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INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

PA SERIES PUMP

MODEL

PA4B60—4045H

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA Printed in U.S.A

www.grpumps.com.

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

Valid serial number and e-mail address required.

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

RECORD YOUR PUMP MODEL AND SERIAL NUMBER

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

Pump Model: _____

Serial Number: _____

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INTRODUCTION

Thank You for purchasing a Gorman-Rupp pump. **Read this manual** carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump. This Installation, Operation, and Maintenance manual is designed to help you achieve the best performance and longest life from your Gorman-Rupp pump.

This pump is a PA Series, priming-assisted centrifugal model. The unit is designed for handling non-volatile, non-flammable liquids containing specified entrained solids. The basic material of construction for wetted parts is gray iron.

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 which are not covered in this manual or in other literature accompanying the 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 engine, contact the engine manufacturer's local dealer or representative.

The following are used to alert 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.

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

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, or lock out incoming power to the motor and take precautions to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure the pump is cool 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 designed to handle most non-volatile, non-flammable liquids 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.

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Attach lifting equipment to the lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

WARNING!

After the pump has been installed, make certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.

WARNING!

Do not operate the pump against a closed discharge valve. 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. Momentary closure of a discharge valve is acceptable only

when required for startup or shutdown procedures.

WARNING!

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 completely before servicing.

WARNING!

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

WARNING!

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

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.

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!

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

WARNING!

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 on Page E-1 for the maximum continuous operating speed for this pump.

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

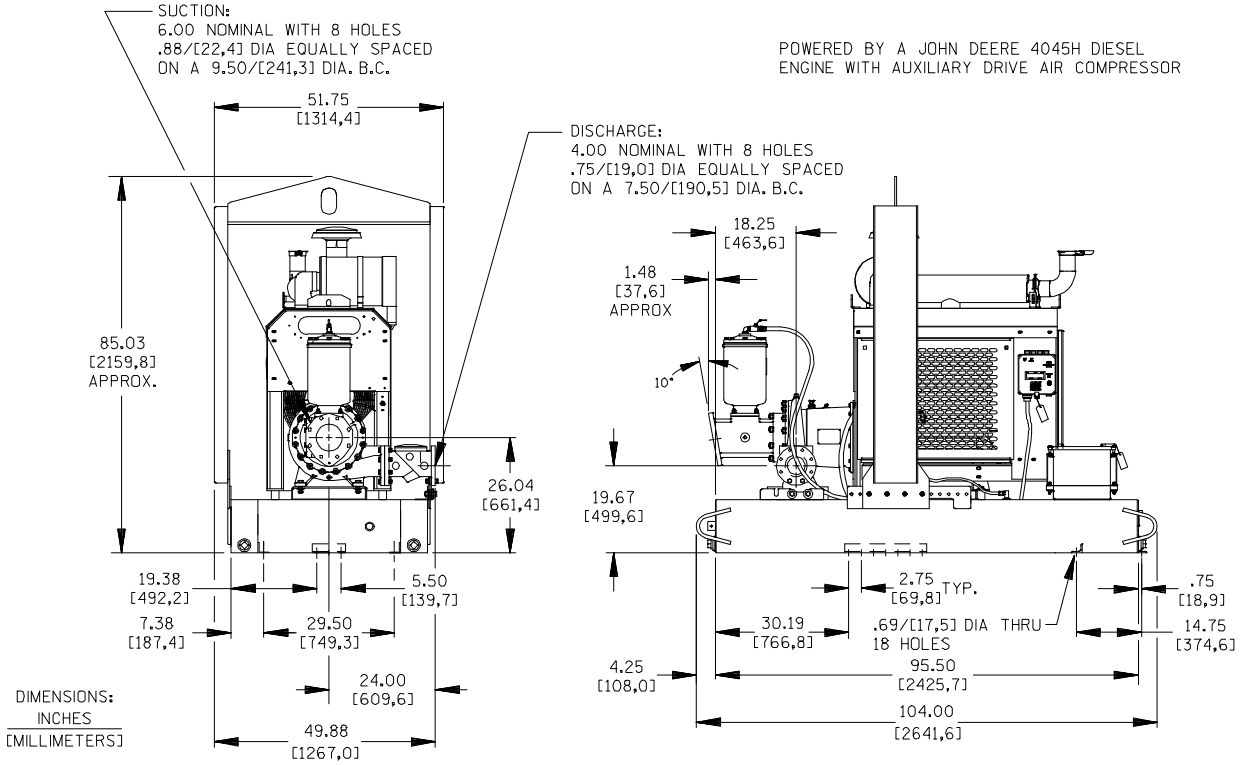


Figure 1. Pump Model PA4B60–4045H

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 for cracks, dents, damaged threads, and other obvious damage.

b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated. Note that the pump shaft rotates in the required direction.

d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **Maintenance and Repair Manual** and perform duties as instructed.

e. If the pump has 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 Installation

Unless otherwise specified on the pump order, the engine battery is **not** included with engine driven units.

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

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

POSITIONING PUMP

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Attach lifting equipment to the lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

Lifting

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

CAUTION

The pump assembly can be seriously damaged if the chains or cables used to lift and move the unit are improperly wrapped around the pump.

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 and eliminate vibration.

For engine driven units, the pump **must** be positioned as level as possible to ensure sufficient lubrication and fuel supply to the engine.

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

WARNING!

If the pump has been mounted on a movable base, do not attempt to operate the pump unless the unit is level. Be sure

the leveling stands are positioned on a solid surface, and the wheels are chocked.

SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See the performance curve and operating range shown 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

The pump is drilled and tapped for installing discharge pressure and vacuum suction gauges. It is recommended that gauges be installed to monitor pump performance. Seal the gauge threads with pipe dope to ensure an airtight 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

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

Be certain to use the strainer furnished with the pump; any spherical solids which pass through the strainer will also pass through the pump itself.

If a strainer not furnished with the pump 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 0.41 inch (10,4 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 airtight seal. Follow the sealant manufacturer's rec-

ommendations 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.

Although not recommended, the vacuum assisted priming feature allows the pump to be operated temporarily in a “slurping” application with varying water levels.

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).

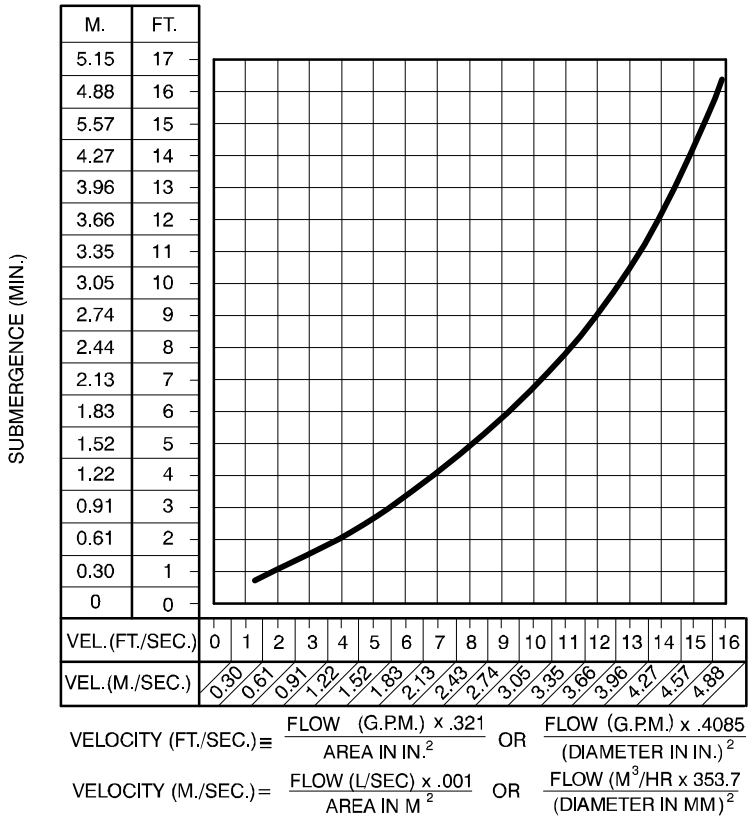


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

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

This pump is designed with a check valve in the discharge line.

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 be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.

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

ALIGNMENT

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

AUTO-START

The standard pump is equipped with an auto-start control system which allows the pump to start and stop as the liquid level in the wet well or sump rises and falls.

Refer to the information which follows for installation details for the liquid level sensing system provided with your pump.

Float Switch Installation

The Float Switch autostart system employs either a single or double float switch, where a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch. The floats are equipped with a socket type connector that plugs into a matching receptacle on the auto-start control box.

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

When installing the floats, note the following:

a. **Be sure** to provide sufficient room in the wet well or sump so that floats do not get obstructed or drawn into the suction line. If a flexible suction hose is used, it may be extended to lay along the bottom of the wet well or sump and the float can be attached to the hose above the point where it bends along the bottom. Direct the suction line toward the flow, and the float(s) away from the flow. If a standpipe is available, attach the float switch cable to the standpipe in the sump at the approximate desired liquid level.

b. In a single float system, the cable can be tethered to the suction line or standpipe approximately 6 inches (152 mm) above the float. This setting allows approximately 9 inches (229 mm) of liquid rise between pump start/stop. The start/stop interval may be increased by extending the float end of the cable. The liquid level in the sump will increase approximately 8 inches (203 mm) between start/stop intervals for every 6 inches (152 mm) of cable increase.

c. If a double float switch system is used, position the “Start” float at the desired high water level in the sump, and the “Stop” float at the desired low water level in the pump.

d. Refer to Figure 3 for additional float switch data.

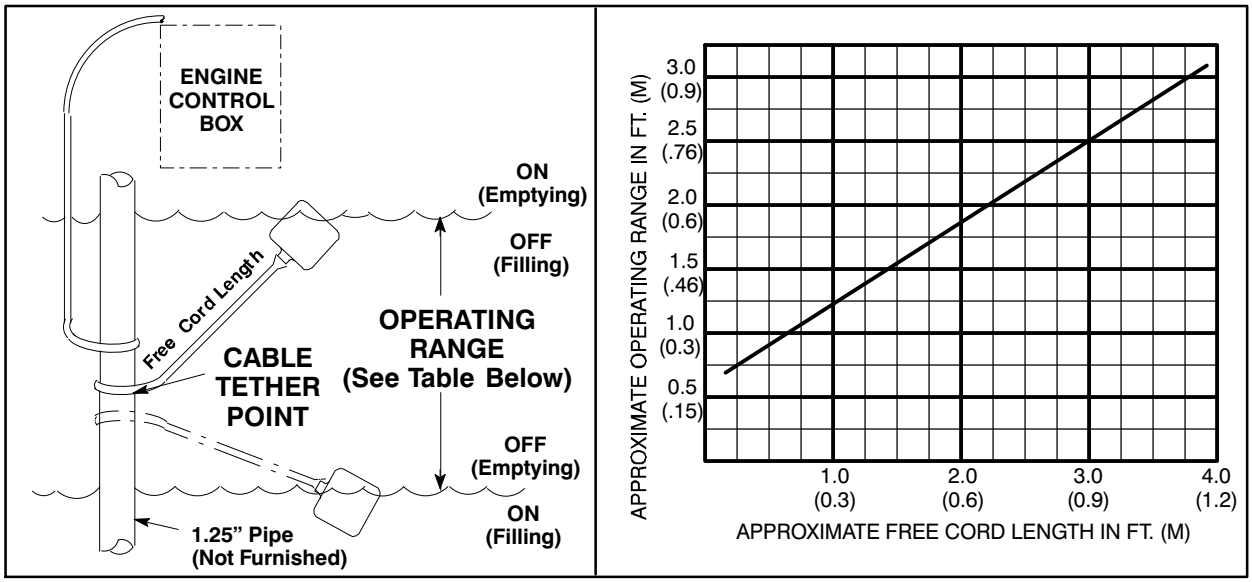


Figure 3. Float Switch Data

OPERATION — SECTION C

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.

OPERATION

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 in Section E on page E—1.

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**).

The pump will begin to prime upon startup. The air in the suction line will be discharged from the eductor discharge line. Complete priming is indicated by a positive discharge pressure reading.

If full priming is not achieved, the discharge check valve may be malfunctioning. If this occurs, shut down the pump and consult **Maintenance and Repair,** Section E for further details.

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

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

Manual Starting

On initial start-up, set the engine speed at in the half-throttle position. Turn the keyswitch to 'MANU-

AL'. After the engine starts and the unit is fully primed, adjust the engine RPM until the desired flow rate is achieved.

CAUTION

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

Automatic Starting

With the float system installed, follow the procedures outlined for manual starting and throttle adjustment. Switch the keyswitch to 'OFF' until the water level rises above the on point for the float system, then turn the keyswitch to the 'AUTO' setting. The unit will run until the float signals the control that the water in the wet well is at the float off point, at which time the unit will shut down automatically. When the float signals the control that the water in the wet well is at the float on point, the unit will restart automatically, repeating the cycle.

OPERATION

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.

As a safeguard against rupture or explosion due to heat, this pump is equipped with a pressure relief valve which will open if vapor pressure within the pump casing reaches a critical point. If over-heating does occur, stop the pump immediately and allow it to cool before servicing it. **Approach any over-heated pump cautiously**. It is recommended that the pressure relief valve assembly be replaced at each overhaul, or any time the pump casing over-heats and activates the valve. **Never** replace this valve with a substitute which has not been specified or provided by the Gorman-Rupp Company.

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

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly.

Reduce the throttle speed slowly and allow the engine to idle briefly before stopping.

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

After stopping the pump, switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.

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 the Maintenance and Repair Manual). 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.

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 and disconnect the positive battery cable and take precautions to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure pump is cool 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.**

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Discharge check valve contaminated, damaged, or unable to seat.	Clean or replace check valve.
	Air compressor head 180° out.	Consult factory.
	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**.
	Air compressor damaged or belts broken.	Check and repair/replace.
	Strainer clogged.	Check strainer and clean if necessary.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Eductor clogged.	Check and clean eductor.
	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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.)	Strainer clogged.	Check strainer and clean if necessary.
	Discharge check valve clogged.	Check and clean check valve.
	Suction intake not submerged at proper level or sump too small.	Check installation and correct submergence as needed.
	Impeller or other wearing parts worn or damaged.	Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.
	Impeller clogged.	Free impeller of debris.
	Discharge head too high.	Install bypass line.
	Suction lift too high.	Measure lift w/vacuum gauge. Reduce lift and/or friction losses in suction line.
	Pump speed too slow.	Check engine output; consult engine operation manual.
	Belt or flexible coupling broken.	Check and replace as necessary.
PUMP REQUIRES TOO MUCH POWER	Pump speed too high.	Check engine output.
	Extreme ambient temperature.	Reduce pump output.
	Discharge head too low.	Adjust discharge valve.
	Fuel filter clogged.	Check & replace often in extreme operating conditions.
	Liquid solution too thick.	Dilute if possible.
	Fuel contaminated.	Check and replace as required.
	Pump or jack shaft bearing(s) frozen.	Disassemble, check and replace bearing(s) as required..
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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
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.
	Excessive tension on drive belt.	Check belt tension. Adjust as required.

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

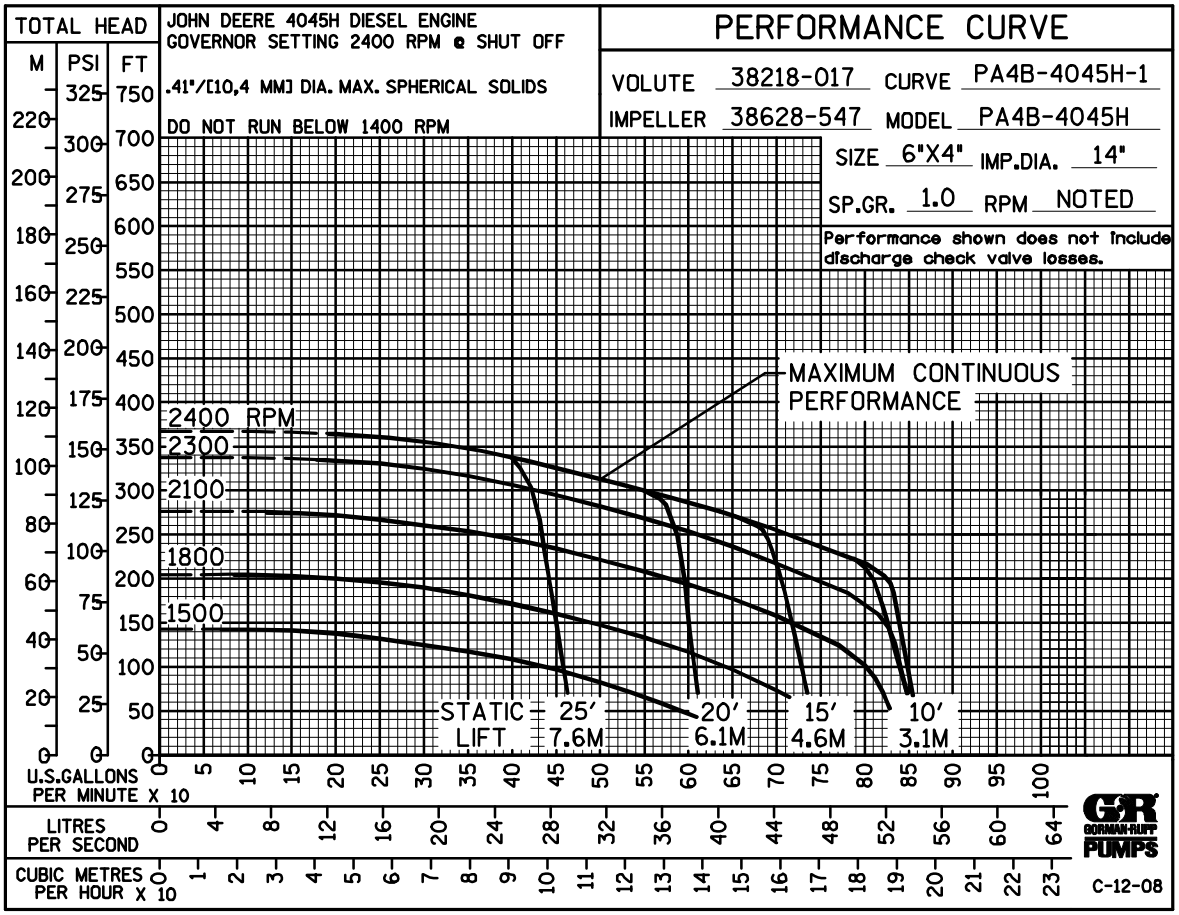
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication				I	
Seal Lubrication (And Packing Adjustment, If So Equipped)		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 (Back 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 intermittent 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 PA4B60–4045H**

✳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.

SECTION DRAWING

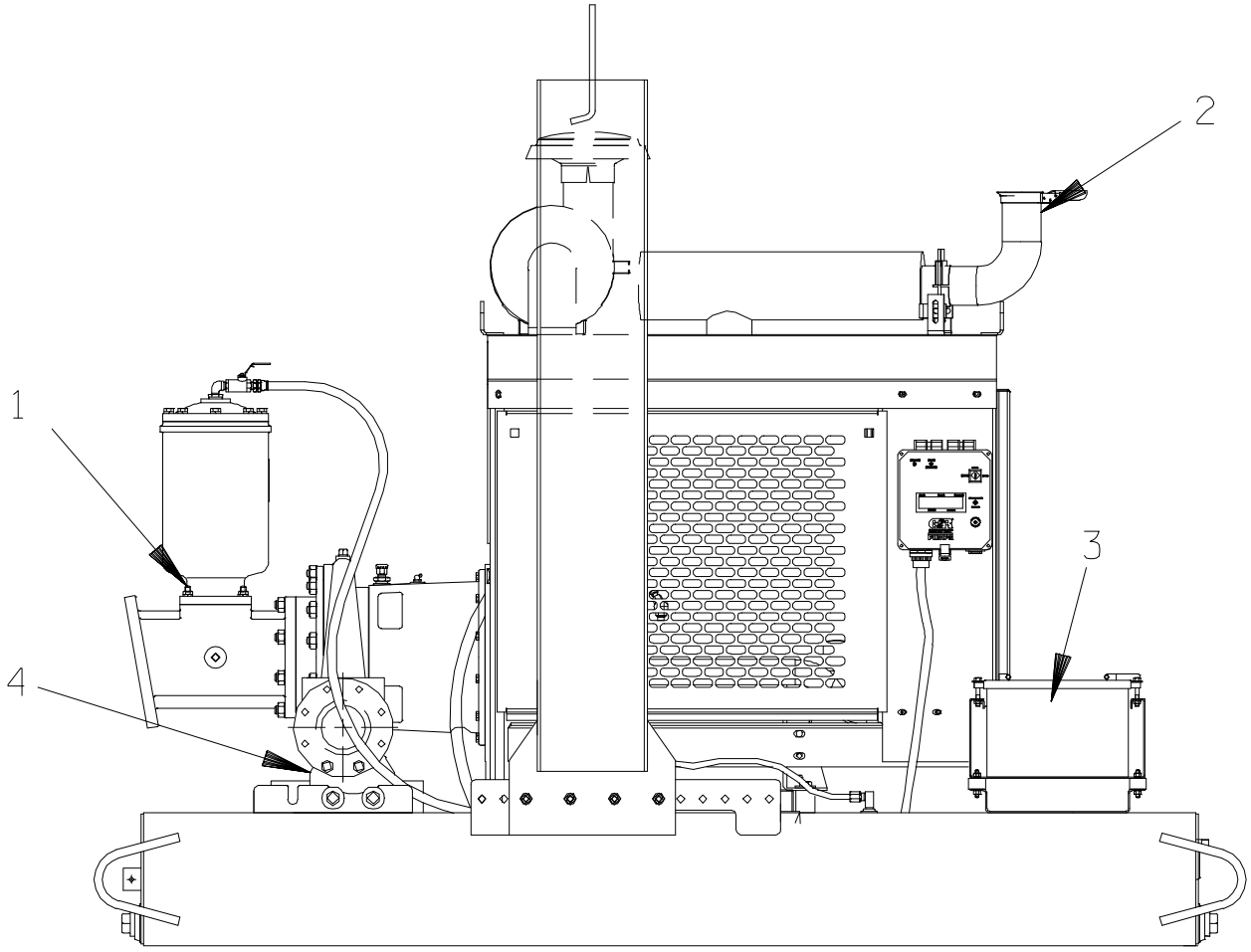


Figure 1. Pump Model PA4B60—4045H

PARTS LIST
Pump Model PA4B60–4045H
(From S/N 1417817 Up)

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	PUMP END ASSEMBLY	PA4B60–(SAE 4/10)	–––	1
2	POWER UNIT KIT	46143–099	–––	1
3	BATTERY	SEE OPTIONS		REF
4	PUMP MOUNTING KIT	48157–036	–––	1
NOT SHOWN:				
	PRIME AIRE DECAL	38812–078	–––	2
	G-R DECAL	GR–06	–––	3
	INSTRUCTION TAG	38817–085	–––	1
	CAUTION DECAL	2613FJ	–––	1
	WARNING DECAL	2613FE	–––	1

SECTION DRAWING

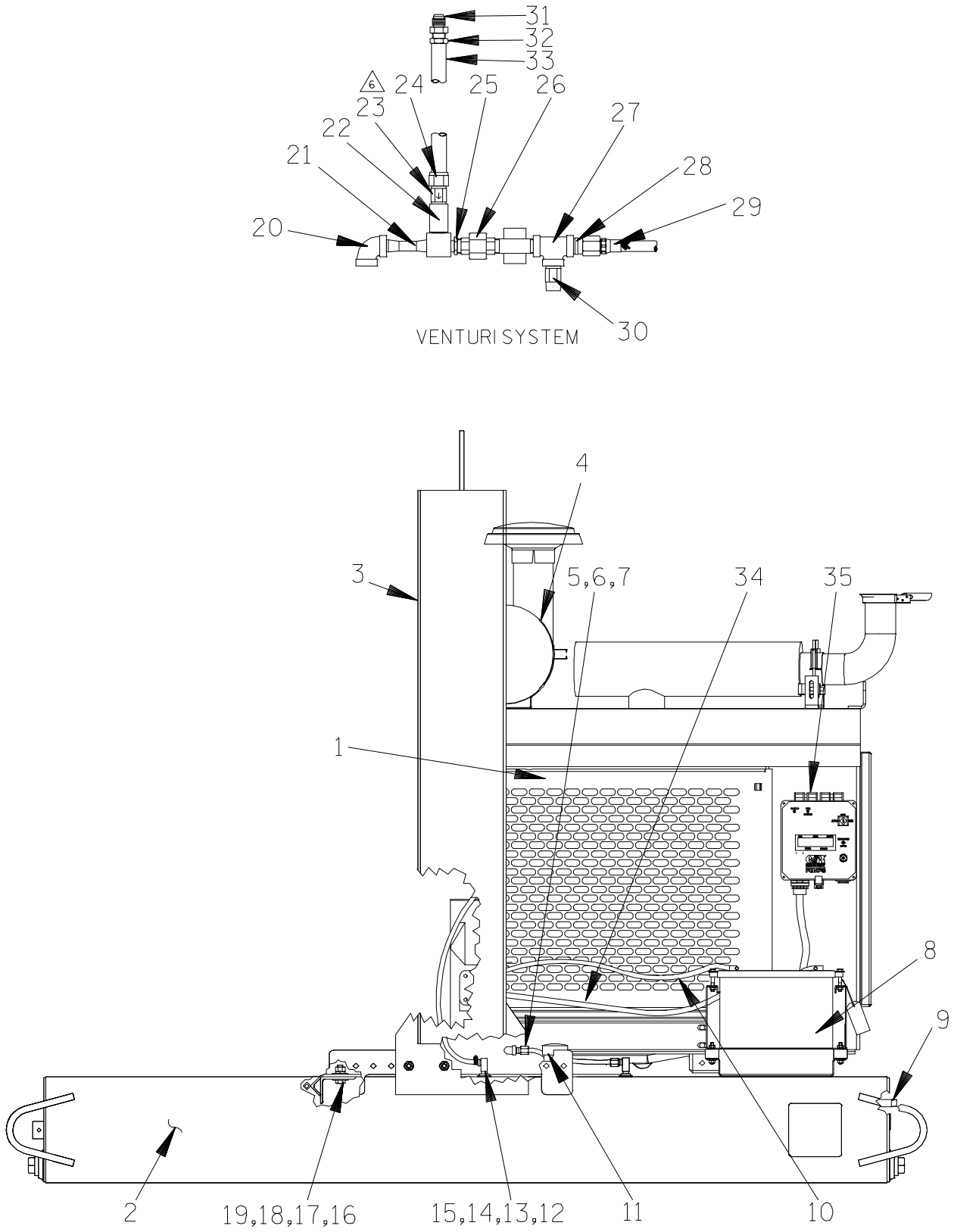


Figure 2. 46143—088 Power Unit Kit

PARTS LIST
46143–088 Power Unit Kit

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	JOHN DEERE ENGINE	29224–309	–––	1
2	BASE/FUEL TANK	41553–006	24150	1
3	LIFTING BAIL KIT	48274–804	–––	1
4	MUFFLER GUARD ASSEMBLY	NOT REQUIRED	–––	1
5	MALE ELBOW	26351–131	–––	1
6	CONNECTOR	S1447	–––	2
7	HOSE ASSEMBLY	46341–789	–––	1
8	BATTERY BOX KIT	42432–005	–––	1
9	OIL DRAIN ASSEMBLY	46342–013	–––	1
10	POSITIVE CABLE ASSEMBLY	47311–137	–––	1
11	FUEL GAUGE	29332–135	–––	1
12	FUEL PICKUP/RETURN	29332–145	–––	2
13	HOSE BARB FITTING	26523–386	–––	2
14	HOSE	11308G	–––	1
15	HOSE CLAMP	26518–641	–––	2
16	HEX HD CAPSCREW	B1007	15991	4
17	HEX NUT	D10	15991	4
18	LOCKWASHER	J10	15991	4
19	FLAT WASHER	K10	15991	4
20	PIPE ELBOW	R08	11999	1
21	VENTURI	26817–002	–––	1
22	1/2" PIPE COUPLING	AE08	15079	1
23	BALL/CHECK VALVE	26641–092	–––	1
24	HOSE BARB FITTING	26523–446	–––	1
25	REDUCING PIPE BUSHING	AP0806	15079	1
26	PIPE UNION	AH08	11999	1
27	TEE	U08	11999	1
28	MALE ADAPTOR	26351–065	–––	2
29	HOSE ASSEMBLY	46341–426	–––	1
30	PRESSURE RELIEF VALVE	26662–028	–––	1
31	CONNECTOR	S1598	–––	1
32	HOSE BARB FITTING	26523–047	–––	1
33	1/2" ID x 60" LG. HOSE	18513–113	–––	1
34	NEG. BATTERY CABLE	47311–133	–––	1
35	CONTROL PANEL KIT	48122–544	–––	1
NOT SHOWN:				
	ENGINE STARTUP TAG	38816–269	–––	1
	WARNING DECAL	38816–203	–––	4
	INSTRUCTION DECAL	38818–144	–––	1
	FLOAT SWITCH KIT	48312–980	–––	1
	WARNING DECAL	38816–132	–––	2
OPTIONAL:				
	DUAL FLOAT SWITCH KIT	48312–981	–––	1
	DRY BATTERY	29331–517	–––	1
	WET BATTERY	29331–527	–––	1
	WHEEL KIT	GRP30–262	–––	1
	EPS W/TRANSDUCER AUTO CONT PANEL	48122–545	–––	1

SECTION DRAWING

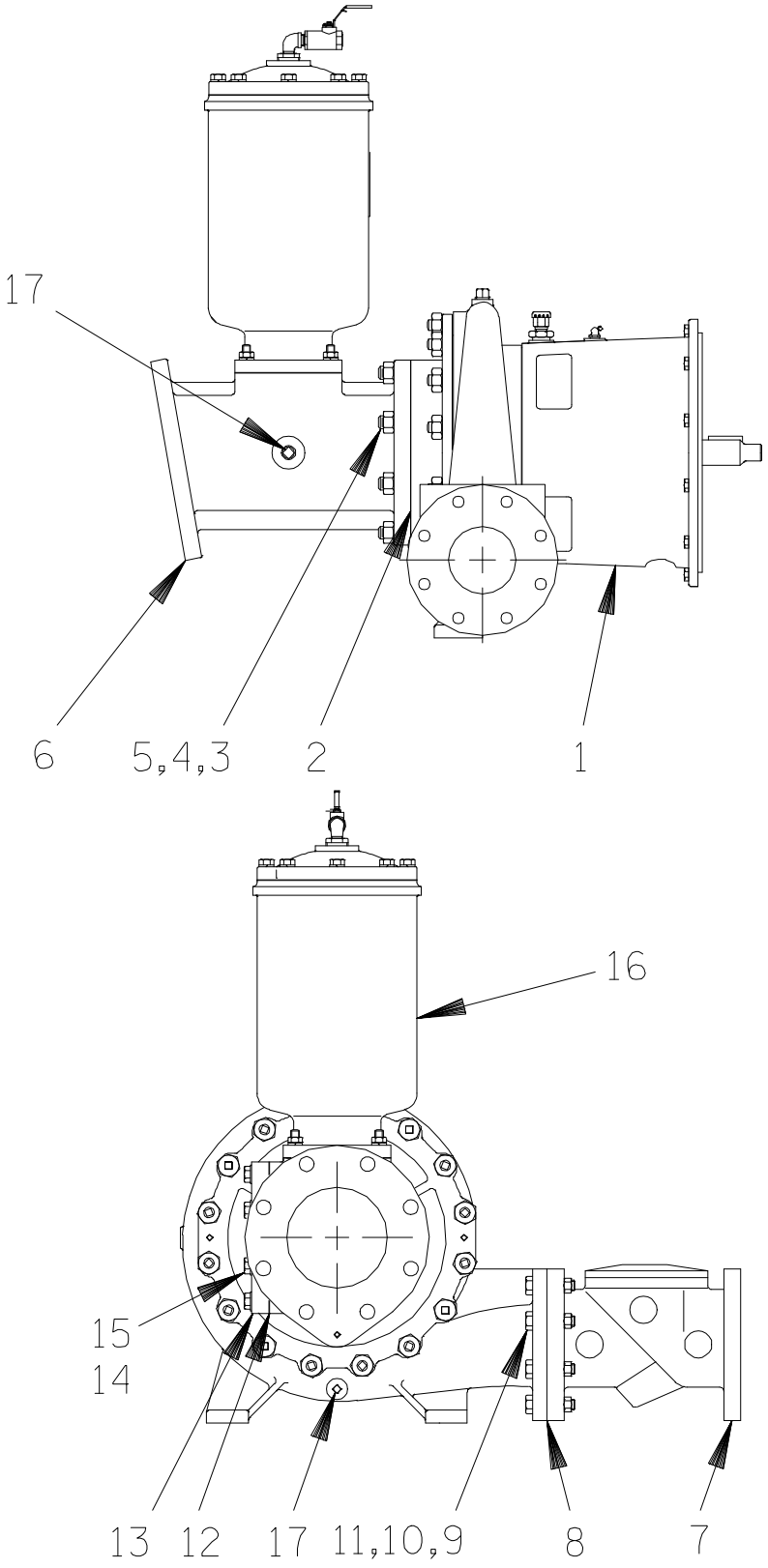


Figure 3. PA4B60—(SAE 4/10) Pump End Assembly

PARTS LIST
PA4B60–(SAE 4/10) Pump End Assembly

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PUMP ASSEMBLY	64B60–(SAE 4/10)	–––	1
2	✳	GASKET	1679G	18000	1
3		STUD	C1211	15991	8
4		HEX NUT	D12	15991	8
5		LOCK WASHER	J12	15991	8
6		SUCTION HOPPER SPOOL	38642–507	10000	1
7		DISCHARGE CHECK VALVE ASSY	26642–124	–––	1
	✳	–FLAPPER	26685–005	–––	1
	✳	–O-RING	25152–366	–––	1
8	✳	GASKET	1676G	18000	1
9		HEX HD CAPSCREW	B1010	15991	6
10		HEX NUT	D10	15991	6
11		LOCK WASHER	J10	15991	6
12	✳	GASKET	1676G	18000	1
13		BLIND FLANGE ASSY	42111–358	–––	1
14		LOCK WASHER	J10	15991	8
15		HEX HD CAPSCREW	B1008	15991	8
16		PRIMING HOPPER KIT	48275–006	–––	1
17		PIPE PLUG	P04	15079	2
NOT SHOWN:					
		DRIVE SCREW	BM#04–03	17000	4
		NAME PLATE	38818–127	13000	1
		STRAINER	S1529	24000	1
OPTIONAL:					
		4" NPT THREADED SUCT FLANGE KIT	48274–203	–––	1
		6" NPT THREADED DISCH FLANGE KIT	48274–205	–––	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

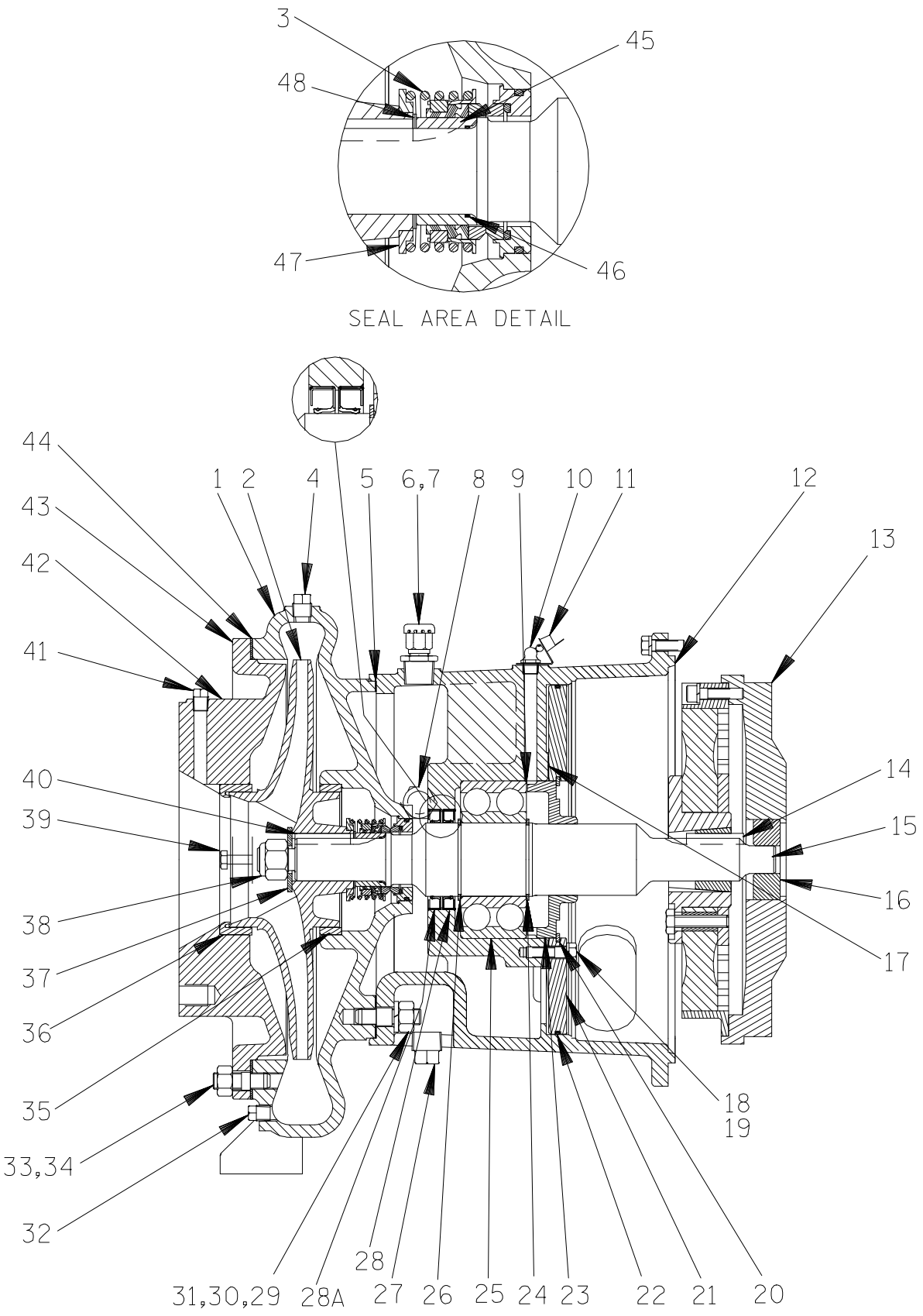


Figure 4. 64B60—(SAE 4/10) Pump Assembly

PARTS LIST
64B60–(SAE 4/10) Pump Assembly

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PUMP CASING	38218–017	10000	1
2	✳	IMPELLER	38628–547	10010	1
3	✳	MECH SEAL ASSY	46512–048	–––	1
4		PIPE PLUG	P06	15079	2
5	✳	CASING GASKET	38684–502	18000	1
6		AIR VENT	S1703	–––	1
7		RED PIPE BUSHING	AP1206	15079	1
8		SIGHT GAUGE	S1471	–––	1
9		BEARING ADJ SHIM SET	8548	15990	1
10		LUBE FITTING	S194	–––	1
11		CAP PLUG	25141–151	–––	1
12		INTERMEDIATE	38264–703	10000	1
13		DRIVE ASSY	44162–119	–––	1
14	✳	SHAFT KEY	N0608	15990	1
15	✳	IMPELLER SHAFT	38515–585	1706H	1
16		PILOT BUSHING	8312A	15010	1
17	✳	GASKET	38683–446	18000	1
18		HEX HD CAPSCREW	B0606	15991	3
19		LOCK WASHER	J06	15991	3
20		RETAINING RING	24121–080	–––	1
21		OIL CHAMBER PLATE	31255–009	15080	1
22	✳	O-RING	25152–278	–––	1
23		BEARING RETAINER	38322–526	10000	1
24		RETAINING RING	S720	–––	1
25	✳	DBL ROLLER BRG	23421–414	–––	1
26		RETAINING RING	S720	–––	1
27		PIPE PLUG	P12	15079	1
28	✳	OIL SEAL	25227–773	–––	1
28A	✳	OIL SEAL	25227–773	–––	1
29		STUD	C1009	15991	4
30		HEX NUT	D10	15991	4
31		LOCK WASHER	J10	15991	4
32		PIPE PLUG	P04	15079	1
33		STUD	C1009	15991	16
34		HEX NUT	D10	15991	16
35	✳	BALANCE RING	64H6	14000	1
36	✳	WEAR RING	64H5	15000	1
37	✳	IMPELLER WASHER	K14	15991	1
38	✳	IMPELLER LOCK NUT	BC14S	15991	1
39		HEX HD CAPSCREW	B0604	15991	2
40	✳	IMPELLER KEY	N0608	15990	1
41		PIPE PLUG	P04	15079	1
42		SUCTION STICKER	6588AG	–––	1
43		SUCTION HEAD	38247–418	10000	1
44	✳	SUCTION HEAD GASKET	7557G	18000	1
45	✳	SHAFT SLEEVE	31163–018	17060	1
46		SHAFT SLEEVE O-RING	25154–026	–––	REF
47	✳	SPRING HOLDER	31167–023	15000	1
48	✳	IMP ADJ SHIM SET	5091	17090	1
NOT SHOWN:					
		OIL LEVEL DECAK	38816–123	–––	1
		DISCHARGE STICKER	6588BJ	–––	1
		INTERMEDIATE GRD ASSY	42381–504	–––	2

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

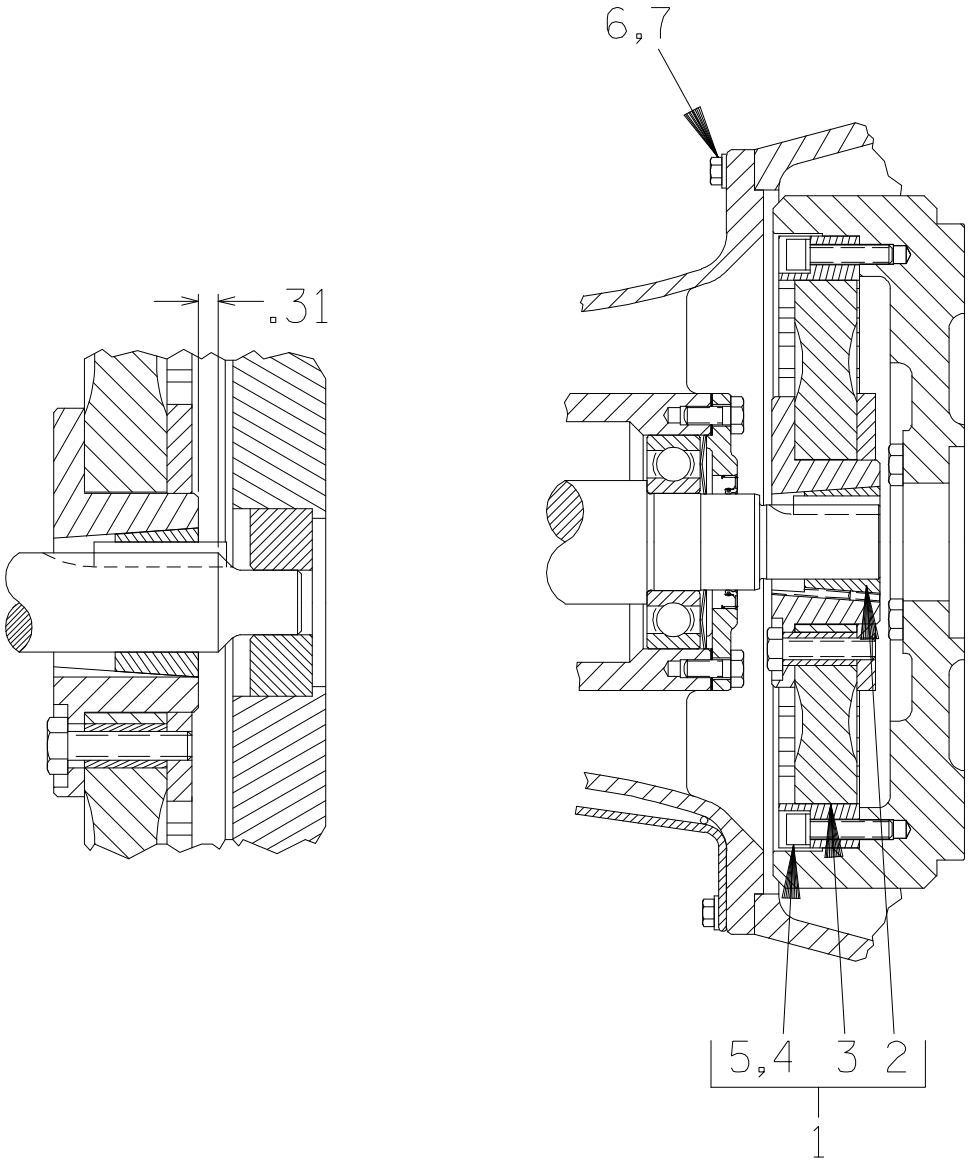


Figure 5. 44162–119 Drive Assembly

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		COUPLING KIT	48112–001	–––	1
2		–BUSHING	24131–345	–––	1
3		–COUPLING ASSY	44165–011	–––	1
4		–LOCK WASHER	21171–536	–––	8
5	☞	–SOCKET HD CAPSCREW	BD0606–1/2	15991	8
5	◗	–SOCKET HD CAPSCREW	22644–220	–––	8
6	☞	HEX HEAD CAPSCREW	B0605	15991	12
6	◗	HEX HEAD CAPSCRW	22645–164	–––	12
7	☞	LOCKWASHER	J06	15991	12
7	◗	LOCKWASHER	21171–511	–––	12

☞ USE FOR SAE APPLICATIONS
◗ USE FOR METRIC APPLICATIONS

SECTION DRAWING

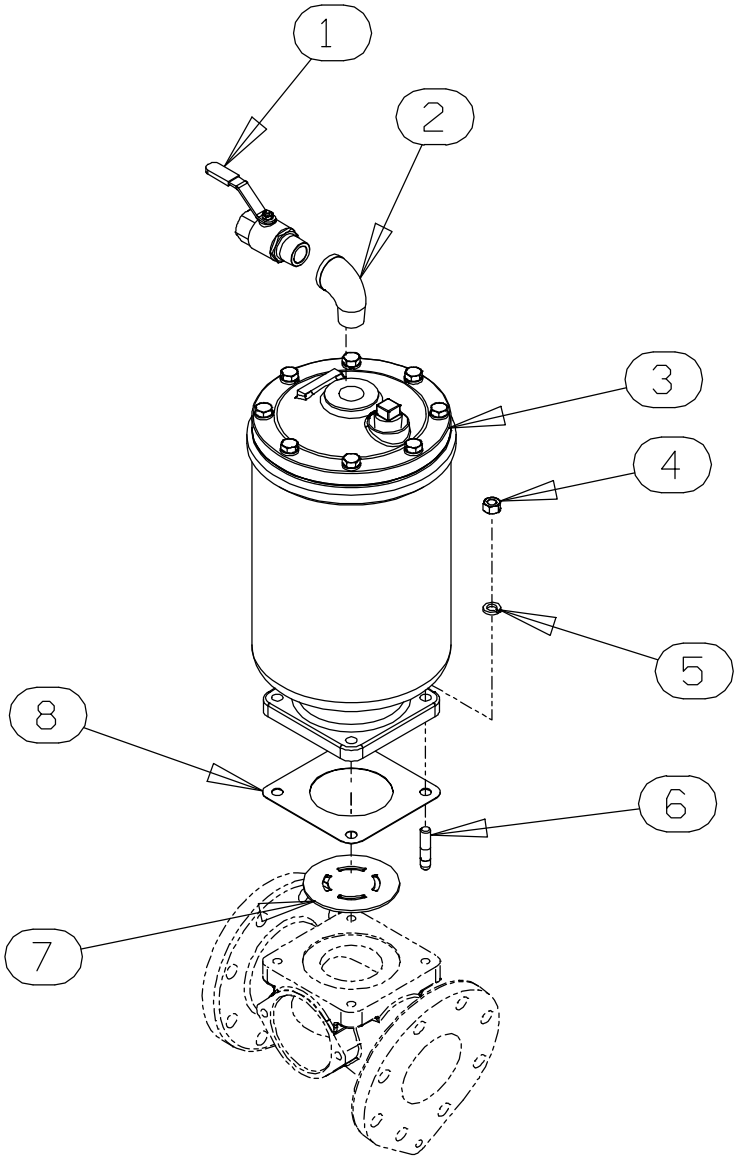


Figure 6. 48275−006 Priming Chamber Kit

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		BALL VALVE	26631−114	−−−	1
2		STREET ELBOW	RS16	11990	1
3		PRIMING CHAMBER ASSY	46112−709	−−−	1
4		HEX NUT	D08	15991	4
5		LOCK WASHER	J08	15991	4
6		STUD	C0809	15991	4
7		BAFFLE	31113−011	17000	1
8	✳	GASKET	38687−053	19060	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

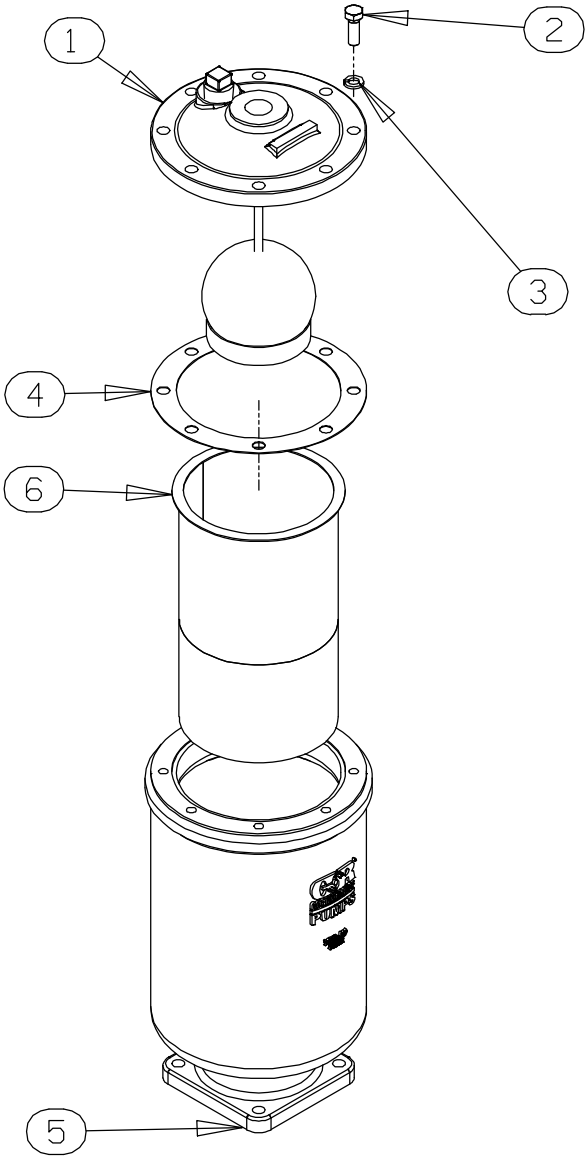


Figure 7. 46112−709 Priming Chamber Assembly

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	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

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 7) and the accompanying parts lists.

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

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

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

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

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. If slings or chains are used to move the pump or components, make sure that the load is balanced; otherwise serious personal injury or death could result. Suction and discharge hoses and piping must be removed from the pump before lifting.

WARNING!

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

Priming Chamber Removal And Disassembly

(Figure 6)

Disconnect the air discharge tubing from the priming chamber assembly (3). Support the priming chamber assembly using a sling and a suitable lifting device. Remove the hardware (4 and 5) and separate the priming chamber assembly, gasket (8) and baffle (7) from the suction spool (4, Figure 3).

(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 discharge piping. Support the discharge check valve assembly (7) using a sling and a suitable lifting device. Remove the attaching hardware (9, 10 and 11) and separate the discharge check valve assembly and gasket (8) 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 and O-ring. Separate the valve cover and remove the flapper.

Suction Head Removal

(Figure 4)

Remove the suction and discharge piping. Before attempting to service the pump, remove the pump casing drain plug (32) and drain the pump. Clean and reinstall the drain plug.

Remove the nuts (34) and use the jacking screws (39) to force the suction head (42) out of the pump casing. Turn the screws evenly to prevent binding. Remove the suction head gasket (44).

Inspect the wear ring (36) for excessive wear or scoring. If replacement is required, use a small bit to drill two holes horizontally, 180° apart, through the wear ring. Use a chisel or other suitable tool to complete the cuts through the wear ring. **Use caution** not to damage the suction head bore. Remove the wear ring from the suction head.

Impeller Removal

(Figure 4)

Before attempting to remove the impeller (2), remove the pipe plug (27) and drain the seal cavity. This will prevent the seal lubricant from spilling as the impeller is removed.

To remove the impeller, secure the shaft from rotating by reaching through the discharge port and tightly wedging a soft-metal bar between the vanes of the impeller.

Remove the impeller nut and washer (37 and 38). Install two 3/8—16 UNC by 3-inch long capscrews (not supplied) in the tapped holes in the impeller and use a suitable puller to remove the impeller from the shaft. Use caution when removing the impeller; tension on the seal spring will be released when the impeller is removed. Retain the impeller key (40). Remove the metal bar from the impeller vanes.

Remove the impeller adjusting shims (48). For ease of reassembly, tie and tag the shims or measure and record their thickness.

Seal Removal and Disassembly

(Figure 4)

Carefully remove the spring holder (47) and seal spring. Slide the shaft sleeve (45) and rotating portion of the seal assembly off the shaft as a unit.

Apply oil to the sleeve and work it up under the bellows. Slide the rotating portion of the seal off the sleeve.

Remove the shaft sleeve O-ring (46) from the shaft.

Use a pair of stiff wires with hooked ends to remove the stationary seat and O-ring from the pump casing bore.

NOTE

An alternate method of removing the stationary portion of the seal is to remove the pump casing as described below and then press the seal components out of the pump casing from the back side.

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

Pump Casing Removal

(Figure 4)

Support the pump casing using a suitable hoist and sling and remove the hardware securing the casing to the base.

Remove the hardware (30 and 31) securing the casing to the intermediate (12). Separate the parts by pulling the casing straight away from the intermediate. Remove any leveling shims from under the casing feet. Tie and tag the shims for ease of reassembly. Remove the casing gasket (5).

Inspect the balance ring (35) for excessive wear or scoring. If replacement is required, use a small bit to drill two holes horizontally, 180° apart, through the wear ring. Use a chisel or other suitable tool to complete the cuts through the wear ring. **Use caution** not to damage the pump casing.

Separating Intermediate and Drive Assembly From Engine

(Figure 5)

To service the bearing (25) or drive components, the intermediate must be separated from the engine.

Support the intermediate using a suitable hoist and sling and remove the hardware (6 and 7) securing the intermediate to the engine bellhousing. 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 (14, figure 4).

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.

Inspect the pilot bushing (16, Figure 4) for excessive wear or scoring. If replacement is required, it can be easily removed from the engine flywheel by making a hydraulic ram from a piece of steel bar stock. Turn the ram to a diameter of 0.983 inch (25 mm).

CAUTION

When performing the following procedure, grease can be ejected with great force. Wear safety glasses or goggles to prevent injury.

Completely pack the bore of the pilot bushing with grease. Insert the end of the ram into the I.D. of the bushing. Strike the ram sharply with a hammer, compressing the grease, and forcing the bushing out of the flywheel. Use additional grease as required, and continue to strike the ram until the bushing is completely free.

Shaft And Bearing Removal And Disassembly

(Figure 4)

When the pump is properly operated and maintained, the shaft and bearing should not require disassembly. Disassemble the shaft and bearing **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.

After removing the drive components from the impeller shaft, remove the hardware (18 and 19) securing the oil chamber plate (21) to the intermediate. Place a block of wood against the impeller end of the shaft, and tap the shaft (15), bearing (25), bearing retainer (23) and oil chamber plate out of the drive end of the intermediate. **Be careful** not to damage the shaft.

NOTE

There are no provisions for draining the grease from the intermediate cavity. Place a drip pan under the intermediate before removing the shaft and bearing.

Remove the oil chamber plate, gasket (17) and bearing retainer. Remove the O-ring (22) and, if necessary, the retaining ring (20) from the oil chamber plate. Remove the bearing retainer from the shaft.

Press the oil seals (18 and 18A) from the intermediate bore.

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

CAUTION

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

Clean the intermediate, shaft and all component parts (except the bearing) 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 bearing thoroughly in **fresh** cleaning solvent. Dry the bearing 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 bearing by hand to check for roughness or binding and inspect the bearing rollers. If rotation is rough or the rollers are discolored, replace the bearing.

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

If bearing replacement is required, use snap ring pliers to remove the bearing retaining ring (24) from the shaft. Use an arbor (or hydraulic) press to remove the bearing from the shaft.

Remove the inboard retaining ring (26) from the shaft if required.

Shaft and Bearing Reassembly and Installation

(Figure 4)

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

CAUTION

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

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

The bearing may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearing. The bearing 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 bearing, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

If removed, install the inboard bearing retaining ring (26) in the groove in the shaft.

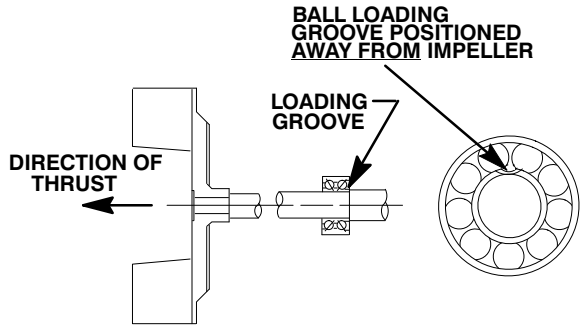
Heat the bearing to a uniform temperature **no higher than** 250°F (120°C), and slide the it onto the shaft until fully seated against the retaining ring. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

WARNING!

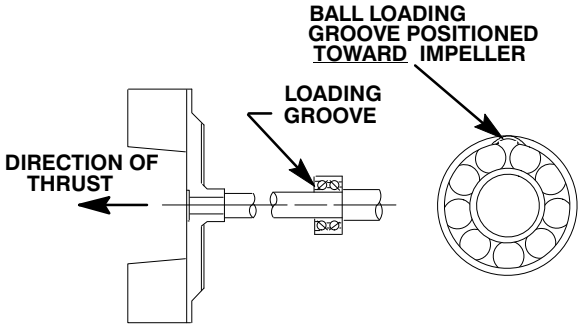
Use caution when handling hot bearings to prevent burns.

NOTE

Position the bearing on the shaft as indicated by the following illustrations.



INSTALLATION OF NEW DEPARTURE OR BCA/FEDERAL MOGAL 5300W SERIES BEARINGS (OPEN OR ENCLOSED IMPELLERS)



INSTALLATION OF MRC/SKF 5300M OR FAFNIR 5300W SERIES BEARINGS (OPEN OR ENCLOSED IMPELLERS)

Figure 8. Bearing Installation

After the bearing has been installed and allowed to cool, check to ensure that it has not moved out of position in shrinking. If movement has occurred, use a suitably sized sleeve and a press to reposition the bearing.

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

CAUTION

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

After the bearing is installed on the shaft, pack the bearing by hand with No. 0 lithium base grease until the bearing rollers are thoroughly lubricated. Secure the bearing on the shaft with the bearing retaining ring (24).

Slide the shaft and assembled bearing into the intermediate bore from the drive end until the bearing seats squarely against the bore shoulder.

CAUTION

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

If removed, install the retaining ring (20) in the groove in the oil chamber plate (21). Install a new O-ring (22) in the groove in the oil chamber plate and lubricate it with light oil.

Install the same thickness of bearing adjusting shims (9) as previously remove, and position the bearing retainer (23) against the shims. Install a new gasket (17) and press the oil chamber plate into the intermediate until the retaining ring (20) is fully seated against the bearing retainer. Secure the oil chamber plate to the intermediate with the hardware (18 and 19).

NOTE

Impeller shaft endplay should be between .002 and .010 inch (0,05 to 0,25 mm). To achieve the correct endplay, add or remove bearing shims (9) as required.

Position the inboard lip seal (18) in the intermediate bore with the lip positioned as shown in Figure 4 and press it into the intermediate until it is just flush with the inner machined face of the intermediate bore.

Position the outboard lip seal (18A) in the intermediate bore with the lip positioned as shown in Figure 4 and press it into the intermediate until it is fully seated against the inboard lip seal.

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

Securing Intermediate and Drive Assembly to Engine

(Figure 5)

Install the shaft key (14, Figure 4) in the shaft keyway. Position the flexible portion of the coupling assembly (3) on the shaft to the dimension shown in Figure 5.

NOTE

The flexible portion of the coupling must be properly positioned on the shaft. The heads of the capscrews in the center of the coupling ***must be positioned toward the pump end of the shaft****.*

Align the keyway in the bushing (2) with the shaft key and slide it onto 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 mounted as shown in Figure 5. The end of the shaft must be recessed aproximately 0.41 inch (10 mm) from the face of the bushing. **This dimension 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.

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 14.6 ft. lbs. (175 in. lbs. or 2 m. kg.).

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

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.*

Using a suitable lifting device, position the assembled coupling, intermediate, shaft and bearings so the flexible portion of the coupling seats inside the outer ring attached to the engine flywheel.

Secure the intermediate to the engine bellhousing with the previously removed hardware (6 and 7).

Pump Casing Installation

(Figure 4)

If the balance ring (35) was removed, position the replacement ring in the casing bore with the chamfered end toward the bore shoulder. Press the ring into the casing until it seats squarely against the casing shoulder.

CAUTION

The balance ring **must** seat squarely in the suction head; otherwise binding and/or excessive wear will result.

NOTE

The stationary seat and O-ring for the shaft seal assembly may be installed in the pump casing before the casing is secured to the intermediate (see ***Seal Reassembly and Installation****). If the stationary seat is installed,* ***be careful*** *not to damage it on the shaft threads.*

Position the pump casing over the shaft and against the intermediate. Secure the casing to the intermediate with the hardware (30 and 31).

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

Seal Reassembly and Installation

(Figures 4 and 9)

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

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.

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

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

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Clean and polish the shaft sleeve, or replace it if badly worn. If any components are worn, replace the complete seal; **never mix old and new seal parts**.

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

To ease installation of the seal, lubricate the stationary seat O-ring, bellows and shaft sleeve with water or a very **small** amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 9).

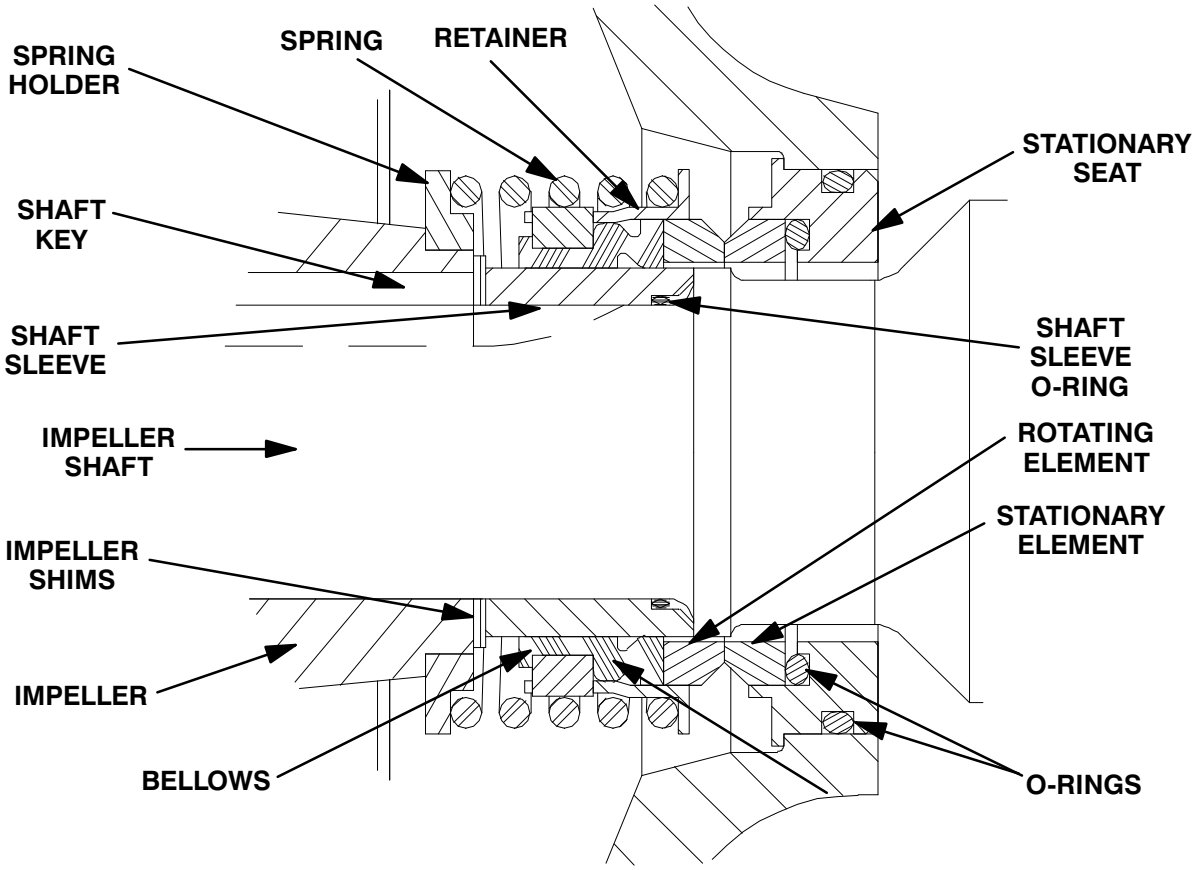


Figure 9. 46512—048 Seal Assembly

CAUTION

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

Inspect the pump casing and impeller shaft for burrs or sharp corners and remove any that exist.

With the stationary seat O-ring lubricated and installed in the stationary seat, press the stationary seat and element into the pump casing until it seats squarely against the bore shoulder. Be careful not to damage the stationary element. A push tube cut from a length of plastic pipe would aid this installation. The O.D. of the pipe should be approximately the same diameter as the O.D. of the seal spring.

NOTE

If the pump casing has not been installed, position the casing over the shaft and against the intermediate, using caution not to damage the seal stationary seat and element. Secure the casing to the intermediate with the hardware (30 and 31).

Lubricate the shaft sleeve O-ring (46) and slide it onto the shaft.

Subassemble the rotating element into the retainer and bellows. Use even pressure to carefully press this subassembly onto the lubricated sleeve (45) until the seal face is **just flush** with the chamfered end of the sleeve.

Slide the assembled sleeve and rotating portion of the seal onto the shaft until the seal faces contact. Continue to push the sleeve through the seal until it seats squarely against the shaft shoulder.

Install the seal spring and spring holder (47).

Impeller Installation

(Figure 4)

If the balance ring (35) was removed, press the replacement ring into the pump casing as described in **Pump Casing Installation**.

CAUTION

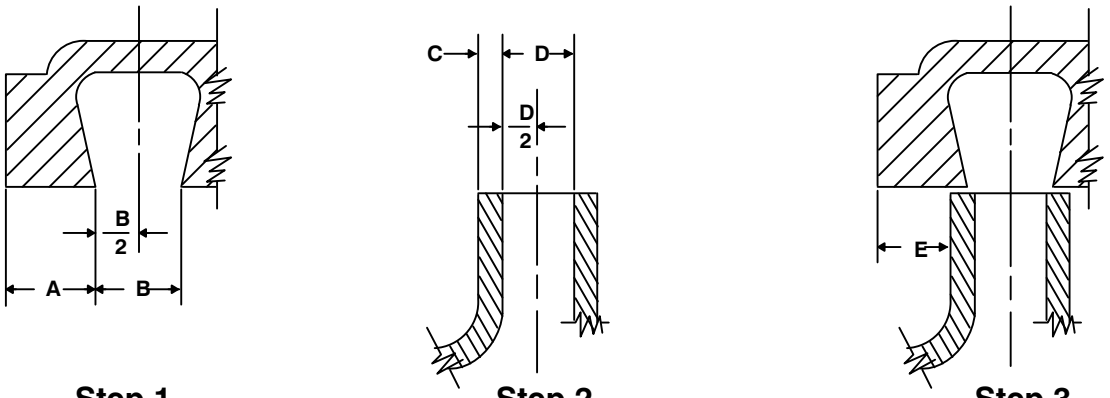
The balance ring **must** seat squarely in the

suction head; otherwise binding and/or excessive wear will result.

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

For maximum pump efficiency, the impeller should be centered within the volute scroll.

To verify the impeller positioning, measure the pump casing and impeller as shown in Figure 10. Use these measurements to calculate the required impeller location (dimension E). Add or remove impeller adjusting shims (48) until dimension E is obtained.



$$\left(A+\frac{B}{2}\right)-\left(C+\frac{D}{2}\right)=E$$

Figure 10. Centering Impeller Within Volute Scroll

Install the calculated thickness of impeller shims (48). Install the impeller key (40) and slide the impeller completely onto the shaft.

Secure the shaft from rotating by reaching through the discharge port and tightly wedging a soft-metal bar between the vanes of the impeller. Secure the impeller with the impeller washer and nut (37 and 38).

NOTE

After the impeller has been properly positioned, check for free rotation. Correct any scraping binding before further reassembly.

Suction Head Installation

(Figure 4)

If removed at disassembly, press the replacement wear ring (36) into the suction head (42) until it seats squarely against the bore shoulder.

CAUTION

The wear ring **must** seat squarely in the suction head; otherwise binding and/or excessive wear will result.

Install the suction head gasket (44) and secure the suction head to the pump casing with the nuts (34). Make sure the jacking screws (39) do not interfere with the suction head seating.

Discharge Check Valve Assembly And Installation

(Figure 3)

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 and O-ring. Separate the valve cover and replace the flapper.

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

Support the discharge check valve assembly (7) using a sling and a suitable lifting device. Use the

previously removed hardware (9, 10 and 11) to secure the discharge check valve assembly and gasket (8) 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 (1 and 2).

(Figure 6)

Install the baffle (7) and gasket (6) and use a sling and suitable lifting device to position the priming chamber assembly on the hopper spool (not shown). Secure the priming chamber assembly with the hardware (4 and 5).

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

Final Pump Assembly

(Figure 4)

Turn the shaft to make sure that the impeller is not binding or scraping. If it does, check the installation of the wear ring and balance ring, or remove adjusting shims until the impeller rotates freely when the pump is fully assembled.

Be sure the pump and intermediate are secure to the engine and the base.

Install the suction and discharge lines and open all valves. Make certain that all piping connections are tight, properly supported and secure.

Be sure the pump and engine have been properly lubricated, see **LUBRICATION**.

LUBRICATION

(Figure 4)

Seal Assembly

Check the oil level regularly through the sight gauge (8) and maintain it at the middle of the gauge. When lubrication is required, add SAE No. 30 non-detergent oil through the hole for the air vent (6). **Do not** over-lubricate..

NOTE

The white reflector in the sight gauge must be positioned horizontally to provide proper drainage.

When lubricating a dry seal cavity, add approximately 6 quarts (5,7 L) of oil. Check the oil level regularly and refill as required.

CAUTION

To ensure lubrication of the seal assembly, do not allow the oil level to drop below the line on the sight gauge.

Bearings

The intermediate was fully lubricated when shipped from the factory. Under normal conditions, add three shots of No. 0 lithium base grease from a grease gun through the grease fitting (10) after each 250 hours of operation or once each month, whichever comes first. **Do not** over-lubricate. Over-lubrication can cause the bearing to over-heat, resulting in premature bearing failure.

CAUTION

Observe the area between the shaft and bearing retainer (23) as grease is added. If old grease is forced out as new grease is added, the bearing cavity is full and should be disassembled and cleaned immediately.

There are no provisions in the bearing cavity to drain or flush the lubricant. The pump and intermediate must be disassembled to completely clean and maintain this cavity.

Under normal conditions, change the grease after each 5000 hours of operation, or at 12 month intervals, whichever comes first. Change the grease more frequently if the pump is operated continuously or installed in an environment where variable hot and cold temperatures are common.

When lubricating a dry (overhauled) intermediate, fill the cavity through the lubrication fitting with approximately one third pound (0,15 kg) of grease (approximately one-third full).

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

Engine

Consult the manual supplied with the engine or contact your local engine representative.

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