GOULDS PUMPS

Installation, Operation and Maintenance Instructions

Model 3296 M Group

ITT

FOREWORD

This manual provides instructions for the Installation, Operation, and Maintenance of the Goulds Model 3296 "M Group" Magnetic Drive Process Pump. 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.

Goulds 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.

Warranty is valid only when genuine Goulds parts are used.

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

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

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

THIS MANUAL EXPLAINS

- **Proper Installation**
- **Start Up Procedures**
- **Operation Procedures**
- **Routine Maintenance**
- **Pump Overhaul**
- **Troubleshooting**
- **Ordering Spare or Repair Parts**

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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 tapped 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.
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.

General Precautions		
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.
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.

General Precautions		
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 3296 is a sealless frame-mounted centrifugal pump with an enclosed impeller, that is driven by a synchronous magnetic coupling, and meets dimensional standards of ANSI B73.1.

Magnetic Coupling - is a coaxial synchronous type using rare earth magnets. This concept results in a compact design and allows the impeller to turn at the same speed as the motor, (i.e.) there is no slip between the drive and driven magnets.

Magnets - Two types of rare earth magnets are available. Neodymium Iron (NdFe), which is used when pumpage temperatures are less than 250°F (120°C). For liquid pumpage between 250°F (120°C) and 425°F (220°C) Samarium Cobalt (SmCo) magnets are used.

Containment Shell - isolates the pumped liquid from the atmosphere. Standard material is Hastelloy-C which provides excellent corrosion and erosion resistance.

Sleeve Bearings and Thrust Bearings - Goulds standard bearing material is Pure Sintered Alpha Grade Silicon Carbide. The sleeve bearings are flexibly mounted using O-rings.

Impeller - Model 3296 utilizes an enclosed impeller, hydraulically balanced and keyed to the shaft.

Bearing Frame - the standard configuration is cast ductile iron with flood oil lubricated ball bearings. Pure oil mist systems are available as an option. For protection and reliability of the bearings and the lubricant, a carbon filled teflon non-contacting labyrinth seal is provided. On the inboard side a lip seal is used to prevent leakage of oil into the magnetic drive assembly.

Casing - is top centerline discharge, self venting type incorporates a fully confined gasket. 150 lb. ANSI serrated raised face flanges are standard. The 3296 has been designed such that there is a metal to metal fit between the casing and frame adapter.

NAMEPLATE INFORMATION

Every pump has 3 Goulds nameplates that provide information on your pump. The tags are located on the casing and bearing frame.

Pump Casing Tag - provides information relative to the pumps characteristics. The format of pump size information is: Discharge x Suction - Nominal Impeller Diameter, (ex. 1 x 1 ½-6)

Bearing Frame Tag - provides information relative to the type of magnets being used.

Pump Warning Tag - is permanently fastened to the bearing frame. It contains precautions to be observed during the operation, disassembly, maintenance and reassembly of the pump.

When ordering spare parts you will need to know the pump model, size, serial number, and the item number of the required parts. Information can be taken from the pump casing tag. Item number information can be found in this manual.

RECEIVING THE PUMP

Inspect the pump as soon as it is received. Make notes of damaged or missing items on the receipt and freight bill. File any claims with the transportation company immediately.

STORAGE REQUIREMENTS

Short Term - (Less than 3 months) Goulds normal packaging procedure is designed to protect the pump during shipping. Upon receipt store in a covered and dry location.

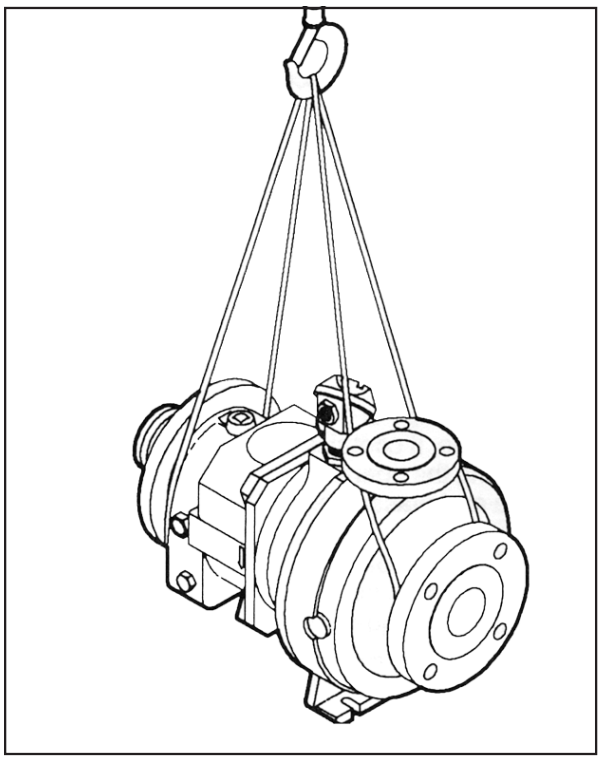
Long Term - (More than 6 months) Preservative treatment of bearings and machined surfaces will be required. Rotate shaft several times every 3 months. Refer to driver and coupling manuals for their long term storage procedures. Store in a dry covered location.

HANDLING

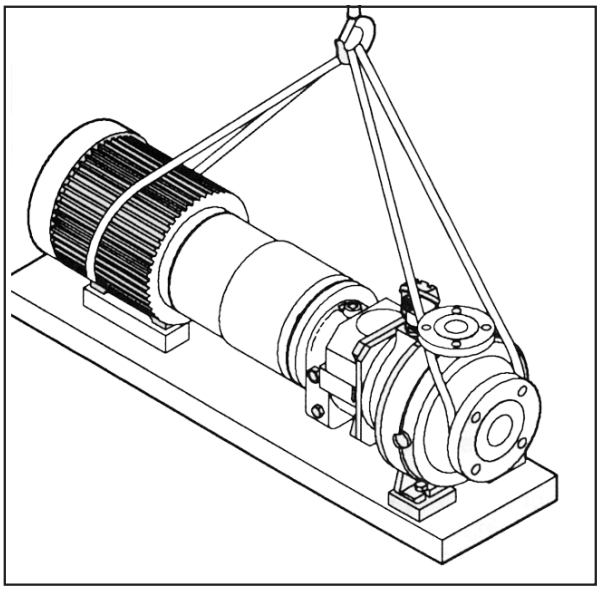
⚠ WARNING

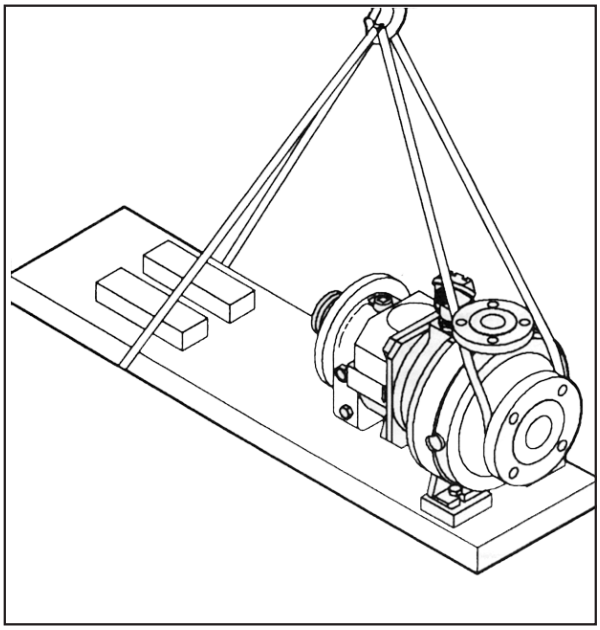
Failure to properly lift and support equipment could result in serious injury or damage to pumps.

Use care when moving pumps. Lifting equipment must be able to adequately support the entire assembly. Hoist bare pumps, using a sling under the suction flange and bearing housing.



Baseplate mounted units are moved with slings under the pump and driver.





INSTALLATION

SITE/FOUNDATION

A pump should be located near the supply of liquid and have adequate space for operation, maintenance, and inspection.

Baseplate mounted pumps are normally grouted to a concrete foundation, which has been poured on a solid footing. The foundation must be able to absorb any vibration and to form a permanent, rigid support for the pumping unit.

The location and size of the foundation bolts are shown on the outline assembly drawing, provided with the pump data package.

Foundation bolts commonly used are sleeve type (Fig. 4A) and J type (Fig. 4B). Both designs permit movement for final bolt adjustment.

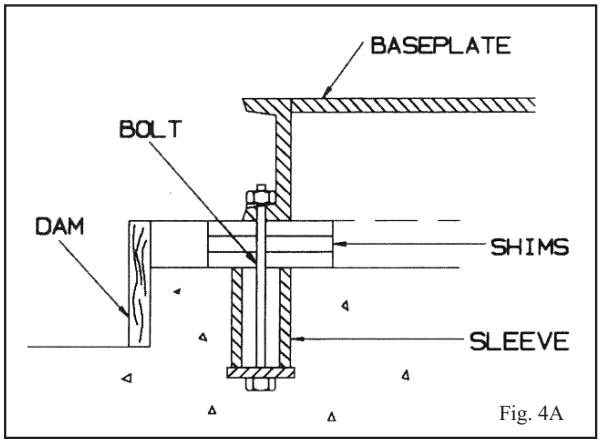


Fig. 4A

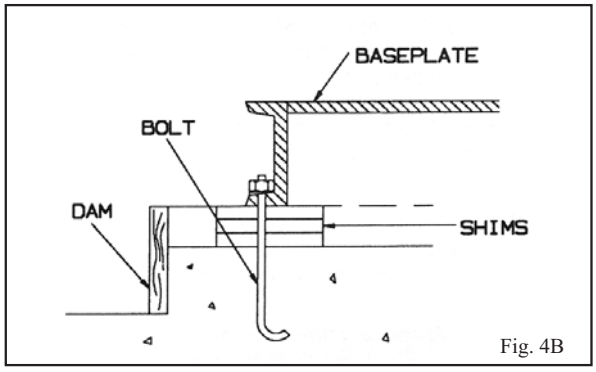


Fig. 4B

LEVEL BASEPLATE

1. Place 2 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 the sleeve type bolts are being used, fill the sleeves with rags to prevent grout from entering.
3. Carefully lower baseplate onto foundation bolts.
4. Level baseplate to within .125 in.(3mm) over the length of the base and .062 in. (1.5 mm) over the width of the base by adjusting shims or wedges.
5. Hand tighten bolts.

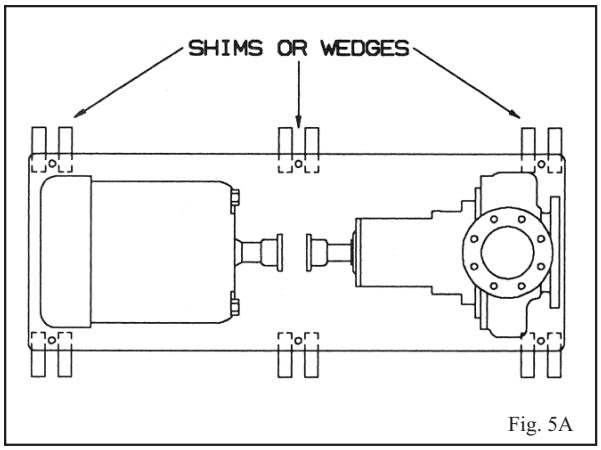


Fig. 5A

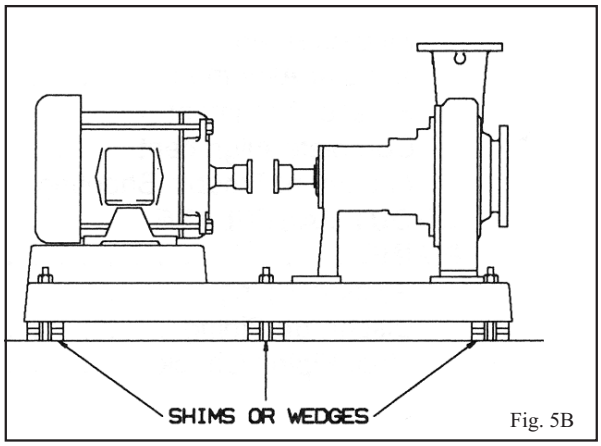


Fig. 5B

ALIGNMENT AND ALIGNMENT PROCEDURE

⚠ WARNING

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

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 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 to alignment have occurred during grouting process.
- After Connecting Piping -To ensure that pipe strains haven't 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 and maintenance procedures.

ALIGNMENT CRITERIA

Good alignment is achieved when 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 below shows recommended 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 Settings of Parallel Vertical Alignment

PUMPAGE TEMPERATURE	SET DRIVER SHAFT
50°F (10°C)	.002in. (.05mm) LOW
150°F (65°C)	.001in. (.03mm) HIGH
250°F (120°C)	.005in. (.12mm) HIGH
350°F (175°C)	.009in. (.23mm) HIGH
425°F (218°C)	.013in. (.33mm) HIGH

SET UP

1. Mount two dial indicators on one of the coupling halves (X) so they contact the other coupling half (Y) (Fig. 6).
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.

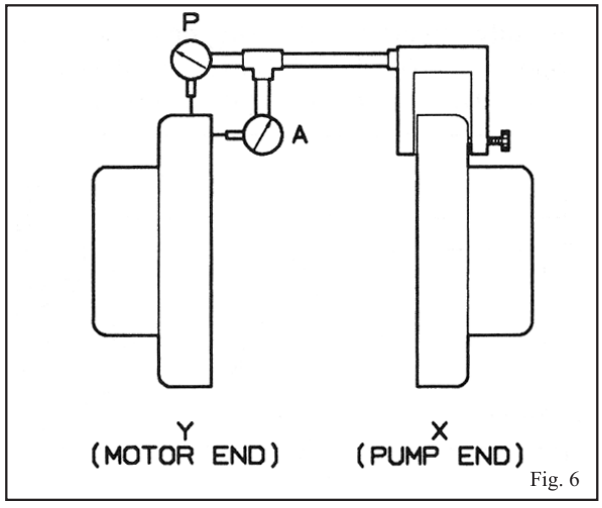


Fig. 6

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 locations 90° apart.

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) (Fig. 7A).

   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).

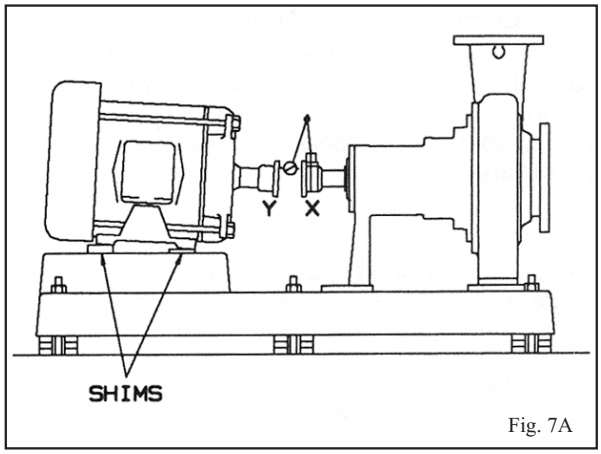


Fig. 7A

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 (Fig. 7B).

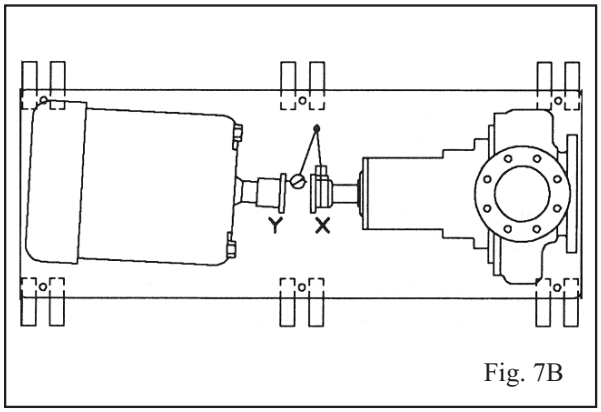


Fig. 7B

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 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 (Fig. 6).

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 (Fig. 8A).

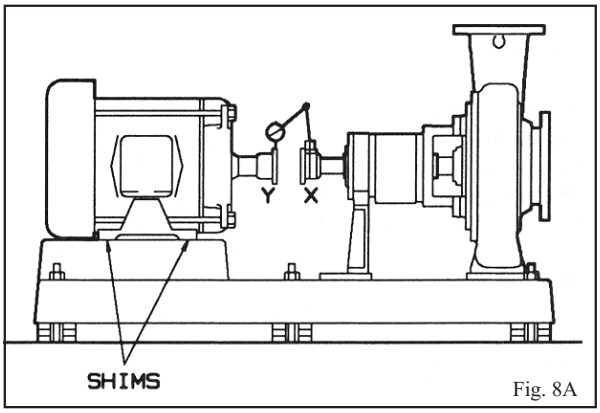


Fig. 8A

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. Observe needle and record reading (3 o'clock).

3. **Negative Reading** - Coupling half Y is to the left of coupling half X. Correct by sliding driver evenly in the appropriate direction (Fig. 8B).

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

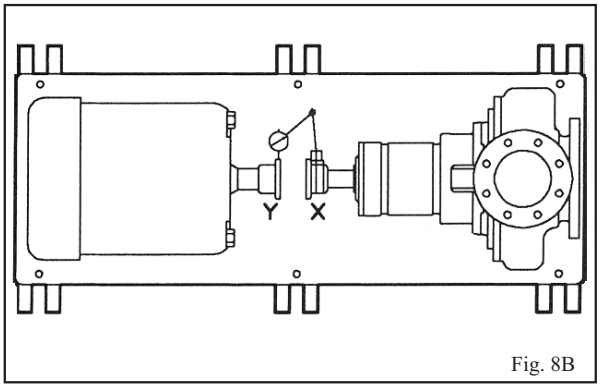


Fig. 8B

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.

Table 2
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 an oil-based cleaner because grout will not bond to it.

2. Build a dam around foundation (Fig. 9A). Thoroughly wet foundation.

3. Pour grout slowly through grout holes in baseplate, until level with the top of the dam. The use of non-shrink epoxy grout is recommended, follow manufacturers recommendations. If cementitious grout is used, remove air by puddling or with a vibrator (Fig. 9A).

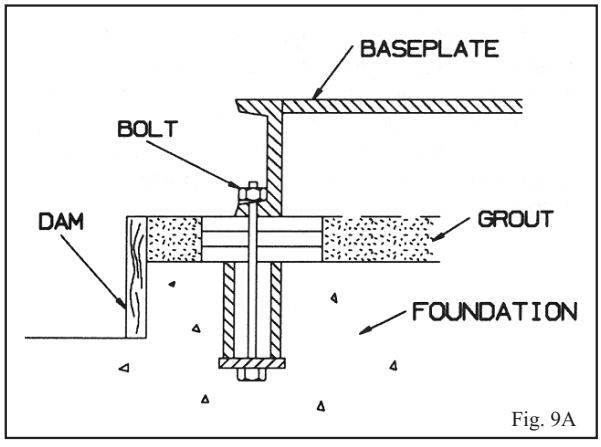


Fig. 9A

4. Allow grout to set.

5. Fill remainder of baseplate with grout. Remove air as before (Fig. 9B).

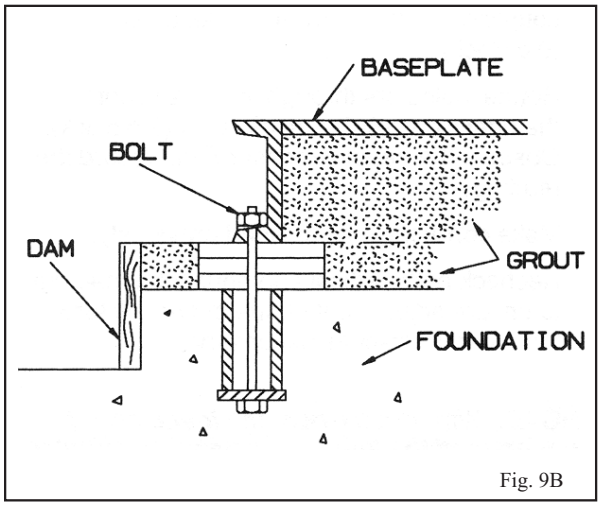


Fig. 9B

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

Guidelines for piping are given in the "Hydraulic Institute Standards" (Edition 14, Centrifugal pump section) and should be reviewed prior to pump installation.

1. All piping must be supported independently and must line up naturally with the pump flanges.

⚠ WARNING

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

2. Piping runs shall be designed to minimize friction losses.

3. DO NOT make final connection of piping to pump until grout has hardened and pump and driver hold-down bolts have been tightened.

4. Piping that handles hot liquids requires proper installation of expansion loops/joints so that linear expansion of piping will not cause mis-alignment.

5. Piping should be arranged to allow pump flushing and draining prior to the removal of pump for servicing.

6. System should be thoroughly cleaned prior to installation.

7. Gasket installation and materials must be suitable for the service.

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 2 pipe diameters of straight pipe between the elbow and suction inlet. Any elbows used should be long radius.

2. Size suction pipe one or two sizes larger than pump suction, with a reducer at suction flange. Suction piping must never be of smaller diameter than the pump suction.

3. Reducers, if used, must be eccentric at pump suction flange with sloping side down.

4. Suction strainers, when used, must have a net "free area" of at least three times the suction pipe area.

5. 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 continuously slope upward towards pump suction to eliminate air pockets.
2. All joints must be air tight.
3. 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 suction line to permit closing of the line for pump inspection and maintenance.
2. Piping should be level or slope gradually downward from source of supply.
3. No portion of piping should extend below pump suction flange.
4. The suction pipe shall be submerged sufficiently 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 check valve between isolation valve and pump which will permit inspection of check valve. An isolation valve is required for isolating, priming, regulation of flow, inspection and maintenance of the pump. A check valve prevents pump damage due to reverse flow when driver is turned off.
2. Increasers, if used, should be placed between pump and check valves.
3. Cushioning devices should be used to protect pump from surges and water hammer, if quick-closing valves are installed in system.

FINAL PIPING CHECK

After Connecting Piping to the 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

FLUSHING PUMP

The 3296 is flushed with Ethylene Glycol Solution at the factory to prevent accidental freezing during shipping or storage at the customers site. Residual amounts will remain in the pump but if this is a problem, the 3296 can be flushed out following the below procedure before pump is installed.

Procedure

1. Remove ⅜" NPT plug (408A) and connect clean flush liquid supply.
2. Devise a means of collecting flush liquid as it drains out the suction nozzle or casing drain if supplied.
3. Turn flush supply on and run for 5 minutes to remove Ethylene Glycol residue.
4. When done, raise the coupling end of the pump (suction flange down) to drain remaining flush liquid from pump internals. Or, if pump is equipped with a casing drain plug, remove it to drain remaining liquid.

⚠ WARNING

Failure to properly lift and support equipment could result in serious injury or damage to pumps.

5. Replace any plugs removed and continue preparation for start up.

CHECKING ROTATION

! CAUTION

Serious damage may result if pump is run in the wrong rotation.

1. Lock out power to driver.

⚠ WARNING

Lock out driver power to prevent accidental start-up that could result in serious personal injury.

2. Make sure coupling spacer is removed and coupling hubs are fastened tightly to the shafts and are not loose.

NOTE: Pump is shipped with coupling spacer removed.

3. unlock driver power.
4. Make sure everyone is clear. Jog driver just long enough to determine direction of rotation. Rotation must correspond to arrow on bearing frame.
5. Lock out power to driver.

COUPLE PUMP AND DRIVER

WARNING

Lock out driver power to prevent accidental start-up that could result in serious personal injury.

Lubricate coupling per manufacturer's instructions and install coupling spacer.

INSTALL COUPLING GUARD

Install coupling guard as defined in the appendix.

WARNING

Never operate a pump without a coupling guard properly installed. Operating pump without a properly installed coupling guard can result in serious personal injury.

LUBRICATING BEARINGS

Flood Oil Lubrication - Pumps are shipped without oil. Fill bearing frame with oil, through filler connection until oil level reaches center of sight-glass (Fig A). A high quality turbine type oil, with rust and oxidation inhibitors should be used as specified in Table 5.

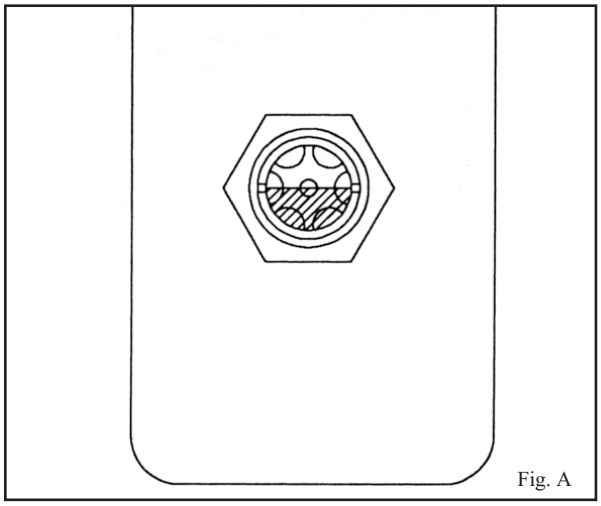


Fig. A

Pure Oil Mist Lubrication - Pure oil mist is an optional feature for the 3296. If your pump is equipped with pure oil mist refer to oil mist generator manufacturer's instruction book for proper operation.

WARNING

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

CONNECT CONDITION MONITORING DEVICES

Always connect thermocouple to control panel and/or temperature switch in driver starter. If unit is also equipped with leak detection and vibration monitoring systems, these must also be connected. (See Appendix for wiring diagrams.)

PRIMING PUMP

Never start pump until properly primed (pump casing and suction piping are full of liquid). Components such as internal sleeve bearings depend on liquid for lubrication and will quickly fail if run dry.

Your particular system conditions will dictate method used to prime pump.

STARTING PUMP

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

CAUTION

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

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

CAUTION

Continuous operation against closed discharge valve will cause pump to overheat. Overheating the magnetic drive assembly will weaken or ruin the magnets.

WARNING

Continuous operation against closed discharge valve may vaporize liquid creating an explosive hazard due to confined vapor under high pressure and temperature.

OPERATION

GENERAL CONSIDERATIONS

Always vary capacity with valve in discharge line. ***NEVER*** throttle flow from suction side.

Driver may overload or magnets de-couple if pumpage specific gravity (density) is greater than originally assumed, or rated flow rate is exceeded.

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

CAUTION

Do not operate above rated temperature range of magnets as this will weaken or ruin the magnets.

Table 3
Temperature Ratings

Magnetic Types	Drive Designation	Rated Temperature
Neodymium Iron NdFe	A,B,C,D,E,F	250°F (120°C)
Samarium Cobalt SmCo	AA,BB,CC,DD, EE,FF	425°F (220°C)

OPERATING AT REDUCED CAPACITY

WARNING

Do NOT operate pump below minimum rated flows or with discharge valve closed. These conditions may vaporize liquid creating an explosive hazard due to confined vapor under high pressure and temperature.

Table 4
Minimum Allowable Flow

Group	Pump Size	Minimum Flow*			
		60 Hertz		50 Hertz	
		GPM		m^3/h	
		3600	1800	2900	1500
M	2x3-8	60	32	11	6
	3x4-8	-	112.5	40	23
	3x4-8G	150	75	30	14
	1x2-10	17	8.5	3	1.6
	2x3-10	80	44	16	8
	3x4-10H	-	150	-	28
	1½x3-13	-	41	-	8
	2x3-13	-	80	-	15

* Based on water with a specific Gravity of 1.0 and Specific Heat of 1.0

OPERATING UNDER FREEZING CONDITIONS

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

SHUTDOWN

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

WARNING

When handling hazardous and/or toxic fluids, skin, eye and respiratory protection are required. If pump is being drained, precautions must be taken to prevent injury or environmental contamination. Pumpage must be handled and disposed of in conformance with 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 operating temperature.
2. Check and reset alignment per alignment procedure outlined earlier.
3. Reinstall coupling guard per instruction in appendix.

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. A sample form is in the appendix that can be copied and used for this purpose.

MAINTENANCE SCHEDULE

Routine Maintenance

- Bearing lubrication
- Temperature monitoring
- Vibration analysis
- Discharge pressure

Routine Inspections

- Check level and condition of oil through sight glass on bearing frame.
- Check for unusual noise, vibration, and bearing temperatures.
- Inspect pump and piping for leaks.

3 Month Maintenance

- Check foundation hold down bolts of motor and pump for tightness.
- Change oil per section V-C.
- Check alignment per section III-B.

Yearly Inspections

- Check pump capacity, pressure, and power. If the pump performance does not satisfy your process requirements, the pump should be disassembled and inspected. Worn parts should be replaced.

MAINTENANCE OF BEARINGS

OIL LUBRICATED BEARINGS

Oil level is measured through sight glass. Oil level must not fall below center of site glass. An increase in level may be noted after start up due to oil circulation within the bearing frame. Change Oil after 200 hours for new bearings, thereafter every 4000 operating hours or 6 months, which ever period is shorter. Change oil every 2000 operating hours under severe operating conditions, such as high temperature services [pumpage temperatures in excess of 325°F (160°C)].

We recommend using Table 5 to help determine your lubricating oil needs.

Table 5
Bearing Frame Lubrication Requirement

Oil Grades	Pumpage Temp. of less than 325°F (160°C)	Pumpage Temp. of 325° - 375°F (160° - 190C°) with bearing frame cooling	Pumpage Temp. of greater than 375°F (190°C) with bearing frame cooling
ISO Grade	VG 68		Synthetic VG 68
Approximate SSU 100°F (38°C)	300		Synthetic 300
DIN 51517	C 68		Synthetic C68
Kenematic Viscosity at 40°C (105°F) (mm/sec)	68		Synthetic 68
Acceptable	Exxon Chevron Mobil Gulf Shell Phillips Phillips Phillips	Teresstic EP 68 GTS Oil 68 DTE 26 Harmony 68 Tellus Oil 68 Mangus Oil 315 MM SAE 20-20W HDS SAE 20-20W	Royal Purple Synfilm 68

NOTE: This is a list of oils that meet the lubrication requirements of this pump. It is not intended to be an endorsement of products listed nor exclude other oils that meet these requirements.

Table 6 Troubleshooting Pump		
PROBLEM / MALFUNCTION	**PROBABLE CAUSE**	**REMEDY**
No liquid delivered	Pump not primed.	Reprime pump, check that pump and suction line are full of liquid.
	Suction line clogged.	Check suction line pressure. If low, locate and remove obstructions.
	Impeller clogged with foreign material.	Disassemble and remove blockage.
	Magnet de-coupling	Shut down. Check temperature and viscosity of pumpage. Check magnets with breakaway torque test.
Pump not producing rated flow or head	Air leak in suction line	Check for leakage and correct.
	Impeller partly clogged	Back flush pump to clean impeller
	Worn impeller rings	Replace defective part as required
	Insufficient suction head	Ensure that suction line shutoff valve is fully open and line is unobstructed. Check suction pressure
	Worn or broken impeller	Inspect and replace if necessary
Pump starts then stops pumping	Improperly primed pump	Reprime pump
	Air leak in suction line	Check for leakage and correct
	Magnet de-coupling	Shut down. Check temperature and viscosity of pumpage. Check magnets with breakaway torque test.
	Air or vapor pockets in suction line	Rearrange piping as necessary, to eliminate air pockets
Bearings run hot	Improper lubrication	Check lubricant for suitability and level
	Lube cooling	Check cooling system
	Improper alignment	Check pump alignment
Pump is noisy or vibrates	Improper pump/driver alignment	Align shafts
	Partly clogged impeller causing imbalance	Disassemble and remove blockage
	Broken or bent impeller or shaft	Replace as required
	Base not rigid enough	Tighten hold down bolts of pump and motor or adjust stilts. Check grout.
	Worn bearings	Replace
	Suction or discharge piping not anchored or properly supported	Anchor per Hydraulic Institute Standards recommendations (Edition 14, Centrifugal pump section).
	Pump is cavitating	Increase NPSH available.

Table 6 Troubleshooting Pump		
PROBLEM / MALFUNCTION	**PROBABLE CAUSE**	**REMEDY**
Motor requires excessive power	Head lower than rating. Pumps too much liquid	Install throttle valve.
	Liquid heavier than expected.	Check specific gravity and viscosity.
	Head higher than rating, capacity at rating	Check impeller diameter.
	Rotating parts binding or severly worn	Check internal wearing parts for proper clearances.
Condition monitoring device shuts down pump	Damaged sleeve & thrust bearings	Replace as required.
	Plugged recirculation circuit	Disassemble and remove blockage. Determine and correct cause of blockage.
	Recirculation liquid vaporization	Check actual liquid temperature versus design temperature. Check actual NPSH available versus design. Check minimum flow requirement for pump size. Check recirculation circuit and flush screen for blockage. Correct all as necessary.
	Damaged containment shell	Replace as required.
	Magnets decoupled	Check temperature and viscosity of pumpage. Check magnets with breakaway torque test.
	Pump run dry	Check control device for proper operation. Check suction line for blockage. Reprime pump.
	Excessive motor power	System head lower than rating. Pumps too much liquid. Check rotating parts for binding and wear. Liquid heavier than expected.

DISASSEMBLY & REASSEMBLY

REQUIRED TOOLS

WARNING

This pump contains extremely strong magnets. The use of non-magnetic tools and work surface are required.

Non-Magnetic Tools

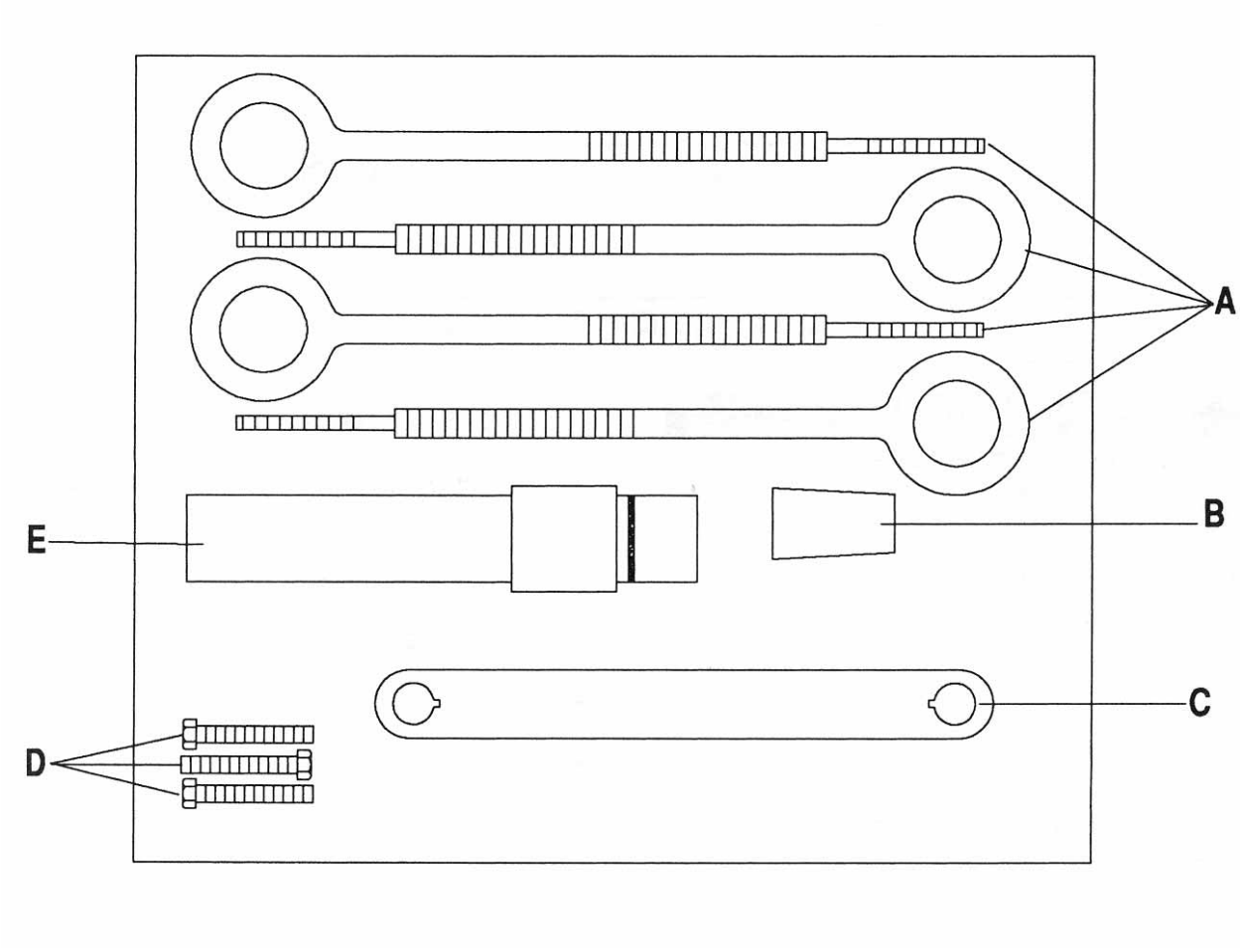
- 1-5/16" Socket wrench with 6" minimum extension
- 9/16" Socket wrench with speed handle

Tools

NOTE: Keep magnetic tools away from magnets.

- 3296 Tool Kit
- Assorted Open end wrenches
- 3/4", 15/16" sockets
- Socket wrench with minimum 4" minimum extension
- Needle nose pliers
- Torque wrench
- Screw drivers
- 1/2", 5/8" stud drivers
- Lip seal driver
- Non-metallic hammer
- Hammer
- Heat gun
- Non-Magnetic Support blocks

Table 7 3296 M Tool Kit #R296TK01				
Tool	**Use**	**Qty**	**Tool Number**	**Mat'l**
A	Bearing Frame Jacking Screw Drive Carrier Jacking Screws	4	A03777A02	304SS
B	O-ring Installation Tool	1	A03817A	Nylon
C	Shaft Wrench	1	A01676A	304SS
D	Wear Ring Jacking Screw Wear Ring Alignment Screw End Cover Jacking Screw	3	49521 61	304SS
E	Sleeve Bearing Driver	1	A03817A	Nylon



PREPARATION FOR DISASSEMBLY

WARNING

The 3296 usually handles hazardous and/or toxic fluids. Skin, eye and respiratory protection required. Precautions must be taken to prevent injury or environmental contamination.

WARNING

If pump has failed, pumpage may be present in the area between the adapter and the frame and also inside of the bearing frame.

1. Lock out power to driver.
2. Shut off all valves controlling flow to and from pump.
3. Drain and decontaminate pump in accordance with all Federal, State, local and company regulations. The 3296 should be drained and thoroughly flushed before it is removed from the piping. After isolating the pump from the system flush the pump using a compatible liquid.

WARNING

Ensure pump is isolated from system and pressure is relieved before any plugs are removed or piping disconnected.

4. To decontaminate pump recirculation path, remove plug 408A and inject flush into external flush connection.
5. Disconnect all piping and auxiliary equipment.
6. Remove coupling guard.
7. Remove coupling.

NOTE: If the only service required is to change the impeller, the flush screen or the wear ring, please refer to the appendix "Changing the Impeller".

8. Remove casing foot and bearing frame foot bolts.
9. Remove bare pump from baseplate and take to shop.

DISASSEMBLY

WARNING

Each component must be individually decontaminated using procedures in accordance with all federal, state, local and company environmental regulations.

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

NOTE: When working on pump use a bench with a non-magnetic work surface such as wood with a brass surface.

CAUTION

The shop area must be clean and free of any substances that would contaminate the magnets, ex. ferrous metals.

1. Remove thermocouple (758B) (Fig. A).
2. Remove casing nuts (425). Remove casing (100) (Fig. A).
3. Remove casing gasket (351) and discard (Fig. A).

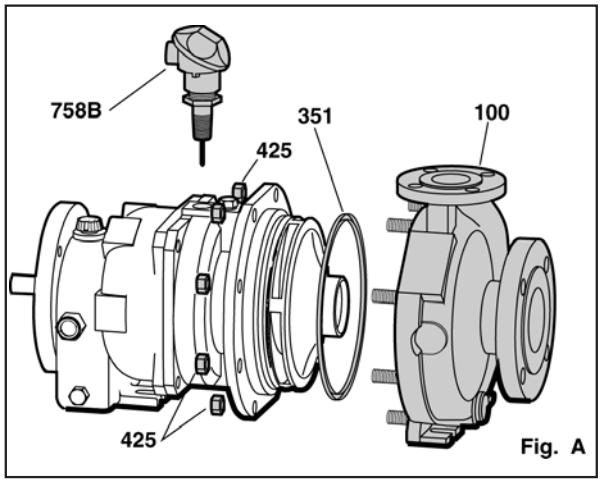


Fig. A

4. Place shaft wrench on coupling end as shown. Remove impeller bolt (198), impeller lockwasher (199A) and impeller washer (199) (Fig. B).

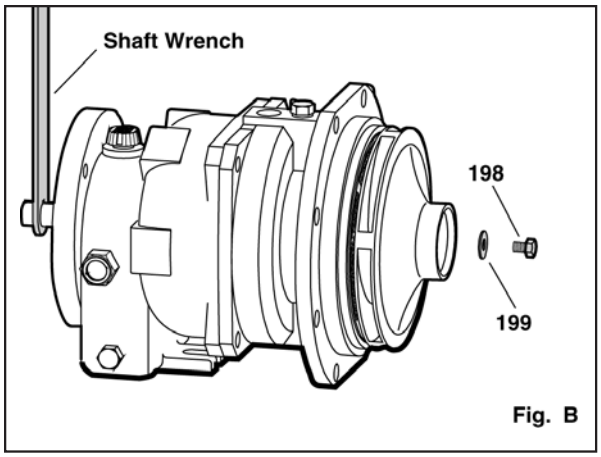


Fig. B

5. Place unit in vertical position resting on non-magnetic blocks (Fig. C).

WARNING

Pump and some individual components weigh more than 50 lbs (23 kg). Care should be taken when handling.

6. Remove frame adapter bolts (370) (Fig. C).

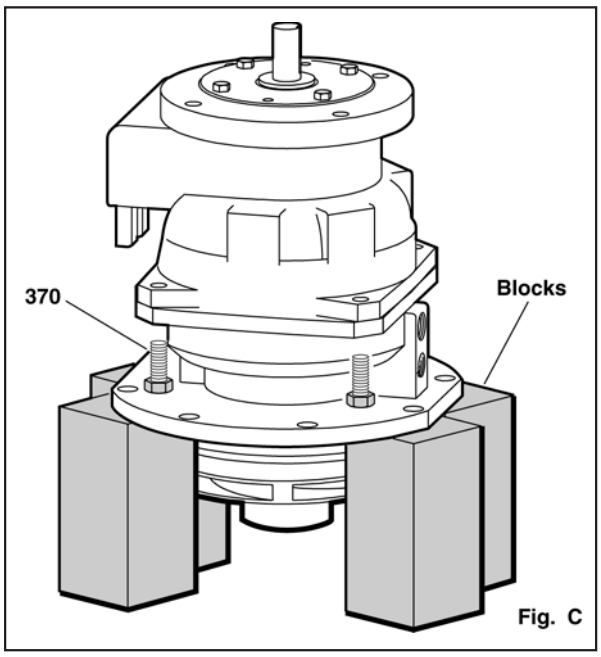


Fig. C

7. Remove bearing frame using four (4) jacking screws (Fig. D).

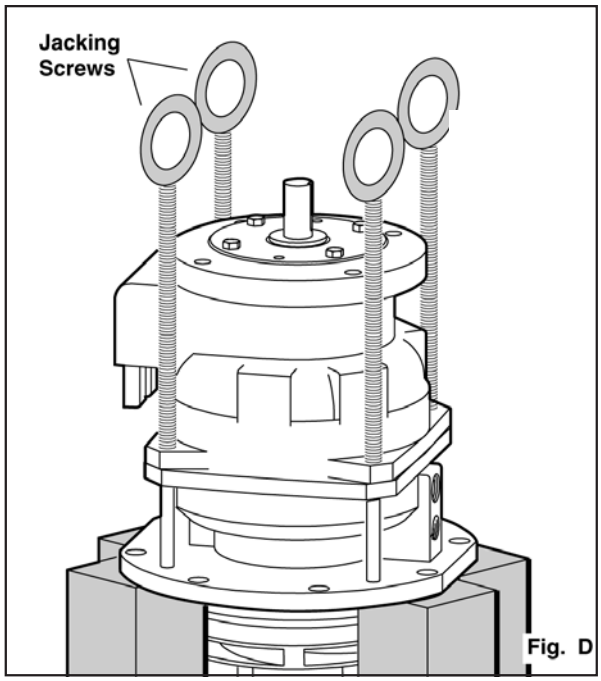


Fig. D

WARNING

Do NOT attempt to remove bearing frame (228) without using the jacking screws. Personal injury and damage to the magnets will occur.

8. Evenly tighten bearing frame jacking screws until bearing frame (228) is above containment shell (750) as shown. Lift bearing frame (228) off frame adapter (108) and set aside away from attracting metals.

Use of a lifting device with a strap through two opposite eyes in the jacking screws is recommended.

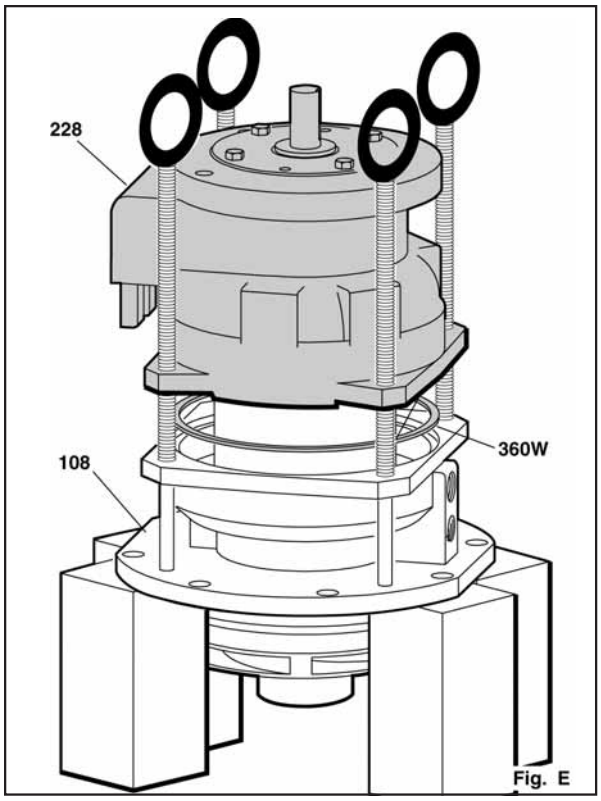
Remove adapter to frame gasket (360W) and discard (Fig. E).

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

WARNING

This component can weigh more than 50 lbs (23 kg). Care should be taken when handling.



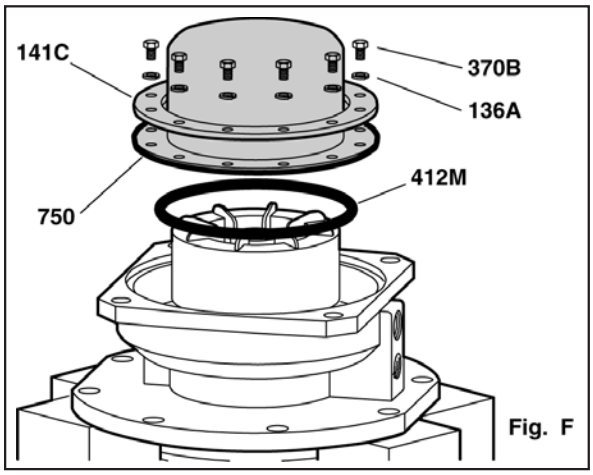
9. Remove clamp ring screws (370B) and lock washers (136A) (Fig. F).

WARNING

Use non-magnetic socket and speed wrench to avoid personal injury or damage to parts.

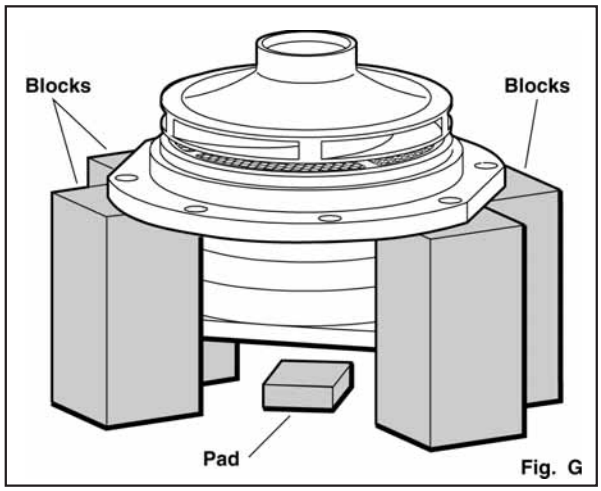
10. Remove clamp ring (141C) and containment shell (750) simultaneously (Fig. F).

11. Remove O-ring (412M) and discard (Fig. F).



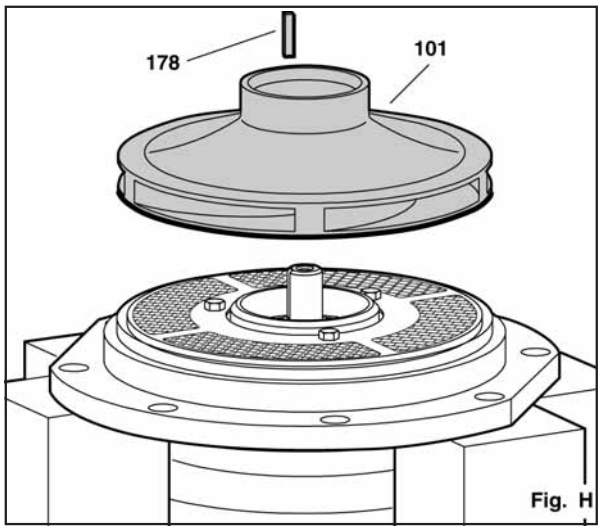
12. Orient frame adapter assembly in vertical position and support on blocks (Fig. G).

NOTE: Place a folded clean cloth or cardboard under frame adapter assembly to soften impact of driven magnet assembly (740A) on work surface. Shaft and magnet assembly should rest on work surface.



13. Remove impeller (101) (Fig. H).

NOTE: It may be necessary to use a puller. Puller must be placed under vanes so as not to damage the impeller.



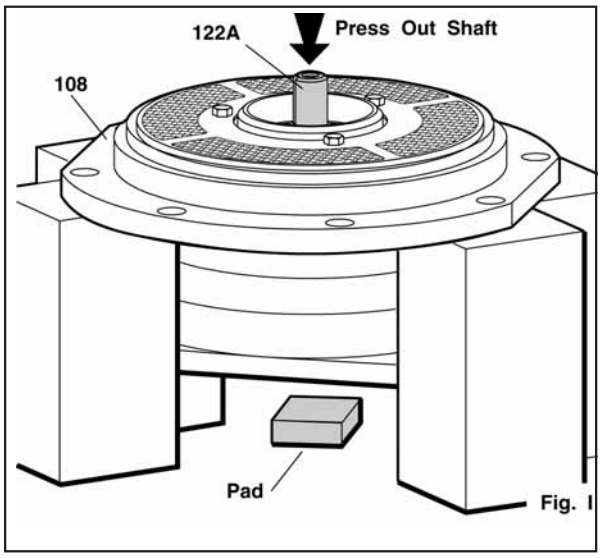
14. Press driven shaft (122A) out until it disengages (Fig. I).

NOTE: Light tapping with a non-metallic hammer may be necessary to disengage shaft.

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

15. Lift frame adapter (108) off shaft (122). Set aside.



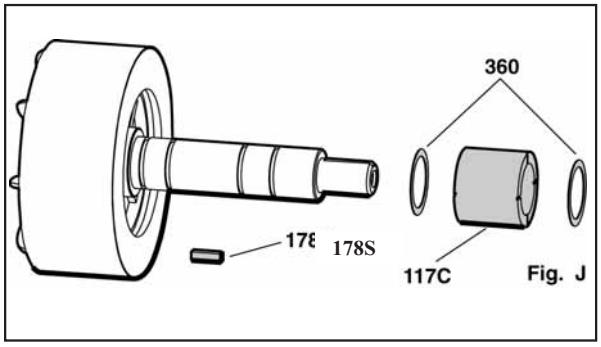
NOTE: Outboard rotary sleeve bearing will remain on shaft.

WARNING

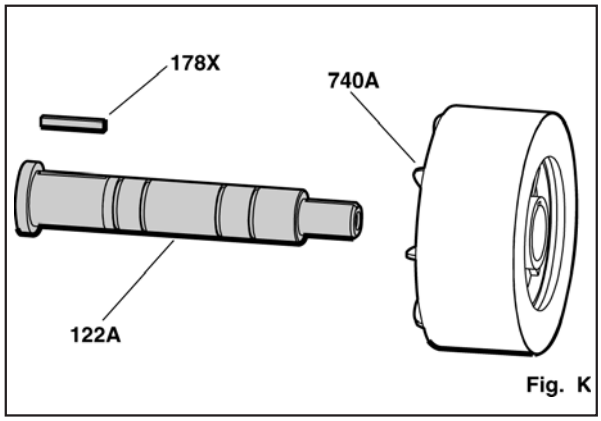
This component can weigh more than 50 lbs (23 kg). Care should be taken when handling.

16. Remove thrust bearing holder key from shaft (178S) (Fig. J).

17. Remove outboard rotary sleeve bearing (117C) and two spacer gaskets (360). Discard spacer gaskets (Fig. J).



18. Press driven shaft (122A) out of driven magnet assembly (740A). Remove key (178X) (Fig. K).

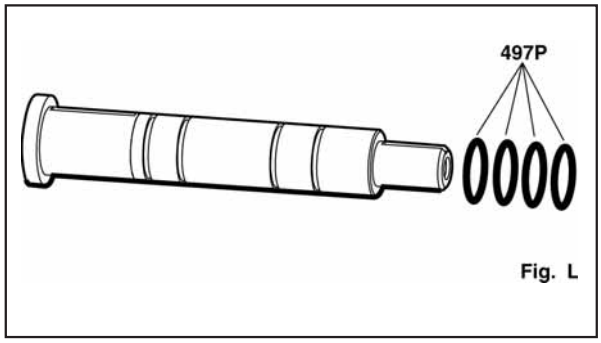


19. Wrap driven magnet assembly (740A) in a clean cloth to keep clean and set aside away from attracting metals.

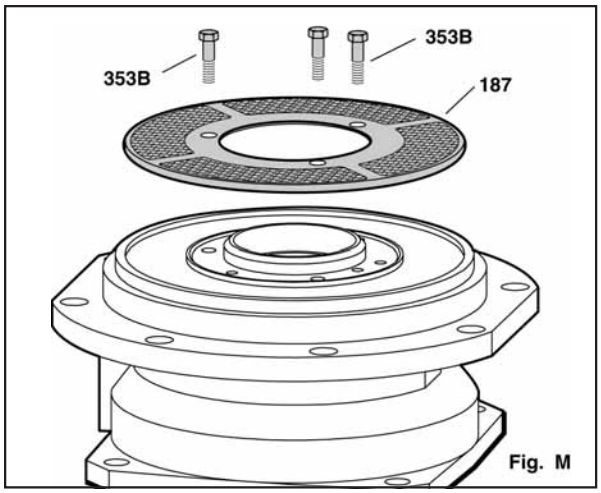
WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

20. Remove and discard four shaft O-rings (497P) (Fig. L). Set shaft aside.



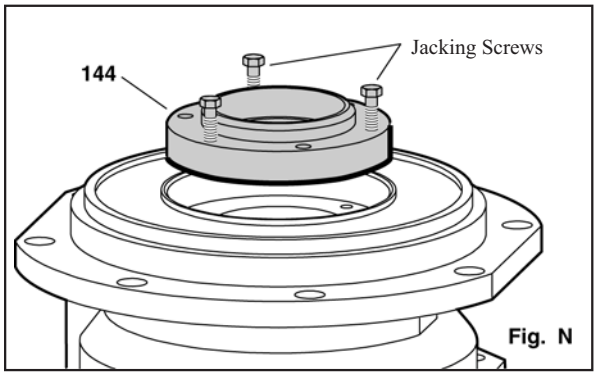
21. Place frame adapter (108) on work bench as shown. Remove wear ring bolts (353B) and flush screen (187) (Fig. M).



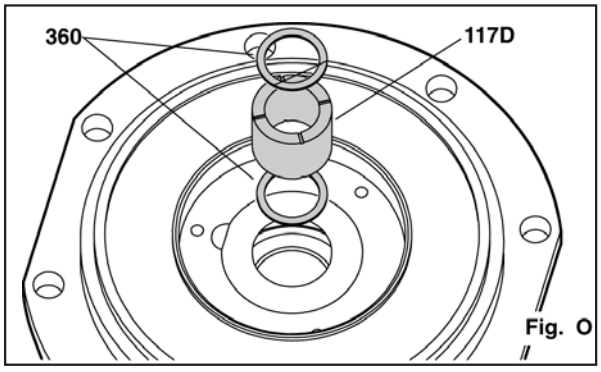
22. Place wear ring jacking screws in threaded jacking screw holes in wear ring (144) as shown. Tighten bolts evenly and in sequence until wear ring (144) can be removed (Fig. N).

NOTE: Do not over tighten jacking bolts. Tighten until snug and move to next one in sequence.

23. Remove wear ring (144) and stationary bearing key (178K) (Fig. N).



24. Remove inboard rotary sleeve bearing (117D) and two spacer gaskets (360) (Fig. O). Discard gaskets.

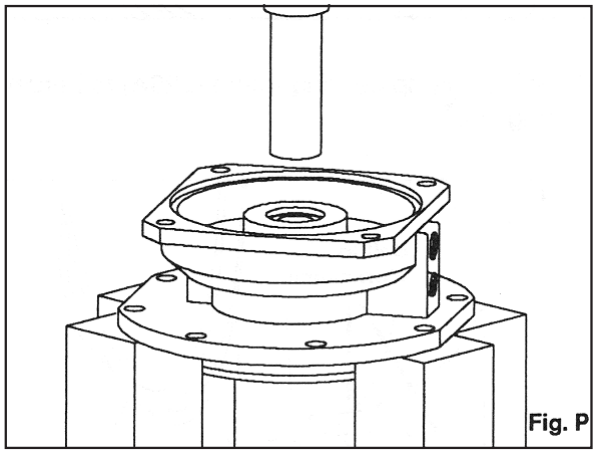


25. Set frame adapter (108) on blocks, impeller side down, and place clean cloth underneath as shown to absorb impact when bearings drop (Fig. P).

CAUTION

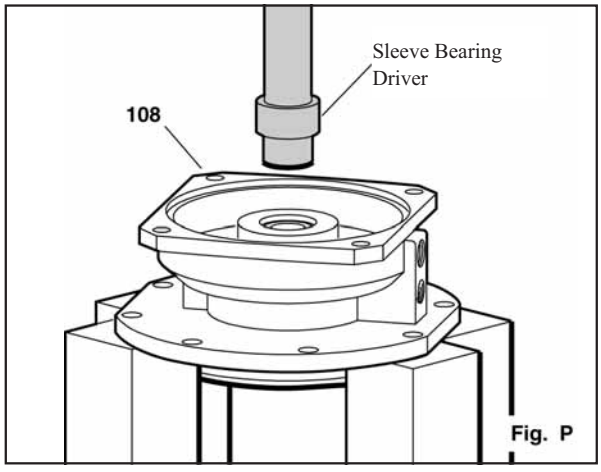
The bearing material is extremely brittle. Take every precaution necessary to avoid shock to the bearings.

26. Press out thrust bearing assembly (212) and inboard stationary sleeve bearing (117B) using hand pressure and sleeve bearing driver oriented as shown (Fig. P).



27. Set aside thrust bearing assemblies (212) and outboard stationary sleeve bearing (117B).

28. Press outboard stationary sleeve bearing (117A) out of frame adapter (108) using sleeve bearing driver oriented as shown (Fig. Q).



29. Invert frame adapter (108), impeller end up, and set on bench. Remove outboard stationary O-rings (496A) and inboard stationary O-rings (496B). Discard O-rings (Fig. R).

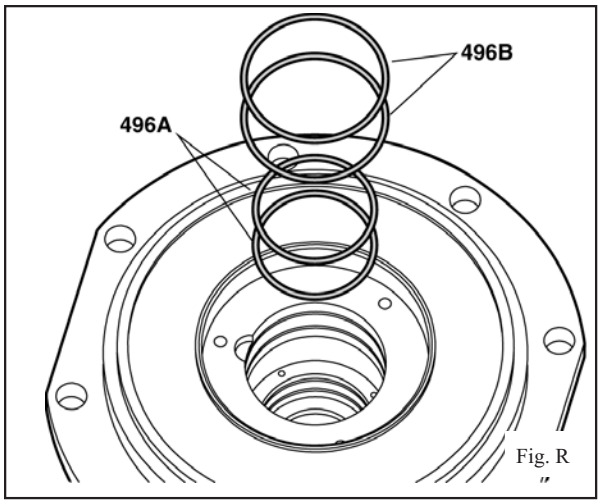


Fig. R

30. Bolt or clamp bearing frame (228A) to bench (Fig. S).

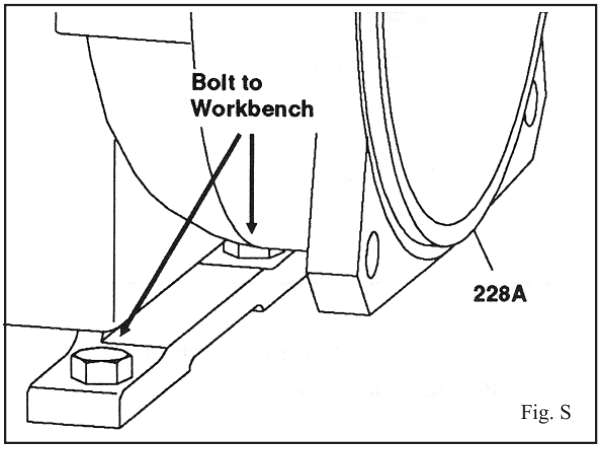


Fig. S

31. Place shaft wrench on drive shaft (122B) and loosen the drive magnet assembly hex nut (355A) until it can be removed by hand. Leave nut on shaft for now (Fig. T).

WARNING

Use non-magnetic socket and extension to avoid personnel injury or damage to parts.

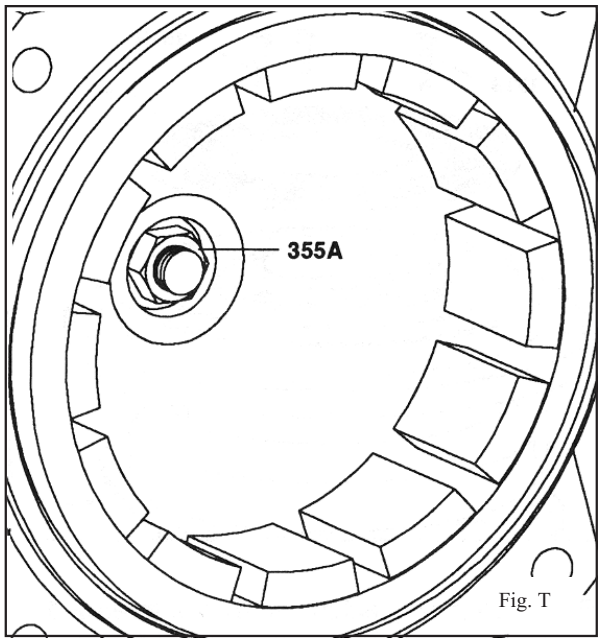


Fig. T

32. Remove two rub ring retaining screws (372Y) (Fig. U).

33. Thread two rub ring jacking screws into holes provided in rub ring (144A) until they bottom (Fig. U).

34. Tighten jacking screws until rub ring can be removed.

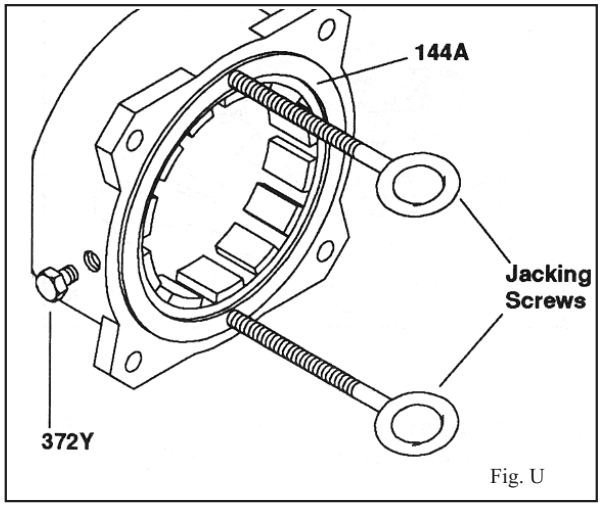


Fig. U

35. Carefully invert bearing frame assembly, drive magnet assembly up. Clamp firmly to work bench (Fig. V).

WARNING

This component can weigh more than 50 lbs (23 kg). Care should be taken when handling.

NOTE: A workbench with a two inch hole in the surface to accommodate the coupling end of shaft works well (Fig. V).

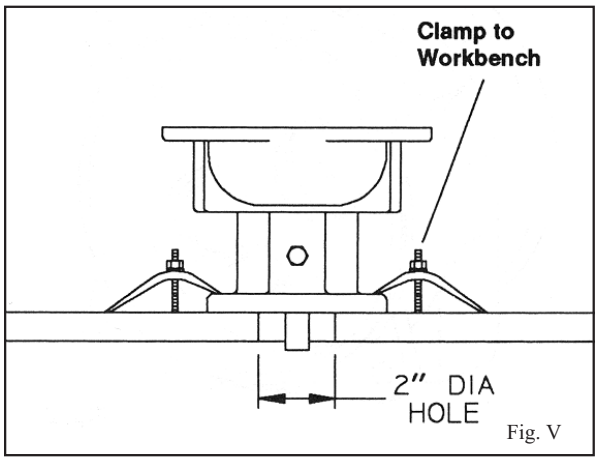


Fig. V

36. Remove drive magnet assembly nut (355A) from shaft (Fig. W).

37. Thread the drive carrier jacking screws into holes provided in drive magnet assembly (740B) until screws bottom against frame (Fig. W).

38. Tighten jacking screws evenly and in sequence until drive magnet assembly is free from shaft.

    Using a lifting strap through the eyebolts and a lifting device, raise drive magnet assembly.

    Remove from frame and set aside away from attracting metals (Fig. W).

WARNING

This component can weigh more than 50 lbs (23 kg). Care should be taken when handling.

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

39. Remove drive magnet assembly key (178Y) (Fig. W).

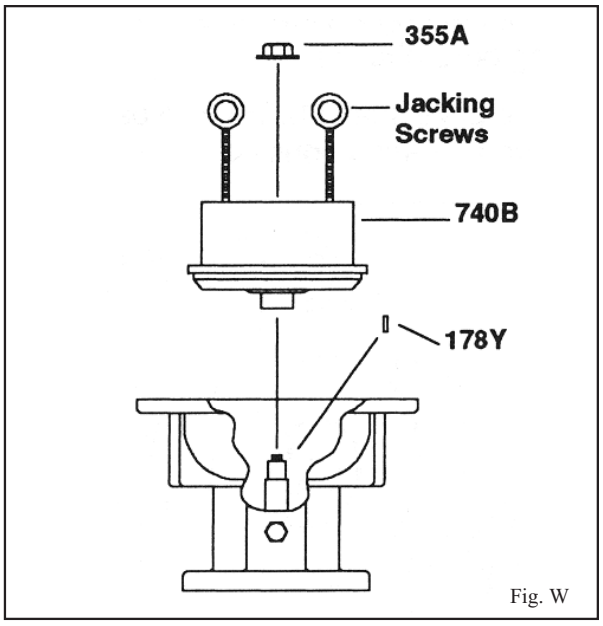


Fig. W

40. Remove bearing end cover bolts (370C) (Fig. X).

41. Install jacking screws in jacking screw holes, tighten evenly to back off bearing end cover (109A) (Fig. X).

42. Slide bearing end cover (109M) back. Labyrinth oil seal (332A) will slide back with end cover (Fig. X).

43. Remove labyrinth seal (332A) (Fig. X).

44. Remove bearing end cover (109A). Remove gasket (360A) and discard (Fig. X).

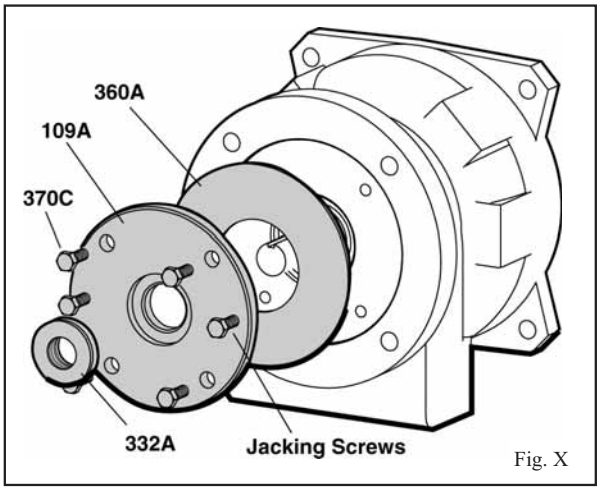


Fig. X

45. Remove bearing wavewasher (529) from bearing bore (Fig. Y).

46. Remove drive shaft (122B) with ball bearings (112) from bearing housing (228) (Fig. Y).

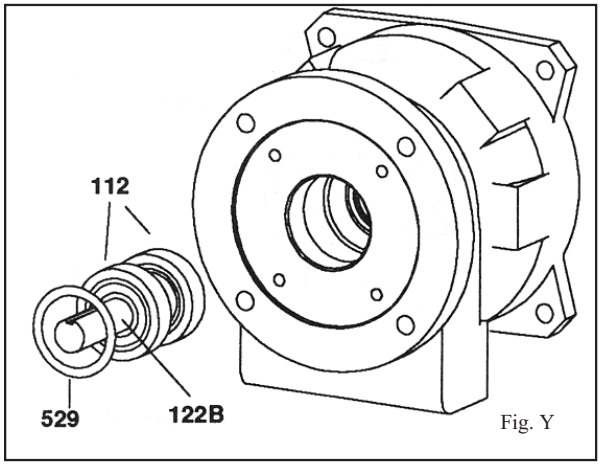


Fig. Y

47. Press bearings (112) off shaft and discard.

48. Remove lip seal (333D) as shown and discard (Fig. Z).

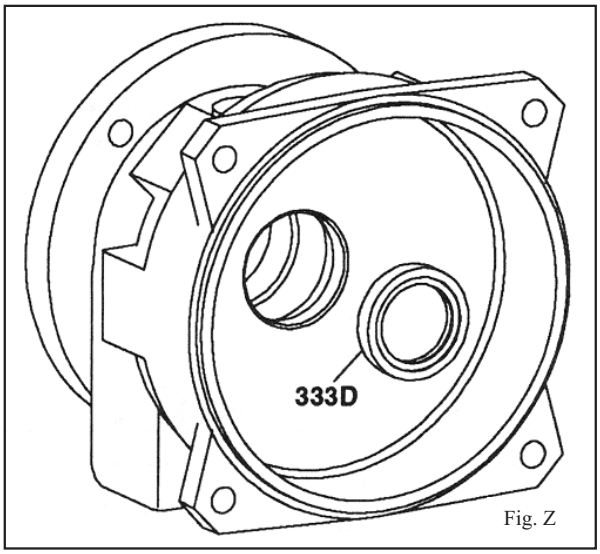


Fig. Z

INSPECTIONS

Model 3296 parts must be inspected to the following criteria before reassembly to ensure pump will run properly. Any part not meeting required criteria should be replaced.

NOTE: Various tolerances specified on the 3296 are held extremely close, measure parts at standard temperature 68°F(20°C) to ensure accurate measurement.

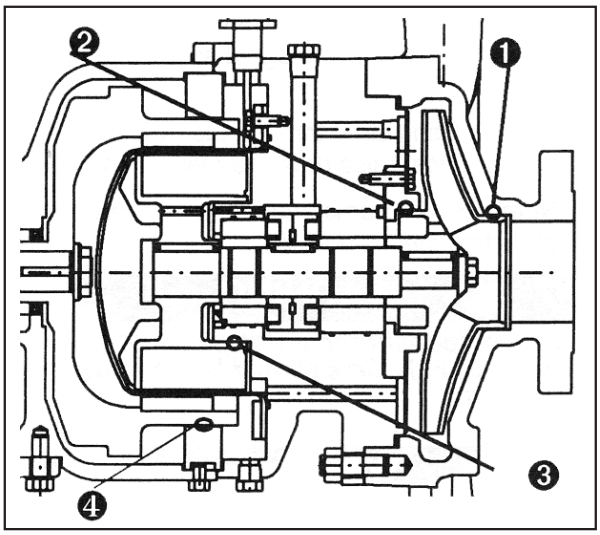
CASING (100)

Casing (100) should be inspected for excessive wear or pitting. It should be repaired or replaced if it exceeds the following criteria.

Table 8
Minimum Casing Thickness

Group	Pump Size	Minimum Thickness Inches (mm)
M	2x3-8	0.31 (7.9)
	3x4-8	0.31 (7.9)
	3x4-8G	0.31 (7.9)
	1x2-10	0.37 (9.4)
	2x3-10	0.37 (9.4)
	3x4-10H	0.37 (9.4)
	1½x3-13	0.37 (9.4)
	2x3-13	0.37 (9.4)

WEAR RING CLEARANCES



Refer to Table 9 to check wear ring clearances.

Table 9
Diametrical Wear Ring Clearance

		LOCATION							
		❶ Impeller to casing in. (mm)		❷ Impeller to wear ring in. (mm)		❸ Driven magnet to adapter in (mm)		❹ Drive Magnet to Rub Ring in (mm)	
Group	Size	New	Replace	New	Replace	New	Replace	New	Replace
M	2x3-8	.024 - .028 (.61 - .71)	.048 (1.22)	.024 - .028 (.61 - .71)	.048 (1.22)	.024 - .028 (.61 - .71)	.048 (1.22)	.067 - .073 (1.70 - 1.85)	.090 (2.29)
	3x4-8	.026- .030 (.66 - .76)	.052 (1.32)	.026 - .030 (.66 - .76)	.052 (1.32)				
	3x4-8G	.026 - .030 (.66 - .76)	.052 (1.32)	.026 - .030 (.66 - .76)	.052 (1.32)				
	1x2-10	.022 - .026 (.56 - .66)	.044 (1.12)	.026 - .030 (.66 - .76)	.052 (1.32)				
	2x3-10	.026 - .030 (.66 - .76)	.052 (1.32)	.026 - .030 (.66 - .76)	.052 (1.32)				
	3x4-10H	.027 - .031 (.69 - .79)	.054 (1.37)	.026 - .030 (.66 - .76)	.052 (1.32)				
	1½x3-13	.026 - .030 (.66 - .76)	.052 (1.32)	.026 - .030 (.66 - .76)	.052 (1.32)				
	2x3-13	.026 - .030 (.66 - .76)	.052 (1.32)	.026 - .030 (.66 - .76)	.052 (1.32)				

IMPELLER (101)

1. Inspect wear ring surface for signs of pitting.
2. Inspect front and back wear ring clearance per wear ring clearance Table 9.
3. Inspect leading and trailing edges of vanes for pitting, and erosion or corrosion damage.
4. Check impeller bore and keyway. Bore should measure .7490 to .7505 in. (19.025 to 19.063 mm). If oversize, replace impeller.
5. Check impeller balance per Table 10. Values are based on ISO - 1940/1 grade 2.5 at 3000 RPM.

Table 10
Impeller Balance Specification

Part #	Pattern #	Part Name	oz-inches
C03333A	68455	2x3-8 Impeller	.04
C03363A	68491	3x4-8 Impeller	.06
C03362A	68490	3x4-8G Impeller	.05
C03335A	68456	1x2-10 Impeller	.06
C03172A	68325	2x3-10 Impeller	.06
C03367A	68457	3X4-10H Impeller	.07
C03360A	68358	1.5x3-13 Impeller	.09
C03265A	68383	2x3-13 Impeller	.09

FLUSH SCREEN (187)

1. Must be clean and free from holes or tears.
2. Inspect for erosion and corrosion.

FRAME ADAPTER (108)

1. Inspect wear ring clearances per clearance Table 9.
2. Check all internal recirculation passages to make sure they are open and free from excessive wear due to erosion or corrosion.

SILICON CARBIDE BEARINGS (117A-D)

Sleeve Bearings

1. Inspect bearings for cracks and chips.
2. Inspect dimensions per Table 11.

Table 11
Bearing Clearances

Group	Location	New Clearance in. (mm)	Replace at in. (mm)
M	Shaft to Bearing	.0045 - .0065 (.114 - .165)	.0085 (.216)
	Bearing to Bearing	.003 - .006 (.076 - .152)	.008 (.203)
	Bearing to Adapter	.0015 - .0035 (.038 - .089)	.0055 (.140)

Thrust Bearings (237)

1. Inspect for cracks or chips.

CONTAINMENT SHELL (750)

1. Wall thickness .050 in. (1.3 mm) minimum.
2. Must be free from pitting or cracks.
3. Grooves in excess of .005 in. (.13 mm) require containment shell replacement.

MAGNETS (740A & B)

Driven Magnet Assembly (740A)

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result otherwise.

1. Must be free from bulges.
2. Must be free of pits and scratches exceeding .005 in. (.13 mm) deep.
3. Must be free of erosion or corrosion exceeding .005 in. (.13 mm) deep.
4. Inspect wear ring clearance per wear ring clearance Table 9.
5. Check pump-out vanes for cracks or corrosion.
6. Ensure circulation holes are open.

Drive Magnet Assembly (740B)

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result otherwise.

NOTE: The magnets are extremely brittle. It is normal to have chips (up to 10% of the magnet surface) per MMPA standard no. 0100-90.

1. Magnets must be free of major cracks (extending over 50% of surface) and also free of imperfections that create loose particles.
2. If magnets and drive magnet carrier were exposed to product, they should be replaced.
3. Inspect drive magnet carrier for cracks and replace if any are found.
4. Drive magnet carrier hub O.D. must be free from grooves and scratches greater than .005 in. (.13 mm).
5. Inspect magnets for proper bonding to metal carrier.

BEARING FRAME (228)

1. Visually inspect frame and frame foot for cracks.
2. Inspect for corrosion or pitting if frame has been exposed to pumpage
3. Inspect frame bearing bores. The maximum acceptable bore is 3.1506 in. (80.025 mm).
4. Inspect ball bearings for contamination and damage.
5. Make sure gasket surfaces are clean.
6. Visually inspect bearing end cover (109A) for cracks and pits. Gasket surface must be clean.
7. Inspect labyrinth seal O-rings (332A) for cuts and cracks.
8. Replace lip seal.

REASSEMBLY

Please refer to the Appendix for assembly and inspection checklist for your convenience. Make a copy and checkoff parts as they are assembled.

Refer to Table 12 for torque values while reassembling pump.

Table 12
***Bolt Torque Table**
Ft-Lbs (Nm)

Location	Dry Threads
Drive Magnet Assy Nut (355A)	120 (160)
Wear Ring Screw (353B)	17 (25)
Clamp Ring Screws (370B)	12 (16)
Impeller Nut (198)	45 (60)
Adapter to Frame Srews (370)	50 (70)
Casing Nuts (425)	45 (60)
* Torque values based on Dry Threads	

⚠ WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

1. Install key (178X) on driven shaft (112A) (Fig. A).

NOTE: Ensure shaft O-ring, grooves, shaft keyways and keyway in driven carrier are free of burrs.

2. Install driven shaft (122A) into driven magnet assembly (740A) (Fig. A).

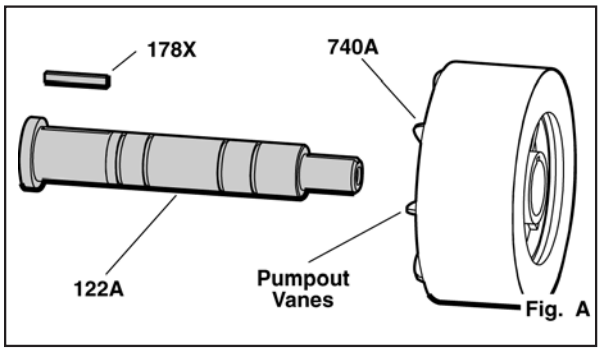


Fig. A

3. Place the first spacer gasket (360) over driven shaft (122A) (Fig. B) and shoulder against driven magnet assembly.

NOTE: Use new spacer gaskets when reassembling.

NOTE: Spacer gaskets require care when handling to avoid damage.

4. Place O-ring installation tool on driven shaft (122A) and install impeller washer (199) and bolt (198), hand tighten. Install two outboard shaft O-rings (497P) (Fig. B).

NOTE: Cover first three O-ring (497P) grooves with tape before installing O-rings. Remove tape as necessary to install O-rings (497P). O-rings may have to be heat shrunk to be fully seated in O-ring grooves. Do not overheat O-rings

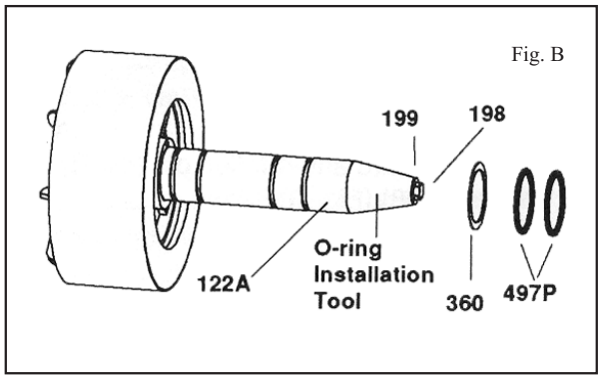


Fig. B

5. Put lube on O-rings.

6. Install outboard rotary sleeve bearing (117C) on driven shaft (122A) using bearing driver (Fig. C).

7. Place the second spacer gasket (360) over driven shaft (122A). Shoulder against outboard rotary sleeve bearing (117C) (Fig. C).

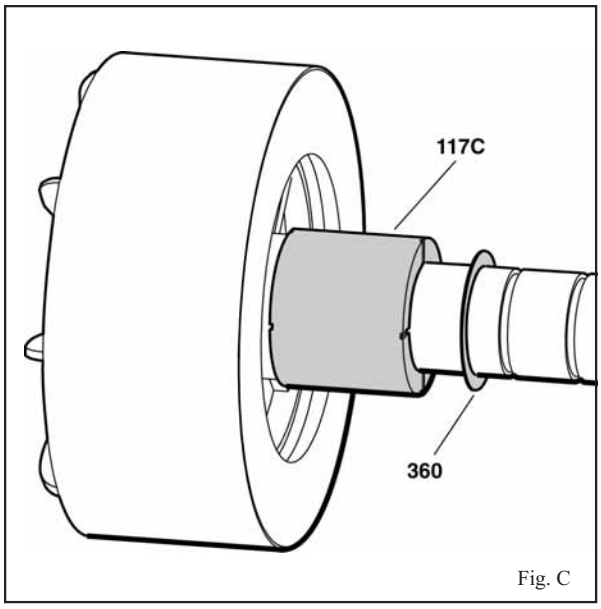


Fig. C

8. Set partially built driven assembly aside well away from attracting metals. Prepare to build up frame adapter assembly.

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result otherwise.

9. Install outboard anti-rotation pin (445B) in frame adapter (108) (Fig. D).

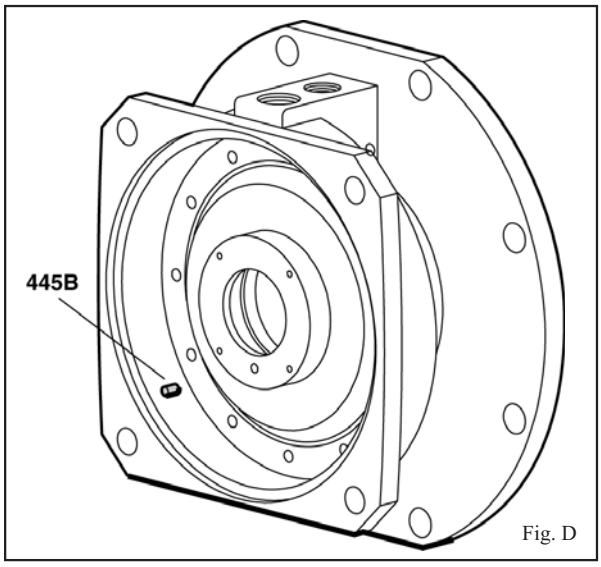


Fig. D

10. Install outboard stationary O-rings (496A) (Fig. E). Lubricate O-rings and bores.

CAUTION

Carefully stretch O-rings so when installed they fit securely in O-ring groove. Care must be taken not to over stretch the O-rings.

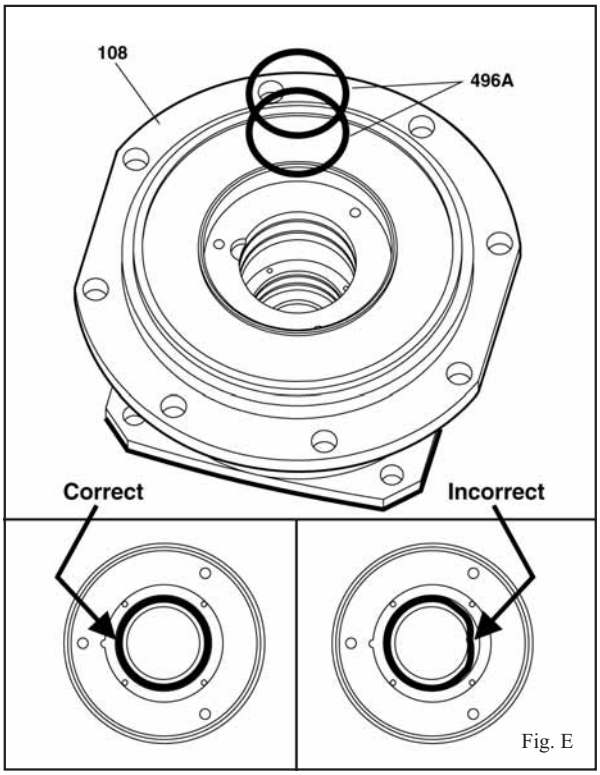


Fig. E

11. Install inboard stationary O-rings (496B) (Fig. F). Lubricate O-rings.

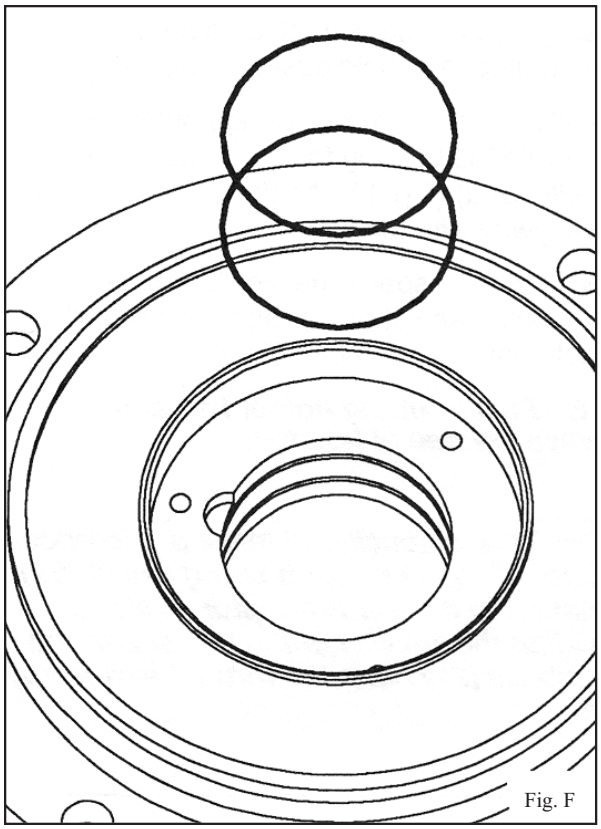


Fig. F

12. Install outboard stationary sleeve bearing (117A) (Fig. G). The anti-rotation slot in bearing (117A) must line up with anti-rotation pin (445B) in outboard end of frame adapter (108). Press outboard stationary sleeve bearing (117A) in by hand using sleeve bearing driver.

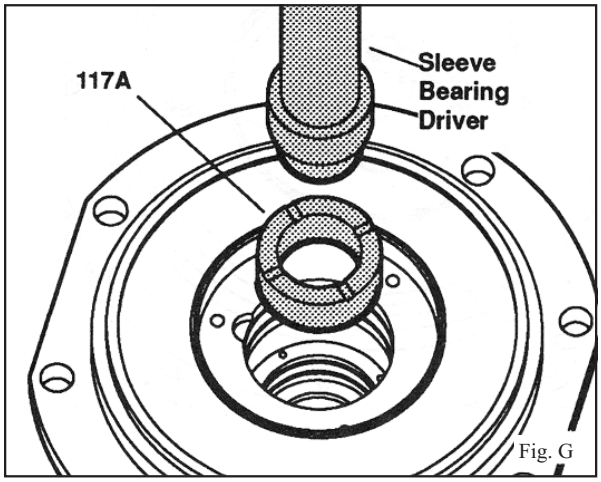


Fig. G

13. Install thrust bearing holder key (178S) into driven shaft (122A) (Fig. H). Use a small amount of O-ring lube in keyway to hold key in place.

14. With partially assembled rotating assembly positioned as shown install into partially built frame adapter assembly (Fig. H).

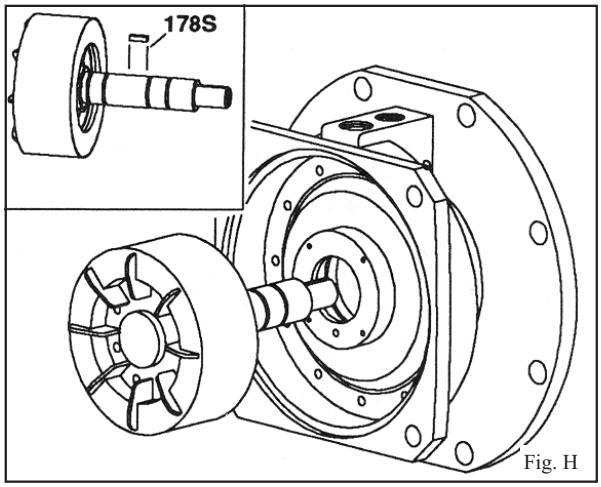


Fig. H

15. Carefully roll adapter with rotary assembly onto face of rotary assembly (impeller end of shaft facing up).

WARNING

Ensure rotary assembly does not fall out of adapter. This could cause bodily injury and damaged parts.

16. Install a tolerance ring (505) into both thrust bearing holders (212) (Fig. I). Shoulder tolerance ring against face in thrust bearing holder.

NOTE: It may be necessary to form ring with your fingers to insure good contact between ring OD and holder bore.

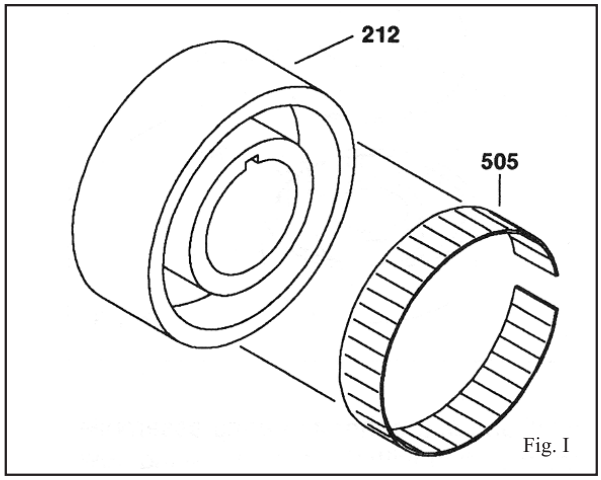


Fig. I

17. Install thrust collar bearing (237) (chamfered side in) into bore of thrust bearing with the tolerance ring (Fig. J). Ensure bearing is fully seated in holder.

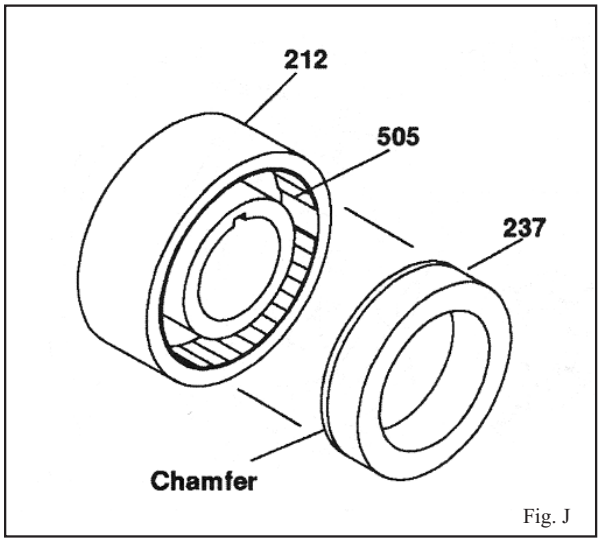


Fig. J

NOTE: To ease assembly and minimize the risk of damage to the thrust bearing (237), the use of an arbor press is recommended during installation (Fig. K). Use a small amount of O-ring lube on the tolerance ring and O.D. of thrust collar before assembly.

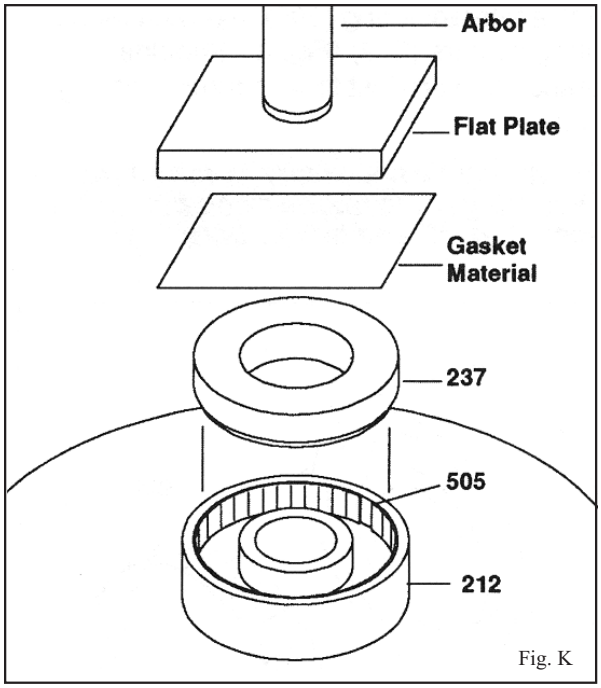


Fig. K

18. Install one of the thrust bearing assemblies onto the shaft with the bearing facing down (towards the driven magnet assembly) (Fig. L). Be careful to align the keyway on the thrust bearing assembly with the thrust bearing key (178S) on the shaft.

19. Install thrust bearing holder gasket (428C) into groove on back of thrust bearing assembly on shaft (Fig. L). Use a small amount of O-ring lube in groove to hold gasket in place.

20. Install the other thrust bearing holder onto the shaft with the bearing facing up (towards the impeller end) (Fig. L). Again, carefully align the keyway with the key.

21. Place the third spacer gasket (360) over driven shaft and shoulder against inboard thrust bearing assembly (Fig. L).

NOTE: Ensure thrust holder key and keyways are free of burrs.

NOTE: Take a pencil and make a reference mark locating the thrust bearing key (178S) in relation to the frame adaptor. This will help align the keyway of the thrust bearing assemblies (212) with the thrust bearing key (178S).

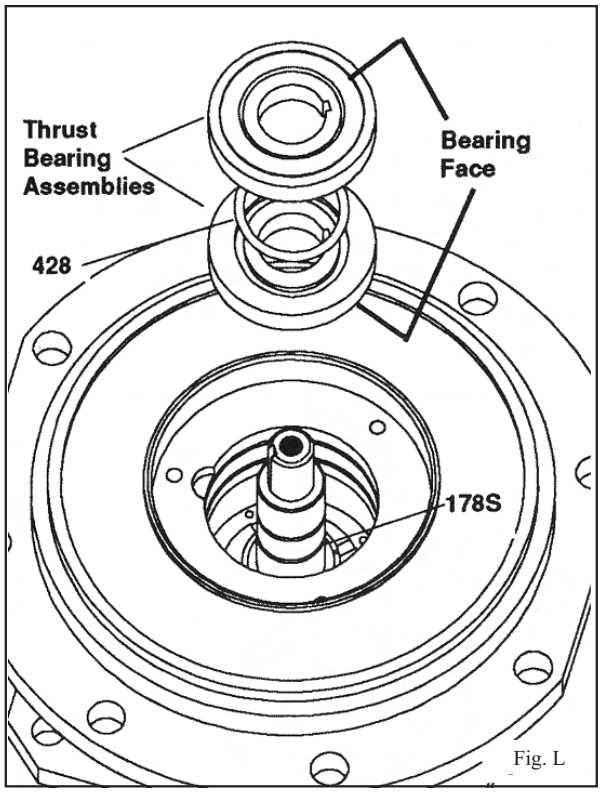


Fig. L

22. Place O-ring installation tool on driven shaft (122A) and install impeller washer (199) and bolt (198) as before (Fig. B). Install two shaft O-rings (497P) and then remove tool.

NOTE: Tape first groove on shaft to allow O-ring to slide over. O-ring may have to be heated to seat in groove. Do not overheat O-rings.

23. Press inboard stationary sleeve bearing (117B) into frame adapter (108) by hand using bearing driver. The stationary inboard key slot in the inboard stationary bearing (117B) must line up with the woodruff key slot in the frame adapter (108) as shown. Press inboard stationary bearing in by hand using bearing driver (Fig. M).

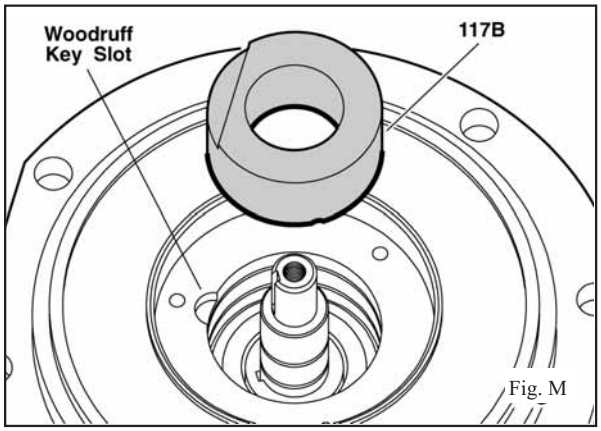


Fig. M

24. Press inboard rotary sleeve bearing (117D) onto driven shaft (122A) using bearing driver (Fig. N).

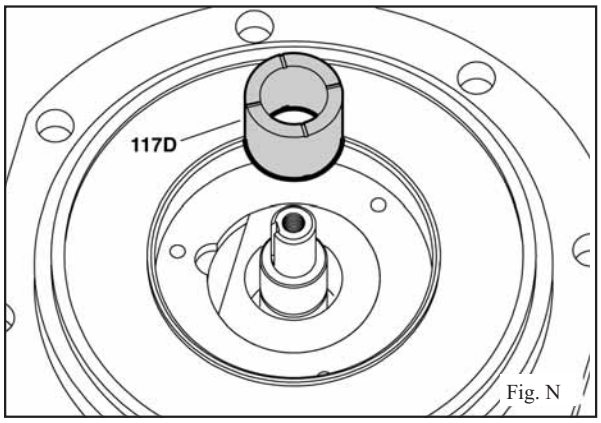


Fig. N

25. Install stationary inboard bearing key (178K) in frame adapter (108) (Fig. O).

26. Install the fourth spacer gasket (360) (Fig. O) and shoulder against face of inboard rotary sleeve bearing (117D).

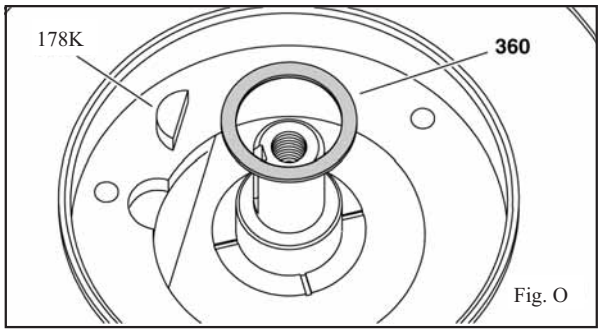


Fig. O

27. Install wear ring (144) (Fig. P). Place wear ring alignment screws through unthreaded holes in wear ring (144) and thread into wear ring bolt holes in frame adapter (108). These are used to align the wear ring holes in the frame adapter (108). Press wear ring (144) into the frame adapter (108). Remove alignment screws after wear ring is in place.

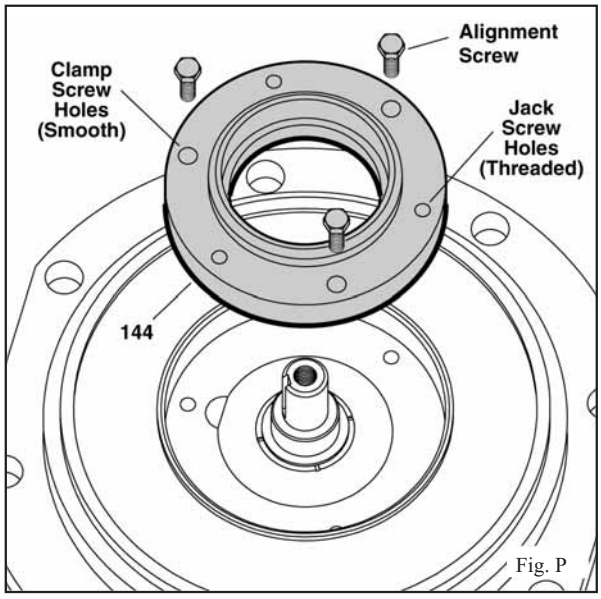
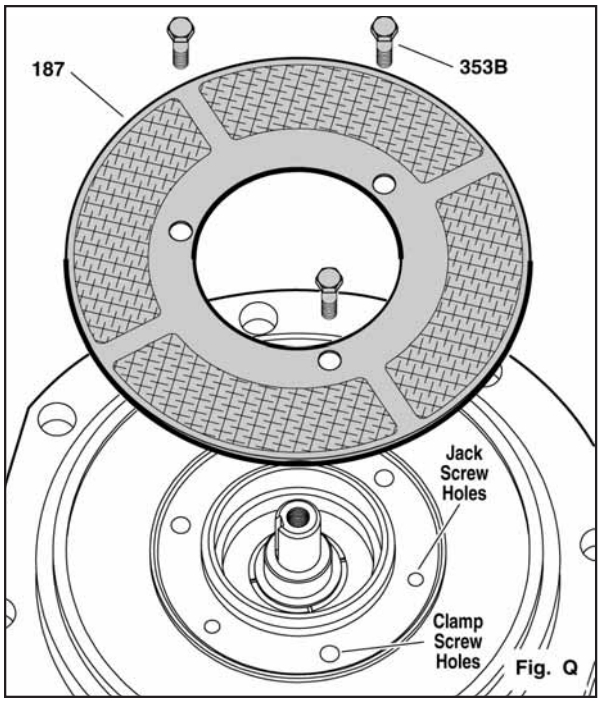


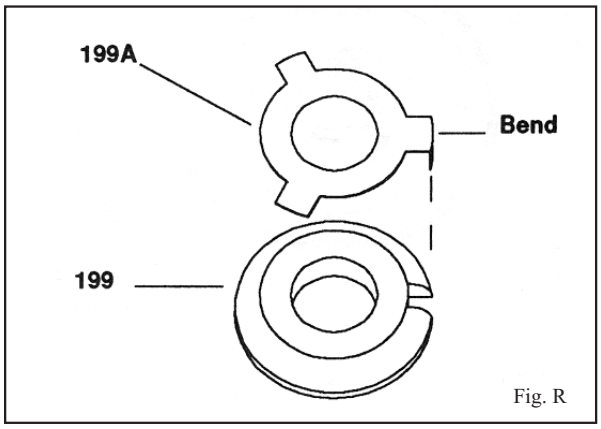
Fig. P

28. Install flush screen (187) (Fig. Q).

29. Install wear ring clamp screws (353B) (Fig. Q).



30. Bend long narrow tang of impeller lockwasher (199A) so tang will fit in slot on impeller washer (199) (Fig. R).

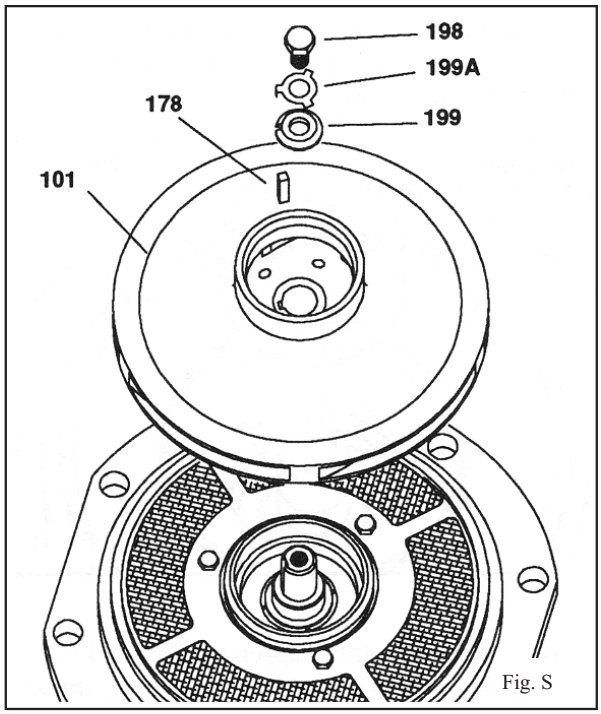


NOTE: Support bottom end of shaft to prevent shaft from moving during installation of thrust bearing assemblies and impeller.

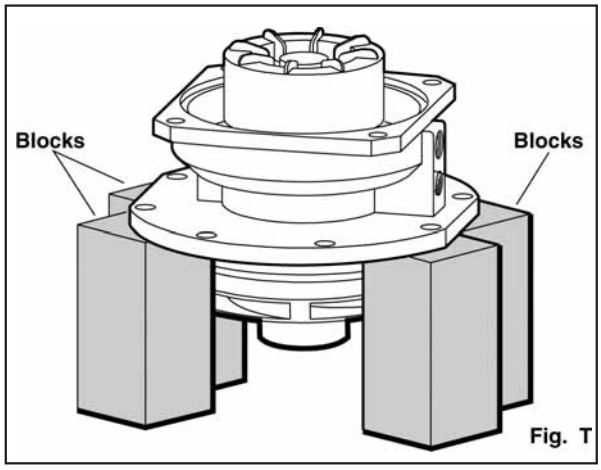
NOTE: Ensure impeller key and keyway are free of burrs.

31. Install impeller key (178) and impeller (101) (Fig. S). Install impeller washer (199) and impeller bolt (198). Hand tighten impeller bolt (198) only.

NOTE: Unit can now be moved safely. Rotary assembly will not fall out of adapter once impeller is installed.



32. Place unit on non-magnetic blocks, as shown, with impeller facing down (Fig. T).



33. Install containment shell to adapter O-ring (412M) (Fig. U).

34. Install containment shell (750) and containment shell clamp ring (141C) (Fig. U).

35. Install containment shell clamp ring screws (370B) and lock washers (136A) (Fig. U). Torque per bolt Torque Table 12 in beginning of this section.

WARNING

Use non-magnetic socket and speed wrench to avoid personal injury or damage to parts.

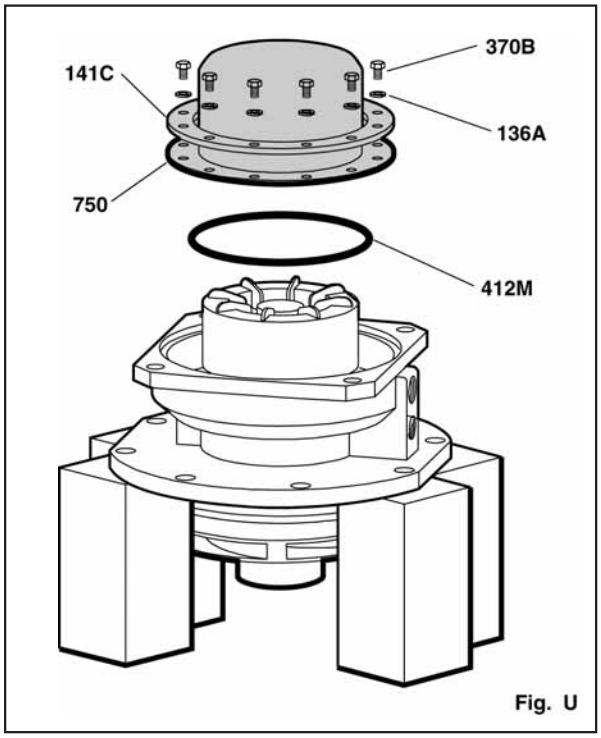


Fig. U

36. Install ball bearings (112) on drive shaft (122B) (Fig. V).

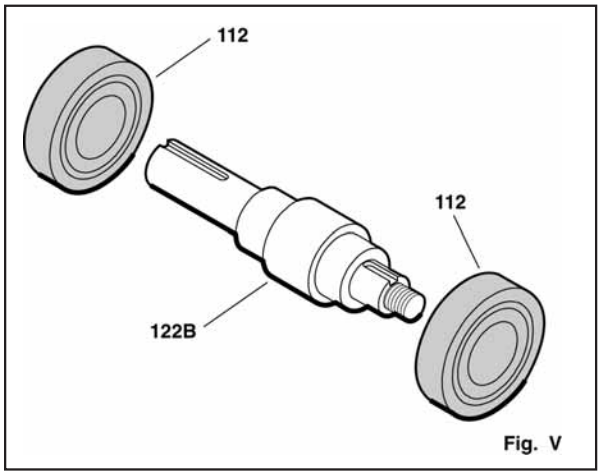


Fig. V

NOTE: There are several methods used to install bearings. The preferred method is to use an induction heater that heats as well as de-magnetizes the bearings.

37. Install inboard lip seal (333D) (Fig. W).

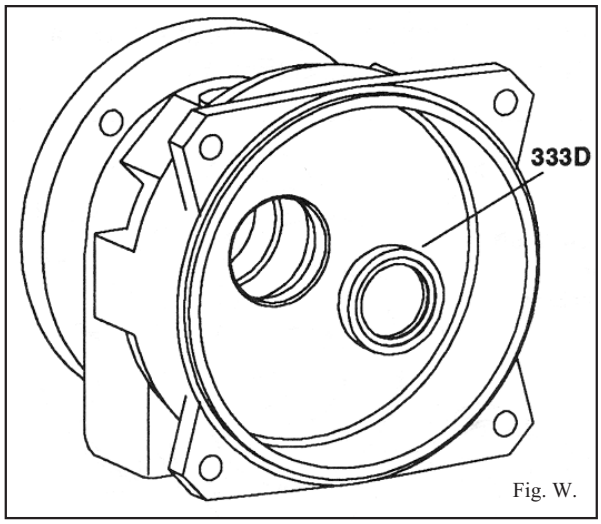


Fig. W.

38. Bolt or clamp bearing frame (228) to work bench (Fig. X).

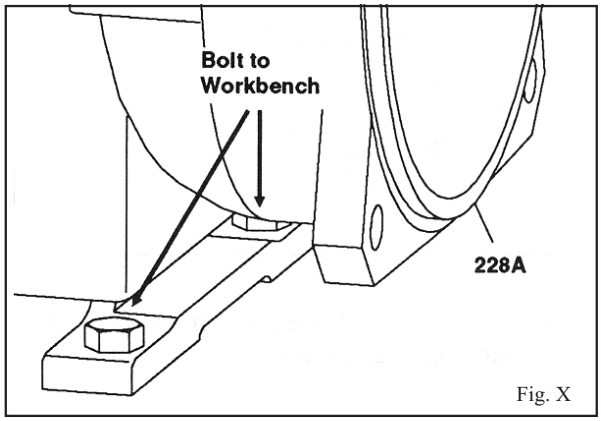


Fig. X

39. Install drive shaft (122B) with ball bearings (112) in bearing frame (228) as shown. The threaded end of the shaft goes toward the magnets (Fig. Y).

NOTE: It may be necessary to lightly press shaft with bearings into the bearing frame (228). It is important to press the bearings in by putting a sleeve on the inner race of the outboard ball bearing.

40. Place bearing wavewasher (529) in bearing bore and shoulder against outer race of outboard ball bearing (Fig. Y).

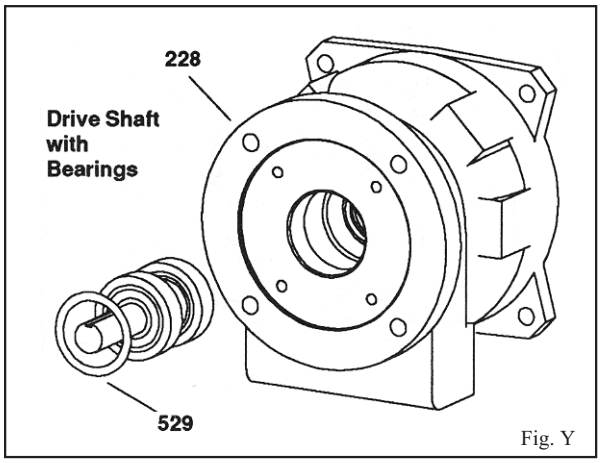


Fig. Y

41. Install bearing end cover gasket (360A) and bearing end cover (109A) (Fig. Z). Install bearing end cover screws (370C).

NOTE: Bolt pattern for the bearing end cover (109A) is not symmetric so the bearing end cover gasket (360A) and bearing end cover (109A) can only go on one way.

42. Install labyrinth seal (332A). Ensure O-rings are in grooves of labyrinth seal. Orient expulsion ports to the 6 o'clock position and press stationary part into bearing end cover (109A) until it is shouldered against end cover. Slide rotating part of labyrinth seal on shaft until it is in contact with stationary part. No adjustment is necessary (Fig. Z).

NOTE: The bearing driver can be used to install stationary part of the labyrinth seal (332A) if necessary.

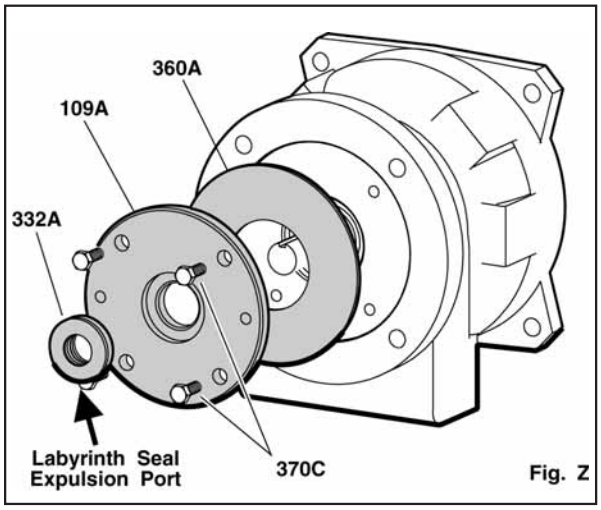


Fig. Z

43. Carefully invert bearing frame assembly, drive magnet assembly up. Clamp firmly to workbench (Fig. AA)

WARNING

Pump and some individual components weigh more than 50 lbs (23 kg). Care should be taken when handling.

NOTE: A workbench with a two inch (2 in.) hole in the surface to accommodate the coupling end of shaft works well (Fig. AA).

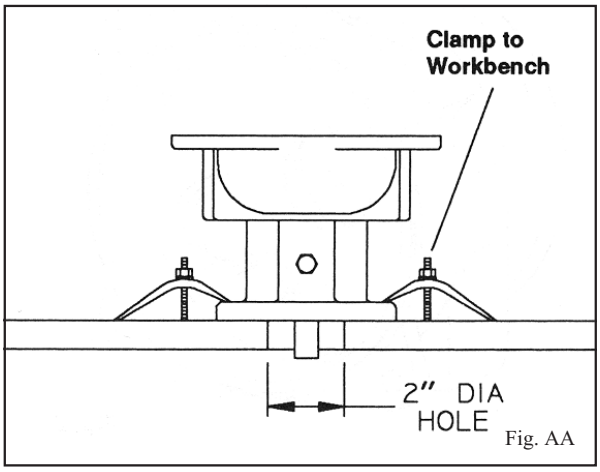


Fig. AA

NOTE: Ensure drive carrier key and keyway are free of burrs.

44. Install drive magnet carrier key (178Y) on to drive shaft (122B) (Fig. BB).

45. Thread two drive carrier jacking screws into holes provided in drive magnet assembly (740B). Do not thread jacking screws past back side of magnet assembly. Using a lifting strap through the eyebolt and a lifting device, lower drive magnet assembly onto drive shaft. Be careful not to disengage key (178Y) (Fig. BB).

WARNING

Pump and some individual components weigh more than 50 lbs (23 kg). Care should be taken when handling.

46. Thread drive magnet assembly nut (355A) on shaft and hand tighten (Fig BB).

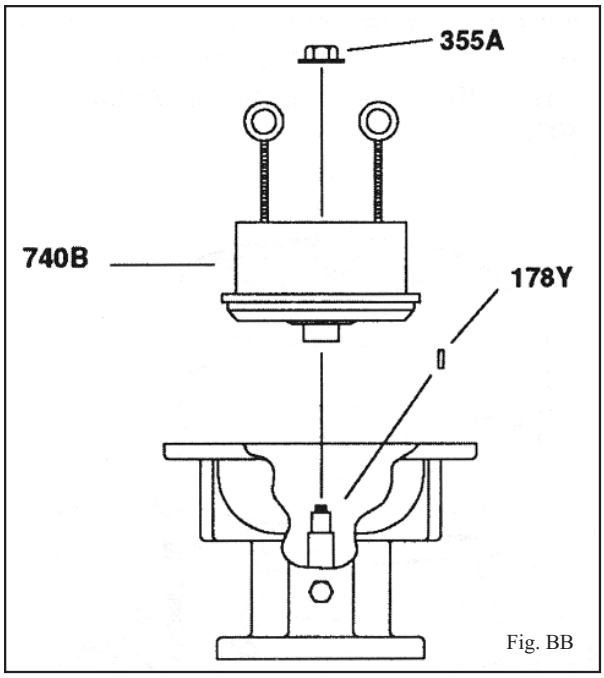


Fig. BB

47. Place frame horizontal and rebolt to workbench (Fig. X).

CAUTION

Do NOT hammer drive magnet assembly (740B) on to shaft. this will damage ball bearings (112).

48. Place shaft wrench on drive shaft (122B). Torque nut (355A) per Torque Table 12 in this section.

WARNING

Use non-magnetic socket and extension wrench to avoid personal injury or damage to parts.

49. Install one gasket (360W) in bearing frame. Install rub ring (144A) so that the two milled slots are at the 3:00 and 9:00 positions. Thread the rub ring retaining screws (372Y) into each side of the frame. Tighten screws ensuring they are fully engaged into milled slots on rub ring (Fig. CC)

WARNING

If rub ring retaining screws are not fully engaged, ring may fall out during installation of adapter assembly. This could cause personal injury and damage to parts.

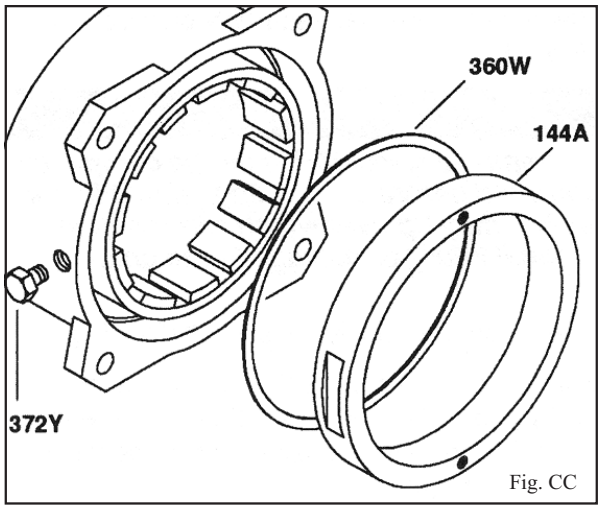


Fig. CC

50. Install bearing frame jacking screws into bearing frame (228) (Fig. DD).

WARNING

When installing jacking screws make sure threads extends a minimum of 8 inches beyond inside face of bearing frame (228). Serious personal injury or damage to the drive magnet assemble (740B) will result if this is not done.

WARNING

The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of six (6) feet [two (2) meters]. Serious injury to fingers and hands will result.

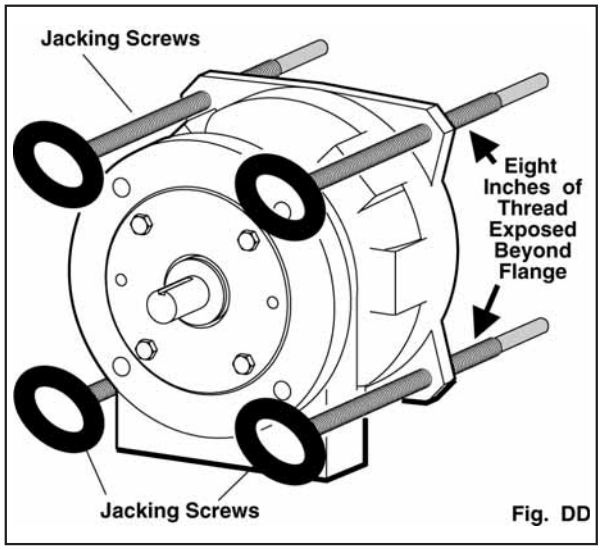


Fig. DD

51. Place frame adapter assembly on blocks (Fig. EE).

WARNING

The frame adapter (108) must be completely supported before proceeding. If unit is not stable it may tip over which can result in personal injury or damage to the unit.

52. Install a second rub ring gasket (360W) (Fig. EE).

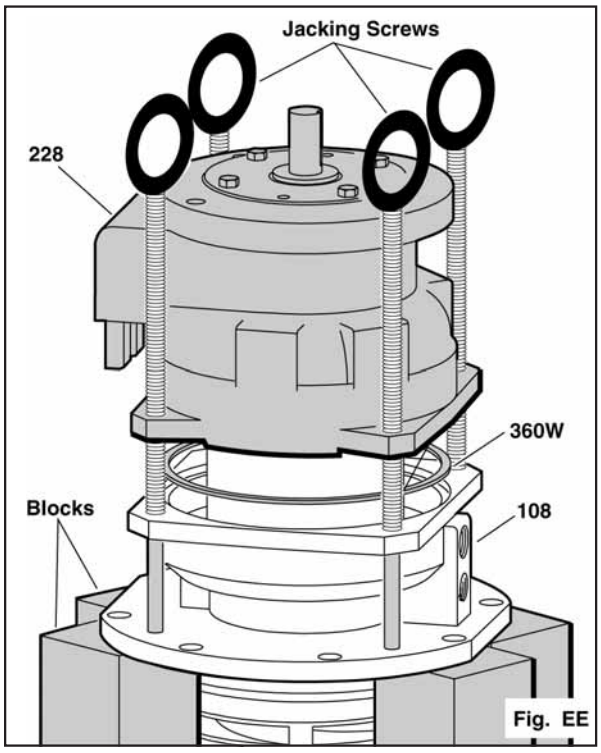
53. Place bearing frame (228) on frame adapter (108) (Fig. EE). Use of a lifting device with a strap through the opposite eyes in the jacking screws is required.

WARNING

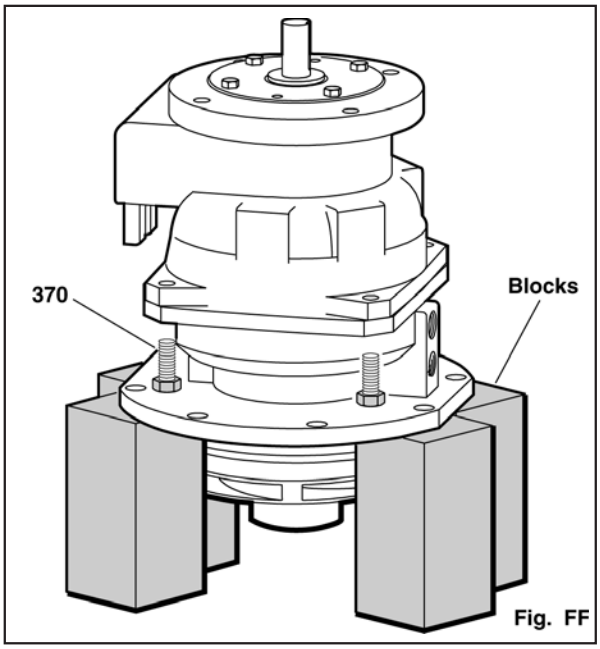
Pump and some individual components weigh more than 50 lbs (23 kg). Care should be taken when handling.

NOTE: Bearing frame jacking screws pass through the clearance holes in the adapter (108). The top of the adapter (108) has two NPT holes in it. Make sure the top of the bearing frame (228) and the top of the frame adapter (108) coincide.

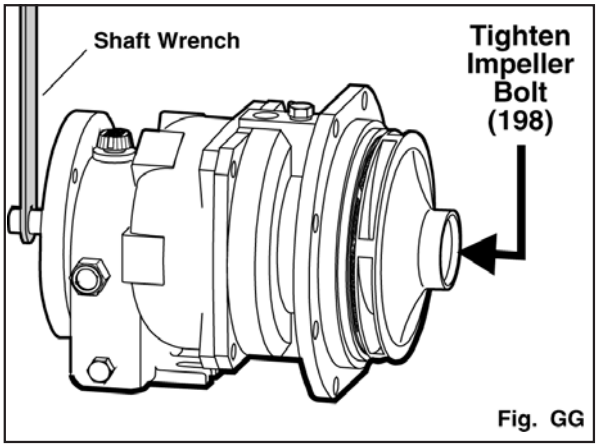
54. Lower bearing frame (228) on to frame adapter (108) using jacking screws. Jacking screws should be backed off in sequence so that bearing frame (228) is lowered evenly. Lower bearing frame (228) until it is firmly seated in frame adapter. Remove jacking screws (Fig. EE).



55. Install frame-to-adapter bolts (370) into frame adapter as shown. Torque bolts per Torque Table 12 at the beginning of this section (Fig. FF).



56. Remove unit from blocks and place on bench (Fig. GG). Place shaft wrench on coupling end of drive shaft (122B) as shown and tighten impeller screw (198) refer to Torque Table 12 at beginning of this section.



57. Check rotary assembly end play by placing a dial indicator on the face of the impeller. End play should be between .020 and .060 in. (.5 to 1.5 mm).

58. Bend one of the impeller lockwasher tangs that best lines up with flat on impeller bolt against that flat.

59. Install casing gasket (351), casing (100) and casing nuts (425) (Fig. HH).

60. Tighten casing nuts (425) in a crisscross pattern and refer to Torque Table 12 at the beginning of this section for torque values.

61. Install thermocouple (458) (Fig. HH).

62. Install all plugs and auxiliary equipment.

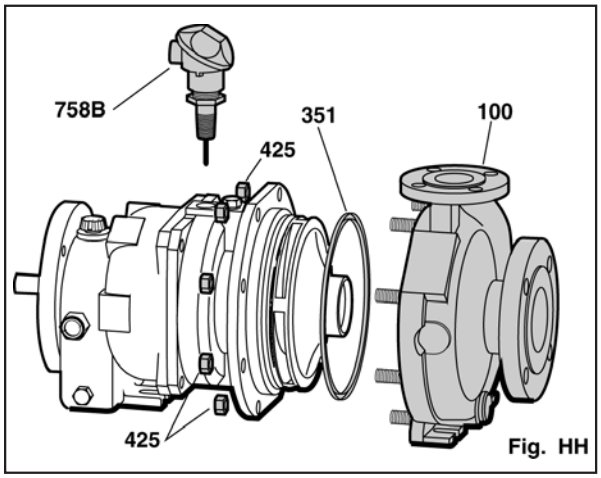


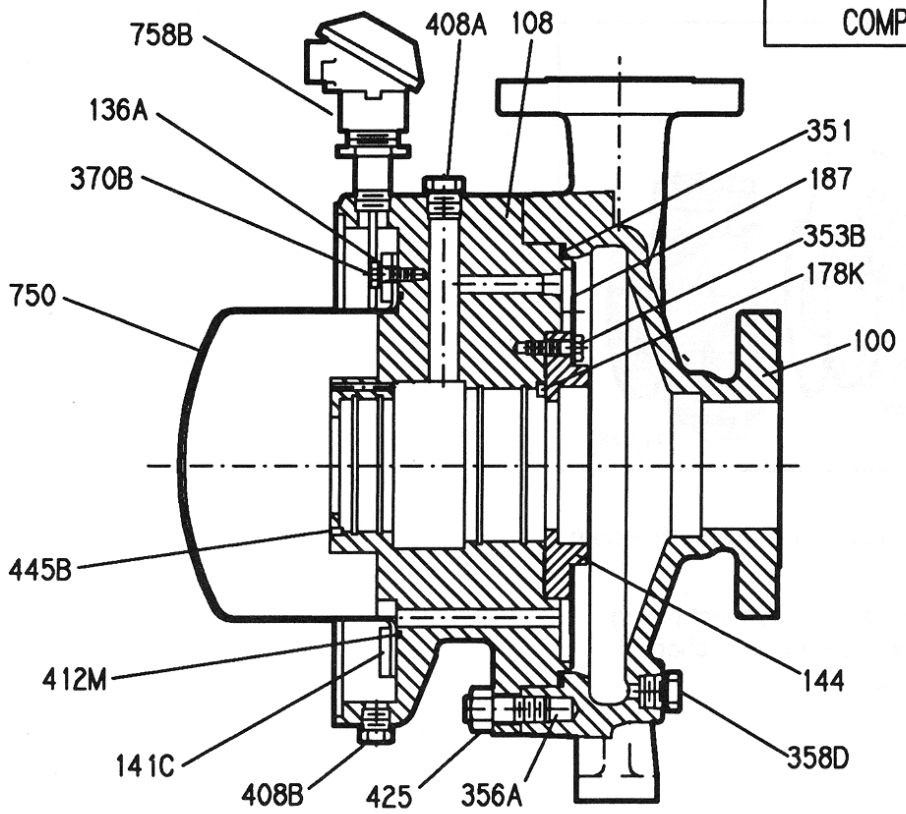
Fig. HH

63. Turn drive shaft (122B), to check for freedom of rotation.

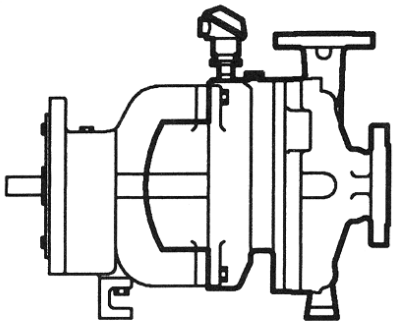
64. Install pump on baseplate, connect piping, align driver in accordance with sections 1 through 4 of this manual.

SECTIONALS

PRESSURE CONTAINING COMPONENTS

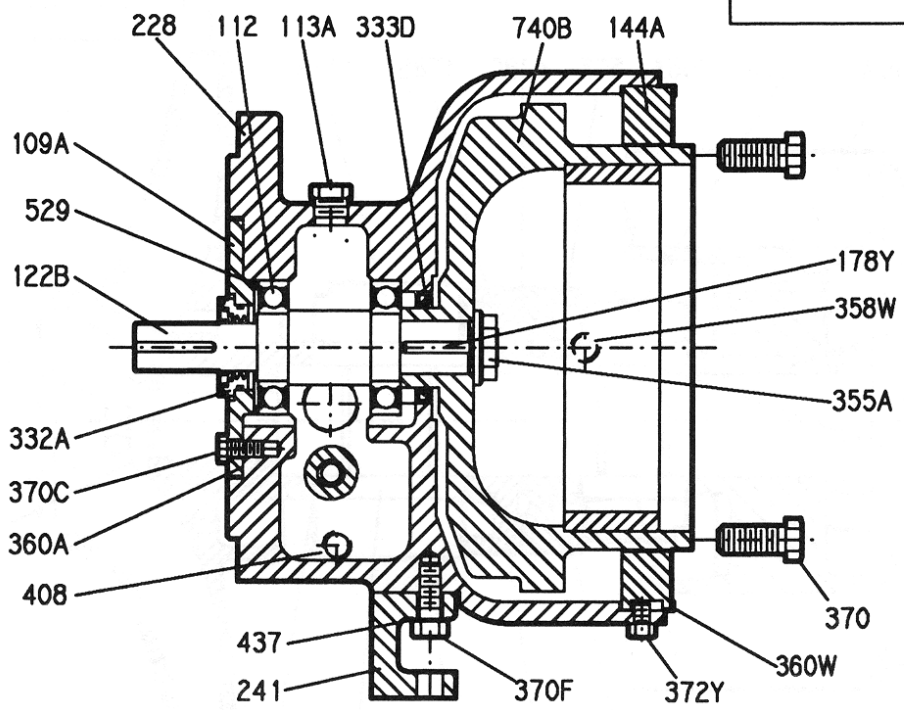


LIST OF COMPONENTS		
ITEM NO.	NO. REQ'D	PART NAME
100	1	CASING
108	1	ADAPTER
136A	20	LOCK WASHER, CLAMP RING
141C	1	CLAMP RING
144	1	WEAR RING
178K	1	INBOARD STATIONARY BEARING KEY
187	1	FLUSH SCREEN
351	1	CASING GASKET
353B	3	CAP SCREW, WEAR RING
356A	▲	CASING STUD
358D	1	CASING DRAIN PLUG
370B	20	CAP SCREW, CLAMP RING
408A	1	ADAPTER PLUG
408B	1	ADAPTER PLUG
412M	1	O-RING, CONTAINMENT SHELL
425	▲	CASING HEX NUT
445B	1	OUTBOARD STATIONARY BEARING KEY
750	1	CONTAINMENT SHELL
758B	1	TEMPERATURE SENSOR

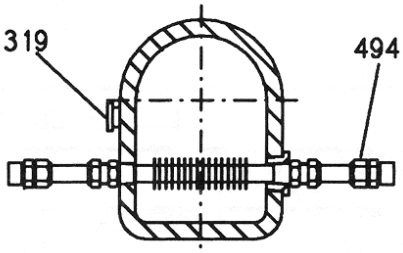


▲ NO. REQ'D PER CASING SIZE	
SIZE	NO. REQ'D
8"	8
10"	12
13"	16

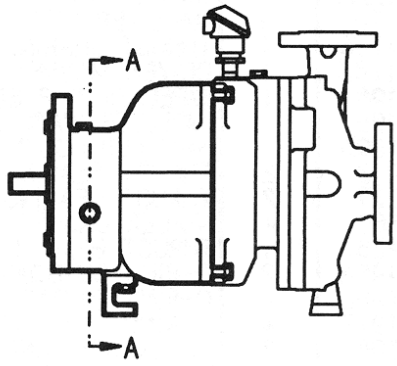
DRIVE COMPONENTS



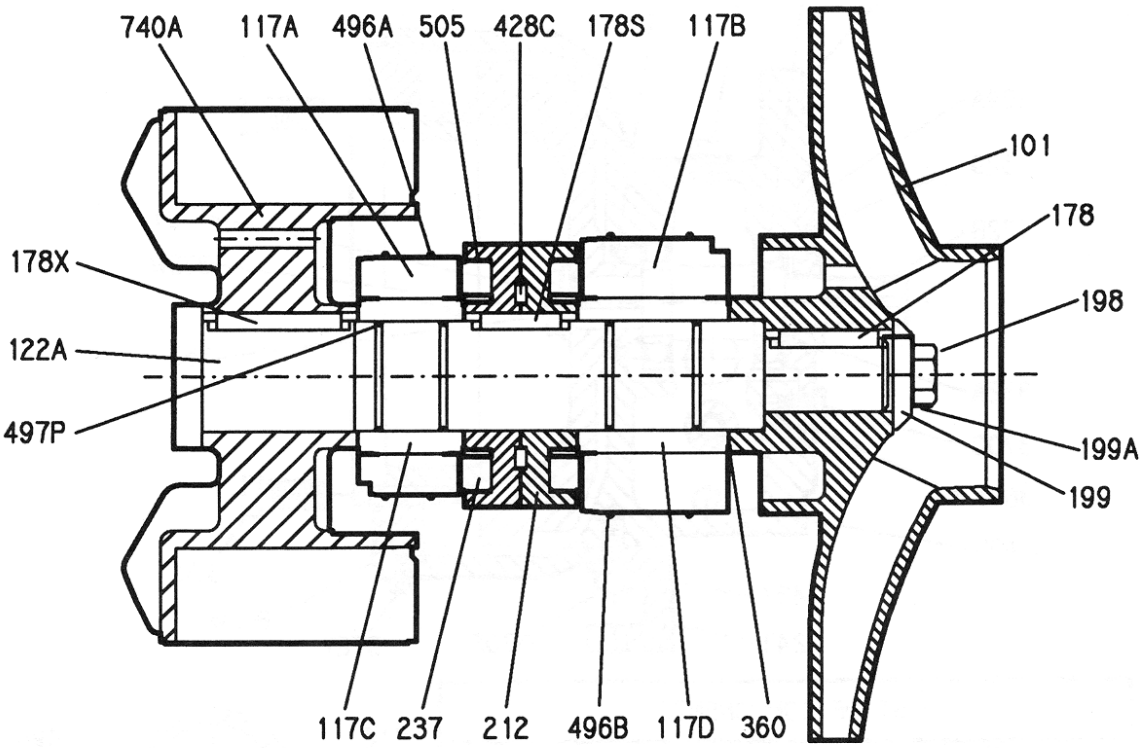
LIST OF COMPONENTS		
ITEM NO.	NO. REQ'D	PART NAME
109A	1	BEARING ENDCOVER
112	2	BALL BEARING
113A	1	OIL FILL PLUG
122B	1	DRIVE SHAFT
144A	1	RUB RING
178Y	1	DRIVE MAGNETIC CARRIER KEY
228	1	BEARING FRAME
241	1	FRAME FOOT
319	1	SIGHT GLASS OIL LEVEL INDICATOR
332A	1	LABYRINTH OIL SEAL
333D	1	LIP SEAL
355A	1	FLANGE HEX NUT
358W	1	PRESSURE SWITCH PLUG
360A	1	BEARING ENDCOVER GASKET
360W	2	ADAPTER TO FRAME GASKET
370	4	CAP SCREW, ADAPTER TO FRAME
370C	4	CAP SCREW, BEARING END COVER
370F	2	CAP SCREW, FRAME FOOT
372Y	2	RUB RING RETAINING SCREW
408	1	OIL DRAIN PLUG
437	2	LOCKWASHER, FRAME FOOT
494	1	OIL COOLER ASSEMBLY
529	1	WAVE WASHER
740B	1	DRIVE MAGNET ASSEMBLY



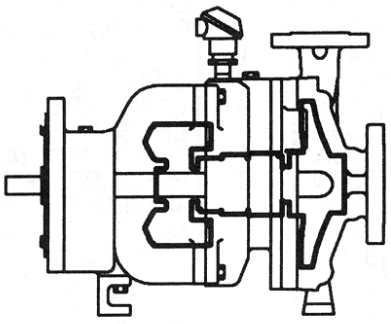
SECTION A-A



DRIVEN COMPONENTS



LIST OF COMPONENTS		
ITEM NO.	NO. REQ'D	PART NAME
101	1	IMPELLER
117A	1	OUTBOARD STATIONARY SLEEVE BEARING
117B	1	INBOARD STATIONARY SLEEVE BEARING
117C	1	OUTBOARD ROTATING SLEEVE BEARING
117D	1	INBOARD ROTATING SLEEVE BEARING
122A	1	DRIVEN SHAFT
178	1	IMPELLER KEY
178S	1	THRUST BEARING HOLDER KEY
178X	1	DRIVEN MAGNET CARRIER KEY
198	1	IMPELLER CAP SCREW
199	1	IMPELLER WASHER
199A	1	IMPELLER LOCKWASHER
212	2	THRUST BEARING HOLDER
237	2	THRUST BEARING
360	4	SPACER GASKET
428C	1	THRUST BEARING HOLDER GASKET
496A	2	O-RING, OUTBOARD STATIONARY BEARING
496B	2	O-RING, INBOARD STATIONARY
497P	4	O-RING, ROTATING BEARINGS
505	2	TOLERANCE RING
740A	1	DRIVEN MAGNET ASSEMBLY



PARTS LIST AND MATERIALS OF CONSTRUCTION					
Item No.	Qty/ Pump	Part Name	Pump Construction		
			316SS	Alloy 20	Hastelloy C
100	1	Casing	1203	1204	1215
101	1	Impeller	1203	1204	1215
108	1	Adapter	1203	1204	1215
109A	1	Bearing End Cover	1013		
112	2	Ball Bearing	Steel		
113A	1	Oil Filler Plug	Steel		
117A	1	Outboard Stationary Sleeve Bearing	Silicon Carbide		
117B	1	Inboard Stationary Sleeve Bearing	Silicon Carbide		
117C	1	Outboard Rotating Sleeve Bearing	Silicon Carbide		
117D	1	Inboard Rotating Sleeve Bearing	Silicon Carbide		
122A	1	Driven Shaft	2229	2230	2248
122B	1	Drive Shaft	2238		
136A	20	Lockwasher	2228		
141C	1	Containment Shell Clamp Ring	3211		
144	1	Wear Ring	1203	1204	1215
144A	1	Rub Ring	1104		
178	1	Impeller Key	2248		
178K	1	Stationary Inboard Bearing Key	2248		
178S	1	Thrust Bearing Holder Key	2248		
178X	1	Driven Magnet Carrier Key	2248		
178Y	1	Drive Magnet Carrier Key	2213		
187	1	Flush Screen	316SS	Hastelloy C	Hastelloy C
198	1	Impeller Cap Screw	2248		
199	1	Impeller Washer	2248		
199A	1	Impeller Lock Washer	2248		
212	2	Thrust Bearing Holder	2229	2230	2248
228	1	Bearing Frame	1013		
237	2	Thrust Collar Bearing	Silicon Carbide		
241	1	Frame Foot	1001		
319	1	Sight Window (Not Shown)	Glass/Steel		
332A	1	Labyrinth Oil Seal	Carbon Filled Teflon		
333D	1	Lip Seal	Buna Rubber		
351	1	Casing Gasket	Grafoil		
353B	3	Wear Ring to Adapter Cap Screw	2248		
355A	1	Flange Hex Nut	2210		
356A	*	Casing Stud	2228		
358W		Pipe Plug – 1/4" (not shown)	2210		
360	4	Spacer Gaskets	Grafoil		
360A	1	Bearing End Cover Gasket	Varnished Kraft		
360W	2	Adapter to Frame Gasket	Aramid Fiber with EPDM Binder		
370	4	Adapter to Frame Cap Screw	2228		
370B	20	Containment Shell to Adapter Hex Cap Screw	2228		
370C	4	Bearing End Cover Cap Screw	2228		
370F	2	Frame Foot Cap Screw	2210		
372Y	2	Rub Ring Cap Screw	2228		
408		Drain Plug (not shown)	2210		
408A	2	Adapter Pipe Plug - 1/2"	2229	2230	2248
408B		Adapter Flush Plug - 3/8"	2229	2230	2248
412M	1	Containment Shell to Adapter O-ring	PFA Encapsulated Viton		
425	*	Casing Nut	2228		
428C	1	Holder Gasket	Grafoil		
437	2	Frame Foot Lock Washer	2210		

PARTS LIST AND MATERIALS OF CONSTRUCTION (con'td)					
Item No.	Qty/ Pump	Part Name	Pump Construction		
			316SS	Alloy 20	Hastelloy C
445B	1	Outboard Stationary Bearing Roll Pin	2248		
496A	2	Outboard Stationary Bearing O-ring	PFA Encapsulated Viton		
496B	2	Inboard Stationary Bearing O-ring	PFA Encapsulated Viton		
497P	4	Driven Shaft O-ring	PFA Encapsulated Viton		
505	2	Tolerance Ring	Hastelloy C		
529	1	Wave Washer	Steel		
740A	1	Driven Magnet Assembly	316SS	Alloy 20	Hastelloy C
740B	1	Drive Magnet Assembly	1013		
750	1	Containment Shell	3212		
758B	1	Thermocouple	Aluminum/304		

*

For 8" Pumps — Quantity is 8
For 10" Pumps — Quantity is 12
For 13" Pumps — Quantity is 16

Hastelloy™ is a Trademark of Haynes International, Inc.
Teflon™ is a Trademark of E.I. DuPont
Graphoil™ is a Trademark of Union Carbide

MATERIAL CROSS REFERENCE CHART		
Cast Iron	1001	A48 Class 20
Ductile Iron	1013	A536 Gr60-42-10
Bronze	1104	B584-C93200
316SS	1203	A744 CF-8M
GA20	1204	A744 CN-7M
Hastelloy C	1215	A494 CW-7M
Carbon Steel	2210	A108 Gr1211
Carbon Steel	2213	A108 Gr1018-B1112
304SS	2228	A276 Type 304
316SS	2229	A276 Type 316
Carpenter 20	2230	B473 (N08020)
4140 Steel	2238	A434 Gr4140
Alloy C-276	2248	B574 (N10276)
316SS	3211	A240 Type 316
Hastelloy C 276	3212	B575 (N10276)

Fasteners/Plugs		
Carbon Steel	2210	A307 Gr.B.
Stainless Steel	2228	A193 B
316 Stainless Steel	2272	A193 B8M
316 Stainless Steel	2229	A193 B8
Alloy Steel	2239	A193 Grade B7

SPARE AND REPAIR PARTS

When ordering parts, always refer to part name, Goulds serial No., and indicate item No. from the sectional drawing.

RECOMMENDED SPARES

Pump Repair Kit			
M-Group - Part No. R296-MKM081013			
Part	**Material**	**Item**	**Quantity**
Casing Gasket - 8 in.	Grafoil	351	1
Casing Gasket - 10 in.	Grafoil	351	1
Casing Gasket - 13 in.	Grafoil	351	1
End Cover Gasket	Varnished Kraft	360A	1
Containment Shell O-ring	PFA/Viton	412M	1
Labyrinth Seal O-ring	Viton	497F	1
Labyrinth Seal O-ring	Viton	497G	1
Driven Shaft O-ring	PFA/Viton	497P	4
Outboard KStationary Bearing O-ring	PFA/Viton	496A	2
Inboard Stationary Bearing O-ring	PFA/Viton	496B	2
Rub Ring Gasket	Aramid Fiber/EPDM Binder	360W	2
Spacer Gasket	Grafoil	360	4
Ball Bearing	Steel	112A	2
Lip Seal	BUNA	333D	1
Hex Flange Nut	Steel	355A	1
Impeller Lockwasher	Hast C	199A	1

Sleeve Bearing Kit - Silicon Carbide		
M-Group - A03746A02 - 6127		
Part	**Item**	**Quantity**
Outboard Stationary Sleeve Bearing	117A	1
Inboard Stationary Sleeve Bearing	117B	1
Outboard Rotary Sleeve Bearing	117C	1
Inboard Rotary Sleeve Bearing	117D	1
Thrust Collar Bearing	237	2

PARTS

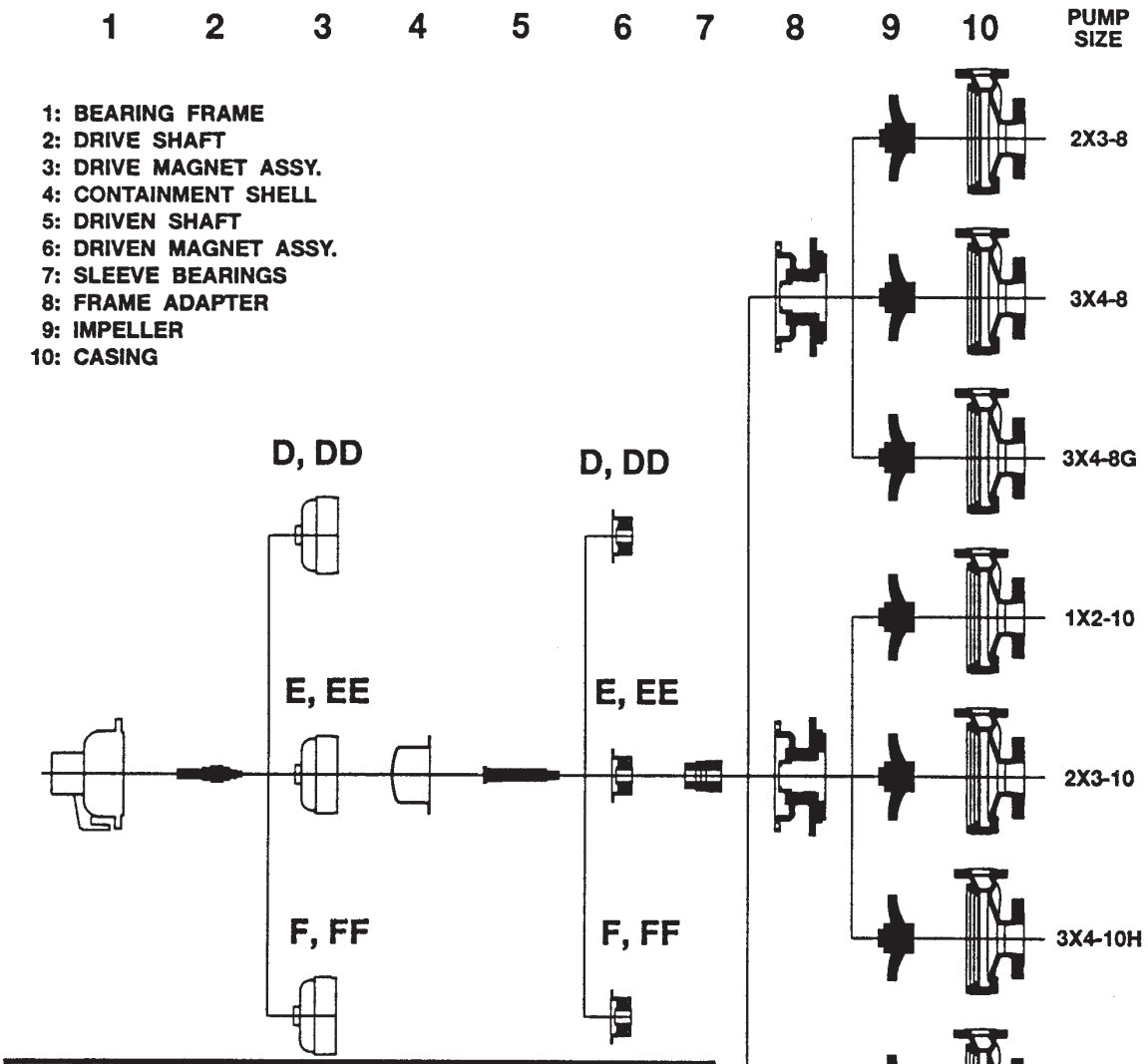
- Impeller (101)
- Impeller cap screw and washer (198, 199)
- Impeller key (178)
- Driven Magnet Assembly (740A)
- Drive Magnet Assembly (740B)
- Containment Shell (760)
- Driven Shaft (122A)
- Wear ring (144)
- Flange Nut (355A)

HOW TO ORDER PARTS

When ordering parts call
1-800-446-8537
or your local Goulds representative.

INTERCHANGEABILITY

3296 INTERCHANGEABILITY CHART
M FRAME



Drive Assembly	Motor HP & kW (max.)*							
	60 Hertz				50 Hertz			
	2 Pole		4 Pole		2 Pole		4 Pole	
	HP	kW	HP	kW	HP	kW	HP	kW
D, DD	40	29.8	20	14.9	33.3	24.9	16.7	12.4
E, EE	60	44.7	30	22.4	50	37.3	25	18.6
F, FF	100	74.6	50	37.3	83.3	62.1	41.7	31.1

* Based on Hastelloy C276 containment shell and Neodymium Iron (Drives D, E, F) or Samarium Cobalt (Drives DD, EE, FF) magnets.

Figure 8

RETURN OF MATERIALS

If it is necessary to return the pump to a Goulds factory or repair facility for service certain procedures must be followed.

A **Return Material Label** must be completed by the **USER** prior to the return of the pump. The **USER** must also contact a Goulds representative prior to the return of the pump for instructions and authorization to return the pump.

Before shipping check with your carrier for special procedures that may be required when shipping highly magnetic materials.

All pumps must be decontaminated prior to return, reference Section 4, *Flushing Pump*.

APPENDIX

COUPLING GUARD INSTALLATION

⚠ WARNING

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

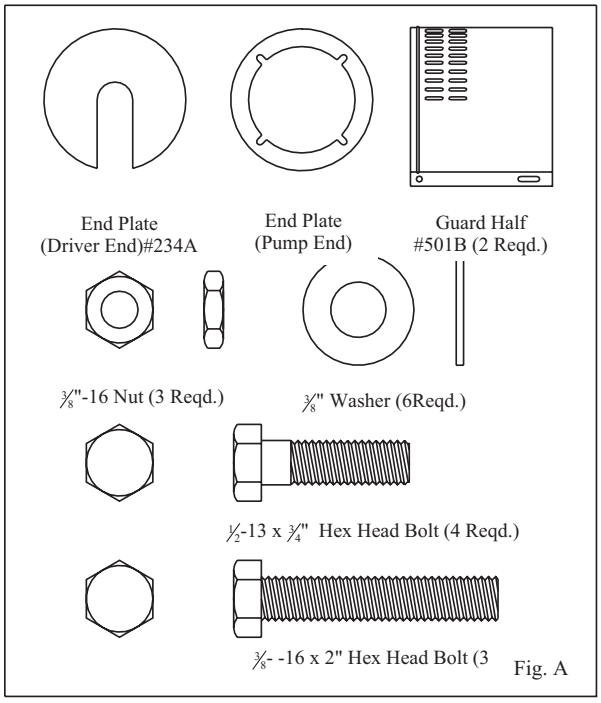


Fig. A

Simplicity of design allows complete assembly of the coupling guard in about five minutes.

ASSEMBLY:

NOTE: If end plate (pump end) is already installed, make any necessary coupling adjustments and then proceed to Step 2.

1. Align end plate (pump end) to the Bearing Frame and install ½ - 13x¾" hex head bolts. (Fig. B)

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

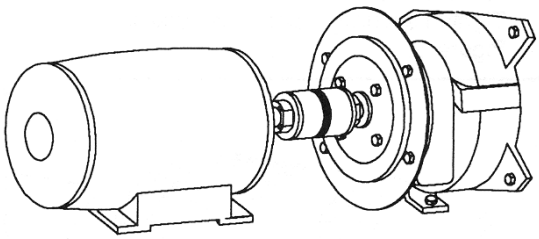


Fig. B

2. Spread bottom of coupling guard half (pump end) slightly and place over pump end plate as shown in Figure C. The annular groove in the guard half locates around the end plate. See detail drawing, Figure E.

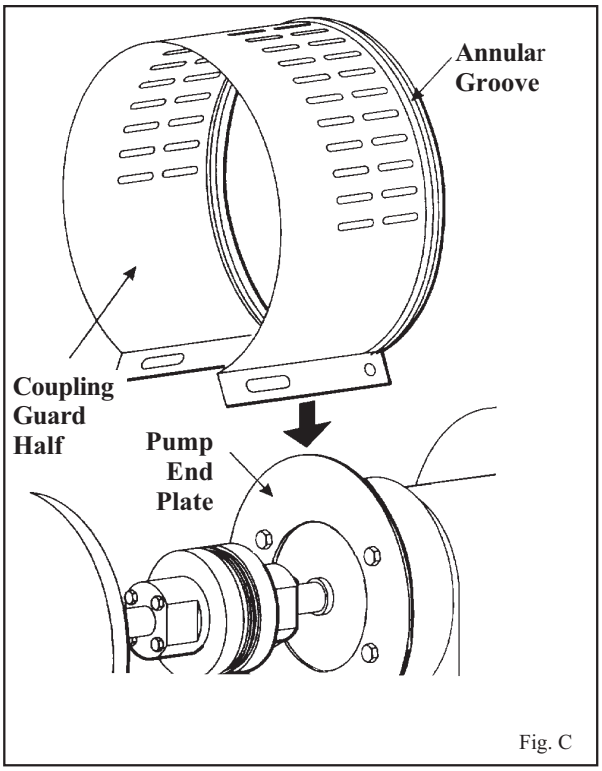


Fig. C

3. After the coupling guard half (pump end) is located around the end plate, secure it with a ⅜ - 16x2" hex head bolt, nut and two (2) washers through the round hole at the front end of the guard half as shown in Figure D. Tighten securely. See detail drawing, Figure E.

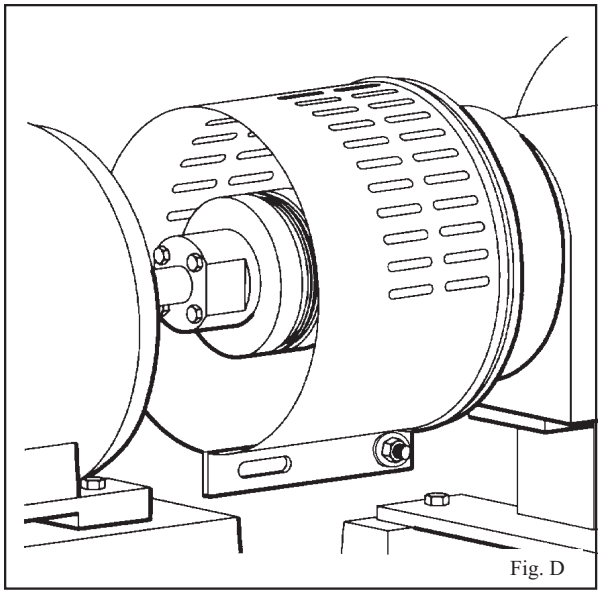


Fig. D

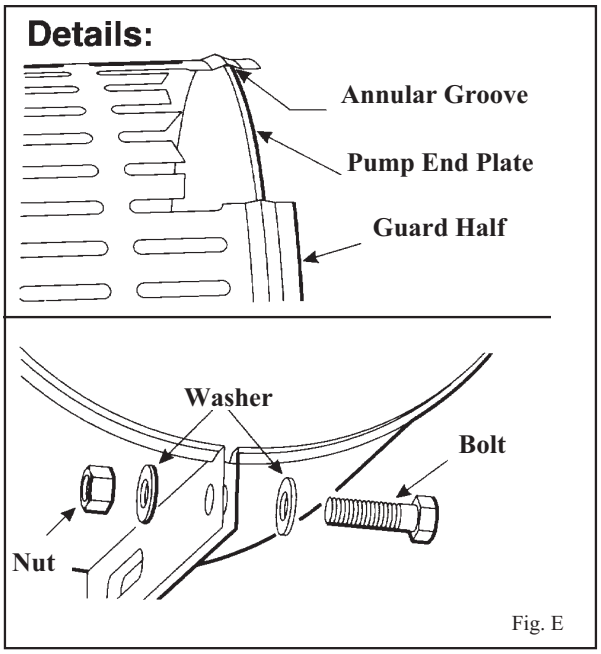


Fig. E

4. Spread bottom of coupling guard half (driver end) slightly and place over coupling guard half (pump end) so that annular groove in coupling guard half (driver end) faces the motor as shown in Figure F.

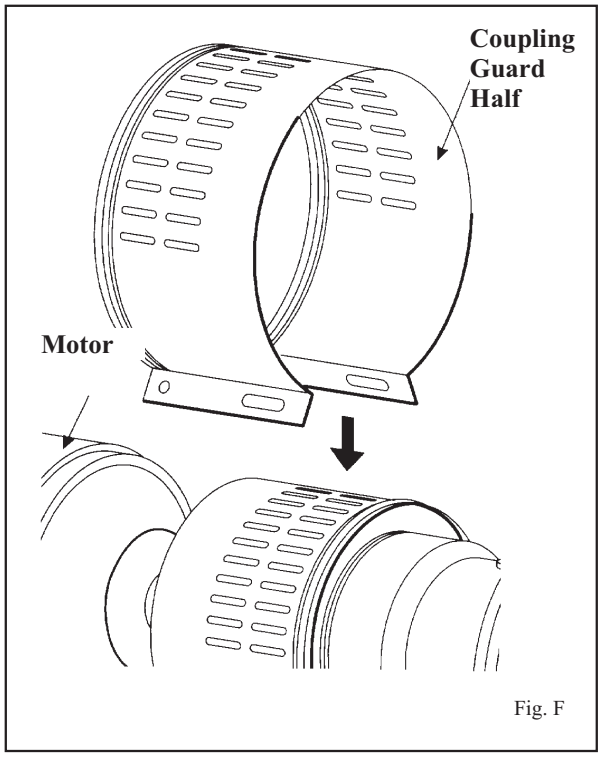


Fig. F

5. Place end plate (driver end) over motor shaft as shown in Figure G. Locate the end plate in the annular groove at the rear of the coupling guard half (driver end) and secure with a bolt, nut, and two (2) washers through the round hole at the rear of the guard half. Finger tighten only.

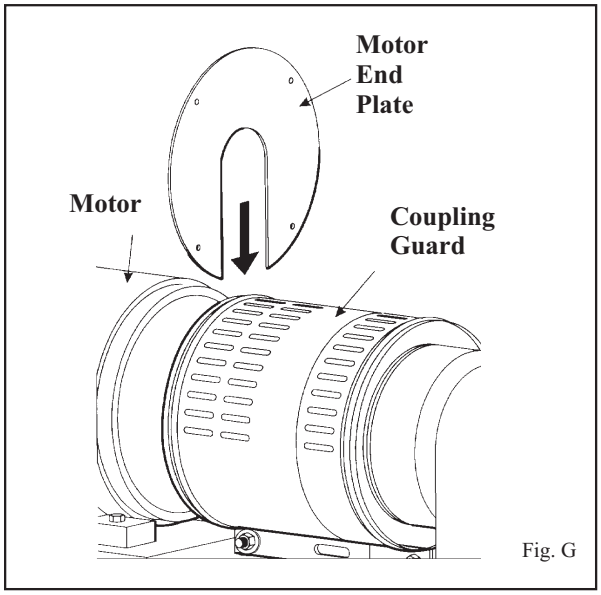


Fig. G

6. Adjust length of coupling guard to completely cover shafts and coupling as shown in Figure H by sliding coupling guard half (driver end) towards motor. After adjusting guard length, secure with bolt, nut and two (2) washers through the slotted holes at the center of the guard and tighten. Check all nuts on the guard assembly for tightness.

WARNING

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

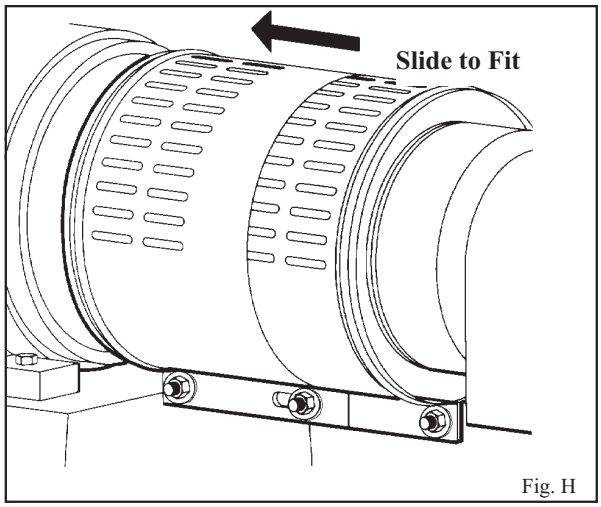


Fig. H

DISASSEMBLY

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

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

NOTE: Refer to illustrations for disassembly in reverse order.

1. Remove nut, bolt, and washers from center slotted hole in the coupling guard. Slide motor end coupling guard half towards pump. Figure H.
2. Remove nut, bolt, and washers from coupling guard half (driver end), and remove end plate. Figure G.
3. Spread bottom of coupling guard half slightly and lift off. Figure F.
4. Remove remaining nut, bolt, and washers from coupling guard half (pump end). Spread bottom of coupling guard half slightly and lift off. Figure C.

This completes disassembly of the coupling guard.

NOTE: It is not necessary to remove the end plate (pump end) from the pump bearing housing. The end plate will not interfere with maintenance or repair of the pump.

CHANGING THE IMPELLER

1. Refer to Section 6, Preparation for Disassembly
   - Note and observe all warnings.
   - Follow steps 1 through 7.

2. Remove bearing frame foot bolts from baseplate and note the presence of any shims between frame foot and baseplate. Save shims and reuse during installation.

3. Remove casing nuts (425) and remove back pull-out assembly from casing (Fig. A).

4. Remove casing gasket (351) and discard (Fig. A).

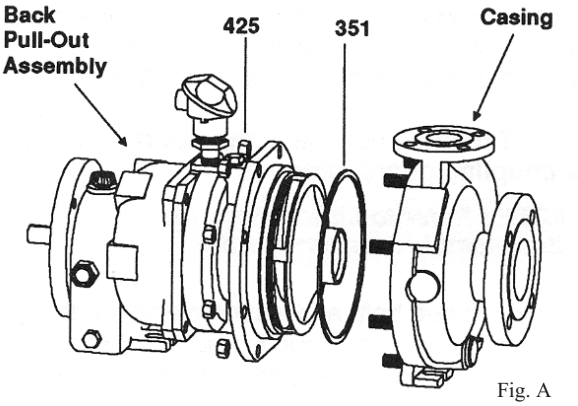


Fig. A

5. Place shaft wrench on coupling end of shaft and remove impeller bolt (198), lockwasher (199A) and impeller washer (199).

6. Remove impeller (101). It may be necessary to use a puller. Puller must be placed as close to vanes as practical so as not to damage the impeller.

NOTE: At this time, maintenance can be conducted on the flush screen or the wear ring. Refer to the appropriate steps in Section 6.

7. Ensure keyway on replacement impeller is free of burrs.

8. Clean old spacer gasket (360) from rotary sleeve bearing face (117D) and replace with new gasket.

9. Make an impeller installation tool similar to that shown in Fig. B.

CAUTION

Do not use force such as a press or a hammer to install impeller as the driven shaft (122A) will slide rearward. This will loosen the bearing stack and cause damage to the sleeve bearings, the remaining spacer gaskets (360) and possibly the containment shell (750).

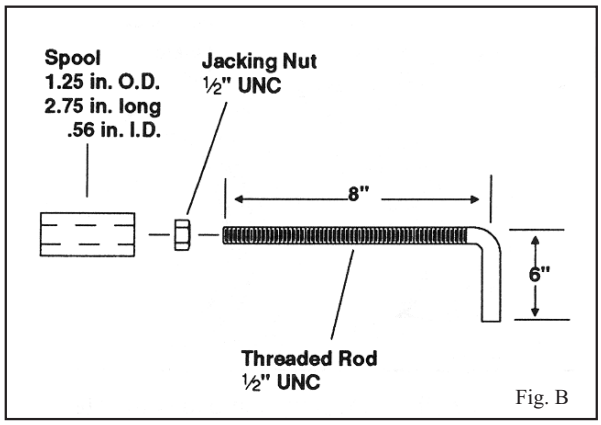


Fig. B

10. Thread jacking nut on threaded rod back about 6 inches (150 mm).

11. Place spool on threaded rod against nut and impeller on threaded rod against spool.

12. Carefully align impeller bore with driven shaft (122A) and install threaded rod into impeller screw hole in shaft (Fig. C).

13. Tighten jacking nut by hand until impeller is supported by end of shaft and spool (Fig. C).

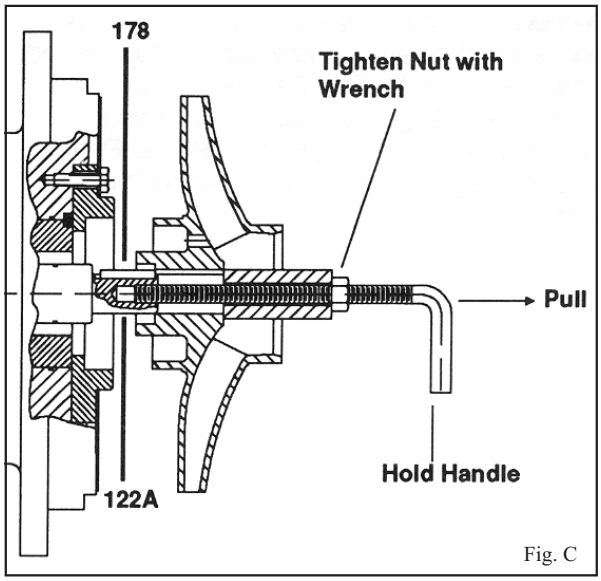


Fig. C

14. Ensure impeller key (178) is in shaft keyway and align impeller keyway to it.

15. While keeping light tension on the threaded rod, prevent rod from turning while tightening the jacking nut. Tighten nut until impeller is seated.

CAUTION

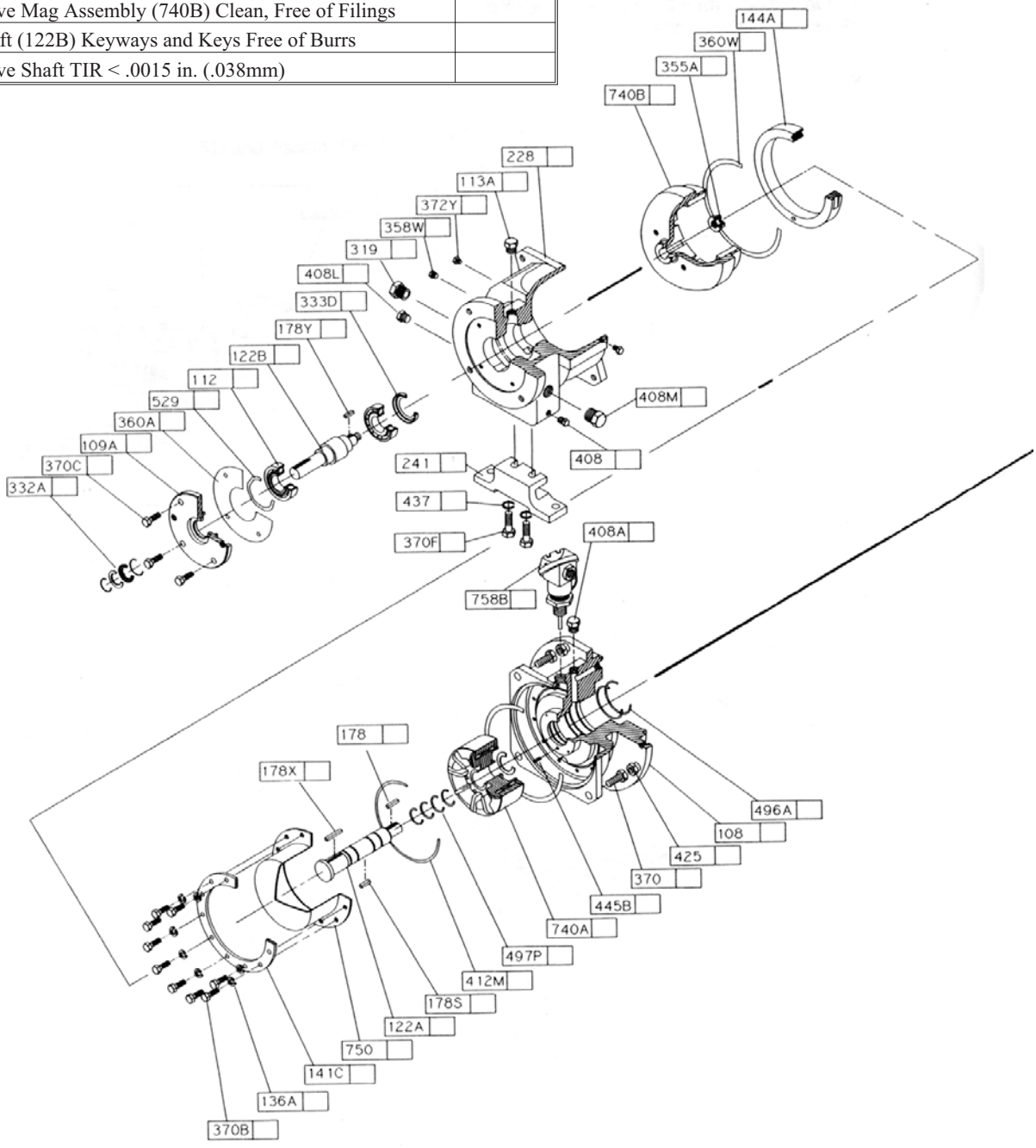
Ensure impeller starts squarely on the shaft. If impeller cocks, loosen nut slightly and tap LIGHTLY on the outside diameter of the impeller until it is square. Ensure shaft does not slide rearward.

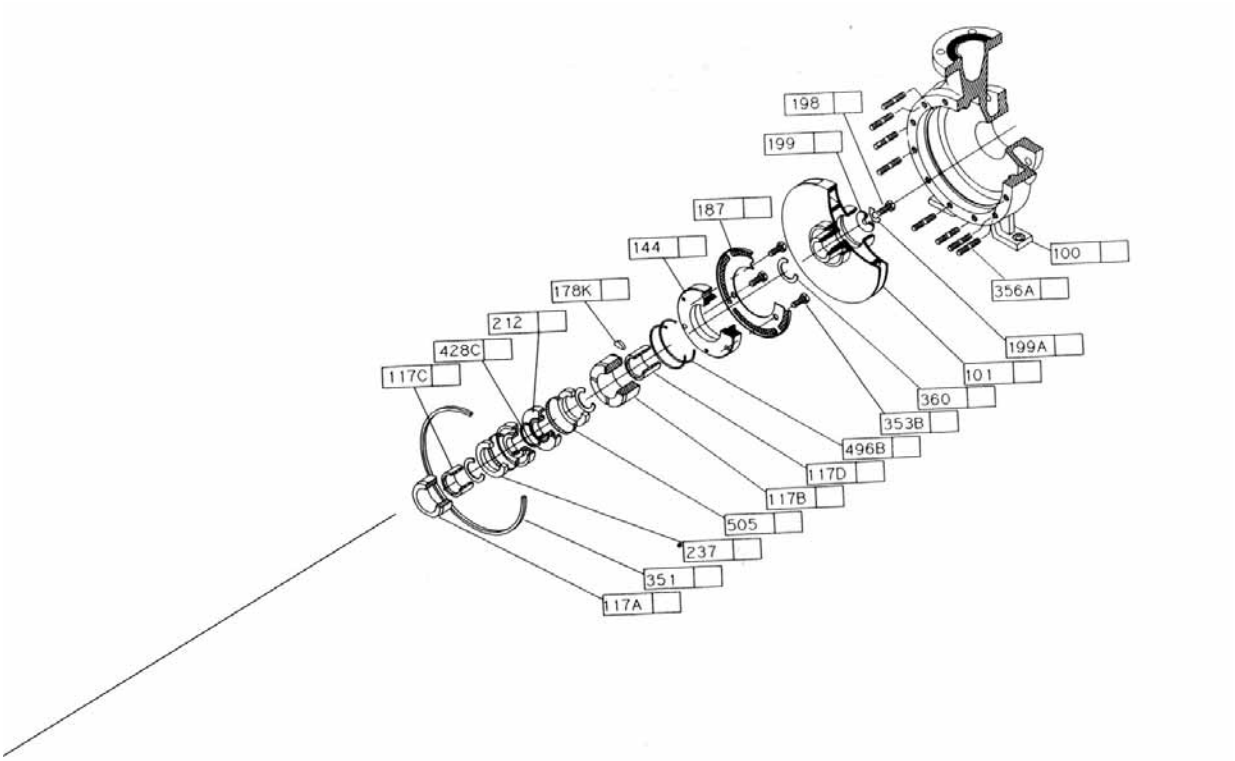
16. Remove threaded rod and install impeller screw (198), lockwasher (199A) and impeller washer (199).

17. Torque impeller bolt, set lockwasher, install back pull-out, align pump, etc. As specified in Section 6, Reassembly, steps 56 through 64.

3296 M ASSEMBLY AND INSPECTION CHECKLIST

POWER END INSPECTIONS	CHECK
Bearing Frame (228) Clean	
Gasket Surfaces Clean	
No Cracks or Excessive Corrosion	
Bearing Bores Maximum 3.1506 in. (80.025mm)	
Ball Bearings (112) New or Clean	
Oil Seal (333D) New	
Labyrinth Seal (332A) O-rings serviceble	
Labyrinth Seal (332A) Drain Port at 6:00	
Drive Mag Assembly (740B) Clean, Free of Filings	
Shaft (122B) Keyways and Keys Free of Burrs	
Drive Shaft TIR < .0015 in. (.038mm)	





*BOLT TORQUE Ft-lbs. (N•M)		Check
Drive Mag Assy Nut (355A)	170 (230)	
Wear Ring Screw (353B)	17 (25)	
Clamp Ring Screws (370B)	12 (16)	
Impeller Screw (198)	45 (60)	
Adapter to Frame Screws (370)	50 (70)	
Casing Nuts (425)	45 (60)	
* Torque Values based on Dry Threads		

LIQUID END INSPECTIONS	CHECKS
Parts Clean, Free of Burrs	
Keyways and Keys Free of Burrs	
O-ring Grooves Free of Burrs	
Gasket Surfaces Clean	
Casing (100) Thickness Meets Table 8	
Containment Shell (750) Thicker Than .050 in. (1.25mm)	
Cooling Passages in Adapter (108) Clear	
Flush Screen (187)Clear	
Bearings (117) Free of Cracks and Major Chips	
O-ring Lube Compatible with Pumpage?	
Driven Mag Assy (740A) Free of Erosion/Corrosion	
Driven Assy Axial Travel .020-.060 in. (.5 to 1.5mm)	
New Gaskets used for Assembly	
Impeller Lockwasher (199A) Set	

CLEARANCES	
Wear Ring (Compare to Table 9)	
Impeller to Casing . . . . . Actual	
Impeller to Wear Ring . . . . . Actual	
Driven Magnet to Adapter . . . . . Actual	
Drive Magnet to Rub Ring . . . . . Actual	
Sleeve Bearings (Compare to Table 11)	
Shaft to Bearing . . . . . Actual	
Bearing to Bearing . . . . . Actual	
Bearing to Adapter . . . . . Actual	

EQUIPMENT # _____ DATE _____

SERIAL # _____ WORK ORDER # _____

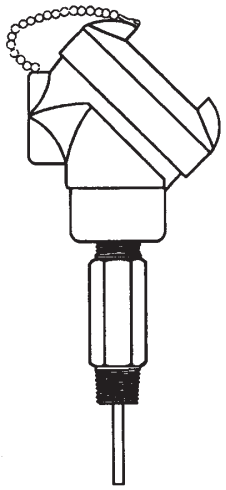
PUMP SIZE _____ NAME _____

CONDITION MONITORING SYSTEM

Temperatue Sensor (Option)

DESCRIPTION

A temperature sensor is used to sense the metal containment shell temperature. The customer is required to wire the temperature sensor to their condition monitoring system.



COMPONENTS SUPPLIED

(1) Thermocouple with specifications as noted:

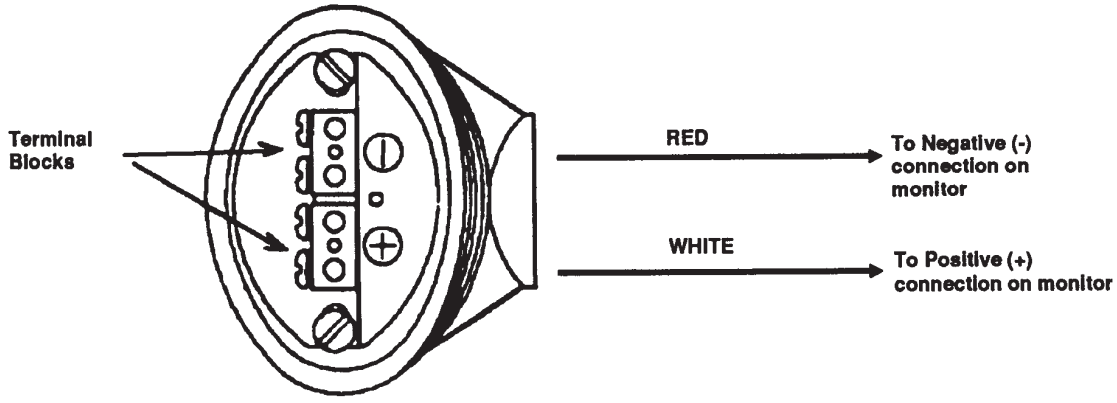
Specification:

Type "J" undergrounded junction
Spring loaded 316SS sheath (ensures contact with shell)
Internally sealed (Vapor tight, does not allow leakage through conduit)
NEMA 4 aluminum screw cover heard (NEMA 7 optional)
Connection for customer's conduit

INSTRUCTION

Wire temperature sensor to customer's monitoring system to either sound an alarm and / or shut unit off. Set point should be set 30° F (17° C) above pumpage temperature to protect the unit (for most applications) or should be set at a temperature predetermined to cause a pump problem due to the unique characteristic of the liquid being pumped (problems such as recirculation, liquid vaporization or polymerization). A wiring diagram for a Type J thermocouple is below:

Thermocouple Head
Top View, Cover Removed



CONDITION MONITORING DEVICES

Temperature Controller (Option)

DESCRIPTION

The temperature controller monitors the temperature signal from the temperature sensor (usually the thermocouple) to alarm and/or stop the pump if an over-temperature condition exists. If the customer does not have a controller to work with the thermocouple, this option should be provided. Common set points are the maximum temperature of the magnetic coupling, the boiling point of the pumpage or solidification temperature of the pumpage. The controller will also trip if the temperature sensor is disconnected or the electrical power supply is interrupted.

COMPONENTS SUPPLIED

(1) Controller with instructions
(1) Terminal Socket

Specifications

Make – Omega
Model – 6102
Type – J
Range – 0° F to 500° F
Supply Voltage – 120 VAC 50/60 Hz
Power Consumption – 2 VA
Output Relay – 7A

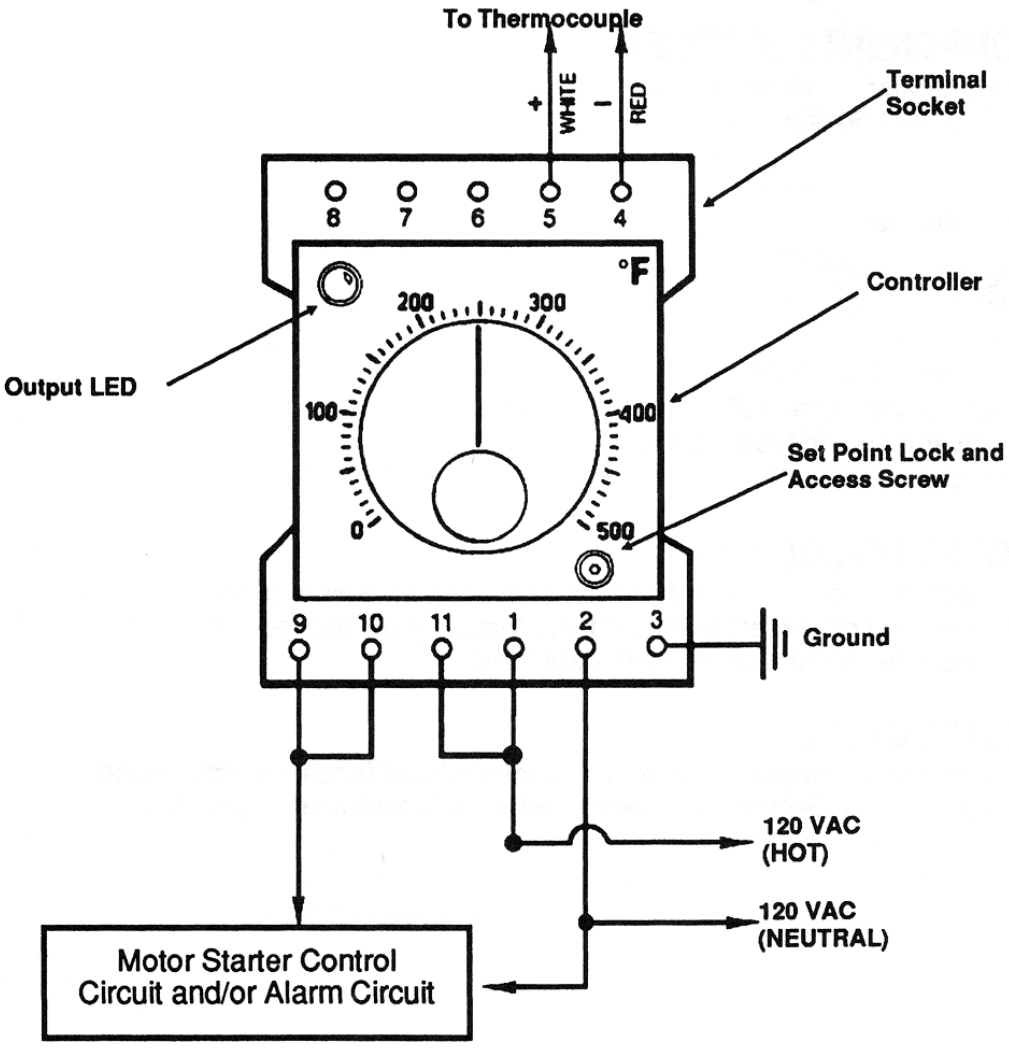
MOUNTING LOCATION

It is recommended to mount components in an enclosure to avoid excessive shock, vibration, dirt, moisture and oil. an area with ambient temperature between 32° F and 122° F (0° C and 50° C), such as the motor starter enclosure or in a control room.

INSTRUCTION

Wire to thermocouple, motor starter control circuit (and/or alarm) and to 120 VAC source as shown in wiring diagram. Set trip point to desired alarm/shutdown temperature.

Wiring Diagram
Temperature Controller



CONDITION MONITORING DEVICES

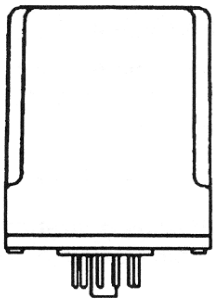
Low Amp Relay (Option)

DESCRIPTION

The Low Amp Relay System senses the current level of the electric motor. The monitor triggers to sound an alarm and/or shutdown the pump when the current falls below a preset level (indicating a pump problem such as magnet decoupling, dry running or low flow operation). Sensing low current provides pump protection, preventing pump damage from operation problems.

COMPONENTS SUPPLIED

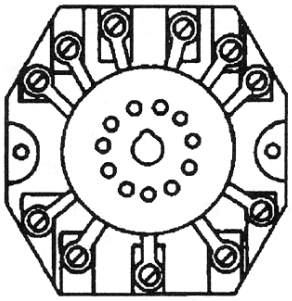
(1) Current Monitor
(1) Terminal Socket
(1) Current Transformer (supplied only if full load operating current exceeds 8 amps)



Specifications

Current Monitor

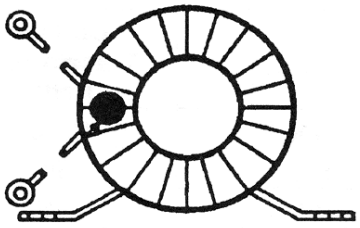
Make - Diversified Electronics
Series - CMU
Control Voltage - 120 VAC 50/60 Hz
Trip Points - Drop Out - Adjustable
- Pick Up - 5% Above Drop Out
Response Times - Operate - .1 Seconds
- Release - .1 to 5 Secs. Adjustable
Output - DPDT, 10 Amps at 120 VAC, Resistive



Current Transformer

24 in. leads
600 V Insulation
25 - 400 Hz Operation

Rating Ratios:	25/5
(as specified on	50/5
transformer	100/5
supplied)	200/5



NOTE: Maximum operating current must be less than twice the rated current.

MOUNTING LOCATION

It is recommended to mount components in an enclosure to avoid excessive shock, vibration, dirt, moisture and oil. Ambient temperature should be between 15° F to 150° F (-10° C to +65° C). Typically, the motor starter enclosure or a control room is adequate. Note that unit should be mounted in close proximity to motor electrical leads for convenience.

INSTRUCTION

NOTE: Do not install low amp relay system until after pump is installed and operational. Various current measurements must be taken to verify selection of system components and to adjust trip point of the controller.

I. Measure and record current levels

A. No load motor current (I_{NL}) = _____

1. Use motor manufacturer's data or measure motor current with motor uncoupled from pump and running.

B. Full load operating current (I_{FLO}) = _____

1. Operate pump at highest flow that the system will allow and measure motor current.

C. No flow operating current (I_{NFO}) = _____

1. With pump operating, close discharge valve momentarily (no more than 1 minute) and measure motor current.

⚠ WARNING

Continuous operation against closed discharge valve may vaporize liquid, creating an explosive hazard due to confined vapor under HIGH pressure and temperature.

II. Verify selection of system components

A. Find the current transformer ratio and the minimu current setting from Table I. based on the full load operating current (I_{FLO}) measured above.

B. Ensure the transformer specified from Table I is the same as that supplied. If it is not, contact your Goulds representative.

C. Ensure the minimum current setting from Table I is less than the no flow operating current (I_{NFO}) measured above. It is is not, contact your Goulds representative.

Table I

I_{FLO} (Amps)	Current Transformer Ratio	Current Transformer (No. of Turns)	Minimum Current Setting (Amps)	Part Number
4 to 8	None	N/A	1.0	A03790A01
8 to 11	25/5	4	1.25	A03790A02
11 to 22	24/5	2	2.5	A03790A02
22 to 45	25/5	1	5.0	A03790A02
45 to 60	100/5	3	6.5	A03790A04
60 to 90	50/5	1	10	A03790A03
90 to 120	200/5	3	13	A03790A05
120 to 180	200/5	2	20	A03790A05

INSTALLATION

1. Mount the Current Transformer (CT), if supplied, in an area that is convenient to loop one of the motor leads through it, usually the motor starter enclosure.
2. Loop one of the motor leads through the CT the number of turns specified in Table I.
3. Mount the Terminal Socket at desired location.
4. Connect wiring (Not Supplied) per wiring Diagram I for use with *no Current Transformer* and per wiring Diagram II for use *with a Current Transformer.*
5. Plug Motor into Terminal Socket.

SETTINGS

1. To protect against dry running, set Current Adjuster to a current value midway between full load operating current (I_{NFO}) and no load motor current (I_{NL}).

NOTE: The minimum current setting shown in Table I corresponds to "I" on the Current Adjuster Dial. Each setting on the dial is a multiple of the minimum setting.

2. To protect against Low Flow Operation, operate pump at desired flow and slowly increase setting on Current Adjuster until pump shuts off.
3. Set time delay from .1 to 5 seconds as desired. Delay is used to prevent nuisance tripping that occurs from variations in line voltage.

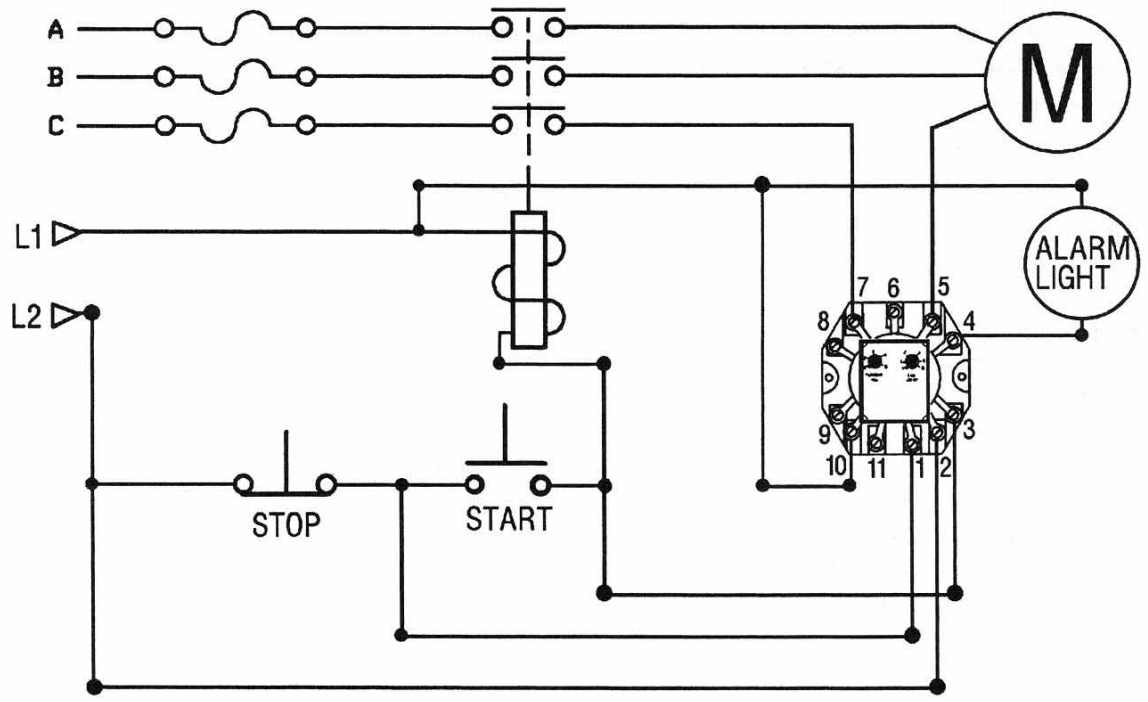


DIAGRAM I

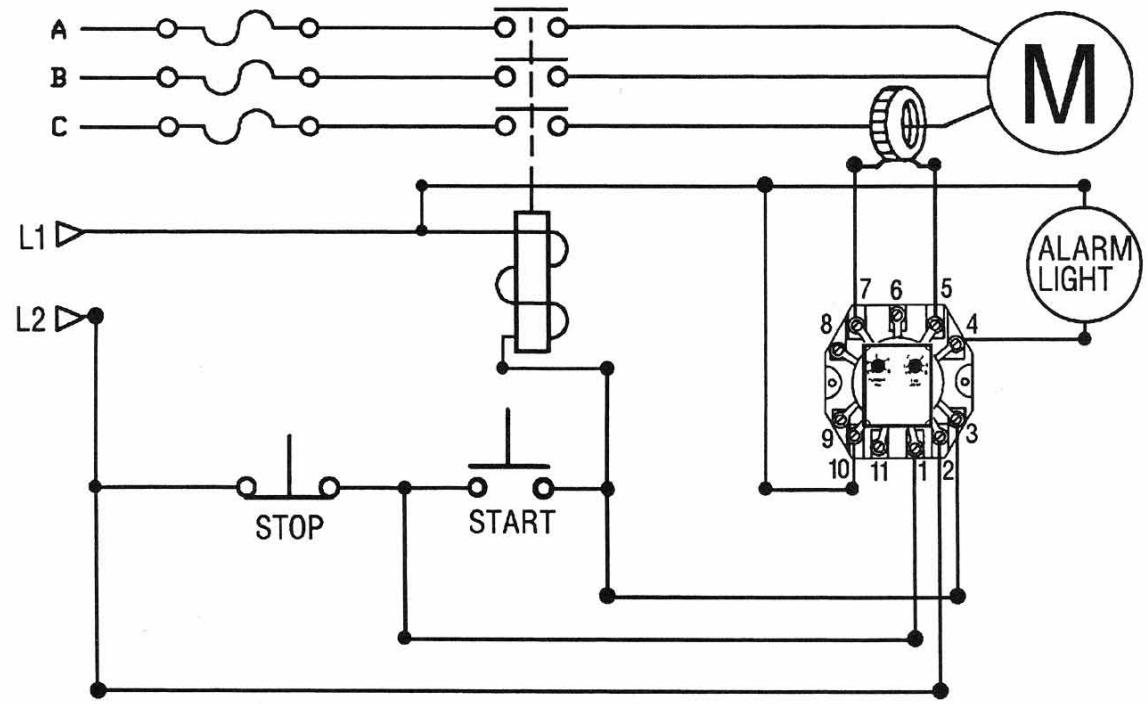


DIAGRAM II

CONDITION MONITORING DEVICES

NEMA 4 Pressure Switch (Option)
Leak Detector

DESCRIPTION

This detector senses a leak in the containment shell by detecting pressure in the bearing frame bell housing. A pressure switch preset to trip at 10 PSIG on increasing pressure is supplied. The switch must be wired to the customer's monitoring system to sound an alarm and/or stop the pump. Recommended for use with volatile liquids (liquids that will flash when exposed to atmospheric pressure). Should be provided to those customers who require warning of containment shell leakage.

LIMITATIONS

1. The total developed pressure of the pump plus suction pressure must be above 15 PSIG in order to have sufficient pressure in containment shell to trip switch should there be a leak.

CAUTION

This method of leak detection may not prevent release of pumpage to the atmosphere. It is possible that liquid could infiltrate bearing frame lubricating oil.

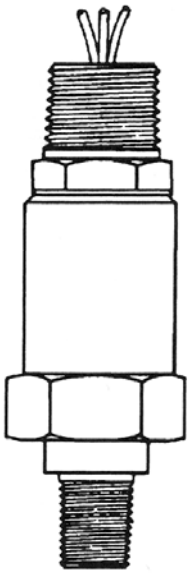
COMPONENTS SUPPLIED

(1) Pressure Switch - Custom Control Sensors, Inc., Model 6703 G 8001

Specifications

Rating - NEMA4
¼ - 18 NPT Pressure Port
½ - 14 NPT Conduit Connection
18" Free Leads

Wetted Parts	* Aluminum * Polyimide * Buna N * Cadmium Plated Steel * 300SS
Trip Point - Preset at 10 PSIG (69 kPa) on increasing pressure	
Switch Element	* SPDT * 120/240 VAC * 50/60 Hz * 11 Amps
Ambient Temperature Range	-30° F to 160° F (-34° C - 71° C)



INSTRUCTION

1. Remove ¼" NPT pressure switch plug (408C) from bearing frame bell housing (Fig. 1).
2. Put suitable thread sealer on ¼" NPT threads on pressure switch and install switch in bell housing.
3. Mount a junction box near switch and run conduit to control room. Use flexible conduit from junction box to switch.
4. Wire switch to customer supplied monitoring system for either normally open (N.O.) or normally closed (N.C.) as shown (Fig. 1).

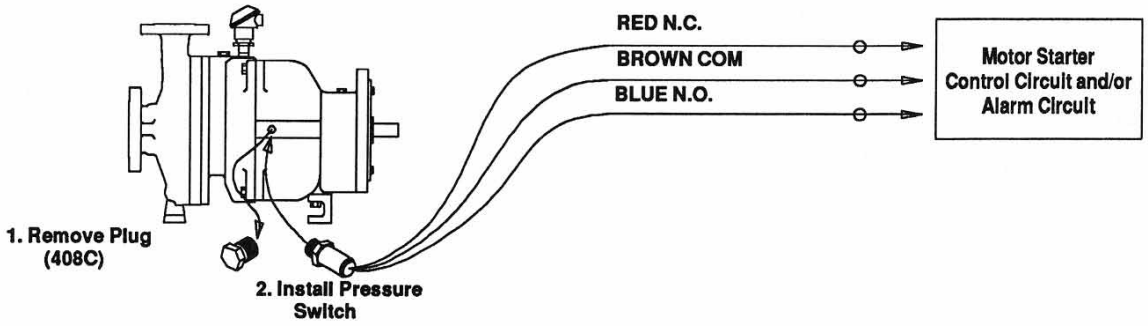


Figure 1

CONDITION MONITORING DEVICES

NEMA 7 Pressure Switch (Option)
Leak Detector

DESCRIPTION

This detector senses a leak in the containment shell by detecting pressure in the bearing frame bell housing. A pressure switch preset to trip at 10 PSIG on increasing pressure is supplied. The switch must be wired to the customer's monitoring system to sound an alarm and/or stop the pump. This liquid leak detector is identical in operation and function to the NEMA 4 pressure switch leak detector. The only difference is the NEMA rating. Recommended usage is also for volatile liquids.

LIMITATIONS

1. The total developed pressure of the pump plus suction pressure must be above 15 PSIG in order to have sufficient pressure in containment shell to trip switch should there be a leak.

CAUTION

This method of leak detection may not prevent release of pumpage to the atmosphere. It is possible that liquid could infiltrate bearing frame lubricating oil.

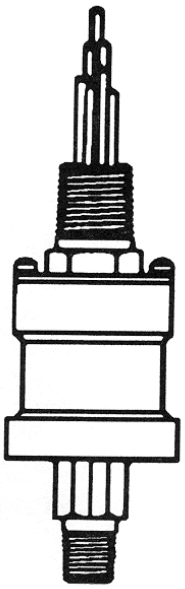
COMPONENTS SUPPLIED

(1) Pressure Switch - Custom Control Sensors, Inc., Model 511GCE1

Specifications

Rating - NEMA7 Explosion Proof: DIV 1,2
¼ - 18 NPT Pressure Port
½ - 14 NPT Conduit Connection
18" Free Leads

Wetted Parts	* 316SS
Trip Point - Preset at 10 PSIG (69 kPa) on increasing pressure	
Switch Element	* SPDT * 120/240 VAC * 50/60 Hz * 11 Amps
Ambient Temperature Range	-30° F to 160° F (-34° C - 71° C)



INSTRUCTION

1. Remove 1/4" NPT pressure switch plug (408C) from bearing frame bell housing (Fig. 2).
2. Put suitable thread sealer on 1/4" NPT threads on pressure switch and install switch in bell housing.
3. Mount a junction box near switch and run conduit to control room. Use flexible conduit from junction box to switch.
4. Wire switch to customer supplied monitoring system for either normally open (N.O.) or normally closed (N.C.) as shown (Fig. 2).

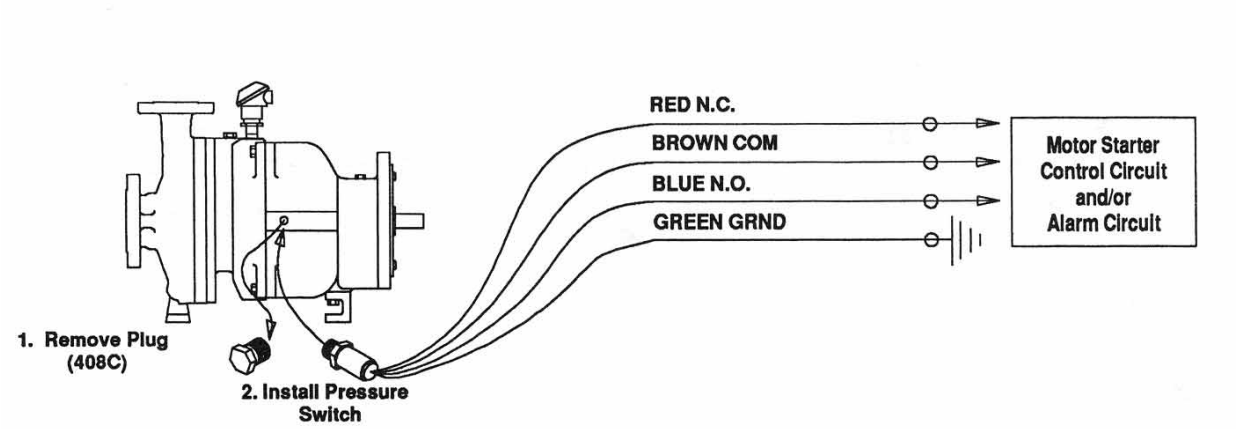


Figure 2

CONDITION MONITORING DEVICES

Vibration Monitor (Option)

DESCRIPTION

The vibration monitor senses the vibration signal from an accelerometer mounted on the pump bearing frame. The monitor has two fully adjustable set points and relays. Typically, one set point is used for an alarm and the second set point is used to stop the pump.

COMPONENTS SUPPLIED

(1) Vibration monitor with instructions
(1) Vibration transmitter (Accelerometer)

Specifications

Vibration Monitor

Make - Balmac Inc. Phone 614-876-1295
Model - 1112
Input - 4-20 milliamp 500 OHM load
Limits - Dual limit 0-100%
- Jumper selects either N.O. or N.C. operation
Limit Output - Relay 10 VAC max. 200VDC max. switching voltage
1.5A switching current
Time Delay - Adjustable (each limit) 1 to 7 secs.
Reset - Automatic or remote
Mute - Available, inhibits the relay operation with a
circuit closure between the "GND"
and "GND TO MUTE" terminals.
Power - 115 VAC
Weight - 13 ounces (369 grams)
Mounting - 0.156 diameter holes (4 places)
Temperature - 32° F to 120° F
Size - 6.0" x 5.1875" x 1.75"

Current Transformer

Make - Balmac
Model - 191
Vibration Range - Output 4 to 20 mA
Model - 191-1 – 0 to 1 in/sec
Frequency Range - 7 Hz to 1300 Hz -3 dB
Supply Voltage (Vs) - 8 to 50 Vdc, unregulated:
Black neg., red pos., with reverse voltage protection
Maximum Load - (R_L)50 (Vs-8) ohms
Resistance Isolation - 500 V, circuit-to-case
Electrical Connection - 2-wire, AWG #18, 24 in.
Temperature Range - -20° C to +100° C
Environment Rating - NEMA 4, weatherproof
Case Cadmium-plated steel
Mount - 1/2 in NPT thread
Conduit Connection - 1" NPT

MOUNTING LOCATION

It is recommended to mount monitor in a control room to avoid excessive shock, vibration, dirt, moisture and oil. The transmitter must be mounted on pump bearing frame, in hole provided. Run connecting wiring through conduit.

INSTRUCTION

1. After pump installation is complete, thread ½" NPT end of transmitter into hole provided in pump bearing frame (Fig. 3). Tighten until snug.

NOTE: Hole is predrilled on M Group. Hole is only predrilled on S Frames at the factory when Vibration Monitor System is ordered with the pump. The S Frame is scheduled to come from the factory predrilled in 1993.

2. Mount monitor in appropriate location.

3. Mount a junction box near transmitter and run conduit to monitor. Use flexible conduit from junction box to transmitter.

WARNING

Ensure electrical power is OFF until all connections are made and system is ready for operation.

4. Wire transmitter to monitor (Fig. 3).

5. Wire monitor to alarm circuit (Fig. 3).

NOTE: The design of the alarm and motor starter control circuits is the responsibility of the user.

6. Wire monitor to motor starter circuit (Fig. 3).

7. Wire rest for either automatic (Fig. 3) or remote (See Balmac, Inc. instruction).

8. If a relay mute is desired, wire according to Balmac, Inc. instructions.

9. Wire monitor to 120 VAC source (Fig. 3)

LIMIT SETTINGS

1. Limit 1 is intended to be an early warning to alert the operator of a potential problem. Set limit to trip at a vibration level 25% over the baseline. The baseline is the vibration level measured during operation of a new properly installed pump. If the baseline exceeds .3 in/sec., determine cause of vibration and correct. Set delay 1 to maximum delay (7 seconds) to avoid nuisance alarms that may occur during transient operation.

2. Limit 2 is intended to shut down the pump to prevent catastrophic failure. Set limit to trip at .5 in/sec. Set delay 2 to minimum delay (1 second) for quick shutdown response.

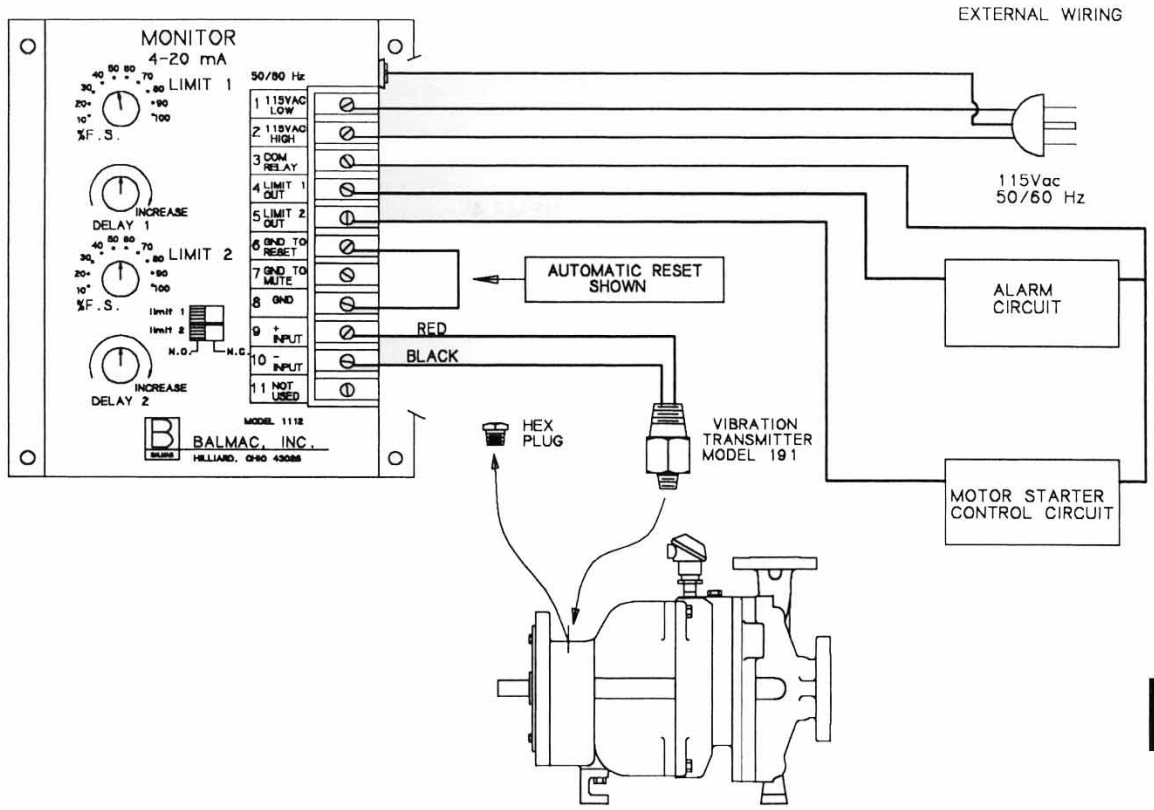

EXTERNAL WIRING
MONITOR
4-20 mA
LIMIT 1
LIMIT 2
%F.S.
INCREASE
DELAY 1
INCREASE
DELAY 2
50/60 Hz
1 115VAC LOW
2 115VAC HIGH
3 COM RELAY
4 LIMIT 1 OUT
5 LIMIT 2 OUT
6 GND TO RESET
7 GND TO MUTE
8 GND
9 + INPUT
10 - INPUT
11 NOT USED
MODEL 1112
BALMAC, INC.
HILLIARD, OHIO 43026
115Vac
50/60 Hz
AUTOMATIC RESET SHOWN
ALARM CIRCUIT
RED
BLACK
HEX PLUG
VIBRATION TRANSMITTER MODEL 191
MOTOR STARTER CONTROL CIRCUIT

Figure 3

8

CONDITION MONITORING DEVICES

Goulds Total Protection System (Option)

DESCRIPTION

The Goulds Total Protection System (GTP System) is a controller designed to protect the 3296 from damage that may occur due to abnormal operating conditions. Five input channels provide sensing capability for AC motor `current, containment shell temperature, vibration level, containment shell leakage and a system pressure switch. The controller will sound an alarm and/or shut down the pump if any of the system set points are exceeded.

COMPONENTS

Supplied with Unit

(1) GTP System Controller with (1) AC Current Sense Transformer and instructions		Part No.	A03792A

Available - Must be Ordered Separately

(1) Leak Detection Pressure Switch	- NEMA 4	Part No.	A03787A
	- NEMA 7	Part No.	A03788A
(1) Vibration Transmitter	- NEMA 4	Part No.	A05075A
	- NEMA 7	Not Available	

NOTE: To attain a NEMA 7 rating on the vibration transmitter, a safety barrier is required to limit power to the unit. This specialized equipment is beyond the scope of Goulds' supply and responsibility. Contact Balmac, Inc. 614-876-1295 for further information.

Not Supplied

System Pressure Switch - This must be supplied by the customer due to the diversity of requirements such as pressure range and materials of construction.

SPECIFICATIONS

GTP Controller and AC Current Transformer - Keytron, Inc., Model K1000

Input Power	120/240 VAC, 50/60 Hz, 6 VA
AC Current Sense Range	0.2 to 20, 2 to 200 and 20 to 300 Amp
Type AC Current Sensor	Toroidal transformer
AC Current Adjustments	Overcurrent and undercurrent setpoint
AC Sense Accuracy	± 3% (proportional and fixed errors).
Temperature Input interference	Switchbale between thermocouple and RTD
Temperature Control	Setpoint.
Temperature Display Range	0° to 2000°C. Actual range depends on type sensor used.
4 to 20 mA Display Range	0-1, 0 to 10, 0 to 100.
4 to 20 mA Controls	Set point and Span.
Auxiliary Inputs (2)	Momentary opening of sensor switch contacts will trigger and set latch.
Switches	a. 120/240 AC Line Select
	b. AC Current Range
	c. Therm/RED Select
	d. 4-20 mA Meter Decimal Select.
	e. Hi/Lo AC Threshold Select.
	f. Relay OFF/ON.
	g. Auto Reset OFF/ON.
Alarm & Control Relay Contacts	NC, 5.0 amps resistive, 240 VAC.
Alarm Circuit	Alarm relay contacts will open if AC power to the K1000 or internal supply fails
Start Delay	10 Seconds (for inrush current)
DC Supply for External Sensors	15 Volts DC, 50 ma regulated
Reset	Front panel pushbutton switch, or remotely from K1000 terminal block.
Auto-Reset	Selectable, effective on undercurrent mode only. One minute delay.
Panel Meter	3 ½ digit LCD type meter
Indicators	6 LED red status indicators, which flash in the on state, and one green AC Line indicator.
Enclosure	Molded polyester fiberglass, NEMA-4X UL and CSA approved.
Enclosure Size and Mounting Dim.	6" x 6" x 4", 6.94" x 4.00"
Line Protection	Transient suppressor
Operating Temperature Range	-25 to +55° C.

Leak Detection Pressure Switch -
NEMA 4 - Custom Control Sensors, Inc., Model G 8001, REF Instruction D.
NEMA 7 - Custom Control Sensors, Inc., Model 611GCE1, REF Instruction E.

Vibration Transmitter
NEMA 4 - Balmac, Inc., Model 191, REF Instruction F.

SET UP INSTRUCTIONS

The following are setup instructions which, along with the GTP System instruction manual, will guide you through the proper setup and operation of the total protection package.

Mounting Location

The Goulds Total Protection System can be located most non-hazardous plant locations where a NEMA 4X enclosure is appropriate. If a NEMA 7 enclosure is required, the GTP Controller should be mounted in a separate NEMA 7 enclosure, such as a junction box, that is supplied by the customer. It should be in an area that is convenient to view, monitor and make adjustments. It should also be mounted near the starter to simplify wiring to the AC current sense transformer and to the motor starter control circuit. Note that if the starter control transformer secondary voltage is 120 VAC ro 240 VAC, the GTP System can be wired to it because of its low power requirement (6 VA).

The current transformer should be mounted in the starter on one of the legs of the power cable between the starter contacts and the motor. The cable is passed through the current transformer once if AC current range switch is set at 200 or 300. Route the cable through the sense transformer 4 times if the range switch is set at 20 (Total of 5 lines through transformer window) Refer to current settings for appropriate switch setting.

Wiring

To prevent personal injuries, follow the INSTALLATION WARNING instructions in the GTP system instruction manual when wiring the GTP controller to the starter, current transformer, thermocouple and auxiliary sensor. Be sure to route power and sensor wiring in different conduit runs and have each cable properly grounded.

Alarm Level Settings

Follow the ADJUSTMENT PROCEDURE section of the GTP system instruction manual when making adjustments to the threshold levels for the temperature and current and the delay control adjustments. This instruction covers the levels required to properly protect the 3296 pump and avoid nuisance trips and alarms as follows:

Current Settings

The GTP System protects the 3296 from dry running, low flow, magnet decoupling and AC motor overload by monitoring both under current and over current.

Dry Running Protection

To protect against dry running the pump, the current level measurements of the motor uncoupled as well as with the 3196 pump running at shutoff are needed. Although these values can be calculated from the motor manufacturer's data for no load motor current and the horsepower from the pump performance curve, it is best to obtain them during the initial installation and startup of the motor and pump using the GTP system. While operating the motor uncoupled the current level is obtained directly from the GTP System panel meter, with the selection switch set at "AC Level." With the pump coupled, started and stabilized, reduce pump flow to zero and read the current level from the meter. **(CAUTION: DO NOT OPERATE THE PUMP AT ZERO FLOW FOR LONGER THAN 1 MINUTE)**. Set the under current threshold level to the average of these two current values (REF GTP system manual) adjustment procedure, Step 2).

Low Flow Protection

To protect against low flow operation of the pump, set the pump to the minimum flow desired (refer to Goulds Supplemental Engineering Data 725.9A108 for minimum flow for 3296 pumps), read the current level on the meter and set this current level for the under current threshold (REF GTP system manual adjustment procedure, Step 2).

Magnetic Decoupling and Motor Overload Protection

Set the over current threshold level to prevent magnetic decoupling of the 3296 pump or over current operation of the motor, depending on which threshold is lower. Refer to the pump performance curve and note the maximum drive power listed. Calculate the current draw for the HP on the motor selected to drive the pump. This is the over current threshold level to set for preventing decoupling. If this level exceeds the full load current of the motor, use the motor full load current value as the threshold level. This will protect the motor from over current operation as well as magnetic decoupling of the pump (REF GTP system manual adjustment procedure, Step 3).

High Temperature Protection

The temperature circuit monitors the containment shell skin temperature and shuts down the pump once a predetermined temperature level is reached. The temperature set point should be adjusted to alarm at a temperature of 30° F (17° C) above the anticipated pumpage temperature (for most applications) or should be set at a temperature predetermined to cause a pump problem due to the unique characteristics of the liquid being pumped (problems such as recirculation, liquid vaporization or polymerization). This set point should not exceed the maximum continuous operating temperature for the magnetic material supplied in the pump. If neodymium magnets were supplied the maximum temperature set point is 125 C (250° F). For Samarium Cobalt magnets, the maximum temperature set point is 220° C (428° F). (REF GTP system manual adjustment procedure, Step 4).

Vibration Transmitter (Optional)

The vibration monitor circuit detects vibration and shuts down the pump once a predetermined vibration level is reached. (REF 3296 instruction F). With the meter selector switch set to "VIBRA LEVEL" (Vibration Level), the vibration reading in IN/SEC is displayed on the meter.

The transmitter is not installed at the factory in order to minimize the risk of shipping damage. It, therefore, must be installed by the user - refer to Vibration Monitor Option in this manual as shown.

Adjust meter span to read the desired full scale reading, usually 1.00 (Refer to GTP system manual adjustment procedure Steps 5 and 6). Adjust the decimal select switch as required to make this adjustment.

Set the limit to trip at a vibration level 50% higher than the baseline vibration, but not to exceed .5 IN/SEC. The baseline is the vibration level shown on the monitor during operation of a new properly installed pump. If the baseline exceeds .3 IN/SEC, determine cause of vibration and correct.

NOTE: This is an analogue 4-20 mA circuit and is, therefore, compatible with any sensor that produces a 4-20 mA signal. If the vibration transmitter is not purchased, this circuit is available to the user to measure another parameter as desired. Be sure to relabel face of GTP controller to reflect new function.

Liquid Leak Detector (Optional)

This detector senses a leak in the containment shell by detecting pressure in the bearing frame bell housing. A pressure switch preset to trip at 10 PSIG on increasing pressure is supplied. Two pressure switches are available, NEMA 4 and NEMA7. (REF 3296 pressure switch leak detector options in this manual)..

The switch is not installed at the factory in order to minimize the risk of shipping damage. It, therefore, must be installed by the user - Again, refer to the pressure switch section.

For the NEMA 4 switch, connect the wire labeled "common" to terminal No. 9 on the GTP System controller and the wire labeled "N.O." (Normally Open) to terminal No. 14. The N.C. (Normally Closed) wire is not used and must be taped. For the NEMA 7 switch, connect in the same way except, in addition, run the green wire to ground per applicable electrical codes.

System Pressure

This circuit, if utilized, shuts down the pump if it is operating dry or at too low a suction pressure. A user supplied pressure switch monitoring pressure in either the discharge or the suction pipe is required. This switch is not available through Goulds due to the diversity in pressure, materials of construction and connection sizes.

Dry Running Protection

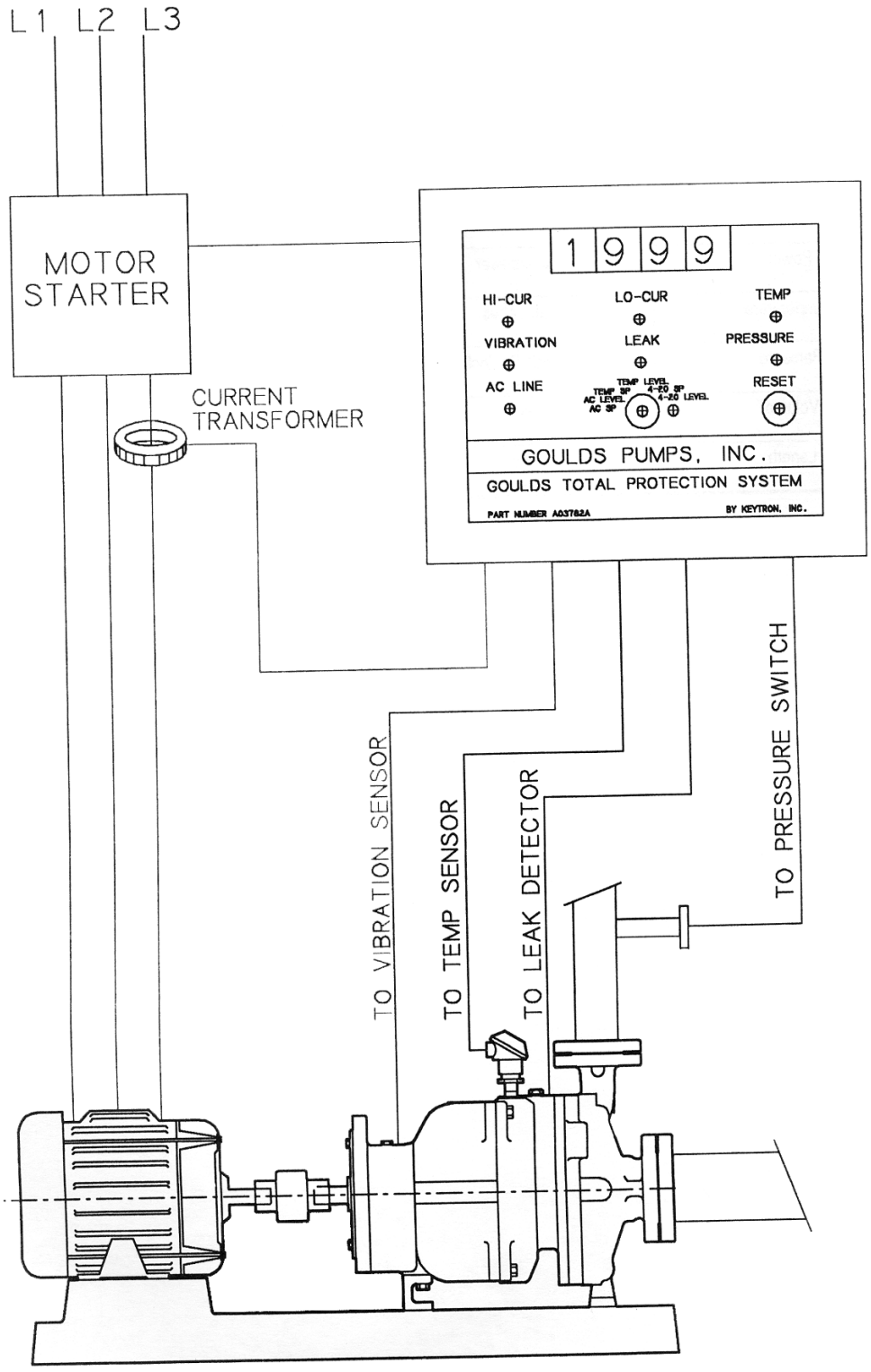
A pressure switch monitoring the pressure in the discharge pipe senses low pressure, indicating a loss of prime or operation at too high a flow. Switch should be normally closed, SPDT, adjustable set point, trigger on decreasing pressure, capable of system pressure, compatible with pumpage and compatible with plant environment. Adjust set point to trigger at 2 PSI below the lowest discharge pressure reading attained during normal operation. Connect wiring to terminal 15, common and ground as required.

Low Suction Pressure Protection

A pressure switch monitoring the pressure in the suction pipe senses low pressure, indicating low tank level, clogged suction screen, or closed suction valve. The switch should be normally closed, SDPT, adjustable set point, trigger on decreasing pressure, capable of system pressure, compatible with environment. Adjust set point to trigger at 1 PSI below the lowest pressure reading attained during normal operation. Ensure NPSH requirements of pump are met under these conditions. Note that suction pressure detection alone does not in itself monitor NPSH available to pump. Connect wiring to terminals 15, common and ground as required.

NOTE: If the Liquid Leak Detector and/or the System Pressure Monitors are not used, terminals 14 and/or 15 are available for use with any latched type switch. A temperature switch or vibration switch could also be utilized to satisfy a particular user's need. Be sure to relabel face of GTP controller to reflect new function.

NOTE: If these terminals, 14 and 15, are not used, they must be shorted to common in order for the GTP System to operate properly.


L1 L2 L3
MOTOR STARTER
CURRENT TRANSFORMER
1999
HI-CUR
LO-CUR
TEMP
VIBRATION
LEAK
PRESSURE
AC LINE
RESET
GOULDS PUMPS, INC.
GOULDS TOTAL PROTECTION SYSTEM
PART NUMBER A03782A
BY KEYTRON, INC.
TO VIBRATION SENSOR
TO TEMP SENSOR
TO LEAK DETECTOR
TO PRESSURE SWITCH

METRIC CONVERSIONS

Measurement	English	Metric	Conversion
Capacity	Gallons/Minute (GPM)	Cubic Meter/Hour (mH	GPM x 0.2271 = m/H
Head	Feet (ft)	Meters (m)	Ft x 0.3048 =m
Power	Horsepower (HP)	Kilowatts (kw)	HP x 0.746 = kw
Temperature	Fahrenheit (°F)	Celsius (°C)	(°F-32) x 0.556 = °C
Pressure	Pounds/Sq. Inch (PSI)	Kilograms/Sq.Centimeter (kg/cm)	PSI x 0.0703 =kg/cm
Volume	Gallons (G)	Cubic Meters (m)	G x 0.003785 = m
Length	Inch (in)	Milimeters (mm)	in x 25.4 = mm

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