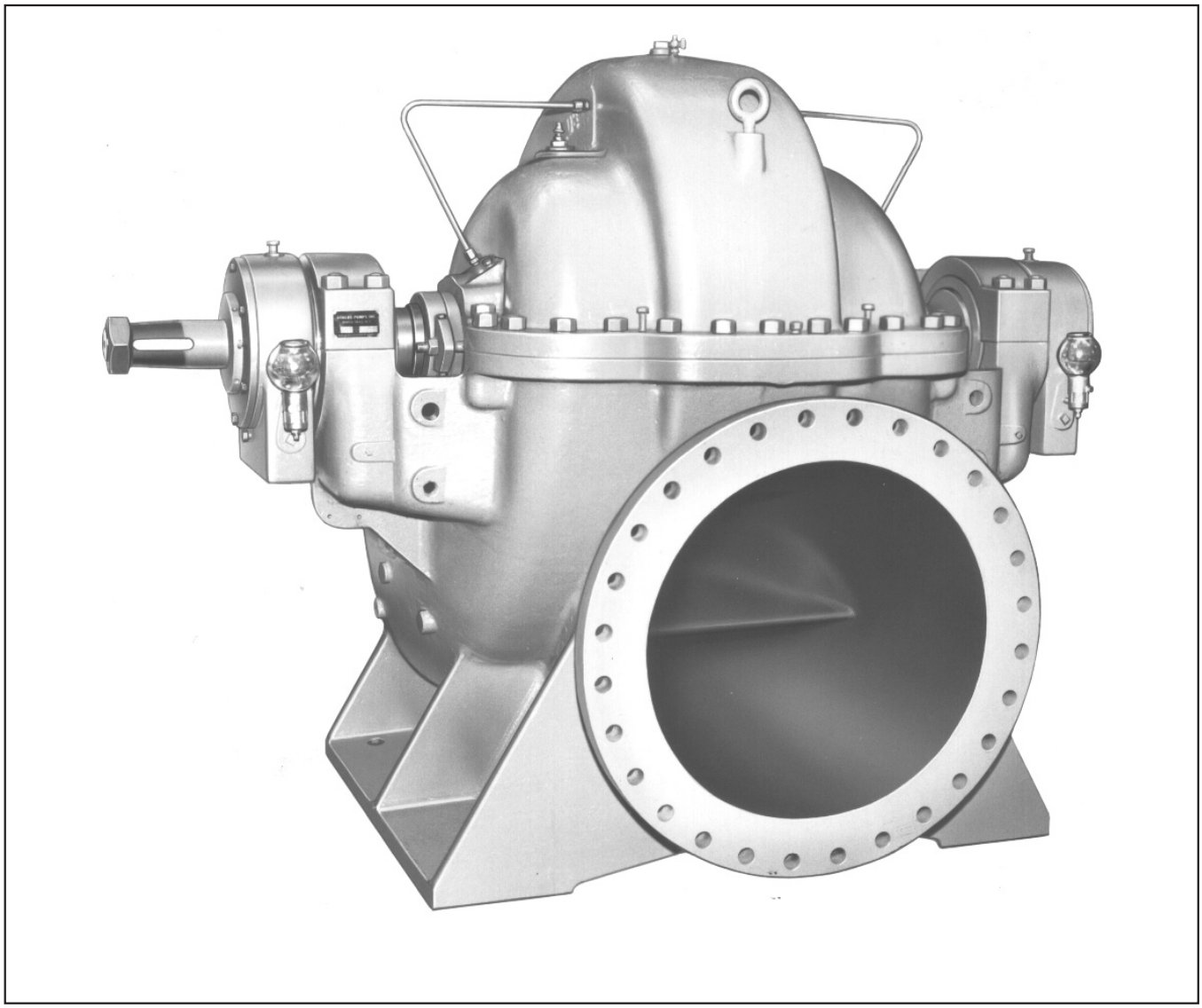
GOULDS PUMPS

Installation, Operation and Maintenance Instructions



Model 3420

ITT

FOREWORD

This manual provides instructions for the Installation, Operation, and Maintenance of the Goulds Model 3420/25 Single Stage Double Suction Pump*. This manual covers the standard product plus common options that are available. For special options, supplemental instructions are supplied. This manual must be read and understood before installation and start-up.

The design, materials, and workmanship incorporated in the construction of Goulds pumps makes them capable of giving trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by correct application, proper installation, periodic inspection, condition monitoring and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and the correct methods of installing, operating, and maintaining these pumps.

ITT - Goulds Pumps shall not be liable for physical injury, damage or delays caused by a failure to observe the instructions for Installation, Operation, and Maintenance contained in this manual.

When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a Goulds representative before proceeding.

Warranty is valid only when genuine ITT - Goulds Pumps parts are used.

Use of the equipment on a service other than stated in the order will nullify the warranty, unless written approval is obtained in advance from ITT - Goulds Pumps.

Supervision by an authorized ITT - Goulds Pumps representative is recommended to assure proper installation.

Additional manuals can be obtained by contacting your local ITT - Goulds Pumps representative or by calling 1-800-446-8537.

* The 3420 is an all English dimension unit and the 3425 is a hard metric design.

THIS MANUAL EXPLAINS

- **Proper Installation**
- **Start-up Procedures**
- **Operation Procedures**
- **Routine Maintenance**
- **Pump Overhaul**
- **Trouble Shooting**
- **Ordering Spare or Repair Parts**

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Industrial Process Pump Safety Manual

IMPORTANT SAFETY NOTICE

To: Our Valued Customers

User safety is a major focus in the design of our products. Following the precautions outlined in this manual will minimize your risk of injury.

ITT Goulds pumps will provide safe, trouble-free service when properly installed, maintained, and operated.

Safe installation, operation, and maintenance of ITT Goulds Pumps equipment are an essential end user responsibility. This *Pump Safety Manual* identifies specific safety risks that must be considered at all times during product life. Understanding and adhering to these safety warnings is mandatory to ensure personnel, property, and/or the environment will not be harmed. Adherence to these warnings alone, however, is not sufficient — it is anticipated that the end user will also comply with industry and corporate safety standards. Identifying and eliminating unsafe installation, operating and maintenance practices is the responsibility of all individuals involved in the installation, operation, and maintenance of industrial equipment.

Please take the time to review and understand the safe installation, operation, and maintenance guidelines outlined in this Pump Safety Manual and the Instruction, Operation, and Maintenance (IOM) manual. Current manuals are available at www.gouldspumps.com/literature_ioms.html or by contacting your nearest Goulds Pumps sales representative.

These manuals must be read and understood before installation and start-up.

For additional information, contact your nearest Goulds Pumps sales representative or visit our Web site at www.gouldspumps.com.

SAFETY WARNINGS

Specific to pumping equipment, significant risks bear reinforcement above and beyond normal safety precautions.

⚠ WARNING

A pump is a pressure vessel with rotating parts that can be hazardous. Any pressure vessel can explode, rupture, or discharge its contents if sufficiently over pressurized causing death, personal injury, property damage, and/or damage to the environment. All necessary measures must be taken to ensure over pressurization does not occur.

⚠ WARNING

Operation of any pumping system with a blocked suction and discharge must be avoided in all cases. Operation, even for a brief period under these conditions, can cause superheating of enclosed pumpage and result in a violent explosion. All necessary measures must be taken by the end user to ensure this condition is avoided.

⚠ WARNING

The pump may handle hazardous and/or toxic fluids. Care must be taken to identify the contents of the pump and eliminate the possibility of exposure, particularly if hazardous and/or toxic. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks.

⚠ WARNING

Pumping equipment Instruction, Operation, and Maintenance manuals clearly identify accepted methods for disassembling pumping units. These methods must be adhered to. Specifically, applying heat to impellers and/or impeller retaining devices to aid in their removal is strictly forbidden. Trapped liquid can rapidly expand and result in a violent explosion and injury.

ITT Goulds Pumps will not accept responsibility for physical injury, damage, or delays caused by a failure to observe the instructions for installation, operation, and maintenance contained in this Pump Safety Manual or the current IOM available at www.gouldspumps.com/literature.

SAFETY

DEFINITIONS

Throughout this manual the words **WARNING**, **CAUTION**, **ELECTRICAL, and ATEX** are used to indicate where special operator attention is required.

Observe all Cautions and Warnings highlighted in this Pump Safety Manual and the IOM provided with your equipment.

⚠ **WARNING**
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Example: Pump shall never be operated without coupling guard installed correctly.

⚠ **CAUTION**
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Example: Throttling flow from the suction side may cause cavitation and pump damage.

ELECTRICAL HAZARD
Indicates the possibility of electrical risks if directions are not followed.

Example: Lock out driver power to prevent electric shock, accidental start-up, and physical injury.

When installed in potentially explosive atmospheres, the instructions that follow the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact an ITT Goulds Pumps representative before proceeding.

Example: Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.

GENERAL PRECAUTIONS

⚠ WARNING

A pump is a pressure vessel with rotating parts that can be hazardous. Hazardous fluids may be contained by the pump including high temperature, flammable, acidic, caustic, explosive, and other risks. Operators and maintenance personnel must realize this and follow safety measures. Personal injuries will result if procedures outlined in this manual are not followed. ITT Goulds Pumps will not accept responsibility for physical injury, damage or delays caused by a failure to observe the instructions in this manual and the IOM provided with your equipment.

General Precautions		
WARNING	⚠	NEVER APPLY HEAT TO REMOVE IMPELLER. It may explode due to trapped liquid.
WARNING	⚠	NEVER use heat to disassemble pump due to risk of explosion from trapped liquid.
WARNING	⚠	NEVER operate pump without coupling guard correctly installed.
WARNING	⚠ 	NEVER run pump below recommended minimum flow when dry, or without prime.
WARNING	⚠ 	ALWAYS lock out power to the driver before performing pump maintenance.
WARNING	⚠	NEVER operate pump without safety devices installed.
WARNING	⚠ 	NEVER operate pump with discharge valve closed.
WARNING	⚠ 	NEVER operate pump with suction valve closed.
WARNING	⚠ 	DO NOT change service application without approval of an authorized ITT Goulds Pumps representative.
WARNING	⚠	**Safety Apparel:** • Insulated work gloves when handling hot bearings or using bearing heater • Heavy work gloves when handling parts with sharp edges, especially impellers • Safety glasses (with side shields) for eye protection • Steel-toed shoes for foot protection when handling parts, heavy tools, etc. • Other personal protective equipment to protect against hazardous/toxic fluids
WARNING	⚠	**Receiving:** Assembled pumping units and their components are heavy. Failure to properly lift and support equipment can result in serious physical injury and/or equipment damage. Lift equipment only at specifically identified lifting points or as instructed in the current IOM. Current manuals are available at www.gouldspumps.com/literature_ioms.html or from your local ITT Goulds Pumps sales representative. Note: Lifting devices (eyebolts, slings, spreaders, etc.) must be rated, selected, and used for the entire load being lifted.

General Precautions		
WARNING		**Alignment:** Shaft alignment procedures must be followed to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow coupling manufacturer's coupling installation and operation procedures.
WARNING		Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.
CAUTION		**Piping:** Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.
WARNING		**Flanged Connections:** Use only fasteners of the proper size and material.
WARNING		Replace all corroded fasteners.
WARNING		Ensure all fasteners are properly tightened and there are no missing fasteners.
WARNING		**Startup and Operation:** When installing in a potentially explosive environment, please ensure that the motor is properly certified.
WARNING		Operating pump in reverse rotation may result in contact of metal parts, heat generation, and breach of containment.
WARNING		Lock out driver power to prevent accidental start-up and physical injury.
WARNING		The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
WARNING		If using a cartridge mechanical seal, the centering clips must be installed and set screws loosened prior to setting impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.
WARNING		The coupling used in an ATEX classified environment must be properly certified and must be constructed from a non-sparking material.
WARNING		Never operate a pump without coupling guard properly installed. Personal injury will occur if pump is run without coupling guard.
WARNING		Make sure to properly lubricate the bearings. Failure to do so may result in excess heat generation, sparks, and / or premature failure.
CAUTION		The mechanical seal used in an ATEX classified environment must be properly certified. Prior to start up, ensure all points of potential leakage of process fluid to the work environment are closed.

General Precautions		
CAUTION		Never operate the pump without liquid supplied to mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if mechanical seal fails.
WARNING		Never attempt to replace packing until the driver is properly locked out and the coupling spacer is removed.
WARNING		Dynamic seals are not allowed in an ATEX classified environment.
WARNING		DO NOT operate pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.
WARNING		Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
WARNING		**Shutdown, Disassembly, and Reassembly:** Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes must be worn at all times.
WARNING		The pump may handle hazardous and/or toxic fluids. Observe proper decontamination procedures. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
WARNING		Operator must be aware of pumpage and safety precautions to prevent physical injury.
WARNING		Lock out driver power to prevent accidental startup and physical injury.
CAUTION		Allow all system and pump components to cool before handling them to prevent physical injury.
CAUTION		If pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107, there may be a risk of static electric discharge from plastic parts that are not properly grounded. If pumped fluid is non-conductive, pump should be drained and flushed with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.
WARNING		Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.
CAUTION		Wear heavy work gloves when handling impellers as sharp edges may cause physical injury.
CAUTION		Wear insulated gloves when using a bearing heater. Bearings will get hot and can cause physical injury.

ATEX CONSIDERATIONS and INTENDED USE

Special care must be taken in potentially explosive environments to ensure that the equipment is properly maintained. This includes but is not limited to:

1. Monitoring the pump frame and liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

The ATEX conformance is only applicable when the pump unit is operated within its intended use. Operating, installing or maintaining the pump unit in any way that is not covered in the Instruction, Operation, and Maintenance manual (IOM) can cause serious personal injury or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT Goulds Pumps. If there is any question regarding the intended use of the equipment, please contact an ITT Goulds representative before proceeding. Current IOMs are available at www.gouldspumps.com/literature_ioms.html or from your local ITT Goulds Pumps Sales representative.

All pumping unit (pump, seal, coupling, motor and pump accessories) certified for use in an ATEX classified environment, are identified by an ATEX tag secured to the pump or the baseplate on which it is mounted. A typical tag would look like this:

The CE and the Ex designate the ATEX compliance. The code directly below these symbols reads as follows:

II	=	Group 2
2	=	Category 2
G/D	=	Gas and Dust present
T4	=	Temperature class, can be T1 to T6 (see Table 1)

Table 1

Code	Max permissible surface temperature °F (°C)	Max permissible liquid temperature °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

The code classification marked on the equipment must be in accordance with the specified area where the equipment will be installed. If it is not, do not operate the equipment and contact your ITT Goulds Pumps sales representative before proceeding.

PARTS

The use of genuine Goulds parts will provide the safest and most reliable operation of your pump. ITT Goulds Pumps ISO certification and quality control procedures ensure the parts are manufactured to the highest quality and safety levels.

Please contact your local Goulds representative for details on genuine Goulds parts.

GENERAL INFORMATION

PUMP DESCRIPTION

The model is based on 8 bearing configurations and 15 hydraulic sizes. Groupings are as follows:

Group	Description	Sizes
SX	Ball radial and duplex ball thrust bearings. Flood oil lube with constant level oiler optional grease lube. Bearing housings bolt to the casing. Goulds non-metallic labyrinth seals.	12 x 14-15 16 x 18-17H
MX	Ball radial and duplex ball thrust bearings. Flood oil lube with constant level oiler optional grease lube. Bearing housings bolt to the casing. Goulds non-metallic labyrinth seals.	18 x 20-20
M	Ball radial and duplex ball thrust bearings. Ring oil lube with constant level oiler optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	16 x 18-30 18 x 20-30 20 x 24-24 20 x 24-30
M (modified)	Same as M group except the shaft is longer to accommodate a wider pump.	20 x 24-28
—	Ball radial and duplex ball thrust bearings. Ring oil lube with constant level oiler, optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	18 x 20-24
L	Double row roller bearings, both thrust and radial. Ring oil lube with constant level oiler, optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	24 x 30-32
LDS	Double row roller bearings, both thrust and radial. Ring oil lube with constant level oiler, optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	30 x 30-31 30 x 30-38
XL	Double row roller bearings, both thrust and radial. Ring oil lube with constant level oiler, optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	30 x 36-42 20x30-42
XXL	Double row roller bearings, both thrust and radial. Ring oil lube with constant level oiler, optional grease lube. Bearing housing secured with tongue and groove fits and a bearing cap with studs and nuts. Goulds metallic labyrinth seals.	36x42-52

The model 3420 is a horizontal between bearings, enclosed impeller double suction centrifugal pump.

Casing - The casing is horizontally split. The upper and lower halves are held together with studs and nuts and/or capscrews. Flanged suction and discharge connections are located in the lower half of the casing and conform to ANSI 16.1/16.5 class 125/150. The casing is supported by integrally cast feet. Separate bearing housings are attached directly to machined fits in each end of the casing with capscrews or machined fits secured with bearing caps and studs and nuts. All sizes have dual volute casings to reduce radial loads on the shaft. The casings are standard with two jacking screws, two lifting lugs for the upper half, two tapered dowel pins for alignment, and a .030 or .016 in. (.75 or .41 mm) non-asbestos parting gasket. The upper half is provided with a vent connection, a priming connection, and one or two stuffing box seal ring connections. The lower half is provided with two drain connections, suction and discharge gauge connections, and stuffing box overflow connections.

Impeller - The impeller is an enclosed, double suction design providing axial hydraulic balance. All exterior surfaces are fully machined. The impeller receives a one or two plane spin balance as standard. The impeller is keyed to the shaft and held in place using shaft sleeves and sleeve nuts.

Wear Rings - Casing and impeller wear rings are supplied as standard to maintain proper running clearances and to minimize leakage between the suction and discharge chambers in the casing. Each casing ring is held in place with

a machined hook lock. The impeller rings are held in place using axial set screws.

Shaft - The shaft is a heavy duty design that minimizes deflection and vibration. The shaft deflection is a maximum of .002 in (.051 mm) at the stuffing box face under the worst operating conditions. The shaft is completely dry with O-ring seals between the impeller and shaft sleeves and the shaft sleeves and the sleeve nuts. The standard shaft is AISI 4340 steel with an option for 316 stainless steel.

Shaft Sleeves - Shaft sleeves are standard on all pumps. They are keyed to the shaft at the impeller and held in place using sleeve nuts. The sleeve nuts tighten against rotation and are secured in place with set screws.

Stuffing Box - Non-asbestos packing is standard. The stuffing box contains a Teflon™ split lantern ring and renewable stuffing box throat bushings. Tapped openings are provided for water sealing from either the pump casing or an outside source. Bypass piping is optional. Two-piece machined split glands are standard on all packed pumps.

Mechanical Seals - Mechanical seals can be supplied as a non-standard option. Most seal designs fit in the standard stuffing box. Goulds does not have its own design gland, so the gland must be supplied by the seal manufacturer.

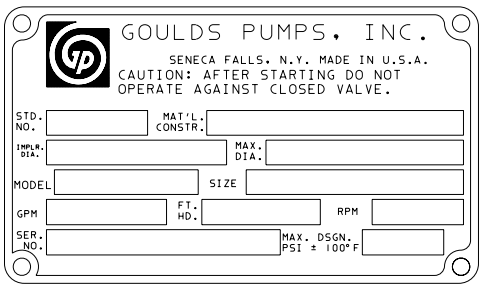
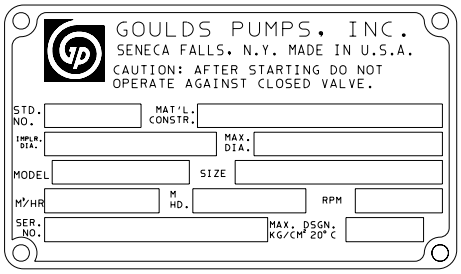
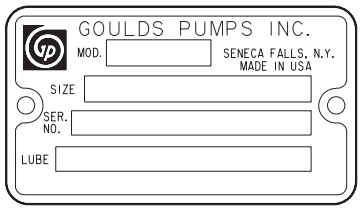
Bearings - There are many different bearing configurations that are offered on the 3420. Specific configurations are dependent on pump size and group and purchased setup. Grease lubricated ball, grease lubricated roller, flood oil lubricated ball, ring oil lubricated ball, and ring oil lubricated roller bearings are used on various sizes. Oil lubrication is standard with grease optional. The bearing housings are sealed with machined labyrinth seals or lip seals.

Baseplates - Fabricated steel bases are standard with a drip collection chamber and a tapped drain connection. The base is designed to be grouted and has grout and vent holes. Soleplates for the pump only or motor only are offered as an option.

NAMEPLATE INFORMATION

Every pump has two or three Goulds nameplates that provide information about the pump. The tags are located on the upper half and lower half of the casing.

When ordering parts, you will need to identify the pump model, size, serial number, and the item number of the required parts. Information can be taken from the pump casing tags. Item numbers can be found later on in this manual.

Description	Fig. No.	Example
Pump Casing Tag - provides information about the pump's hydraulic characteristics. Note the format of the pump size: Discharge x Suction - Nominal maximum Impeller Diameter in inches. (Example: 2x3-8) (Figs. 1 & 2).	**Fig. 1 English**	
	Fig. 2 Metric	
Bearing Frame Tag - provides information on the lubrication system used (Fig. 3).	**Fig. 3**	
ATEX Tag - If applicable, your pump unit may have the following ATEX tag affixed to the pump and/or baseplate. See the Safety section for a description of the symbols and codes (Fig. 4).	**Fig. 4**	

RECEIVING THE PUMP

Inspect the pump as soon as it is received. Carefully check that everything is in good order. Make notes of damaged or missing items on the receipt and freight bill. File any claims with the transportation company as soon as possible.

Storage Requirements

Short Term: (Less than 6 months): Goulds normal packaging procedure is designed to protect the pump during shipping. Upon receipt, store in a covered and dry location.

Long Term: (More than 6 months): Preservative treatment of bearings and machined surfaces will be required. Rotate shaft several times every three months. Refer to driver and coupling manufacturers for their long term storage procedures. Store in a covered dry location.

Note: Long term storage treatment can be purchased with the initial pump order.

HANDLING

⚠ WARNING

Pump and components are heavy. Failure to properly lift and support the equipment could result in serious physical injury, or damage to the pump(s). Steel-toed shoes must be worn at all times.

Use care when moving pumps. Lifting equipment must be able to adequately support the entire assembly. Hoist a bare pump or a pump and soleplate unit using a suitable sling, under the two bearing housings (Fig. 3A). Baseplate mounted units without motors are moved by supporting the pump with a sling under the two bearing housings and a sling under the motor end of the baseplate (Fig. 3B). Baseplate mounted units with motors are moved with slings attached to the baseplate lifting lugs. The use of a spreader bar is required so that the pump is not damaged (Fig 3C).

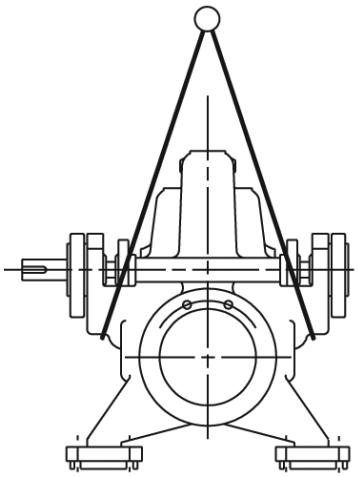


Fig. 3A

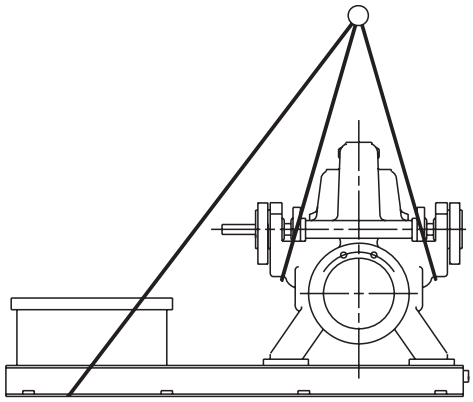


Fig. 3B

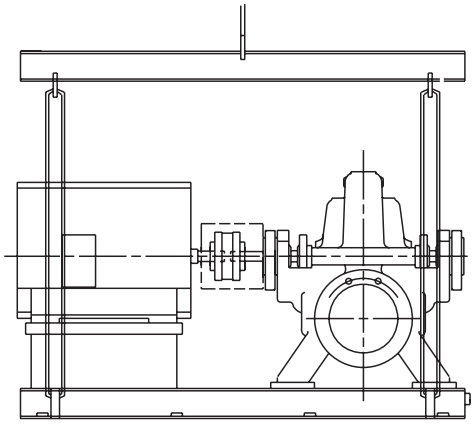


Fig. 3C

INSTALLATION

FOUNDATION

The foundation must be substantial enough to absorb vibration. (*Hydraulic Institute Standards* recommends the foundation weigh at least five [5] times the weight of the pump unit.) It must form a permanent and rigid support for the baseplate. This is important in maintaining the alignment of a flexibly coupled unit.

Foundation bolts of the proper size should be embedded in the concrete to a depth of eight (8) to twelve (12) inches and locked with either a hook around a reinforcing bar or alternatively, a nut and washer at the bottom. The bolts should have a sleeve around them at least six (6) times the bolt diameter in length and at least two (2) bolt sizes larger in I.D. If a nut and washer are used for locking, the washer should have an O.D. two (2) sizes larger than the sleeve. Foundation bolts should be sized .125" less than the anchor bolt holes in the base.

The foundation should be poured to within .75" - 1.5" of the finished height. (See Fig. 4) Freshly poured foundations should be allowed to cure for several days before the unit is set in place and grouted.

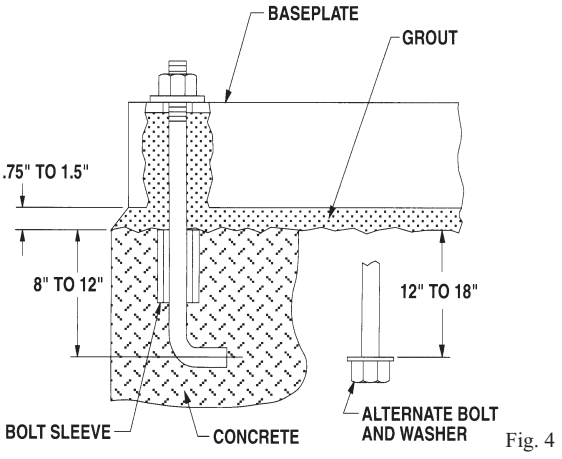


Fig. 4

BASEPLATE INSTALLATION PROCEDURE

Industry standard procedures and/or the following procedure should be followed prior to grouting the baseplate. The procedure assumes the installer has a basic knowledge of baseplate and foundation design and installation methods.

BASEPLATE PREPARATION

1. Inspect all surfaces of the baseplate that will contact the grout for contamination (rust, oil, grime, etc.)
2. Thoroughly clean all surfaces of the baseplate that will contact the grout with a cleaner that will not leave any residue.

NOTE: It may be necessary to sandblast the contact surfaces and coat with a primer compatible with the grout. If sandblasting is necessary, remove all the equipment prior to sandblasting.

3. Inspect all machined surfaces for burrs, rust, paint, or any other type of contamination. If necessary, use a honing stone to remove any burrs.

FOUNDATION PREPARATION

1. Chip the top of the foundation .50-1.0 in. (13-25 mm) to remove porous or low strength concrete. If using a pneumatic hammer, assure that it is not contaminating the surface with oil, moisture, etc.
2. Remove water and/or debris from the foundation bolt holes/sleeves. If sleeve type bolts are being used, fill the sleeves with stuffing material and seal to prevent grout from entering.
3. Coat the exposed portion of the anchor bolts with a non-bonding compound to prevent grout from adhering to the anchor bolts.
4. If recommended by the grout manufacturer, coat the foundation surface with a compatible primer.

LEVEL BASEPLATE

1. Place two sets of wedges or shims on the foundation, one set on each side of every foundation bolt. The wedges should extend .75 in. (20 mm) to 1.5 in. (40 mm) above the foundation to allow for adequate grouting. This will provide even support for the baseplate once it is grouted.
2. Remove water and/or debris from anchor bolt holes/sleeves prior to grouting. If sleeve type bolts are being used, fill the sleeves with rags to prevent grout from entering.

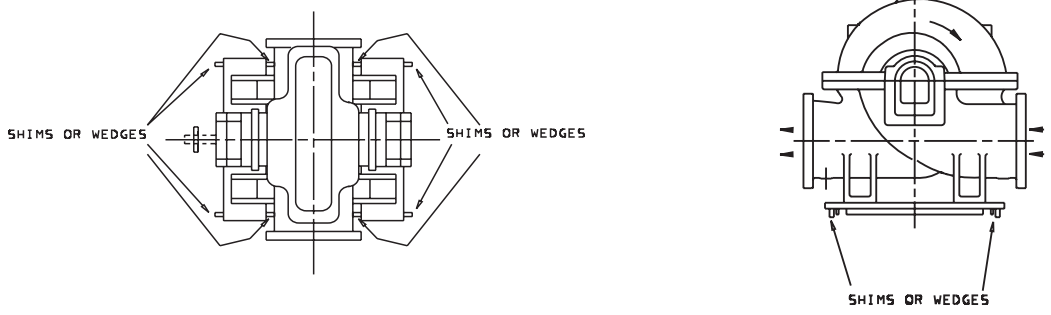
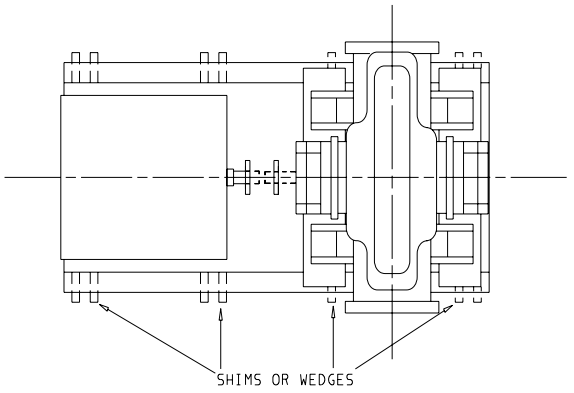


Fig. 6

3. Carefully lower the baseplate onto the foundation bolts.

4. Level the baseplate to within .125 in. (3.2 mm) over the length of the baseplate and to within .088 in. (1.5 mm) over the width of the baseplate by adjusting the wedges. If the baseplate has vertical leveling screws, use the screws to level the base.

5. Hand tighten the foundation bolts.



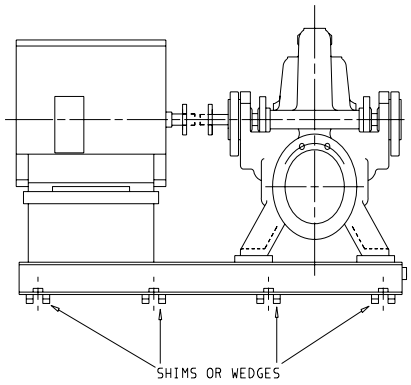


Fig. 7

ALIGNMENT AND ALIGNMENT PROCEDURE

Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.

WARNING

Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power may result in serious physical injury.

To remove guard, refer to coupling guard assembly/ disassembly instructions.

The points at which alignment is checked and adjusted are:

- **Initial Alignment** is done prior to operation when the pump and the driver are at ambient temperature.
- **Final Alignment** is done after operation when the pump and driver are at operating temperature.

Alignment is achieved by adding or removing shims from under the feet of the driver and shifting equipment horizontally as needed.

NOTE: Proper alignment is the responsibility of the installer and user of the unit.

Accurate alignment of the equipment must be attained. Trouble-free operation can be accomplished by following these procedures.

ALIGNMENT CHECKS

Initial Alignment (Cold Alignment)

- Before Grouting Baseplate - To ensure alignment can be obtained.
- After Grouting Baseplate - To ensure no changes have occurred during grouting process.
- After Connecting Piping - To ensure pipe strains have not altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

Final Alignment (Hot Alignment)

- After First Run - To obtain correct alignment when both pump and driver are at operating temperature. Thereafter, alignment should be checked periodically in accordance with plant operating procedures.

NOTE: Alignment check must be made if process temperature changes, piping changes and or pump service is performed.

ALIGNMENT CRITERIA

Good alignment is achieved when the dial indicator readings as specified in the alignment procedure are .002 in. (.05 mm) Total Indicated Reading (T.I.R.) or less when the pump and driver are at operating temperature (Final Alignment).

During the installation phase, however, it is necessary to set the parallel alignment in the vertical direction to a different criteria due to differences in expansion rates of the pump and driver. Table 1 shows recommended preliminary (cold) settings for electric motor driven pumps based on different pumpage temperatures. Driver manufacturers should be consulted for recommended cold settings for other types of drivers (steam turbines, engines, etc.)

Table 1
Cold Setting of Parallel
Vertical Alignment

Pumpage Temperature	Set Driver Shaft
ambient	N/A
100°F	.000" - .002" HIGH
200°F	.002" - .004" HIGH
300°F	.004" - .006" HIGH

SET UP

1. Mount two dial indicators on the pump coupling half (X) so they contact the other coupling half (Y) (Figs. 8 & 9).

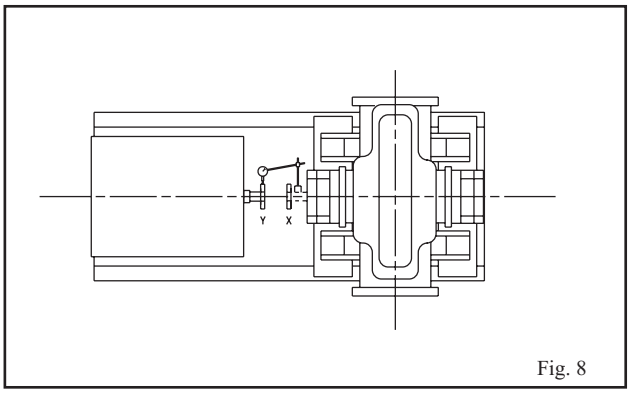


Fig. 8

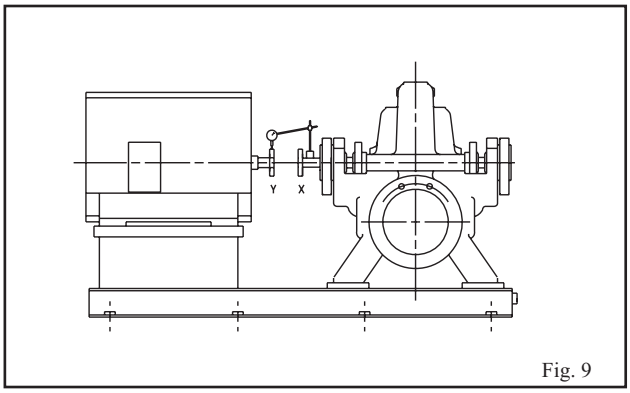


Fig. 9

2. Check setting of indicators by rotating coupling half X to ensure indicators stay in contact with coupling half Y but do not bottom out. Adjust indicators accordingly.

MEASUREMENT

1. To ensure accuracy of indicator readings, always rotate both coupling halves together so indicators contact the same point on coupling half Y. This will eliminate any measurement problems due to runout on coupling half Y.
2. Take indicator measurements with driver feet hold-down bolts tightened. Loosen hold down bolts prior to making alignment corrections.
3. Take care not to damage indicators when moving driver during alignment corrections.

ANGULAR ALIGNMENT

A unit is in angular alignment when indicator A (Angular indicator) does not vary by more that .002 in. (.05 mm) as measured at four points 90° apart (Fig. 10).

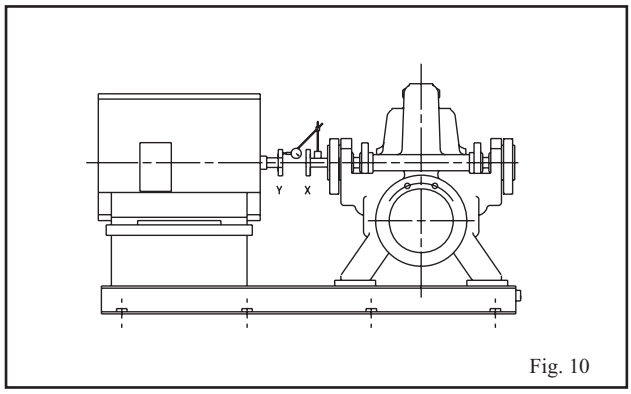


Fig. 10

Vertical Correction (Top-to-Bottom)

1. Zero indicator A at top dead center (12 o‘clock) of coupling half Y.
2. Rotate indicators to bottom dead center (6 o‘clock). Observe needle and record reading.
3. **Negative Reading** - The coupling halves are further apart at the bottom than at the top. Correct by either raising the driver feet at the shaft end (add shims) or lowering the driver feet at the other end (remove shims).

   Positive Reading - The coupling halves are closer at the bottom than at the top. Correct by either lowering the driver feet at the shaft end (remove shims) or raising the driver feet at the other end (add shims).
4. Repeat steps 1-3 until indicator A reads .002 in (.05 mm) or less.

Horizontal Correction (Side-to-Side)

1. Zero indicator A on left side of coupling half Y, 90° from top dead center (9 o’clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o’clock). Observe needle and record reading.
3. **Negative Reading** - The coupling halves are further apart on the right side than the left. Correct by either sliding the shaft end of the driver to the left or the other end to the right.

   Positive Reading - The coupling halves are closer together on the right side than the left. Correct by either sliding the shaft end of the driver to the right or the other end to the left.
4. Repeat steps 1 through 3 until indicator A reads .002 in. (.05 mm) or less.
5. Re-check both horizontal and vertical readings to ensure adjustment of one did not disturb the other. Correct as necessary.

PARALLEL ALIGNMENT

A unit is in parallel alignment when indicator P (parallel indicator) does not vary by more than .002 in. (.05 mm) as measured at four points 90° apart at operating temperature. Note the preliminary vertical cold setting criteria, Table 1.

Vertical Correction (Top-to-Bottom)

1. Zero indicator P at top dead center of coupling (12 o'clock) half Y.
2. Rotate indicator to bottom dead center (6 o'clock). Observe needle and record reading.
3. **Negative Reading** - Coupling half X is lower than coupling half Y. Correct by removing shims of thickness equal to half of the indicator reading under each driver foot.

   Positive Reading - Coupling half X is higher than coupling half Y. Correct by adding shims of thickness equal to half of the indicator reading from each driver foot.

NOTE: Equal amounts of shims must be added to or removed from each driver foot. Otherwise the vertical angular alignment will be affected.

4. Repeat steps 1 through 3 until indicator P reads within .002 in. (.05 mm) or less when hot, or per Table 1 when cold.

Horizontal Correction (Side-to-Side)

1. Zero indicator P on the left side of coupling half Y, 90° from top dead center (9 o'clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o'clock). Observe needle and record reading.
3. **Negative Reading** - Coupling half Y is to the left of coupling half X. Correct by sliding driver evenly in the appropriate direction.

   Positive Reading - Coupling half Y is to the right of coupling half X. Correct by sliding driver evenly in the appropriate direction.

NOTE: Failure to slide motor evenly will affect horizontal angular correction.

4. Repeat steps 1 through 3 until indicator P reads .002 in. (.05 mm) or less.
5. Re-check both horizontal and vertical readings to ensure adjustment of one did not disturb the other. Correct as necessary.

COMPLETE ALIGNMENT

A unit is in complete alignment when both indicators A (angular) and P (parallel) do not vary by more than .002 in. (.05 mm) as measured at four points 90 apart.

Vertical Correction (Top-to-Bottom)

1. Zero indicators A and P at top dead center (12 o'clock) of coupling half Y.
2. Rotate indicator to bottom dead center (6 o'clock). Observe the needles and record the readings.
3. Make corrections as outlined previously.

Horizontal Correction (Side-to-Side)

1. Zero indicators A and P on the left side of coupling half Y, 90° from top dead center (9 o'clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o'clock). Observe the needle, measure and record the reading.
3. Make corrections as outlined previously.
4. Recheck both vertical and horizontal readings to ensure adjustment of one did not disturb the other. Correct as necessary.

NOTE: With experience, the installer will understand the interaction between angular and parallel and will make corrections appropriately.

ALIGNMENT TROUBLESHOOTING

Problem	Probable Cause	Remedy
Cannot obtain horizontal (Side-to-Side) alignment, angular or parallel	Driver feet bolt bound.	Loosen pump hold-down bolts and slide pump and driver until horizontal alignment is achieved.
	Baseplate not leveled properly, probably twisted.	Determine which corner(s) of the baseplate are high or low and remove or add shims at the appropriate corner(s) and realign.
Cannot obtain vertical (Top-to-Bottom) alignment, angular or parallel	Baseplate not leveled properly, probably bowed.	Determine if center of baseplate should be raised or lowered and correct by evenly adding or removing shims at the center of the baseplate.

GROUT BASEPLATE

1. Clean areas of baseplate that will contact grout. Do not use oil-based cleaners because grout will not bond to it. Refer to grout manufacturers instructions.
2. Build dam around foundation. Thoroughly wet foundation (Fig. 11).
3. Pour grout through grout hole in baseplate, up to level of dam. Remove air bubbles from grout as it is poured by puddling, using a vibrator, or pumping the grout into place. Non-shrink grout is recommended.

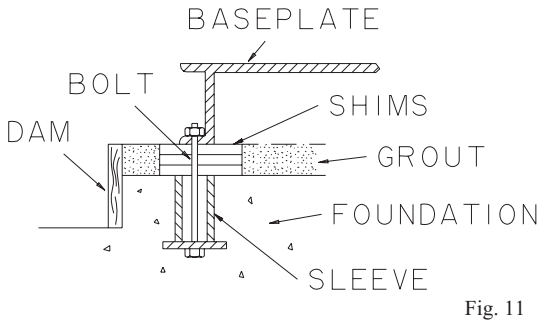


Fig. 11

4. Allow grout to set.
5. Fill remainder of baseplate with grout. Remove air as before (Fig. 12).

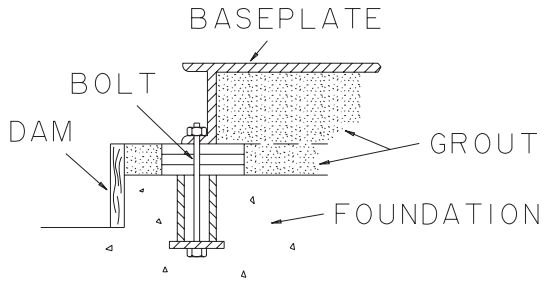


Fig. 12

6. Allow grout to set at least 48 hours.
7. Tighten foundation bolts.

ALIGNMENT CHECK

Re-check alignment before continuing, using methods previously described.

PIPING

Flange loads from the piping system, including those from thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts and result in excess heat generation, sparks and premature failure.

GENERAL

Guidelines for piping are given in the “Hydraulic Institute Standards” available from: Hydraulic Institute, 30200 Detroit Road, Cleveland, OH 44145-1967 and must be reviewed prior to pump installation.

WARNING

Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.

1. All piping must be supported independently of, and line up naturally with, the pump flanges.
2. Piping runs should be as short as possible to minimize friction losses.
3. **DO NOT** connect piping to pump until grout has hardened and pump and driver hold-down bolts have been tightened.
4. It is suggested that expansion loops or joints be properly installed in suction and/or discharge lines when handling liquids at elevated temperatures, so linear expansion of piping will not draw pump out of alignment.

WARNING

All expansion joints should be properly supported, anchored, and restrained. Failure to do so may result in serious physical injury if the expansion joint fails.

5. The piping should be arranged to allow pump flushing prior to removal of the unit on services handling corrosive liquids.
6. Carefully clean all pipe parts, valves and fittings, and pump branches prior to assembly.

SUCTION PIPING

WARNING

NPSH must always exceed NPSH as shown on Goulds performance curves received with order. Reference Hydraulic Institute for NPSH and pipe friction values needed to evaluate suction piping.

Properly installed suction piping is a necessity for trouble-free pump operation. Suction piping should be flushed **BEFORE** connection to the pump.

1. Use of elbows close to the pump suction flange should be avoided. There should be a minimum of two pipe diameters of straight pipe between the elbow and suction inlet. Where used, elbows should be long radius.
2. If an elbow must be used at the suction flange, it must be in the vertical position only. If an elbow must be used in other than a vertical position, it is permissable only by providing a minimum of two diameters of straight pipe between the elbow and the pump suction flange.
3. Use suction pipe one or two sizes larger than the pump suction, with a reducer at the suction flange. Suction piping should never be of smaller diameter than the pump suction.
4. Reducers, if used, should be eccentric, at the pump suction flange, with sloping side down.
5. Pump must never be throttled on suction side.
6. Suction strainers, when used, must have a net “free area” of at least three times the suction pipe area.
7. Separate suction lines are recommended when more than one pump is operating from the same source of supply.

Suction Lift Conditions

1. Suction pipe must be free from air pockets.
2. Suction piping must slope upwards to pump.
3. All joints must be air tight.
4. A means of priming the pump must be provided, such as a foot valve.

Suction Head/Flooded Suction Conditions

1. An isolation valve should be installed in the suction line at least two pipe diameters from the suction to permit closing of the line for pump inspection and maintenance.
2. Keep suction pipe free from air pockets.
3. Piping should be level or slope gradually downward from the source of supply.
4. No portion of the piping should extend below pump suction flange.
5. The size of entrance from supply should be one or two sizes larger than the suction pipe.
6. The suction pipe must be adequately submerged below the liquid surface to prevent vortices and air entrainment at the supply.

DISCHARGE PIPING

1. Isolation and check valves should be installed in discharge line. Locate the check valve between isolation valve and pump, this will permit inspection of the check valve. The isolation valve is required for priming, regulation of flow, and for inspection and maintenance of pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.
2. Increasers, if used, should be placed between pump and check valves.

3. Cushioning devices should be used to protect the pump from surges and water hammer if quick- closing valves are installed in system.

FINAL PIPING CHECK

After connecting the piping to pump:

1. Rotate shaft several times by hand to be sure that there is no binding and all parts are free.
2. Check alignment, per the alignment procedure outlined previously to determine absence of pipe strain. If pipe strain exists, correct piping.

OPERATION

PREPARATION FOR START-UP

When installing in a potentially explosive environment, ensure that the motor is properly certified.

CHECK ROTATION

1. Lock out power to the driver.

WARNING

Lock out driver power to prevent accidental start-up and physical injury.

All equipment being installed must be properly grounded to prevent unexpected static electric discharge.

2. Make sure the coupling hubs are securely fastened to the shafts.

WARNING

Do not jog a coupled pump.

CAUTION

Serious injury may result if pump is run in the wrong direction.

NOTE: Pump is shipped with the coupling hubs disconnected.

3. Unlock driver power.
4. Make sure everyone is clear. Jog driver just long enough to determine the direction of rotation. The rotation must correspond to the arrow on the pump casing.
5. Lock out the power to the driver.

COUPLE PUMP & DRIVER

WARNING

Lock out driver power to prevent accidental rotation and physical injury.

1. Install and lubricate the coupling per the manufacturer's instructions.

The coupling used in an ATEX classified environment must be properly certified.

2. Install the coupling guard (Fig. 13). Refer to the Coupling Guard Installation and Disassembly Section (Appendix I).

The coupling guard used in an ATEX classified environment must be constructed from a non-sparking material.

WARNING

Never operate a pump without the coupling guard installed. Personal injury will occur if the pump is run without the coupling guard.

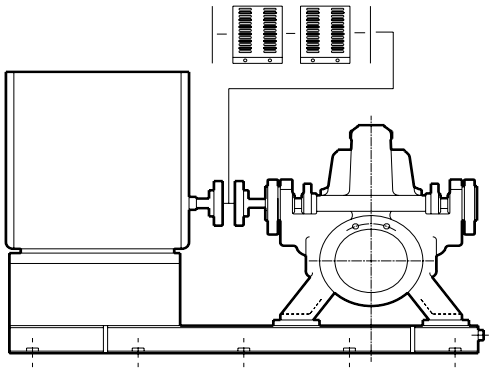


Fig. 13

Cooling systems such as those for bearing lubrication, mechanical seal systems, etc, where provided, must be operating properly to prevent excess heat generation, sparks and premature failure.

Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation and or sparks.

Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.

Do not insulate bearing housings as this can result in excess heat generation, sparks and premature failure.

Check for magnetism on the pump shaft and degauss the shaft if there is any detectable magnetism. Magnetism will attract ferritic objects to the impeller, seal and bearings which can result in excess heat generation, sparks and premature failure.

Leakage of process liquid may result in creating an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid.

A build up of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.

LUBRICATING BEARINGS

Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.

CAUTION

Pumps are shipped without oil.

Oil Lubrication: Oil lubricated pumps are not lubricated at the factory. Constant level oilers are supplied with oil lubricated pumps. The oiler can be found in the box of fittings that accompanied the pump during shipment. The oiler was adjusted to maintain the proper oil level before leaving the factory. The adjustment should be checked in case the setting was disturbed during shipment. See Figure 14. The correct dimensions for A and B are given in Table 2. Fill the bearing housing with oil using the oil bottle. Continue to refill the oil bottle until oil stops draining from the oiler into the housing. See Table 4 for recommended oil.

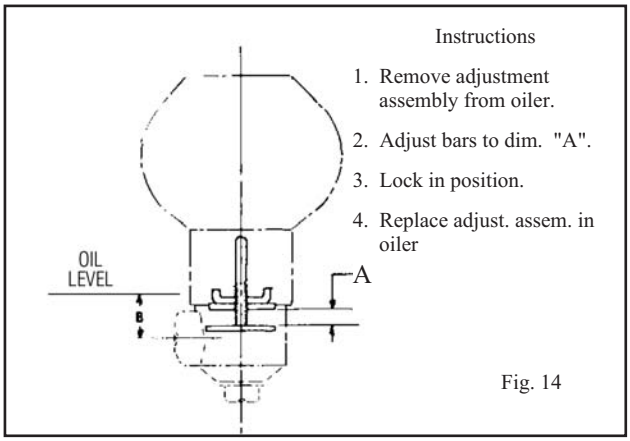


Fig. 14

Pure/Purge Oil Mist: For pure oil mist, connect the oil mist system according to the manufacturer's recommendations. For purge oil mist, connect the oil mist system per the manufacturers instructions. Fill the pump with oil as detailed for oil lubrication above. In both cases, refer to the pump dimensional drawing for the location of the oil mist connections to the bearing housings. See Table 2 for oil bottle settings and Table 4 for recommended oil.

Table 2 Oil Settings - Inches (mm)				
Group	Sizes	Flood Oil Ball / Ring Oil Ball / Ring Oil Roller		
		Oiler Size	"A" in (mm)	"B" in (mm)
SX	12 x 14-15 16 x 18-17H	# 3 4 OZ.	27/32 (21.4)	3/4 (19)
MX	18 x 20-20	# 3 4 OZ.	27/32 (21.4)	3/4 (19)
M	16 x 18-30 18 x 20-30 20 x 24-24 20 x 24-30	# 10 16 OZ.	9/16 (14.3)	1/2 (12.7)
M Modified	20 x 24-28	# 10 16 OZ.	27/32 (21.4)	3/4 (19)
-	18 x 20-24	# 10 16 OZ.	27/32 (21.4)	3/4 (19)
L	24 x 30-32	# 10 16 OZ.	7/8 (22.2)	13/16 (20.6)
LDS	30 x 30-31 30 x 30-38	# 10 16 OZ.	9/16 (14.3)	1/2 (12.7)
XL	30 x 36-42 20x30-42	# 10 16 OZ.	9/16 (14.3)	1/2 (12.7)
XXL	36x42-52	#10 16 OZ.	3/8 (9.7)	7/16 (11.1)

Grease Lubrication: Pumps are shipped with grease installed, sufficient for 2,000 hours operation. It is recommended that additional or replacement lubrication be added after every 2,000 hours or at three month intervals. The lubricant should be renewed in the housings at least once each year. See Table 5 (p. 35) for recommended greases.

If the pump is put into operation after a prolonged shut-down, flush out the bearing housings with a light oil to remove any contaminants. During flushing, rotate the shaft slowly by hand. Finally, flush the bearing housing with the proper lubricating oil to ensure oil quality after cleaning.

⚠ WARNING

Operation of the unit without proper lubrication will cause bearing failure and pump seizure.

SHAFT SEALING

Packed stuffing boxes are not allowed in an ATEX classified environment.

Packed Stuffing Box: Pumps are shipped without packing, lantern ring, or split gland installed. These are included in the box of fittings shipped with the pump and must be installed before start-up.

Installation of Packing:

1. Carefully clean the stuffing box bore.
2. Twist the packing just enough to get it around the shaft (Fig 15).

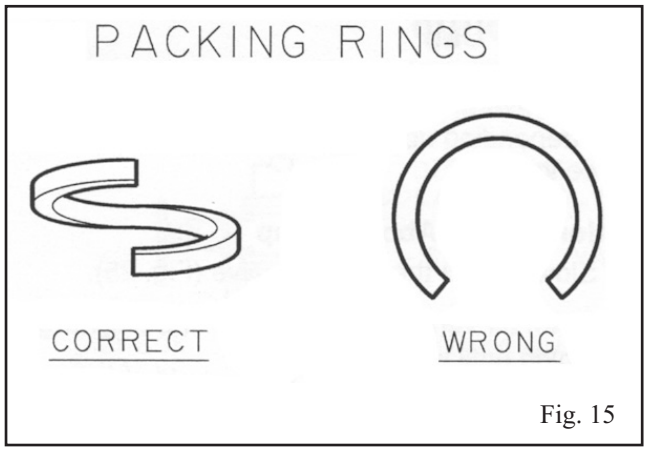


Fig. 15

3. Insert packing, staggering the joints in each ring by 90° degrees.

4. Use a wooden split bushing to properly seat the first two rings of packing. See Fig 16.

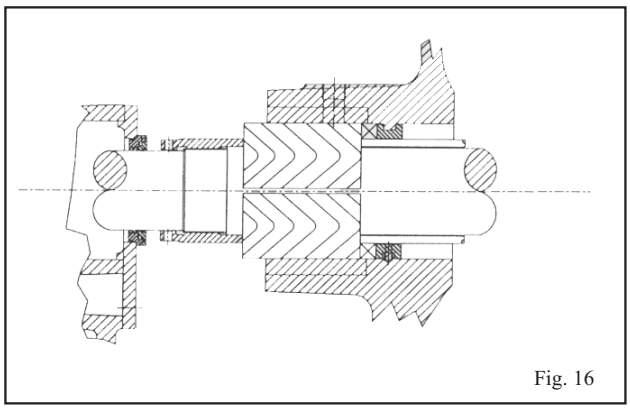


Fig. 16

5. The stuffing box arrangement in order of installation is: two packing rings, lantern ring, then three packing rings. See Fig. 17.

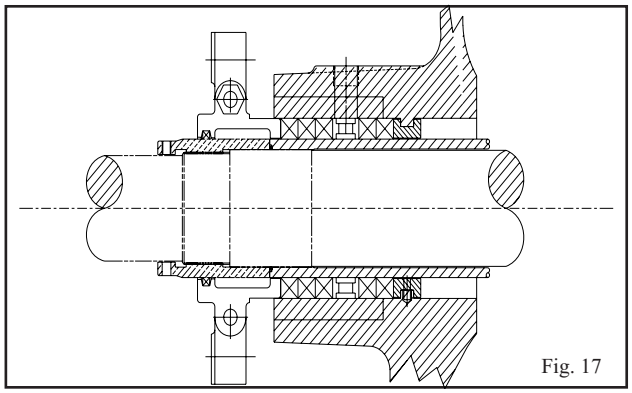


Fig. 17

! CAUTION

Follow instructions to ensure the lantern ring is located at the flushing connection. Otherwise, no flush will be obtained.

6. Install the gland halves. Bolt the gland halves together and mount on gland studs. Tighten gland nuts.

Connection of Sealing Liquid: If the stuffing box pressure is above atmospheric pressure and the pumpage is clean, normal gland leakage of 40-60 drops per minute is usually sufficient to lubricate and cool the packing. Sealing liquid then, is not required.

An external sealing liquid is required when:

1. Abrasive particles in the pumpage could score the shaft sleeve.
2. Stuffing box pressure is below atmospheric pressure due to the pump running with suction lift or when the suction source is under a vacuum. Under these conditions, packing will not be cooled and lubricated and air will be drawn into the pump.

If an outside source of clean compatible liquid is required, the pressure should be 15 psi (1.0 kg/cm) above the suction pressure for clean pumpages. For an abrasive pumpage, the flush water pressure should be 30-50 psi (2.1-3.5 kg/cm) above the suction pressure.

NOTE: A product flush can be used if a clean pumpage exists.

NOTE: Most packing requires lubrication. Failure to lubricate the packing may shorten the life of the packing and the pump.

PRIMING THE PUMP

Never start the pump until it has been properly primed. Several different methods of priming can be used, depending on the type of installation and service involved.

Pumps must be fully primed at all times during operation.

⚠ WARNING

If the pump is run dry, rotating parts within the pump may seize to non-moving parts. This may result in serious physical injury.

Suction Supply Above Pump

When the pump is installed as shown in Fig. 18, the pump will prime itself.

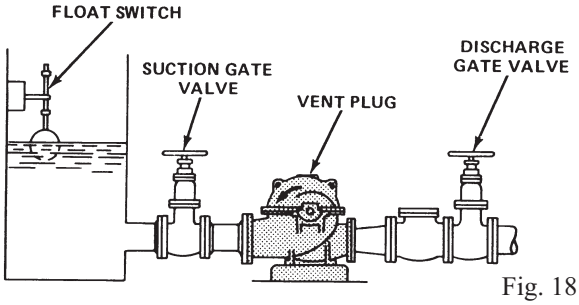


Fig. 18

1. Close the discharge valve.
2. Open the suction valve.
3. Remove the vent plugs or open the vent valves on the top of the pump and the two suction lobes until all air is expelled and fluid flows through the openings.
4. Replace the vent plugs or close the vent valves.
5. Start the pump and open the discharge valve.

The pump will continue to be primed for any future starting. This method is the simplest and, particularly for automatic operation, the safest. A float switch in the suction reservoir can be arranged to stop the pump, should the liquid supply fall below minimum levels.

Suction Supply Below Pump

A. Priming with a Foot Valve - With the pump installed on a suction lift and with a foot valve at the end of the suction line, priming can be done any of the following three ways:

Outside Supply (Fig. 19)

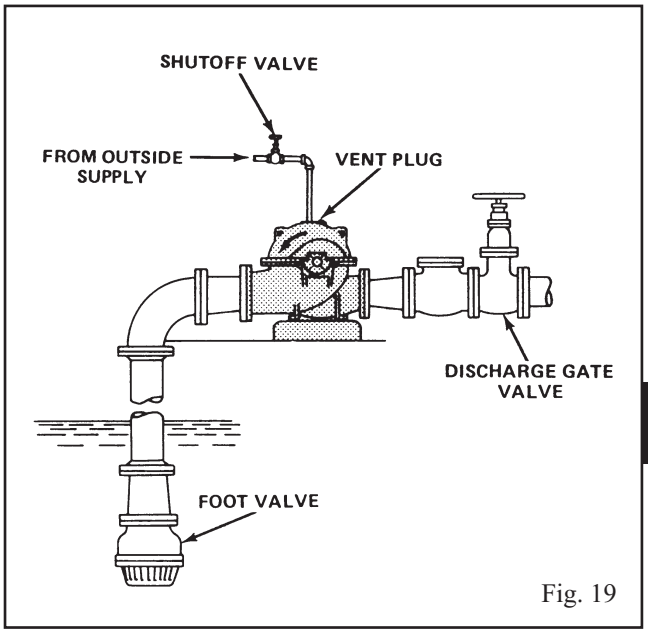


Fig. 19

1. Close the discharge valve.
2. Remove the vent plugs or open the vent valves on the top of the pump and the two suction lobes.
3. Open the valve in the priming supply line. Fill the pump until all air is expelled and fluid flows through the vents.
4. Replace the vent plugs or close the vent valves and close the valve in the priming supply line.
5. Start the pump and open the discharge valve.

The pump will continue to be primed for any future starting.

Priming with a Separate Hand or Manually Controlled Priming Pump (Fig. 20)

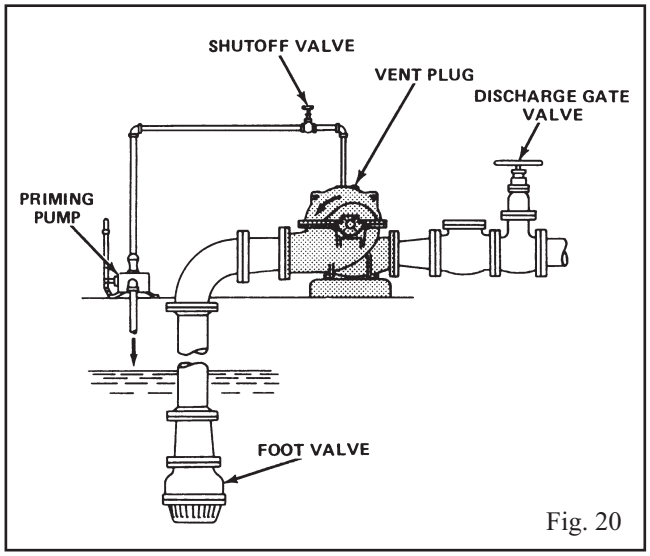


Fig. 20

1. Close the discharge valve.
2. Open the valve in the priming line.
3. Exhaust the air from the pump and the suction piping until water flows from the priming pump.
4. Close the valve in the priming line.
5. Shutoff the priming pump.
6. Start the pump and open the discharge valve.

Priming by Bypassing Around the Discharge Check Valve (Fig. 21)

NOTE: This method can only be used when there is liquid under some pressure in the discharge line. The original prime must be effected from some outside source.

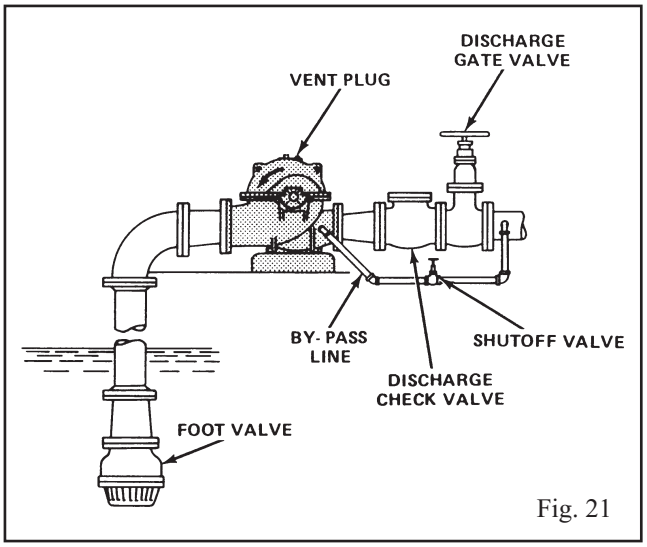


Fig. 21

1. Close the discharge valve.
2. Remove the vent plugs or open the vent valves on the top of the pump and the two suction lobes.
3. Open the valve in the check valve bypass line.
4. Exhaust the air from the pump and the suction piping until water flows from vent connections.
5. Replace the vent plugs or close the vent valves and close the valve in the bypass line.
6. Start the pump and open the discharge valve.

Priming with an Ejector (Fig. 22)

On suction lift applications, an ejector (operated by steam, compressed air, or pressurized water) connected to the top of the casing (priming or vent connection) can be used to remove air from the casing and suction line, thus priming the pump.

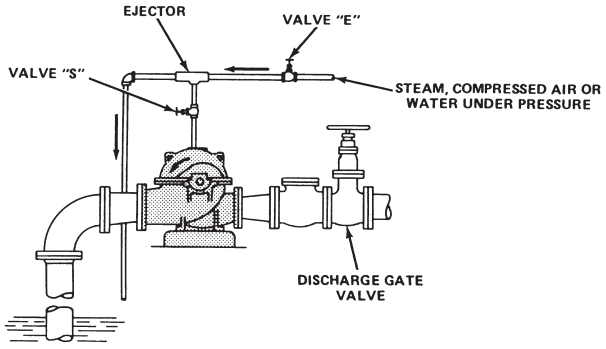


Fig. 22

1. Close the discharge valve.
2. Open the ejector supply valve in the steam, air, or water line, valve "E".
3. Open the priming isolation valve, "S".
4. Once the unit is primed, close the priming isolation valve, "S".
5. Close the ejector supply valve, "E".
6. Start the pump and open the discharge valve.

STARTING PUMP

1. Make sure the suction valve and any recirculation or cooling lines are open.
2. Fully close or partially open the discharge valve as dictated by system conditions.
3. Start the driver.

CAUTION

Immediately observe the pressure gauges. If the discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart.

4. Slowly open the discharge valve until the desired flow is obtained.

CAUTION

Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and troubleshoot the problem.

OPERATION

GENERAL CONSIDERATIONS

Always vary the capacity by regulating the discharge valve. NEVER throttle the flow from the suction side.

The driver may overload if the pumpage specific gravity (fluid density) is greater than originally stated or if the flow rate is exceeded.

Always operate the pump at or near the rated conditions to prevent damage resulting from cavitation or recirculation.

OPERATING AT REDUCED CAPACITY

WARNING

DO NOT operate the pump below the minimum rated flow or with the suction and/or discharge valves closed. These conditions may create an explosive hazard due to vaporization of the pumpage. This can quickly lead to pump failure and physical injury. Refer to Appendix II for the pump's minimum flow.

Damage occurs from:

1. Increased vibration levels - This affects the bearings, stuffing box, and mechanical seal (if supplied).

2. Increased radial loads - Increases stress on the shaft and increases loads on the bearings.
3. Heat build up - Vaporization of the pumpage may cause the rotating parts to score or seize.
4. Cavitation - Damages the internal surfaces of the pump.

OPERATING UNDER FREEZING CONDITIONS

Exposure to freezing conditions, while the pump is idle, could cause the liquid to freeze and damage the pump. Liquid inside the pump should be drained. Liquid inside cooling coils, if supplied, should also be drained.

SHUTDOWN

1. Slowly close the discharge valve.
2. Shut down and lock out the driver to prevent accidental rotation.

WARNING

Lock out driver power to prevent accidental rotation and physical injury.

WARNING

When handling hazardous and/or toxic fluids, proper personal protective equipment should be worn. If the pump is being drained, precautions must be taken to prevent physical injury. The pumpage must be handled and disposed of in conformance with the applicable environmental regulations.

FINAL ALIGNMENT

1. Run the unit under actual operating conditions for a sufficient length of time to bring the pump and driver up to the normal operating temperature.
2. Check the alignment while the unit is at the normal operating temperature per the alignment procedure in Section 3.
3. Reinstall the coupling guard. Refer to the coupling guard instructions in *Appendix I*.

PREVENTIVE MAINTENANCE

GENERAL COMMENTS

A routine maintenance program can extend the life of your pump. Well maintained equipment will last longer and require fewer repairs. You should keep maintenance records. This will help pinpoint potential causes of problems.

The preventive maintenance section must be adhered to in order to keep the applicable ATEX classification of the equipment. Failure to follow these procedures will void the ATEX classification for the equipment.

MAINTENANCE SCHEDULE

INSPECTION INTERVALS

Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive,

or if the environment is classified as potentially explosive.

ROUTINE MAINTENANCE

- Bearing lubrication
- Seal Monitoring
- Vibration Analysis
- Discharge Pressure Monitoring
- Temperature Monitoring

ROUTINE INSPECTIONS

- Check the level and the condition of the oil
- Check for unusual noise, vibration, and bearing temperatures
- Inspect the pump and piping for leaks
- Check the seal chamber/stuffing box leakage
  - Mechanical Seal - There should be no leakage.
  - Packing - Excessive leakage requires adjustment or possible packing replacement. Refer to section 4: Operation, for packing gland adjustment.

THREE MONTH INSPECTIONS

- Check foundation and hold-down bolts for tightness.
- If the pump has been left idle, check the packing. Replace, if required.
- Oil should be changed every three months (2,000 hrs) or more often if there are any adverse atmospheric conditions or other conditions that may contaminate or break-down the oil. Change the oil whenever it appears cloudy or contaminated.
- Check the shaft alignment. Re-align if required.

ANNUAL INSPECTIONS

- Check the pump capacity, pressure, and power. If the pump performance does not satisfy your process requirements and your process requirements have not changed, the pump should be disassembled, inspected, and the worn parts replaced. Otherwise, a system inspection should be done.

MAINTENANCE OF BEARINGS

Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.

OIL LUBRICATED BEARINGS

WARNING

Pumps are shipped without oil. Oil lubricated bearings must be lubricated at the jobsite.

Change the oil after 200 hours for new bearings. Thereafter, change the oil every 2,000 hours or three months, whichever comes first.

Ring oil or flood oil lubricated anti-friction bearings are standard on all model 3420 pumps. Oil lubricated pumps are supplied with oilers which maintain a constant oil level in the bearing housings. Each oiler should be installed and the pump lubricated as follows:

1. Check the oiler adjustment prior to installing the oiler, refer to Table 2 for the proper oiler setting.
2. Install one oiler in each bearing housing.

CAUTION

Do not fill the bearing housings with oil through any connection other than the oiler connection. This can result in an improper oil level which may shorten the life of the bearings and cause damage to the pump.

Table 3
Bearings and Oil Requirements

Bearing Arrangement	Group	Sizes	Bearing Size		Oil Volume Required (per each housing)	
			Thrust	Radial	mL	pints
Flood Oil Ball Bearing	SX	12 x 14-15 16 x 18-17H	7313	6313	thrust = 850 radial = 580	thrust = 1.80 radial = 1.23
	MX	18 x 20-20	7316	6316	thrust = 1350 radial 857	thrust = 2.85 radial = 1.81
Ring Oil Ball Bearing	M	16 x 18-30 18 x 20-30 20 x 24-24 20 x 24-30	7321	6321	1170	2.47
	M (modified)	20 x 24-28	7321	6321	1350	2.85
	-	18 x 20-24	7318	6318	620	1.32
Ring Oil Roller Bearing	L	24 x 30-32	22226		1700	3.60
	LDS	30 x 30-31 30 x 30-38	22228		1720	3.64
	XL	30 x 36-42 20x30-42	22230		1350	2.85
	XXL	36x42-52	22240		4350	9.2

3. Fill each oiler bottle with oil and replace the oiler bottle in its housing. The oil will drain into the bearing housing. Several refills will be required. Oil will be at the proper level in the housings when oil remains in the bottle. Do not fill the bearing housings with oil through any other bearing housing connection. Refer to Table 2 (p. 27) for setting and Table 3 for volume.

A high quality turbine oil with rust and oxidation inhibitors should be used. For the majority of operational conditions, bearing temperatures will run between 120°F (50° C) and 180° F (82° C). In this range, an oil of ISO viscosity grade 68 at 100° F (40° C) is recommended. If bearing temperatures exceed 180° F (82° C) use ISO viscosity grade 100. See Table 4 for oil requirements.

Some acceptable lubricants are:

Table 4
Lube Oil Requirements

Exxon	Teresstic EP 68
Mobil	Mobil DTE 26 300 SSU @ 100F (38C)
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Lubricant

GREASE LUBRICATED BEARINGS

Grease lubricated bearings are lubricated at the factory. Regrease the bearings every 2,000 operating hours or every three months, whichever comes first.

NOTE: When regreasing, there is a danger of impurities entering the bearing housing. The grease container, the greasing device, and the fittings must be clean.

To grease the bearings:

1. Remove relief plugs on the bearing end covers.
2. Insert grease through the grease fittings while the shaft is rotating, until grease appears through the relief plug holes.
3. Operate the unit for approximately 30 minutes with the relief holes open to prevent overgreasing. After 30 minutes, replace the relief plugs.

NOTE: The bearing temperatures usually rise after regreaseing due to an excess supply of grease. Temperatures will return to normal after the pump has run and purged the excess grease from the bearings. This usually takes two to four hours.

For most operating conditions, a lithium based mineral oil grease of NGLI consistency No. 2 is recommended. This grease is acceptable for bearing temperatures of 5° F to 230° F (-15° C to 110° C). Bearing temperatures are generally 20° F (18° C) higher than the bearing housing outer surface temperature. See Table 5 for acceptable greases.

Table 5
Lubricating Grease Requirements

NGLI consistency	2
Mobil	Mobilux EP2
Exxon	Unirex N2
Sunoco	Multipurpose EP
SKF	LGMT 2

! CAUTION

Never mix greases of different consistency (1 or 3 with NGLI 2) or different thickener. For example, never mix a lithium based grease with a polyurea based grease.

NOTE: If it is necessary to change the grease type or consistency, the bearings must be removed and the old grease removed.

BEARING REMOVAL

Ball Bearings

A puller, such as the one shown in Figures 23 and 24, should be used. The puller bar must be square with the end of the shaft at all times in order to keep even pressure on the outer circumference of the bearing. The puller screw should be tightened steadily to enable the bearing to slide smoothly off the shaft. Do not damage the end of the shaft.

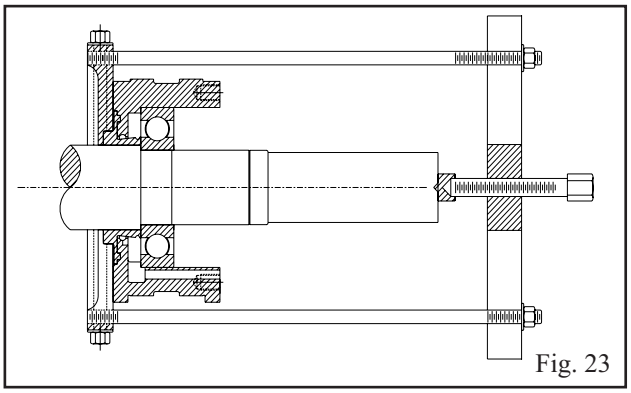


Fig. 23

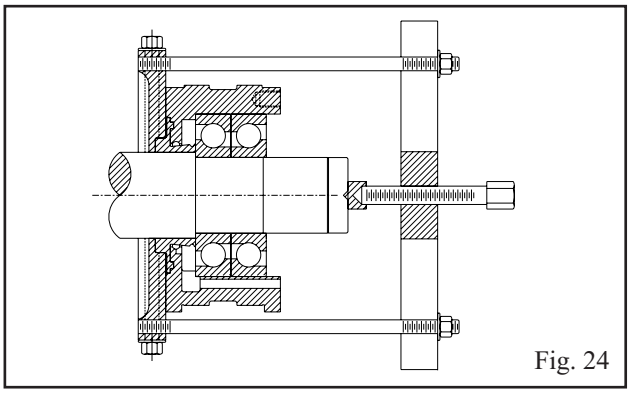


Fig. 24

On the SX/MX units, the bearing housings slide off the bearings and the puller, such as the one shown in Figures 25 and 26, should be used. This type of puller applies force directly against the bearing itself. The puller bar must be square with the end of the shaft at all times and the puller screw should be tightened steadily to enable the bearings to slide smoothly off the shaft. Do not damage the end of the shaft.

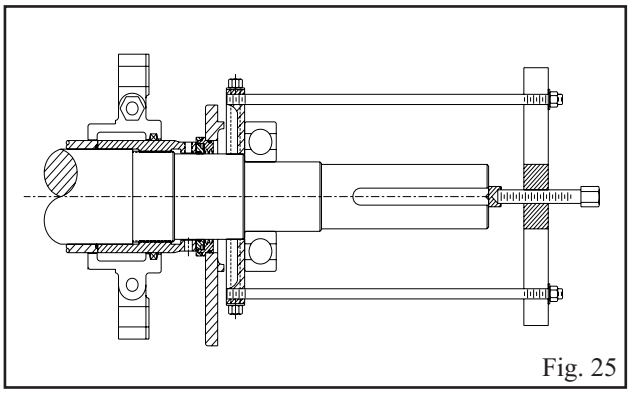


Fig. 25

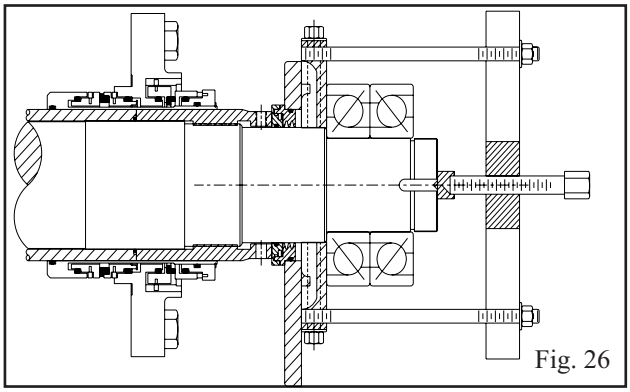


Fig. 26

Roller Bearings

1. Screw the adapter sleeve removal nut (furnished in the box of fittings which accompanied the pump) onto the adapter sleeves (item 521). Tightening the nut will "jack" the sleeves out from under the inner race of the bearings.

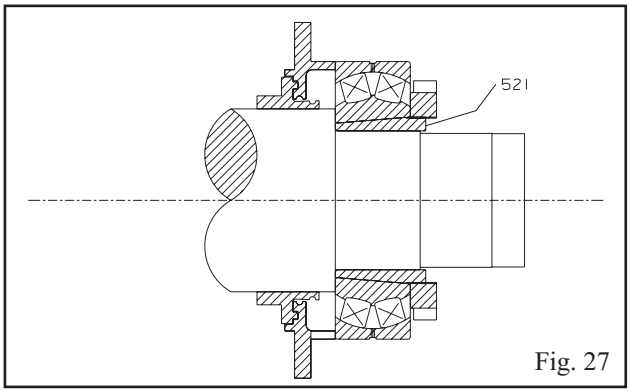


Fig. 27

2. Slide the adapter sleeves and bearings off of the shaft and protect them from contamination. Unscrew the adapter removal nut and store it for future use.

MAINTENANCE OF SHAFT SEALS

MECHANICAL SEALS

When mechanical seals are furnished, a manufacturers reference drawing is supplied with the data package. This drawing should be kept for future use when performing maintenance and adjusting the seal. The seal drawing will also specify required flush liquid and tapped connections. The seal and all the flush piping must be checked and installed as needed, prior to starting the pump.

The life of a mechanical seal depends on various factors such as cleanliness of the liquid handled and its lubricating properties. Due to the diversity of the operating conditions it is, however, not possible to give definite indications as to its life.

WARNING

Never operate the pump without liquid supplied to the mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if the mechanical seal fails.

The mechanical seal used in an ATEX classified environment must be properly certified.

The mechanical seal must have an appropriate seal flush system. Failure to do so will result in excess heat generation and seal failure.

Leakage of process liquid may result in creating an explosive atmosphere. Follow all pump and seal assembly procedures.

Sealing systems that are not self purging or self venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.

PACKED STUFFING BOX

WARNING

Lock out driver power to prevent accidental start-up and physical injury.

The stuffing box is not packed at the factory and must be packed properly before operating the pump. The packing is furnished in the box of fittings which accompanies the pump. The packing used must be suitable for the pumpage. Make sure the stuffing box is clean. Examine the shaft sleeve for wear or scoring, replace if necessary. Refer to Preparation for Start-up (p. 25) for packing installation instructions.

TROUBLESHOOTING		
PROBLEM	**PROBABLE CAUSE**	**REMEDY**
No liquid delivered.	Pump not primed.	Reprime pump, check that pump and suction line are full of liquid.
	Suction line clogged.	Remove obstructions.
	Impeller clogged with foreign material.	Back flush pump to clean impeller.
	Wrong direction of rotation.	Change rotation to concur with direction indicated by arrow on bearing housing or pump casing.
	Foot valve or suction pipe opening not submerged enough.	Consult factory for proper depth. Use baffle to eliminate vortices.
	Suction lift too high.	Shorten suction pipe.
Pump not producing rated flow or head.	Air leak thru gasket.	Replace gasket.
	Air leak thru stuffing box / seal chamber.	Replace or readjust packing/mechanical seal.
	Impeller partly clogged.	Back flush pump to clean impeller.
	Worn wear rings.	Replace defective part as required.
	Insufficient suction head.	Ensure that suction line shutoff valve is fully open and line is unobstructed.
	Worn or broken impeller.	Inspect and replace if necessary.
Pump starts then stops pumping.	Improperly primed pump.	Reprime pump.
	Air or vapor pockets in suction line.	Rearrange piping to eliminate air pockets.
	Air leak in suction line.	Repair (plug) leak.
Bearings run hot.	Improper alignment.	Re-align pump and driver.
	Improper lubrication.	Check lubricant for suitability and level.
	Lube cooling.	Check cooling system.
Pump is noisy or vibrates.	Improper pump/driver alignment.	Align shafts.
	Partly clogged impeller causing imbalance.	Back-flush pump to clean impeller.
	Broken or bent impeller or shaft.	Replace as required.
	Foundation not rigid.	Tighten hold-down bolts of pump and motor or adjust stilts.
	Worn bearings.	Replace.
	Suction or discharge piping not anchored or properly supported.	Anchor per Hydraulic Institute Standards Manaul recommendations.
	Pump is cavitating.	Locate and correct system problem.
Excessive leakage from stuffing box/ seal chamber.	Packing gland improperly adjusted.	Tighten gland nuts.
	Stuffing box improperly packed.	Check packing and repack box.
	Worn mechanical seal parts.	Replace worn parts.
	Shaft sleeve scored.	Check lubrication and cooling lines.
Motor requires excessive power.	Head lower than rating. Pumps too much liquid.	Re-machine or replace as required.
	Liquid heavier than expected.	Check specific gravity and viscosity.
	Stuffing packing too tight.	Readjust packing. Replace if worn.
	Rotating parts bind.	Check internal wearing parts for proper clearances.

DISASSEMBLY & REASSEMBLY

DISASSEMBLY

⚠ WARNING

Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed/safety shoes must be worn at all times.

⚠ WARNING

The 3420 may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. The pumpage must be handled and disposed of in conformance with applicable environmental regulations.

NOTE: Before Disassembling the pump for overhaul, ensure all replacement parts are available.

⚠ WARNING

Lock out power supply to driver to prevent accidental start-up and physical injury.

1. Shut off all valves controlling flow to and from the pump.

⚠ WARNING

The operator must be aware of the pumpage and safety precautions to prevent physical injury.

2. Drain the liquid from the piping and flush the pump, if necessary.
3. Disconnect all auxiliary piping and tubing.
4. Remove the coupling guard. Refer to the Coupling Guard Installation and Disassembly Section in Appendix I.
5. Disconnect the coupling.

6. Remove the coupling guard endplate.

7. Oil Lubrication: Drain the oil from the bearing housings by removing the bearing housing drain plugs (item 358). Replace the plugs after the oil is drained. Remove the oiler.

NOTE: Oil analysis should be a part of a preventative maintenance program, and is helpful in determining a cause of a failure. Save the oil in a clean container for inspection.

8. Packing: Remove the gland nuts (355) and slide the glands (107) away from the stuffing boxes.

   Conventional Mechanical Seal: Remove the gland nuts (355) and slide the gland, with the stationary seat, away from the seal chamber.

   Cartridge Mechanical Seal: Replace the spacer clips on the mechanical seal sleeve. Loosen the set screws in the locking collar on the mechanical seal. Remove the gland nuts (355) and slide the mechanical seal away from the seal chamber.

9. Remove the casing parting nuts (425B).

10. Remove the dowel pins (469G).

11. Loosen the upper half casing (100) by using the casing jacking bolts (418).

12. Remove the upper half casing evenly using the lifting lugs. See Fig 28. Make sure adequate clearance is available to remove the upper half. See Table 6.

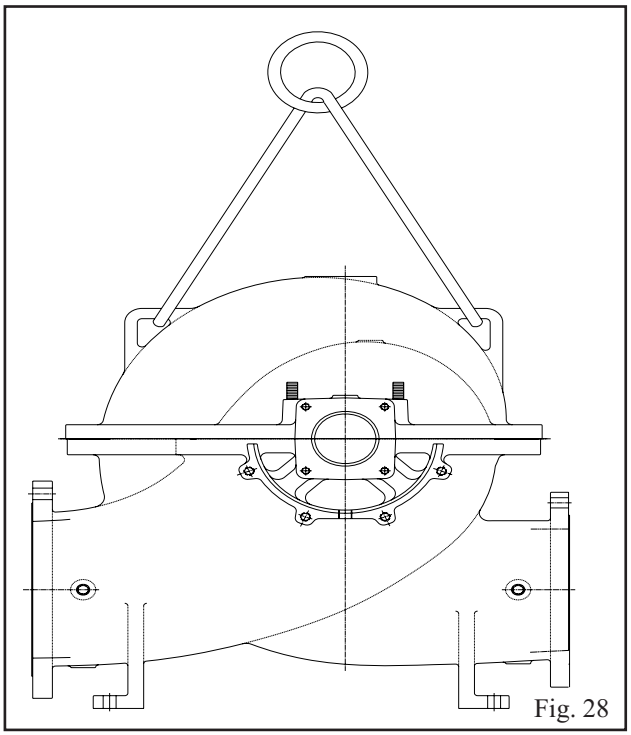


Fig. 28

Table 6
Minimum Headroom for U.H. Removal

Frame	Pump Size	(From Suct C/L) inches (mm)
SX	12x14-15	25 (635)
	16x18-17h	31 (787)
MX	18x20-20	34 (864)
M	16x18-30	41.25 (1048)
	18x20-30	41.75 (1061)
	20x24-24	37.75 (959)
	20x24-30	42.5 (1080)
M (Mod)	20x24-28	44 (1118)
-	18x20-24	38 (965)
L	24x30-32	45 (1143)
LDS	30x30-31	50.69 (1288)
	30x30-38	53.25 (1353)
XL	30x36-42	62 (1575)
	20x30-42	70 (1778)
XXL	36x42-52	76 (1930)

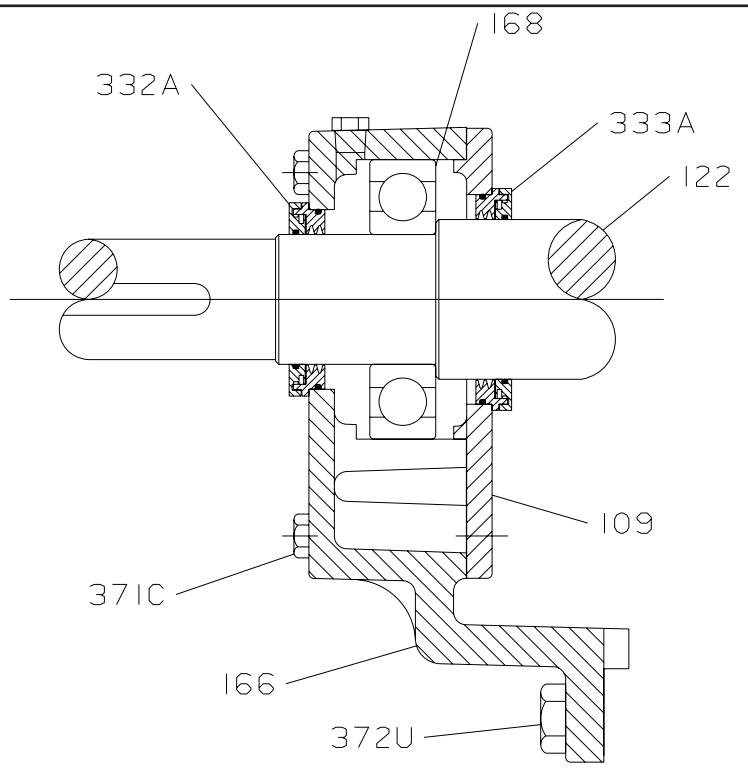
⚠ WARNING

Do not lift the entire pump using the lifting lugs. They are not designed to support the full weight of the casing. They may break and cause serious physical injury and severely damage the pump.

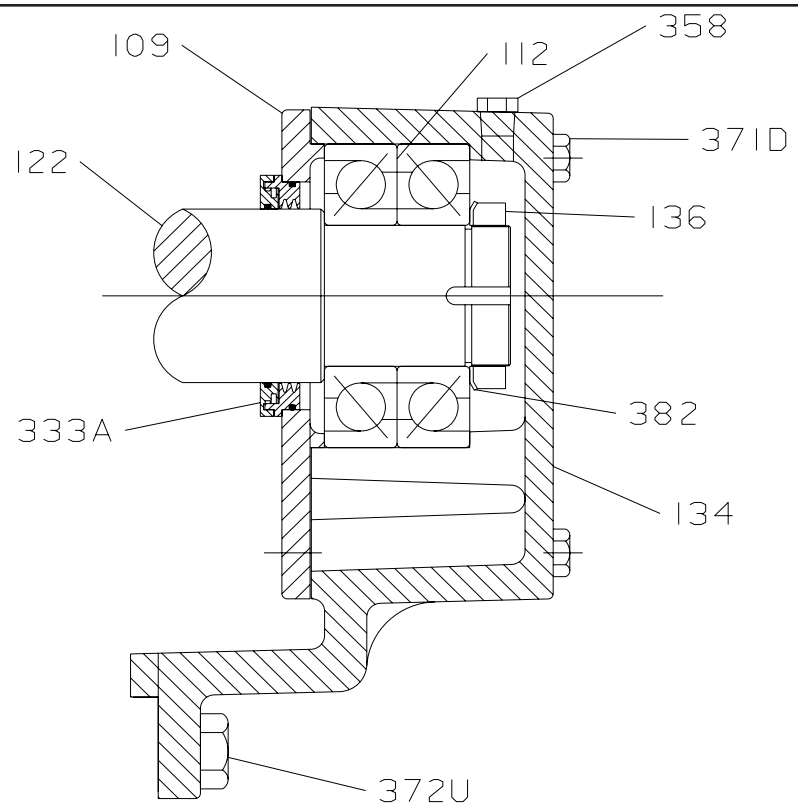
13. Exercise care to prevent the casing gasket from tearing.

Removal of the Bearing Housings and Bearings

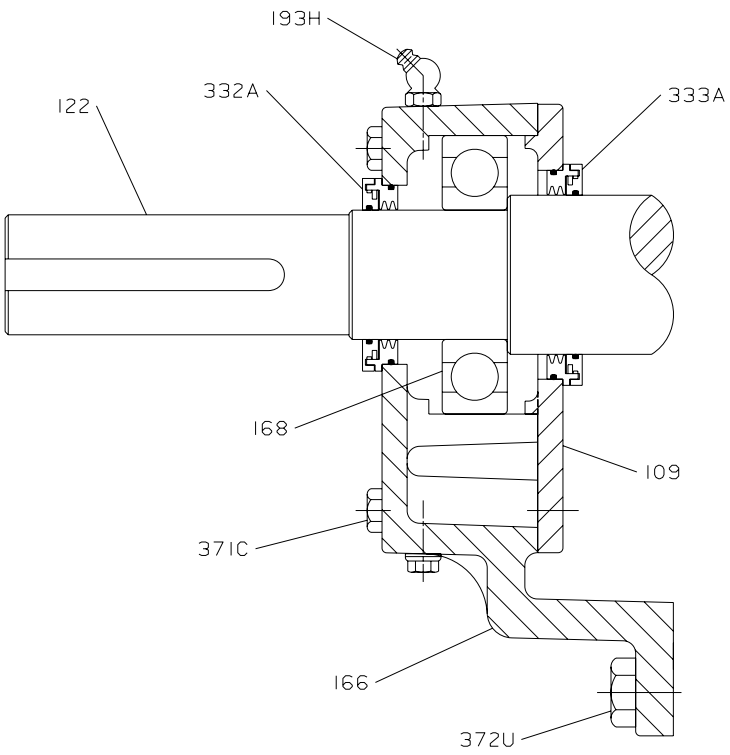
A. SX/MX Group - 12x14-15, 16x18-17H, 18x20-20



Flood Oil, Radial Fig. 29

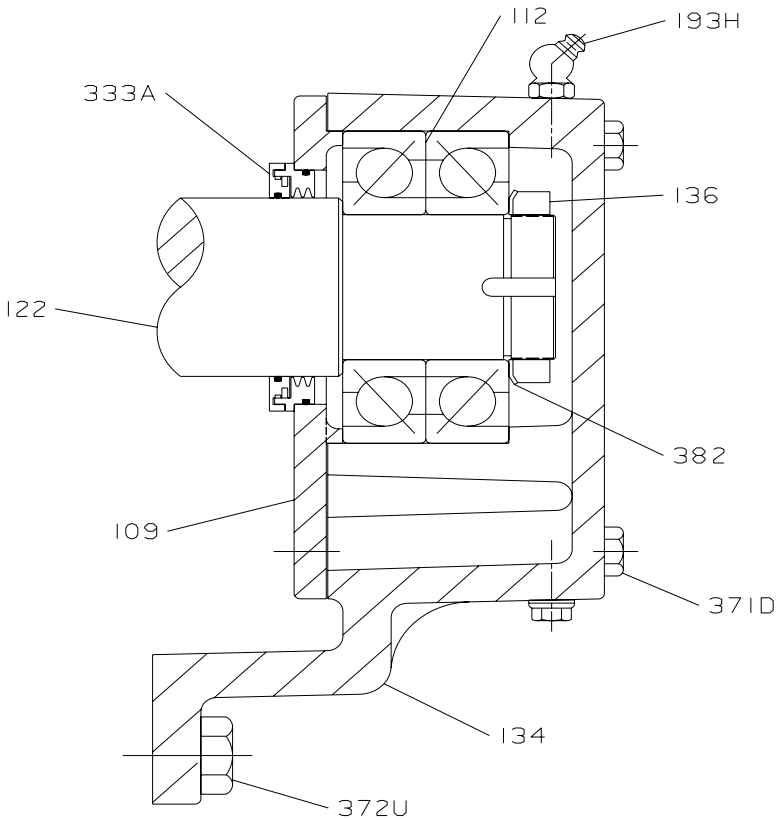


Flood Oil, Thrust Fig. 30



Grease, Radial

Fig. 31



Grease, Thrust

Fig. 32

SX/MX Group (Figs. 29-33)

1. Remove the eight bearing housing to casing capscrews (372U).
2. Place the sling in position, refer to Fig. 33. Adjust the sling tension to take weight off of the rotating element. Make sure all stationary parts of the rotating element are loose before the rotating element is removed. It is desirable to rotate the casing wearing rings (127) 180° to disengage the tongue and groove locks.

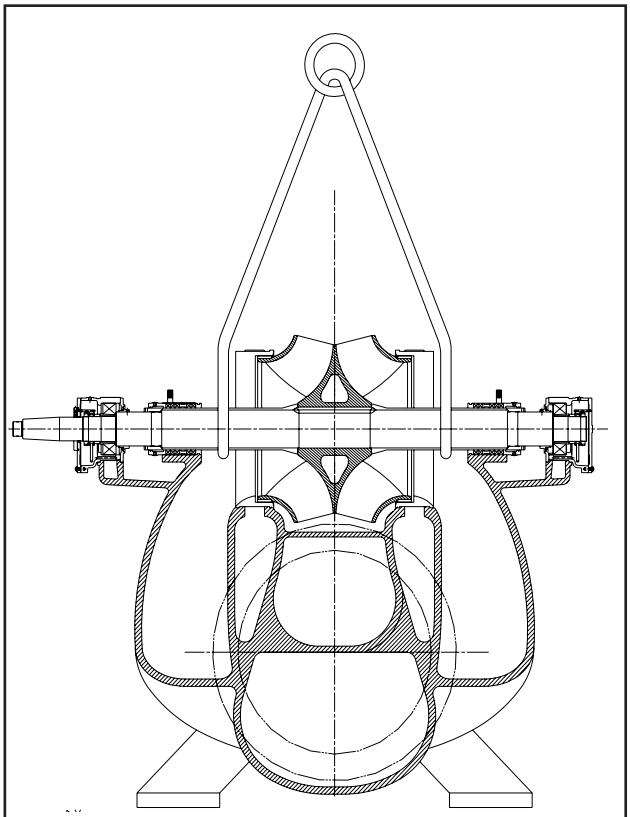
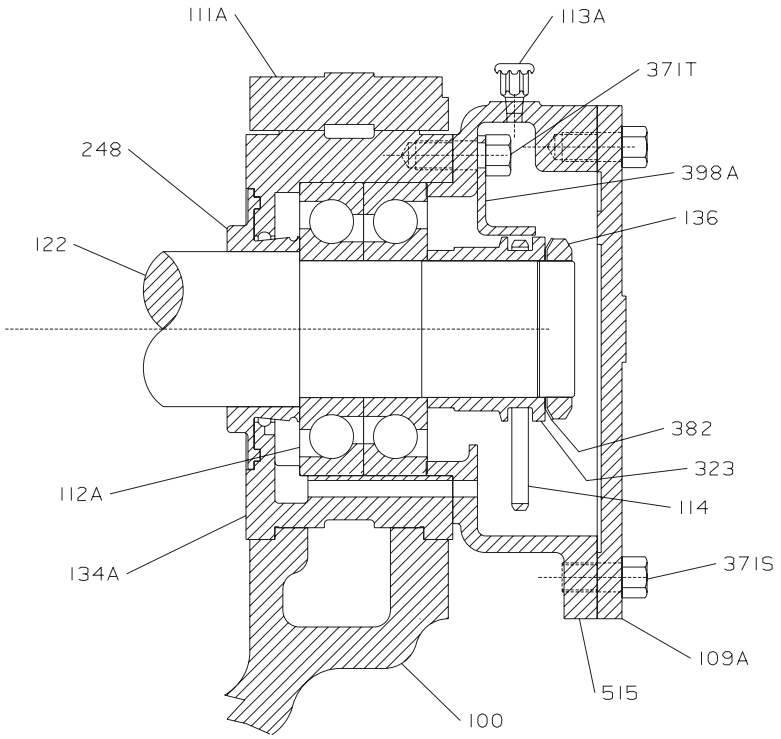


Fig. 33

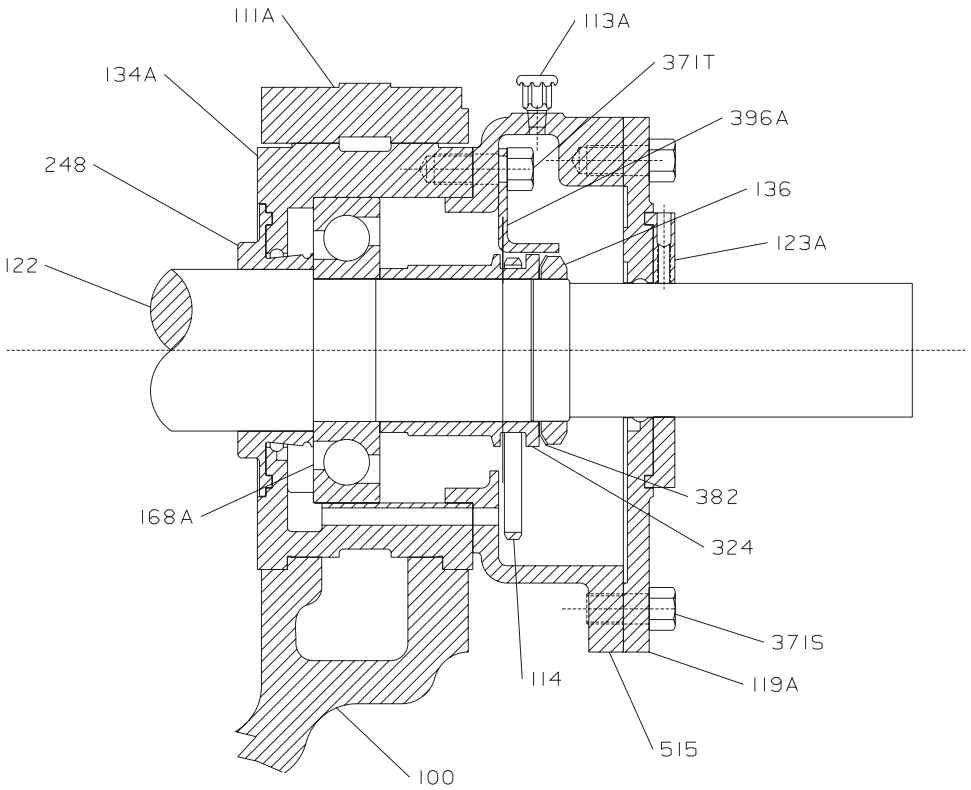
3. Remove the element and place it on padded supports.
4. Slide the casing rings off the rotating element.
5. Scribe the coupling position on the shaft (122) and remove the coupling and the coupling key (400).
6. Remove eight bearing housing to bearing end cover capscrews (371C and 371D).
7. Remove the outboard (thrust) bearing housing (134) by sliding it over the thrust bearings (112).
8. Remove the coupling end bearing housing (166) and labyrinth seal (332A) together by sliding them over the radial bearing (168) and off the shaft.
9. Press the labyrinth seal out of the bearing housing from the inside with a suitablly sized arbor.
10. Straighten the tangs in the bearing lockwasher (382) and remove the bearing locknut (136) and lockwasher from the outboard (thrust) end of the shaft.
11. Remove the thrust and radial bearings using a bearing puller per the instructions in the Preventive Maintenance section, (Figures 25 and 26). Save the bearings for inspection.
12. Slide the bearing end covers (109) and labyrinth seals (333A) off of the shaft. Press the labyrinth seals out of the end covers from the inside using a suitably sized arbor.

B. M Group - 16x18-30, 18x20-30, 20x24-24, 20x24-30, 20x24-28, 18x20-24



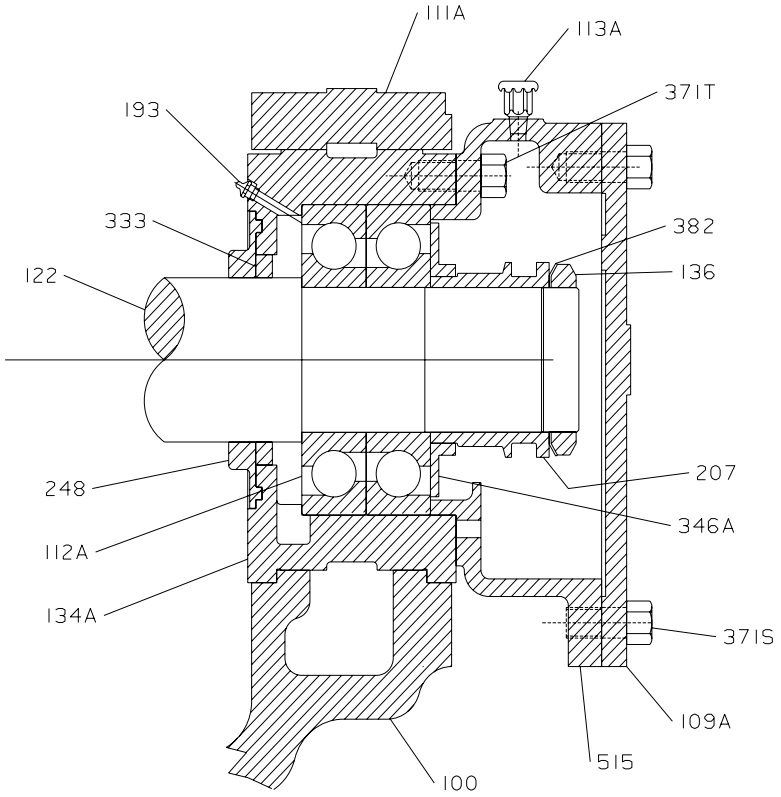
Ring Oil, Thrust

Fig. 34



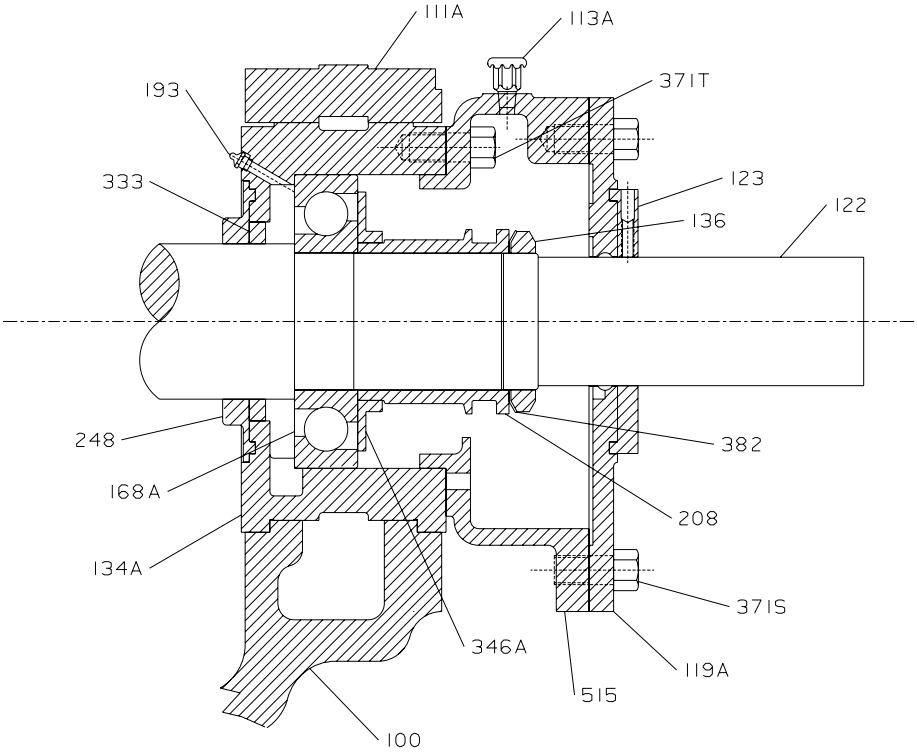
Ring Oil, Radial

Fig. 35



Grease, Thrust

Fig. 36



Grease, Radial

Fig. 37

M Group (Figs. 34-37)

1. Loosen the set screw (222P) and slide the dust cover (123A) towards the coupling.
2. Remove the bearing cap hex nuts (425A) and the bearing caps (111A). Match-mark each bearing cap. They must be replaced on the same end and in the same position on the pump during reassembly.

NOTE: The casing and the bearing caps are machined as a matched set.

CAUTION

Failure to reassemble the pump with the bearing caps in the correct position could result in damage to the pump.

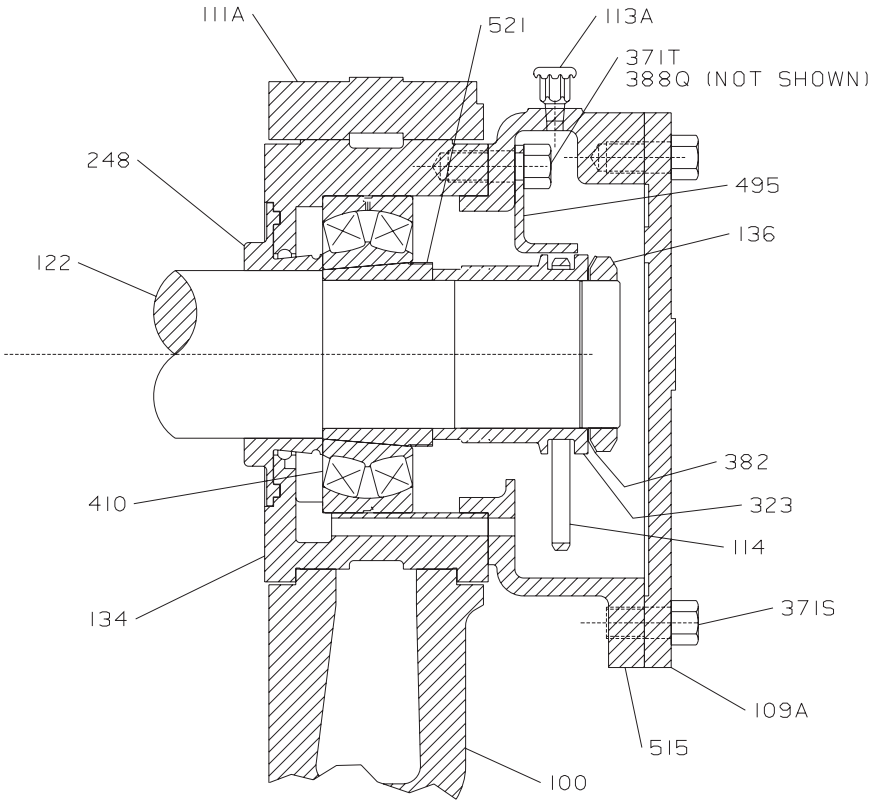
3. Place the sling in position, refer to Fig. 33. Adjust the sling tension to take weight off of the rotating element. Make sure all stationary parts of the rotating element are loose before the rotating element is removed. It is desirable to rotate the casing wearing rings (127), stuffing box bushings (125), and the bearing housings (134A) 180° to disengage the tongue and groove locks.
4. Remove the element and place it on padded supports.
5. Slide the casing rings off the rotating element.
6. Scribe the coupling position on the shaft (122) and remove the coupling and the coupling key (400).
7. Unbolt and remove both bearing end covers (109A and 119A).
8. Oil Lubrication: Remove the oil rings (114) and the oil ring housings (515).

   Grease Lubrication: Remove the oil ring housings (515).
9. Loosen the set screws (363B) in the oil throwers (248) and slide them toward the shaft sleeves (126).
10. Straighten the tangs in the lockwashers (382) and remove both bearing locknuts (136) and lockwashers.
11. Slide the oil ring sleeves (324/323 or 207/208) off of the shaft.

NOTE: On grease lubricated units, a grease shield (346A) is mounted on the oil ring sleeves (207 and 208).

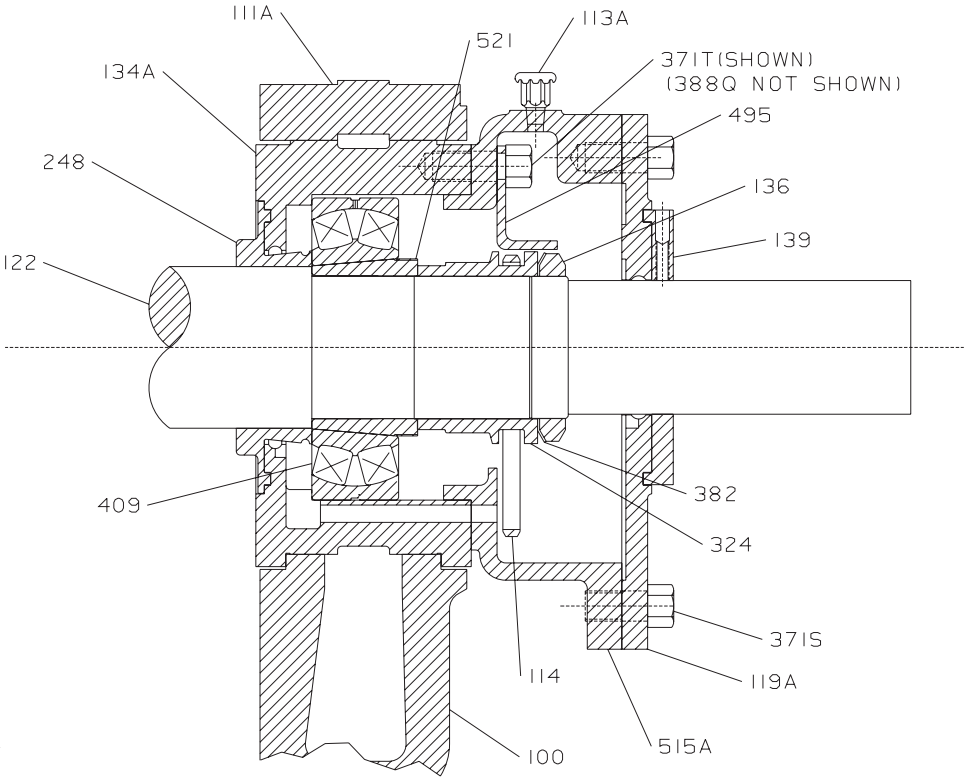
12. Remove the bearings (112A and 168A) using the bearing puller shown in Figs. 23 and 24 and as documented in Section 5. Save the bearings for inspection.
13. Slide the bearing housings off of the shaft.
14. Slide the oil throwers off of the shaft.

C. L GROUP - 24X30-32



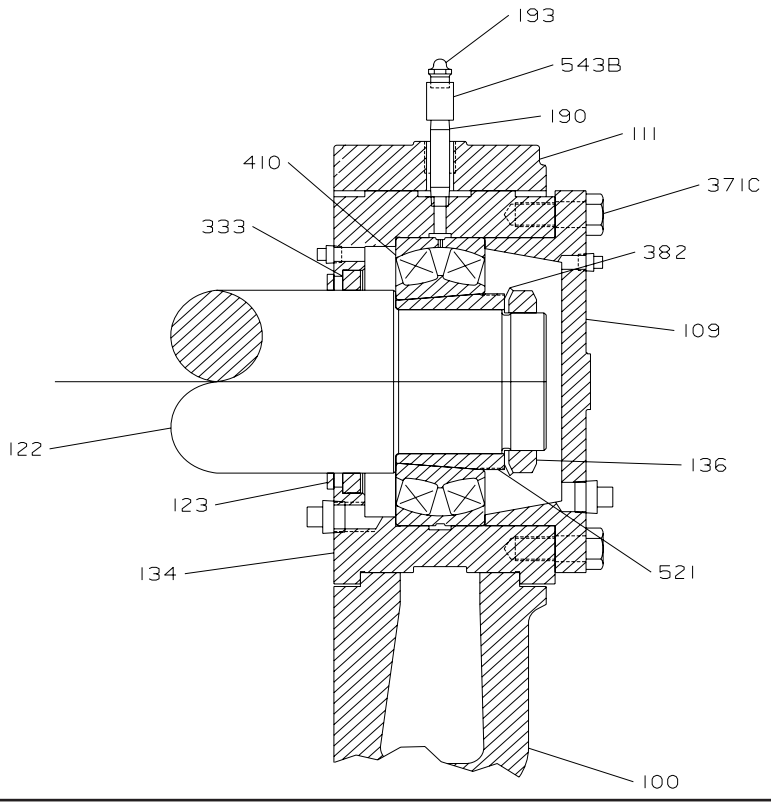
Ring Oil, Thrust

Fig. 38



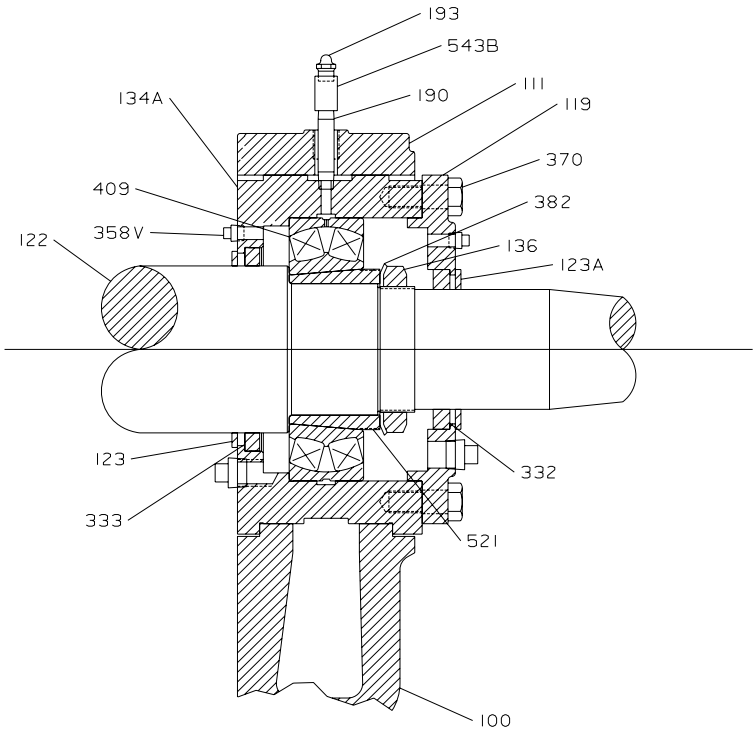
Ring Oil, Radial

Fig. 39



Grease, Thrust

Fig. 40



Grease, Radial

Fig. 41

L Group (Figs. 38-41)

1. Oil Lubrication: Loosen the set screw (363B) in the dust cover (139) on the coupling end and slide it towards the coupling.

   Grease Lubrication: Slide the deflector (123A) on the coupling end toward the coupling.

2. Remove the bearing cap hex nuts (425A) and the bearing cap (111A). Match-mark each bearing cap. They must be replaced on the same end and in the same position on the pump during reassembly.

! CAUTION

Failure to reassemble the pump with the bearing caps in the correct position could result in damage to the pump.

NOTE: The casing and the bearing caps are machined as a matched set.

3. Place the sling in position, refer to Fig. 33 (p. 43). Adjust the sling tension to take weight off of the rotating element. Make sure all stationary parts of the rotating element are loose before the rotating element is removed. It is desirable to rotate the casing wearing rings (127) , stuffing box bushings (125), and the bearing housings (134 and 134A) 180° to disengage the tongue and groove locks.

4. Remove the element and place it on padded supports.

5. Slide the casing rings off the rotating element.

6. Scribe the coupling position on the shaft (item 122) and remove the coupling and the coupling key (400).

7. Oil Lubrication: Slide the dust cover (139) off of the coupling end of the shaft.

   Grease Lubrication: Slide the deflector (123A) off of the coupling end of the shaft.

8. Unbolt and remove both bearing end covers (109A and 119A).

9. Oil Lubrication: Remove the oil rings (114) and the oil ring housings (515).

10. Straighten the tangs in the lockwashers (382) and remove both bearing locknuts (136) and lockwashers.

11. Oil Lubrication: Slide the oil ring sleeves (324 and 323) off of the shaft (122).

    Grease Lubrication: Remove the grease shield (346A) and the oil ring sleeves (207 and 208).

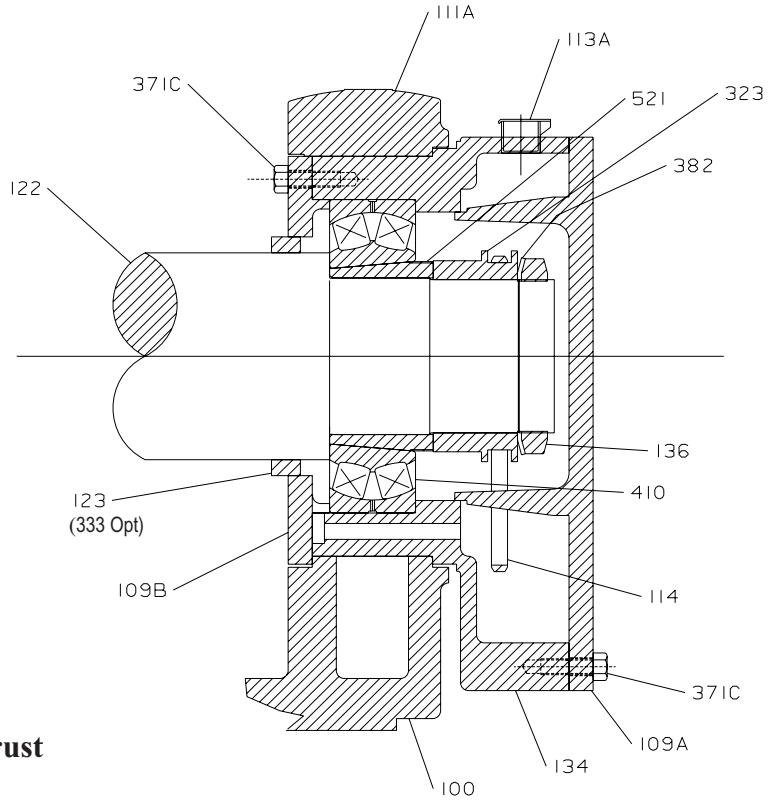
12. To remove the bearings (409 and 410), refer to the instruction in Section 5.

13. Slide the bearing housings off of the shaft.

14. Oil Lubrication: Loosen the set screws (363B) in the oil throwers (248) and slide the oil throwers off of the shaft.

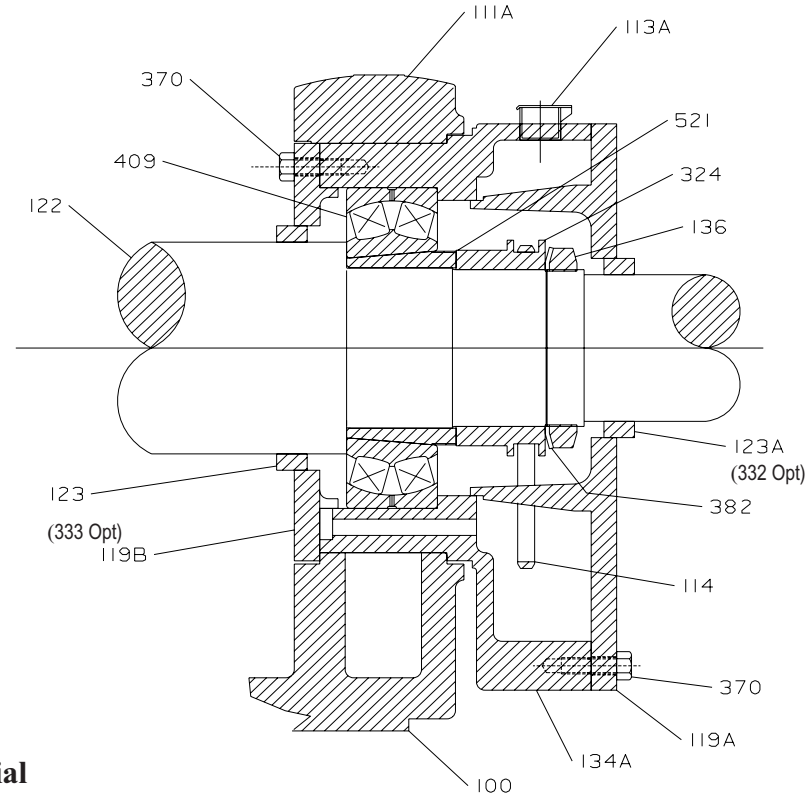
    Grease Lubrication: Slide the deflectors (123) off of the shaft.

D. LDS, XL, XXL Group - 30x30-31, 30x30-38, 30x36-42, 20x30-42, 36x42-52



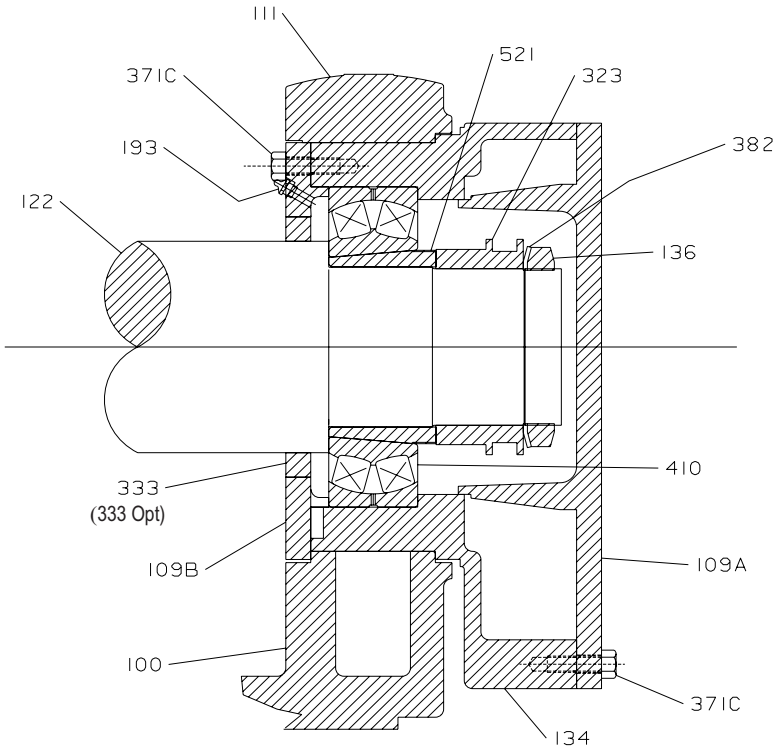
LDS Ring Oil, Thrust

Fig. 42



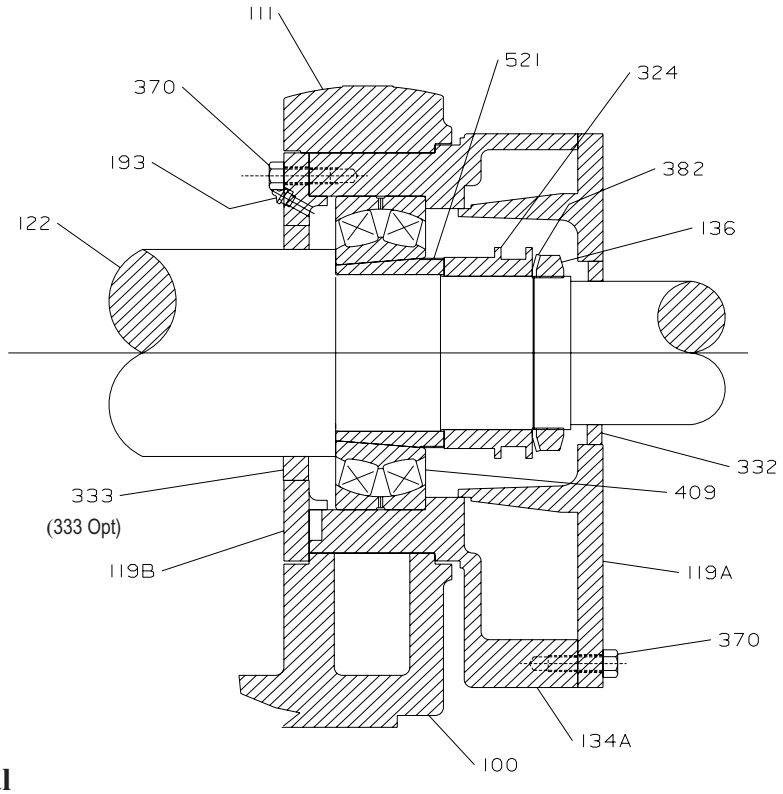
LDS Ring Oil, Radial

Fig. 43



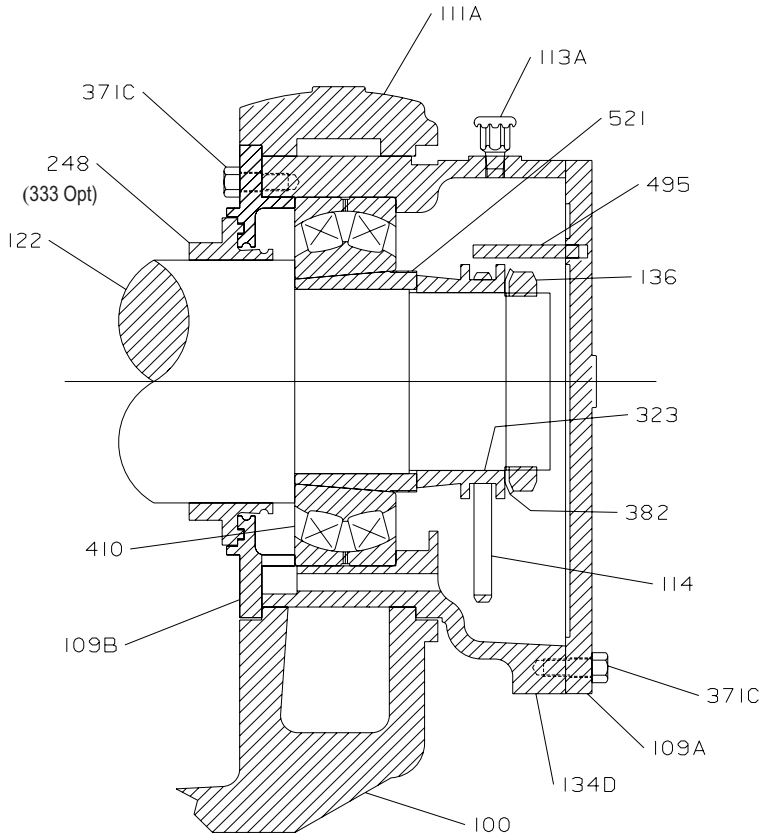
LDS Grease, Thrust

Fig. 44



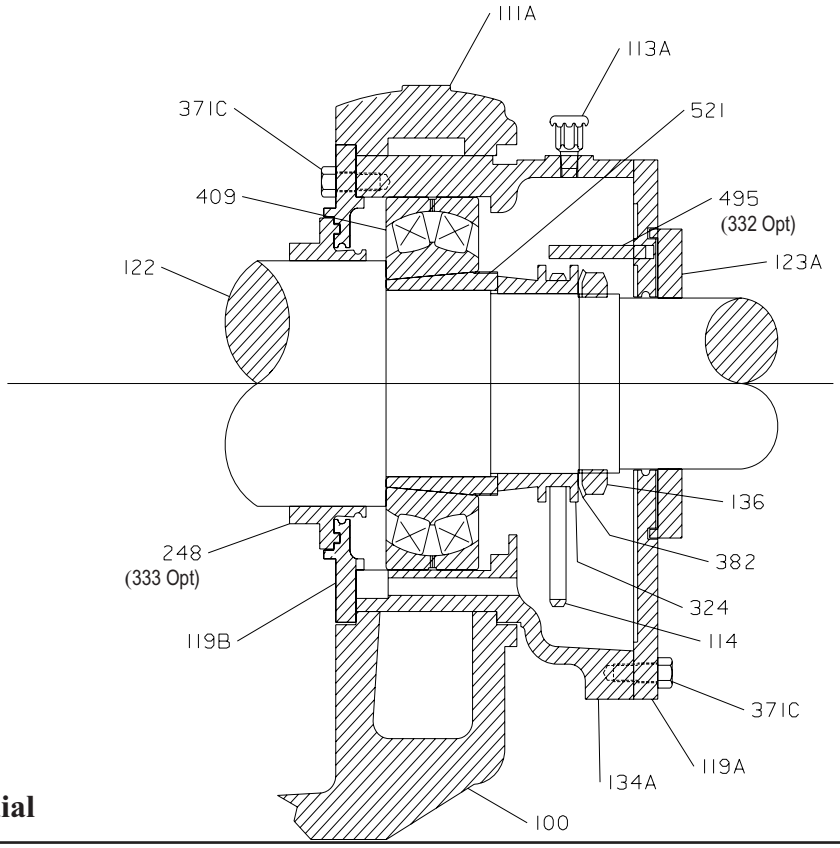
LDS Grease, Radial

Fig. 45



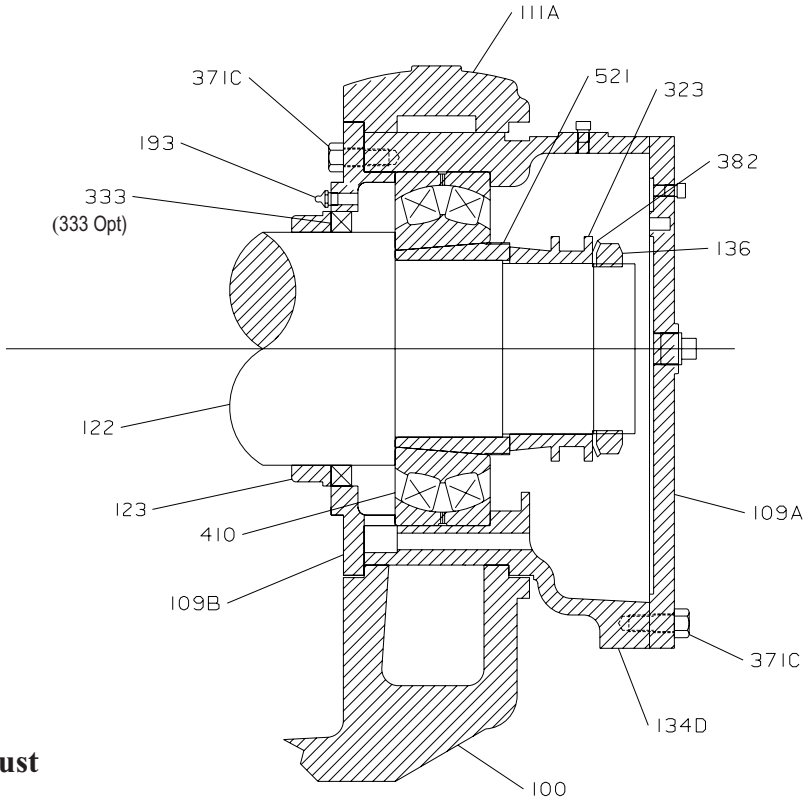
XL Ring Oil, Thrust

Fig. 46



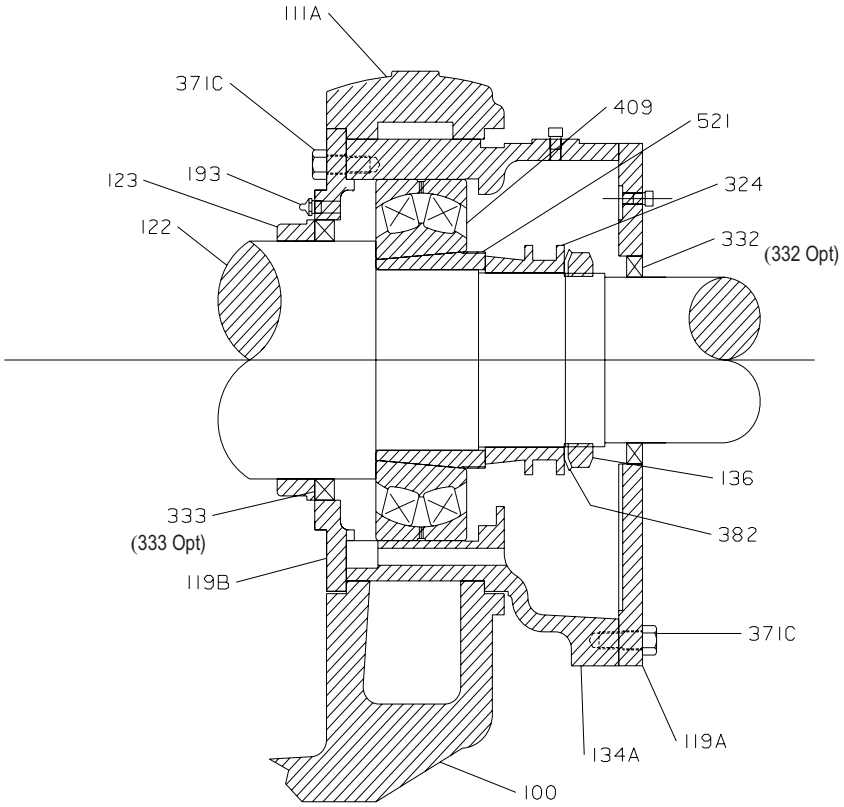
XL Ring Oil, Radial

Fig. 47



XL Grease, Thrust

Fig. 48



XL Grease, Radial

Fig. 49

LDS, XL, and XXL Group

1. Oil Lubrication: Loosen the set screw (364) in the dust cover (123A) on the coupling end and slide it towards the coupling.

   Grease Lubrication: Slide the deflector (332) on the coupling end toward the coupling.

   (See Step 15 for optional labyrinth seals).

2. Remove the bearing cap hex nuts (425A) and the bearing cap (111). Match-mark each bearing cap. They must be replaced on the same end and in the same position on the pump during reassembly.

! CAUTION

Failure to reassemble the pump with the bearing caps in the correct position could result in damage to the pump.

NOTE: The casing and the bearing caps are machined as a matched set.

3. Place the sling in position, refer to Fig. 33. Adjust the sling tension to take weight off of the rotating element. Make sure all stationary parts of the rotating element are loose before the rotating element is removed. It is desirable to rotate the casing wearing rings (127), stuffing box bushings (125), and the bearing housings (134 and 134A or 134A and 134D) 180° to disengage the tongue and groove locks.
4. Remove the element and place it on padded supports.
5. Slide both casing rings off the rotating element.
6. Scribe the coupling position on the shaft (item 122) and remove the coupling and the coupling key (400).
7. Oil Lubrication: Slide the dust cover (123A) off of the coucpling end of the shaft.

   (See Step 15 for optional labyrinthh seals).

   Grease Lubrication: Slide the deflector (332) off of the cou;ing end of the shaft.
8. Unbolt and remove both bearing end covers (109A and 119A).
9. Oil Lubrication: Remove the oil rings (114).
10. Straighten the tangs in the lockwashers (382) and remove both bearing locknuts (136) and lockwashers.
11. Oil Lubrication: Slide the oil ring sleeves (324 and 323) off of the shaft (122).

    Grease Lubrication: Remove the grease shield (346A) and the oil ring sleeves (207 and 208).
12. To remove the bearings (409 and 410), refer the instruction in Section 5.
13. Slide the bearing housings and the inboard bearing end covers (109B and 119B) off of the shaft. If desired, at this time, the inboard bearing end covers can be removed from the bearing housings in order to replace the end cover to housing gasket (360N or 360B).
14. Oil Lubrication: Loosen the set screws (364) in the oil throwers (248) and slide the oil throwers off of the shaft.

    Grease Lubrication: Slide the deflectors (333) off of the shaft.

    (See Step 15 for optional laby seals).
15. With labyrinth seal option (332 Opt, 333 Opt), see Paragraphs 8, 9, 12 for SX/MX Group bearing housing disassembly.

DISASSEMBLY OF THE ROTATING ELEMENT

1. **Conventional Mechanical Seals:** Slide the gland, with the stationary seats in place, off of the shaft. Use care to prevent damage to the seal faces.

   Cartridge Mechanical Seals: Slide the mechanical seal (383) off of the shaft.

   Packed Stuffing Box: Slide the glands (107) off of the shaft. Remove the packing (106), lantern rings (105), and stuffing box bushings (125).
2. Loosen the set screws (222B) in the sleeve nuts (124). Using a spanner or strap wrench, remove the sleeve nuts. Discard the sleeve O-rings (497).

NOTE: One sleeve has right hand threads and one has left hand threads. The nuts tighten against the pump's rotation.

3. Smoothe the shaft (122) with a fine emery cloth so that the sleeves will not bind upon removal.
4. Carefully slide the sleeves (126) off of the shaft. Discard the impeller O-rings (412A).

NOTE: If the pump has conventional mechanical seals, the sleeves will still have the stuffing box bushings and the rotary elements of the mechanical seals still mounted.

5. Lightly scribe a line on the shaft at the impeller hub (101). This will determine the proper position of the impeller on the shaft for reassembly.
6. Press or drive the impeller off of the shaft.

! WARNING

Do not damage the impeller hub surface. This is an O-ring sealing surface. Damage to the hub surface could result in a failed seal. A failed seal could result in serious physical injury.

7. Remove the impeller key (178).

INSPECTION AND OVERHAUL

The model 3420 parts must be inspected to the following criteria before they are reassembled to ensure the pump will run properly. Any part not meeting the required criteria should be replaced.

GENERAL

Clean all parts before assembly. This is especially important at all O-ring grooves, threads, and bearing areas. Remove any burrs. Replace all o-rings. Inspect labyrinth seals for rubbing and wear. Replace as required. Replace all lip (grease) seals. Inspect the oil rings. Replace if worn excessively. Inspect and replace as necessary the mechanical seal and/or its components per the manufacturer's instructions.

CASING

The casing (100) should be inspected for excessive wear or pitting, particularly at the cutwater areas. It should be repaired or replaced if the wear or pitting exceeds 1/8 in depth. The parting gasket surfaces on both the upper and lower halves should be cleaned and inspected for any irregularities.

PARTING GASKET

Inspect the parting flange gaskets (351S and 351D) and replace if torn or otherwise damaged. The recommended gasket materials are Garlock Blue Gard 3000™ or Armstrong N8090. See Table 8 for the correct gasket thickness. Use the upper half casing as a template. Strike the sheet with a soft face hammer. This will cut the gasket against the edge of the casing.

! CAUTION

Take care not to chip any internal coatings that may have been applied to the casing's internal passages. If the casing has an internal coating, it may be easier to cut the gasket using a knife.

The gasket must cover the entire surface of the parting flange. Pay special attention to the areas around the wear ring locks.

NOTE: If the area around the wear ring locks are not properly sealed, leakage will occur from the high to the low pressure zones in the pump. This will result in lost performance and efficiency.

For pumps with mechanical seals, cut the gasket approximately ¼ in (6.35 mm) long at the face of the stuffing box. This excess then should be trimmed to a perfect fit after the pump casing is assembled.

NOTE: SX and MX pump parting flange gaskets are supplied with pre-cut outer edges and fastener holes.

IMPELLER

Inspect the impeller (101) and replace if there is excessive wear due to erosion or corrosion, particularly at the leading and trailing edges of the impeller vanes. If the impeller needs to be trimmed, it should be balanced to the tolerances in Table 7. Determine whether a single plane or a two plane spin balance is required by calculating the diameter to width ratio of the trimmed impeller. Imbalance can be corrected by grinding on the outside of the shrouds near the impeller periphery. The impeller bore diameter should be measured to ensure a proper fit on the shaft. Refer to Table 8 for the correct tolerances. Contact your Goulds representative for special requirements on Lo-Pulse impellers or rotating elements.

Table 7

Group	Size	Impeller Drawing	Pattern	Pump Max Speed (rpm)	Static D/b | 6 G2.5 X/N		Dynamic D/b | 6 G2.5 X/N	
					oz. in./lb per plane	g mm/kg per plane	oz. in./lb per plane	g mm/kg per plane
SX	12x14-15	D06911A	69117	1800	0.009	14.29	0.0045	7.14
		D07551A	69407	1800	0.009	14.29	0.0045	7.14
	16x18-17H	D06983A	69171	1200	0.013	20.64	0.0065	10.32
		D07603A	69686	1200	0.013	20.64	0.0065	10.32
MX	18x20-20			1200	0.013	20.64	0.0065	10.32
M	16x18-30	D00038A	54341	1200	0.013	20.64	0.0065	10.32
		D00039A	55147	1200	0.013	20.64	0.0065	10.32
	16x18-30G	113-13	57068	1200	0.013	20.64	0.0065	10.32
		D00016A	57068	1200	0.013	20.64	0.0065	10.32
	16x18-30H	112-62	57024	1200	0.013	20.64	0.0065	10.32
		D00321A	57024	1200	0.013	20.64	0.0065	10.32
	18x20-30	250-2	54342	1200	0.013	20.64	0.0065	10.32
		252-121	55148	1200	0.013	20.64	0.0065	10.32
	20x24-24	253-6	55098	1200	0.013	20.64	0.0065	10.32
		253-12	55197	1200	0.013	20.64	0.0065	10.32
	20x24-30	254-105	55442	1200	0.013	20.64	0.0065	10.32
		257-89	55796	1200	0.013	20.64	0.0065	10.32
M (mod)	20x24-28	D01533A	58714	900	0.018	28.58	0.009	14.29
		D01536A	58717	900	0.018	28.58	0.009	14.29
		D00225A	57692	900	0.018	28.58	0.009	14.29
		D01109A	58337	900	0.018	28.58	0.009	14.29
	20x24-28G	D02282A	58954	900	0.018	28.58	0.009	14.29
		D02283A	58955	900	0.018	28.58	0.009	14.29
	20x24-28H	D01539A	58719	900	0.018	28.58	0.009	14.29
	20x24-28N	D02299A	58976	900	0.018	28.58	0.009	14.29
		D02300A	58977	900	0.018	28.58	0.009	14.29
—	18x20-24	D01532A	58713	1200	0.013	20.64	0.0065	14.29
		D01535A	58716	1200	0.013	20.64	0.0065	14.29
	18x20-24G	D02280A	58952	1200	0.013	20.64	0.0065	14.29
		D02281A	58953	1200	0.013	20.64	0.0065	14.29
	18x20-24N	D02301A	58978	1200	0.013	20.64	0.0065	14.29
		D02302A	58979	1200	0.013	20.64	0.0065	14.29
L	24x30-32	265-84	56879	900	0.018	28.58	0.009	14.29
		262-25	56529	900	0.018	28.58	0.009	14.29
	24x30-32G	267-21	56884	900	0.018	28.58	0.009	14.29
		D00013A	57618	900	0.018	28.58	0.009	14.29
	24x30-323H	267-27	56890	700	0.024	38.1	0.012	19.05
		D00014A	57643	700	0.024	38.1	0.012	19.05
	24x30-32N	265-82	56848	700	0.024	38.1	0.012	19.05
		262-22	56528	700	0.024	38.1	0.012	19.05

Table 7

Group	Size	Impeller Drawing	Pattern	Pump Max Speed (rpm)	Static D/b | 6 G2.5 X/N		Dynamic D/b | 6 G2.5 X/N	
					oz. in./lb per plane	g mm/kg per plane	oz. in./lb per plane	g mm/kg per plane
LDS	30x30-31	D02370A	63131	700	0.024	38.1	0.012	19.05
		D02414A	63030	700	0.024	38.1	0.012	19.05
	30x30-31G	D05540A	68567	900	0.018	28.58	0.009	14.29
	30x30-38	D02257A	57783	700	0.024	38.1	0.012	19.05
		D02259	58685	700	0.024	38.1	0.012	19.05
	30x30-38G	D02284A	58596	700	0.024	38.1	0.012	19.05
		D02285A	58597	700	0.024	38.1	0.012	19.05
	30x30-38N	D02297A	58973	700	0.024	38.1	0.012	19.05
		D02298A	58974	700	0.024	38.1	0.012	19.05
XL	30x36-42	D01537A	58718	700	0.024	38.1	0.012	19.05
		D01534A	58715	700	0.024	38.1	0.012	19.05
		D00147A	57644	700	0.024	38.1	0.012	19.05
		267-56	57038	700	0.024	38.1	0.012	19.05
	30x36-42G	D02286A	58958	700	0.024	38.1	0.012	19.05
		D02287A	58959	700	0.024	38.1	0.012	19.05
	30x36-42H	267-57	57039	600	0.0304	48.26	0.0152	24.13
		272-80	57039	600	0.0304	48.26	0.0152	24.13
	30x36-42N	D07751A	69830	600	0.0304	48.26	0.0152	24.13
	20X30-42	D11284A	IE994	600	0.0304	48.26	0.0152	24.13
XXL	36x42-52	E02707A	IE922	600	0.0304	48.26	0.0152	24.13

Table 8 (inches)

Group	Sizes	S.B. Bushing I.D.	Shaft Sleeve O.D.	Dia. Clearance	Impeller Hub I.D.	Impeller Shaft O.D.	Tol.	Parting Flange Gasket Thk.
SX	12x14-15 16x18-17H	3420 4.191/4.195 3425 4.191/4.195	3420 4.125/4.123 3425 4.134/4.132	3420 .066/.072 3425 .057/.063	3.5433 3.5447	3.5428 3.5420	.0005 .0027	1/32
MX	18x20-20	3420 4.932/4.936 3425 4.978/4.982	3420 4.875/4.873 3425 4.921/4.919	3420 .057/.063 3425 .057/.063	4.5276 4.5289	4.5271 4.5262	.0005 .0027	1/32
M	16x18-30 18x20-30 20x24-24 20x24-30	5.548 5.553	5.498 5.496	.050 .057	5.125 5.126	5.124 5.123	.001 .003	1/64
M (Modified)	20x24-28	5.548 5.553	5.498 5.496	.050 .057	5.125 5.126	5.124 5.123	.001 .003	1/64
—	18x24-24	5.050 5.055	5.000 4.998	.050 .057	4.375 4.376	4.374 4.373	.001 .003	1/64
L	24x30-32	6.552 6.557	6.492 6.490	.060 .067	6.125 6.126	6.124 6.123	.001 .003	1/64
LDS	30x30-31 30x30-38	7.560 7.565	7.500 7.498	.060 .067	6.875 6.876	6.874 6.873	.001 .003	1/32
XL	30x36-42	8.060 8.065	8.00 7.998	.060 .067	7.250 7.251	7.249 7.248	.001 .003	1/64
	20x30-42	7.560 7.565	7.500 7.498	.060 .067	6.875 6.876	6.874 6.873	.001 .003	1/32
XXL	36x42-52	9.060 9.065	9.000 8.998	.060 .067	8.250 8.251	8.248 8.249	.001 .003	1/32

Table 8 (mm)

Group	Sizes	S.B. Bushing I.D.	Shaft Sleeve O.D.	Dia. Clearance	Impeller Hub I.D.	Impeller Shaft O.D.	Tol.	Parting Flange Gasket Thk.
SX	12x14-15 16x18-17H	3420 106.45/.55 3425 106.45/.55	3420 104.78/.72 3425 105.000/104.95	3420 1.68/1.83 3425 1.45/1.60	90.00 90.04	89.99 89.97	.0127 .0686	.794
MX	18x20-20	3420 125.27/.37 3425 126.44/.54	3420 123.83/.77 3425 124.99/.94	3420 1.45/1.60 3425 1.45/1.60	115.00 115.03	114.99 114.97	.0127 .0686	.794
M	16x18-30 18x20-30 20x24-24 20x24-30	140.92 141.05	139.65 139.60	1.27 1.45	130.18 130.20	130.15 130.12	.0254 .0762	.397
M (Modified)	20x24-28	140.92 141.05	139.65 139.60	1.27 1.45	130.18 130.20	130.15 130.12	.0254 .0762	.397
—	18x24-24	128.27 128.49	139.65 139.60	1.27 1.45	111.13 111.15	111.10 111.07	.0254 .0762	.397
L	24x30-32	166.42 166.55	164.90 164.85	1.52 1.70	155.58 155.60	155.55 155.52	.0254 .0762	.397
LDS	30x30-31 30x30-38	192.02 192.15	190.50 190.45	1.52 1.70	174.63 174.65	174.60 174.57	.0254 .0762	.397
XL	30x36-42	204.72 204.85	203.20 203.15	1.52 1.70	184.15 184.18	184.12 184.10	.0254 .0762	.397
	20x30-42	192.02 192.15	190.50 190.45	1.52 1.70	174.63 174.65	174.60 174.57	0.0254 0.0762	0.794 0.794
XXL	36x42-52	230.12 230.25	228.60 228.55	1.52 1.70	209.55 209.58	209.50 209.52	0.0254 0.0762	0.794 0.794

WEAR RINGS

The clearance between the casing wear rings (127) and the impeller wear rings (142) is shown in. When hydraulic performance is reduced substantially, the casing and/or impeller wear rings should be replaced.

Table 9 (inches)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
SX	12x14-15	Iron & Bronze	7	11.214	11.227	.013	11.214	11.227	.013	.38	8°
				11.212	11.229	.017	11.212	11.229	.017		
		Steel	7	11.214	11.237	.023	11.224	11.237	.023	.38	8°
				11.212	11.239	.027	11.222	11.239	.027		
	16x18-17H	Iron & Bronze	7	13.970	13.983	.013	13.970	13.983	.013	.50	8°
				13.968	13.985	.017	13.968	13.985	.017		
		Steel	7	13.970	13.993	.023	13.970	13.993	.023	.50	8°
				13.968	13.995	.027	13.968	13.995	.027		
MX	18x20-20	Iron & Bronze	5 & 6	16.529	16.542	.013	16.529	16.542	.013	.87	8°
				16.527	16.544	.017	16.527	16.544	.017		
		Steel	5 & 6	16.529	17.373	.023	16.529	17.373	.023	.87	8°
				16.527	17.376	.027	16.527	17.376	.027		
M	16x18-30	Iron & Bronze	5	17.355	17.383	.018	17.355	17.383	.018	.38	8°
				17.352	17.386	.024	17.352	17.386	.024		
		Steel	5	17.355	17	.373.028	17.355	17.373	.028	.38	8°
				17.352	17.376	.034	17.352	17.376	.034		
	16x18-30H	Iron & Bronze	7	17.355	17.383	.018	17.355	17.383	.018	.62	8°
				17.352	17.386	.024	17.352	17.386	.024		
		Steel	7	17.355	17.373	.028	17.355	17.373	.028	..62	8°
				17.352	17.376	.034	17.352	17.376	.034		
	16x18-30G	Iron & Bronze	7	17.355	17.383	.018	17.355	17.383	.018	.62	8°
				17.352	17.886	.024	17.352	17.886	.024		
		Steel	7	17.355	17.383	.028	17.355	17.383	.028	.62	8°
				17.352	17.386	.034	17.352	17.386	.034		
	18x20-30	Iron & Bronze	5	19.528	19.548	.020	18.595	18.615	.020	.38	8°
				19.525	19.551	.026	18.592	18.618	.026		
		Steel	5	19.528	19.558	.030	18.595	18.625	.030	.38	8°
				19.525	19.561	.036	18.592	18.628	.036		
	20x24-24	Iron & Bronze	5 & 6	18.345	18.365	.020	18.345	18.365	.020	.38	8°
				18.342	18.368	.026	18.342	18.368	.026		
		Steel	5 & 6	18.345	18.375	.030	18.345	18.375	.030	.38	8°
				18.342	18.378	.036	18.342	18.378	.036		
	20x24-30	Iron & Bronze	5 HIGH RPM	19.528	19.548	.020	18.595	18.615	.020	.38	8°
				19.525	19.551	.026	18.592	18.618	.026		
		Steel	5 HIGH RPM	19.528	19.548	.030	18.595	18.625	.030	.38	8°
				19.525	19.551	.036	18.592	18.628	.036		
	20x24-30	Iron & Bronze	5 LOW RPM	21.903	19.558	.022	20.968	20.990	.022	.38	8°
				21.900	19.561	.028	20.965	20.993	.028		
		Steel	5 LOW RPM	21.903	21.928	.032	20.968	21.000	.032	.38	8°
				21.900	21.928	.038	20.965	21.003	.038		

Table 9 (inches) (con't)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
M Modified	20x24-28	Iron & Bronze	6&7	18.480	18.500	.020	18.480	18.500	.020	.38	8°
				18.477	18.503	.026	18.477	18.503	.026		
		Steel	6&7	18.470	18.500	.030	18.470	18.500	.030	.38	8°
				18.477	18.530	.036	18.477	18.503	.036		
	20x24-28H	Iron & Bronze	7	19.538	19.558	.020	19.538	19.558	.020	.38	8°
				19.535	19.561	.026	19.535	19.561	.026		
		Steel	7	19.528	19.558	.030	19.528	19.558	.030	.38	8°
				19.525	19.561	.036	19.525	19.561	.036		
	20x24-28N	Iron & Bronze	5	18.980	19.000	.020	18.980	19.000	.020	.38	8°
				18.977	19.003	.026	18.977	19.003	.026		
		Steel	5	18.980	19.000	.020	18.980	19.000	.020	.38	8°
				18.977	19.003	.026	18.977	19.003	.026		
	20x24-28g	Iron & Bronze	5	17.607	17.625	.018	17.607	17.625	.018	.38	8°
				17.604	17.628	.024	17.604	17.628	.024		
		Steel	5	17.607	17.635	.028	17.635	17.635	.028	.38	8°
				17.604	17.638	.034	17.638	17.638	.034		
—	18x20-24	Iron & Bronze	6	15.492	15.508	.016	15.492	15.508	.016	.38	8°
				15.489	15.511	.022	15.489	15.511	.022		
		Steel	6	15.482	15.508	.026	15.492	15.508	.016	.38	8°
				15.479	15.511	.032	15.489	15.511	.022		
	18x20-24G	Iron & Bronze	5	14.734	14.750	.016	14.734	15.508	.016	.38	8°
				14.731	14.753	.022	14.731	15.511	.022		
		Steel	5	14.724	14.750	.026	14.724	14.750	.026	.38	8°
				14.721	14.753	.032	14.721	14.753	.032		
	18x20-24N	Iron & Bronze	5	15.984	16.000	.016	15.984	16.000	.016	.38	8°
				15.981	16.003	.022	15.981	16.003	.022		
		Steel	5	15.974	16.000	.026	15.974	16.000	.026	.38	8°
				15.971	16.003	.032	15.971	16.003	.032		
L	24x30-32	Iron & Bronze	6	23.707	23.731	.024	23.707	23.731	.024	.50	8°
				23.702	23.734	.032	23.702	23.734	.032		
		Steel	6	23.707	23.741	.034	23.707	23.741	.034	.50	8°
				23.702	23.744	.042	23.702	23.744	.042		
	24x30-32N	Iron & Bronze	6	23.707	23.731	.024	23.707	23.730	.024	.50	8°
				23.702	23.734	.032	23.702	23.734	.032		
		Steel	6	23.707	23741	.034	23.707	23.741	.034	.50	8°
				23.702	23.744	.042	23.702	23.744	.042		
	24x30-32H	Iron & Bronze	7	21.959	21.981	.022	21.959	21.981	.022	.50	8°
				21.956	21.984	.028	21.956	21.984	.028		
		Steel	7	21.959	21.991	.032	21.959	21.991	.032	.50	8°
				21.956	21.994	.038	21.956	21.994	.038		
	24x30-32G	Iron & Bronze	6	21.959	21.981	.022	21.959	21.981	.022	.50	8°
				21.956	21.984	.028	21.956	21.984	.028		
		Steel	6	21.959	21.991	.032	21.959	21.991	.032	.50	8°
				21.956	21.994	.038	21.956	21.994	.038		

Table 9 (inches) (con't)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
LDS	30x30-31	Iron & Bronze	7	23.382	23.406	.024	23.382	23.406	.024	.38	8°
				23.378	23.410	.032	23.378	23.410	.032		
		Steel	7	23.372	23.406	.034	23.372	23.406	.034	.38	8°
				23.368	23.410	.042	23.368	23.410	.042		
	30x30-31G	Iron & Bronze	5	23.382	23.406	.024	23.385	23.406	.024	2.25	8°
				23.378	23.410	.032	23.378	23.410	.032		
		Steel	5	23.372	23.406	.034	23.372	23.406	.034	2.25	8°
				23.368	23.410	.042	23.368	23.410	.042		
	30x30-31G	Iron & Bronze	7	20.728	20.750	.022	2.728	20.750	.022	.38	8°
				20.725	20.753	.028	20.725	20.753	.028		
		Steel	7	20.718	20.750	.032	20.718	50.750	.032	.38	8°
				20.715	20.753	.038	20.715	20.753	.038		
	30x30-38	Iron & Bronze	6	24.286	24.312	.026	24.286	24.312	.026	.38	8°
				24.282	24.316	.034	24.282	24.316	.034		
		Steel	6	24.276	24.312	.036	24.276	24.312	.036	.38	8°
				24.272	24.316	.044	24.272	24.316	.044		
	30x30-38G	Iron & Bronze	5	24.286	24.312	.026	24.286	24.312	.026	.38	8°
				24.282	24.316	.034	24.282	24.316	.034		
		Steel	5	24.276	24.312	.036	24.276	24.312	.036	.38	8°
				24.272	24.316	.044	24.272	24.316	.044		
	30x30-38N	Iron & Bronze	5	24.974	25.000	.026	24.974	25.000	.026	.38	8°
				24.970	25.004	.034	24.970	25.004	.034		
		Steel	5	24.964	25.000	.036	24.964	25.000	.036	.38	8°
				24.960	25.004	.044	24.960	25.004	.044		
XL	30x36-42	Iron & Bronze	6&7	26.978	27.000	.022	26.978	27.000	.022	.50	8°
				26.975	27.003	.028	26.975	27.003	.028		
		Steel	6&7	26.968	27.000	.032	26.968	27.000	.032	.50	8°
				26.965	27.003	.038	26.965	27.003	.038		
	30x36-42G	Iron & Bronze	5	25.726	25.750	.024	25.726	25.750	.024	.50	8°
				25.722	25.754	.032	25.722	25.754	.032		
		Steel	5	25.716	25.750	.034	25.716	25.750	.034	.50	8°
				25.712	25.754	.042	25.712	25.754	.042		
	30x36-42H	Iron & Bronze	7	28.978	29.000	.022	28.978	29.000	.022	.50	8°
				28.975	29.003	.028	28.975	29.003	.028		
		Steel	7	28.968	29.000	.032	28.968	29.000	.032	.50	8°
				28.965	29.003	.038	28.965	29.003	.038		
	30x36-42N	Iron & Bronze	5	27.978	28.000	.022	27.978	28.000	.022	.38	8°
				27.975	28.003	.028	27.975	28.003	.028		
		Steel	5	27.968	28.000	.032	27.968	28.000	.032	.38	8°
				27.965	28.003	.038	27.965	28.003	.038		
	20x30-42	Iron & Bronze	6	20.849	20.878	.032	N/A	N/A	N/A	N/A	N/A
				20.846	20.874	.025					
		Steel	6	20.842	20.878	.038	N/A	N/A	N/A	N/A	N/A
				20.840	20.874	.032					
XXL	36x42-52	Iron & Bronze	5	33.470	33.523	.057	N/A	N/A	N/A	N/A	N/A
				33.474	33.527	.049					
		Steel	5	33.590	33.523	.067	N/A	N/A	N/A	N/A	N/A
				33.585	33.527	.058					

Table 9 (mm)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance (B)	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
SX	12x14-15	Iron & Bronze	7	284.84	285.17	0.33	284.84	285.17	0.33	9.65	8°
				284.78	285.22	0.43	284.78	285.22	0.43		
		Steel	7	284.84	285.42	0.58	285.09	285.42	0.58	9.65	8°
				284.78	285.47	0.69	285.04	285.47	0.69		
	16x18-17H	Iron & Bronze	7	354.84	355.17	0.33	354.84	355.17	0.33	12.70	8°
				354.79	355.22	0.43	354.79	355.22	0.43		
		Steel	7	354.84	355.42	0.58	354.84	355.42	0.58	12.70	8°
				354.79	355.47	0.69	354.79	355.47	0.69		
MX	18x20-20	Iron & Bronze	5 & 6	419.84	420.17	0.33	419.84	420.17	0.33	22.10	8°
				419.79	420.22	0.43	419.79	420.22	0.43		
		Steel	5 & 6	419.84	441.27	0.58	419.84	441.27	0.58	22.10	8°
				419.79	441.35	0.69	419.79	441.35	0.69		
M	16x18-30	Iron & Bronze	5	440.82	441.53	0.46	440.82	441.53	0.46	9.65	8°
				440.74	441.60	0.61	440.74	441.60	0.61		
		Steel	5	440.82	441.27	0.71	440.82	441.27	0.71	9.65	8°
				440.74	441.35	0.86	440.74	441.35	0.86		
	16x18-30H	Iron & Bronze	7	440.82	441.53	0.46	440.82	441.53	0.46	15.75	8°
				440.74	441.60	0.61	440.74	441.60	0.61		
		Steel	7	440.82	441.27	0.71	440.82	441.27	0.71	15.75	8°
				440.74	441.35	0.86	440.74	441.35	0.86		
	16x18-30G	Iron & Bronze	7	440.82	441.53	0.46	440.82	441.53	0.46	15.75	8°
				440.74	454.30	0.61	440.74	454.30	0.61		
		Steel	7	440.82	441.53	0.71	440.82	441.53	0.71	15.75	8°
				440.74	441.60	0.86	440.74	441.60	0.86		
	18x20-30	Iron & Bronze	5	496.01	496.52	0.51	472.31	472.82	0.51	9.65	8°
				495.94	496.60	0.66	472.24	472.90	0.66		
		Steel	5	496.01	496.77	0.76	472.31	473.08	0.76	9.65	8°
				495.94	496.85	0.91	472.24	473.15	0.91		
	20x24-24	Iron & Bronze	5 & 6	495.96	466.47	0.51	465.96	466.47	0.51	9.65	8°
				465.89	466.55	0.66	465.89	466.55	0.66		
		Steel	5 & 6	465.96	466.73	0.76	465.96	466.73	0.76	9.65	8°
				465.89	466.80	0.91	465.89	466.80	0.91		
	20x24-30	Iron & Bronze	5 HIGH RPM	496.01	496.52	0.51	472.31	472.82	0.51	9.65	8°
				495.94	496.60	0.66	472.24	472.90	0.66		
		Steel	5 HIGH RPM	496.01	496.52	0.51	472.31	473.08	0.76	9.65	8°
				495.94	496.60	0.66	472.24	473.15	0.91		
	20x24-30	Iron & Bronze	5 LOW RPM	556.34	556.97	0.64	532.59	533.15	0.56	9.65	8°
				556.26	556.90	0.64	532.51	533.22	0.71		
		Steel	5 LOW RPM	556.34	556.97	0.64	532.59	533.40	0.81	9.65	8°
				556.26	556.90	0.64	532.51	533.48	0.97		

Table 9 (mm)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance (B)	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
M Modified	20x24-28	Iron & Bronze	6 & 7	469.39	469.90	0.51	469.39	469.90	0.51	9.65	8°
				469.32	469.98	0.66	469.32	469.98	0.66		
		Steel	6 & 7	469.14	469.90	0.76	469.14	469.90	0.76	9.65	8°
				469.32	470.66	0.91	469.32	469.98	0.91		
	20x24-28H	Iron & Bronze	7	496.27	496.77	0.51	496.27	496.77	0.51	9.65	8°
				496.19	496.85	0.66	496.19	496.85	0.66		
		Steel	7	496.01	496.77	0.76	496.01	496.77	0.76	9.65	8°
				495.94	496.85	0.91	495.94	496.85	0.91		
	20x24-28N	Iron & Bronze	5	482.09	482.60	0.51	482.09	482.60	0.51	9.65	8°
				482.02	482.68	0.66	482.02	482.68	0.66		
		Steel	5	482.09	482.60	0.51	482.09	482.60	0.51	9.65	8°
				482.02	482.68	0.66	482.02	482.68	0.66		
	20x24-28G	Iron & Bronze	5	447.22	447.68	0.46	447.22	47.68	0.46	9.65	8°
				447.14	447.75	0.61	447.14	447.75	0.61		
		Steel	5	447.22	447.93	0.71	447.93	447.93	0.71	9.65	8°
				447.14	448.01	0.86	448.01	448.01	0.86		
—	18X20-24	Iron & Bronze	6	393.50	393.90	0.41	393.50	393.90	0.41	9.65	8°
				393.42	393.98	0.56	393.42	393.98	0.56		
		Steel	6	393.24	393.90	0.66	393.50	393.90	0.41	9.65	8°
				393.17	393.98	0.81	393.42	393.98	0.56		
	18X20-24G	Iron & Bronze	5	374.24	374.65	0.41	374.24	393.90	0.41	9.65	8°
				374.17	374.73	0.56	374.17	393.98	0.56		
		Steel	5	373.99	374.65	0.66	373.99	374.65	0.66	9.65	8°
				373.91	374.73	0.81	373.91	374.73	0.81		
	18X20-24N	Iron & Bronze	5	405.99	406.40	0.41	405.99	406.40	0.41	9.65	8°
				405.92	406.48	0.56	405.92	406.48	0.56		
		Steel	5	405.74	406.40	0.66	405.74	406.40	0.66	9.65	8°
				405.66	406.48	0.81	405.66	406.48	0.81		
L	24x30-32	Iron & Bronze	6	602.16	602.77	0.61	602.16	602.77	0.61	12.70	8°
				602.03	602.84	0.81	602.03	602.84	0.81		
		Steel	6	602.16	552.22	0.86	602.16	552.22	0.86	12.70	8°
				602.03	552.30	0.61	602.03	552.30	1.07		
	24x30-32N	Iron & Bronze	6	602.16	602.77	0.61	602.16	602.74	0.61	12.70	8°
				602.03	602.84	0.81	602.03	602.84	0.81		
		Steel	6	602.16	552.22	0.86	602.16	552.22	0.86	12.70	8°
				602.03	552.30	1.07	602.03	552.30	1.07		
	24x30-32H	Iron & Bronze	7	557.76	558.32	0.56	557.76	558.32	0.56	12.70	8°
				557.68	558.39	0.71	557.68	558.39	0.71		
		Steel	7	557.76	558.57	0.81	557.76	558.57	0.81	12.70	8°
				557.68	558.65	0.97	557.68	558.65	0.97		
	24x30-32G	Iron & Bronze	6	557.76	558.32	0.56	557.76	558.32	0.56	12.70	8°
				557.68	558.39	0.71	557.68	558.39	0.71		
		Steel	6	557.76	558.57	0.81	557.76	558.57	0.81	12.70	8°
				557.68	558.65	0.97	557.68	558.65	0.97		

Table 9 (mm) (cont'd)

Group	Impeller Size	Material	Vanes	Standard Impeller and Casing Wearing Rings (Fig. 51)			Flashed Impeller Wearing Rings (Fig. 52)				
				Impeller Ring (A)	Casing Ring	Diameter Clearance (B)	Impeller Ring (C)	Casing Ring	Diameter Clearance	Length (E)	Angle (F)
LDS	30x30-31	Iron & Bronze	7	593.90	594.51	0.61	593.90	594.51	0.61	9.65	8°
				593.80	594.61	0.81	593.80	594.61	0.81		
		Steel	7	593.65	594.51	.086	593.65	594.51	0.86	9.65	8°
				593.55	594.61	1.07	593.55	594.61	1.07		
	30x30-31G	Iron & Bronze	5	593.90	594.51	0.61	593.90	594.51	0.61	9.65	8°
				593.80	594.61	0.81	593.80	594.61	0.81		
		Steel	5	593.65	594.51	0.86	593.65	594.51	0.86	9.65	8°
				593.55	594.61	1.07	593.55	594.61	1.07		
	30x30-31G	Iron & Bronze	7	526.49	527.05	0.56	69.29	527.05	0.56	9.65	8°
				526.42	527.13	0.71	526.42	527.13	0.71		
		Steel	7	526.24	527.05	0.81	526.24	1289.05	0.81	12.70	8°
				526.16	527.13	0.97	526.16	527.13	0.97		
	30x30-38	Iron & Bronze	6	616.86	617.52	0.66	616.86	617.52	0.66	12.70	8°
				616.76	617.63	0.86	616.76	617.63	0.86		
		Steel	6	616.61	617.52	0.91	616.61	617.52	0.91	9.65	8°
				616.51	617.63	1.12	616.51	617.63	1.12		
	30x30-38G	Iron & Bronze	5	616.86	617.52	0.66	616.86	617.52	0.66	9.65	8°
				616.76	617.63	0.86	616.76	617.63	0.86		
		Steel	5	616.61	617.52	0.91	616.61	617.52	0.91	9.65	8°
				616.51	617.63	1.12	616.51	617.63	1.12		
	30x30-38N	Iron & Bronze	5	634.34	635.00	0.66	634.34	635.00	0.66	9.65	8°
				634.24	635.10	0.86	634.24	635.10	0.86		
		Steel	5	634.09	635.00	0.91	634.09	635.00	0.91	9.65	8°
				633.98	635.10	1.12	633.98	635.10	1.12		
XL	30x36-42	Iron & Bronze	6 & 7	685.24	685.80	0.56	685.24	685.80	0.56	12.70	8°
				685.17	685.88	0.71	685.17	685.88	0.71		
		Steel	6 & 7	684.99	685.80	.081	684.99	685.80	0.81	12.70	8°
				684.91	685.88	0.97	684.91	685.88	0.97		
	30x36-42G	Iron & Bronze	5	653.44	654.05	0.61	653.44	654.05	0.61	12.70	8°
				653.34	654.15	0.81	653.34	654.15	0.81		
		Steel	5	653.19	654.05	0.86	653.19	654.05	0.86	12.70	8°
				653.08	654.15	1.07	653.08	654.15	1.07		
	30x36-42H	Iron & Bronze	7	736.04	736.60	0.56	736.04	736.60	0.56	12.70	8°
				735.97	736.68	0.71	735.97	736.68	0.71		
		Steel	7	735.79	736.60	0.81	735.79	736.60	0.81	12.70	8°
				735.71	736.68	0.97	735.71	736.68	0.97		
	30x36-42N	Iron & Bronze	5	710.64	711.20	0.56	710.64	711.20	0.56	9.65	8°
				710.57	711.28	0.71	710.57	711.28	0.71		
		Steel	5	710.39	711.20	0.81	710.39	711.20	0.81	9.65	8°
				710.31	711.28	0.97	710.31	711.28	0.97		
	20X30-42	Iron & Bronze	6	529.56	530.30	0.81					
				529.49	530.20	0.64					
		Steel	6	529.39	530.30	0.97					
				529.34	530.20	0.81					
XXL	36x42-52	Iron & Bronze	5	850.14	851.48	1.45					
				850.24	851.59	1.24					
		Steel	5	853.19	851.48	1.70					
				853.06	851.59	1.47					

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To replace the impeller wear rings

1. Remove the old rings by removing the three set screws (320) and pulling the ring (142) off of the impeller hub.
2. Clean the impeller hub and press on a new wear ring.
3. Drill and tap three holes in the ring/hub seam 120° apart, offset from the original setscrew holes. Insert new setscrews (320) and lightly upset the threads.

NOTE: Replacement impeller wear rings are supplied .020-.030 in. oversized and must be turned to size (see) after mounting on the impeller. SX and MX size rings are supplied turned to the finished diameter.

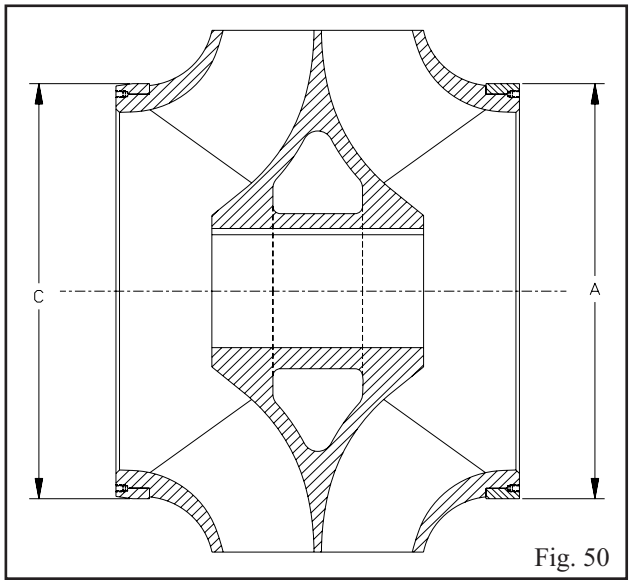


Fig. 50

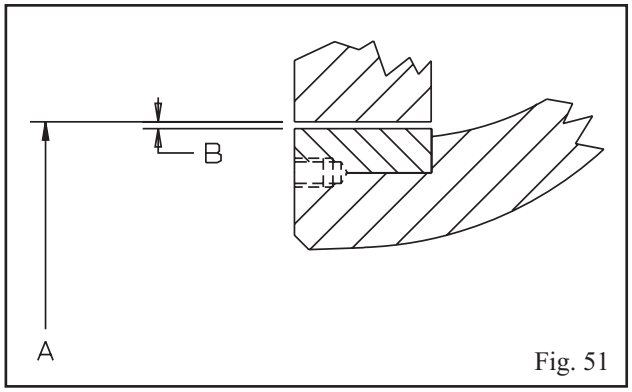


Fig. 51

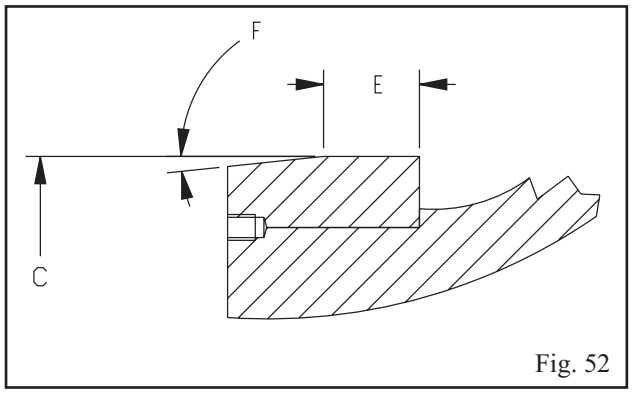


Fig. 52

SHAFT

Inspect the shaft (122) for runout to verify the shaft is straight. See Fig. 53 for proper shaft runout inspection. Inspect the bearing seats and the impeller seats. Verify they are the correct size and free from any scratches or grooves. Bearing fits and tolerances are found in Table 10. The shaft threads must be in good condition. Inspect the keyways for burrs or foreign matter. Replace the shaft if necessary.

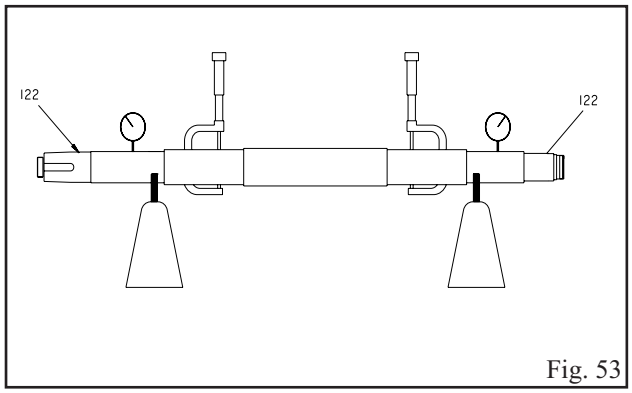


Fig. 53

Table 10 (inches)

Bearings	Group	Sizes	Bearing Size		Inboard			Inboard			Outboard			Outboard		
			Thrust	Radial	Shaft O.D.	Bearing I.D.	Tol.	Hsg I.D.	Bearing O.D.	Tol.	Shaft O.D.	Bear-ing I.D.	Tol.	Hsg I.D.	Bearing O.D.	Tol
Ball	SX	12x14-15	7313	6313	2.5596	2.5585	+.0011	5.5118	5.5118	-.0000	2.5596	2.5585	+.0011	5.5118	5.5118	-.0000
		16x18-17H			2.5591	2.5591	+.0000	5.5111	5.5111	-.0017	2.5591	2.5591	+.0000	5.5128	5.5111	-.0017
	MX	18x20-20	7316	6316	3.1502	3.1490	+.0012	6.6929	6.6929	-.0000	3.1502	3.1490	+.0012	6.6929	6.6929	-.0000
					3.1497	3.1496	+.0001	6.6939	6.6919	-.0020	3.1497	3.1496	+.0001	6.6939	6.6919	-.0020
	M	16x18-30 18x20-30 20x24-24 20x24-30	7321	6321	4.1346 4.1340	4.1331 4.1339	+.0015 +.0001	8.8590 8.8602	8.8583 8.8571	-.0007 -.0031	4.1346 4.1340	4.1331 4.1339	+.0015 +.0001	8.8590 8.8602	8.8583 8.8571	-.0007 -.0031
	M (modified)	20x24-28	7321	6321	4.1346	4.1331	+.0015	8.8590	8.8583	-.0007	4.1346	4.1331	+.0015	8.8590	8.8583	-.0007
					4.1340	4.1339	+.0000	8.8602	8.8571	-.0031	4.1340	4.1339	+.0001	8.8602	8.8571	-.0031
	—	18x20-24	7318	6318	3.5440	3.5425	+.0015	7.4803	7.4803	-.0000	3.5440	3.5425	+.0015	7.4803	7.4803	-.0000
					3.5434	3.5433	+.0001	7.4815	7.4791	-.0024	3.5434	3.5433	+.0001	7.4815	7.4791	-.0024
Roller	L	24x30-32	22226		N/A	N/A	N/A	9.0557	9.0551	-.0006	N/A	N/A	N/A	9.0557	9.0551	-.0006
								9.0575	9.0539	.0036				9.0575	9.0539	-.0036
	LDS	30x30-31	22228		N/A	N/A	N/A	9.8431	9.8425	-.0006	N/A	N/A	N/A	9.8431	9.8425	-.0006
		30x30-38						9.8449	9.8413	-.0036				9.8449	9.8413	-.0036
	XL	30x36-42	22230		N/A	N/A	N/A	10.6306	10.6299	-.0007	N/A	N/A	N/A	10.6306	10.6299	-.0007
		20x30-42						10.6326	10.6285	-.0041				10.6326	10.6285	-.0041
	XXL	36x42-52	22240		N/A	N/A	N/A	14.1762	14.1716	-.0007	N/A	N/A	N/A	14.1762	14.1716	-.0007
								14.1739	14.1732	-.0046				14.1739	14.1732	-.0046

Table 10 (mm)

Bearings	Group	Sizes	Bearing Size		Inboard			Inboard			Outboard			Outboard		
			Thrust	Ra-dial	Shaft O.D.	Bearing I.D.	Tol.	Hsg I.D.	Bearing O.D.	Tol.	Shaft O.D.	Bearing I.D.	Tol.	Hsg I.D.	Bearing O.D.	Tol
Ball	SX	12x14-15	7313	6313	65.014	64.986	0.028	140.000	140.000	0	65.014	64.986	0.028	140.000	140.000	0
		16x18-17H			65.001	65.001	0.000	139.982	139.982	-0.043	65.001	65.001	0	140.025	139.982	-0.043
	MX	18x20-20	7316	6316	80.015	79.985	0.030	170.000	170.000	0	80.015	79.985	0.030	170.00	170.000	0
					80.002	80.000	0.003	170.025	169.974	-0.051	80.002	80.000	0.003	170.025	169.974	-0.051
	M	16x18-30 18x20-30 20x24-24 20x24-30	7321	6321	105.019 105.004	104.981 105.001	0.038 0.003	225.019 225.049	225.001 224.970	-0.018 -0.079	105.019 105.004	104.981 105.001	0.038 0.003	225.019 225.049	225.001 224.970	-0.018 -0.079
	M (modified)	20x24-28	7321	6321	105.019	104.981	0.038	225.019	225.001	-0.018	105.019	104.981	0.038	225.019	225.001	-0.018
					105.004	105.001	0	225.049	224.970	-0.079	105.004	105.001	0.003	225.049	224.790	-0.079
	—	18x20-24	7318	6318	90.018	89.980	0.038	190.000	190.000	0	90.018	89.980	0.038	190.000	190.000	0
					90.002	90.000	0.003	190.030	189.969	-0.061	90.002	90.000	0.003	190.030	189.969	-0.061
Roller	L	24x30-32	22226		N/A	N/A	N/A	230.015	230.000	-0.015	N/A	N/A	N/A	230.015	230.000	-0.015
								230.061	229.969	0.091				230.061	229.969	-0.091
	LDS	30x30-31	22228		N/A	N/A	N/A	250.015	250.000	-0.015	N/A	N/A	N/A	250.015	250.000	-0.015
		30x30-38						250.060	249.969	-0.091				250.060	249.969	-0.091
	XL	30x36-42	22230		N/A	N/A	N/A	270.017	269.999	-0.018	N/A	N/A	N/A	270.017	269.999	-0.018
		20x30-41						270.068	269.964	-0.104				270.068	269.964	-0.104
	XXL	36x42-52	22240		N/A	N/A	N/A	360.075	359.959	-0.018	N/A	N/A	N/A	360.075	359.959	-0.018
								360.017	359.999	-0.117				360.017	359.999	-0.017

SHAFT SLEEVES

The shaft sleeve (126) surface in the stuffing box area must be smooth and free of grooves. If grooved, replace the sleeve. The O-ring groove must be in good condition. Check the diametrical clearance between the sleeve and the stuffing box bushing. See Figure 54. The original clearance is shown in Table 8. If the clearance has increased more than .030 in. (.762 mm). The shaft sleeve and/or the stuffing box bushing should be replaced.

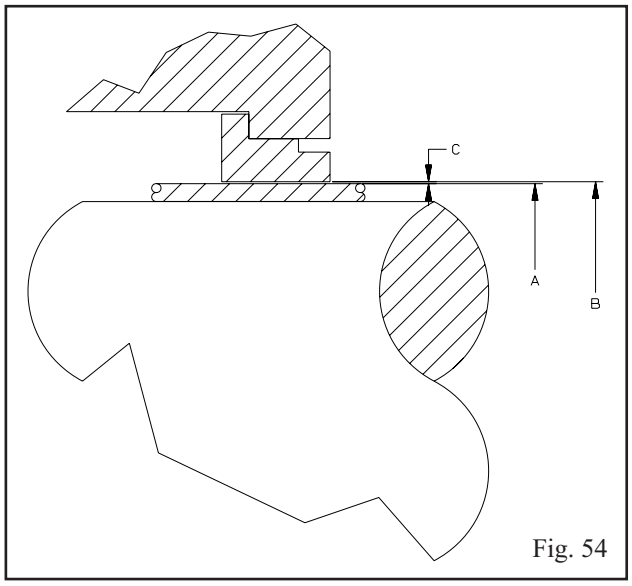


Fig. 54

BEARING HOUSINGS

Visually inspect the interior of the housings (134, 134A, 134D, or 166) for damage, cracks, corrosion, scale, or debris. Remove all loose and foreign materials. Make sure all lubrication passages are clear. Inspect the bearing bores according to the tolerances in Table 10. Replace the housings if they are out of tolerance.

BEARINGS

Ball and roller bearings (112, 168, 409 and 410) should be inspected for contamination and damage. The condition of the bearings will provide useful information on operating conditions in the bearing housing. Lubricant condition and residue should be noted. Oil analysis is often helpful in diagnosing conditions and/or problems. Bearing damage should be investigated to determine the cause. If the cause is not normal wear, it should be corrected before the pump is returned to service. It is not recommended that anti-friction bearings be reused after they have been disassembled and inspected.

REASSEMBLY

1. Determine the correct positioning of the impeller (101) on the shaft (122) based on the direction of rotation. Refer to Figure 55.

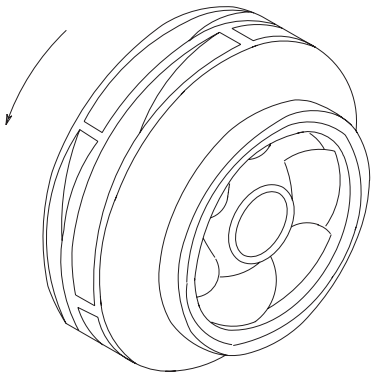


Fig. 55

2. Insert the impeller key (178) in the shaft and slide the impeller on the shaft. Drive or press the shaft into the impeller.

CAUTION

Do not damage the end of the shaft.

Line up the impeller hub with the scribe mark made on the shaft during disassembly. If a new shaft is being used, center the impeller on the keyway.

3. Place the impeller O-rings (412A) in the grooves in the end of the sleeves (126). Slide the shaft sleeves on the shaft.

4. Place the sleeve O-rings (497) in the grooves in the end of the sleeve nuts (124 and 130). Slide the sleeve nuts on the shaft. Tighten the nuts against shaft rotation using a spanner or strap wrench.

NOTE: One sleeve has right hand threads and one has left hand threads. The nuts tighten against the pump's rotation.

5. Tighten the set screws (222B) in the sleeve nuts.

6. Packing: Slide the stuffing box bushings (125) over the sleeves. Position them such that the lock is facing the packing. Slide the lantern ring (105) on the shaft.

   Conventional Mechanical Seals: Carefully slide the rotary portion on the sleeve and fasten in position according to the manufacturer's instructions. Carefully slide the seal glands with the stationary seats and the gland gaskets on the shaft.

   Cartridge Mechanical Seal: Carefully slide the cartridge unit on the sleeve.

INSTALLATION OF THE BEARING HOUSINGS AND BEARINGS

A. SX/MX Group

1. Press the inboard labyrinth seals (333A) into the end covers (109) with a suitably sized arbor. Slide the end covers with the seals installed onto the shaft (122) up to the sleeve nuts (130). The labyrinth seals should face the sleeve nuts as shown in Fugures 29-32.

2. Install the radial (coupling end) bearing (168) on the shaft.

NOTE: There are several ways to install bearings. The recommended method is to use an induction heater that heats as well as demagnitizes the bearings.

WARNING

Wear insulated gloves when using a bearing heater. The bearings will get hot and can cause physical injury.

NOTE: Coat internal surfaces of bearings with the lubricant that is to be used in service.

3. Install the thrust bearing (112) on the shaft.

NOTE: The SX and MX groups use duplex bearings mounted back to back. Make sure the orientation is correct.

NOTE: There are several ways to install bearings. The recommended method is to use an induction heater that heats as well as demagnitizes the bearings.

WARNING

Wear insulated gloves when using a bearing heater. The bearings will get hot and can cause physical injury.

NOTE: Coat internal surfaces of bearings with the lubricant that is to be used in service.

4. Place the bearing lockwasher (382) on the shaft. Be sure to place the tang of the lockwasher in the keyway of the shaft.

5. Thread the bearing locknut (136) onto the shaft. After the bearing and the shaft have cooled to ambient temperature, tighten the locknut to the value shown in Table 11. Bend any tang of the lockwasher into a slot in the locknut.

6. Press the outboard labyrinth seal (332A) into the radial (coupling end) bearing housing (166) with a suitably sized arbor. Install the radial (coupling end)

bearing housing with the labyrinth seal installed and a bearing housing gasket (360). Slide the housing assembly over the radial bearing.

7. Secure the bearing housing by installing four bearing housing to end cover capscrews (371C). Tighten the capscrews to the torque value shown in Table 11.

8. Install the thrust (outboard end) bearing housing (134) with a bearing housing gasket (360). Slide the bearing housing over the thrust bearing.

9. Secure the bearing housing by installing four bearing housing to end cover capscrews (371C). Tighten the capscrews to the torque value shown in Table 11.

B. M Group, 18x20-24 and 20x24-28

1. Oil Lubrication: Slide both oil throwers (248) on the shaft (122).

   Grease Lubrication: Slide both deflectors (248) on the shaft (122).

2. Grease Lubrication only - Install the grease seals (333) in the bearing housings (134A) using a suitably sized arbor.

3. Slide the bearing housings (134A) on the shaft and install the bearings. The radial (coupling end) bearing (168A) is a single row ball bearing and the thrust (outboard) bearing (112A) is a duplex angular contact bearing.

NOTE: The duplex bearing is mounted back to back. Make sure the orientaion is correct.

NOTE: There are several ways to install bearings. The recommended method is to use an induction heater that heats as well as demagnitizes the bearings.

⚠ WARNING

Wear insulated gloves when using a bearing heater. The bearings will get hot and can cause physical injury.

NOTE: Coat internal surfaces of bearings with the lubricant that is to be used in service.

4. Grease Lubrication only - Install the grease shields (346A) on the oil ring sleeves (207 and 208).

5. Slide the oil ring sleeves (207n and 208 or 323 and 324) on the shaft against the bearings.

6. Place the bearing lockwashers (382) and the bearing locknuts (136) on the shaft. After the bearings and shaft have cooled to ambient temperature, tighten the locknut to the torque value shown in Table 11. Bend any tang of the lockwasher into a slot on the locknut.

7. Bolt the oil ring housings (515) with a gasket (360G) to the bearing housing on each end of the shaft.

   Tighten the oil ring housing to bearing housing capscrews (371T) to the torque value shown in Table 11.

NOTE: Rotating element total travel is adjusted by adding oil ring housing to bearing housing gaskets (360G) on the thrust (outboard) end of the pump in a later step.

8. Oil Lubrication only

   a. Place oil rings (114) in position on the groove in the oil ring sleeves (323 and 324).

   b. Install the oil ring retaining bracket (398A) in the oil ring housing (515).

   c. Bolt the end covers (109A and 119A) to the oil ring housings. Tighten the capscrews (371S) to the torque value shown in Table 11.

   d. Slide the coupling end dust covers (123 and 123A) on the shaft.

C. L Group

1. Oil Lubrication: Slide the oil throwers (248) and the bearing housings (134 and 134A) on the shaft (122).

   Grease Lubrication: Slide the deflectors (123) and the bearing housings (134 and 134A) on the shaft (122).

2. Slide the roller bearings (409 and 410) on the shaft until they contact the shaft shoulder.

NOTE: The inner race of the roller bearing has a tapered bore. Make sure the large bore end of the bearing faces the end of the shaft. The lip of the adapter sleeve slides under the inner race of the bearing.

3. Lightly oil the shaft and the outside diameter of the adapter sleeve. Slide the lip of the sleeve under the inner race of the bearing.

4. For Oil Lubrication Only: Slide the oil ring sleeves (324) on the shaft.

5. Place the bearing lockwashers (382) and the bearing locknuts (136) on the shaft and tighten finger tight.

6. Adjust the roller bearing clearances:

   a. Rotate the shaft until a roller is in the top vertical position.

   b. Measure the clearance between the roller and the outer race with a feeler gauge. The amount of adjustment to the internal clearance is based on this initial clearance. Consult the bearing manufacturer's installation procedure for the proper amount of residual internal clearance.

   c. Tighten the bearing locknut until the recommended clearance is obtained.

d. Check the clearance by rotating the shaft 90° and measuring the clearance. Tighten the locknut, if required. This should be done several times to ensure the bearing is not distorted.

7. Bend a tang of the lockwasher into a locknut groove.

8. Oil Lubrication

a. Bolt the oil ring housings (515 and 515A) to the bearing housings (134 and 134A) using capscrews (371T).

b. Place the oil rings (114) in the grooves on the oil ring sleeve.

c. Bolt the end covers (109A) and 119A) to the bearing housings using capscrews (371S). Tighten finger tight.

d. Slide the dust cover (139) and the coupling on the shaft.

Grease Lubrication: Slide the dust cover (123A) with the seal installed and the coupling on the shaft.

D. LDS and XL Group

1. Oil Lubrication

*a. Slide the oil throwers (123) on the shaft (122).

b. Install the bearing end covers (109B and 119B) on the bearing housings (134 and 134A) with capscrews (370). Tighten the capscrews to the torque value shown in Table 11.

c. Slide the bearing housing sub-assemblies on the shaft.

Grease Lubrication

*a. Slide the deflectors (333) on the shaft (122).

*b. Install the grease seals (333) in the inboard bearing end covers (109B and 119B).

c. Install the bearing end covers on the bearing housings (134 and 134A) with capscrews (370). Tighten the capscrews to the torque value shown in Table 11.

d. Slide the bearing housing sub-assemblies on the shaft.

2. Slide the roller bearings (409 and 410) on the shaft until they contact the shaft shoulder.

NOTE: The inner race of the roller bearing has a tapered bore. Make sure the large bore end of the bearing faces the end of the shaft. The lip of the adapter sleeve slides under the inner race of the bearing.

3. Lightly oil the shaft and the outside diameter of the adapter sleeve. Slide the lip of the sleeve under the inner race of the bearing.

4. Slide the oil ring sleeves (324) on the shaft.

5. Place the bearing lockwashers (382) and the bearing locknuts (136) on the shaft and tighten finger tight.

6. L, LDS, XL, and XXL frames use spherical roller bearings mounted on tapered sleeves which require tightening of the bearing locknut to draw the bearing up on the taper. Correct tightening of the locknut is accomplished by measuring the clearance before and after tightening to arrive at a given change in bearing clearnace. Once this change in clearance has been reached, the bearing is correctly mounted on the sleeve. The minumum clearance after tightening should also not be less than the given value. The following steps describe how this is accomplished:

a. With the bearing axis horizontal and no upward force on the bearing outer race, rotate the inner race such that a set of rollers is at the bottom. Measure the clearance between the bottom roller OD and the ID of the bearing outer race using a feeler gauge. Record this value.

b. Tighten the locknut (136) until a reduction (measurement from Step 6a minus the measurement after tightening of the locknut) in bearing clearance is reached as given below. Also, verify the minimum clearance is not less than the value given below. Rotate the bearing through 90 degree increments and verify the clearance in a few positions.

Group	SKF Bearing Size	Clearance Reduction		Minimum Clearance	
		Inches	mm	In.	mm
L	22226 CN	.0025-.0035	.065-.09	.002	.055
LDS	22228 CN	.0025-.0035	.065-.09	.002	.055
XL	22230 CN	.003-.004	.075-.10	.0022	.06
XXL	22240 CN	.0032-.0043	.08-.11	.0024	.06

7. Bend a tang of the lockwasher into a locknut groove.

8. Oil Lubrication

a. Bolt the bearing housings (134 and 134A or 134D and 134A) to the bearing end covers (109A and 119B) using capscrews (370 or 371C). Tighten the capscrews to the torque shown in Table 11.

b. Place the oil rings (114) in the grooves on the oil ring sleeve.

c. Bolt the end covers (109A and 119A) to the bearing housings using capscrews (370 or 371C). Tighten finger tight.

*d. Slide the dust cover (123A) and the coupling on the shaft.

* These parts are replaced by the optional labyrinth seals (332 Opt), 333 Opt) when so equipped. Do not separate the rotor from the stator with labyrinth style seals.

Grease Lubrication

a. Bolt the bearing housings (134 and 134A or 134D and 134A) to the bearing end covers (109B and 119B) using capscrews (370 or 371C). Tighten the capscrews to the torque shown in Table 11.

b. Bolt the end covers (109A and 119A) to the bearing housings using capscrews (370 or 371C). Tighten finger tight.

*c. Slide the dust cover (332) and the coupling on the shaft.

* These parts are replaced by the optional labyrinth seals (332 Opt, 333 Opt) when so equipped. Do not separate the rotor from the stator with labyrinth style seals.

INSTALLATION OF THE ROTATING ELEMENT

1. Install and position the coupling hub on the shaft (122). Heat the hub in an oven or hot oil bath until the hub reaches 300°F (150°C). Slide the hub on the shaft until it is positioned in the same location as it was originally. It should like up with the mark scribed on the shaft during disassembly.

⚠ WARNING

Use proper personal safety equipment when handling the hot coupling hub.

2. Clean all the fits/seats (wear ring, bearing housing, stuffing box bushing) in both the upper and lower half casing.
3. Slide the casing wear rings (127) onto the impeller. Be sure the continuous lock on the rings is facing toward the impeller.
4. SX/MX: Carefully lower the rotating element into the lower half casing. Make sure the double locks on the wear rings are facing up and the anti-rotation pins (445A) in the stuffing box bushings and the rabbet fit of the bearing housings are facing down. Ensure the pin engages the hole in bushing fit bore. The unit should easily settle into place.

   All other Groups: Carefully lower the rotating element into the lower half casing. Make sure the double locks on the wear rings, bearing housings, and stuffing box bushings are facing up.

! CAUTION

Do not completely take the weight off of the sling.

5. SX/MX: After the element has been properly seated, rotate the rings 180° so that the double locks are located in the lower half casing.

   All other Groups: After the element has been properly seated, rotate the rings, bearing housings, and stuffing box bushings 180° so that the double locks are located in the lower half casing.
6. Check the location of the impeller with respect to the casing. Make sure the impeller is centered in the casing. If it is not, loosen the sleeve nuts and shift the sleeves and the impeller as required. Check for free turning by rotating the shaft by hand.
7. SX/MX: Bolt the thrust end bearing housing to the casing using the bearing housing to casing capscrews (372U). Tighten the capscrews to the torque values shown in Table 11.

   All other Groups: Replace the thrust end bearing cap (111A) and tighten the nuts (425A) evenly to the torque values listed in Table 11.

! CAUTION

Make sure the caps are replaced on the same end from which they were removed and that the match marks are lined up.

   Check for free turning by turning the shaft by hand.

8. For SX/MX, M, 18x20-24 and 20x24-28 ONLY:

Adjust the shaft end play.

a. Clamp a dial indicator to the pump such that the button rests against the end of the shaft.

b. Push the shaft back and forth as far as possible. The total end play must be at least .001 in. and not more than .008 in. (.025 - .203 mm).

c. If the end play is less than .001 in., add thrust end bearing end cover gaskets or bearing housing to oil ring housing gaskets (360 or 360G) until the proper clearance is obtained. If the endplay is greater than .008 in., remove gaskets as necessary.

NOTE: Because of manufacturing tolerances, duplex bearings may vary in width up to .030 in. A correctly assembled pump may require several gaskets to correctly set the bearing end play.

9. SXMX: Bolt the radial end bearing housing to the casing using the bearing housing to casing cap screws (372U). Tighten the cap screws to the torque values shown in Table 11.

   All other Groups: Replace the radial end bearing cap and tighten the nuts evenly to the torque values listed in Table 11.

! CAUTION

Make sure the caps are replaced on the same end from which they were removed and that the match marks are lined up.

10. Check for free turning by turning the shaft by hand.
11. Replace any grease fittings (193), if required.
12. Place the parting gasket (351) in position on the lower half casing. Make sure the edge of the gasket is tight against the wear rings and the stuffing box bushings.

NOTE: If the area around the wear ring locks are not properly sealed, leakage will occur from the high to the low pressure zones in the pump. This will result in lost performance and efficiency.

13. Carefully lower the upper half casing onto the lower half. It should settle into place without resistance.
14. Replace the dowel pins (469G).
15. Check for free turning by rotating the shaft by hand.
16. Tighten the parting nuts alternately on each side starting from the center.
17. Check for free turning by rotating the shaft by hand.
18. Trim the parting gasket at the stuffing box face, if required.

! CAUTION

Make sure the gasket is flush to the stuffing box face to prevent leakage.

19. *Oil Lubrication: Slide the oil throwers (248) and dust covers (139) to within 1/32 in. of the bearing end covers or adapters. Tighten the set screws (222N).

    *Grease Lubrication**:** Slide the deflectors (123) to within 1/32 in. of the bearing end covers or adapters. Tighten the set screws (364).
20. Packing: Repack the stuffing box and replace the gland assembly as detailed in Section 4 - Operation.
21. Install all auxiliary piping.
22. Follow the procedures outlined in Section 4 for preparation and operation of the unit.

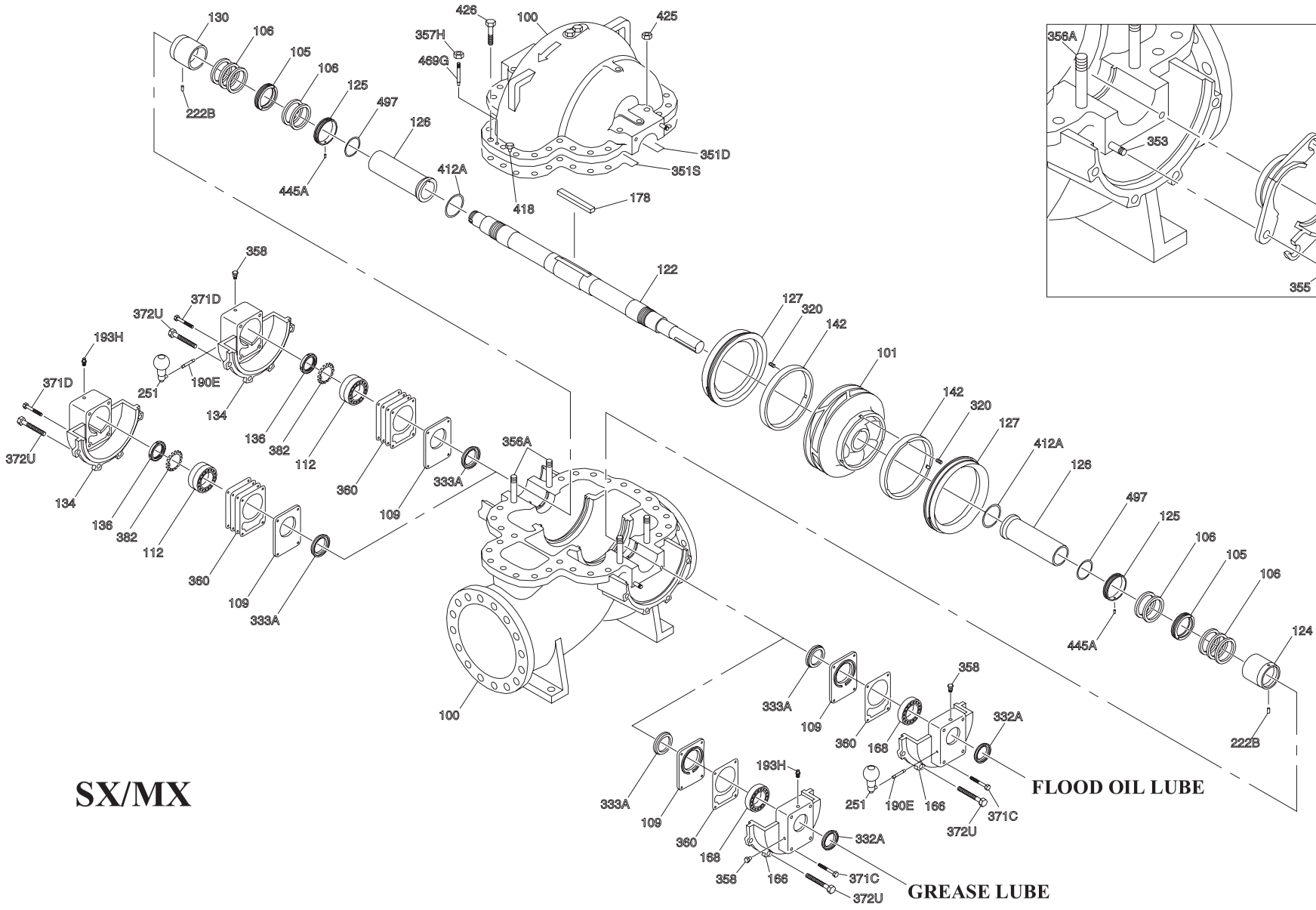
* N/A for labyrinth seal option.

Table 11
Bolt Torque Values - Ft-lb. (N-m)

Sizes	Dry Threads 2210 2442	Lub. Threads 2210 2442	Dry Threads 2239 2443	Lub. Threads 2239 2443
½"	30 (41)	20 (27)	90 (122)	60 (81)
⅝"	60 (81)	40 (54)	175 (237)	115 (156)
¾"	105 (142)	70 (95)	305 (414)	205 (278)
⅞"	170 (231)	115 (156)	495 (671)	330 (447)
1	255 (346)	170 (231)	740 (1003)	495 (671)
1⅛"	360 (488)	240 (325)	1050 (1424)	700 (949)
1½"	885 (1200)	590 (800)	2580 (3498)	1720 (2332)
1¾"	1400 (1898)	935 (1268)	N/A	N/A
M12	30 (41)	20 (27)	85 (115)	55 (75)
M16	60 (81)	40 (54)	175 (237)	115 (156)
M20	130 (176)	85 (115)	375 (509)	250 (339)
M24	220 (298)	145 (197)	640 (868)	425 (576)
M30	440 (597)	295 (400)	1275 (1729)	850 (1153)

2210 - ASTM A108 GR. 1211 - Carbon Steel
2239 - ASTM A193 GR. B7 - AISI 4140 Steel
2242 - ASTM A108 GR. 1018 - Carbon Steel
2243 - ASTM A108 GR. 1212 - Carbon Steel

SPARE AND REPAIR PARTS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332A
FLOOD OIL LUBE
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190E
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371C
372U
193H
333A
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332A
371C
372U
GREASE LUBE

SX/MX

Parts List with Materials of Construction

SX, MX

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron/316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48Class25B	B584 C87500	A743 CF-8M	
105	2	Lantern Ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Gland - Stuffing Box	A743 CF-8M			
109	2	End Cover	A48 Class 25B			
112	2	Ball Bearing - Thrust	Steel			
122	1	Shaft	A434 GR 4140			A564 Type 630
124	1	Sleeve Nut, RH	A48 Class 25B	B584 C87500	A743 CF-8M	
125	2	Stuffing Box Bushing	B584 C87500		A743 CF-8M	
126	2	Shaft Sleeve	B584 C87500		A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 20B	B584 C87500	A743 CF-8M	
130	1	Sleeve Nut, LH	A48 Class 25B	B584 C87500	A743 CF-8M	
134	1	Bearing Housing - Thrust	A48 Class 25B			
136	1	Bearing Locknut	Steel			
142	2	Impeller Wear Ring	A48 Class 20B	B584 C87500	A743 CF-8M	
166	1	Bearing Housing - Radial	A48 Class 25B			
168	1	Ball Bearing - Radial	Steel			
178	1	Impeller Key	Steel		A582 Type 303	
190E	2	Pipe Nipple	A53			
193H	2	Grease Fitting	Steel			
222B	2	Set Screw - Sleeve Nut	F738M Class A4-50			
251	2	Sight Oiler	Metal / Glass			
320	6	Set Screw - Impeller Wearing Ring	F738M Class A4-50			
332A	1	Seal, Labyrinth - O.B.	Carbon/Graphite filled Teflon w/ Viton O-rings			
333A	2	Seal Labyrinth - I.B.	Carbon/Graphite filled Teflon w/ Viton O-rings			
351D	1	Gasket - Casing Discharge	Non-Asbeston Sheet Packing			
351S	1	Gasket - Casing Suction	Non-Asbestos Sheet Packing			
353	4	Stud - Gland	Steel - 2441			
355	4	Hex Nut - Gland Stud	Steel - 2441			
356A	var.	Stud - Casing	Steel - 2443			
357H	2	Hex Nut - Casing Taper Pin	Steel - 2442			
358	8	Pipe Plug - Casing (Not Shown)	Steel			
360	8	Gasket - Cover to Housing	Vellumoid Sheet Packing D-1170			
371C	4	Hex Cap Screw - Cover to Housing	Steel - 2442			
371D	4	Hex Cap Screw - Cover to Housing	Steel - 2442			
372U	8	Hex Cap Screw - Housing to Casing	Steel - 2442			
382	1	Bearing Lockwasher	Steel			
400	1	Key - Coupling (Not Shown)	Steel			
408	10	Pipe Plug - Casing (Not Shown)	Steel			
412A	2	O-ring - Impeller	Nitrile (Buna-N) Rubber			
418	2	Hex Cap Screw - Casing Jacking	Steel - 2442			
425	var.	Hex Nut - Casing Stud	Steel - 2442			

Parts List with Materials of Construction						
SX, MX						
Item	**Qty per Pump**	**Part Name**	**All Iron**	**Bronze Fitted**	**Iron/316 Trim**	**All 316SS**
426	var.	Hex Cap Screw - Casing Parting	Steel			
445A	2	Pin - Anti-Rotation	F738M Class A2-70			
469G	2	Taper Pin	Steel			A276 Type 316
497	2	O-ring - Sleeve Nut	Nitrile (Buna-N) Rubber			

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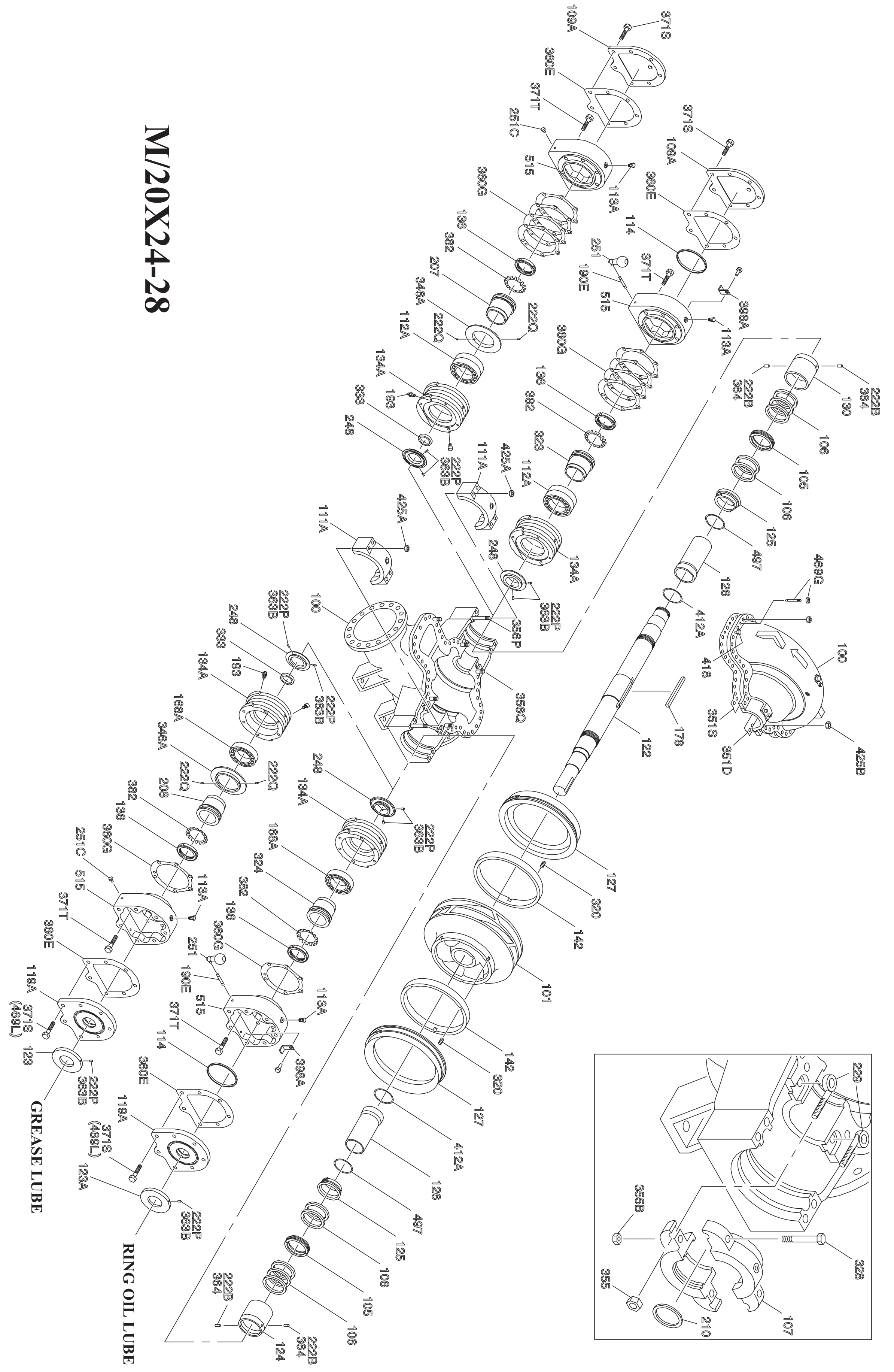
M/20X24-28



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107
GREASE LUBE
RING OIL LUBE

Parts List With Materials Of Construction

M & 20x24-28

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48 Class 25B	B584 C87500	A743 CF-8M	
105	2	Lantern Ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Quench Gland - Stuffing Box	A48 Class 25B	B584 C87500	A743 CF-8M	
109A	1	Bearing End Cover	A48 Class 25B			
111A	2	Bearing Cap	A48 Class 30B			
112A	1	Ball Bearing - Thrust	Steel			
113A	2	Breather	Steel			
114	2	Oil Ring	B584 C87500			
119A	1	Bearing End Cover	A48 Class 25B			
122	1	Shaft	A322 GR 4340		A276 Type 316	
123	1	Deflector - O.B., Grease	A48 Class 20B			
123A	1	Deflector - O.B.	A48 Class 20B			
124	1	Sleeve Nut, RH	A48 Class 25B	B584 C87500	A743 CF-8M	
125	2	Stuffing Box Bushing	A48 Class 25B	B584 C87500	A743 CF-8M	
126	2	Shaft Sleeve	A48 Class 25B	B584 C87500	A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
130	1	Sleeve Nut, LH	A48 Class 25B	B584 C87500	A743 CF-8M	
134A	2	Bearing Housing	A48 Class 25B			
136	2	Bearing Locknut	Steel			
142	2	Impeller Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
168A	1	Ball Bearing - Radial	Steel			
178	1	Impeller Key	A582 Type 303		A276 Type 316	
190E	2	Pipe Nipple	A53			
193	2	Grease Fitting	Steel			
207	1	Oil Ring Sleeve, Grease	Steel			
208	1	Oil Ring Sleeve, Grease	Steel			
210	2	Packing - Gland	Non-Asbestos			
222B	4	Set Screw - Sleeve Nuts	A276 Type 316			
222P	6	Set Screw - Deflector	A276 Type 316			
222Q	4	Set Screw, Grease Shield	A276 Type 316			
229	4	Swing Bolt	Steel		A276 Type 316	
248	2	Oil Thrower - I.B.	A48 Class 20B			
251	2	Sight Oiler	Metal / Glass			
251C	2	Pipe Plug (Sight Oiler)	Steel			
320	12	Set Screw - Impeller Wearing Ring	A276 Type 316			
323	1	Oil Ring Sleeve - Thrust	Steel			
324	1	Oil Ring Sleeve - Radial	Steel			
328	4	Hex Cap Screw - Gland	Steel	A276 Type 316		
333	2	Oil Seal - I.B., Grease	Buna Rubber and Steel			
346A	2	Grease Shield	Steel			
351D	1	Gasket - Casing Discharge	Non-Asbestos Sheet Packing			
351S	1	Gasket - Casing Suction	Non-Asbestos Sheet Packing			
355	4	Hex Nut - Gland Stud	Steel		A276 Type 316	
355B	4	Hex Nut - Quench Gland	Steel	A276 Type 316		

Parts List With Materials Of Construction						
M & 20x24-28						
Item	**Qty per Pump**	**Part Name**	**All Iron**	**Bronze Fitted**	**Iron / 316 Trim**	**All 316SS**
356P	8	Stud - Casing Bearing Cap	Steel - 2210			
356Q	var.	Stud - Casing Parting	Steel - 2210			
358C	var.	Pipe Plug - Casing (Not Shown)	Steel - 2210			
358V	var.	Pipe Plug - Frame (Not Shown)	Steel			
360E	2	Gasket - Cover to Housing	Kraft Paper			
360G	8	Gasket - Housing to Housing	Kraft Paper			
363B	6	Insert - Set Screw	Non-Asbestos Sheet Packing			
364	4	Insert - Set Screw	Non-Asbestos Sheet Packing			
371S	14	Hex Cap Screw - Cover to Housing	Steel - 2210			
371T	12	Hex Cap Screw - Hsg. to Hsg.	Steel - 2210			
382	2	Bearing Lockwasher	Steel			
398A	2	Retaining Bracket - Oil Ring	Steel			
400	1	Key - Coupling (Not Shown)	Steel			
412A	2	O-Ring - Impeller	O-Ring Nitrile (Buna-N) Rubber			
418	2	Hex Cap Screw - Casing Jacking	Steel - 2210			
425A	8	Hex Nut - Casing Bearing Cap	Steel - 2210			
425B	var.	Hex Nut - Casing Parting	Steel - 2210			

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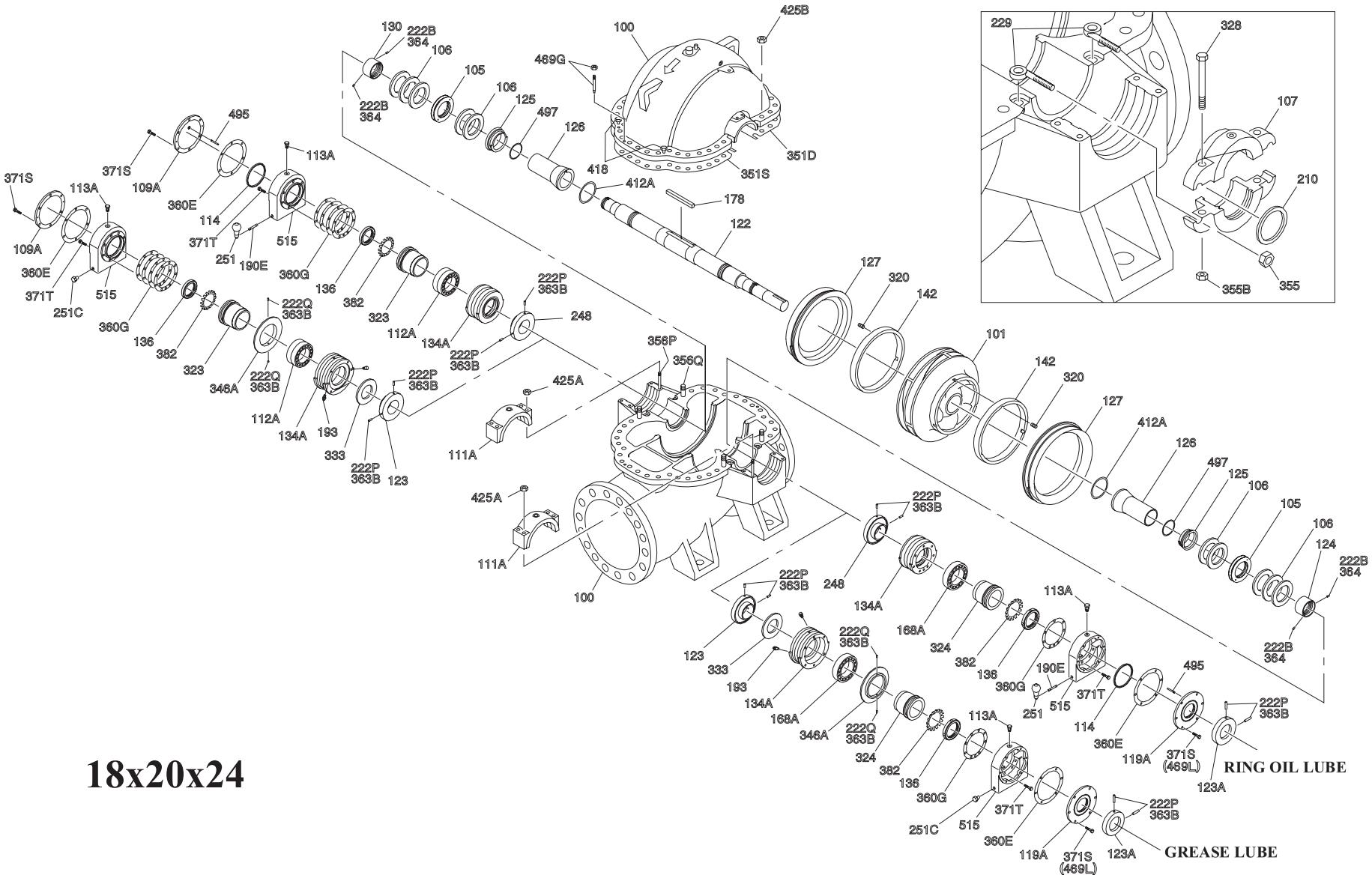
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GREASE LUBE
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355B
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18x20x24

Parts List with Materials of Construction

18x20-24

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48 Class 25B	B584 C87500	A743 CF-8M	
105	2	Lantern Ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Quench Gland - Stuffing Box	A48 Class 25B	B584 C87500	A743 CF-8M	
109A	1	Bearing End Cover	A48 Class 20B			
111A	2	Bearing Cap	A48 Class 30B			
112A	1	Ball Bearing - Thrust	Steel			
113A	2	Breather	Steel			
114	2	Oil Ring	B584 C87500			
119A	1	Bearing End Cover	A48 Class 20B			
122	1	Shaft	A322 FR 4340		A276 Type 316	
123	2	Deflector - I.B., Grease	A48 Class 20B			
123A	1	Deflector - O.B.	A48 Class 20B			
124	1	Sleeve Nut, RH	A48 Class 20B	B584 C87500	A743 CF-8M	
125	2	Stuffing Box Bushing	A48 Class 20B	B584 C87500	A743 CF-8M	
126	2	Shaft Sleeve	A48 Class 20B	B584 C87500	A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 20B	B584 C87500	A743 CF-8M	
130	1	Sleeve Nut, LH	A48 Class 20B	B584 C87500	A743 CF-8M	
134A	2	Bearing Housing	A48 Class 25B			
136	2	Bearing Locknut	Steel			
142	2	Impeller Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
168A	1	Ball Bearing - Radial	Steel			
178	1	Impeller Key	A582 Type 303		A276 Type 316	
190E	2	Pipe Nipple	A53			
193	2	Grease Fitting	Steel			
210	2	Packing - Gland	Non-Asbestos			
222B	4	Set Screw - Sleeve Nuts	A276 Type 316			
222P	6	Set Screw - Deflector	A276 Type 316			
222Q	4	Set Screw - Grease Shield	A276 Type 316			
229	4	Swing Bolt	Steel		A276 Type 316	
248	2	Oil Thrower	A48 Class 20B			
251	2	Sight Oiler	Metal / Glass			
251C	2	Pipe Plug (Sight Oiler)	Steel			
320	12	Set Screw - Impeller Wearing Ring	A276 Type 316			
323	1	Oil Ring Sleeve - Thrust	Steel			
324	1	Oil Ring Sleeve - Radial	Steel			
328	4	Hex Cap Screw - Gland	A276 Type 316			
333	2	Oil Seal - I.B., Grease	Buna Rubber and Steel			
346A	2	Grease Shield	Steel			
351D	1	Gasket - Casing Discharge	Non-Asbestos Sheet Packing			
351S	1	Gasket - Casing Suction	Non-Asbestos Sheet Packing			
355	4	Hex Nut - Gland Stud	Steel		A276 Type 316	
355B	4	Hex Nut - Quench Gland	Steel	A276 Type 316		
356P	8	Stud - Casing Bearing Cap	Steel - 2210			

Parts List with Materials of Construction						
18x20-24						
Item	**Qty per Pump**	**Part Name**	**All Iron**	**Bronze Fitted**	**Iron / 316 Trim**	**All 316SS**
356G	52	Stud - Casing Parting	Steel - 2210			
358C	var.	Pipe Plug - Casing (Not Shown)	Steel - 2210			
358V	var.	Pipe Plug - Frame (Not Shown)	Steel - 2210			
360E	2	Gasket - Cover to Housing	Kraft Paper			
360G	8	Gasket - Cover to Housing	Kraft Paper			
363B	10	Gasket - Housing to Housing	Non-Asbestos Sheet Packing			
364	4	Insert - Set Screw	Non-Asbestos Sheet Packing			
371S	12	Insert - Set Screw	Steel			
371T	14	Hex Cap Screw - Hsg. to Hsg.	Steel - 2210			
382	2	Bearing Lockwasher	Steel			
400	1	Key - Coupling (Not Shown)	Steel			
412A	2	O-ring - Impeller	Nitrile (Buna-N) Rubber			
418	4	Hex Cap Screw - Casing Jacking	Steel - 2210			
425A	8	Hex Nut - Casing Bearing Cap	Steel - 2210			
425B	52	Hex Nut Casing Parting	Steel - 2210			
469G	2	Dowel Pin - Casing	Steel - 2210			
469L	2	Dowel Pin - End Cover	Steel - 2210			

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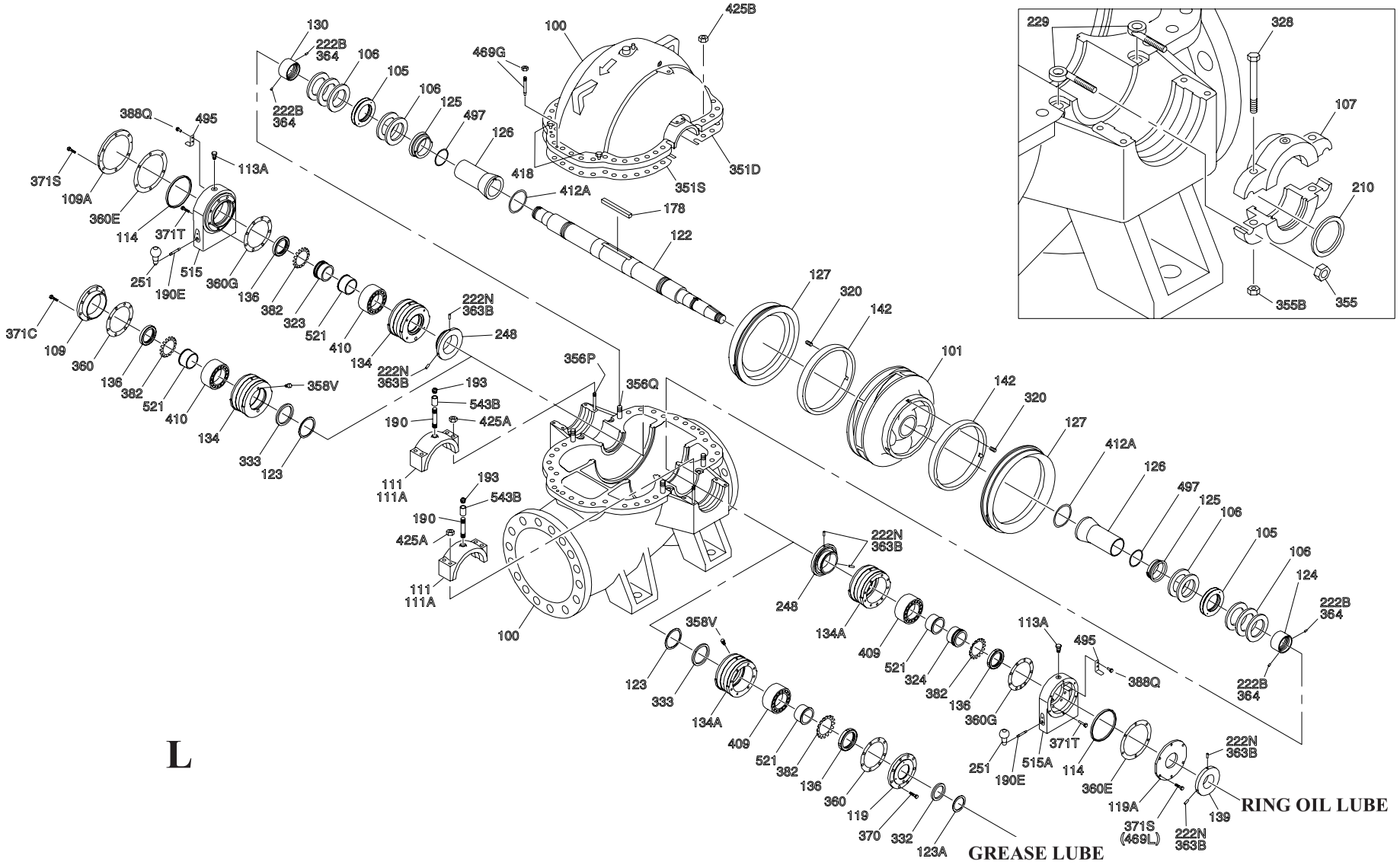
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RING OIL LUBE
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Parts List with Materials of Construction

L

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48 Class 25B	B584 C87500	A743 CF-8M	
105	2	Lantern ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Quench gland - Stuffing Box	A48 Class 20B	B584 C87500	A743 CF-8M	
109	1	Bearing end Cover, Grease	A48 Class 25B			
109A	1	Bearing End Cover	A48 Class 25B			
111	2	Bearing Cap, Grease	A48 Class 30B			
111A	2	Bearing Cap	A48 Class 30B			
113A	2	Breather	Steel			
114	2	Oil Ring	B584 C87500			
119	1	Bearing End Cover, Grease	A48 Class 25B			
119A	1	Bearing End Cover	A48 Class 20B			
122	1	Shaft	A322 GR 4340		A276 Type 316	
123	2	Deflector, - I.B., Grease	Laminate Plastic - NEMA GR. C			
123A	1	Deflector - O.B., Grease	Laminated Plastic - NEMA GR. C			
124	1	Sleeve Nut, RH	A48 Class 20B	B584 C87500	A743 CF-8M	
125	2	Stufing Box Bushing	A48 Class 20B	B584 C87500	A743 CF-8M	
126	2	Shaft Sleeve	A48 Class 20B	B584 C87500	A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 20B	B584 C87500	A743 CF-8M	
130	1	Sleeve Nut, LH	A48 Class 20B	B584 C87500	A743 CF-8M	
134	1	Bearing Housing - Thrust	A48 Class 25B			
134A	1	Bearing Housing - Radial	A48 Class 25B			
136	2	Bearing Locknut	Steel			
139	1	Dust Cover	A48 Class 20B			
142	2	Impeller Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
178	1	Impeller Key	A582 Type 303		A276 Type 316	
190	2	Pipe Nipple, Grease	A53			
190E	2	Pipe Nipple	A53			
193	2	Grease Fitting	Steel			
210	6	Packing - Gland	Non-Asbestos			
222B	6	Set Screw - Sleeve Nuts	A276 Type 316			
222N	4	Set Screw - Oil Thrower	A276 Type 316			
229	2	Swing Bolt	Steel		A276 Type 316	
248	2	Oil Thrower - I.B.	A48 Class 20B			
251	12	Sight Oiler	Metal / Glass			
320	1	Set Screw - Impeller Wearing Ring	A276 Type 316			
323	1	Oil Ring Sleeve - Thrust	B584 C87500			
324	4	Oil Ring Sleeve - Radial	B584 C87500			
328	4	Hex Cap Screw - Gland	Steel	A276 Type 316		
332	1	Oil Seal - O.B., Grease	Buna Rubber and Steel			
333	2	Oil Seal - I.B., Grease	Buna Rubber and Steel			
351D	1	Gasket - Casing Discharge	Non-Asbestos Sheet Packing			
351S	1	Gasket - Casing Parting	Non-Asbestos Sheet Packing			
355	4	Hex Nut - Gland Stud	Steel		A276 Type 316	
355B	4	Hex Nut Quench Gland	Steel		A276 Type 316	

Parts List with Materials of Construction

L

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
356P	8	Stud - Casing Bearing Cap	Steel - 2210			
356Q	38	Stud - Casing Parting	Steel - 2210			
358C	var.	Pipe Plug - Casing (Not Shown)	Steel - 2210			
358V	var.	Pipe Plug - Frame (Not Shown)	Steel			
360	2	Gasket - Cover to Housing, Grease	Kraft Paper			
360E	2	Gasket - Cover to Housing	Kraft Paper			
360G	2	Gasket - Housing to Housing	Kraft Paper			
363B	6	Insert - Set Screw	Non-Asbestos Sheet Packing			
364	6	Insert - Set Screw	Non-Asbestos Sheet Packing			
370	8	Hex Cap Screw - Cover to Hsg., Gr.	Steel - 2210			
371C	8	Hex Cap Screw - Cover to Hsg., Gr.	Steel - 2210			
371S	12	Hex Cap Screw - Cover to Housing	Steel - 2210			
371T	16	Hex Cap Screw - Hsg. to Hsg.	Steel - 2210			
382	2	Bearing Lockwasher	Steel			
388Q	4	Hex Cap Screw - Retainer	Steel - 2210			
400	1	Key - Coupling (Not Shown)	Steel			
409	1	Roller Bearing - Radial	Steel			
410	1	Roller Bearing - Thrust	Steel			
412A	2	O-ring - Impeller	Nitrile (Buna-N) Rubber			
418	4	Hex Cap Screw - Casing Jacking	Steel - 2210			
425A	8	Hex Nut - Casing Bearing Cap	Steel - 2210			
425B	38	Hex Nut - Casing Parting	Steel - 2210			
469G	2	Dowel Pin - Casing	Steel - 2210			
469L	2	Dowel Pin - End Cover (Oil Lube)	Steel - 2210			
495	2	Retainer Pin - Oil Ring	Steel - 2210			
497	2	O-ring - Sleeve Nut	Nitrile (Buna-N) Rubber			
515	1	Oil Ring Housing - Thrust	A48 Class 25B			
515A	1	Oil Ring Housing - Radial	A48 Class 25B			
518	1	Nut - Bearing Removal (Not Shown)	Steel			
519	1	Locking Plate - Cplg. (Not Shown)	Steel			
520	1	Nut - Coupling (Not Shown)	Steel			
521	2	Sleeve - Roller Bearing	Steel			
543B	2	Coupling - Grease Ftg.	Steel			

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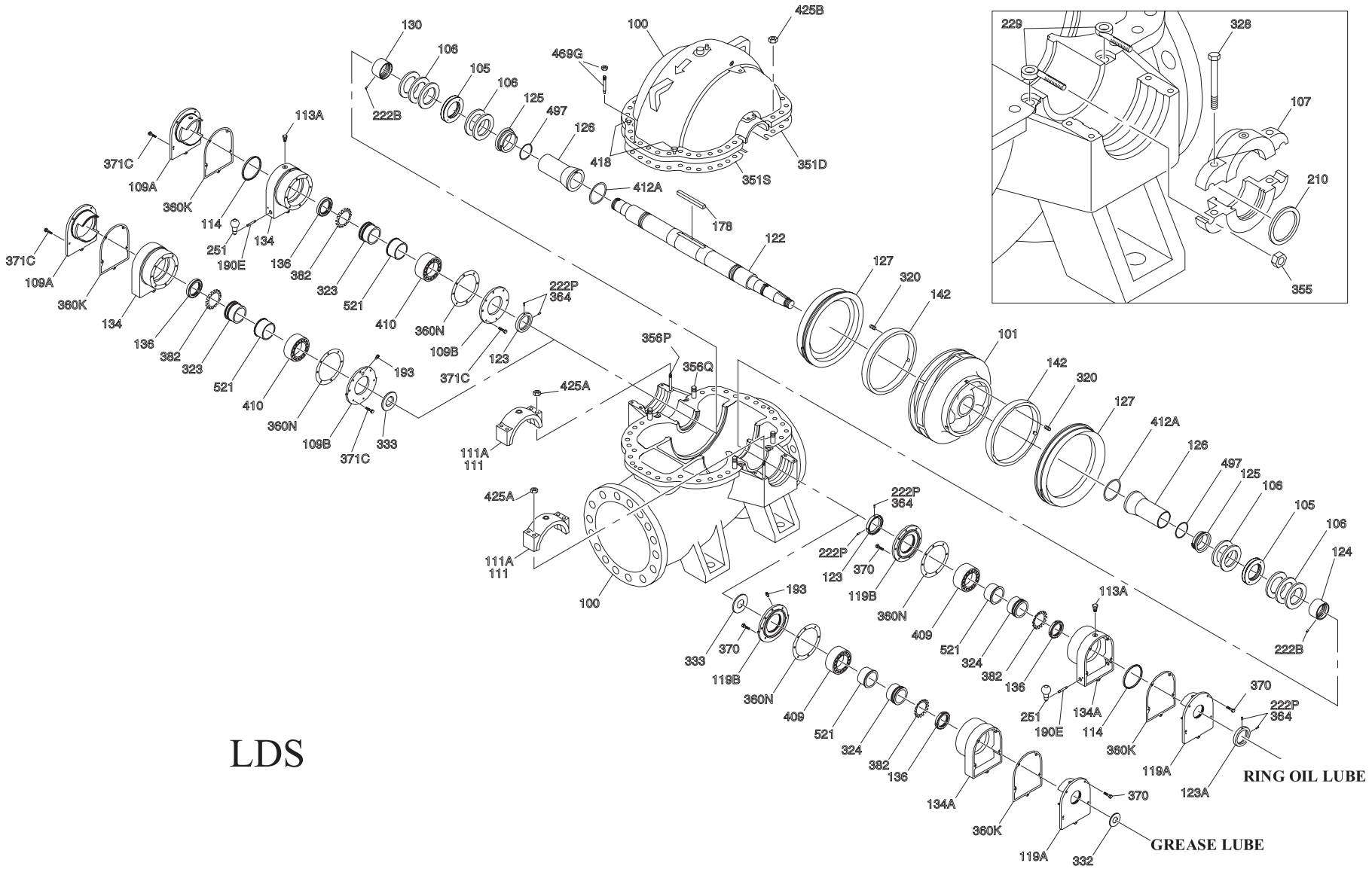
130
106
105
106
125
497
126
222B
469G
100
425B
418
351S
351D
412A
178
122
127
320
142
101
142
320
127
412A
126
497
125
106
105
106
124
222B
229
328
107
210
355
113A
371C
109A
360K
114
251
190E
134
136
382
323
521
410
360N
109B
371C
193
333
222P
364
123
371C
109B
360N
356P
356Q
425A
111A
111
425A
111A
111
100
222P
364
222P
123
370
119B
360N
409
521
324
382
136
113A
251
190E
134A
114
360K
119A
370
222P
364
123A
RING OIL LUBE
193
333
370
119B
360N
409
521
324
382
136
134A
360K
119A
370
332
GREASE LUBE
371C
109A
360K
134
136
382
323
521
410
360N
109B
371C
193
333

LDS

Parts List with Materials of Construction

LDS

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48 Class 25B	B584 C87500	A743 CF-8M	
105	2	Lantern Ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Quench gland - Stuffing Box	A743 CF-8M			
109A	1	Brg. End Cover	A48 Class 25B			
109B	1	Brg. End Cover	A48 Class 25B			
111	2	Bearing Cap, Grease	A48 Class 25B			
111A	2	Bearing Cap	A48 Class 25B			
113A	2	Breather	Steel			
114	2	Oil Ring	B584 C87500			
119A	1	Bearing End Cover	A48 Class 25B			
119B	1	Bearing End Cover	A48 Class 25B			
122	1	Shaft	A322 GR 4340		A276 Type 316	
123	2	Deflector - I.B.	A48 Class 20B			
123A	1	Deflector - O.B.	A48 Class 20B			
124	1	Sleeve Nut, RH	A48 Class 20B	B584 C87500	A743 CF-8M	
125	2	Stuffing Box Bushing	A48 Class 20B	B584 C87500	A743 CF-8M	
126	2	Shaft Sleeve	A48 Class 20B	B584 C87500	A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 20B	B584 C87500	A743 CF-8M	
130	1	Sleeve Nut, LH	A48 Class 20B	B584 C87500	A743 CF-8M	
134	1	Bearing Housing - Thrust	A48 class 25B			
134A	1	Bearing Housing - Thrust	A48 Class 25B			
136	2	Bearing Locknut	Steel			
142	2	Impeller Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
178	1	Impeller Key	A582 Type 303		A276 Type 316	
190E	2	Pipe Nipple	A53			
193	2	Grease Fitting	Steel			
210	2	Packing - Gland	Non-Asbestos			
222B	2	Set Screw - Sleeve Nuts	A276 Type 316			
222P	6	Set Screw - Deflector	A276 Type 316			
229	4	Swing Bolt	A276 Type 316			
251	2	Sight Oiler	Metal / Glass			
320	12	Set Screw - Impeller Wearing Ring	A276 Type 316			
323	1	Oil Ring Sleeve - Thrust	Steel			
324	1	Oil Ring Sleeve - Radial	Steel			
328	4	Hex Cap Screw - Gland	A276 Type 316			
332	1	Oil Seal - O.B., Grease	Buna Rubber and Steel			
333	2	Oil Seal - I.B., Grease	Buna Rubber and Steel			
351D	1	Gasket - Casing Discharge	Non-Asbestos Sheet Packing			
351S	1	Gasket - Casing Suction	Non-Asbestos Sheet Packing			
355	4	Hex Nut - Gland Stud	A276 Type 316			
356P	8	Stud - Casing Bearing Cap	Steel - 2210			
356Q	58	Stud - Casing Parting	Steel - 2210			
357P	2	Hex Nut - Casing Taper Pin	Steel - 2210			

Parts List with Materials of Construction						
LDS						
Item	**Qty per Pump**	**Part Name**	**All Iron**	**Bronze Fitted**	**Iron / 316 Trim**	**All 316SS**
358C	var.	Pipe Plug - Casing (Not Shown)	Steel - 2210			
358V	var.	Pipe Plug - Frame (Not Shown)	Steel - 2210			
360K	2	Gasket - Cover to Housing	Kraft Paper			
360N	2	Gasket - Cover to Housing	Kraft Paper			
364	6	Insert - Set Screw	Non-Asbestos Sheet Packing			
370	13	Hex Cap Screw - Cover to Housing	Steel - 2210			
371C	13	Hex Cap Screw - Cover to Housing	Steel - 2210			
382	2	Bearing Lockwasher	Steel			
400	1	Key - Coupling (Not Shown)	Steel			
409	1	Roller Bearing - Radial	Steel			
410	1	Roller Bearing - Thrust	Steel			
412A	2	O-ring - Impeller	Nitrile (Buna-N) Rubber			
418	4	Hex Cap Screw - Casing Jacking	Steel - 2210			
425A	8	Hex Nut - Casing Bearing Cap	Steel - 2210			
425B	58	Hex Nut - Casing Parting	Steel - 2210			
469G	2	Dowel Pin - Casing	Steel - 2210			
497	2	O-ring - Sleeve Nut	Nitrile (Buna-N) Rubber			

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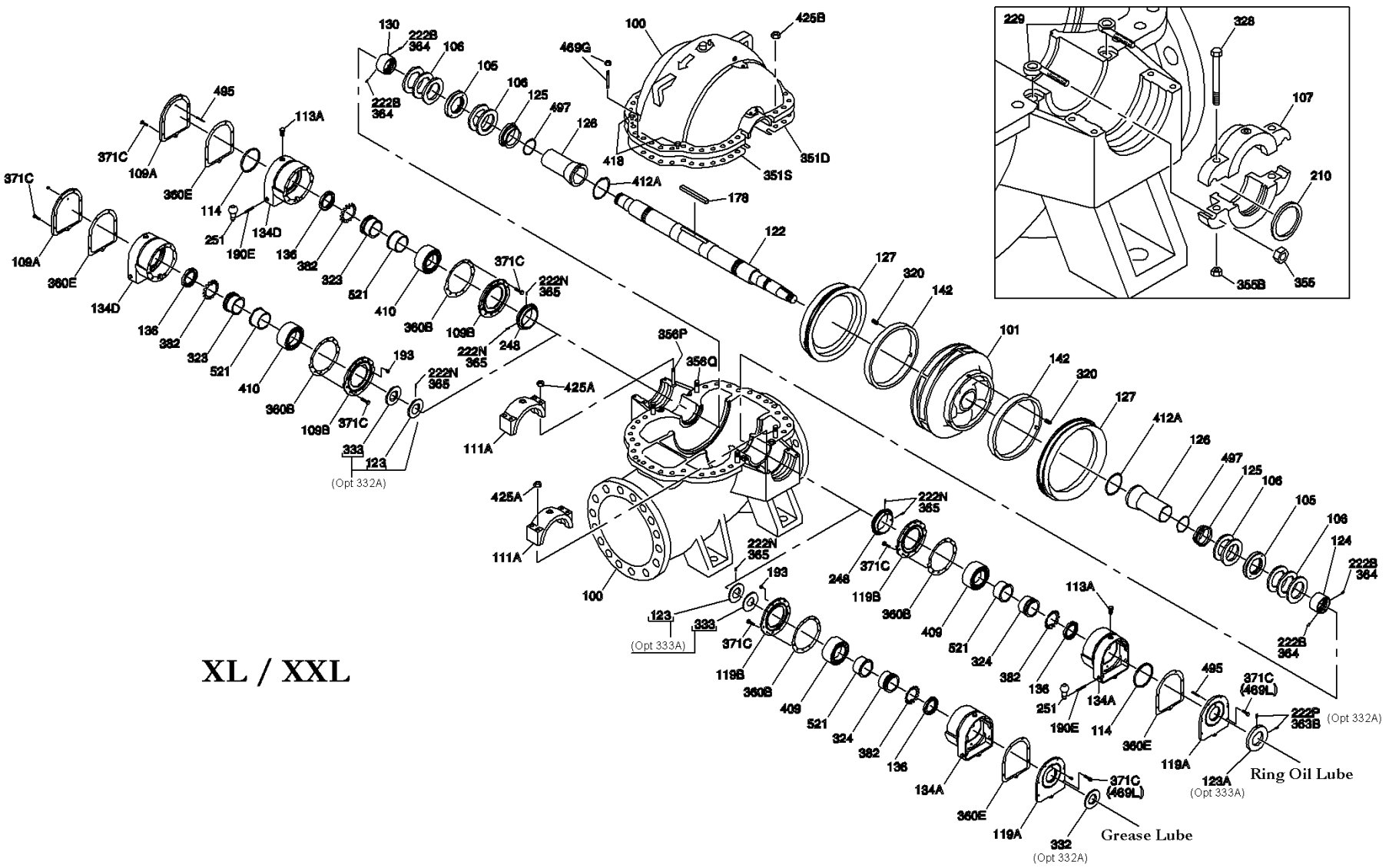

XL / XXL
Ring Oil Lube
Grease Lube
(Opt 332A)
(Opt 333A)

Parts List with Materials of Construction

XL and XXL

Item	Qty per Pump	Part Name	All Iron	Bronze Fitted	Iron / 316 Trim	All 316SS
100	1	Casing	A48 Class 30B			A743 CF-8M
101	1	Impeller	A48 Class 25B	B584 C87500	A743 CF-8M	
105	2	Lantern Ring	25% Glass Filled TFE			
106	1 set	Stuffing Box Packing	Non-Asbestos			
107	2	Quech Gland - Stuffing Box	A48 class 25B	B584 C87500	A743 DF-8M	
109A	1	Bearing End Cover	A48 Class 25B			
109B	1	Bearing End Cover	A48 Class 25B			
111A	2	Bearing cap	A48 Class 25B			
113A	2	Breather	Steel			
114	2	Oil Ring	B584 C87500			
119A	1	Bearing End Cover	A48 Class 25B			
119B	1	Bearing End Cover	A48 Class 25B			
122	1	Shaft	A322 GR 4340		A276 Type 316	
123	2	Deflector - I.B., Grease	A48 Class 25B			
123A	1	Deflector - O.B.	A48 Class 25B			
124	1	Sleeve Nut, RH	A48 Class 25B	B584 C87500	A743 CF-8M	
125	2	Stuffing Box Bushing	A48 Class 25B	B584 C87500	A743 CF-8M	
126	2	Shaft Sleeve	A48 Class 25B	B584 C87500	A743 CF-8M	
127	2	Casing Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
130	2	Sleeve Nut, LH	A48 Class 25B	B584 C87500	A743 CF-8M	
134A	1	Bearing Housing - Radial	A48 Class 25B			
134D	1	Bearing Housing - Thrust	A48 Class 25B			
136	2	Bearing Locknut	Steel			
142	2	Impeller Wear Ring	A48 Class 25B	B584 C87500	A743 CF-8M	
178	1	Impeller Key	A582 Type 303		A276 Type 316	
190E	2	Pipe Nipple	A53			
193	2	Grease Fitting	Steel			
210	2	Packing Gland	Non-Asbestos			
222B	4	Set Screw - Sleeve Nuts	A276 Type 316			
222N	4	Set Screw - Oil Thrower	A276 Type 316			
222P	2	Set Screw - Deflector	A276 Type 316			
229	4	Swing Bolt	Steel		A276 Type 316	
248	2	Oil Thrower	A48 Class 25B			
251	2	Sight Oiler	Metal / Glass			
320	12	Set Screw - Impeller Wearing ring	A276 Type 316			
323	1	Oil Ring Sleeve - Thrust	A48 Class 25B			
324	2	Oil Ring Sleeve - Radial	A48 Class 25B			
328	4	Hex Cap Screw - Gland	Steel	A276 Type 316		
332/332(A)	1	Oil Seal - O.B., Grease	Buna Rubber and Steel (A) Bronze for Laby Seal			
333/333(A)	1	Oil Seal - I.B., Grease	Buna Rubber and Steel (A) Bronze for Laby Seal			
351D	1	Gasket - Casing Discharge	Non-Asbestos Sheet Packing			
351S	1	Gasket - Casing Suction	Non-Asbestos Sheet Packing			
355	4	Hex Nut - Gland Stud	Steel		A276 Type 316	
355B	4	Hex Nut - Quench Gland	Steel		A276 Type 316	
356P	8	Stud - Casing Bearing Cap	Steel - 2210			

Parts List with Materials of Construction						
XL and XXL						
Item	**Qty per Pump**	**Part Name**	**All Iron**	**Bronze Fitted**	**Iron / 316 Trim**	**All 316SS**
356Q	var.	Stud - Casing Parting	Steel - 2210			
358C	var.	Pipe Plug - Casing (Not Shown)	Steel - 2210			
358V	var.	Pipe Plug - Frame (Not Shown)	Steel - 2210			
360B	2	Gasket - I.B. - Cover to Housing	Kraft Paper			
360E	2	Gasket - O.B. - Cover to Housing	Kraft Paper			
363B	2	Insert - Set Screw	Non-Asbestos Sheet Packing			
364	4	Insert - Set Screw	Non-Asbestos Sheet Packing			
365	4	Insert - Set Screw	Non-Asbestos Sheet Packing			
371C	38	Hex Cap Screw - Cover to Housing	Steel - 2210			
382	2	Bearing Lockwasher	Steel			
400	1	Key - Coupling (Not Shown)	Steel			
409	1	Roller Bearing - Radial	Steel			
410	1	Roller Bearing - Thrust	Steel			
412A	2	O-ring Impeller	Nitrile (Buna-N) Rubber			
418	4	Hex Cap Screw - Casing Jacking	Steel - 2210			
425A	8	Hex Nut - Casing Bearing Cap	Steel - 2210			
425B	var.	Hex Nut - Casing Parting	Steel - 2210			
469G	2	Dowel Pin - Casing	Steel - 2210			
469L	2	Dowel Pin - End Cover	Steel - 2210			
495	2	Retainer Pin - Oil Ring	Steel - 2210			
497	2	O-ring - Sleeve Nut	Nitrile (Buna-N) Rubber			
518	1	Nut - Bearing Removal (Not Shown)	Steel			
519	1	Locking Plate - Cplg. (Not Shown)	Steel			
520	1	Nut Coupling - (Not Shown)	Steel			
521	2	Sleeve - Roller Bearing	Steel			

APPENDIX I

INSTALLATION AND DISASSEMBLY INSTRUCTIONS FOR GOULDS ANSI B15.1 COUPLING GUARDS

The coupling guard used in an ATEX classified environment must be constructed from a non-sparking material.

WARNING

Before installation or disassembly of the coupling guard is performed, the driver must be de-energized, the driver controller/starter put in a locked-out position and a caution tag placed at the controller/starter indicating the disconnect. Replace coupling guard before resuming normal operation of the pump. ITT / Goulds Pumps, Inc. assumes no liability for avoiding the practice.

Simplicity of design allows complete assembly of the coupling guard, including the end plate (pump end), in about fifteen minutes. If the end plate is already in place, assembly can be accomplished in about five minutes. Fig I-A shows the coupling guard components.

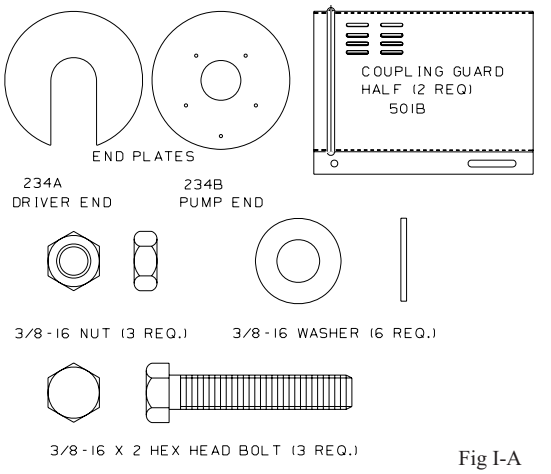


Fig I-A

INSTALLATION

NOTE: If end plate (pump end) is already installed, make any necessary coupling adjustments and then proceed to Step 7.

1. Disconnect the coupling. Refer to coupling manufacturer's instructions for assistance.
2. If the coupling hub diameter is larger than the diameter of the opening in the end plate (234B), remove the coupling hub.
3. Remove five thrust bearing end cover/bearing frame screws (370N) as indicated in Fig. I-B.

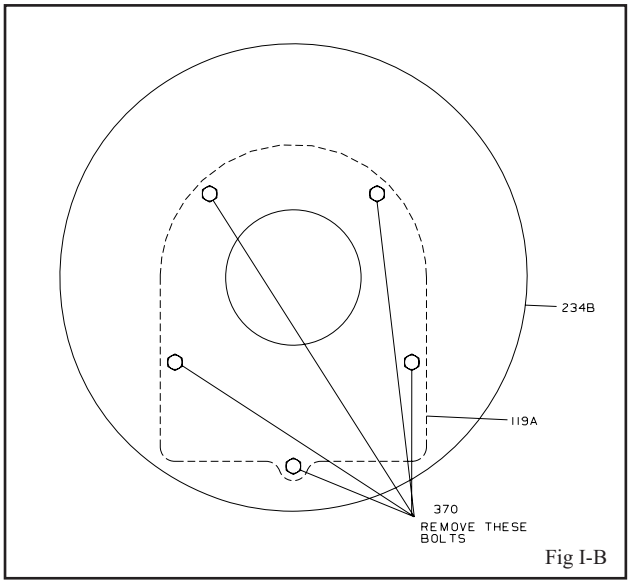


Fig I-B

4. Align the end plate (234B) to the thrust bearing end cover (109A) so that the five holes in the end plate align with the bolt holes in the end cover.
5. Replace the three to five thrust bearing end cover/bearing end cover bolts (371S) and torque to values provided in Table 11 (p. 72).
6. Replace coupling hub (if removed) and reconnect the coupling. Refer to coupling manufacturer's instructions for assistance.

NOTE: Coupling adjustments should be completed before proceeding with coupling guard assembly.

8

7. Spread opening of coupling guard half (501B) slightly and place over pump end plate (234B) as shown in Fig. I-C.

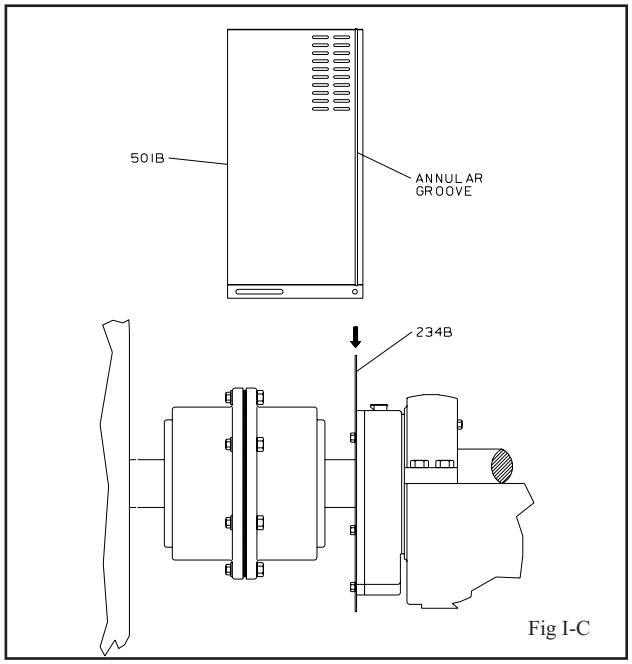


Fig I-C

The annular groove in the guard is located around the end plate as indicated in Fig. I-D.

NOTE: Locate opening (flange) so that it will not interfere with piping but will allow access for installing bolts (Step 8).

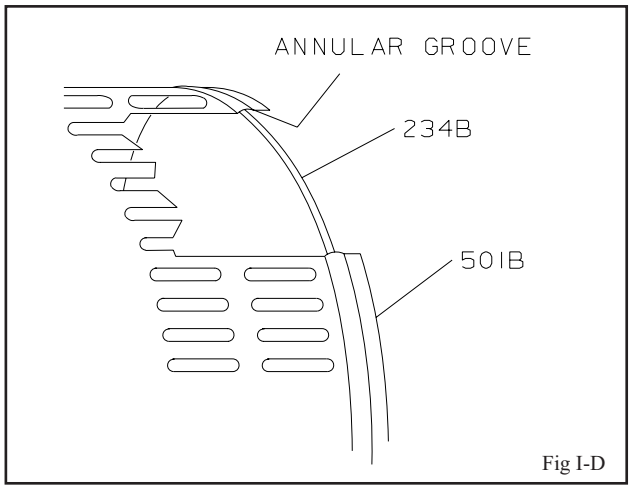


Fig I-D

8. Placed one washer over bolt and insert bolt through round hole at front end of guard half (501B).
9. Place a second washer over exposed end of bolts.
10. Thread nut onto exposed end of bolt end, tighten firmly.

The proper sequence of components is shown in Fig. I-E; an assembled unit is shown in Fig. I-F.

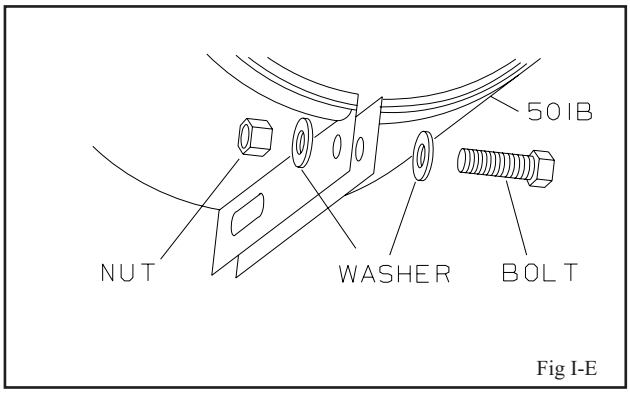


Fig I-E

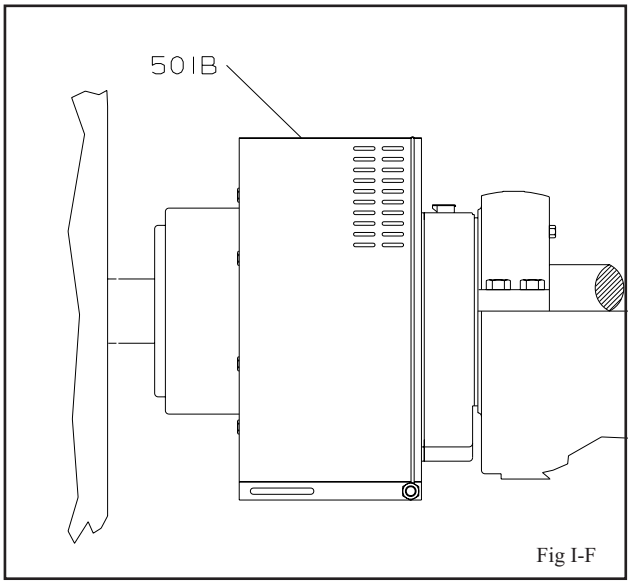


Fig I-F

11. Spread opening of remaining coupling guard half (501B) slightly and place over installed coupling guard half so that annular groove in remaining coupling guard half faces the driver as indicated in Fig. I-G.

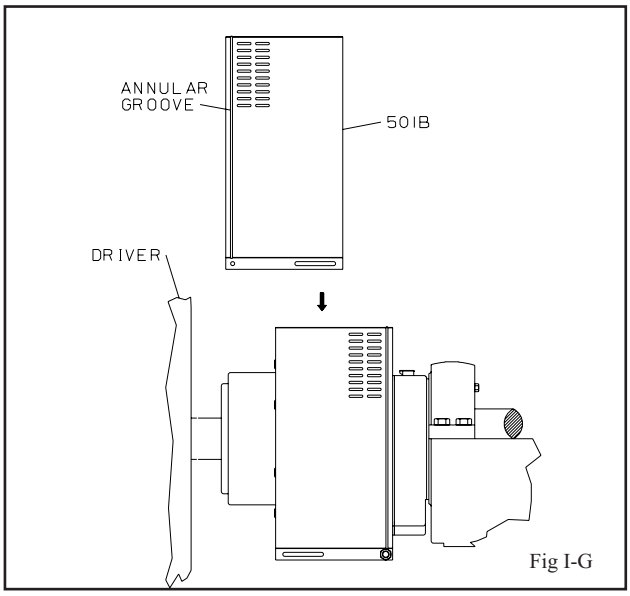


Fig I-G

12. Place end plate (234A) over driver shaft as indicated in Fig. I-H. Locate the end plate in the annular groove at the rear of the coupling guard half (501B).

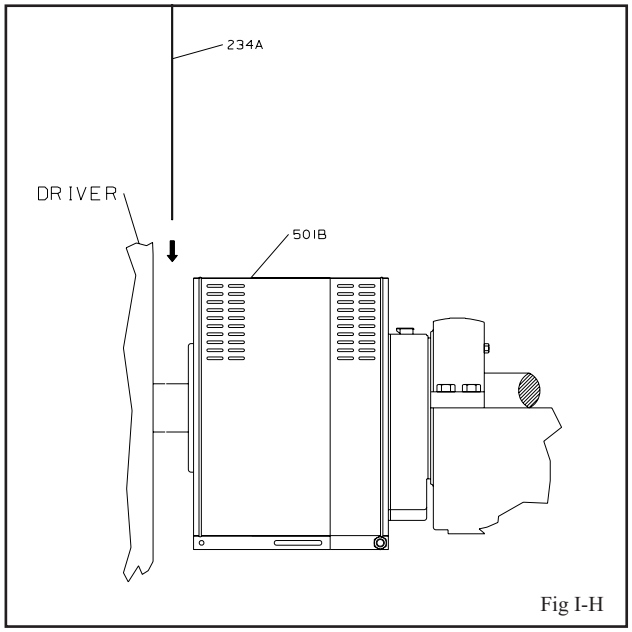


Fig I-H

13. Repeat steps 8-10 for rear end of coupling guard half (501B), except that nut should be finger tightened only.
14. Adjust length of coupling guard to completely cover shaft and coupling as shown in Fig. I-I by sliding rear coupling guard half (501B) towards motor.
15. Repeat steps 8-10 for center slots in coupling guard.
16. Tighten all nuts on the guard assembly firmly.

DISASSEMBLY

The coupling guard must be removed for certain maintenance and adjustments to the pump, such as adjustment of the coupling. The coupling guard should be replaced after maintenance is completed.

⚠ WARNING

Before assembly or disassembly of the coupling guard is performed, the driver must be de-energized, the driver controller/starter put in a locked-out position and a caution tag placed at the controller/starter indicating the disconnect. Replace coupling guard before resuming normal operation of the pump. ITT / Goulds Pumps, Inc. assumes no liability for avoiding this practice.

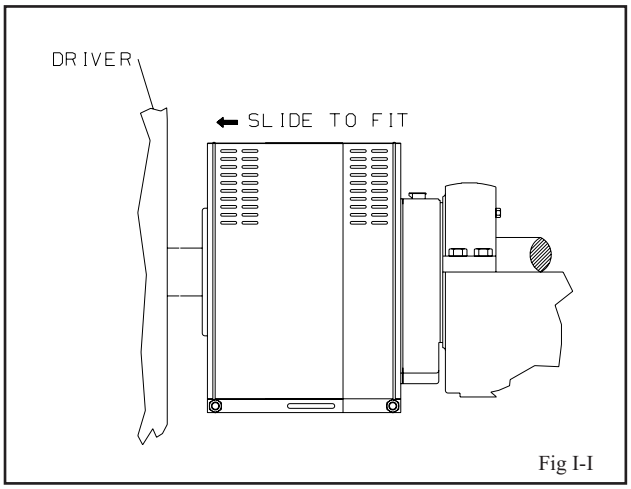


Fig I-I

⚠ WARNING

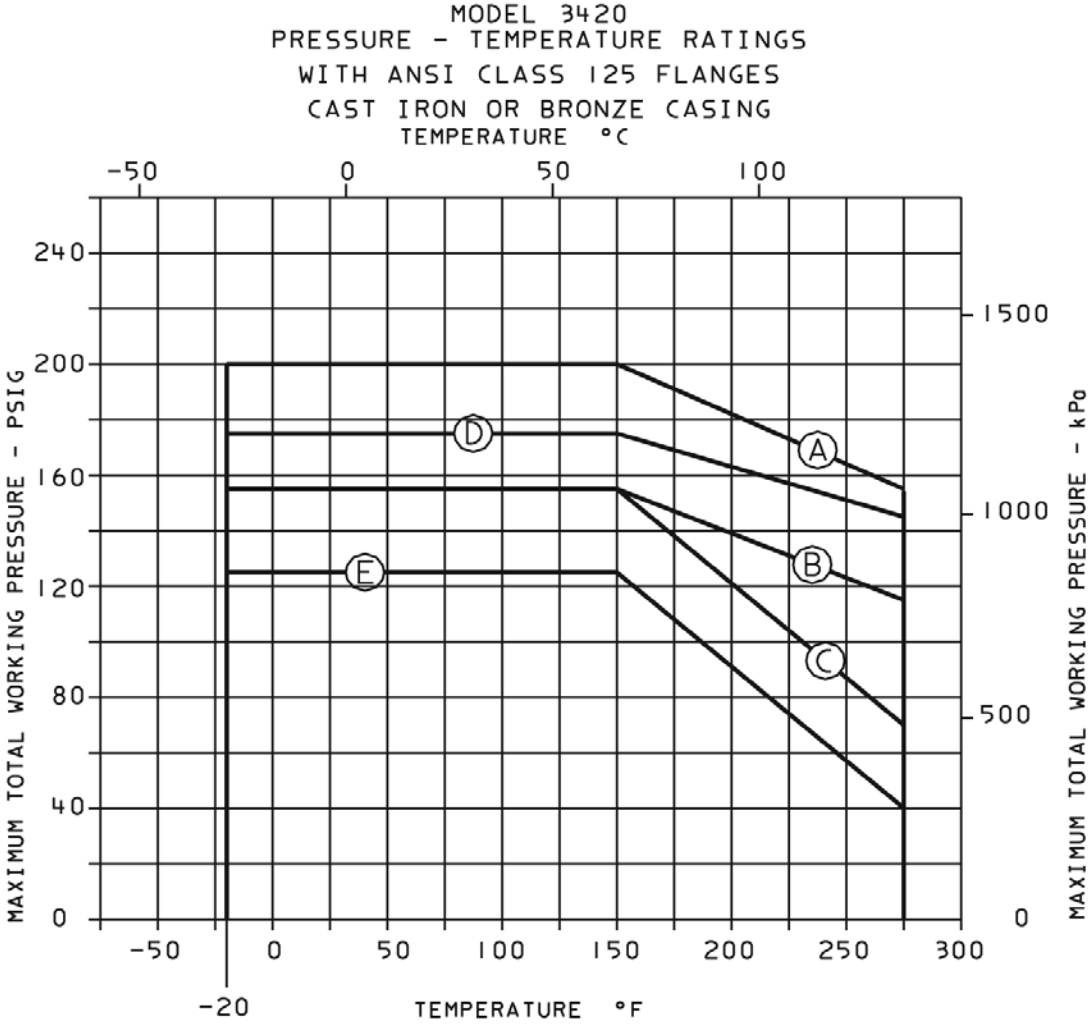
DO NOT resume normal pump operation with the coupling guard removed.

1. Remove nut, bolt, and washers from center slotted hole in the coupling guard assembly.
2. Slide driver end coupling guard half (501B) towards pump (Fig. I-I).
3. Remove nut, bolt, and washers from driver coupling guard half (501B).
4. Remove driver end plate (234A) (Fig. I-H).
5. Spread opening of driver coupling guard half (501B) slightly and lift over remaining coupling guard half (Fig. I-G).
6. Remove nut, bolt, and washers from remaining coupling guard half (501B).
7. Spread bottom of coupling guard half slightly and lift off pump end plate (234B) (Fig. I-C).

This completes disassembly of the coupling guard.

NOTE: It is not necessary to remove the end plate (pump end) from the pump bearing frame. Before removing other components, refer to Disassembly section of this manual.

APPENDIX II



CURVE	PUMP SIZE
A	16X18-30 18X20-30 20X24-24 20X24-30
B	18X20-24 20X24-28
C	30X36-42 24X30-32 20X30-42
D	12X14-15 16X18-17H
E	30X30-31 30X30-38 30X36-42 36X42-52

8

CONSTRUCTION DETAILS

FEATURE	SIZE							
	12x14-15	16x18-17H	18x20-24	16x18-30	18x20-30	20x24-24	20x24-28	20x24-30
WEIGHT								
BF Bare Pump (lbs.)	2520	5060	5650	7060	7500	7200	8650	8000
BF Upper Case (lbs.)	610	1160	1200	1300	1500	1400	1800	1700
BF Rot. Element (lbs.)	500	760	1000	1150	1450	950	1550	1550
Casing Thickness	13/16"	13/16"	1"	1"			1 3/16"	1"
STUFFING BOX								
Bore	5 3/8"	5 3/8"	6 1/4"	7 1/2"				
Depth (To Bushing)	4 5/16"	4 5/16 "	4 5/8"	6 3/4"				
Packing Size	5/8 x 5/8"	5/8 x 5/8"	5/8 x 5/8"	1" x 1"				
No. of Rings/Box	5							
Width of Lantern Ring	15/16"	15/16"	1 1/4"	1 1/4"				
Shaft Sleeve O.D.	4 1/8"	4 1/8"	5"	5 1/2"				
SHAFT DIAMETERS								
At Impeller	3.54	3.54	4 3/8"	5 1/8"				
Under Sleeve	3.5	3.5	4 1/4"	5"				
At Coupling	2.36	2.36	3 1/4"	3 7/8"				
BEARING (Cplg. End)								
Ball	6313	6313	318S	321M				
BEARING (Thrust)								
Ball	7313	7313	7318PDU	7321PDU				
SLEEVE (Cplg./Thrust End)								
Length	—	—	—	6"			—	6"
Bore (Approx.)	—	—	—	4 11/16"			—	4 11/16"
Bearing Centers(1)	48 1/2"	48 1/2"	49 1/2"	55"			62"	55"
Max. Shaft HP/100 RPM	90	90	125	170			170	
Max. Total Wkg. Press.	175 PSI	175	150 PSI	200 PSI			150 PSI	200 PSI
Hydrotest Press.	263 PSI	263	225 PSI	300 PSI			225 PSI	300 PSI
Max. Liq. Temp. w/o Quench	180° F	180	180°F					
Max. Liq. w/Quench Gld.	275° F	275	275°F					
FLANGES								
Discharge Size	12	16	18	16	18	20	20	20
Suction Size	14	18	20	18	20	24	24	24
ANSI Rating	125 lb.	125 lb.	Class 125 lb. FF					

(1) Bearing centers are for standard oil lube bearing configuration.

CONSTRUCTION DETAILS

FEATURE	SIZE					
	24x30-32	30x30-31	30x30-38	30x36-42	20x30-42	36x42-52
WEIGHT						
BF Bare Pump (lbs.)	11500	16200	15400	25250	20000	43200
BF Upper Case (lbs.)	2350	3640	3060	5350	60000	18000
BF Rot. Element (lbs.)	1850	3060	3120	4600	3500	6500
Casing Thickness	1⅛"	1 ¼"			1.25	1.75
STUFFING BOX						
Bore	8 ½"	9 ½"		10"	9.50	11.00
Depth (To Bushing)	7 ⅛"	6 ½"		7 ⅝"	6.50	6.65
Packing Size	1" x 1"					
No. of Rings/Box	5					
Width of Lantern Ring	1 ½"	1 ⅛"		1 ½"	1 ⅛"	1.12
Shaft Sleeve O.D.	6 ½"	7 ½"		8"	7.50	9.00
SHAFT DIAMETERS						
At Impeller	6 ⅛"	6 ⅞"		7 ¼"	6.88	8.25
Under Sleeve	5 ¾"	6 ¾"		7 3/16"	6.75	8.125
At Coupling (2)	4 ⅛"(2)	4 ⅞"(2)				6.88
BEARING (Cplg. End) - SKF						
Roller	22226	222228		22230		22240
BEARING (Thrust) - SKF						
Roller	22226	22228		22230		22240
SLEEVE (Cplg./Thrust End)						
Length	6"	—	—	7 ½"	—	2.63
Bore (Approx.)	5 ⅜"	—	—	7"	—	7.08
Bearing Centers(1)	63 ½"	72 ½"		80 ⅜"	76.12	94.65
Max. Shaft HP/100 Rpm	265	383		500		760
Max. Total Wkg. Press.	150 PSI	125 PSI		150 PSI		150
Hydrotest Press.	225 PSI	188 PSI		225 PSI		225
Max. Liq. Temp. w/o Quench	180° F					
Max. Liq. w/Quench Gld.	275° F					
FLANGES						
Discharge Size	24	30		30	20	36
Suction Size	30	30		36	30	42
ANSI Rating	Class 125 FF				Class 250 FF	

(1) Bearing centers are for standard oil lube bearing configuration.

(2) Pump Shaft has taper of 1¼" per foot.

Pipe Tap Data
Table "A" Model 3420

Purpose of Tap	12x14-15	16x18-17H	16x18-30	18x20-24	18x20-30	20x24-24	20x 24-28	20x24-30	24x30-32	20x30-42 30x36-42	30x30-31 30x30-38	36x42-52
Suction Chamber Vent	2-¾"	2-¾"	2-2"	2-2"	2-2"	2-2"	2-2"	2-2"	2-2"	2-2"	2-2"	2-2"
Stuffing Box Seal Ring	2-½"	2-½"	4½"	4⅜"	4½"	4½"	4⅜"	4½"	4⅜"	4⅜"	4⅜"	4⅜"
Gland Quenching (Packing)	2-½"	2-½"	2⅜"	4½"	2⅜"	2⅜"	4⅜"	2⅜"	4⅜"	4⅜"	4⅜"	4⅜"
Stuffing Box Overflow	2-¾"	2-¾"	4-1"	4¾"	4-1"	4-1"	4¾"	4-1"	4-1"	4¾"	4¾"	4¾"
Casing Vent	1-½"	1-½"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"
Priming	1-¾"	1-¾"	1-2"	1-2"	1-2"	1-2"	1-2"	1-2"	1-2"	1-2"	1-2"	1-2"
Ball Bearing Cooling (Opt.)	4-¼"	4-¼"	4¾"	4-1¼"	4¾"	4¾"	4-1¼"	4¾"	4-1"	—	—	—
Oil Drain	2-¼"	2-¼"	2½"	2½"	2¼"	2¼"	2½"	2¼"	2½"	2¼"	2¼"	2¼"
Suction & Discharge Gauge	2-½"	2-½"	4¼"	4¼"	4¼"	4¼"	4¼"	4¼"	4¼"	4¼"	4¼"	4¼"
Casing Drain	2-¾"	2-¾"	2-1"	2-1"	2-1"	2-1"	2-1"	2-1"	2-1"	2-1"	2-1"	2-1"
Bypass-Casing to Stuffing Box	—	—	2½"	2⅜"	2½"	2½"	2⅜"	2½"	2⅜"	2⅜"	2⅜"	2⅜"

Impeller Description

Size (In.)	Max. Imp. (In.)	Effective Peripheral Width (In.)	No. of Vanes	Eye Area (Sq. In.)	Split	Staggered/ Skewed	Iron/Bronze		Steel	
							Dwg. No.	Pattern	Dwg. No.	Pattern
12x14-15	15 3/8	5 1/16	7	121.7	No	No/No	D06911A	69117	D07551A	69407
16x18-17H	17 5/8	7	7	200	Yes	Yes/No	D06983A	69171	D07603A	69686
16x18-30	30	2 5/8	5	244	Yes	Yes/Yes	D00038A	54341	D00039A	55147
16x18-30G	30	2 7/8	7	179	No	No/No	113-13	57068	D00016A	57068
16x18-30H	30	3 1/2	7	202	No	No/No	112-62	57024	D00321A	57024
18x20-24	24	5 1/8	6	238	Yes	Yes/No	D01532A	58713	D01535A	58716
18x20-24	24	5 1/8	7	238	Yes	Yes/No	D00161A	57572	D00356A	57831
18x20-24G	24	5 3/4	5	227.4	Yes	Yes/No	D02280A	58952	D02281A	58953
18x20-24N	24	6 3/4	5	281.3	Yes	Yes/No	D02301A	58978	D02302A	58979
18x20-30	30	3 3/16	5	286	Yes	Yes/Yes	250-2	54342	252-121	55148
20x24-24	24	5 3/16	6	308.4	Yes	Yes/Yes	253-6	55098	253-12	55197
20x24-28	28 1/2	6 1/16	6	320	Yes	Yes/No	D01533A	58714	D01536A	58717
20x24-28	28 1/2	6 1/16	7	320	Yes	Yes/No	D00225A	57692	D01109A	58337
20x24-28G	28 1/2	6 5/8	5	328.5	Yes	Yes/No	D02282A	58954	D02283A	58955
20x24-28N	28 1/2	8	5	404.5	No	No/No	D02229A	58976	D02300A	58977
20x24-28H	28 1/2	8 3/4	7	441	Yes	Yes/No	—	—	D01539A	58719
20x24-30	30	3 3/4	5	318.4	Yes	Yes/Yes	254-105	55442	257-89	55796
24x30-32N	32	6 5/8	6	521	Yes	Yes/No	265-82	56848	262-22	56828
24x30-32STD	32	6 1/8	6	460	Yes	Yes/No	265-84	56879	262-25	56529
24x30-32G	32	6 1/8	6	385	Yes	Yes/No	267-21	56884	D00013A	57618
24x30-32H	32	9 1/16	7	460	Yes	Yes/No	267-27	56890	D00014A	57643
30x30-31	31	12 1/8	7	609.5	Yes	Yes/No	D02414A	63030	D02370A	63131
30x30-31G	33	10 1/4	5	254	Yes	Yes/No	—	—	D05540A	68567
30x30-38	38	8 1/8	6	610	Yes	Yes/No	D02257A	58783	D02259A	58785
30x30-38G	38	8 3/4	5	567.9	Yes	Yes/No	D02284A	58956	D02285A	58957
30x30-38N	38	10 1/2	5	703.1	Yes	Yes/No	D02297A	58973	D02298A	58974
30x36-42	42	9	6	745	Yes	Yes/No	D01534A	58715	D01537A	58718
30x36-42	42	9	7	745	Yes	Yes/No	267-56	57038	D00147A	57644
30x36-42H	42	11 1/4	7	905	Yes	Yes/No	267-57	57039	272-80	57039
30x36-42G	42	10 1/8	5	716	Yes	Yes/No	D02286A	58958	D02287A	58959
30x36-42N	42	11 3/8	5	881.2	Yes	Yes/No	D02293A	58968	D02294A	58970
20x30-42	42	4 1/32	6	210	Yes	No/No	D11284A	1E994	D11284A	—
36x42-52	52	10 1/16	5	1036	Yes	Yes/No	E02707A	1E922	E02707A	—

Impeller Description WR^2

Model 3420

To determine the WR of an impeller:

1. For bronze impellers and water service, select the appropriate "wet" value at the desired diameter from Table II or III.
2. For impeller materials other than bronze, and/or liquids with a specific gravity less than 1.0, proceed as follows:

   A. Determine both "wet" and "dry" values from Table II.

   B. Multiply the "dry" value by the ratio of specific gravities of the impeller material and bronze (See Table I for material specific gravities).

   "Dry" value x $\frac{Sp.\,Gr.\ of\ impeller\ material}{Sp.\,Gr.\ of\ bronze}$ = Answer (B) _____

   C. Subtract the "dry" value from the "wet" value.

   WR "wet" - WR "dry" + _____Answer (C).

   D. Multiply answer (C) by specific gravity of the liquid.

   Answer (C) x Sp. Gr. = _____Answer (D)

   E. Add answers (B) and (D). This is WR of the impeller in Lb.-Ft.

TABLE I

Material	Bronze	Cast Iron	316SS
Specific Gravity	8.86	7.20	7.90

WR^2 Values Include Bronze Impeller Rings

All Values are Lb.-Ft.^{2}

Diameter	12x14-15		16x18-17H		16x18-30		18x20-24		18x20-30		20x24-24		24x24-28		20x24-30	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
10½	7	8														
11	8.5	10														
11½	11	13														
12	13	15														
12½	16	19														
13	19	22														
13½	22	26														
14	26	30														
14½	32	37														
15	35	41														
15½	43	50	43	50												
16			48	56												
16½			55	65												
17			62	73												
17½			68	80												
18			77	90												
19							77	105								
19½							84	111								
20							90	119			131	153	128	192		
20½							98	124			141	165	137	202		
21							106	131			151	176	145	211		
21½							113	139			161	190	155	222		
22					213	230	123	148	217	229	172	204	166	232	159	174
22½					224	242	133	156	225	238	187	221	179	245	167	184
23					235	255	145	163	235	247	201	238	190	255	175	194
23½					240	268	158	173	245	258	216	256	202	267	184	204
24					260	281	170	183	255	269	231	275	218	280	197	214
24½					272	295			265	281			230	295	208	228
25					288	312			278	293			249	310	219	239
25½					306	330			290	309			265	325	234	254
26					329	347			303	322			282	340	249	271
26½					337	365			319	339			305	355	269	289
27					355	385			333	353			325	375	288	309
27½					375	414			350	371			345	392	309	334
28					395	430			365	389			370	415	329	357
28½					418	455			385	409			397	430	354	380
29					440	481			403	429					379	409
29½					470	510			424	449					409	439
30					495	540			443	473					447	478
30½																
31																
31½																
32																

WR^2 Values Include Bronze Impeller Rings

All values are Lb.-Ft.[(2)]

Diameter	24x30-32		30x30-31		30x30-38		30x36-42		20x30-42		36x42-52	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
26	474	564										
26½	494	594										
27	514	624										
27½	544	654	316	395								
28	574	684	344	430	425	1025						
28½	604	714	368	460	520	1125						
29	634	744	400	500	615	1200						
29½	664	784	432	540	715	1285						
30	694	824	464	580	815	1375						
30½	734	864	500	625	910	1460						
31	764	904	540	675	1000	1550						
31½	804	944	576	720	1100	1630						
32	844	994	620	775	1200	1725	1355	1900				
32½			656	820	1300	1810	1415	1960				
33			709	885	1390	1900	1485	2025				
33½					1490	1985	1555	2085				
34					1585	2090	1625	2150				
34½					1685	2160	1695	2215				
35					1785	2240	1765	2285	397	497		
35½					1880	2325	1845	2360	414	522		
36					1975	2410	1935	2445	431	549		
36½					2080	2500	2025	2515	449	576		
37					2175	2575	2105	2600	467	605		
37½					2275	2650	2205	2675	487	635		
38					2375	2725	2305	2760	508	665		
38½							2415	2860	529	698		
39							2535	2955	552	732		
39½							2645	3055	575	767		
40							2785	3155	600	803		
40½							2885	3235	624	841		
41							3015	3340	650	881		
41½							3155	3445	677	922		
42							3300	3555	705	965		
45											6700	9100
46											7200	9600
47											8160	10300
48											8600	10700
49											9560	11500
50											10070	12100
51											11000	12700
52											11500	13200

Recommended Minimum Flows

Size	CDS Ref#	Impeller Dwg.#	Diameter	Speed				
				1180	960	885	710	590
12 x 14-15	5147	D06911A D07551A	Maximum	4000	3300	2500	2000	1850
			Minimum	4000	3300	2500	2000	1850
16 x 18-17H	5219	D06983A D07603A	Maximum	8000	6500	6000	4800	4000
			Minimum	8000	6500	6000	4800	4000
16 x 18-30G	2538	113-13 D00016A	Maximum	4728	3847	3546	2845	2364
			Minimum	4728	3847	3546	2845	2364
16 x 18-30	2539	D00038A D00039A	Maximum	7500	6102	5625	4543	3750
			Minimum	7500	6102	5625	4513	3750
16 x 18-30H	2540 1	112-62	Maximum	7500	6102	5625	4513	3750
			Minimum	7500	6102	5625	4513	3750
18 x 20-24	3145 1	D01532A D01535A	Maximum	7619	6199	5714	4584	3810
			Minimum	7619	6199	5714	4584	3810
18 x 20-24G	3223	D02280A D02281A	Maximum	6203	5047	4652	3732	3102
			Minimum	6203	5047	4652	3732	3102
18 x 20-24N	3253	D02301A D02302A	Maximum	7000	5695	5250	4212	3500
			Minimum	7000	5695	5250	4212	3500
18 x 20-30	1747 6	250-2 252-121	Maximum	8100	6590	6075	4874	4050
			Minimum	8100	6590	6075	4874	4050
20 x 24-24	1999 4	253-6 253-12	Maximum	9000	7322	9288	7451	6192
			Minimum	9000	7322	9288	7451	6192
20 x 24-28	3149 1	D01533A D01536A	Maximum			9288	7451	6192
			Minimum			9288	7451	6192
20 x 24-28G	3224	D02282A D02283A	Maximum			6800	5455	4533
			Minimum			6800	5455	4533
20 x 24-28H	3746	D21539A	Maximum			13800	11071	9200
			Minimum			13800	11071	9200
20 x 24-28N	3252	D02299A D02300	Maximum			7200	5776	4800
			Minimum			7200	5776	4800
20 x 24-30	1929 2	254-105 257-89	Maximum	9600	7810	7200	5776	4800
			Minimum	9600	7810	7200	5776	4800
24 x 24-26	1896	256-44 257-90	Maximum			7690	6169	5127
			Minimum			7690	6169	5127
24 x 30-32	2288	262-25 265-84	Maximum			15032	12060	10021
			Minimum			15032	12060	10021
24 x 30-32	2289	262-22 265-82	Maximum				12073	10032
			Minimum				12073	10032
24 x 30-32G	2498 2	267-21 D00013A	Maximum			12558	10075	8372
			Minimum			12558	10075	8372
24 x 30-32N	2289 3	262-22 265-82	Maximum				12073	10032
			Minimum				12073	10032
24 x 30-32H	2500 4	267-27 D00014A	Maximum				12249	17179
			Minimum				12249	17179
30 x 30-31G	5031	D05540A	Maximum			20000	15000	12500
			Minimum			20000	15000	12500

Size	CDS Ref#	Impeller Dwg.#	Diameter	Speed				
				1180	960	885	710	590
30 x 30-31	3355	D02370A	Maximum				21500	17866
			Minimum				21500	17866
30 x 30-38G	3225	D02284A D02285A	Maximum				14909	12389
			Minimum				14909	12389
30 x 30-38N	3251 1	D02297A D02298A	Maximum				20454	16997
			Minimum				20454	16997
30 x 30-38	3162 1	D02259A D02257A	Maximum				19218	15970
			Minimum				19218	15970
30 x 36-42G	3246	D02286A D02287A	Maximum					18359
			Minimum					18359
30 x 36-42N	3256 1	D02393A D02394A	Maximum				29378	24413
			Minimum				29378	24413
30 x 36-42	3152 2	D01534A D01537A	Maximum				26379	21921
			Minimum				26379	21921
30 x 36-42	2401	267-56 D00147A	Maximum				36338	30196
			Minimum				36338	30196
30 x 36-42H	2404 4	267057 272-80	Maximum				30200	25096
			Minimum				30200	25096
20x30-42	6948	D11284A	All			10,000	9000	6500
36x42-52	6462	E02707A	All					20,000

The following is a tabulation of mechanical seal horsepower draw values for common seal types and pump power end sizes. Refer to 700.7.1 for procedures to apply mechanical seal drag.

	Speed RPM	Seal Size - Diameter in Inches													
		4.125		5.00	5.50				6.50	7.5		8.00	9.00		
		12x14-15	16x18-17H	18x20-24	16x18-30	18x20-30	20x24-24	20x24-28	20x24-30	24x30-32	30x30-31	30x30-38	20x30-42 30x36-42	36x42-52	
Single Inside	1780	.62	—	—	—	—	—	—	—	—	—	—	—	—	
	1450	.51	—	—	—	—	—	—	—	—	—	—	—	—	
	1180	.41	.41	.57	.67	.67	.67	—	.67	—	—	—	—	—	
	960	.33	.33	—	—	—	—	—	—	—	—	—	—	—	
	885	.31	.31	.42	.50	.50	.50	.50	.50	.67	.88	—	—	—	
	710	—	—	—	.40	.40	—	.40	.40	.54	.71	.71	.80	—	
	590	—	—	—	.33	.33	—	.33	.33	.45	.59	.59	.66	.75	
	505	—	—	—	—	—	—	—	—	.39	.50	.50	.57	.64	
Double or Tandem	1780	1.12	—	—	—	—	—	—	—	—	—	—	—	—	
	1450	.92	—	—	—	—	—	—	—	—	—	—	—	—	
	1180	.74	.74	1.02	1.20	1.20	1.20	—	1.20	—	—	—	—	—	
	960	.60	.60	—	—	—	—	—	—	—	—	—	—	—	
	885	.56	.56	.76	.90	.90	.90	.90	.90	1.62	1.58	—	—	—	
	710	—	—	—	.72	.72	—	.72	.72	.97	1.27	1.27	1.43	—	
	590	—	—	—	.60	.60	—	.60	.60	.81	1.06	1.06	1.19	1.34	
	505	—	—	—	—	—	—	—	—	.69	.90	.90	1.02	1.15	

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