OM–07208–01
November 27, 2018

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

PA SERIES® PUMP

MODEL

PA4A60C–ZPP428–ESP

GORMAN-RUPP PUMPS

www.grpumps.com

Printed in U.S.A.

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

Valid serial number and e-mail address required.

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: _____

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

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:

DANGER!

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.

WARNING!

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.

CAUTION

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 Prime Aire® Series pumps. Refer to the manual accompanying the engine or power source before attempting to begin operation.

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 provide detailed instructions and precautions for each specific application or for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner, installer and/or maintenance personnel to ensure that applications and/or maintenance procedures not addressed in this manual are performed only after establishing that neither personal safety nor pump integrity are compromised by such applications or procedures.

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine, remove the key 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.

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 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 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 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.

Natural gas presents an extreme explosion and fire hazard. Follow all safety precautions outlined by the National Fire Protection Association when designing and installing the system. Make certain that the regulators and fuel lines are of the proper size and capacity for the system, and that all fuel lines are securely connected and free of leaks.

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 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.

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

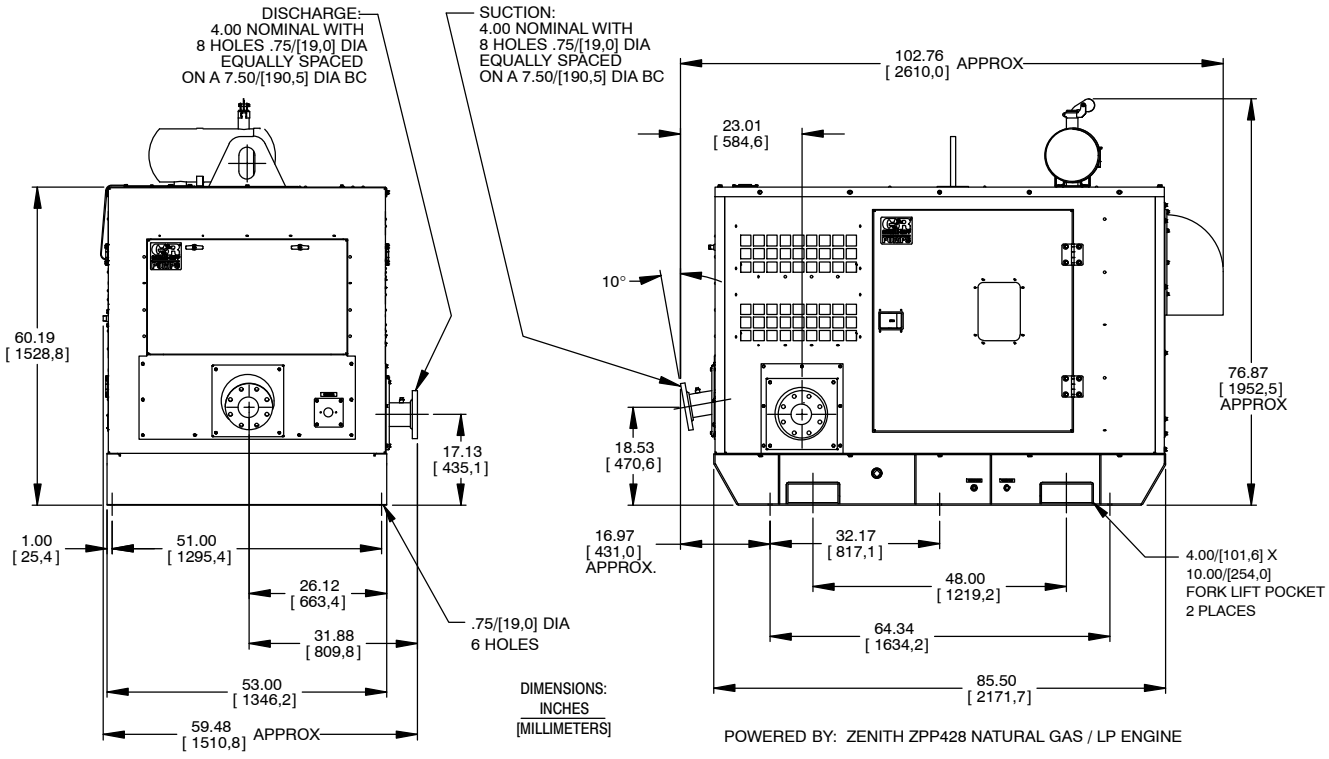


Figure 1. Pump Model PA4A60C–ZPP428–ESP

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. When selecting a battery, refer to the specifications on the paper tag attached to the battery box in order to ensure the proper size and electrical characteristics of the battery.

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

SAFETY AND CONFORMANCE

All aspects of the design and installation of the fuel supply system must be evaluated in terms of safety to personnel and equipment, and conformance to all applicable codes.

DANGER!

Natural Gas and Liquefied Petroleum Gas (LPG) presents an extreme explosion and fire hazard. Follow all safety precautions outlined by the National Fire Protection Association when designing and installing the system. Make certain that the regulators and fuel lines are of the proper size and capacity for the system, and that all fuel lines are securely connected and free of leaks.

Before installing the system:

1. Check all state and local codes pertaining to installations of stationary combustion engines and fuel systems.

2. Consult the following National Fire Protection Association pamphlet:

   NFPA No. 37 – Stationary Combustion Engines/Gas Turbines

   NFPA No. 54 – National Fuel Gas Code Handbook.

   NFPA No. 37 – Liquefied Petroleum Gas Storage and Handling.

Copies may be ordered from:

National Fire Protection Association
1 Batterymarch Park
Quincy, Massachusets 02269

POSITIONING PUMP

Lifting

WARNING!

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.

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.

To ensure sufficient lubrication 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 enclosure suction cover to permit removal of the cover and easy access to the pump.

NATURAL GAS FUEL

The amount of natural gas fuel required for the engine is measured in cubic feet per hour. This is calculated from the BTU (British Thermal Unit) content of the natural gas supplied, and the horsepower required to drive the pump. **This unit requires 614 CF/hr of natural gas with 1000 BTU content at 10 inches of water column.** The BTU content of gas varies in the United States, therefore, it will be necessary to contact your local gas supplier to determine the BTU content of the natural gas in your area.

When burning natural gas having a BTU content of 1000 or over, the engine will deliver the rated horsepower as shown on the pump Specification Data Sheet. On lower grade natural gas, there will be a power loss of approximately 3% for each 100 BTU under 1000.

Natural gas pressures provided by suppliers vary, so in order to provide the optimal gas supply to the engine, Gorman-Rupp has provided a regulator with the unit that can be adjusted to provide 10 inches of water column of gas pressure to the engine. Install the pressure regulator supplied with the unit in the line supplying the engine, then check and adjust the fuel pressure as described in **CONNECTING FUEL SUPPLY LINE TO THE UNIT**.

LPG FUEL

The term Liquefied Petroleum Gas (LPG) refers to any one of many butane/propane compounds, some of which have additives for specific applications. Commercial grade propane is recommended.

FUEL TANK (LPG ONLY)

The amount of LPG fuel required for the engine is measured in BTU (British Thermal Unit) per hour. **This unit requires 671,159 BTU/hr of LPG fuel at 10 inches of water column.**

The amount of fuel which must be stored at the installation will be determined by the length of time the engine must operate before refueling is necessary. Engine operating time is predicted on system characteristics such as flow rates, pump capacity, anticipated number and duration of power failures in a given time period, programmed engine exercise periods, etc.

On LPG fuel systems, fuel consumption is measured in British Thermal Units per Hour (BTU/HR). This rate of consumption will vary according to engine speed and load. For purposes of determining BTU consumption, assume that all engine operating time will be at full load and at the speed required for rated pumping capacity. (Engine speed is shown on the performance curve on the Gorman-Rupp Specification Data Sheet for the pump). Short periods of idle speed time need not be considered, as fuel consumption at idle is negligible. If extended periods of idle speed time are anticipated, calculated fuel consumption should be increased accordingly.

Consult the local LPG supplier to determine the size of fuel tank required. This determination will be based on the BTU/HR consumption rate, total BTU storage required, local climate conditions, BTU content of the fuel to be supplied, and installation parameters such as local code restrictions and proposed tank location.

On all units, be sure to specify that the tank will be used for vapor withdrawal. In this type of system, fuel is taken from the top of the storage tank in the vapor state, eliminating the need for a LP gas converter, which converts liquid fuel to the vapor required by the engine fuel mixer. The vapor withdrawal system provides an adequate amount of fuel for an engine the size of which is on the pump unit. However, if fuel is used at a rate excessive for the tank size and ambient temperature conditions, freezing may occur in the tank. This problem can usually be anticipated by the LPG supplier and may require selection of a larger tank.

REGULATORS (NATURAL GAS)

The engine is equipped with a natural gas regulator designed to supply the engine with natural gas gas at 6 inches of water column.

Gorman-Rupp has provided a secondary natural gas regulator. This regulator has a maximum inlet pressure of 15 psi (1,0 bar) and an outlet pressure range of 6 to 14 inches (152 to 356 mm) water column. This regulator can be used to supply the 10 inches (254 mm) the engine requires when the gas supplier can only supply a pressure greater than 0.5 psi (0,03 bar). The regulator is shipped loose for field installation and should be located before any fuel lock-off valves in the gas supply line.

REGULATORS (LP GAS)

The engine is equipped with an LP gas regulator designed to supply the engine with LP gas at 6 inches of water column. Gorman-Rupp provides a primary regulator and a secondary regulator with the pump unit.

The pressure in an LPG storage tank with vapor withdrawal will vary depending on temperature. For example, the pressure of propane at 70°F (21°C) is approximately 100 psi (6,9 bar), but this pressure increases to 180 psi (12,4 bar) at 100°F (38°C) and decreases to 18 psi (1,2 bar) at 10°F (−23°C). The primary (first stage) regulator is capable of accepting this wide range of inlet pressures while maintaining approximately 10 psi outlet pressure (see the note below) and should be located on or near the storage tank. The secondary (second stage) regulator then reduces this 10 psi (0,6 bar) pressure at its inlet to an outlet pressure of 10 inches of water column (see the note below). This regulator should be located before any fuel lock-off valve in the supply line. If this regulator is located after a fuel lock-off valve the operation of the regulator will be affected by sudden pressure increase when the lock-off valve opens. The regulators are sized to deliver the fuel flow required by the engine during full load operation while maintaining pressures within specified limits.

NOTE

The primary regulator output pressure of 10 psi (0,7 bar) is used to illustrate a typical system. Actual pressure may be higher or lower depending on code requirements. The primary regulator supplied with the pumping unit has a range of 8 psi to 12 psi (0,5 to 0,8 bar).

The secondary regulator output pressure of 10 inches of water column is used to illustrate a typical system. Actual pressure may be higher or lower

depending on code requirements. The secondary regulator supplied with the pumping unit has a range of 4 inches to 12 inches (102mm to 305mm) of water column.

CONNECTING FUEL SUPPLY LINE TO THE UNIT

There is a 1-inch pipe connection on the outside of the enclosure for connecting the incoming gas supply line. Inside the enclosure, there is a 1-inch pipe tee in the engine fuel line. The tee is equipped with a reducer and a 1/4-inch pipe plug. Remove the pipe plug and install a pressure gauge rated in inches of water column.

Open the fuel supply to the regulator and observe the pressure gauge. If the reading is less or greater than 10 inches of water column, remove the cap on the regulator to expose the adjusting screw plug beneath it. Turn the adjusting plug clockwise to increase the fuel supply or counter-clockwise to decrease the fuel supply.

When the supply is properly adjusted to 10 inches of water column, reinstall the protective cap over the adjusting screw on the regulator. Remove the pressure gauge from the fuel line and reinstall the 1/4-inch pipe plug to avoid vibration damage to the gauge.

CHANGING FUEL TYPE

If it is necessary to change the type of fuel from natural gas to LP gas or vice-versa, the fuel line inside the enclosure to the engine must first be switched to the correct regulator on the engine for the desired fuel. After switching the fuel line, set the toggle switch on the engine control to the desired fuel. This tells the engine control module the fuel has been changed so the engine can compensate for the change in fuel supply. After these changes are complete, check the fuel pressure as described in **CONNECTING FUEL SUPPLY LINE TO THE UNIT**.

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).

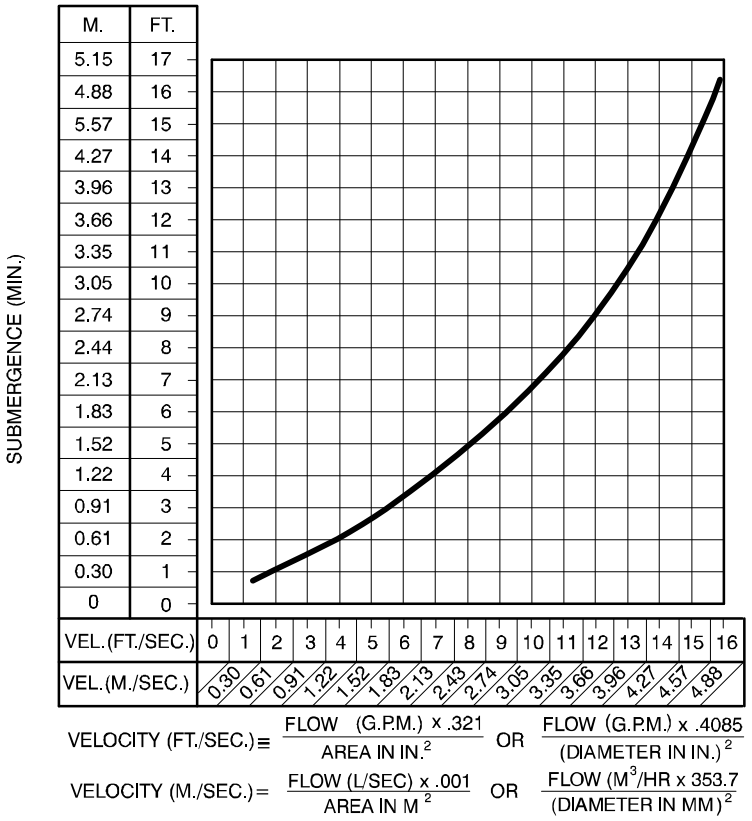


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

SUBMERSIBLE TRANSDUCER

This unit is 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 3 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**.

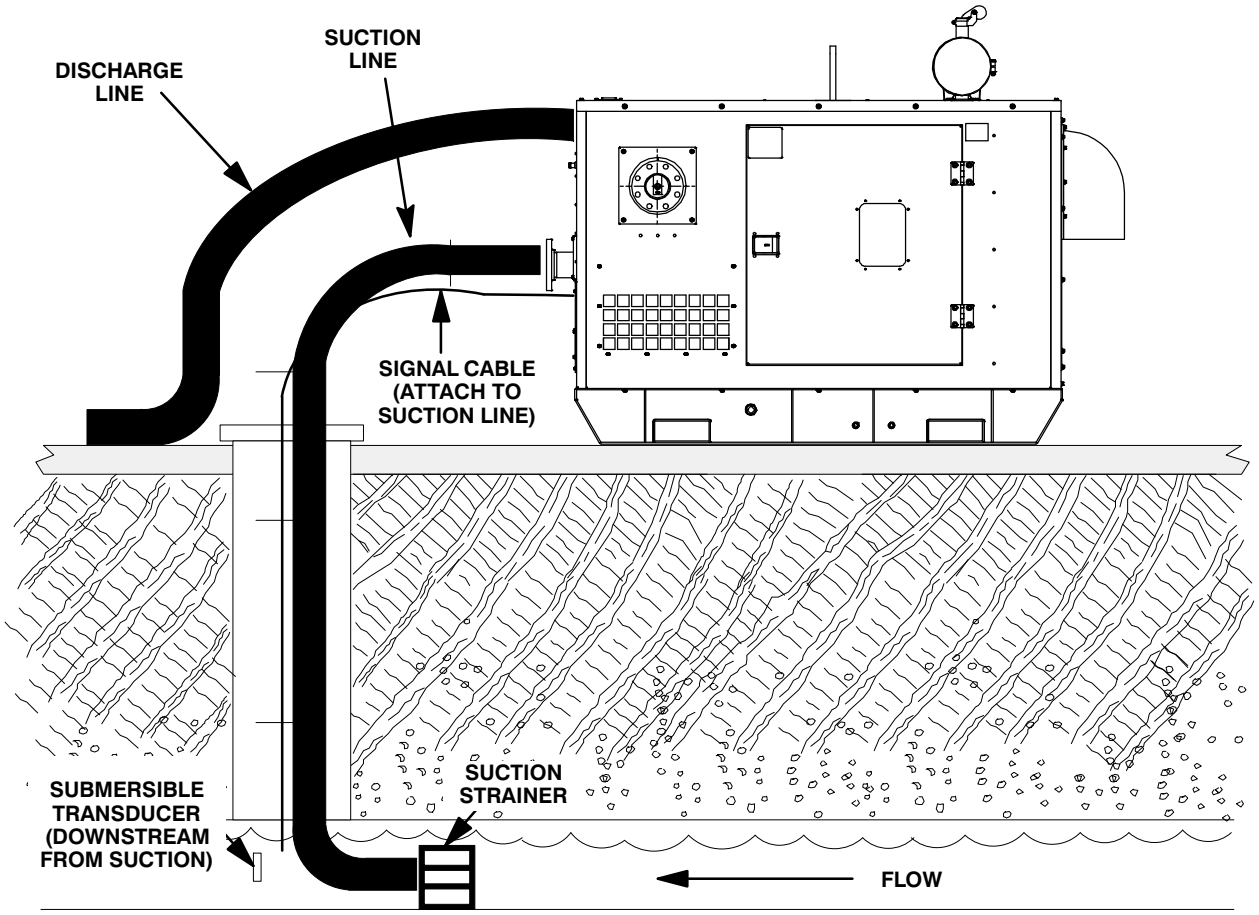


Figure 3. Typical Submersible Transducer Installation

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.

CAUTION

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

OPERATION – SECTION C

OPERATION

Review all SAFETY information in Section A.

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

DANGER!

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.

WARNING!

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.

CAUTION

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.

CAUTION

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.

WARNING!

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.

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.

CAUTION

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.

WARNING!

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.

OPTIONAL EPS CONTROL

Features

The optional EPS Control is equipped with a 12VDC Electronic Pressure Switch which includes the following features:

- 3 Output Relays: 1. A output, delayed
  2. B output, no delay
  3. Horn output, no delay
- 3 Inputs: 1. Horn silence
  2, Pressure transducer
  3. Low Temp Thermostat
- LCD screen with backlight for function monitoring
- Bright LEDs to indicate output status and display modes
- Three switches on front panel for **all** adjustments
- Battery level indicator on LCD screen to alert operator of low battery condition
- Microprocessor Control
- Error display to alert user of errors in calibration

Functional Description

Front Panel Controls/Displays

1. The LCD screen displays level information, A and B setpoint off/on levels, Horn delay, and calibration information.

   Typical Messages on the display:

   a) EEP bAd... Eeprom memory is not correct, user **must** recalibrate unit.

   b) USr CAL... User calibrate mode, i.e., user **wants** to calibrate unit.

   c) SEt a.oF... A OFF setpoint, units of level.

   d) SEt a.on... A ON setpoint, units of level.

   e) SEt b.oF... B OFF setpoint, units of level.

   f) SEt b.on... B ON setpoint, units of level.

   g) Hrn dLy... Horn on, A output delay time, 5—30 seconds, in 5-second increments.

   h) LO BAT... Indicator, shows battery voltage level is below 12VDC.

   i) Lo tpt... Shows status of Low Temperature Thermostat contacts.

2. LEDs:

   a) When the green LED is lighted, the unit is showing level on the LCD display.

   b) When the A output LED is lighted, the A output relay is closed.

   c) When the B output LED is lighted, the B output relay is closed

NOTE

LED's and all segments of the display are lighted

upon connection of power as a lamp test feature. However, no relay outputs are closed during test.

3. Switches:

   a) The ↻ switch functions as a "round robin" type switch. Pressing this switch will cause the unit to show the next selection in the order listed above.

   b) The ▽ switch functions to decrease the selection showing. This switch can be used to decrease the smallest digit by "bumping" the switch, or to continuously decrease the digit by pressing and holding for at least one second and releasing when desired setting is reached.

   c. The △ switch functions to increase the selection showing. This switch can be used to increase the smallest digit by "bumping" the switch, or to continuously increase the digit by pressing and holding for at least one second and releasing when desired setting is reached.

Liquid level adjustment of the Electronic Pressure Switch is accomplished using the three buttons on the control. For EPS functions and level adjustment, refer to the following instructions.

EPS Functions

Actual functions of the control occur as follows:

Power is applied to the unit.

Unit performs display test for approximately 4 seconds.

When the pressure level showing is equal to or greater than the "A.on" setpoint, the Horn output contacts will close in approximately 1 second and a delay, equal to the "Hrn dLy" time, will occur before the A output contacts close.

When the level showing is equal to or greater than the "B.on" setpoint, the B output contacts will close in approximately 1 second.

When the pressure decreases to a level equal to or less than the "B.of" setpoint, B output contacts will open in approximately one second.

When the pressure decreases to a level equal to or less than the "A.of" setpoint, A output contacts will open in approximately one second.

If an optional Low Temperature Thermostat is connected to the unit and the thermostat contacts close, the unit displays "lo tpt" on the display. In approximately 1 second, the Horn output contacts close, then after the "Hrn dLy" time, A output contacts close. A output contacts will remain closed as long as Low Temperature Thermostat contacts are closed.

When the Low Temperature Contacts open, A output contact will open **only** if the level is equal to or less than the "A.off" setpoint.

As long a the Low Temperature Thermostat contacts are closed, the display will show "lo tpt" unless ↻ switch is pressed to display some other information. Level is not viewable until the Low Temperature Thermostat contacts open.

The user may wish to check Setpoints Off/On and Horn output/A output delay times. "Bumping" the ↻ switch will display all of the information desired.

NOTE

One second delays in contact opening/closing is a result of time sampling of the pressure signal to filter false signals that could cause "nuisance" tripping of the contacts.

NOTE

If the "Hrn dLy" is changed during the actual A output delay cycle, the current cycle is not changed; the change becomes effective on the next A output delay cycle.

CAUTION

Use caution to ensure that the "--.on" setpoint (i.e. "A.on") is not adjusted to a level less than the corresponding "--.of" setpoint (i.e. "A.of"). Improper adjustment of the off/on setpoints will render the unit nonfunctional, resulting in flooding.

EPS Calibration

NOTE

Zero offset and span adjustments are only necessary to calibrate a new unit, or when replacing the transducer. Once calibrated, "ON" and "OFF" setpoints will be stored in the unit's memory. Liquid level adjustments will be used whenever "ON" and "OFF" liquid levels must be reset.

There are two reasons for the user to calibrate the unit. When power is applied, the unit confirms setpoints and other calibration information for validity. If the setpoints are not valid, the LCD screen shows "EEP bAd" and the unit must be recalibrated. Also, if the unit is moved, or some other external change takes place, the unit must be recalibrated.

Zero Adjustment

Zero adjustment tells the unit when the transducer is exposed to zero water (atmospheric) pressure. When recalibration is desired, hold the transducer in hand and apply power to the unit. The LCD screen will display "Level ABC". Press and hold ↻ for 5 seconds. The LCD screen displays "Input? External XDUCR". Perform the following calibration procedures.

Press ↻ 3 times and the LCD screen will display "Calibrate Zro". Press △ or ▽ until a character or number on the display changes.

Press ↻ to accept the entry and advance to "Calibrate Span".

Span Adjustment

Span adjustment calibrates the unit to a known water pressure (depth). To set:

Submerge the transducer to an exact known depth. At "Calibrate Span", the span setting in the unit's memory will display. Press △ to increase or ▽ to decrease the value unitl the LCD screen display equals the actual known depth of the transducer.

Level Adjustment

Level adjustment tells the unit when to turn the pump on and off. To set:

From "Level ABC" display, press ↻ once and "Pump Setpt A On" will display. Press △ to increase or ▽ to decrease to the desired level at which the pump turns on. Press ↻ to advance to "Pump Setpt A Off". Press △ to increase or ▽ to decrease to the desired level at which the pump turns off.

Press ↻ again to advance to "Pump Setpt B On". If "B" is to be used, repeat the procedure described above for adjusting level "A".

Horn Delay

The horn delay is pre-set from the factory through the engine control panel, therefore this function is not utilized through the EPS.

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.

WARNING!

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 restarting.

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**.

WARNING!

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'.

CAUTION

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.

WARNING!

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.

WARNING!

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine, remove the key 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.**

WARNING!

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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Not enough liquid in casing.	Add liquid to casing. See **PRIMING**.
	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 **INSTALLATION**.
	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.
	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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.)	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 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 REQUIRES TOO MUCH POWER	Pump speed too high.	Check engine output.
	Discharge head too low.	Adjust discharge valve.
	Liquid solution too thick.	Dilute if possible.
	Bearing(s) frozen.	Disassemble pump and check bearing(s).
PUMP CLOGS FREQUENTLY	Discharge flow too slow.	Open discharge valve fully to increase flow rate, and run engine at maximum governed speed.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Liquid solution too thick.	Dilute if possible.
EXCESSIVE NOISE	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.
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits.	Check bearing temperature regularly to monitor any increase.
	Low or incorrect lubricant.	Check for proper type and level of lubricant.
	Suction and discharge lines not properly supported.	Check piping installation for proper support.
	Drive misaligned.	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.

Preventive Maintenance Schedule

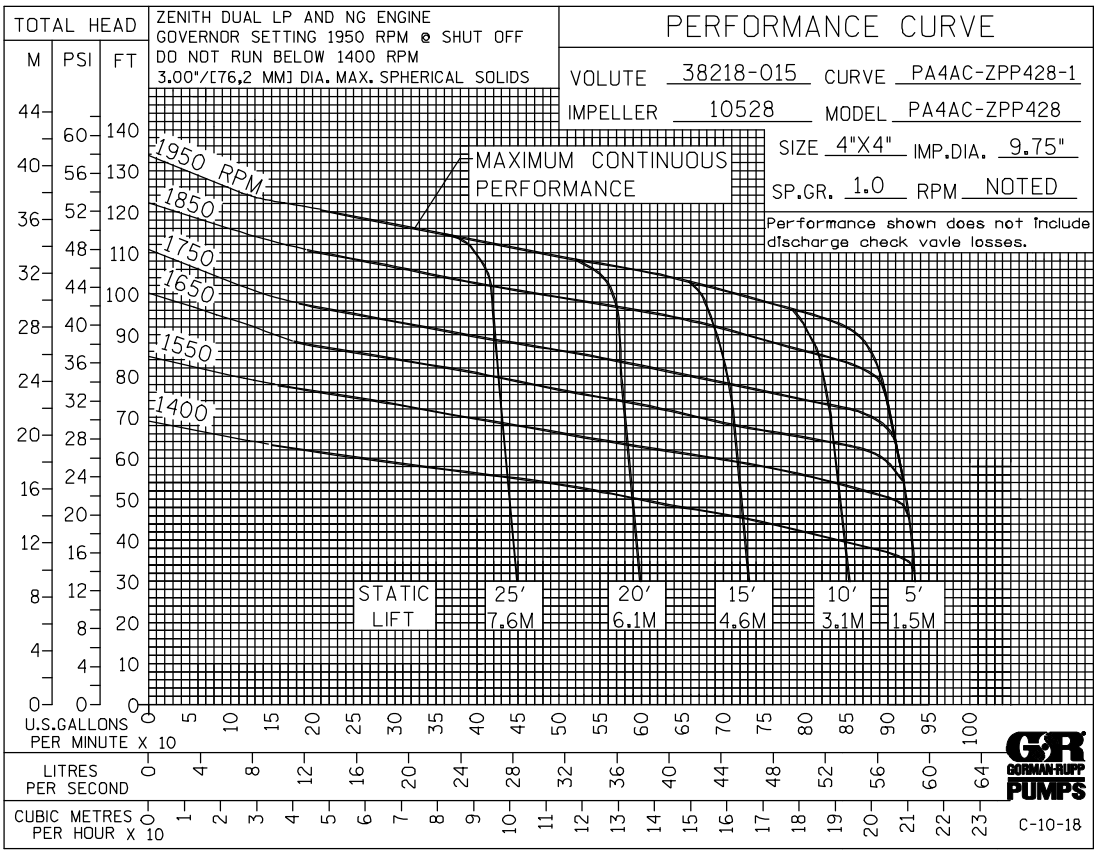
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication (And Packing Adjustment, If So Equipped)		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					

Legend:
I = Inspect, Clean, Adjust, Repair or Replace as Necessary
C = Clean
R = Replace

* Service interval based on an intermittant duty cycle equal to approximately 4000 hours annually. Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.

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 PA4A60C—ZPP428—ESP

✳ 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.

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 performance or part numbers.

CAUTION

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

ILLUSTRATION

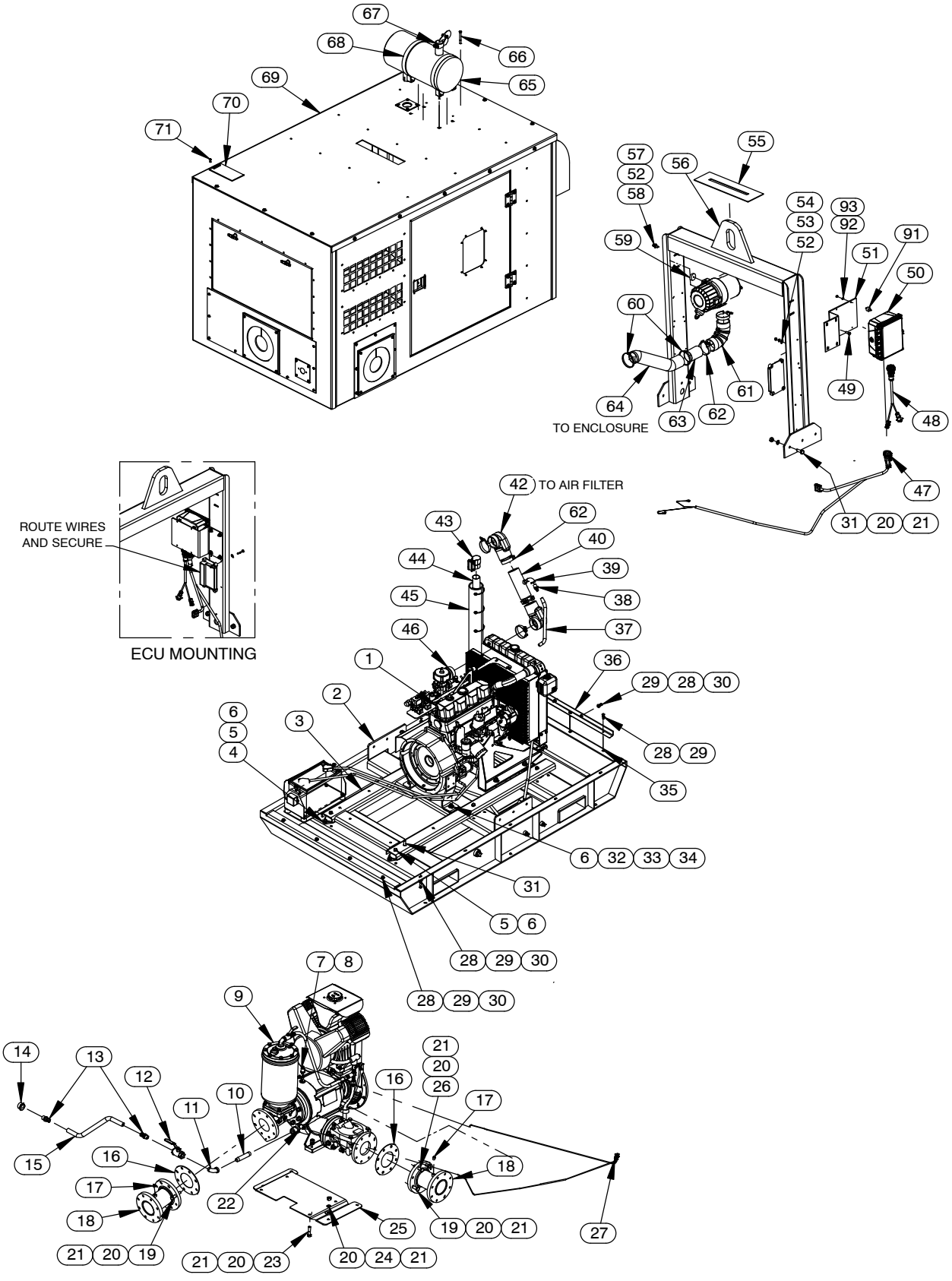


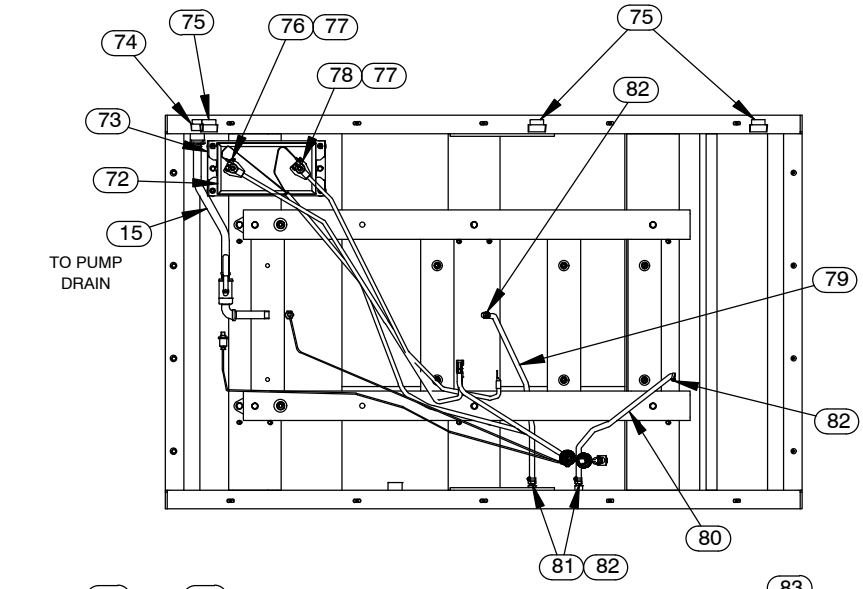
Figure 1. Pump Model PA4A60C—ZPP428—ESP

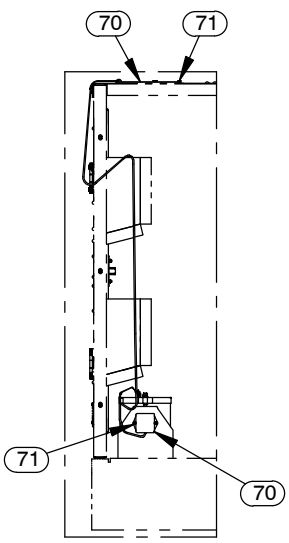
PARTS LIST
Pump Model PA4A60C–ZPP428–ESP
(From S/N 1722839 Up)

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.

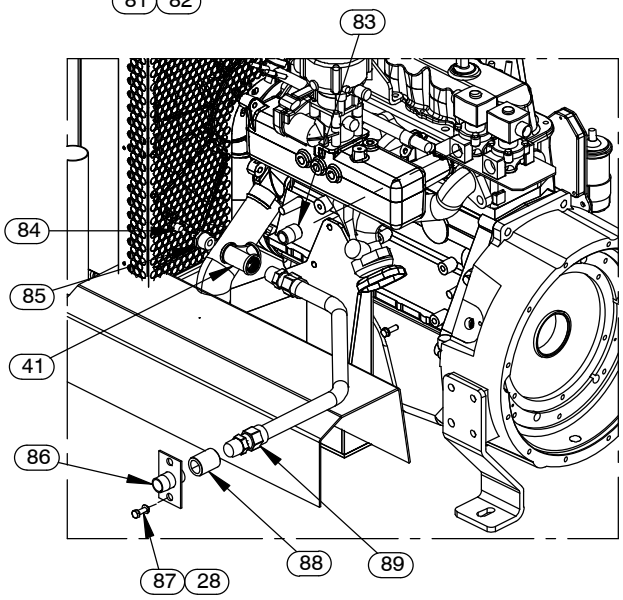
ITEM NO.	PART NAME	PART NUMBER	QTY
1	ZENITH ENGINE	29267–003	1
2	BASE WELDMENT	41565–616 24150	1
3	SUB BASE ASSY	41535–622 24150	1
4	COMPRESSION MOUNT	24631–104	6
5	HEX HEAD CAP SCREW	B0805 15991	18
6	LOCK WASHER	J08 15991	24
7	DSCHRG TRANSDUCER	27780–989	1
8	REDUCER PIPE BUSHING	AP0604 15079	1
9	PUMP END ASSY	46133–695	1
10	PIPE NIPPLE	T1220 15079	1
11	STREET ELBOW	RS12 11999	1
12	3/4 BALL VALVE	26631–034	1
13	HOSE BARB FITTING	26523–392	2
14	REDUCER PIPE BUSHING	AP2012 11999	1
15	.75 ID X 24" LG HOSE	18513–305	1
16	GASKET	25113–034	2
17	PIPE PLUG	P04 15079	2
18	PIPE ASSEMBLY	46353–205 24150	2
19	HEX HEAD CAP SCREW	B1012 15991	14
20	LOCK WASHER	J10 15991	30
21	HEX NUT	D10 15991	30
22	SUCTION TRANSDUCER	27780–988	1
23	HEX HEAD CAP SCREW	B1010 15991	4
24	FLAT WASHER	K10 15991	4
25	MNTNG BRACKET ASSY	41581–091 24150	1
26	HEX HEAD CAP SCREW	B1011 15991	2
27	TRANSDUCER CBL ASSY	47367–090	1
28	LOCK WASHER	J05 15991	27
29	HEX HEAD CAP SCREW	B0505 15991	25
30	FLAT WASHER	K05 15991	17
31	HEX HEAD CAP SCREW	B1007 15991	10
32	FLAT WASHER	K08 15991	6
33	HEX NUT	D08 15991	6
34	HEX HEAD CAP SCREW	B0806 15991	6
35	THREADED INSERT	21769–160	8
36	MOUNTING ASSY	41888–398	1
37	.50 ID X 18" LG HOSE	18513–303	1
38	MALE HOSE END	26525–020	1
39	STREET ELBOW	RS08 11999	1
40	AIR INTAKE PIPE ASSY	46671–506 24150	1
41	TEE 3/4"	U12 11990	1
42	90 DEG COBRA ELBOW, 3"	29196–072	2
43	BAND CLAMP 2"	29196–074	2
44	FLEX EXHAUST ASSEMBLY	46241–523	1
45	EXHAUST BLANKET	46241–016	1
46	INSERT	29284–042	1
47	HARNESS – INTERNAL	29196–075	1
48	TRANSDUCER HARNESS	29196–076	1
49	HEX HEAD CAP SCREW	B0605 15991	4
50	CONTROL PANEL	29196–071	1
51	CNTRL PANEL MTG BRKT	34512–061 13000	1
52	FLAT WASHER	K06 15991	6
53	LOCK WASHER	J06 15991	14
54	HEX NUT	D06 15991	4
55	GASKET	33311–060 19460	1
56	HOIST BAIL ASSY	44713–062 24150	1
57	HEX NUT W/FLANGE	21765–314	2
58	HEX HEAD CAP SCREW	B0606 15991	12
59	SPACER	31141–034 17040	2
60	4IN HOSE CLAMP	26518–675	2
61	ELBOW	29284–039	1
62	TBOLT CLAMP 3.5 IN	26518–164	6
63	EXHAUST TUBING	31417–076 15210	1
64	THERM HOSE X 18" LG	18533–173	1
65	EXHAUST SILENCER	46211–502	1
66	HEX HEAD CAP SCREW	B0614 15991	2
67	WEATHER CAP	S1246	1
68	MUFFLER MTG BRACKET	29334–288	2
69	ENCLOSURE ASSEMBLY	42164–050	1
70	SOLAR CHARGER	27558–013	1
71	TAP SCREW #10 X 3/4	21281–446	6
72	BATTERY 12V	29331–527	1
73	BATTERY BOX ASSY	42432–005	1
74	PIPE PLUG	P20 14990	2
75	PIPE PLUG	P32 14990	3
76	1/0 NEG. CABLE ASSY	47311–142	1
77	SQUARE HEAD BOLT	A0506 15991	2
78	1/0 POS. CABLE ASSY	47311–118	1
79	.38 I.D. X 29" LG HOSE	18513–054	1
80	.38 I.D. X 28" LG HOSE	18513–054	1
81	HOSE FITTING	26523–335	2
82	HOSE CLAMP	26518–642	4
83	CLOSE PIPE NIPPLE	T12 15070	1
84	PIPE PLUG	P04 15070	1
85	REDUCER PIPE BUSHING	AP1204 15070	1
86	GAS PLATE WELDMENT	41888–410	1
87	HEX HEAD CAP SCREW	B0504 15991	2
88	PIPE CPLG 3/4	AE12 15070	1
89	FUEL LINE 3/4"	29332–303	1
90	PIPE PLUG	P08 14990	2
91	STUD MOUNT	24631–014	4
92	LOCK WASHER	J04 15991	4
93	HEX NUT	D04 15991	4
NOT SHOWN:			
	LPG PRESS REGULATOR	29332–329	1
	CABLE TIE 1 1/4	27111–205	6
	TRANSDUCER KIT	48312–993	1
	PUMP DRAIN LABEL	38816–320	1
	SUCTION STICKER	6588AG	1
	DISCHARGE STICKER	6588BJ	1
	OIL DRAIN LABEL	38816–323	1
	RADIATOR DRAIN LABEL	38816–322	1
	ENGINE START–UP TAG	38816–269	1
	WARNING DECAL	38816–203	2
	CAUTION DECAL	2613FJ	1
	WARNING DECAL	2613FE	2
	INSTRUCTION DECAL	38818–144	1
	WARNING DECAL	38817–101	2
	WARNING DECAL	38817–102	2

ILLUSTRATION





SOLAR CHARGING KIT
MOUNTING AND ROUTING



FUEL LINE CONNECTION

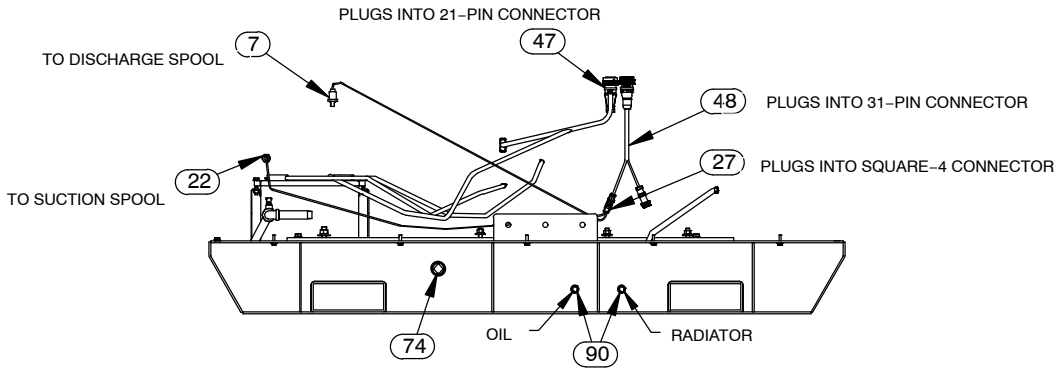


Figure 2. Pump Model PA4A60C–ZPP428–ESP (cont'd)

PARTS LIST
Pump Model PA4A60C–ZPP428–ESP

ITEM NO.	PART NAME	PART NUMBER	QTY
1	ZENITH ENGINE	29267–003	1
2	BASE WELDMENT	41565–616 24150	1
3	SUB BASE ASSY	41535–622 24150	1
4	COMPRESSION MOUNT	24631–104	6
5	HEX HEAD CAP SCREW	B0805 15991	18
6	LOCK WASHER	J08 15991	24
7	DSCHRG TRANSDUCER	27780–989	1
8	REDUCER PIPE BUSHING	AP0604 15079	1
9	PUMP END ASSY	46133–695	1
10	PIPE NIPPLE	T1220 15079	1
11	STREET ELBOW	RS12 11999	1
12	3/4 BALL VALVE	26631–034	1
13	HOSE BARB FITTING	26523–392	2
14	REDUCER PIPE BUSHING	AP2012 11999	1
15	.75 ID X 24” LG HOSE	18513–305	1
16	GASKET	25113–034	2
17	PIPE PLUG	P04 15079	2
18	PIPE ASSEMBLY	46353–205 24150	2
19	HEX HEAD CAP SCREW	B1012 15991	14
20	LOCK WASHER	J10 15991	30
21	HEX NUT	D10 15991	30
22	SUCTION TRANSDUCER	27780–988	1
23	HEX HEAD CAP SCREW	B1010 15991	4
24	FLAT WASHER	K10 15991	4
25	MNTNG BRACKET ASSY	41581–091 24150	1
26	HEX HEAD CAP SCREW	B1011 15991	2
27	TRANSDUCER CBL ASSY	47367–090	1
28	LOCK WASHER	J05 15991	27
29	HEX HEAD CAP SCREW	B0505 15991	25
30	FLAT WASHER	K05 15991	17
31	HEX HEAD CAP SCREW	B1007 15991	10
32	FLAT WASHER	K08 15991	6
33	HEX NUT	D08 15991	6
34	HEX HEAD CAP SCREW	B0806 15991	6
35	THREADED INSERT	21769–160	8
36	MOUNTING ASSY	41888–398	1
37	.50 ID X 18” LG HOSE	18513–303	1
38	MALE HOSE END	26525–020	1
39	STREET ELBOW	RS08 11999	1
40	AIR INTAKE PIPE ASSY	46671–506 24150	1
41	TEE 3/4”	U12 11990	1
42	90 DEG COBRA ELBOW, 3”	29196–072	2
43	BAND CLAMP 2”	29196–074	2
44	FLEX EXHAUST ASSEMBLY	46241–523	1
45	EXHAUST BLANKET	46241–016	1
46	INSERT	29284–042	1
47	HARNESS – INTERNAL	29196–075	1
48	TRANSDUCER HARNESS	29196–076	1
49	HEX HEAD CAP SCREW	B0605 15991	4
50	CONTROL PANEL	29196–071	1
51	CNTRL PANEL MTG BRKT	34512–061 13000	1
52	FLAT WASHER	K06 15991	6
53	LOCK WASHER	J06 15991	14
54	HEX NUT	D06 15991	4
55	GASKET	33311–060 19460	1
56	HOIST BAIL ASSY	44713–062 24150	1
57	HEX NUT W/FLANGE	21765–314	2
58	HEX HEAD CAP SCREW	B0606 15991	12
59	SPACER	31141–034 17040	2
60	4IN HOSE CLAMP	26518–675	2
61	ELBOW	29284–039	1
62	TBOLT CLAMP 3.5 IN	26518–164	6
63	EXHAUST TUBING	31417–076 15210	1
64	THERM HOSE X 18” LG	18533–173	1
65	EXHAUST SILENCER	46211–502	1
66	HEX HEAD CAP SCREW	B0614 15991	2
67	WEATHER CAP	S1246	1
68	MUFFLER MTG BRACKET	29334–288	2
69	ENCLOSURE ASSEMBLY	42164–050	1
70	SOLAR CHARGER	27558–013	1
71	TAP SCREW #10 X 3/4	21281–446	6
72	BATTERY 12V	29331–527	1
73	BATTERY BOX ASSY	42432–005	1
74	PIPE PLUG	P20 14990	2
75	PIPE PLUG	P32 14990	3
76	1/0 NEG. CABLE ASSY	47311–142	1
77	SQUARE HEAD BOLT	A0506 15991	2
78	1/0 POS. CABLE ASSY	47311–118	1
79	.38 I.D. X 29” LG HOSE	18513–054	1
80	.38 I.D. X 28” LG HOSE	18513–054	1
81	HOSE FITTING	26523–335	2
82	HOSE CLAMP	26518–642	4
83	CLOSE PIPE NIPPLE	T12 15070	1
84	PIPE PLUG	P04 15070	1
85	REDUCER PIPE BUSHING	AP1204 15070	1
86	GAS PLATE WELDMENT	41888–410	1
87	HEX HEAD CAP SCREW	B0504 15991	2
88	PIPE CPLG 3/4	AE12 15070	1
89	FUEL LINE 3/4”	29332–303	1
90	PIPE PLUG	P08 14990	2
91	STUD MOUNT	24631–014	4
92	LOCK WASHER	J04 15991	4
93	HEX NUT	D04 15991	4
NOT SHOWN:			
	LPG PRESS REGULATOR	29332–329	1
	CABLE TIE 1 1/4	27111–205	6
	TRANSDUCER KIT	48312–993	1
	PUMP DRAIN LABEL	38816–320	1
	SUCTION STICKER	6588AG	1
	DISCHARGE STICKER	6588BJ	1
	OIL DRAIN LABEL	38816–323	1
	RADIATOR DRAIN LABEL	38816–322	1
	ENGINE START–UP TAG	38816–269	1
	WARNING DECAL	38816–203	2
	CAUTION DECAL	2613FJ	1
	WARNING DECAL	2613FE	2
	INSTRUCTION DECAL	38818–144	1
	WARNING DECAL	38817–101	2
	WARNING DECAL	38817–102	2

ILLUSTRATION

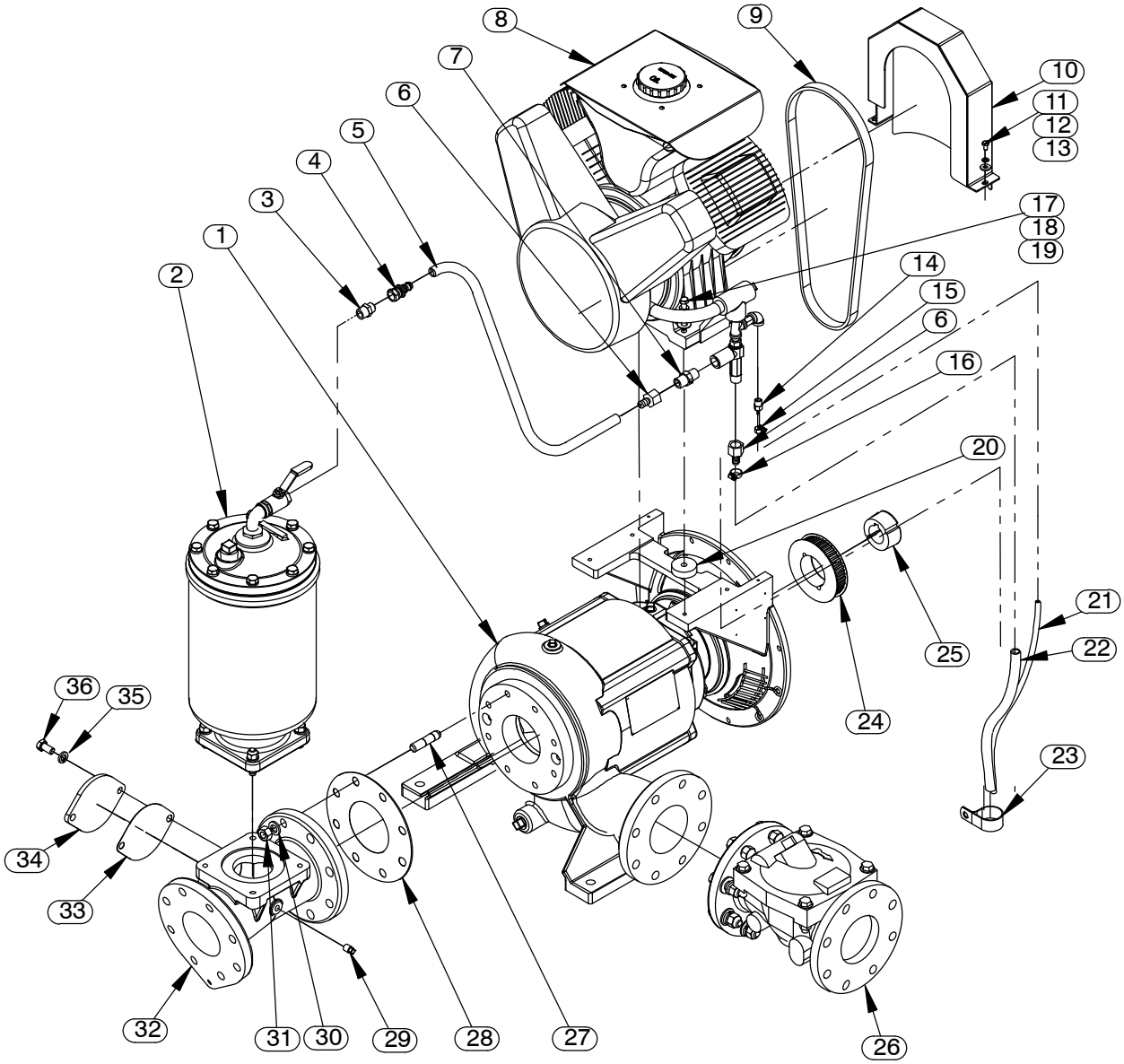


Figure 3. Pump End Assembly

PARTS LIST
Pump End Assembly

ITEM NO.	PART NAME	PART NUMBER	QTY
1	PUMP END ASSEMBLY	46133–694	1
2	PRIMING CHAMBER KIT	48275–005	1
3	CONNECTOR	S1598	1
4	HOSE BARB FTG	26523–047	1
5	.50” ID x 30” LG HOSE	18513–113	1
6	HOSE BARB FITTING	26523–446	2
7	CHECK VALVE	26641–092	1
8	AIR COMPRESSOR ASSY	46181–907	1
9	SYNCHRONOUS BELT	24186–008	1
10	BELT GUARD ASSY	42351–326 24150	1
11	HEX HEAD CAP SCREW	B0402 15991	2
12	LOCK WASHER	J04 15991	2
13	FLAT WASHER	K04 15991	2
14	HOSE BARB FITTING	26523–386	1
15	HOSE CLAMP	26518–641	1
16	HOSE CLAMP	26518–642	1
17	HEX HEAD CAP SCREW	B0610 15991	4
18	LOCK WASHER	J06 15991	4
19	FLAT WASHER	K06 15991	4
20	SPACER	31141–034 17040	4
21	.19” ID X 24” LG HOSE	18513–301	1
22	.50” ID X 20” LG HOSE	18513–113	1
23	CLAMP	27111–348	1
24	SPROCKET	24271–112	1
25	BUSHING	24131–496	1
26	CHECK VALVE KIT 4”	48274–003	1
	–CHECK VALVE	26642–124	1
✳	–FLAPPER	26688–005	1
✳	–O-RING	25152–366	1
27	STUD	C1011 15991	8
28 ✳	GASKET	1676G 18000	1
29	PIPE PLUG	P04 15079	1
30	LOCK WASHER	J10 15991	8
31	HEX NUT	D10 15991	8
32	4” HOPPER SPOOL	38644–802 10000	1
33 ✳	GASKET	38689–037 18000	1
34	COVER PLATE	38244–021 15080	1
35	LOCK WASHER	J08 15991	2
36	HEX HEAD CAP SCREW	B0804 15991	2
NOT SHOWN:			
	4” STRAINER ASSEMBLY	2690C 24000	1
	G-R DECAL 6 IN	GR–06	1
	WARNING DECAL	38817–102	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

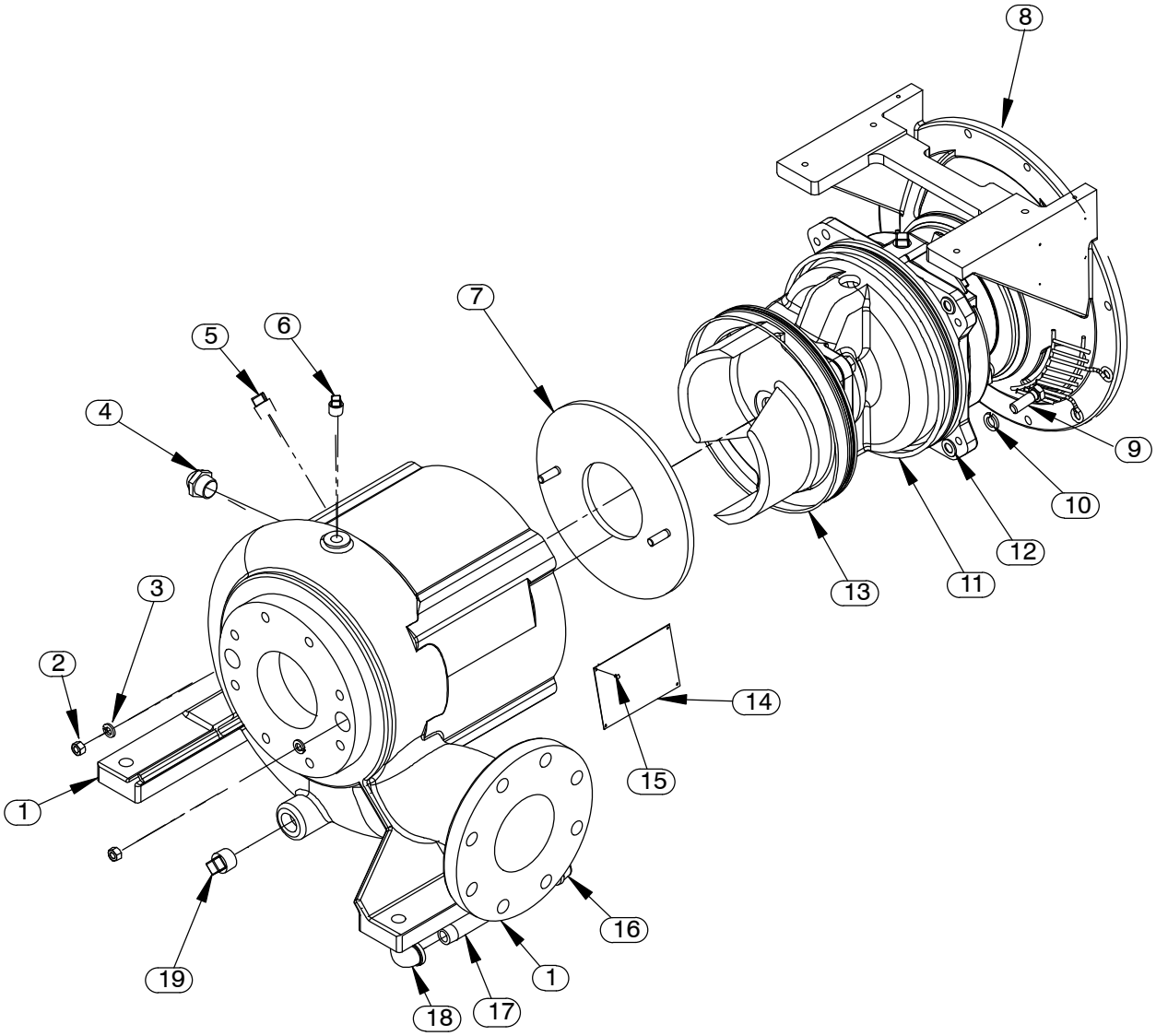


Figure 4. Pump End Assembly

PARTS LIST
Pump End Assembly

	ITEM NO.		PART NAME	PART NUMBER	QTY
☞	1		PUMP CASING	SEE NOTE BELOW	1
	2		HEX NUT	D06 15991	2
	3		LOCK WASHER	J06 15991	2
	4		SIGHT GAUGE	S1471	1
☞	5		PIPE PLUG	P08 15079	1
☞	6		PIPE PLUG	P06 15079	1
	7		WEAR PLATE ASSY	10532B 15990	1
	8		REPAIR ROTATING ASSY	44163–451	1
	9		HEX HEAD CAP SCREW	B0806 15991	4
	10		LOCK WASHER	J08 15991	4
	11	✳	O-RING	S1674	1
	12		SHIM SET – .50 DIA SHAFT	13130 17040	4
	13	✳	O-RING	25152–273	1
	14		NAMEPLATE BLANK	38819–002 13000	1
	15		DRIVE SCREW	BM#04–03 17000	4
	16		PIPE CAP	V08 15079	1
	17		PIPE NIPPLE	T0822 15079	1
	18		STREET ELBOW	RS08 11999	1
☞	19		PIPE PLUG	P12 15079	1
NOT SHOWN:					
			OIL LEVEL DECAL	38816–123	1
			SUCTION STICKER	6588AG	1
			ROTATION DECAL	2613M	1
			WARNING DECAL	2613FE	1
			DISCHARGE STICKER	6588BJ	1
			LUBRICATION DECAL	11421A	1
			INSTRUCTION TAG	38817–085	1
			DRIVE ASSEMBLY	44162–160	1
☞			INCLUDED W/REPAIR PUMP CASING ASSY	46474–354	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

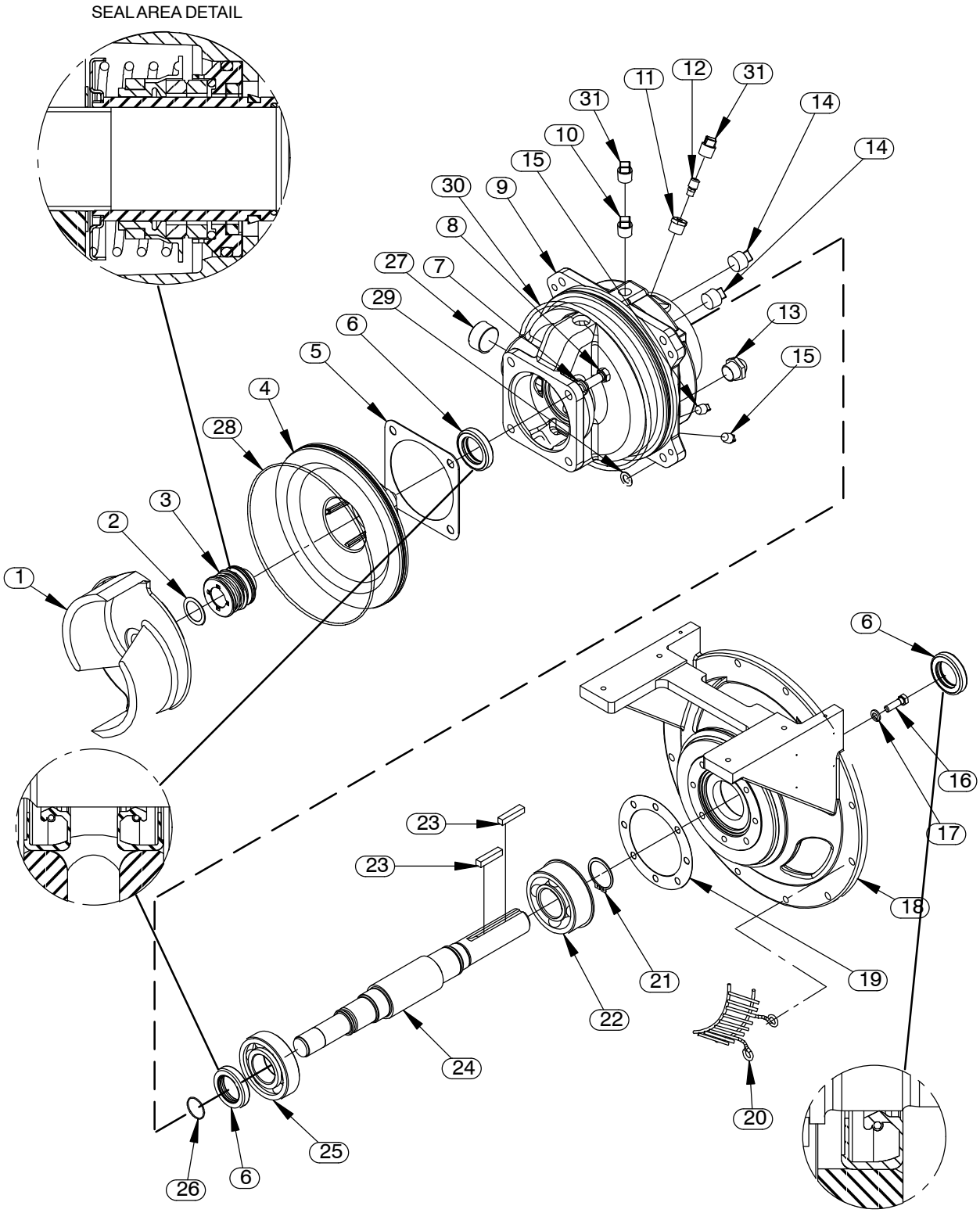


Figure 5. Repair Rotating Assembly

PARTS LIST
Repair Rotating Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1	✳	IMPELLER	10528 11010	1
2	✳	ADJ. SHIM SET	37J 17090	REF
3	✳	1.50 SEAL ASSY	46513–151	1
4		SEAL PLATE	38272–234 10010	1
5	✳	GASKET	10959G 20000	1
6	✳	OIL SEAL	S1352	3
7		LOCK WASHER	J08 15991	4
8		HEX HEAD CAP SCREW	B0805–1/2 15991	4
9		BEARING HOUSING	38251–423 10000	1
10		VENTED PIPE PLUG	4823A 15079	1
11		REDUCER PIPE BUSHING	AP0802 15079	1
12		AIR VENT	S1530	1
13		SIGHT GAUGE	S1471	1
14		PIPE PLUG	P12 15079	2
15		PIPE PLUG	P04 15079	2
16		HEX HEAD CAP SCREW	21632–934	8
17		LOCK WASHER	J06 15991	8
18		MOUNTING FLANGE	38545–013 11010	1
19	✳	GASKET	38683–275 18000	1
20		INTERMEDIATE GUARD	42381–509 24152	2
21		RETAINING RING	S442	1
22	✳	BALL BEARING	S375	1
23	✳	KEY	N0607 15990	2
24	✳	IMPELLER SHAFT	38514–822 1706H	1
25	✳	BALL BEARING	S1088	1
26	✳	O-RING	25154–022	REF
27		SOC HD PIPE PLUG	PC20 10009	1
28	✳	O-RING	25152–273	1
29		SHIM SET – .50 DIA SHAFT	13130 17040	4
30	✳	O-RING	S1674	1
31		SHIPPING PLUG	11495B 15079	2
NOT SHOWN:				
		INSTRUCTION TAG	6588U	1
		WARNING DECAL	38817–102	2

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

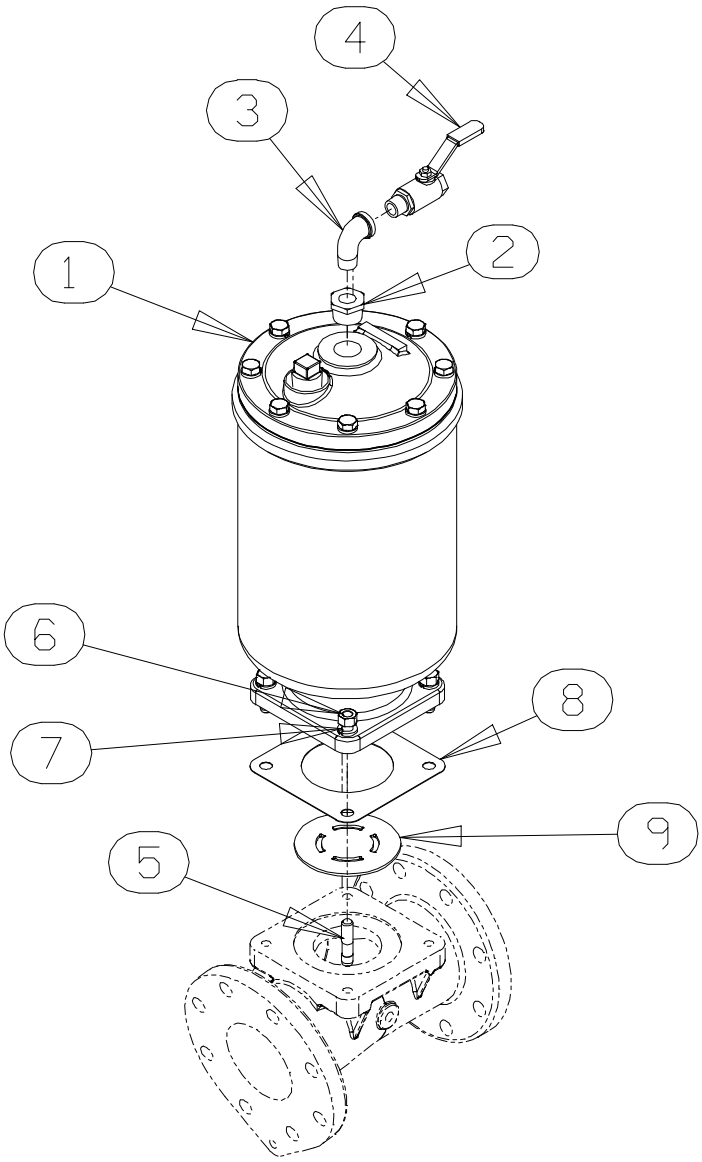


Figure 6. Priming Chamber Kit

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PRIMING CHAMBER ASSY	46112−709	1
2		REDUCER PIPE BUSHING	AP1608 15070	1
3		STREET ELBOW	RS08 11999	1
4		BALL VALVE	26631−052	1
5		STUD	C0809 15991	4
6		HEX NUT	D08 15991	4
7		LOCK WASHER	J08 15991	4
8	✳	GASKET	38687−053 19060	1
9		BAFFLE	31113−011 17000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

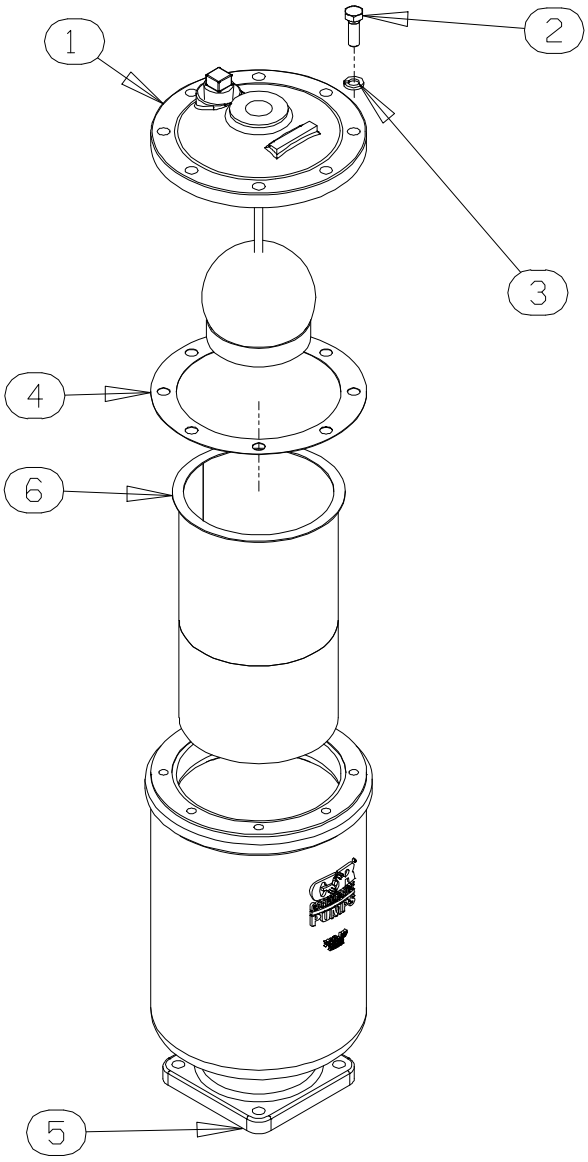


Figure 7. Priming Chamber Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PRIMING VALVE	26664−007	1
		−ORIFICE BUTTON	26688−021	1
2		HEX HD CAPSCREW	B0806 15991	8
3		LOCKWASHER	J08 15991	8
4	✳	PRIMING VALVE GASKET	38683−657 19060	1
5		PRIMING CHAMBER	38343−020 10000	1
6		STRAINER ASSY	46641−222 17000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

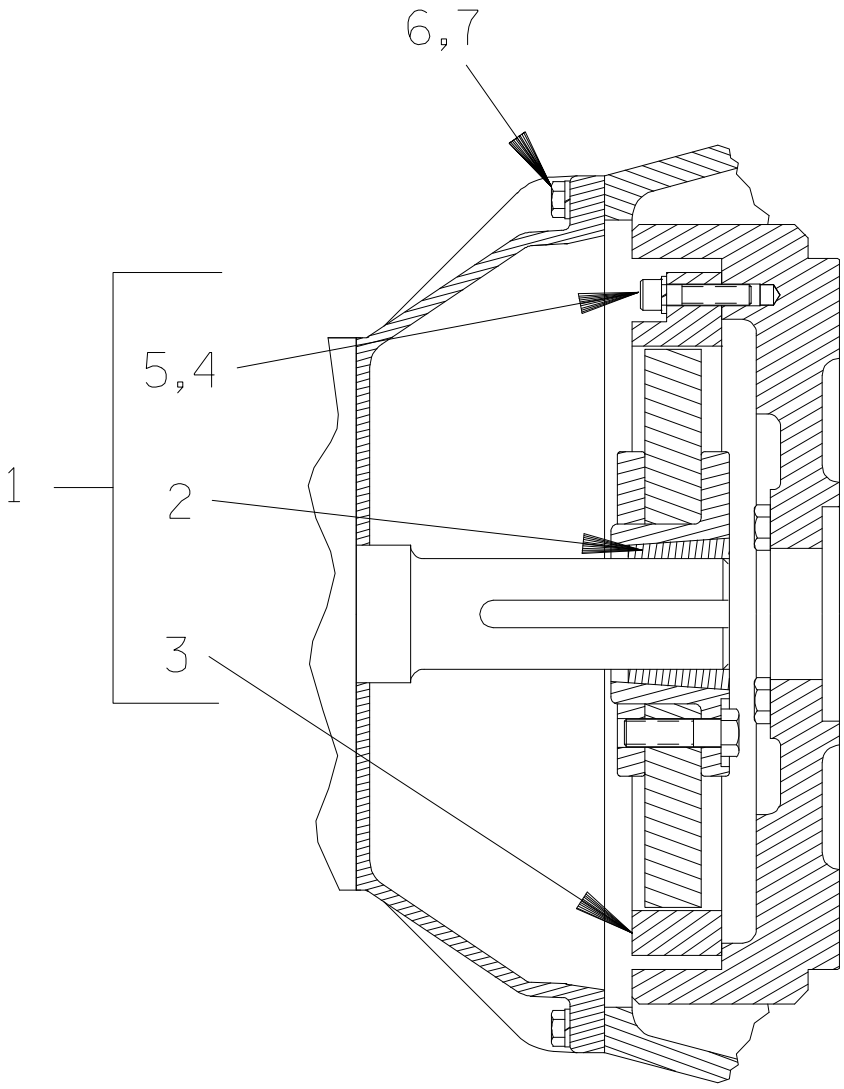


Figure 8. Drive Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	QTY
1		COUPLING KIT	48112–005	1
2		–BUSHING	24131–496	1
3		–COUPLING ASSEMBLY	24391–105	1
4		LOCK WASHER	21171–536	8
5	☞	SOCKET HEAD CAPSCREW	BD0606–1/2 15991	8
5	◗	SOCKET HEAD CAPSCREW	22644–220	8
6	☞	HEX HD CAPSCREW	B0605 15991	12
6	◗	HEX HD CAPSCREW	22645–164	12
7	☞	LOCK WASHER	J06 15991	12
7	◗	LOCK WASHER	21171–511	12

☞ USE FOR SAE APPLICATIONS
◗ USE FOR METRIC APPLICATIONS

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 Sectional Views (see Figures 1 through 8) and the corresponding Parts Lists. Maintenance and repair instructions for the engine and air compressor are covered separately in the specific literature supplied by the manufacturers.

Some pump service functions may be performed without separating the pump end assembly from the engine. However, the priming chamber (2, Figure 3) and discharge check valve assembly (26, Figure 3) must be removed to service most pump components. The following instructions assume complete disassembly of the pump is required.

Before attempting to service the pump, shut down the engine and take precautions to ensure that it will remain inoperative. Close all valves in the suction and discharge lines and drain the pump casing by removing the casing drain plug (19, Figure 4). Clean and reinstall the drain plug.

WARNING!

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 instructions and 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.

WARNING!

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 and make sure it is cool before opening any covers, plates, gauges, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

WARNING!

This pump is designed to handle material which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.

CAUTION

Use **Only Genuine Gorman—Rupp** replacement parts. Failure to do so may create a hazard and damage the pump or diminish optimal pump performance. Any such hazard, damage or diminished performance is not covered by the warranty.

NOTE

When appropriate recycling facilities are available, the user should recycle components and fluids when doing any routine maintenance / repairs and also at the end of the pump's useful life. All other components and fluids shall be disposed of according to all applicable codes and regulations.

Priming Chamber Removal And Disassembly

(Figure 6)

Disconnect both the suction piping and the air discharge tubing from the priming chamber assembly (1). Support the priming chamber assembly using a sling and a suitable lifting device. Remove the hardware (6 and 7) and separate the priming chamber assembly, gasket (8) and baffle (9) from the pump assembly.

(Figure 7)

Remove the hardware (2 and 3) securing the priming valve (1) to the priming chamber (5). Carefully lift the valve components from the priming chamber. Remove the gasket (4) and clean the mating surfaces.

If the priming valve float is stuck or the strainer (6) is clogged, it can usually be cleaned without further disassembly.

The only serviceable part of the priming valve is the orifice button (not shown). If liquid continues to bypass through the priming chamber after adjusting the orifice button (see **Priming Chamber Reassembly and Installation** for adjustment), the button may require replacement. To replace the orifice button, remove one of the "e-clips" from the pivot pin closest to the orifice button and remove the pivot pin. This will allow the linkage to be raised high enough to access the orifice button.

Remove the hex nut and lockwasher securing the orifice button to the linkage bar and unscrew the orifice button from the linkage bar.

Discharge Check Valve Removal and Disassembly

(Figure 3)

Remove the hardware (not shown) securing the discharge check valve bracket to the base.

Support the discharge check valve assembly (26) using a sling and a suitable lifting device. Remove the hardware (not shown) and separate the discharge check valve assembly and gasket (not shown) from the pump assembly (1).

The flapper and cover O-ring are the only serviceable parts of the check valve. If the flapper requires replacement, remove the hardware securing the cover. Separate the cover and O-ring and remove the flapper.

Separating Pump and Drive Assembly From Engine

(Figure 3)

The pump and drive assembly must be separated from the engine before further disassembly.

Disengage the hardware (11, 12 and 13) and remove the belt guard assembly (10). Remove the hardware (17, 18 and 19) securing the air compressor assembly (8) to the mounting flange (8, Figure 2). Use a pry bar to raise the air compressor high enough to remove the spacers (20). Remove the belt (9) from the air compressor drive pulley (not shown).

Disconnect all hoses and fittings from the air compressor and use a suitable hoist and sling to remove the air compressor assembly.

(Figure 8)

Support the pump end using a hoist and sling, and remove the hardware (not shown) securing the pump casing to the base.

Remove the hardware (6 and 7) securing the mounting flange (18, Figure 5) to the engine bellhousing. Remove the intermediate guards (20, Figure 5) and separate the assemblies by pulling the intermediate 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. Remove the shaft key (23, Figure 5).

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.

(Figure 1)

Remove the belt (9, Figure 3). Remove the capscrews from the center of the bushing (25). Reinstall the capscrews in the tapped holes in the bushing and tighten them in an alternating pattern until the bushing is "jacked" out of the sprocket (24). Slide the bushing and sprocket off the shaft. Remove the key (23, Figure 5).

Draining Oil From Seal Cavity

(Figure 5)

If any further disassembly is to be performed on the pump, the seal oil cavity must be drained to prevent the oil in the seal cavity from escaping as the pump casing is removed.

Position a **clean** container under the seal cavity drain plug (15). Remove the plug and drain the oil from the seal cavity into the container. For shorter drain time, remove the vented plug (10). Clean and reinstall the drain plug and vent plug. Inspect the oil for water, dirt or a cloudy condition which could indicate seal failure.

Loosening Impeller

(Figure 5)

With the pump end separated from the engine, wedge a block of wood between the vanes of the impeller (1) and the pump casing (1, Figure 4) to prevent rotation.

Install the shaft key (23) in the shaft keyway. Install a lathe dog on the drive end of the shaft (24) with the "V" notch positioned over the shaft key.

With the impeller rotation still blocked, see Figure 9 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.

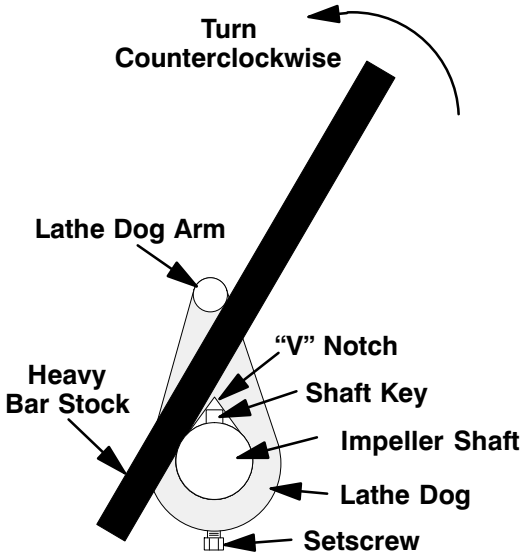


Figure 9. Loosening Impeller

Pump Casing And Wear Plate Removal

(Figure 4)

Support the pump casing using a suitable hoist and sling.

WARNING!

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.

NOTE

*Drain the oil from the seal cavity before removing the pump casing. See **Draining Oil From Seal Cavity**.*

Remove the hardware (9 and 10) securing the pump casing (1) to the rotating assembly (8). Pull the pump casing straight away from the rotating assembly to prevent binding on the impeller. Remove the shims (12) and clean the contacting surfaces. Tie and tag the shims or measure and record their thickness for ease of reassembly.

Inspect the wear plate assembly (7) for excessive wear or scoring. If replacement is required, remove the hardware (2 and 3) and pull the wear plate out of the pump casing.

Impeller Removal

(Figure 3)

With the rotating assembly removed from the pump casing, unscrew the impeller (1) from the shaft (24). Use caution when unscrewing the impeller; tension on the shaft seal spring will be released as the impeller is removed. Inspect the impeller and replace if cracked or badly worn.

Remove the impeller adjusting shims (2); tie and tag the shims, or measure and record their thickness for ease of reassembly.

Seal Removal

(Figures 5 and 10)

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 from the seal plate (4).

An alternate method of removing the stationary seal components is to remove the hardware (7 and 8) and separate the seal plate and gasket (5) from the bearing housing (9). 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.

Remove the shaft sleeve O-ring (26) and seal plate O-ring (28).

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

Shaft and Bearing Removal and Disassembly

(Figure 5)

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.

CAUTION

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 (15) and drain the lubricant. Clean and reinstall the drain plug.

Disengage the hardware (16 and 17) and remove the mounting flange (18), gasket (19) and oil seal (6). Press the oil seal from the mounting flange.

Place a block of wood against the impeller end of the shaft (24) and tap the shaft and assembled bearings (22 and 25) from the bearing housing. Press the oil seals (6) from the bearing housing.

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

CAUTION

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.

WARNING!

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.

CAUTION

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 snap ring (21) and use a bearing puller to remove the inboard and outboard bearings from the shaft.

Shaft and Bearing Reassembly and Installation

(Figure 5)

Inspect the shaft (24) 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.

Clean and inspect the bearings as indicated in **Shaft And Bearing Removal And Disassembly**.

CAUTION

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.*

NOTE

*Position the outboard bearing (22) on the shaft with the retaining ring on the bearing O.D. **toward the drive end of the shaft**.*

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 against the shaft shoulders. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

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.

CAUTION

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.

Secure the outboard bearing to the shaft with the snap ring (21)

Apply a light coating of oil to the lip of the inboard oil seal (6) and press it into the bearing housing bore with the lip positioned as shown in Figure 5. Press the oil seal into the housing until the face is **just flush** with the machined surface on the housing.

It is recommended that a sleeve be positioned against the inboard oil seal 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.

CAUTION

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

Apply a light coating of oil to the lip of the outboard oil seal (6) and press it into the bearing housing with the lip positioned as shown in Figure 5. The face of the oil seal should be **just flush** with the machined face of the bearing housing.

Apply a light coating of oil to the lip of the oil seal (6) and press it into the mounting flange (18) with the lip positioned as shown in Figure 5. The face of the oil seal should be flush with the chamfer on the mounting flange bore.

Install the mounting flange gasket (19) and secure the mounting flange to the bearing housing with the hardware (16 and 17). **Be careful** not to damage the lip of the oil seal on the shaft keyway.

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

Securing Bearing Housing And Drive Assembly To Engine

(Figure 3)

Install the key (23, Figure 5) in the shaft keyway, making sure to leave room in the keyway for the drive key (23, Figure 5). Install the sprocket (24) and bushing (25) on the shaft to the dimension shown in Figure 10.

NOTE

*When properly installed to the dimension shown in Figure 10, the key (23, Figure 5) **will not** extend fully through the bushing. This is an acceptable fit for this application.*

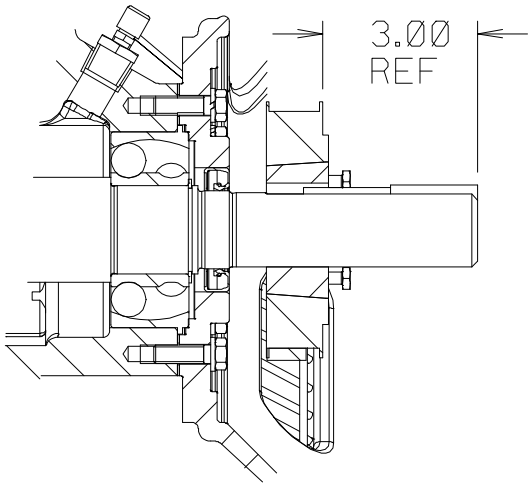


Figure 10. Drive Sprocket Positioning

Secure the bushing and sheave to the shaft by torquing the bushing screws to 23.3 ft. lbs. (280 in. lbs. or 3,2 m. kg.). Install the belt (9) over the sprocket and up through the slot in the mounting flange (18, Figure 5).

(Figure 8)

Install the shaft key (23, Figure 5) in the shaft keyway. Position the flexible portion of the coupling assembly (3) on the shaft as shown in Figure 5.

NOTE

The flexible portion of the coupling must be proper-

ly positioned on the shaft. The heads of the capscrews in the center of the coupling ***must be positioned away from the pump****.*

Align the keyway in the bushing (2) with the shaft key, and slide it onto the shaft until the face of the bushing 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.

CAUTION

Make certain that the flexible portion of the coupling is just flush with the end of the shaft. **This positioning 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 intermediate 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 assembled drive and rotating assembly 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 (20, Figure 5) and secure the mounting flange to the engine bellhousing with the previously removed hardware (6 and 7).

(Figure 3)

Use a suitable hoist and sling to position the air compressor assembly (8) on the mounting flange (18, Figure 5). Slide the belt (9) over the air compressor sprocket. Use a pry bar to raise the compressor high enough to install the spacers (20) between the compressor and the mounting flange. Secure the compressor to the mounting flange with the hardware (17, 18 and 19). Reinstall the guard (10) and secure it with the hardware (11, 12 and 13).

Seal Reassembly and Installation

(Figures 5, 11, 12 and 13)

WARNING!

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 seal cavity and shaft with a cloth soaked in fresh cleaning solvent. Inspect the stationary seat bore in the seal plate for dirt, nicks and burrs, and remove any that exist. The stationary seat bore **must** be completely clean before installing the seal.

CAUTION

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.

To ease installation of the seal, lubricate the shaft sleeve O-ring and the external stationary seat O-ring with a very **small** amount of light lubricating oil. See Figure 11 for seal part identification.

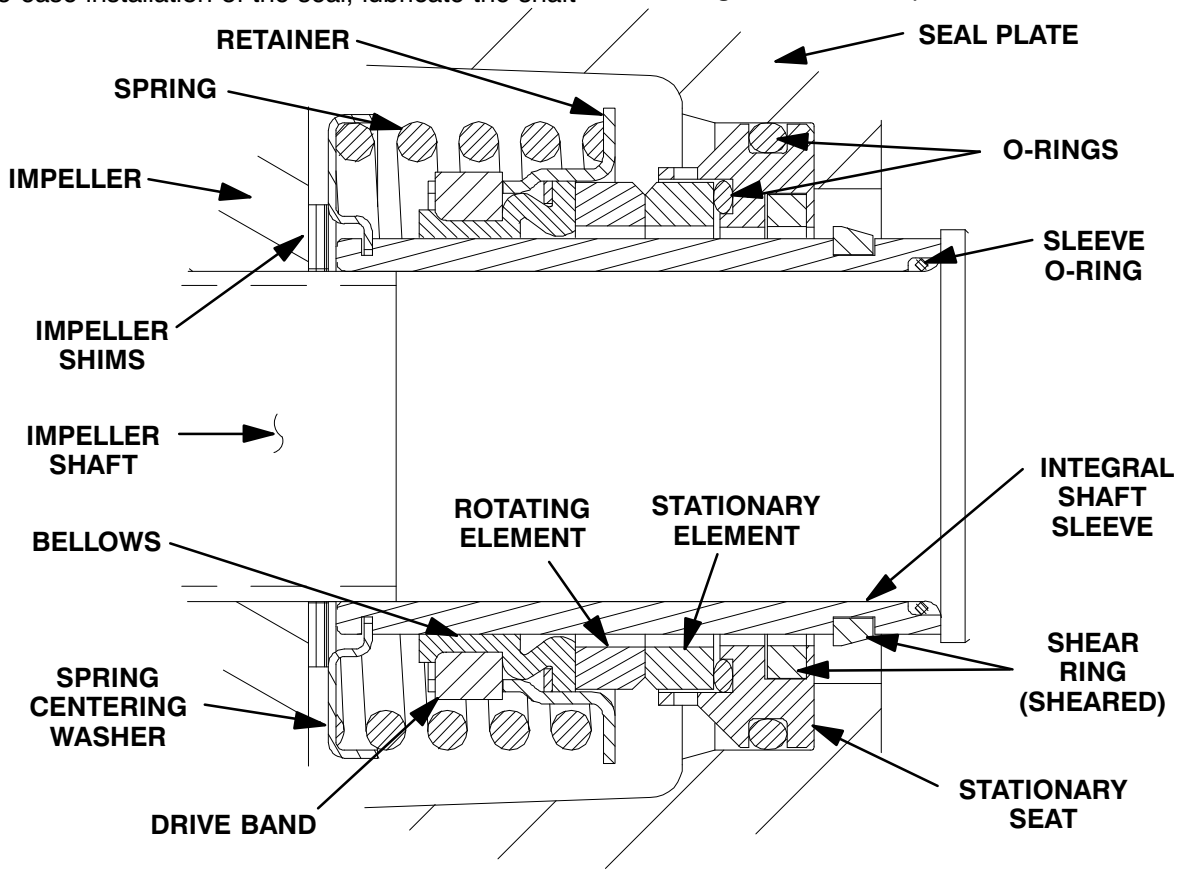


Figure 11. Cartridge Seal Assembly

CAUTION

This seal is not designed for operation at temperatures above 160°F (71°C). Do not use at higher operating temperatures.

If the seal plate was removed, install the seal plate gasket (5). Position the seal plate over the shaft and secure it to the bearing housing with the hardware (7 and 8).

To prevent damaging the shaft sleeve O-ring (26) on the shaft threads, stretch the O-ring over a piece of tubing. The I.D. of the tubing must be slightly larger than the O.D. of the shaft. To ease installation the tubing wall should be as thin as possible. The length should be long enough to cover the threads on the end of the shaft. Slide the tube over the shaft threads, then slide the O-ring off the tube and onto the shaft. Remove the tube, and continue to slide the O-ring down the shaft until it seats against the shaft shoulder.

When installing a new cartridge seal assembly, remove the seal from the container, and remove the mylar storage tabs from between the seal faces.

CAUTION

New cartridge seal assemblies may be equipped with mylar storage tabs between the seal faces. These storage tabs **must** be removed before installing the seal.

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 half of the set of impeller shims (2) provided with the seal,

and screw the impeller onto the shaft until it is seated against the seal (see Figure 12).

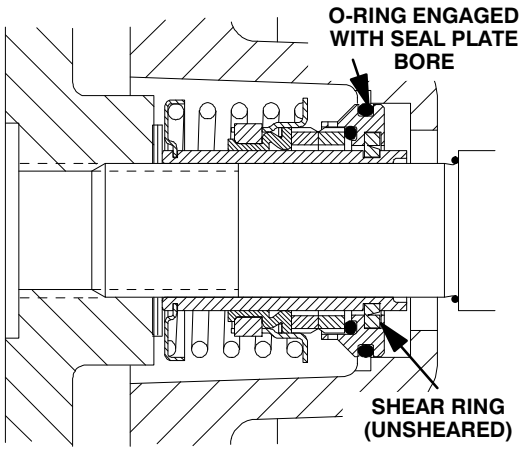


Figure 12. Seal Partially Installed

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 13).

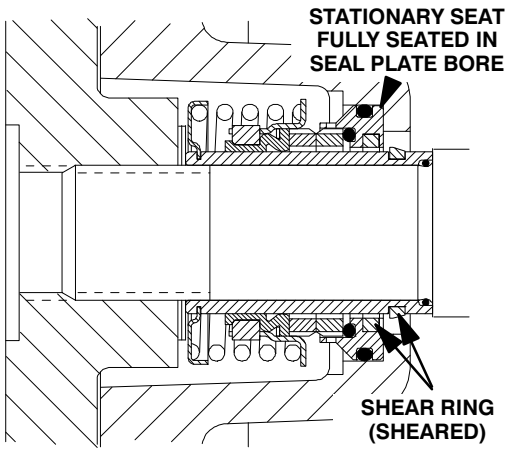


Figure 13. Seal Fully Installed

Measure the impeller-to-seal plate clearance, and add or 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.

CAUTION

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.

CAUTION

Do not attempt to separate the rotating portion of the seal from the shaft sleeve when reusing an old seal. The rubber bel-

lows 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 And Adjustment

(Figure 5)

Inspect the impeller (1) and replace it if cracked or badly worn.

CAUTION

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.

Apply a small amount of 'Never-Seez' or equivalent anti-lock compound on the shaft threads. Screw the impeller onto the shaft until tight.

NOTE

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

A clearance of .025 to .040 inch (0,64 to 1,02 mm) between the impeller and the seal plate is necessary for maximum pump efficiency. Measure this clearance, and add or remove impeller adjusting shims as required.

Pump Casing And Wear Plate Installation

(Figure 4)

If the wear plate (7) was removed, position the replacement wear plate in the casing and secure it with the hardware (2 and 3).

Lubricate the O-rings (11 and 13) with light grease, and install them in the grooves in the bearing housing and seal plate. Ease the rotating assembly into the pump casing. **Be careful** not to damage the O-rings.

Install the same thickness of adjusting shims (12) as previously removed, and secure the rotating assembly to the pump casing with the hardware (9 and 10). Do not fully tighten the capscrews until the impeller face clearance has been set.

A clearance of .010 to .020 inch (0,25 to 0,5 mm) between the impeller and the wear plate is also recommended for maximum pump efficiency. This clearance can be obtained by adding or removing an equal thickness of shims from each rotating assembly shim sets (12) until the impeller scrapes against the wear plate when the shaft is turned. After the impeller scrapes, add approximately .010 inch (0,25 mm) of shims to each shim set.

After the face clearance has been set, tighten the hardware securing the rotating assembly to the pump casing.

Reinstall any leveling shims used under the pump casing mounting feet and secure the casing (1) to the base with the previously removed hardware.

Discharge Check Valve Reassembly And Installation

(Figure 3)

If the discharge check valve (26) was disassembled to replace the flapper or cover O-ring,

position the flapper in the valve body and check to ensure free movement.

Install the valve cover O-ring and secure the cover to the body with the previously removed hardware.

Apply a small amount of light grease to the discharge flange gasket to hold it in place and position it against the pump casing flange. Support the discharge check valve assembly using a sling and a suitable lifting device. Using the previously removed hardware, secure the discharge check valve assembly and flange gasket to the pump assembly (1).

Priming Chamber Assembly And Installation

(Figure 7)

Clean and inspect the components of the priming valve (1). Inspect the linkage and ensure the orifice button (not shown) squarely engages the valve seat. Replace the orifice button if required (see **Priming Chamber Removal and Disassembly** for orifice button removal).

If the orifice button was removed, screw the new orifice button into the linkage bar until fully seated. Align the hole in the linkage bar with the holes in the bracket and reinstall the pivot pin. Secure the pivot pin with the previously removed “e-clip”.

Adjust the orifice button seating as necessary by screwing the orifice button into or out of the linkage bar. Proper adjustment is achieved when the orifice button fully seats against the orifice before the linkage bar on the float bottoms against the threads on the orifice button. When adjustment is complete, install and tighten the lock washer and hex nut securing the orifice button.

Install the strainer (6) and priming valve gasket (4).

Lower the float into the priming chamber (5) and secure the priming valve with the previously removed hardware (2 and 3).

(Figure 6)

Install the baffle (9) and gasket (8) and use a sling and suitable lifting device to position the priming chamber assembly on the hopper spool (32, Figure 3). Secure the priming chamber assembly with the hardware (6 and 7).

Reconnect the suction piping to the hopper spool and the air discharge tubing to the priming chamber assembly.

LUBRICATION

(Figure 5)

Seal Assembly

Before starting the pump, remove the vented plug (10) and fill the seal cavity with approximately 5 quarts (4,7 liters) of SAE No. 30 non-detergent oil or to the center of the sight gauge (4, Figure 4). Clean and reinstall the vented plug. Maintain the oil level at the middle of the sight gauge.

Bearings

(Figure 5)

The bearing housing was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (13) and maintain it at the midpoint of the gauge. When lubrication is required, remove the air vent (12) and add SAE No. 30 non-detergent oil through the opening. When lubricating a dry (overhauled) intermediate, fill the bearing cavity with approximately 28 ounces (0,8 liter). Clean and reinstall the air vent. **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 clean oil. Change the oil more frequently if the pump is operated continuously or installed in an environment with rapid temperature change.

CAUTION

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.

For Warranty Information, Please Visit
www.grpumps.com/warranty
or call:
U.S.: 419—755—1280
Canada: 519—631—2870
International: +1—419—755—1352