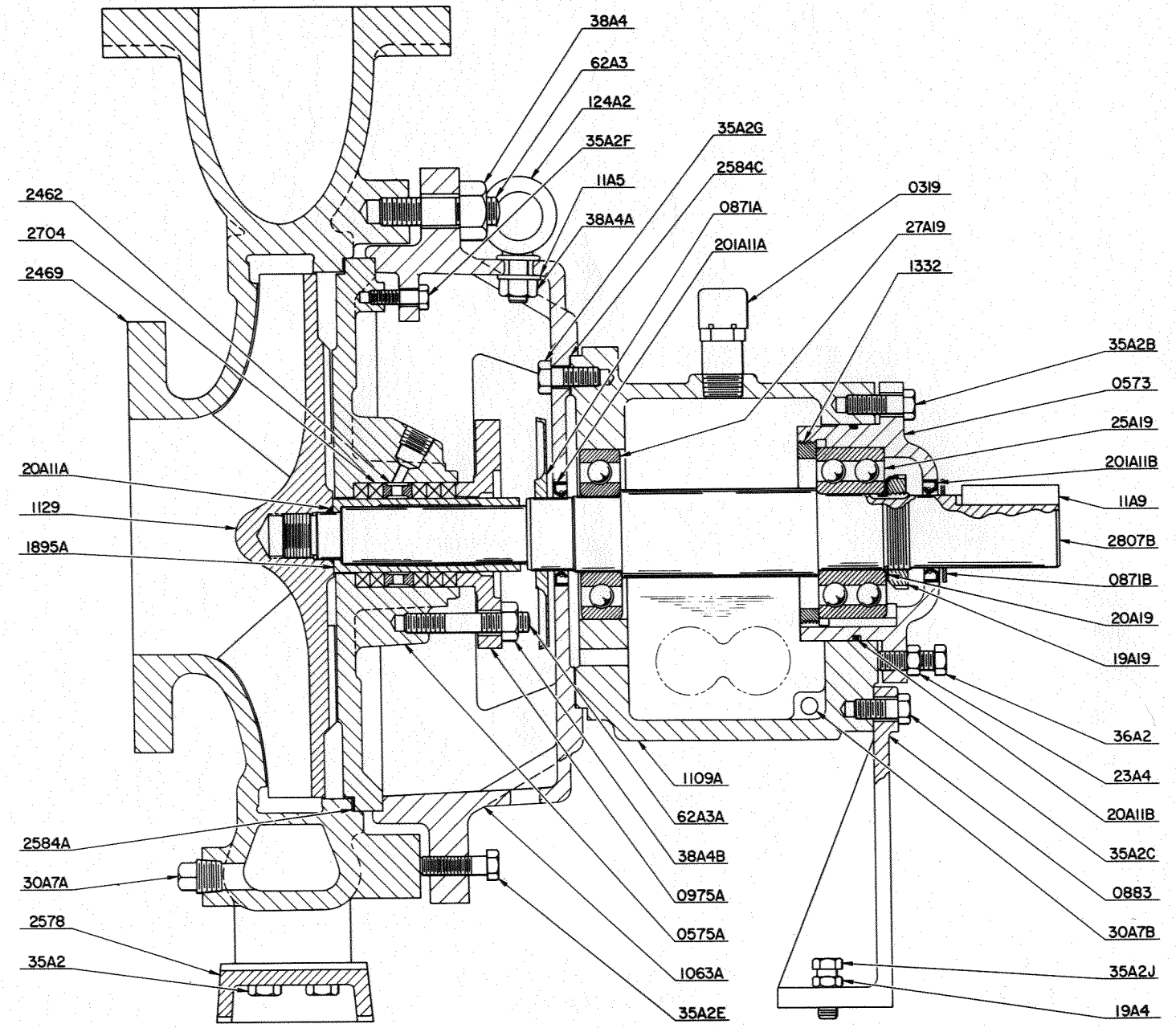


PATENT 4466508 APPLIES

Type HOC2 Pump
6 × 4 × 13 Cross-Sectional

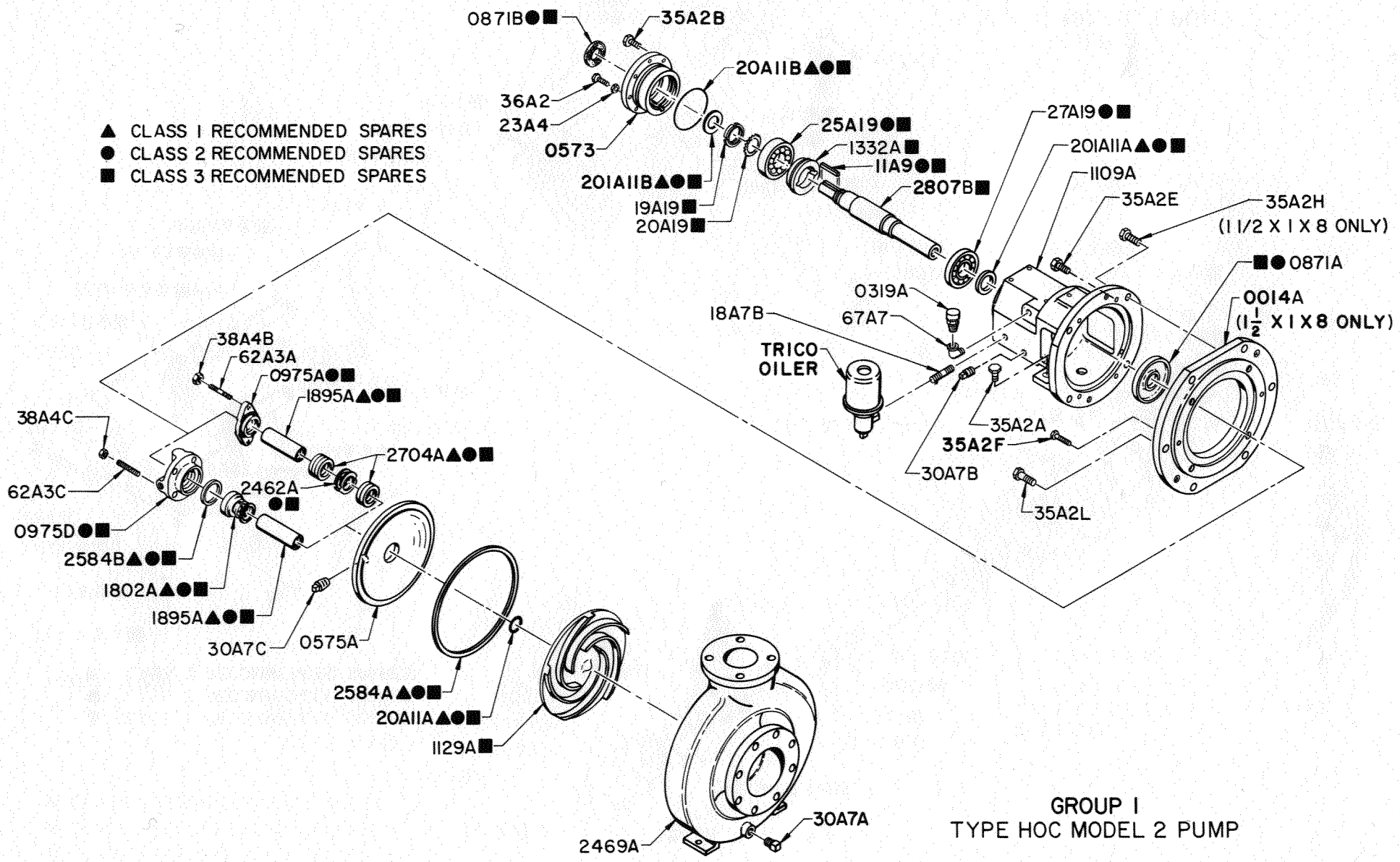


Type HOC2 Pump
Group 3 Cross Sectional



Type HOC2 Pump
Group 1 Exploded Parts Drawing

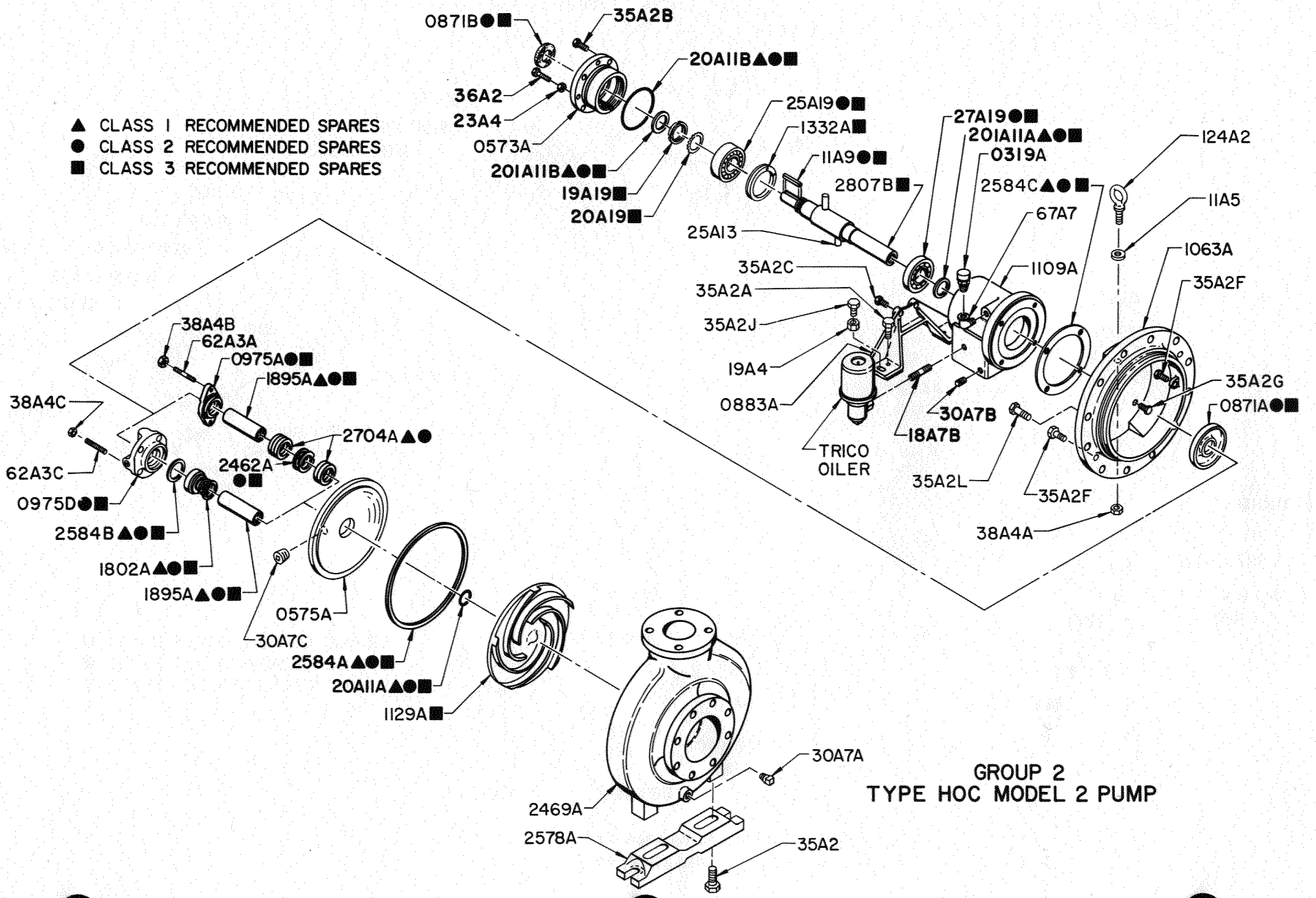
▲ CLASS 1 RECOMMENDED SPARES
● CLASS 2 RECOMMENDED SPARES
■ CLASS 3 RECOMMENDED SPARES



GROUP 1
TYPE HOC MODEL 2 PUMP

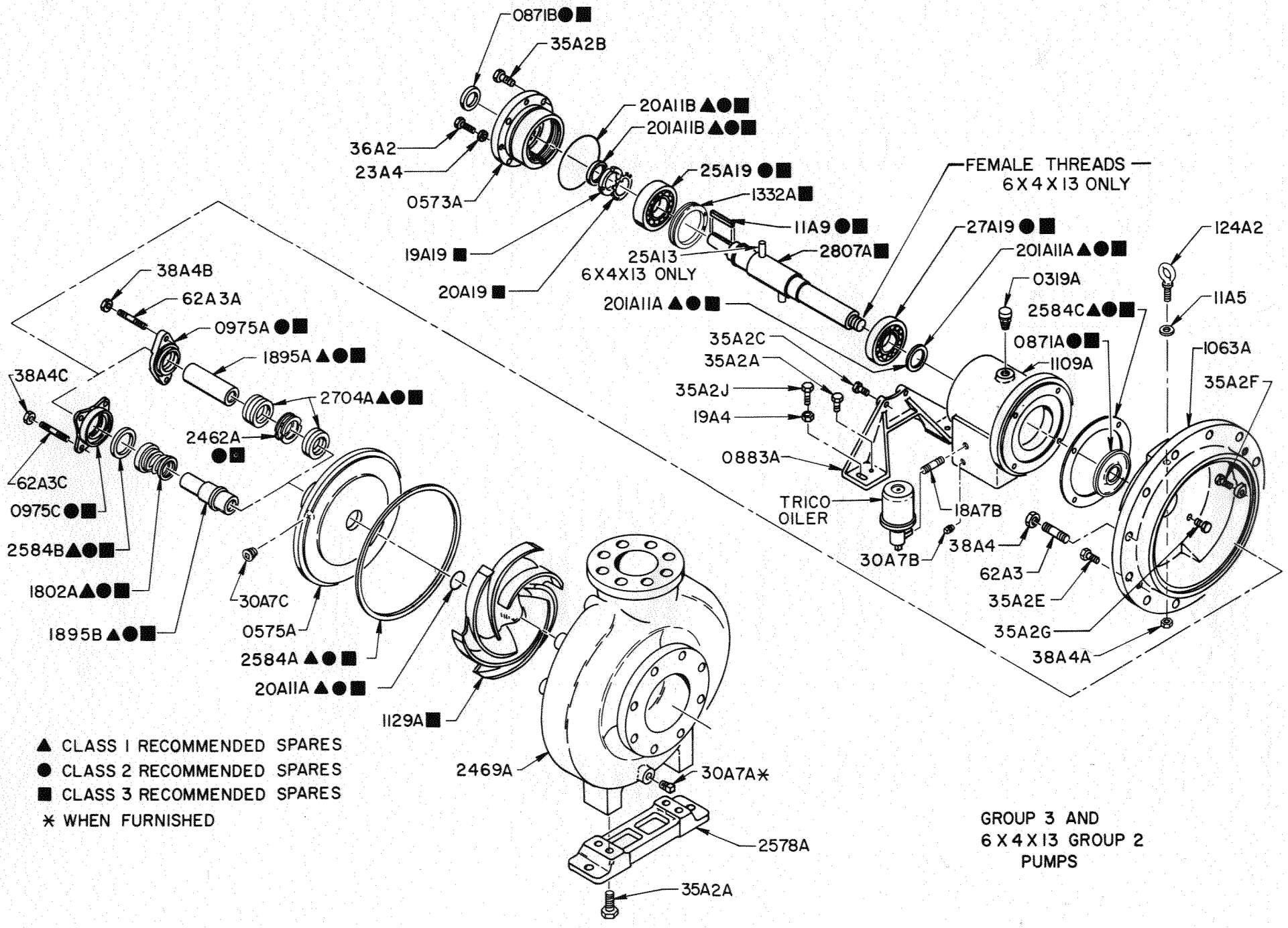
Type HOC2 Pump
Group 2 Exploded Parts Drawing

▲ CLASS 1 RECOMMENDED SPARES
● CLASS 2 RECOMMENDED SPARES
■ CLASS 3 RECOMMENDED SPARES



GROUP 2
TYPE HOC MODEL 2 PUMP

Type HOC2 Pump
Group 3 Exploded Parts Drawing



Recommended Spare Parts List

Part Number	Description	Class Spare 1	2	3	Qty. Per Pump
	Pump End				
0975A	Packing Gland		X	X	1
0975B	Packing Gland, Smothering		X	X	1
0975C	Mech Seal Plain Gland		X	X	1
0975D	Mech Seal Flush Gland		X	X	1
0975E	Mech Seal F, Q, & Drain Gland		X	X	1
1129A	Impeller			X	1
1802A/B/C	Mechanical Seal	X	X	X	1
1895A	Shaft Sleeve, for Packed Pump, Unbalanced, & Dbl Seals	X	X	X	1
1895B	Shaft Sleeve, for Balanced Seal w/Plain Gland	X	X	X	1
1895C	Shaft Sleeve, for J.C. Type 1 Seal w/Plain Gland	X	X	X	1
1895D	Shaft Sleeve, for Balanced Seal w/Flush Gland	X	X	X	1
1895E	Shaft Sleeve, for J.C. Type 1 Seal w/Flush or F, Q, & D Gland	X	X	X	1
20A11A	Imp O-Ring	X	X	X	1
2462	Seal Cage		X	X	1
2584A	Casing Gasket	X	X	X	1
2584B	Gland Gasket, Mech Seal only	X	X	X	1
2704	Packing	X	X	X	5 rings
2807A	Pump Shaft, Unsleeved			X	1
2807B	Pump Shaft, Sleeved			X	1
	Bearing Housing Assembly				
0871A	Flinger, Pump End		X	X	1
0871B	Flinger, Coupling End		X	X	1
11A9	Coupling Key		X	X	1
1332	Locknut			X	1
19A19	BRG Lock Nut			X	1
201A11A	Lip Seal, Pump End	X	X	X	1
201A11B	Lip Seal, Coupling End	X	X	X	1
20A11B	BRG End Cover O-Ring	X	X	X	1
20A19	BRG Lock Washer			X	1
2584C	Gasket, BRG HSG-SPT HD	X	X	X	1
2584D	Gasket, Oil Cooler	X	X	X	1
25A19	Thrust BRG		X	X	1
27A19	Radial BRG		X	X	1

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We recommend use of original IDP replacement parts in the maintenance of your unit. Precise tolerances, metallurgy, manufacturing processes and heat treatment are important factors in the design of each component and the service it will provide. Failure of any component can possibly result in extensive damage to your unit. Warranty may be terminated based on the installation of non-OEM parts.

IDP Regional Entry Centers are designed to be responsive when replacement parts are needed quickly. Direct lines connecting our Parts Distribution Center, Distributors and Pump Repair Centers create a network able to respond almost instantly to your requests.

FASTRAQ (Fast Transactions/Responses/Answers/Quotations) can be accessed by our Order Entry Group or an IDP Distributor to give accurate, up-to-the-minute information on needed parts. In addition, FASTRAQ can provide quotes and place orders.

For repair parts service contact your nearest IDP pump sales office or Pump House distributor. They're in the Yellow Pages.

For the name, address and
phone number of your nearest authorized
Ingersoll-Dresser Pump distributor,
Call 804-485-8000

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