

**INSTALLATION, OPERATION,  
AND MAINTENANCE MANUAL**  
WITH PARTS LIST



**SUPER T SERIES® PUMP**

MODEL
<b>T10A60S-6068T</b>

**GORMAN-RUPP PUMPS**

[www.grpumps.com](http://www.grpumps.com)

Register your new  
Gorman-Rupp pump online at  
**www.grpumps.com**

Valid serial number and e-mail address required.



**The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.**

### **RECORD YOUR PUMP MODEL AND SERIAL NUMBER**

Please record your pump model and serial number in the spaces provided below. Your Gorman-Rupp distributor needs this information when you require parts or service.

Pump Model: \_\_\_\_\_

Serial Number: \_\_\_\_\_

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## INTRODUCTION

**Thank You** for purchasing a Gorman-Rupp pump. **Read this manual** carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for every aspect of each specific application. Therefore, it is the responsibility of the owner/installer of the pump to ensure that applications not addressed in this manual are performed **only** after establishing that neither operator safety nor pump integrity are compromised by the installation. Pumps and related equipment **must** be installed and operated according to all national, local and industry standards.

If there are any questions regarding the pump or its application which are not covered in this manual or in other literature accompanying this unit, please contact your Gorman-Rupp distributor, or The Gorman-Rupp Company:

**The Gorman-Rupp Company**  
P.O. Box 1217  
Mansfield, Ohio 44901—1217  
Phone: (419) 755—1011  
or:  
**Gorman-Rupp of Canada Limited**  
70 Burwell Road  
St. Thomas, Ontario N5P 3R7  
Phone: (519) 631—2870

For information or technical assistance on the power source, contact the power source manufacturer's local dealer or representative.

## HAZARD AND INSTRUCTION DEFINITIONS

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:



**Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.**



**Hazards or unsafe practices which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury which could result from failure to follow the procedure.**



Hazards or unsafe practices which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage which could result from failure to follow the procedure.

### NOTE

*Instructions to aid in installation, operation, and maintenance or which clarify a procedure.*

## SAFETY - SECTION A

This information applies to Super T Series engine driven pumps. Refer to the manual accompanying the engine before attempting to begin operation.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for each specific application. Therefore, it is the owner/installer's responsibility to ensure that applications not addressed in this manual are performed only after establishing that neither operator safety nor pump integrity are compromised by the installation.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Switch off the engine ignition and disconnect the positive battery cable to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



This pump is equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect

the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.



This pump is designed to handle dirty water containing specified entrained solids. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.



This pump may be used to handle materials which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.



Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be damaged when lifting. Suction and discharge hoses and piping must be removed from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.



After the unit has been installed, make certain that the pump and all piping or

hose connections are tight, properly supported and secure before operation.



Do not operate the pump without the guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.



Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to cool before servicing.



Do not operate the pump against a closed discharge valve for long periods of time. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.



Do not operate an internal combustion

engine in an explosive atmosphere. When operating internal combustion engines in an enclosed area, make certain that exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless, and odorless.



Fuel used by internal combustion engines presents an extreme explosion and fire hazard. Make certain that all fuel lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel tank. Always use the correct type of fuel.



Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the performance curve, page E-1, for the maximum continuous operating speed for this pump.



Pumps and related equipment must be installed and operated according to all national, local and industry standards.

## INSTALLATION – SECTION B

### Review all SAFETY information in Section A.

Since pump installations are seldom identical, this section offers only general recommendations and practices required to inspect, position, and arrange the pump and piping.

Most of the information pertains to a standard **static lift** application where the pump is positioned above the free level of liquid to be pumped.

If installed in a **flooded suction application** where the liquid is supplied to the pump under pressure, some of the information such as mounting, line configuration, and priming must be tailored to the

specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to 50% of the maximum permissible operating pressure as shown on the pump performance curve.

For further assistance, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

### Pump Dimensions

See Figure 1 for the approximate physical dimensions of this pump.

### OUTLINE DRAWING

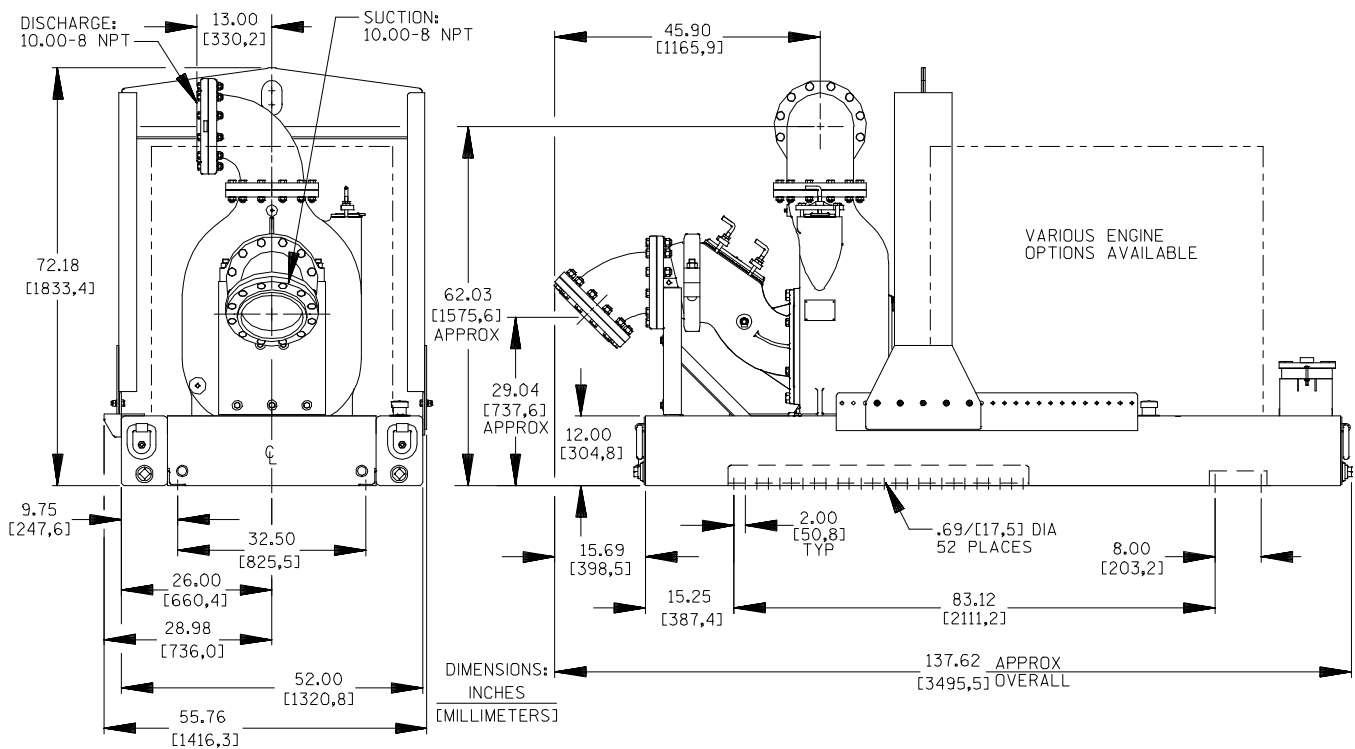


Figure 1. Pump Model T10A60S-6068T

### PREINSTALLATION INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, inspect the pump for damage which may have occurred during shipment. Check as follows:

- a. Inspect the pump assembly for cracks, dents, damaged threads, and other obvious damage.
- b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after dry-

ing, check for loose hardware at mating surfaces.

- c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated.
- d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **MAINTENANCE AND REPAIR** section of this manual and perform duties as instructed.
- e. If the pump and engine have been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected or replaced** to ensure maximum pump service.

If the maximum shelf life has been exceeded, or if anything appears to be abnormal, contact your Gorman-Rupp distributor or the factory to determine the repair or updating policy. **Do not** put the pump into service until appropriate action has been taken.

**Battery Specifications And Installation**

Unless otherwise specified on the pump order, the engine battery was **not** included with the unit. Refer to the following specifications when selecting a battery.

**Table 1. Battery Specifications**

Voltage	Cold Crank Amps @ 0° F	Reserve Capacity @ 80° F (Minutes)	Amp/ Hr. Rating	Approx. Overall Dims. (Inches)
12 Volts	850	120	75	10.25L x 6.75W x 8.88H

Refer to the information accompanying the battery and/or electrolyte solution for activation and charging instructions.

Before installing the battery, clean the positive and negative cable connectors, and the battery terminals. Secure the battery by tightening the holddown brackets. The terminals and clamps may be coated with petroleum jelly to retard corro-

sion. Connect and tighten the positive cable first, then the negative cable.

**POSITIONING PUMP**



**Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be damaged when lifting. Suction and discharge hoses and piping must be removed from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.**

**Lifting**

Pump unit weights will vary depending on the mounting and drive provided. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Drain the pump and remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.

**Mounting**

Locate the pump in an accessible place as close as practical to the liquid being pumped. Level mounting is essential for proper operation.

The pump may have to be supported or shimmed to provide for level operation or to eliminate vibration.

If the pump has been mounted on a moveable base, make certain the base is stationary by setting the brake and blocking the wheels before attempting to operate the pump.

To ensure sufficient lubrication and fuel supply to the engine, **do not** position the pump and engine

more than 15° off horizontal for continuous operation. The pump and engine may be positioned up to 30° off horizontal for **intermittent operation only**; however, the engine manufacturer should be consulted for continuous operation at angles greater than 15°.

### Clearance

When positioning the pump, allow a minimum clearance of **18 inches (457,2 mm)** in front of the back cover to permit removal of the cover and easy access to the pump interior.

## SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See the performance curve and notes on Page E-1 to be sure your overall application allows pump to operate within the safe operation range.

### Materials

Either pipe or hose maybe used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. If hose is used in suction lines, it must be the rigid-wall, reinforced type to prevent collapse under suction. Using piping couplings in suction lines is not recommended.

### Line Configuration

Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss.

### Connections to Pump

Before tightening a connecting flange, align it exactly with the pump port. Never pull a pipe line into place by tightening the flange bolts and/or couplings.

Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration, decreased bearing life,

and increased shaft and seal wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

### Gauges

Most pumps are drilled and tapped for installing discharge pressure and vacuum suction gauges. If these gauges are desired for pumps that are not tapped, drill and tap the suction and discharge lines not less than 18 inches (457,2 mm) from the suction and discharge ports and install the lines. Installation closer to the pump may result in erratic readings.

## SUCTION LINES

To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

### Fittings

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost to avoid creating air pockets. Valves are not normally used in suction lines, but if a valve is used, install it with the stem horizontal to avoid air pockets.

### Strainers

If a strainer is furnished with the pump, be certain to use it; any spherical solids which pass through a strainer furnished with the pump will also pass through the pump itself.

If a strainer is not furnished with the pump, but is installed by the pump user, make certain that the total area of the openings in the strainer is at least three or four times the cross section of the suction line, and that the openings will not permit passage of solids larger than the solids handling capability of the pump.

This pump is designed to handle up to 3-inch (76,2 mm) diameter spherical solids.

### Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an air-tight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

### Suction Lines In Sumps

If a single suction line is installed in a sump, it should be positioned away from the wall of the sump at a distance equal to 1 1/2 times the diameter of the suction line.

If there is a liquid flow from an open pipe into the sump, the flow should be kept away from the suction inlet because the inflow will carry air down into the sump, and air entering the suction line will reduce pump efficiency.

If it is necessary to position inflow close to the suction inlet, install a baffle between the inflow and the

suction inlet at a distance 1-1/2 times the diameter of the suction pipe. The baffle will allow entrained air to escape from the liquid before it is drawn into the suction inlet.

If two suction lines are installed in a single sump, the flow paths may interact, reducing the efficiency of one or both pumps. To avoid this, position the suction inlets so that they are separated by a distance equal to at least 3 times the diameter of the suction pipe.

### Suction Line Positioning

The depth of submergence of the suction line is critical to efficient pump operation. Figure 2 shows recommended minimum submergence vs. velocity.

#### NOTE

*The pipe submergence required may be reduced by installing a standard pipe increaser fitting at the end of the suction line. The larger opening size will reduce the inlet velocity. Calculate the required submergence using the following formula based on the increased opening size (area or diameter).*

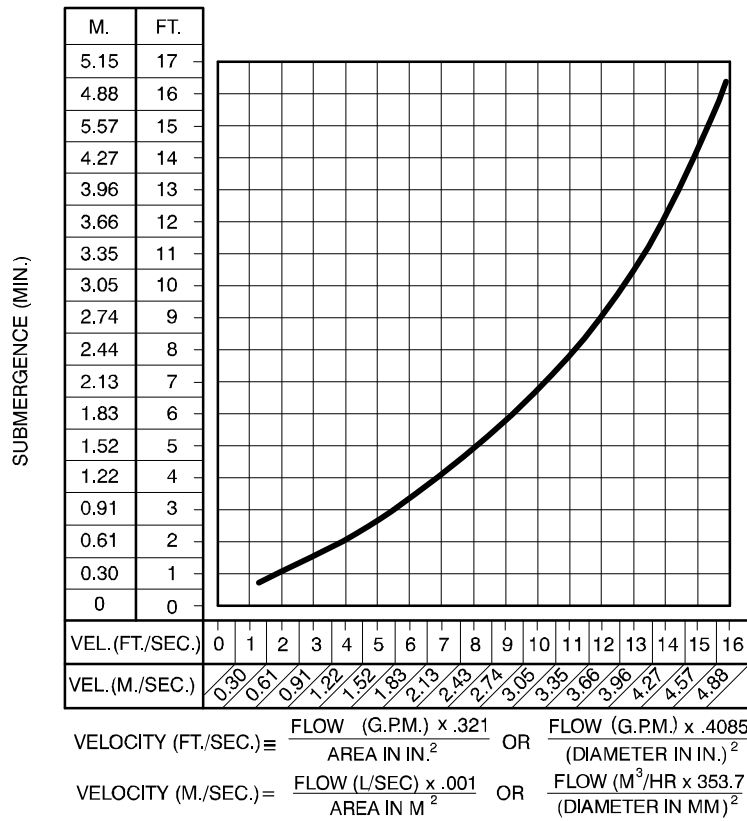


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

**FLOAT SWITCHES**

**Installation**

The standard pump is equipped with an auto-start control system, and can be conformed to start and stop as the liquid level in the wet well or sump rises and falls. The autostart unit employs either a single or double float switch system, where a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch. The floats are equipped with a socket type connector that plugs into a matching receptacle on the auto-start control box.

Standard floats are equipped with 50 feet (15,2 m) of cable.

When installing the floats, note the following:

- a. **Be sure** to provide sufficient room in the wet well or sump so that floats do not get obstructed or drawn into the suction line. If a flexible suction hose is used, it may be extended to lay along the bottom of the wet well or sump and the float can be attached to the hose

above the point where it bends along the bottom. Direct the suction line toward the flow, and the float(s) away from the flow. If a standpipe is available, attach the float switch cable to the standpipe in the sump at the approximate desired liquid level.

- b. In a single float system, the cable can be tethered to the suction line or standpipe approximately 6 inches (152 mm) above the float. This setting allows approximately 9 inches (229 mm) of liquid rise between pump start/stop. The start/stop interval may be increased by extending the float end of the cable. The liquid level in the sump will increase approximately 8 inches (203 mm) between start/stop intervals for every 6 inches (152 mm) of cable increase.
- c. If a double float switch system is used, position the “Start” float at the desired high water level in the sump, and the “Stop” float at the desired low water level in the pump.
- d. Refer to Figure 3 for additional float switch data.

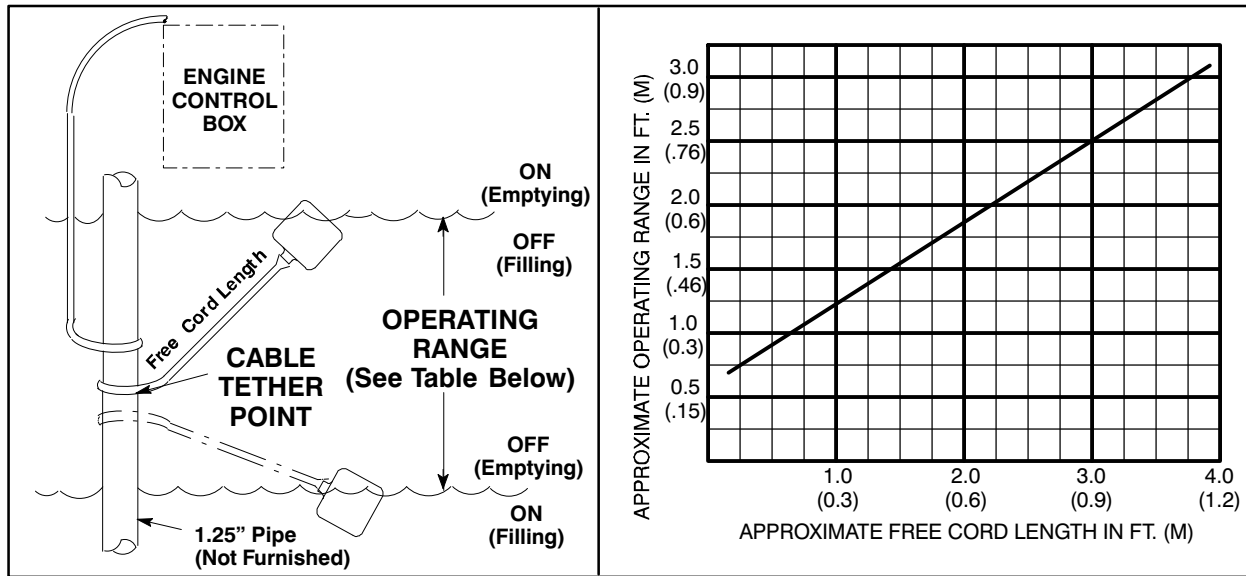


Figure 3. Float Switch Data

**OPTIONAL SUBMERSIBLE TRANSDUCER**

This unit may be equipped with an optional Electronic Pressure Switch (EPS) that works in conjunction with a submersible transducer. The submersible transducer converts pressure to an electrical signal proportional to liquid level. This electrical signal is distributed to the digital display on the EPS through a scaling circuit which converts the electrical signal to “feet of water”.

When installing the submersible transducer, note the following:

- a. Handle the signal cable and transducer with care during installation. **Carefully** lower the transducer into the wet well or sump; **do not** drop it to the bottom. To avoid clogging, suspend the transducer off the bottom.
- b. **Be sure** to provide sufficient room in the wet well or sump so that the transducer does not get drawn into the suction line. To prevent this, a flexible suction hose may be extended to lay along the bottom of the wet well or sump. The transducer can then be attached to the hose

above the point where it bends along the bottom. See Figure B-4 for a typical installation.

- c. The wet well or sump must be vented to atmosphere.
- d. The EPS is scaled in feet of water column. If the measured medium is other than 1.0 specific gravity, the reading on the EPS should be divided by the specific gravity of the measured medium to obtain the actual level.
- e. **Thoroughly** clean the transducer after each use to prevent clogging.



**Do not** disassemble the transducer or loosen the compression nut at the signal cable entry. **This will void warranty.** There are no user-serviceable parts inside. Do not nick or cut the jacket of the signal cable; this will cause leakage and **void warranty.**

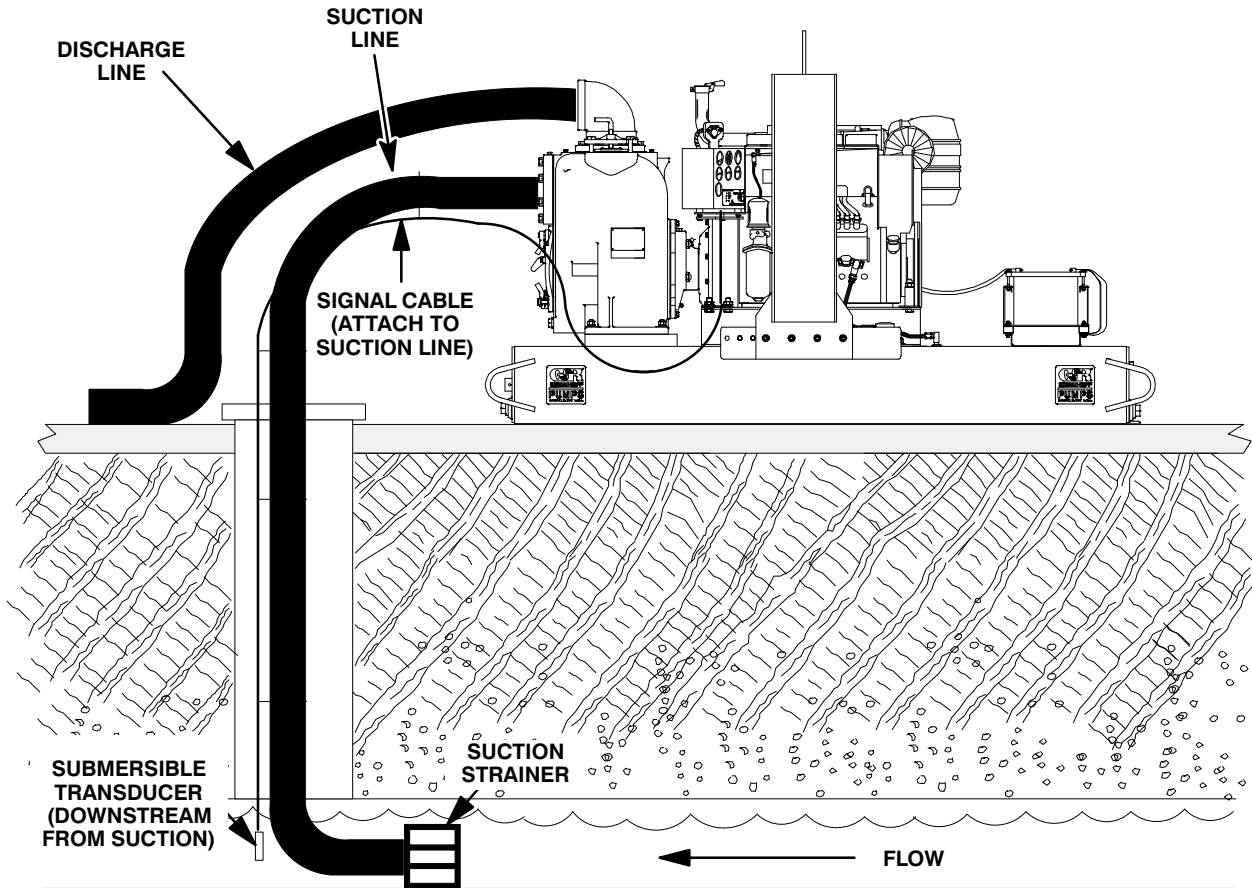


Figure 4. Typical Submersible Transducer Installation

**DISCHARGE LINES**

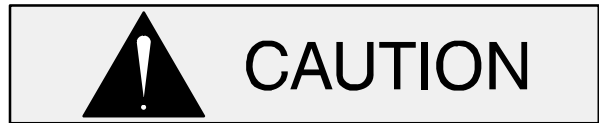
**Siphoning**

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action causing damage to the pump could result.

**Valves**

If a throttling valve is desired in the discharge line, use a valve as large as the largest pipe to minimize friction losses. Never install a throttling valve in a suction line.

With high discharge heads, it is recommended that a throttling valve and a system check valve be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.



If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

**Bypass Lines**

Self-priming pumps are not air compressors. During the priming cycle, air from the suction line must be vented to atmosphere on the discharge side. If the discharge line is open, this air will be vented through the discharge. However, if a check valve has been installed in the discharge line, the discharge side of the pump must be opened to atmospheric pressure through a bypass line installed between the pump discharge and the check valve. A self-priming centrifugal pump **will not prime** if there is sufficient static liquid head to hold the discharge check valve closed.

**NOTE**

*The bypass line should be sized so that it does not*

affect pump discharge capacity; however, the bypass line should be at least 1 inch (25,4 mm) in diameter to minimize the chance of plugging.

In **low discharge head applications** (less than 30 feet (9,1 m)), it is recommended that the bypass line be run back to the wet well, and located 6 inches below the water level or cut-off point of the low level pump. In some installations, this bypass outline may be terminated with a six-to-eight foot (1,8 to 2,4 m) length of 1-1/4 inch (31,8 mm) I.D. **smooth-bore** hose; air and liquid vented during the priming process will then agitate the hose and break up any solids, grease, or other substances likely to cause clogging.

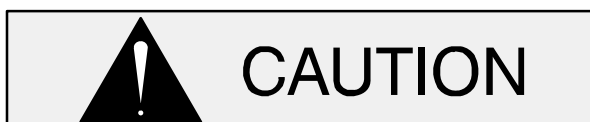


A bypass line that is returned to a wet well must be secured against being drawn into the pump suction inlet.

It is also recommended that pipe unions be installed at each 90° elbow in a bypass line to ease disassembly and maintenance.

In **high discharge head applications** (more than 30 feet (9,1 m)), an excessive amount of liquid may be bypassed and forced back to the wet well under the full working pressure of the pump; this will reduce overall pumping efficiency. **Therefore, it is recommended that a Gorman-Rupp Automatic Air Release Valve be installed in the bypass line.**

Gorman-Rupp Automatic Air Release Valves are reliable, and require minimum maintenance. See **Automatic Air Release Valves** in this section for installation and theory of operation of the Automatic Air Release Valve. Consult your Gorman-Rupp distributor, or contact the Gorman-Rupp Company for selection of an Automatic Air Release Valve to fit your application.



Except in certain specific applications (to prevent flooding during service of an automatic air release valve in a below-ground

lift station), if a manual shut-off valve is installed **anywhere** in a bypass line, it **must** be a full-opening, **ball-type** valve to prevent plugging by solids.



**A manual shut-off valve should not be installed in any bypass line. A manual shut-off valve may inadvertently be left closed during operation. A pump which has lost prime may continue to operate without reaching prime, causing dangerous overheating and possible explosive rupture of the pump casing. Personnel could be severely injured.**

**Allow an over-heated pump to completely cool before servicing. Do not remove plates, covers, gauges, or fittings from an over-heated pump. Liquid within the pump can reach boiling temperatures, and vapor pressure within the pump can cause parts being disengaged to be ejected with great force. After the pump completely cools, drain the liquid from the pump by removing the casing drain plug. Use caution when removing the plug to prevent injury to personnel from hot liquid.**

#### AUTOMATIC AIR RELEASE VALVE

When properly installed, a Gorman-Rupp Automatic Air Release Valve will permit air to escape through the bypass line and then close automatically when the pump is fully primed and pumping at full capacity.

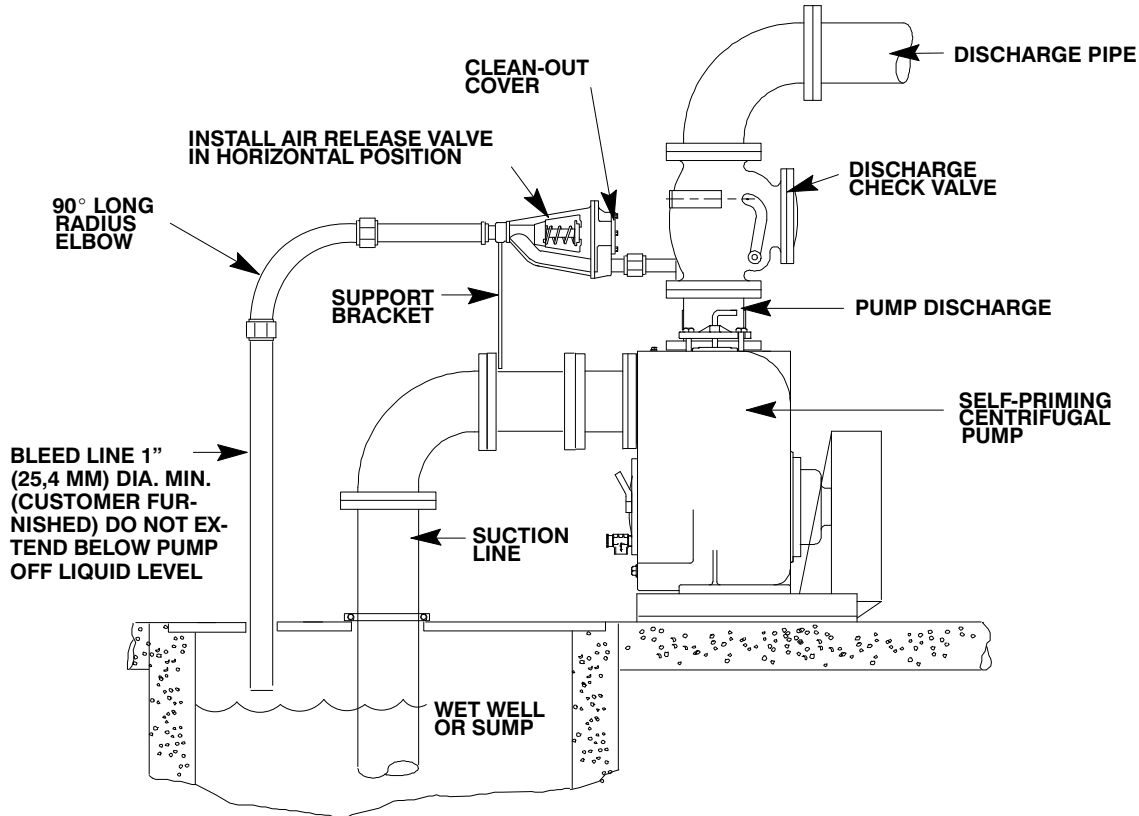


**Some leakage (1 to 5 gallons [3.8 to 19 liters] per minute) will occur when the valve is fully closed. Be sure the bypass line is directed back to the wet well or tank to prevent hazardous spills.**

Consult the manual accompanying the Air Release Valve for additional information on valve installation and performance.

**Air Release Valve Installation**

The Automatic Air Release Valve must be independently mounted in a horizontal position between the pump discharge port and the inlet side of the discharge check valve (see Figure 5). The inlet opening in the Air Release Valve is equipped with standard 1-inch NPT pipe threads.



**Figure 5. Typical Automatic Air Release Valve Installation**

Connect the valve outlet to a bleed line which slopes back to the wet well or sump. The bleed line must be the same size as the outlet opening or larger, depending on which Air Release Valve is being used. If **pipng** is used for the bleed line, avoid the use of elbows whenever possible.

*fold pipe. Contact your Gorman-Rupp distributor or the Gorman-Rupp Company for information about installation of an Automatic Air Release Valve for your specific application.*

**NOTE**

*For multiple pump installations, it is recommended that each Air Release Valve be fitted with an independent bleeder line directed back to the wet well. If multiple Air Release Valves are installed in a system, **do not** direct bleeder lines to a common mani-*

**ALIGNMENT**

The alignment of the pump and the engine is critical for trouble-free mechanical operation. See Section E, **Securing Intermediate And Drive Assembly To Engine** for detailed information.

## OPERATION – SECTION C

### OPERATION

Review all SAFETY information in Section A.

Follow the instructions on all tags, labels and decals attached to the pump.



Do not operate an internal combustion engine in an explosive atmosphere. When operating an internal combustion engine in an enclosed area, make sure exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless and odorless.



This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids and corrosives. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.



Pump speed and operating condition points must be within the continuous performance range shown on the performance curve on page E-1.

### STARTING

Check the fuel level and oil levels in the engine, air compressor, pump bearings and seal housing.

Make sure the pump is level. Lower the jack stands and chock the wheels, if so equipped.



Make sure the pump is level. Lower jack stands and chock the wheels, if so equipped. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank.



This pump is equipped with automatic liquid level controls, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

Consult the engine operations manual before attempting to start the unit.

Consult the manual accompanying the engine control box and start the pump.

### PRIMING

Install the pump and piping as described in **INSTALLATION**. Make sure that the piping connections are tight, and that the pump is securely mounted. Check that the pump is properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

This pump is self-priming, but the pump should never be operated unless there is liquid in the pump casing.



Never operate this pump unless there is liquid in the pump casing. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.

Add liquid to the pump casing when:

1. The pump is being put into service for the first time.
2. The pump has not been used for a considerable length of time.
3. The liquid in the pump casing has evaporated.

Once the pump casing has been filled, the pump will prime and reprime as necessary.



**After filling the pump casing, reinstall and tighten the fill plug. Do not attempt to operate the pump unless all connecting piping is securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.**

To fill the pump, remove the pump casing fill cover or fill plug in the top of the casing, and add clean liquid until the casing is filled. Replace the fill cover or fill plug before operating the pump.

#### NOTE

*If the suction or discharge piping is open, a hose can be used to fill the casing through the piping.*

## ROUTINE OPERATION

Adjust the engine speed to achieve the desired output. Do not exceed the factory set engine speed and system operating pressure. Do not operate below the recommended operating speed (if applicable).



**Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the Performance Curve in Section E for the maximum**

## continuous operating speed for this pump.

A Gorman-Rupp automatic air release valve may be installed in a bypass line, or the bypass line may be left open.



**A manual shut-off valve should not be installed in any bypass line. A manual shut-off valve may inadvertently be left closed during operation. A pump which has lost prime may continue to operate without reaching prime, causing dangerous overheating and possible explosive rupture of the pump casing. Personnel could be severely injured.**

### Lines With a Bypass

If a Gorman-Rupp Automatic Air Release Valve has been installed, the valve will automatically open to allow the pump to prime, and automatically close after priming is complete (see **INSTALLATION** for Air Release Valve operation).

If the bypass line is open, air from the suction line will be discharged through the bypass line back to the wet well during the priming cycle. Liquid will then continue to circulate through the bypass line while the pump is in operation.

### Lines Without a Bypass

Open all valves in the discharge line and start the engine. Priming is indicated by a positive reading on the discharge pressure gauge or by a quieter operation. The pump may not prime immediately because the suction line must first fill with liquid. If the pump fails to prime within five minutes, stop it and check the suction line for leaks.

After the pump has been primed, partially close the discharge line throttling valve in order to fill the line slowly and guard against excessive shock pressure which could damage pipe ends, gaskets, sprinkler heads, and any other fixtures connected to the line. When the discharge line is completely filled, adjust the throttling valve to the required flow rate.

## OPERATION IN EXTREME HEAT

The safety shutdown system will automatically stop the unit if engine operating temperature exceeds design limits. If engine over-temperature shutdown occurs, allow the unit to cool before re-starting.

If engine overheating continues, check the engine lubricant level and viscosity. Consult the engine operation manual for the recommended lubricant for operation in extreme heat.

If the unit is being operated in the **automatic** mode, adjust the liquid level device(s) to allow shorter run and longer cooling periods, if possible.

## OPERATIONAL CHECKS

### Leakage

Once the pump is fully primed, no leakage should be visible at pump mating surfaces, or at pump connections or fittings. Keep all line connections and fittings tight to maintain maximum pump efficiency.

### Pump Vacuum Check

Read the vacuum gauge with the pump primed and at operation speed. Shut off the pump. The vacuum gauge reading will immediately drop proportionate to static suction lift, and should then stabilize. If the vacuum reading falls off rapidly after stabilization, an air leak exists. Before checking for the source of the leak, check the point of installation of the vacuum gauge.

### Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 160°F (71°C). Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump immediately and allow it to completely cool

before servicing it. **Approach any over-heated pump cautiously.**



**Allow an over-heated pump to completely cool before servicing. Do not remove plates, covers, gauges, or fittings from an overheated pump. Liquid within the pump can reach boiling temperatures, and vapor pressure within the pump can cause parts being disengaged to be ejected with great force. After the pump cools, drain the liquid from the pump by removing the casing drain plug. Use caution when removing the plug to prevent injury to personnel from hot liquid.**

### Strainer Check

Check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. Monitor and record the vacuum suction gauge readings regularly to detect strainer blockage.

**Never** introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown on the pump performance curve.

## STOPPING

### Manual Stopping

In the manual mode, reduce the throttle speed slowly, and allow the engine to idle briefly before turning the keyswitch to 'OFF'.



If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

## Automatic Stopping

In the automatic mode, the pump will stop when the liquid in the wet well or sump lowers and activates the “Off” liquid level device(s). The pump will restart automatically when the liquid rises and activates the “On” liquid level device(s).

## Safety Shutdown System

The unit is equipped with a safety system to automatically shut down the engine under certain conditions.

Displays on the control panel will indicate which of the safety features has caused the engine to shut down.

Should any of the safety features cause the engine to shut down, **the cause must be determined and corrected** before putting the unit back into service.

All safety shutdown features are pre-set at the factory for optimum performance and safety; **do not** attempt to adjust these settings.



**Never disconnect any of the safety shutdown features; this will void the warranty and could result in serious damage to the unit and/or injury to personnel. Safety shutdown features are pre-set at the factory; do not attempt to adjust any of the settings. Determine the cause of shutdown before putting the unit back into service. Consult the factory for additional information.**

## PERIODIC CHECKS

### Seal Cavity And Bearing Lubrication

Both the seal and bearing cavities were fully lubricated at the factory. Check the lubrication levels before startup, and regularly thereafter as indicated in Section E, **Maintenance and Repair**. When lubrication is required, use **only** SAE No. 30 non-detergent oil.

## Bearing Temperature Check

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160°F (71°C) are considered normal for bearings, and they can operate safely to at least 180°F (82°C).

Checking bearing temperatures by hand is inaccurate. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the housing. Record this temperature for future reference.

A sudden increase in bearing temperatures is a warning that the bearings are at the point of failing to operate properly. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see **LUBRICATION** in Section E, **Maintenance and Repair**). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

When pumps are first started, the bearings may seem to run at temperatures above normal. Continued operation should bring the temperatures down to normal levels.

## Engine Fuel Filter

Consult the manual accompanying the engine, and change the fuel filter periodically as indicated. If operated under extremely dusty and/or humid conditions, change the filter more frequently. Irregular performance and loss of power usually indicate a dirty fuel filter.

## Engine Oil

The engine was lubricated for test at the factory. However, **always** check the lubrication level before startup.

Consult the manual accompanying the engine, and change the oil filter periodically as indicated. If operated under extremely dusty conditions, change the filter more frequently.

## COLD WEATHER PRESERVATION

In below freezing conditions, drain the pump to prevent damage from freezing. Also, clean out any solids by flushing with a hose. Operate the pump

for approximately one minute; this will remove any remaining liquid that could freeze the pump rotating parts. If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, drain the pump, and flush it thoroughly with clean water. To prevent

large solids from clogging the drain port and preventing the pump from completely draining, insert a rod or stiff wire in the drain port, and agitate the liquid during the draining process. Clean out any remaining solids by flushing with a hose.

## TROUBLESHOOTING – SECTION D

Review all SAFETY information in Section A.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Shut down the engine and disconnect the positive battery cable to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.

5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



This pump is equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

**Table 1. Trouble Shooting Chart**

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Not enough liquid in casing.	Add liquid to casing. See <b>PRIMING</b> .
	Suction check valve contaminated or damaged.	Clean or replace check valve.
	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See <b>INSTALLATION</b> .
	Strainer clogged.	Check strainer and clean if necessary.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.

**Table 1. Trouble Shooting Chart (cont.)**

<b>TROUBLE</b>	<b>POSSIBLE CAUSE</b>	<b>PROBABLE REMEDY</b>
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.)	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Strainer clogged.	Check strainer and clean if necessary.
	Suction intake not submerged at proper level or sump too small.	Check installation and correct submergence as needed.
	Impeller or other wearing parts worn or damaged.	Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.
	Impeller clogged.	Free impeller of debris.
	Discharge head too high.	Install bypass line.
	Suction lift too high.	Measure lift w/vacuum gauge. Reduce lift and/or friction losses in suction line.
PUMP REQUIRES TOO MUCH POWER	Pump speed too slow.	Check engine output; consult engine operation manual.
	EPS limit switches set improperly or submersible transducer clogged.	Check EPS limit settings; check and clean submersible transducer.
	Pump speed too high.	Check engine output.
	Discharge head too low.	Adjust discharge valve.
PUMP CLOGS FREQUENTLY	Liquid solution too thick.	Dilute if possible.
	Bearing(s) frozen.	Disassemble pump and check bearing(s).
	Discharge flow too slow.	Open discharge valve fully to increase flow rate, and run engine at maximum governed speed.
EXCESSIVE NOISE	Suction check valve or foot valve clogged or binding.	Clean valve.
	Liquid solution too thick.	Dilute if possible.
	Cavitation in pump.	Reduce suction lift and/or friction losses in suction line. Record vacuum and pressure gauge readings and consult local representative or factory.
	Pumping entrained air.	Locate and eliminate source of air bubble.
	Pump or drive not securely mounted.	Secure mounting hardware.
	Impeller clogged or damaged.	Clean out debris; replace damaged parts.

**Table 1. Trouble Shooting Chart (cont.)**

<b>TROUBLE</b>	<b>POSSIBLE CAUSE</b>	<b>PROBABLE REMEDY</b>
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits.  Low or incorrect lubricant.  Suction and discharge lines not properly supported.  Drive misaligned.	Check bearing temperature regularly to monitor any increase.  Check for proper type and level of lubricant.  Check piping installation for proper support.  Align drive properly.

**PREVENTIVE MAINTENANCE**

Since pump applications are seldom identical, and pump wear is directly affected by such things as the abrasive qualities, pressure and temperature of the liquid being pumped, this section is intended only to provide general recommendations and practices for preventive maintenance. Regardless of the application however, following a routine preventive maintenance schedule will help assure trouble-free performance and long life from your Gorman-Rupp pump. For specific questions concerning your application, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Record keeping is an essential component of a good preventive maintenance program. Changes in suction and discharge gauge readings (if so

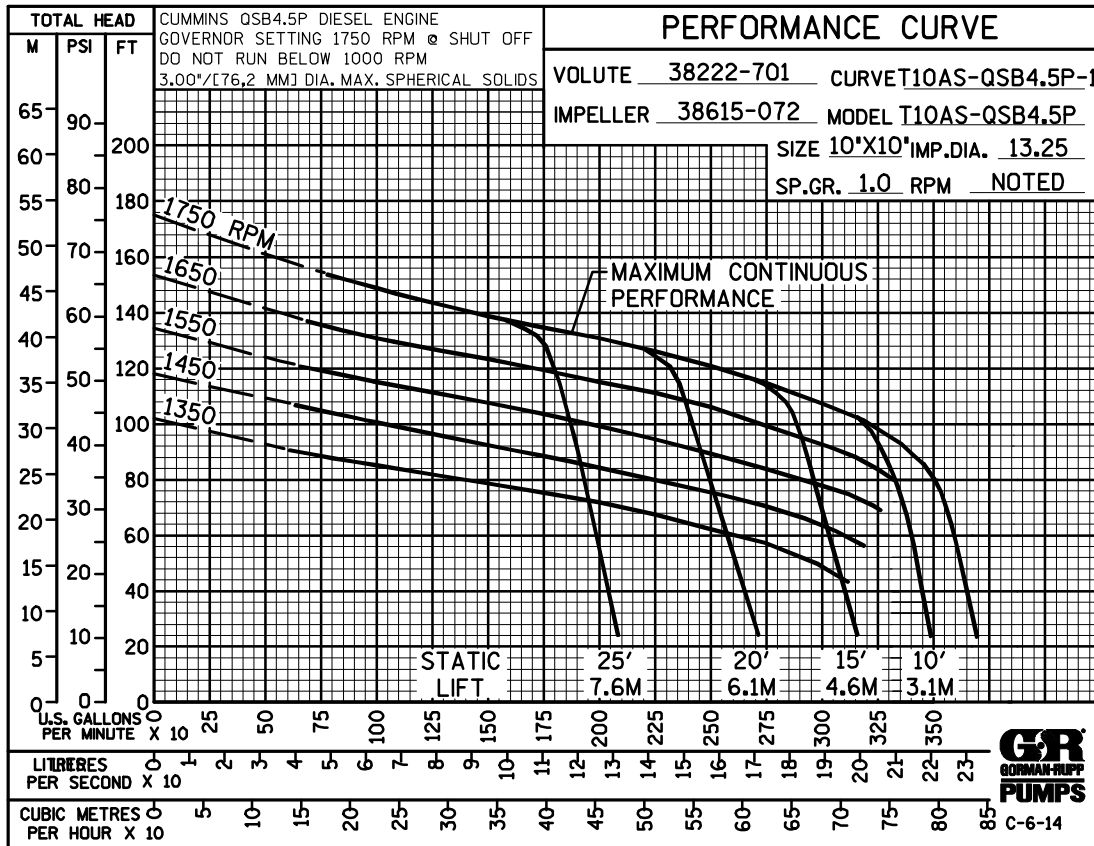
equipped) between regularly scheduled inspections can indicate problems that can be corrected before system damage or catastrophic failure occurs. The appearance of wearing parts should also be documented at each inspection for comparison as well. Also, if records indicate that a certain part (such as the seal) fails at approximately the same duty cycle, the part can be checked and replaced before failure occurs, reducing unscheduled down time.

For new applications, a first inspection of wearing parts at 250 hours will give insight into the wear rate for your particular application. Subsequent inspections should be performed at the intervals shown on the chart below. Critical applications should be inspected more frequently.

<b>Preventive Maintenance Schedule</b>					
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication (And Packing Adjustment, If So Equipped)		I			R
V-Belts (If So Equipped)			I		
Air Release Valve Plunger Rod (If So Equipped)			I	C	
Front Impeller Clearance (Wear Plate)				I	
Rear Impeller Clearance (Seal Plate)				I	
Check Valve					I
Pressure Relief Valve (If So Equipped)					C
Pump and Driver Alignment					I
Shaft Deflection					I
Bearings					I
Bearing Housing					I
Piping					I
Driver Lubrication – See Mfgr’s Literature					I
<p>Legend:                      I = Inspect, Clean, Adjust, Repair or Replace as Necessary                      C = Clean                      R = Replace</p> <p>* Service interval based on an intermittent duty cycle equal to approximately 4000 hours annually. Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.</p>					

## PUMP MAINTENANCE AND REPAIR - SECTION E

**MAINTENANCE AND REPAIR OF THE WEARING PARTS OF THE PUMP WILL MAINTAIN PEAK OPERATING PERFORMANCE.**



**\* STANDARD PERFORMANCE FOR PUMP MODEL T10A60S-QSB4.5P**

\* Based on 70°F (21°C) clear water at sea level with minimum suction lift. Since pump installations are seldom identical, your performance may be different due to such factors as viscosity, specific gravity, elevation, temperature, and impeller trim.

Contact the Gorman-Rupp Company to verify performance or part numbers.



If your pump serial number is followed by an "N", your pump is **NOT** a standard production model.

Pump speed and operating condition points must be within the continuous performance range shown on the curve.

ILLUSTRATION

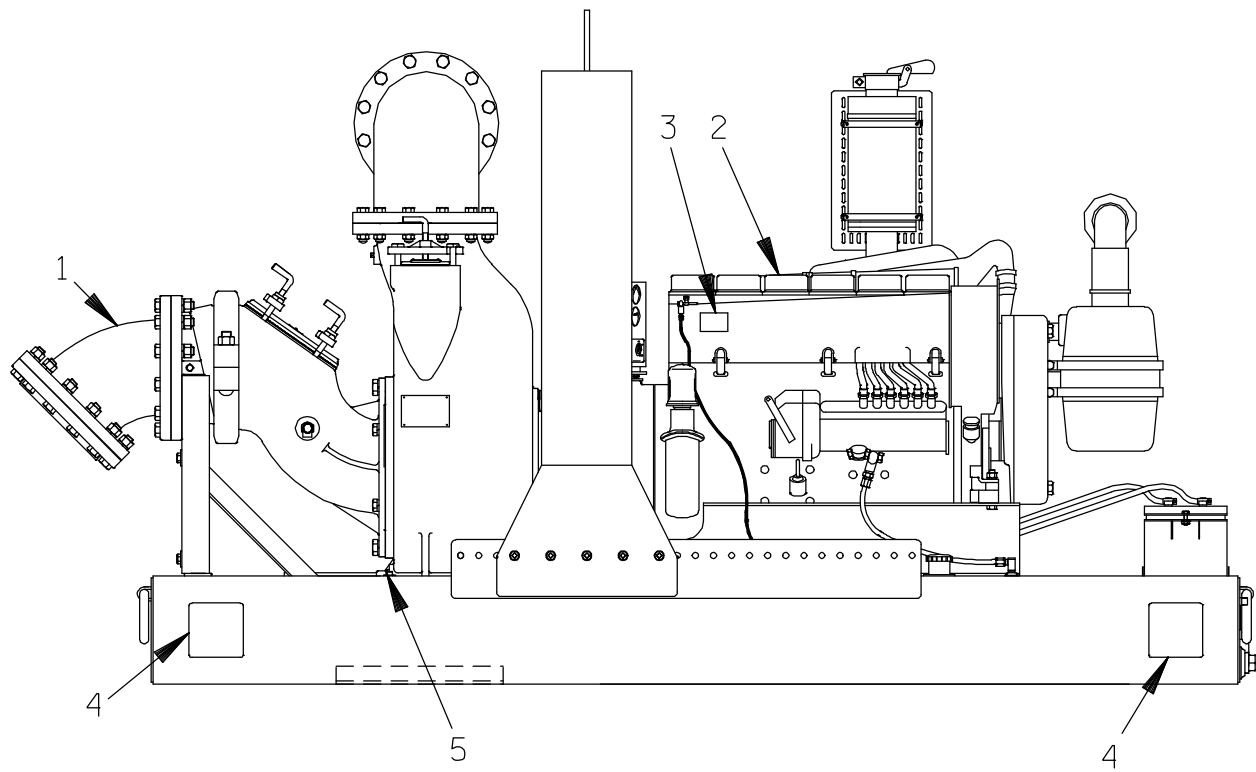


Figure 1. Pump Model T10A60S-6068T

**PARTS LIST**  
**Pump Model T10A60S-6068T**  
 (From S/N 1268074 Up)

If your pump serial number is followed by an "N", your pump is **NOT** a standard production model. Contact the Gorman-Rupp Company to verify part numbers.

ITEM NO.	PART NAME	PART NUMBER	QTY
1	PUMP END ASSY	T10A60S-(SAE 3/11.5)	1
2	POWER UNIT KIT	46143-018	1
3	1000 RPM MIN DECAL	38816-169	1
4	G-R DECAL	GR-06	4
5	PUMP MOUNTING KIT	48157-005	1
OPTIONAL:			
	12V BATTERY	29331-515	1
	WHEEL KIT	GRP30-257	1

ILLUSTRATION

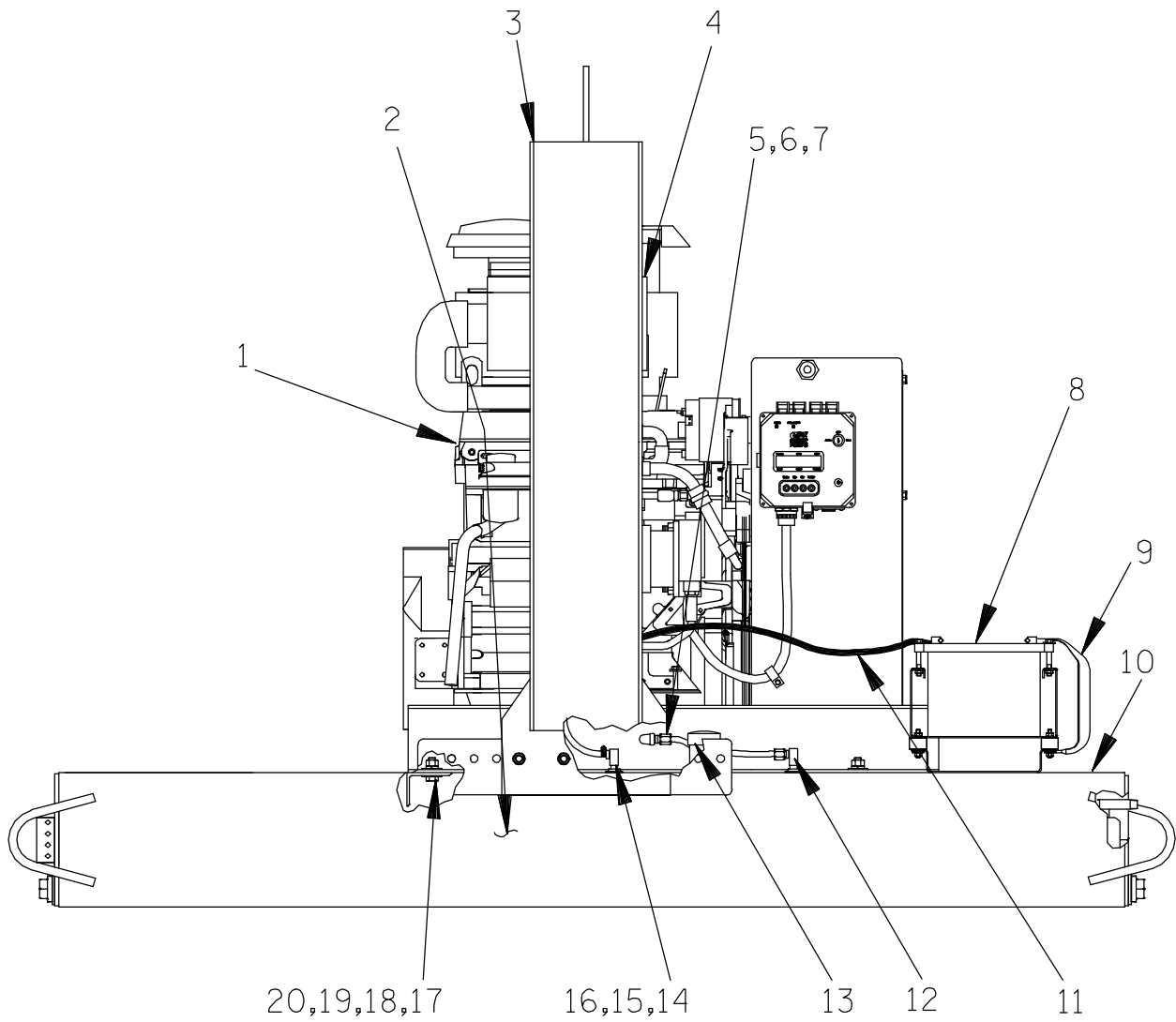


Figure 2. John Deere Power Unit Kit

**PARTS LIST**  
**John Deere Power Unit Kit**

ITEM NO.	PART NAME	PART NUMBER	QTY
1	JOHN DEERE 6068T ENGINE	29224-231	1
2	BASE/FUEL TANK	41553-033 24150	1
3	LIFTING BAIL KIT	48274-802	1
4	MUFFLER GUARD ASSY	42331-066	1
5	MALE CONNECTOR	26351-131	1
6	CONNECTOR	S1447	2
7	HOSE ASSEMBLY	46341-789	1
8	BATTERY BOX KIT	42432-003	1
9	NEG. BATTERY CABLE	47311-215	1
10	OIL DRAIN ASSY	46342-031	1
11	POS. BATTERY CABLE	47311-214	1
12	FUEL PICKUP	29332-145	2
13	FUEL TANK CAP	29332-111	1
14	HOSE BARB FITTING	26523-386	2
15	HOSE	11308G	1
16	HOSE CLAMP	26518-641	2
17	HEX HD CAPSCREW	B1007 15991	6
18	HEX NUT	D10 15991	6
19	LOCKWASHER	J10 15991	6
20	FLAT WASHER	K10 15991	1
21	AIR VENT	S1703	1
22	HOSE BARB FITTING	26523-447	1
23	CABLE TIE	27111-218	1
24	3/8" ID X 36" LG HOSE	18513-302	1
25	HOSE BARB FITTING	26523-389	1
26	MECH FUEL GAUGE ASSY	29332-173	1
27	SOC HD MACH SCREW	BD310-03S 15991	5
NOT SHOWN:			
	FLOAT SWITCH KIT	48312-980	1
	ENGINE STARTUP TAG	38816-269	1
	INSTRUCTION DECAL	38818-144	1
	WARNING DECAL	38816-203	4
	FUEL DECAL	38816-196	1

ILLUSTRATION

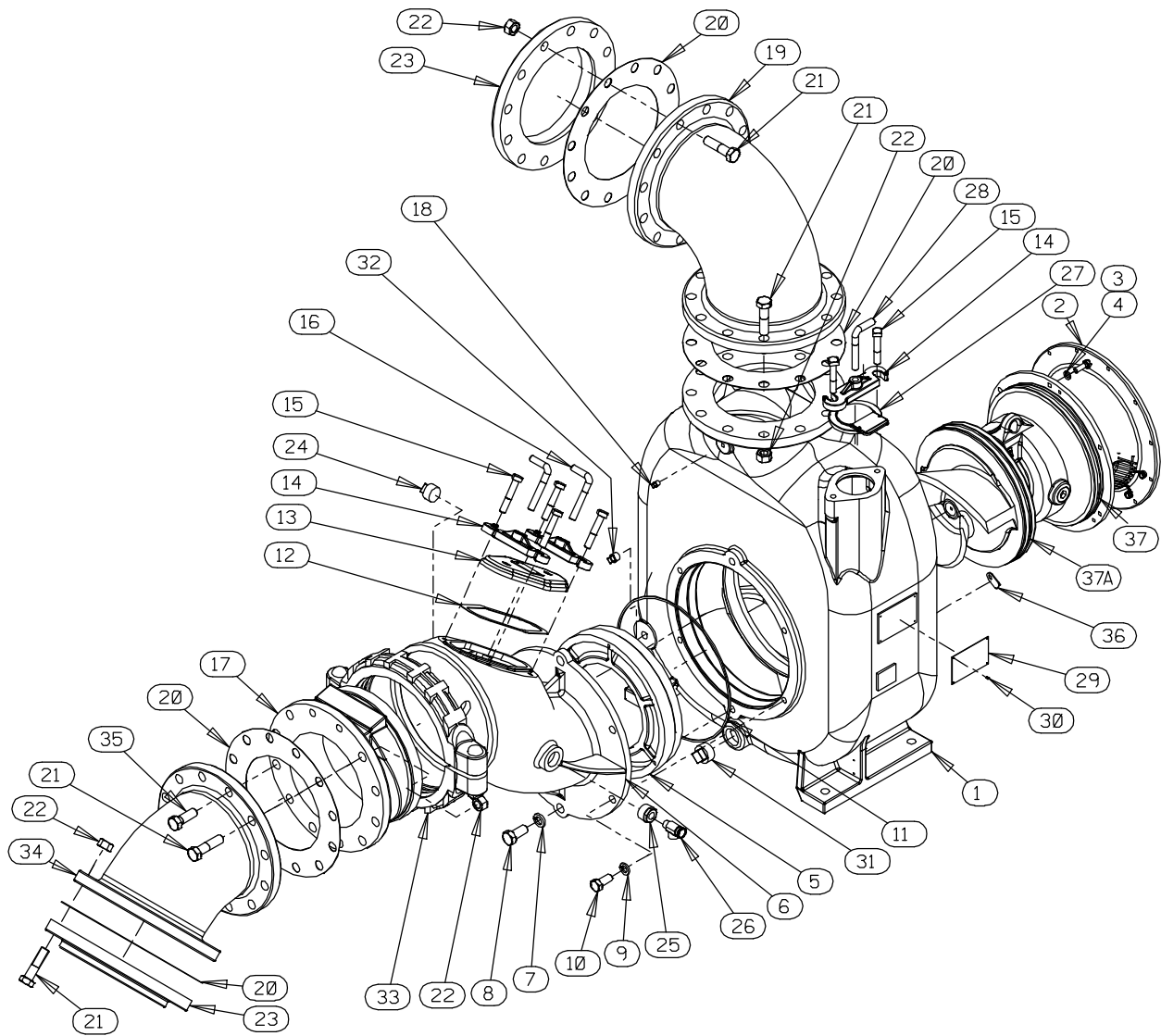


Figure 3. T10A60S-(SAE 3/11.5) Pump End Assembly

**PARTS LIST**  
**T10A60S-(SAE 3/11.5) Pump End Assembly**

ITEM NO.	PART NAME	PART NUMBER	QTY	ITEM NO.	PART NAME	PART NUMBER	QTY
☞ 1	PUMP CASING	SEE NOTE BELOW	1	*26	PRESS RELIEF VALVE	26662-005	1
2	REPAIR ROTATING ASSY	44163-359	1	27	FILL COVER PLATE	42111-344	1
3	LOCK WASHER	J08 15991	6		-WARNING PLATE	38816-097 13990	1
4	HEX HEAD CAP SCREW	B0806 15991	6		-DRIVE SCREW	BM#04-03 17000	2
5 *	WEAR PLATE	38691-826 11010	1		-FILL COVER GASKET	50G 19210	1
6	SUCTION HEAD	38246-609 10010	1	28	CLAMP BAR SCREW	31912-009 15000	1
7	LOCK WASHER	J14 15991	2	29	NAME PLATE	38818-040 13990	1
8	HEX HEAD CAP SCREW	B1408 15991	2	30	DRIVE SCREW	BM#04-03 17000	4
9	LOCK WASHER	J12 15991	4	☞31	PIPE PLUG	P24 10009	1
10	HEX HEAD CAP SCREW	B1207 15991	4	☞32	PIPE PLUG	P08 15079	1
11 *	GASKET	38682-811 20000	1	33	SHOULDER-TYPE CPLNG	25552-213	1
12 *	CLEANOUT CVR GASKET	38688-008 20000	1	34	ELBOW	25512-077	1
13	CLEANOUT CVR PLATE	48271-018	1	35	HEX HEAD CAP SCREW	B1410 15991	2
	-WARNING PLATE	38816-097 13990	1	36	ROT ASSY ADJ SHIM SET	48261-056	6
	-DRIVE SCREW	BM#04-03 17000	2	37 *	BRG HOUSING O-RING	S1914	1
14	CLAMP BAR	38111-004 11010	3	37A *	SEAL PLATE O-RING	S1914	1
☞15	MACHINE BOLT	A1014 15991	6	NOT SHOWN:			
16	CLAMP BAR SCREW	31912-009 15000	2		PRIMING STICKER	6588AH	1
17	CHECK VALVE ASSY	46421-037	1		DISCHARGE STICKER	6588BJ	1
	-HEX HD CAPSCREW	B0606 17090	2		SUCTION STICKER	6588AG	1
	-PIPE PLUG	P08 15079	1		STRAINER	46641-011 24150	1
	-T TYPE LOCKWASHER	AK06 17000	2		WARNING DECAL	2613FE	1
	-FLAT WASHER	KB08 17090	2		WARNING DECAL	38816-302	1
	-PIVOT CAP	38141-003 11060	2		DRIVE ASSEMBLY	44162-172	1
	-CHK VALVE BODY	38341-805 10010	1		WARNING DECAL	2613DK	2
	* -FLAP VALVE	46411-082 24010	1		SUPER "T" DECAL	38812-089	1
☞18	PIPE PLUG	P04 15079	1		INSTRUCTION TAG	38817-025	1
19	FLANGED ELBOW	S5016 10010	1		G-R DECAL	GR-06	1
20 *	GASKET	2751GA 19370	4		LUBRICATION DECAL	38817-084	1
21	HEX HEAD CAP SCREW	B1414 15991	46	OPTIONAL:			
22	HEX NUT	D14 15991	46		AIR RELEASE VALVES:		
23	FLANGE	2751 10010	2		-10# COMP SPRING	GRP33-07A	1
24	PIPE PLUG	P20 10009	1		-25# COMP SPRING	GRP33-07	1
25	RED PIPE BUSHING	AP2008 11999	1		-80# COMP SPRING	GRP33-07B	1

\* INDICATES PARTS RECOMMENDED FOR STOCK

☞ VITON® IS A REGISTERED TRADEMARK OF THE DUPONT CORP.

☞ INCLUDED WITH REPAIR 46472-709 1  
PUMP CASING ASSY

ILLUSTRATION

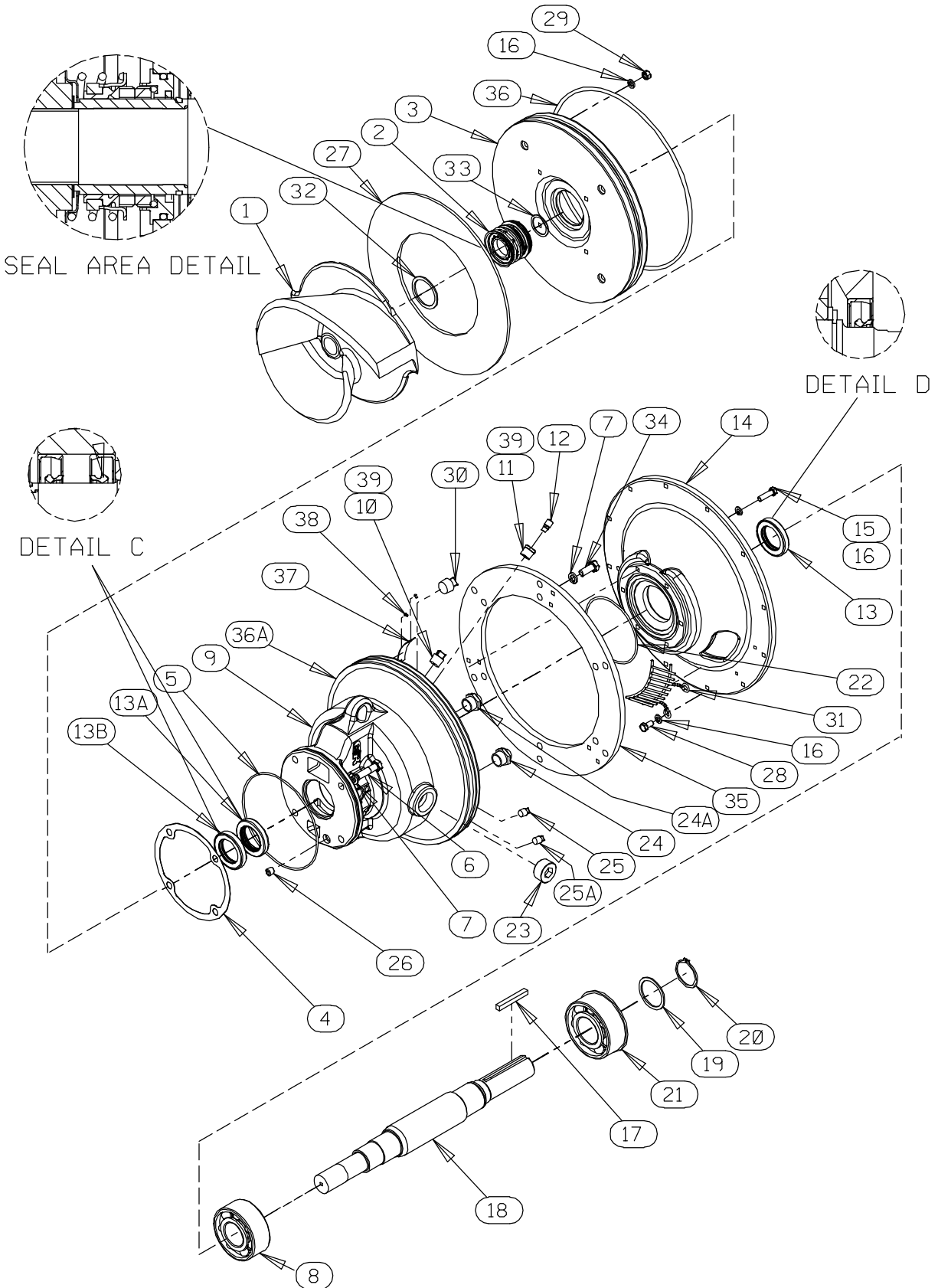


Figure 4. Repair Rotating Assembly

**PARTS LIST**  
**Repair Rotating Assembly**

ITEM NO.	PART NAME	PART NUMBER	QTY
1	IMPELLER	38615-072 11010	1
2	* CARTRIDGE SEAL ASSY	46513-154	1
3	SEAL END PLATE	38272-423 10010	1
4	* SEAL PLATE GASKET	38684-302 19140	1
5	* O-RING	25152-265	1
6	HEX HEAD CAP SCREW	21632-945	4
7	LOCK WASHER	J08 15991	10
8	* DBL ROW BALL BEARING	23421-461	1
9	BEARING HOUSING	38251-515 10000	1
10	VENTED PIPE PLUG	4823A 15079	1
11	REDUCER PIPE BUSHING	AP0802 15079	1
12	AIR VENT	S1530	1
13	* OIL SEAL	S1917	1
13A	* OIL SEAL	S1917	1
13B	* OIL SEAL	S1917	1
14	DRIVE FLANGE	38545-007 11010	1
15	CAP SCREW	21632-936	6
16	LOCK WASHER	J06 15991	14
17	* SHAFT KEY	N0612 15990	1
18	IMPELLER SHAFT	38515-590 1706H	1
19	THRUST WASHER	31134-113 15210	1
20	RETAINING RING	S215	1
21	* DBL ROW BALL BEARING	23422-412	1
22	* O-RING	S333	1
23	SOC HD PIPE PLUG	PC20 10009	1
24	SEAL CAVITY SIGHT GAUGE	S1471	1
24A	BEARING CAVITY SIGHT GAUGE	S1471	1
25	BEARING CAVITY DRAIN PLUG	P04 15079	1
25A	SEAL CAVITY DRAIN PLUG	P04 15079	1
26	SOC HD PIPE PLUG	PC04 15079	1
27	* WEAR PLATE ASSEMBLY	46451-722 24150	1
28	HEX HEAD CAP SCREW	B0603 15991	4
29	HEX NUT	D06 15991	4
30	PIPE PLUG	P12 15079	1
31	INTERMEDIATE GUARD	42381-509 24152	2
32	IMP ADJ SHIM SET	5091 17090	REF
33	SHAFT SLEEVE O-RING	25154-026	REF
34	HEX HEAD CAP SCREW	B0805 15991	6
35	CASING RING	31281-016 15990	1
36	* SEAL PLATE O-RING	S1914	1
36A	* BEARING HOUSING O-RING	S1914	1
37	S/N PLATE	2613GG 13990	1
38	DRIVE SCREW	BM#04-03 17000	2
39	SHIPPING PLUG	11495B 15079	2
NOT SHOWN:			
	ADJ SHIM SET	48261-056	6
	INSTRUCTION TAG	6588U	1
	ROTATION DECAL	2613M	1

\* INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

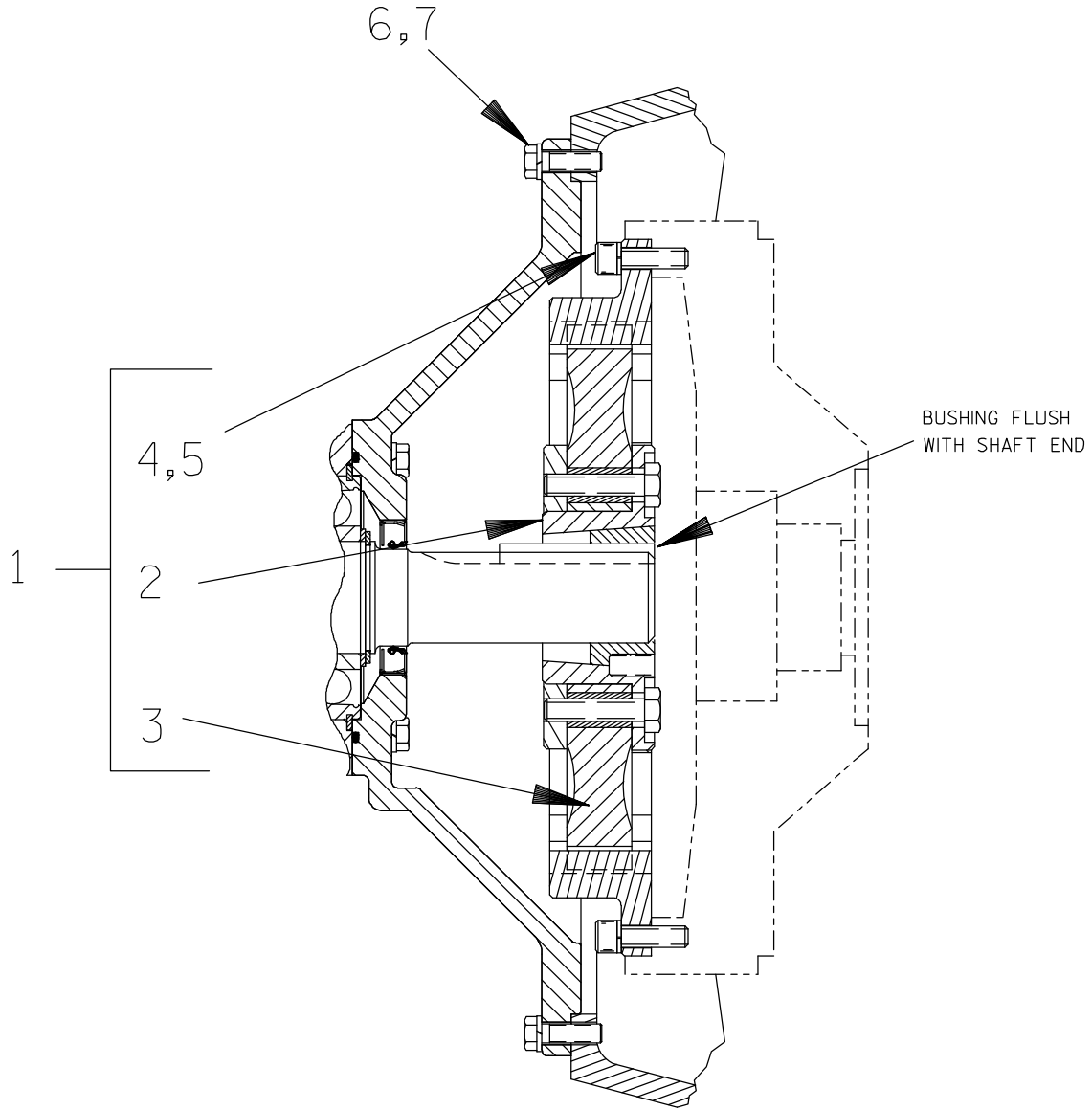


Figure 5. Drive Assembly  
PARTS LIST

ITEM NO.	PART NAME	PART NUMBER	QTY
1	COUPLING KIT	48112-016	1
2	-BUSHING	24131-497	1
3	-COUPLING ASSEMBLY	24391-102	1
4	-LOCKWASHER	21171-536	8
SAE APPLICATION			
5	SOCKET HD CAPSCREW	BD0606 15991	8
6	HEX HD CAPSCREW	B0605 15991	12
7	LOCKWASHER	J06 15991	12
METRIC APPLICATION			
5	SOCKET HD CAPSCREW	22644-218	8
6	HEX HD CAPSCREW	22645-164	12
7	LOCKWASHER	21171-511	12

## PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Review all SAFETY information in Section A.

Follow the instructions on all tags, label and decals attached to the pump.

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the illustrations (see Figures 1 through 5) and the accompanying parts lists.

This manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that **only** safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed **only** after establishing that neither personal safety nor pump integrity are compromised by such practices.

Many service functions may be performed by draining the pump and removing the back cover assembly. If major repair is required, the piping and/or power source must be disconnected. The following instructions assume complete disassembly is required.

Before attempting to service the pump, switch off the engine ignition and disconnect the positive battery cable to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

For engine disassembly and repair, consult the literature supplied with the engine, or contact your local engine representative.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Switch off the engine ignition and disconnect the positive battery cable to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



This pump may be used to handle materials which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.



Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be damaged when lifting. Suction and discharge hoses and piping **must** be re-

**moved from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.**

### **Cleanout Access and Suction Check Valve Removal**

#### **(Figure 3)**

Before attempting to service the pump, remove the casing drain plug (31) and drain the pump. Clean and reinstall the drain plug.

For cleanout access, loosen the clamp screws (16) and clamp bars (14) securing the cleanout cover (13) to the suction head (6).

To remove the check valve assembly, reach through the cleanout opening and remove the hardware securing the check valve to the valve body and suction head.

#### **NOTE**

*An alternate method of removing the check valve assembly is to remove the hardware securing the valve body to the suction piping. Disconnect the shoulder-type coupling (33) and separate the valve body and check valve from the suction head. Separate the check valve from the valve body as described above.*

Replace the cleanout cover gasket (12) before re-installing the cover.

### **Suction Head and Wear Plate Removal**

#### **(Figure 3)**

To remove the suction head, support it with a suitable hoist and sling and remove the hardware (7, 8, 9 and 10) securing it to the pump casing. Remove the suction head gasket (11).

If the wear plate (5) does not slide easily from the casing bore, install capscrews (1/2-13 UNC X 1 inch long, not supplied) in the tapped holes in the suction head and use a suitable puller to remove the wear plate from the pump casing.

#### **NOTE**

*An alternate method of removing the wear plate is to position a wood or soft metal wedge between the*

*impeller vanes and the wear plate, and tap the wedge with a hammer. Turn the impeller every 45 °, repeating the process until the wear plate is "walked" out of the pump casing.*

*If the pump is to be completely disassembled, the wear plate can also be easily removed after removing the rotating assembly (2). Use a suitably sized piece of wood to tap the wear plate out of the casing through the suction head opening.*

### **Separating Pump and Drive Assembly From Engine**

#### **(Figure 3)**

Further disassembly requires separating the pump end and drive assembly from the engine. Remove the discharge elbow and gasket (19 and 20) and fill cover (27) and gasket from the pump casing. Loop a suitable chain or cable through the discharge port and back out the priming port and attach it to a hoist.



Make certain the chain or cable is positioned so that the pump will not be damaged, and so that the load will be balanced.

#### **(Figure 5)**

Disengage the hardware (6 and 7, Figure 3, 16 and 28, Figure 4) securing the drive flange (14, Figure 4) to the engine bellhousing and remove the guards (31, Figure 4). Separate the pump end and drive assembly from the engine by pulling the pump end straight away from the engine.

As the assemblies separate, the flexible portion of the coupling assembly (3) will remain on the shaft. To remove the coupling from the shaft, unscrew the two allen head setscrews from the bushing (2). Screw one of the setscrews into the puller hole on the circumference of the bushing. As the coupling and bushing separate, remove the bushing, and slide the coupling off the shaft.

It is not necessary to remove the outer ring of the coupling from the engine flywheel unless the coupling must be replaced. To remove the ring, disengage the hardware (4 and 5) securing it to the flywheel.

Remove any leveling shims used under the casing mounting feet. Tie and tag the shims for ease of reassembly.

Move the pump end to a clean, well equipped shop area for further disassembly.

**Loosening Impeller**

**(Figure 4)**

Before attempting to loosen the impeller, remove the seal cavity drain plug (25A) and drain the lubricant. This will prevent the oil from escaping as the impeller is removed. Clean and reinstall the drain plug.

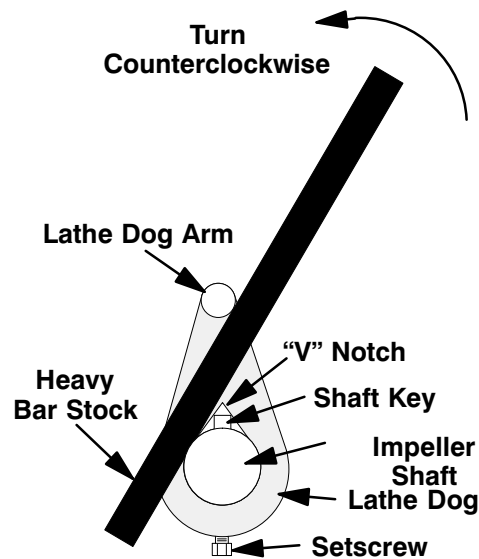
With the pump end separated from the engine and the suction head (6, Figure 3) removed, wedge a block of wood between the vanes of the impeller and the pump casing to prevent rotation.

If removed, install the shaft key (17) in the shaft keyway. Install a lathe dog on the drive end of the shaft (18) with the “V” notch positioned over the shaft key.

With the impeller rotation still blocked, see Figure 6 and use a long piece of heavy bar stock to pry against the arm of the lathe dog in a counterclockwise direction (when facing the drive end of the shaft). **Use caution** not to damage the shaft or keyway. When the impeller breaks loose, remove the lathe dog, key and wood block.

**NOTE**

*Do not remove the impeller until the rotating assembly has been removed from the pump casing.*



**Figure 6. Loosening Impeller**

**Rotating Assembly Removal**

**(Figure 3)**

To ease removal of the rotating assembly, it is recommended that the pump be positioned on supporting blocks with the suction head opening down and the drive flange (14, Figure 4) up.

Remove the outer hardware (3 and 4) from the casing ring (35, Figure 4). Install three of the outer cap-screws in the jacking holes in the casing ring, and use them to jack the rotating assembly loose from the pump casing.

Install hooks in the mounting holes in the drive flange (14, Figure 4) and attach the hooks to a three-legged sling and suitable lifting device. Carefully lift the rotating assembly out of the pump casing.

Remove the shim sets (36). Tie and tag the shim sets for ease of reassembly.

**NOTE**

*It is not necessary to remove the casing ring (35, Figure 4) from the bearing housing in order to disassemble the bearing housing.*

Move the rotating assembly to a suitable work area for further disassembly.

## Impeller and Wear Plate Removal

### (Figure 4)

Unscrew the impeller from the shaft in a counter-clockwise direction (when facing the impeller). Use caution when unscrewing the impeller; tension on the shaft seal spring will be released as the impeller is removed.

Remove the impeller adjusting shims (32). Tie and tag the shims or measure and record their thickness for ease of reassembly.

Inspect the wear plate (27) for excessive wear or scoring and, if replacement is required, remove the hardware (16 and 29) securing it to the seal plate (3).

## Seal Removal and Disassembly

### (Figure 4)

Slide the integral shaft sleeve and rotating portion of the seal off the shaft as a unit.

Use a pair of stiff wires with hooked ends to remove the stationary element and seat.

An alternate method of removing the stationary portion of the seal is to remove the hardware (6 and 7) and separate the seal plate (3) and gasket (4) from the bearing housing (9). Remove the seal plate and bearing housing O-rings (36 and 36A).

Position the seal plate on a flat surface with the impeller side down. Use a wooden dowel or other suitable tool to press on the back side of the stationary seat until the seat, O-rings, and stationary element can be removed.

If no further disassembly is required, refer to **Seal Installation**.

## Shaft and Bearing Removal and Disassembly

### (Figure 4)

#### NOTE

*It is not necessary to remove the casing ring (35) from the bearing housing in order to disassemble the bearing housing.*

When the pump is properly operated and maintained, the bearing housing should not require disassembly. Disassemble the shaft and bearings **only** when there is evidence of wear or damage.



Shaft and bearing disassembly in the field is not recommended. These operations should be performed only in a properly equipped shop by qualified personnel.

Remove the bearing housing drain plug (25) and drain the lubricant. Clean and reinstall the drain plug.

Disengage the hardware (15 and 16) and remove the drive flange (14), O-ring (22) and oil seal (13) from the shaft. Press the oil seal from the drive flange.

Place a block of wood against the impeller end of the shaft (18) and tap the shaft and assembled bearings (8 and 21) from the bearing housing.

After removing the shaft and bearings, clean and inspect the bearings **in place** as follows.



To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Clean the bearing housing, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage and replace as necessary.



**Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.**

Clean the bearings thoroughly in **fresh** cleaning solvent. Dry the bearings with filtered compressed air and coat with light oil.



Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. **Do not** spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

Rotate the bearings by hand to check for roughness or binding and inspect the bearing balls. If rotation is rough or the bearing balls are discolored, replace the bearings.

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the bearing housing. Replace the bearings, shaft, or bearing housing if the proper bearing fit is not achieved.

If bearing replacement is required, remove the outboard bearing retaining ring (20) and thrust washer (19), and use a bearing puller or an arbor (or hydraulic) press to remove the bearings from the shaft.

Press the oil seals (13A and 13B) from the bearing housing bore.

### Shaft and Bearing Reassembly and Installation

(Figures 4 and 7)

Clean the bearing housing, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage as necessary.



**Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.**

Inspect the shaft for distortion, nicks or scratches, or for thread damage on the impeller end. Dress small nicks and burrs with a fine file or emery cloth. Replace the shaft if defective.

Position the inboard oil seal (13A) in the bearing housing bore with the lip positioned as shown in Figure 4. Press the oil seal into the housing until the face is **just flush** with the machined surface inside the housing.



To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

The bearings may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearings. Bearings should **never** be heated with a direct flame or directly on a hot plate.

#### NOTE

*If a hot oil bath is used to heat the bearings, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

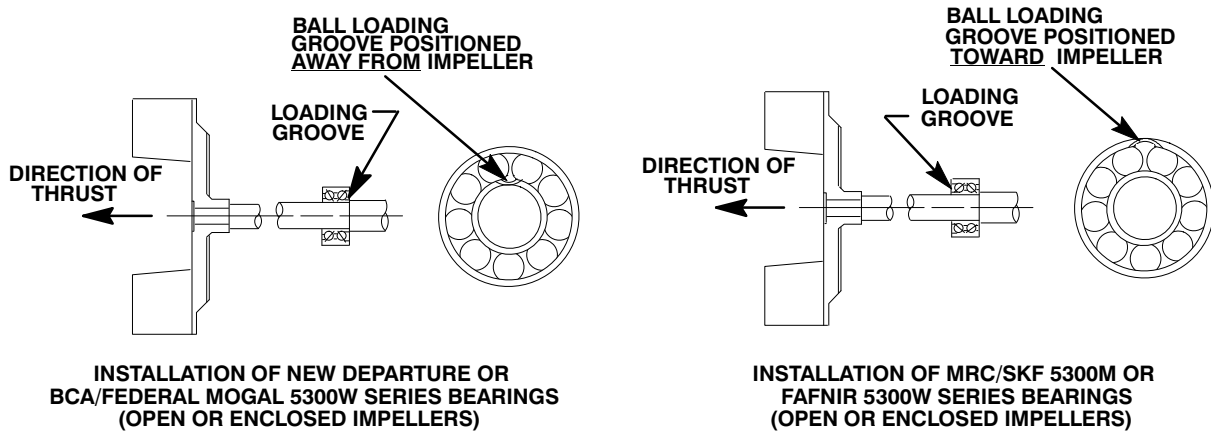
Heat the bearings to a uniform temperature **no higher than 250°F (120°C)**, and slide the bearings onto the shaft, one at a time, until they are fully seated. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.



**Use caution when handling hot bearings to prevent burns.**

#### NOTE

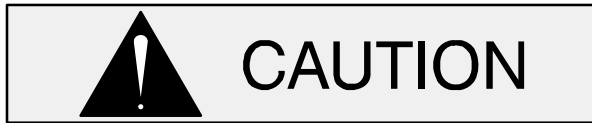
*Position the inboard bearing (8) on the shaft as indicated by the following illustration. Position the outboard bearing (21) on the shaft with the retaining ring in the outer race toward the drive end of the shaft.*



**Figure 7. Inboard Bearing Positioning**

After the bearings have been installed and allowed to cool, check to ensure that they have not moved away from the shaft shoulders in shrinking. If movement has occurred, use a suitably sized sleeve and a press to reposition the bearings against the shaft shoulders.

If heating the bearings is not practical, use a suitably sized sleeve and an arbor (or hydraulic) press to install the bearings on the shaft.



When installing the bearings onto the shaft, **never** press or hit against the outer race, balls, or ball cage. Press **only** on the inner race.

Install the thrust washer (19) and secure the outboard bearing (21) to the shaft with the bearing retaining ring (20).

It is recommended that a sleeve be positioned against the inboard oil seal (13A) to prevent the lip of the oil seal from rolling as the shaft and bearings are installed in the bearing housing. The O.D. of the sleeve should be just smaller than the bearing housing bore, while the I.D. of the sleeve should be just larger than the O.D. of the lip seal area of the shaft.

With the lip seal sleeve in place, lubricate the lip seal area of the shaft, and slide the shaft and assembled bearings into the bearing housing until the retaining ring on the outboard bearing seats

against the bearing housing. Remove the lip seal sleeve.



When installing the shaft and bearings into the bearing bore, push against the outer race. **Never** hit the balls or ball cage.

Position the outboard oil seal (13B) in the bearing housing with the lip positioned as shown in Figure 4. Press the oil seal into the bearing housing until it is **just flush** with the machined surface on the bearing housing.

Press the oil seal (13) into the drive flange (14) with the lip positioned as shown in Figure 4. Replace the drive flange O-ring (22) and secure the drive flange with the hardware (15 and 16). Be careful not to damage the lip of the oil seal (13) on the shaft keyway.

Lubricate the bearing housing as indicated in **LUBRICATION** at the end of this section.

**Seal Reassembly and Installation**

**(Figures 4 and 8)**

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent.



**Most cleaning solvents are toxic and flammable. Use them only in a well ven-**

tilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

The seal is not normally reused because wear patterns on the finished faces cannot be realigned during reassembly. This could result in premature failure. If necessary to reuse an old seal in an emergency, **carefully** wash all metallic parts in fresh cleaning solvent and allow to dry thoroughly.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Inspect the seal area of the impeller shaft, and replace it if badly damaged. Dress any small scratches with a fine file or emery cloth. If any components are worn, replace the complete seal; **never mix old and new seal parts.**

If a replacement seal is being used, remove it from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the bellows and stationary seat O-rings with water or a very **small** amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 8).

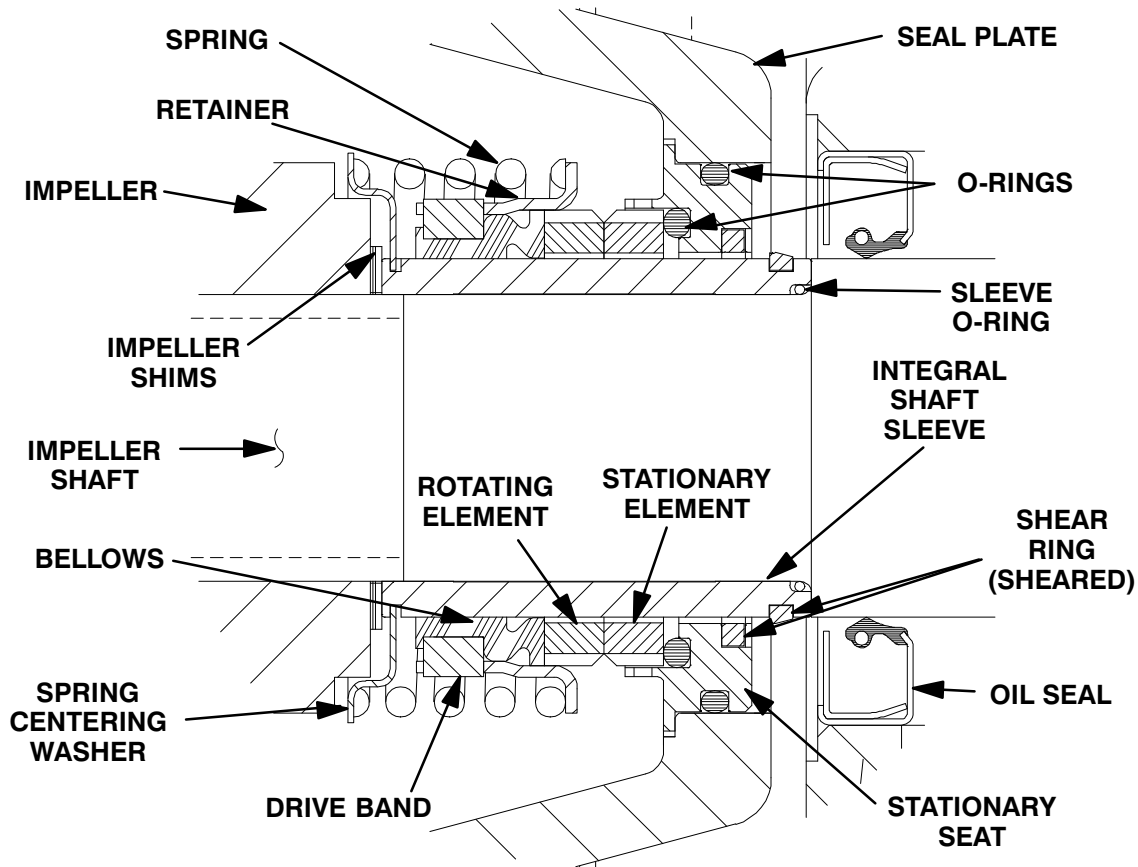
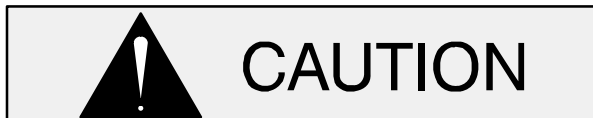


Figure 8. Seal Assembly



This seal is not designed for operation at

temperatures above 160°F (71°C). Do not use at higher operating temperatures.

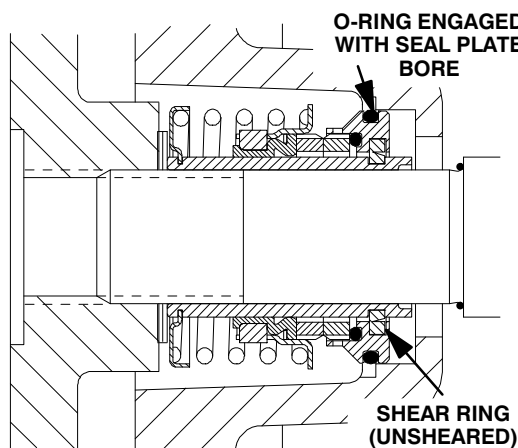
If the wear plate (27) was removed, secure it to the seal plate (3) with the hardware (16 and 29).

If the seal plate was removed, install the seal plate gasket (4) and bearing housing O-ring (5). Lubricate the O-ring with light grease. Position the seal plate over the shaft and secure it to the bearing housing with the hardware (6 and 7).

To prevent damaging the shaft sleeve O-ring (33) on the shaft threads, cover the threads with electrical or duct tape. Slide the O-ring over the shaft until it seats against the shaft shoulder. Remove the tape covering the threads. Check to ensure that the shaft threads are free of any tape residue and clean as required before proceeding with seal installation.

When installing a new cartridge seal assembly, remove the seal from the container, and lubricate the external stationary seat O-ring with light oil. Slide the seal assembly onto the shaft until the external stationary seat O-ring engages the bore in the seal plate.

Clean and inspect the impeller as described in **Impeller Installation and Adjustment**. Install the full set of impeller shims (32) provided with the seal, and screw the impeller onto the shaft until it is seated against the seal (see Figure 9).



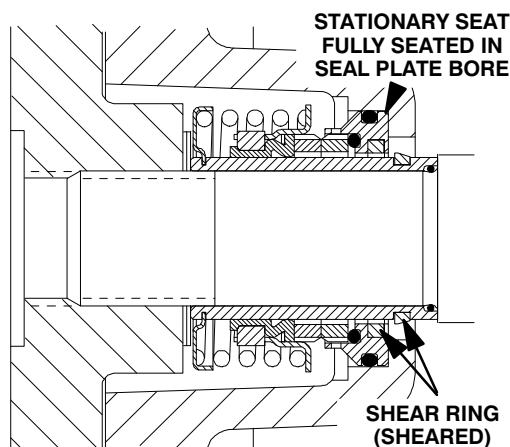
**Figure 9. Seal Partially Installed**

Continue to screw the impeller onto the shaft. This will press the stationary seat into the seal plate bore.

#### NOTE

*A firm resistance will be felt as the impeller presses the stationary seat into the seal plate bore.*

As the stationary seat becomes fully seated, the seal spring compresses, and the shaft sleeve will break the nylon shear ring. This allows the sleeve to slide down the shaft until seated against the shaft shoulder. Continue to screw the impeller onto the shaft until the impeller, shims, and sleeve are fully seated against the shaft shoulder (see Figure 10).



**Figure 10. Seal Fully Installed**

Measure the impeller-to-seal plate clearance, and remove impeller adjusting shims to obtain the proper clearance as described in **Impeller Installation and Adjustment**.

**If necessary to reuse an old seal** in an emergency, carefully separate the rotating and stationary seal faces from the bellows retainer and stationary seat.



A new seal assembly should be installed **any time** the old seal is removed from the pump. Wear patterns on the finished faces cannot be realigned during reassembly. Reusing an old seal could result in premature failure.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

**Carefully** wash all metallic parts in fresh cleaning solvent and allow to dry thoroughly.



**Do not** attempt to separate the rotating portion of the seal from the shaft sleeve when reusing an old seal. The rubber bellows will adhere to the sleeve during use, and attempting to separate them could damage the bellows.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Inspect the integral shaft sleeve for nicks or cuts on either end. If any components are worn, or the sleeve is damaged, replace the complete seal; **never mix old and new seal parts.**

Install the stationary seal element in the stationary seat. Press this stationary subassembly into the seal plate bore until it seats squarely against the bore shoulder. A push tube made from a piece of plastic pipe would aid this installation. The I.D. of the pipe should be slightly larger than the O.D. of the shaft sleeve.

Slide the rotating portion of the seal (consisting of the integral shaft sleeve, spring centering washer, spring, bellows and retainer, and rotating element) onto the shaft until the seal faces contact.

Proceed with **Impeller Installation and Adjustment.**

### Impeller Installation

(Figure 4)

Inspect the impeller and replace it if cracked or badly worn. Inspect the impeller and shaft threads for dirt or damage and clean or dress the threads as required.



The shaft and impeller threads **must** be completely clean before reinstalling the impeller. Even the slightest amount of dirt on the threads can cause the impeller to seize

to the shaft, making future removal difficult or impossible without damage to the impeller or shaft.

Install the same thickness of impeller adjusting shims (32) as previously removed. Apply 'Never-Seez' or equivalent compound to the shaft threads and screw the impeller onto the shaft until tight. **Be sure** the seal spring seats squarely over the shoulder on the back side of the impeller.

### NOTE

*At the slightest sign of scraping, immediately back the impeller off, and check the threads for dirt. **Do not** try to force the impeller onto the shaft.*

A clearance of .020 to .025 inch (0,51 to 0,64 mm) between the impeller and the wear plate is recommended for maximum pump efficiency. Measure this clearance, and add or remove impeller adjusting shims as required.

### NOTE

*If the rotating assembly has been installed in the pump casing, this clearance may be measured by reaching through the priming port with a feeler gauge.*

### Rotating Assembly Installation

(Figure 3)

Install the bearing housing and seal plate O-rings (37 and 37A) and lubricate them with light grease. Slide the rotating assembly into the pump casing. **Be careful** not to damage the O-rings.

Install an equal thickness of rotating assembly shims (36) under the pump casing ring (35, Figure 4) and secure the ring to the pump casing with the hardware (3 and 4).

### NOTE

*If the pump has been completely disassembled, it is recommended that the wear plate (5) and suction head (6) be reinstalled at this point. The suction head and wear plate must be in place to adjust the impeller face clearance.*

A clearance of .020 to .025 inch (0,51 to 0,64 mm) between the impeller and the wear plate is also rec-

ommended for maximum pump efficiency. This clearance can be obtained by removing an equal amount of shims from each rotating assembly shim set (36) until the impeller scrapes against the wear plate when the shaft is turned by hand. After the impeller scrapes, add approximately .020 (0,51 mm) of shims to each shim set.

### NOTE

*An alternate method of adjusting this clearance is to reach through the suction port with a feeler gauge and measure the gap. Add or subtract rotating assembly shims accordingly.*

## Suction Head and Wear Plate Installation

### (Figure 3)

Clean any scale or debris from the contacting surfaces in the pump casing that might prevent a good seal with the suction head (6) or interfere with the wear plate (6). Inspect the wear plate for wear or damage and replace as required. Slide the wear plate into the pump casing until fully seated.

Replace the suction head gasket (11) and lubricate it with a generous amount of No. 2 grease. Use a suitable hoist and sling to position the suction head against the pump casing, and secure it with the hardware (7, 8, 9 and 10). Note that the larger and longer capscrews (7 and 8) must be installed at the 12 O'clock and 6 O'clock positions.

### NOTE

*To ease future disassembly, apply a film of grease or 'Never-Seez' on the suction head, or any surface which contacts the pump casing. This action will reduce rust and scale build-up.*

## Suction Check Valve Installation

### (Figure 3)

Inspect the check valve components and replace if badly worn.

Reach through the cleanout cover opening with the check valve and secure it with the pivot caps and hardware (not shown).

### NOTE

*If the check valve body was removed, install the check valve and secure the body to the suction head with the shoulder type clamp (33).*

## Securing Pump End to Engine

### (Figure 5)

Install the shaft key (17, Figure 4) in the shaft keyway. Position the flexible portion of the coupling assembly (3) on the shaft as shown in Figure 5.

Align the keyway in the bushing (2) with the shaft key, and slide it onto the shaft until it is **just flush** with the end of the shaft. Rotate the flexible portion of the coupling until the tapped holes for the two setscrews align with those in the bushing, and install the setscrews.



Make certain that the flexible portion of the coupling is mounted as shown in Figure 5. **This is critical.** If the coupling is not properly positioned on the shaft, the coupling parts may not fully engage, or a pre-load condition can cause premature bearing failure.

The end of the shaft must be **just flush** with the face of the bushing. This will allow the two portions of the coupling to fully engage when the drive flange is secured to the engine bellhousing, without pre-loading the bearings.

With the flexible portion of the coupling and the bushing properly positioned on the shaft, tighten the two setscrews in an alternating sequence until the bushing and coupling are fully secured. Torque the setscrews to 23.3 ft. lbs. (280 in. lbs. or 3,2 m. kg.).

If the complete coupling assembly is being replaced, apply 'Loctite Retaining Compound No. 242' or equivalent to the threads of the hardware (4 and 5), and secure the outer ring of the coupling to the engine flywheel by torquing the hardware to 45 ft. lbs. (540 in. lbs. or 6,2 m. kg.).

Using a suitable lifting device, position the pump end so the flexible portion of the coupling seats inside the outer ring attached to the engine flywheel.

### NOTE

To ease installation, **lightly** lubricate the rubber portion of the coupling with a **non-petroleum based lubricant** such as vegetable oil or glycerin, or a silicon-based lubricant such as "WD40" or equivalent. **Do not** use petroleum-based lubricants, or any other substance which may soften or otherwise damage the rubber.

Install the intermediate guards (31, Figure 4), and secure the drive flange to the engine bellhousing with the hardware (16 and 28, Figure 4, and 6 and 7, Figure 5).

Install any leveling shims used under the casing mounting feet, and secure the casing to the base with the previously removed hardware.

## PRESSURE RELIEF VALVE MAINTENANCE

### (Figure 3)

The suction head is equipped with a pressure relief valve (26) to provide additional safety for the pump and operator (refer to **Liquid Temperature And Overheating** in **OPERATION**).

It is recommended that the pressure relief valve assembly be replaced at each overhaul, or any time the pump overheats and activates the valve. **Never** replace this valve with a substitute which has not been specified or provided by the Gorman-Rupp Company.

Periodically, the valve should be removed for inspection and cleaning. When reinstalling the relief valve, apply 'Loctite Pipe Sealant With Teflon No. 592', or equivalent compound, on the relief valve threads. Position the valve as shown in Figure 3, with the discharge port pointing down.

## LUBRICATION

### Seal Assembly

#### (Figure 4)

Before starting the pump, remove the vented plug (10) and fill the seal cavity with approximately 85 ounces (2,5 liters) of SAE No. 30 non-detergent oil, or to a level at the middle of the sight gauge (24). Clean and reinstall the vented plug. Maintain the oil at this level.

### Bearings

#### (Figure 4)

The bearing housing was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (24A) and maintain it at the middle of the gauge. When lubrication is required, remove the air vent and bushing (11 and 12) and add SAE No. 30 non-detergent oil through the hole until the level is at the middle of the sight gauge. **Do not** over-lubricate. Over-lubrication can cause the bearings to over-heat, resulting in premature bearing failure.

Under normal conditions, drain the bearing housing once each year and refill with approximately 32 ounces (1 liter) clean oil. Change the oil more frequently if the pump is operated continuously or installed in an environment with rapid temperature change.



Monitor the condition of the bearing lubricant regularly for evidence of rust or moisture condensation. This is especially important in areas where variable hot and cold temperatures are common.

For cold weather operation, consult the factory or a lubricant supplier for the recommended grade of oil.

### Engine

Consult the literature supplied with the engine, or contact your local engine representative.

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