OM—06556—01
January 6, 2016

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

PA SERIES® PUMP

MODEL

PA10A60—QSB4.5P

GORMAN-RUPP PUMPS

www.grpumps.com

Printed in U.S.A.

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

Valid serial number and e-mail address required.

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

RECORD YOUR PUMP MODEL AND SERIAL NUMBER

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

Pump Model: _____

Serial Number: _____

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INTRODUCTION

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

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

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

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

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

HAZARD AND INSTRUCTION DEFINITIONS

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

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.

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 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.**

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.

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 pump 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. 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.

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!

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

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. The maximum continuous operating speed for this pump is 1950 RPM.

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

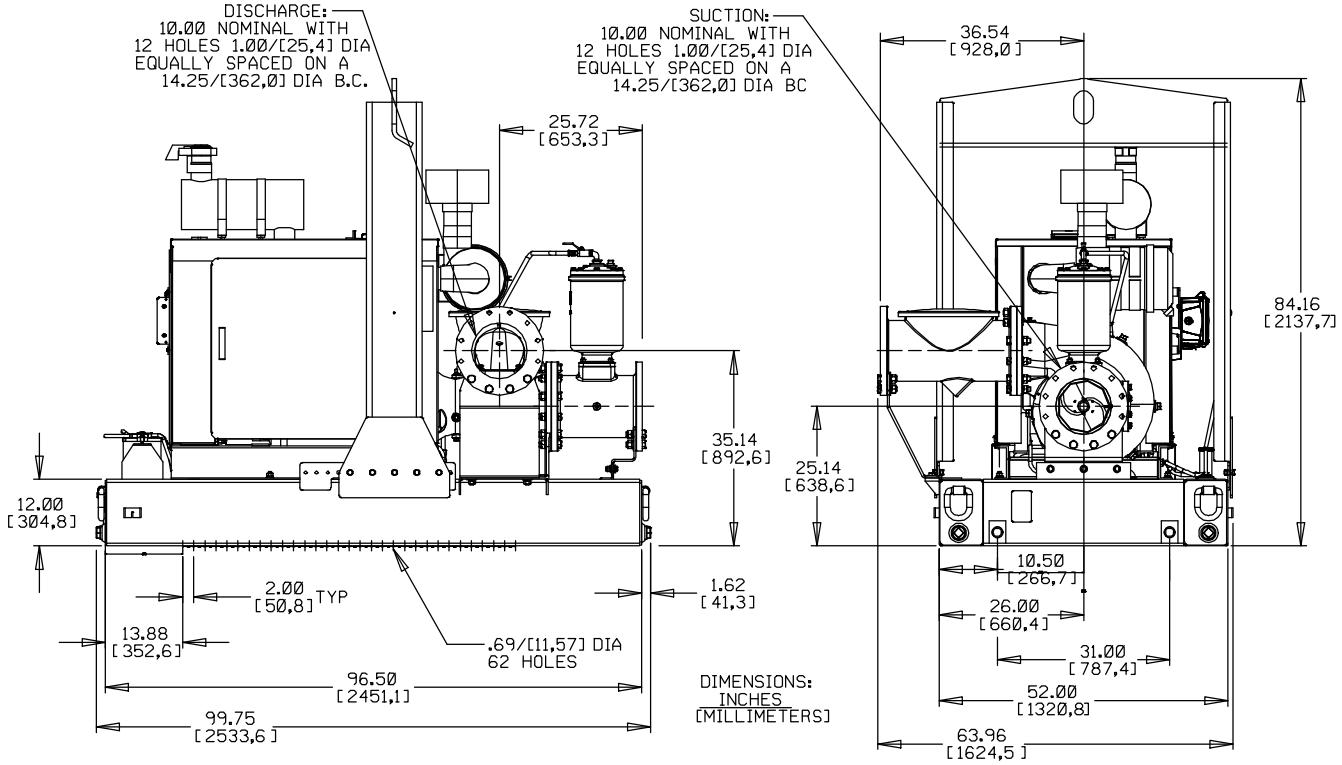


Figure 1. Pump Model PA10A60–QSB4.5P

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.

CAUTION

Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, the impeller could become loosened from the shaft and seriously damage the pump.

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

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.

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.

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 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.

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).

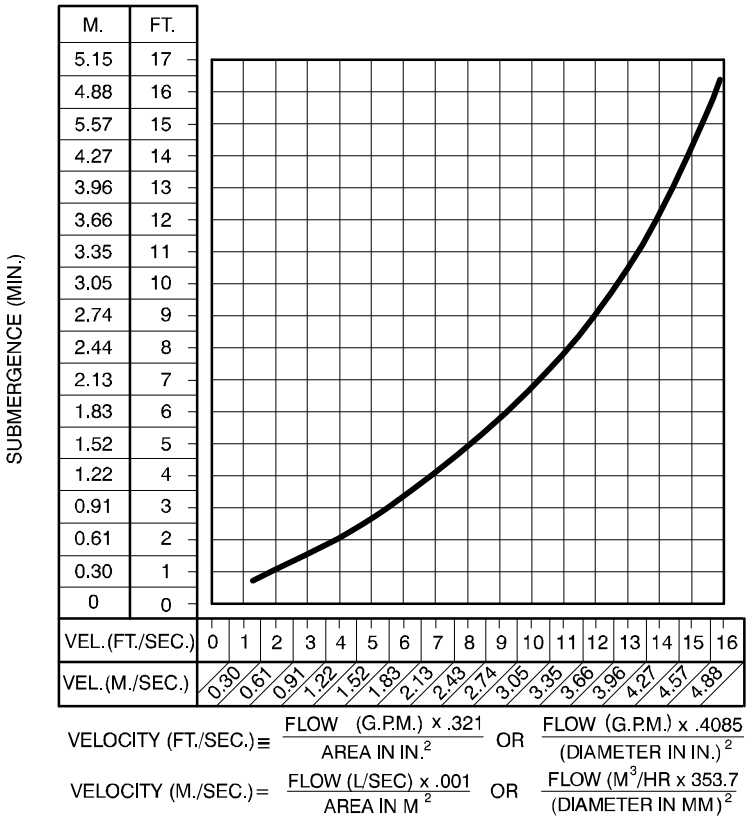


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

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.

CAUTION

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

ALIGNMENT

The alignment of the pump, air compressor 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.

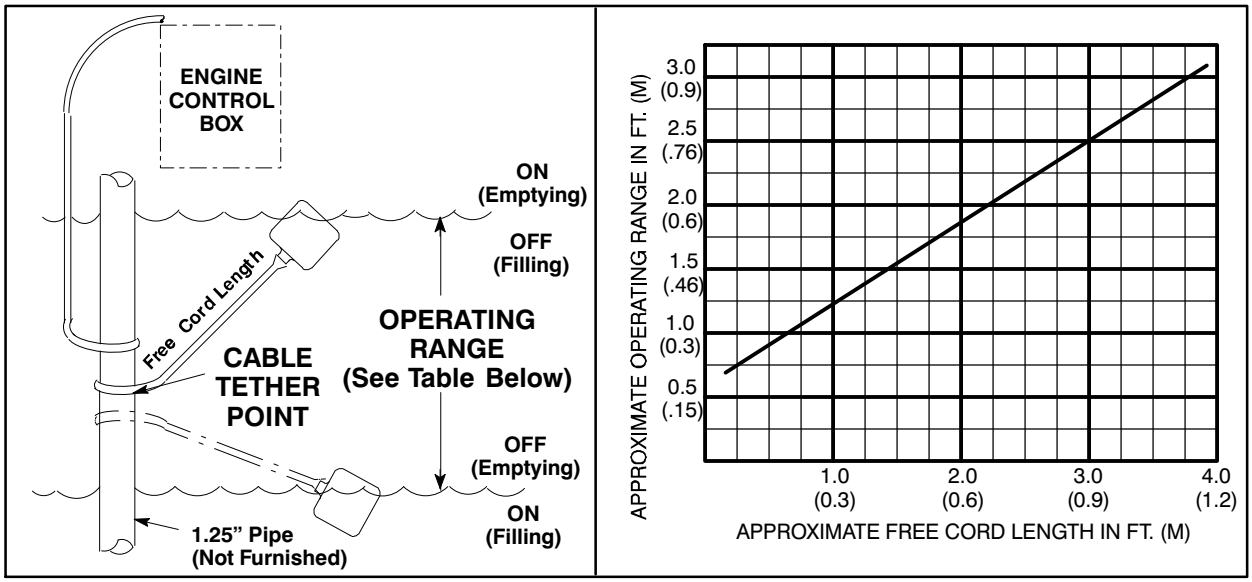


Figure 3. Float Switch Data

OPERATION — SECTION C

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

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

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

PRIMING

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.

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).

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 in Section E for the maximum continuous operating speed for this pump.

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

CAUTION

The engine powering this unit may be equipped with an EPA-compliant Exhaust After-Treatment (EAT) system, which is designed to reduce the amount of polutants expelled into the atmosphere during operation. Refer to the manual accompanying the engine for a detailed explanation of the engine EAT and follow all instructions in the engine manual to ensure uninterrupted operation of the unit.

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 shutting down the engine.

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, **Main-**

tenance 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

If the pump will be idle for an extended period of time in below freezing conditions, drain the pump and priming hopper 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.

If the pump is to be installed in an environment where sub-freezing temperatures will occur during operation, consideration must be given to prevent the pump and components from freezing when the pump is idle between pumping cycles. Refer to **COLD WEATHER INSTALLATION** in the **Installation** section of this manual for details.

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 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

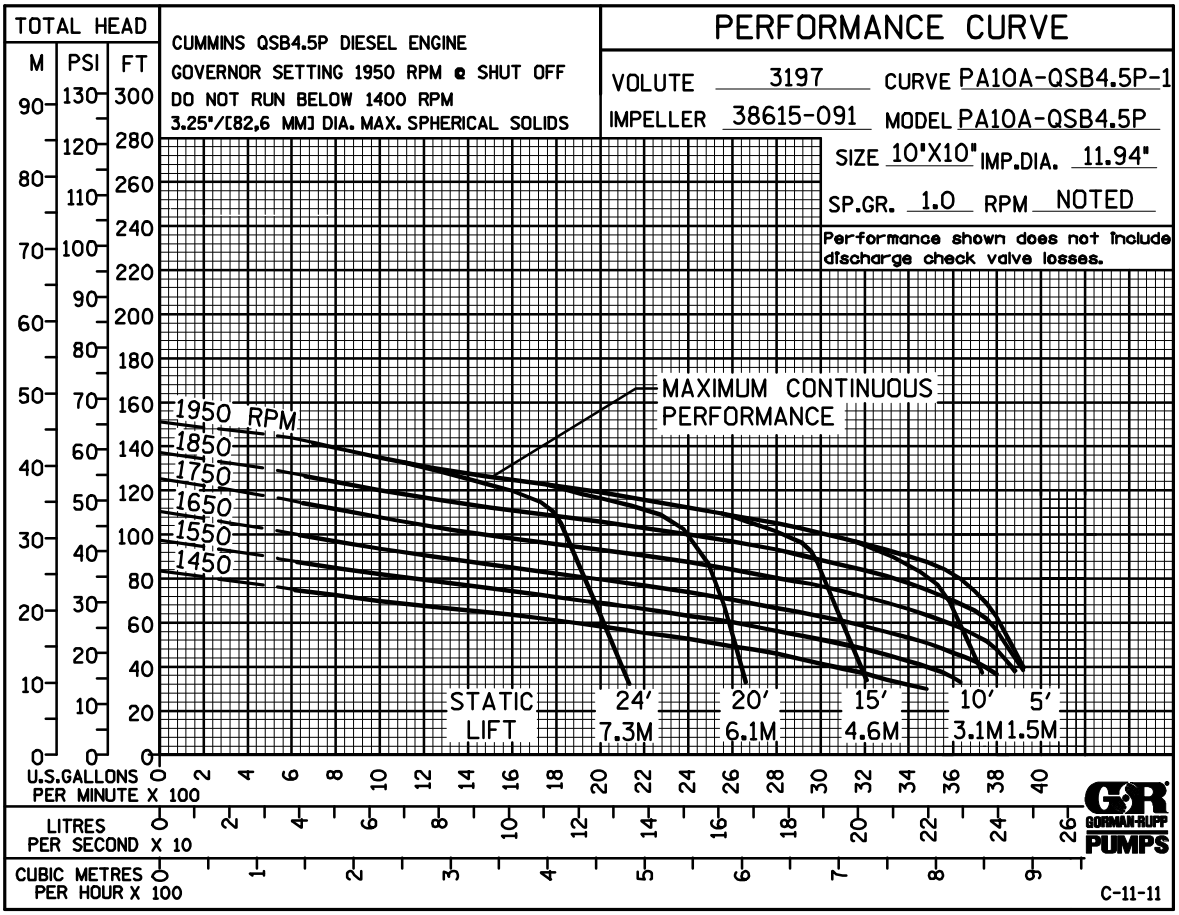
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication (And Packing Adjustment, If So Equipped)		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 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 PA10A60–QSB4.5P**

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

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

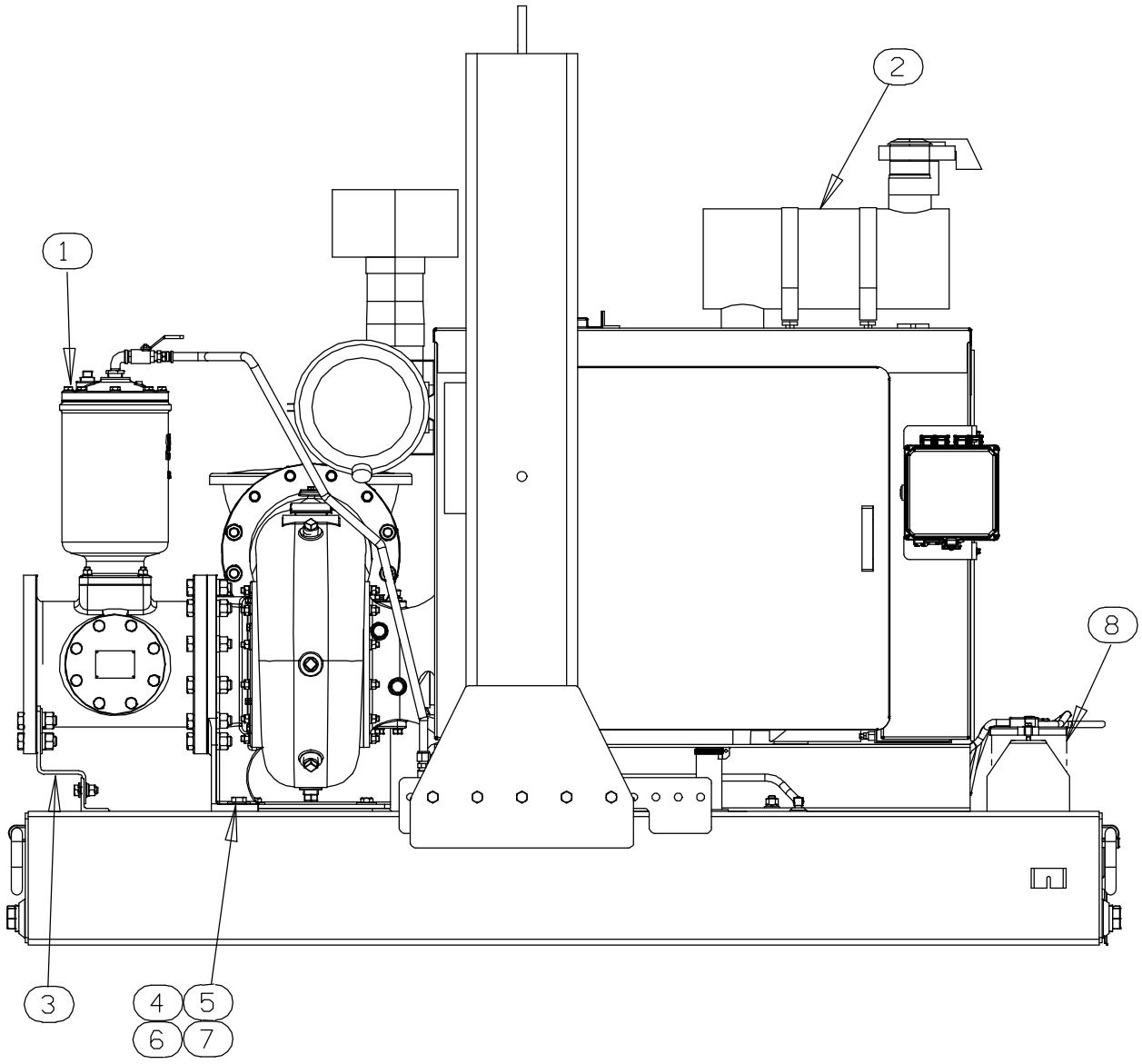


Figure 1. Pump Model PA10A60−QSB4.5P

PARTS LIST

Pump Model PA10A60–QSB4.5P

(From S/N Up)

ITEM NO.	PART NAME	PART NUMBER	QTY
1	PUMP END ASSEMBLY	46133–781	1
2	CUMMINS POWER UNIT	46143–187	1
3	PUMP MOUNTING KIT	48157–064	1
4	HEX HEAD CAP SCREW	B1211 15991	2
5	FLAT WASHER	K12 15991	4
6	LOCK WASHER	J12 15991	2
7	HEX NUT	D12 15991	2
8	BATTERY	SEE OPTIONS	REF
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	2
	NAMEPLATE	38818–127 13000	1
	DRIVE SCREW	BM#04–03 17000	4
	LUBE DECAL	38816–079	1
	OIL LEVEL DECAL	38816–123	1
OPTIONAL:			
	BATTERY	29331–519	2

ILLUSTRATION

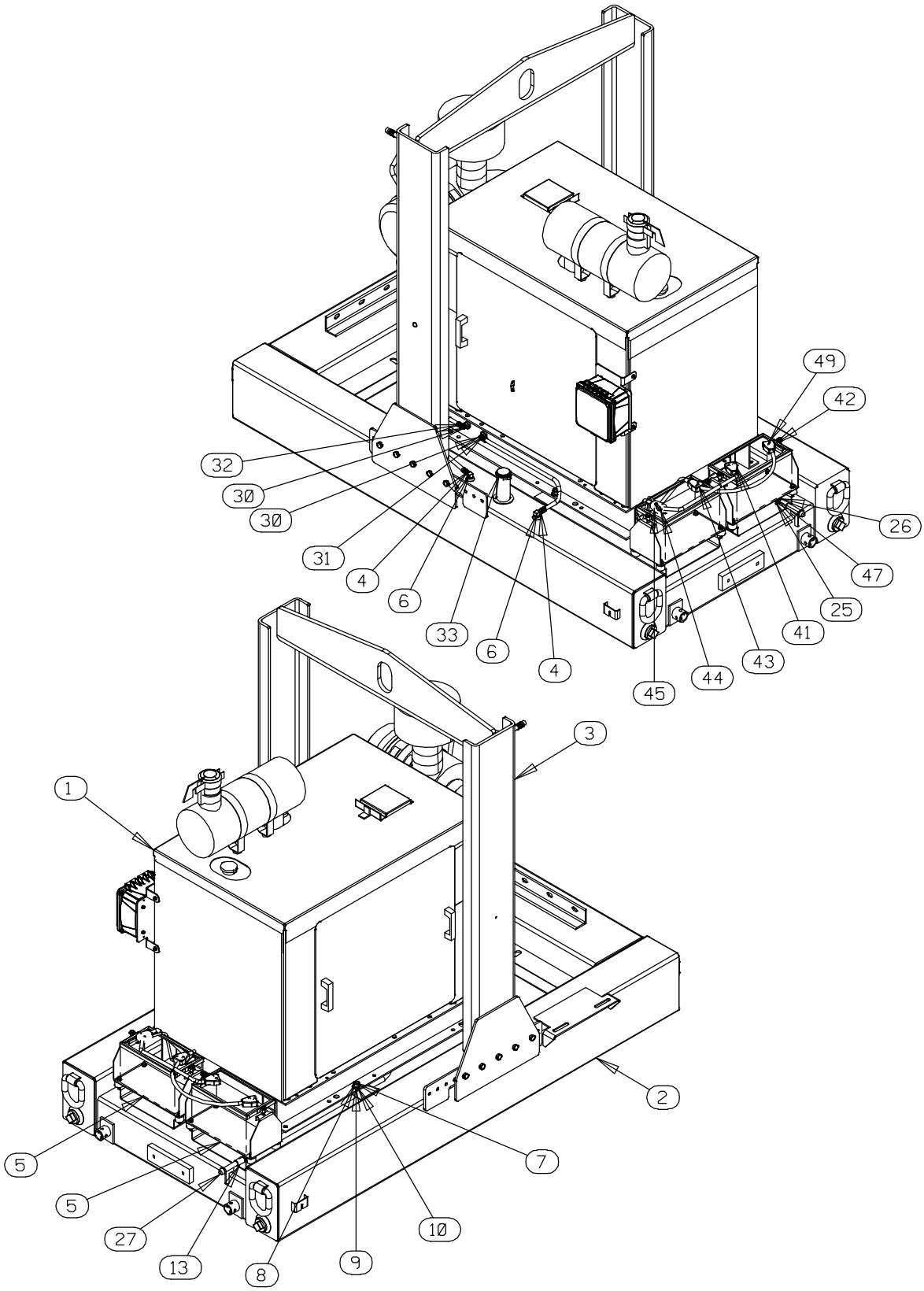


Figure 2. 46143–187 Power Unit Kit

PARTS LIST

46143–187 Power Unit Kit

ITEM NO.	PART NAME	PART NUMBER	QTY
1	CUMMINS QSB4.5P ENG	29216–352	1
2	BASE / FUEL TANK ASSY	41553–047 24150	1
3	LIFTING BAIL KIT	48274–805	1
4	CONNECTOR	S1447	2
5	BATTERY BOX ASSY	42432–009	2
6	FUEL PICKUP	29332–145	2
7	HEX HEAD CAP SCREW	B1007 15991	4
8	HEX NUT	D10 15991	4
9	LOCK WASHER	J10 15991	4
10	WASHER SAE 5/8”	21161–442	8
11	PIPE ELBOW	R08 11999	1
12	VENTURI	26817–002	1
13	PIPE CPLG 1/2”	AE08 15079	2
14	1/2” CHECK VALVE	26641–092	1
15	HOSE BARB FITTING	26523–061	1
16	PIPE UNION	AH08 11999	1
17	REDUCER PIPE BUSHING	AP0806 15079	1
18	PIPE TEE	U08 11999	1
19	CONNECTOR	26351–065	1
20	MALE ELBOW	26341–310	1
21	PRESSURE RELIEF VALVE	26662–028	1
22	HOSE BARB FITTING	26523–047	1
23	CONNECTOR	S1598	1
24	VENTURI MTG BRACKET	41888–199 24150	1
25	HOSE CLAMP	26518–666	2
26	HOSE BARB FITTING	26523–391	1
27	PIPE CAP	V08 15079	1
28	CNTRL PNL INSTALL KIT	48122–560	1
29	HOSE ASSY	46341–426	1
30	MALE ELBOW	26351–131	2
31	HOSE ASSEMBLY	46341–816	1
32	HOSE ASSEMBLY	46341–787	1
33	LOCKING FUEL CAP	29332–111	1
34	REDUCER PIPE BUSHING	AP1208 15079	1
35	HOSE BARB FITTING	26523–389	1
36	CABLE TIE	27111–218	1
37	HOSE BARB FITTING	26523–447	1
38	AIR VENT	S1703	1
39	FUEL GAUGE	29332–173	1
40	SOCKET HD CAP SCREW	BD#10–03S 15991	5
41	2/O CABLE SUB ASSY	47311–227	1
42	2/O CABLE SUB ASSY	47311–228	1
43	2/O CABLE SUB ASSY	47311–229	1
44	#4 CABLE SUB ASSY	47311–556	1
45	2/O CABLE SUB ASSY	47311–230	1
46	HOSE .37 ID X 36.00” LG	18513–302	1
47	HOSE 5/8 X 54.00” LG	18513–042	1
48	HOSE 1/2 X 60.00” LG	18513–113	1
49	WING NUT	BB06 15991	4
NOT SHOWN:			
	ENGINE START UP TAG	38816–269	1
	WARNING DECAL	38816–203	4
	INSTRUCTION DECAL	38818–144	1
	WARNING DECAL	38816–132	2
	FLOAT SWITCH KIT	48312–980	1
	LOW SULFUR DECAL	38816–196	1
	ENG OPERATING DECAL	38816–347	1

ILLUSTRATION

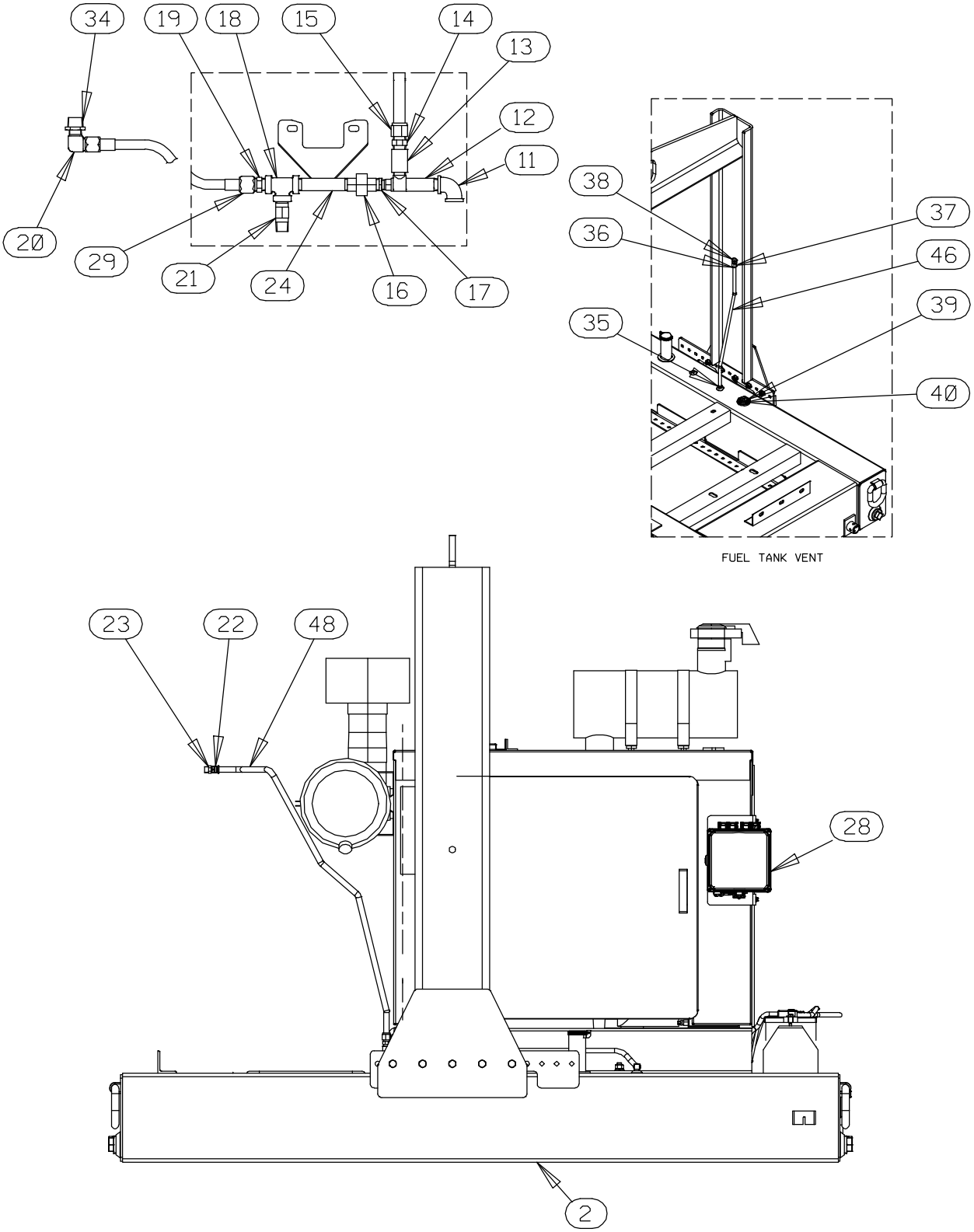


Figure 3. 46143—187 Power Unit Kit (Cont'd)

PARTS LIST

46143–187 Power Unit Kit (Cont'd)

ITEM NO.	PART NAME	PART NUMBER	QTY
1	CUMMINS QSB4.5P ENG	29216–352	1
2	BASE / FUEL TANK ASSY	41553–047 24150	1
3	LIFTING BAIL KIT	48274–805	1
4	CONNECTOR	S1447	2
5	BATTERY BOX ASSY	42432–009	2
6	FUEL PICKUP	29332–145	2
7	HEX HEAD CAP SCREW	B1007 15991	4
8	HEX NUT	D10 15991	4
9	LOCK WASHER	J10 15991	4
10	WASHER SAE 5/8"	21161–442	8
11	PIPE ELBOW	R08 11999	1
12	VENTURI	26817–002	1
13	PIPE CPLG 1/2"	AE08 15079	2
14	1/2" CHECK VALVE	26641–092	1
15	HOSE BARB FITTING	26523–061	1
16	PIPE UNION	AH08 11999	1
17	REDUCER PIPE BUSHING	AP0806 15079	1
18	PIPE TEE	U08 11999	1
19	CONNECTOR	26351–065	1
20	MALE ELBOW	26341–310	1
21	PRESSURE RELIEF VALVE	26662–028	1
22	HOSE BARB FITTING	26523–047	1
23	CONNECTOR	S1598	1
24	VENTURI MTG BRACKET	41888–199 24150	1
25	HOSE CLAMP	26518–666	2
26	HOSE BARB FITTING	26523–391	1
27	PIPE CAP	V08 15079	1
28	CNTRL PNL INSTALL KIT	48122–560	1
29	HOSE ASSY	46341–426	1
30	MALE ELBOW	26351–131	2
31	HOSE ASSEMBLY	46341–816	1
32	HOSE ASSEMBLY	46341–787	1
33	LOCKING FUEL CAP	29332–111	1
34	REDUCER PIPE BUSHING	AP1208 15079	1
35	HOSE BARB FITTING	26523–389	1
36	CABLE TIE	27111–218	1
37	HOSE BARB FITTING	26523–447	1
38	AIR VENT	S1703	1
39	FUEL GAUGE	29332–173	1
40	SOCKET HD CAP SCREW	BD#10–03S 15991	5
41	2/O CABLE SUB ASSY	47311–227	1
42	2/O CABLE SUB ASSY	47311–228	1
43	2/O CABLE SUB ASSY	47311–229	1
44	#4 CABLE SUB ASSY	47311–556	1
45	2/O CABLE SUB ASSY	47311–230	1
46	HOSE .37 ID X 36.00" LG	18513–302	1
47	HOSE 5/8 X 54.00" LG	18513–042	1
48	HOSE 1/2 X 60.00" LG	18513–113	1
49	WING NUT	BB06 15991	4
NOT SHOWN:			
	ENGINE START UP TAG	38816–269	1
	WARNING DECAL	38816–203	4
	INSTRUCTION DECAL	38818–144	1
	WARNING DECAL	38816–132	2
	FLOAT SWITCH KIT	48312–980	1
	LOW SULFUR DECAL	38816–196	1
	ENG OPERATING DECAL	38816–347	1

ILLUSTRATION

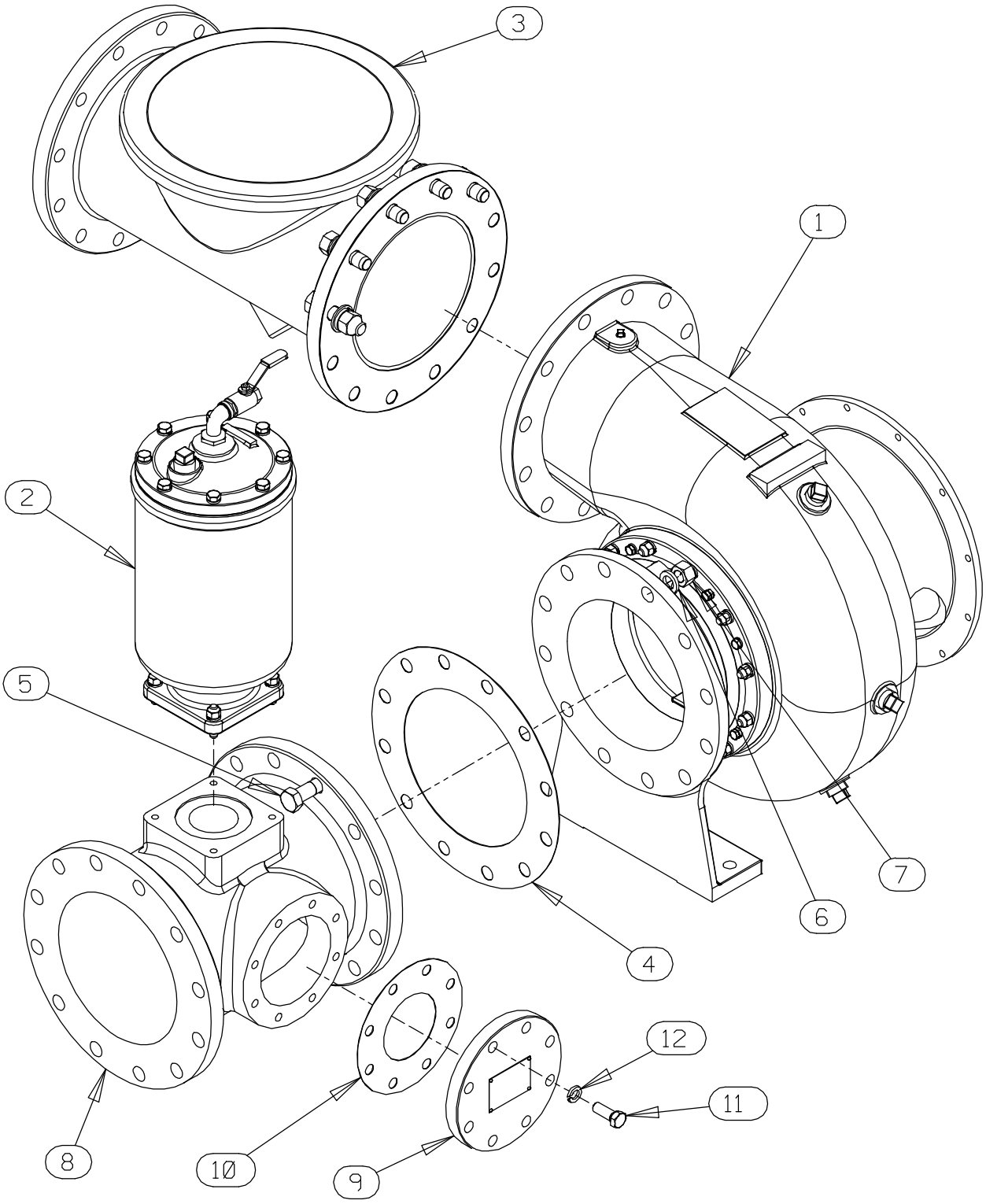


Figure 4. PA10A60–(SAE 3/11.5) Pump Assembly

PARTS LIST
PA10A60–(SAE 3/11.5) Pump Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PUMP END ASSEMBLY	610N60–(SAE 3/11.5)	1
2		PRIMING CHAMBER KIT	48275–005	1
3		CHECK VALVE KIT	48274–007	1
		–CHECK VALVE	26642–127	1
	✳	–FLAPPER	26688–007	1
	✳	–COVER GASKET	26688–008	1
	✳	–GASKET	25113–040	1
4	✳	GASKET	25113–040	1
5		HEX HD CAPSCREW	B1414 15991	12
6		LOCK WASHER	J14 15991	12
7		HEX NUT	D14 15991	12
8		SUCTION SPOOL	38644–807 10000	1
9		BLIND FLANGE ASSY	42111–358	1
10	✳	GASKET	25113–034	1
11		HEX HD CAPSCREW	B1007 15991	8
12		LOCK WASHER	J10 15991	8
NOT SHOWN:				
		STRAINER	46641–011 24150	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

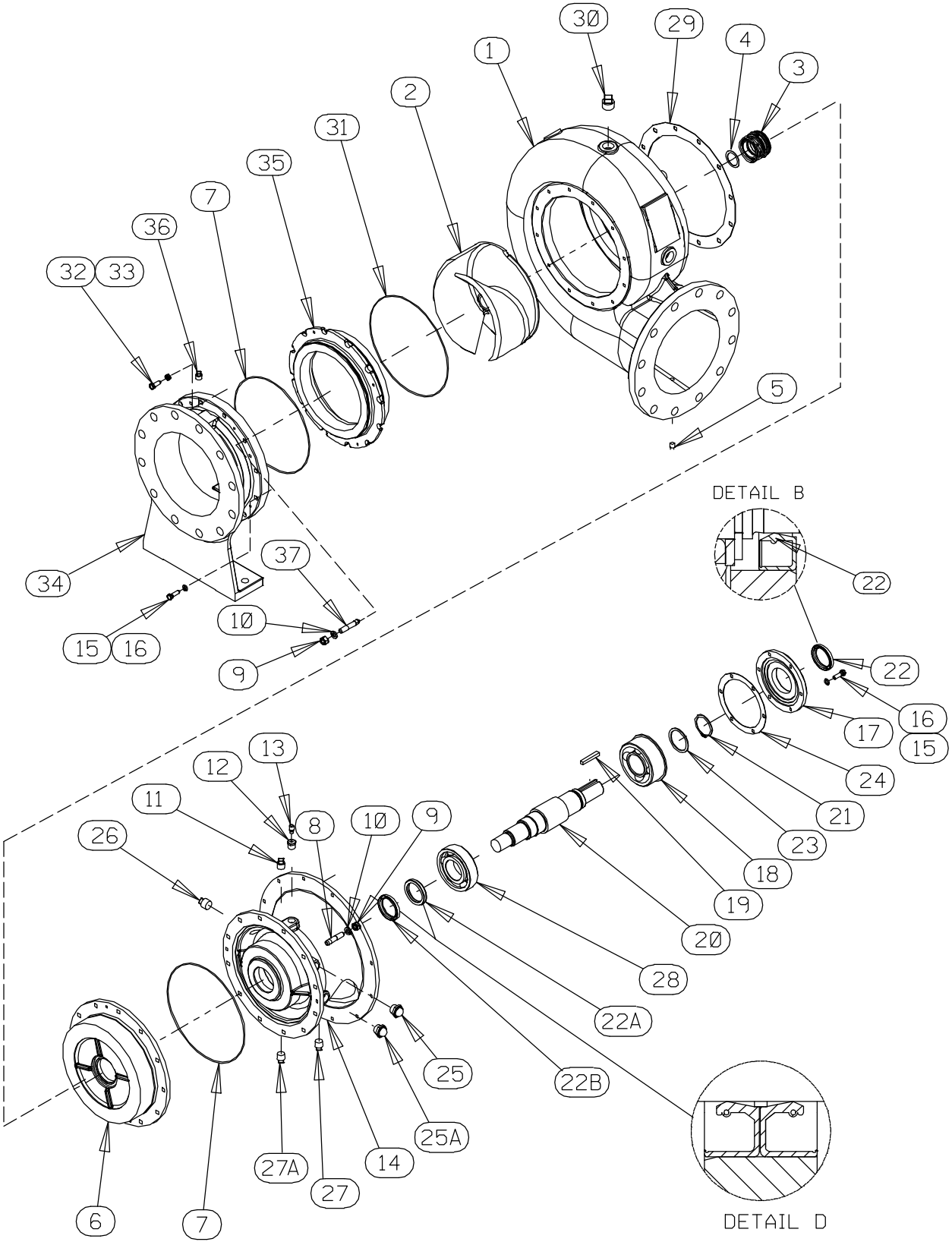


Figure 5. 610N60—(SAE 3/11.5) Pump End Assembly

PARTS LIST

610N60–(SAE 3/11.5) Pump End Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PUMP CASING	SEE NOTE BELOW	1
2	✳	IMPELLER	38615–091 11010	1
3	✳	MECH SEAL ASSY	46512–048	1
4		IMP ADJ SHIM SET	5091 17090	1
5		PIPE PLUG	P04 15079	1
6		SEAL PLATE	38272–716 10000	1
7	✳	O-RING	25152–276	2
8		STUD	C0810 15991	12
9		HEX NUT	D08 15991	24
10		LOCK WASHER	J08 15991	24
11		VENTED PIPE PLUG	4823A 15079	1
12		RED PIPE BUSHING	AP0802 15079	1
13		AIR VENT	S1530	1
14		INTERMEDIATE	38264–705 10000	1
15		HEX HD CAPSCREW	B0605 15991	10
16		LOCK WASHER	J06 15991	10
17		BEARING COVER	38322–432 10000	1
18	✳	BALL BEARING	23422–413	1
19	✳	SHAFT KEY	N0610 15990	1
20	✳	IMPELLER SHAFT	38512–524	1
21		RETAINING RING	24124–052	1
22	✳	LIP SEAL	25258–725	1
22A	✳	LIP SEAL	25258–725	1
22B	✳	LIP SEAL	25258–725	1
23		THRUST WASHER	31134–114 15000	1
24	✳	BRG COVER GASKET	38683–475 18000	1
25		SEAL CVTY SIGHT GAGE	S1471	1
25A		BRG CVTY SIGHT GAGE	S1471	1
26		PIPE PLUG	P12 15079	2
27		BRG CVTY DRAIN PLUG	P08 15079	2
27A		SEAL CVTY DRAIN PLUG	P08 15079	2
28	✳	BALL BEARING	S1911	1
29	✳	CASING GASKET	3200G 18000	1
30		PIPE PLUG	P16 10009	5
31	✳	SUCT HEAD O-RING	25152–277	1
32		HEX HD CAPSCREW	B0604 15991	4
33		JAM NUT	AT06 15991	4
34		SUCTION HEAD	38248–506 10000	1
35	✳	WEAR RING	38691–634 11010	1
36		PIPE PLUG	P06 15079	1
37		STUD	C0811 15991	12
NOT SHOWN:				
		LUBE DECAL	11421A	1
		SUCTION STICKER	6588AG	1
		DISCHARGE STICKER	6588BJ	1
		INTERMEDIATE GUARD	42381–031	2
		DRIVE ASSY	44162–157	1
		HEX HD CAPSCREW	B0604 15991	2

✳ INDICATES PARTS RECOMMENDED FOR STOCK

☞	INCLUDED WITH REPAIR PUMP CASING ASSY	46474–358	1

ILLUSTRATION

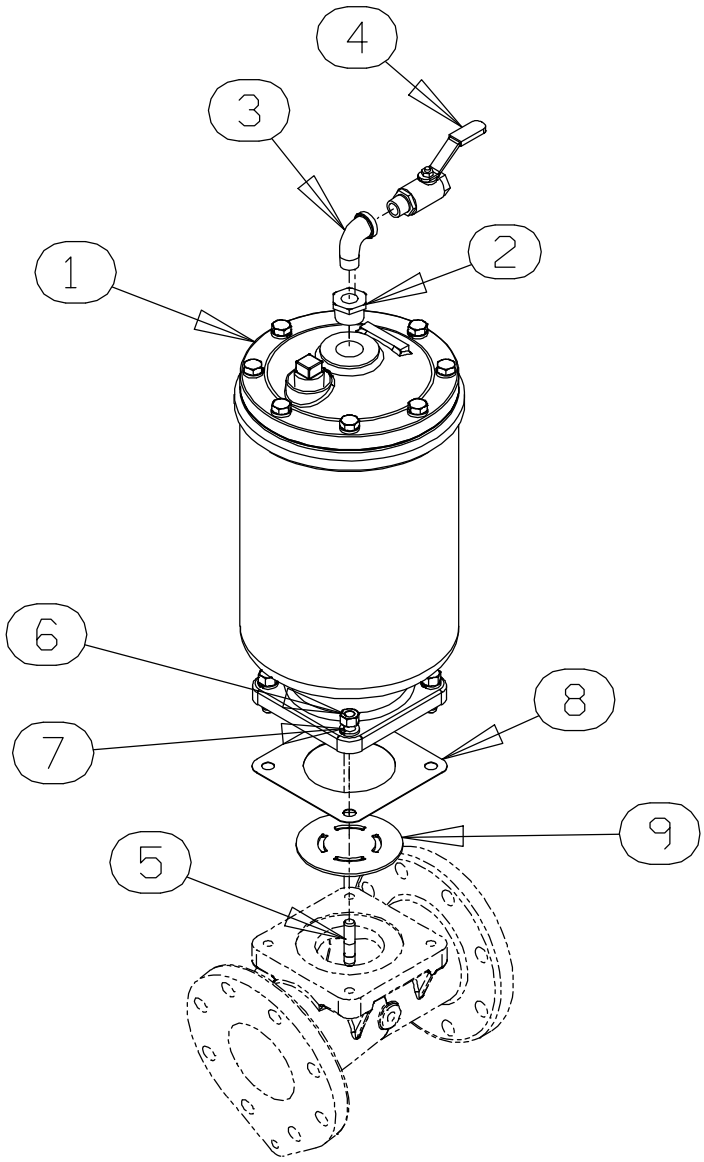


Figure 6. 48275−005 Priming Chamber Kit

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PRIMING CHAMBER ASSY	46112−709	1
2		PIPE BUSHING	AP1608 11999	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

ILLUSTRATION

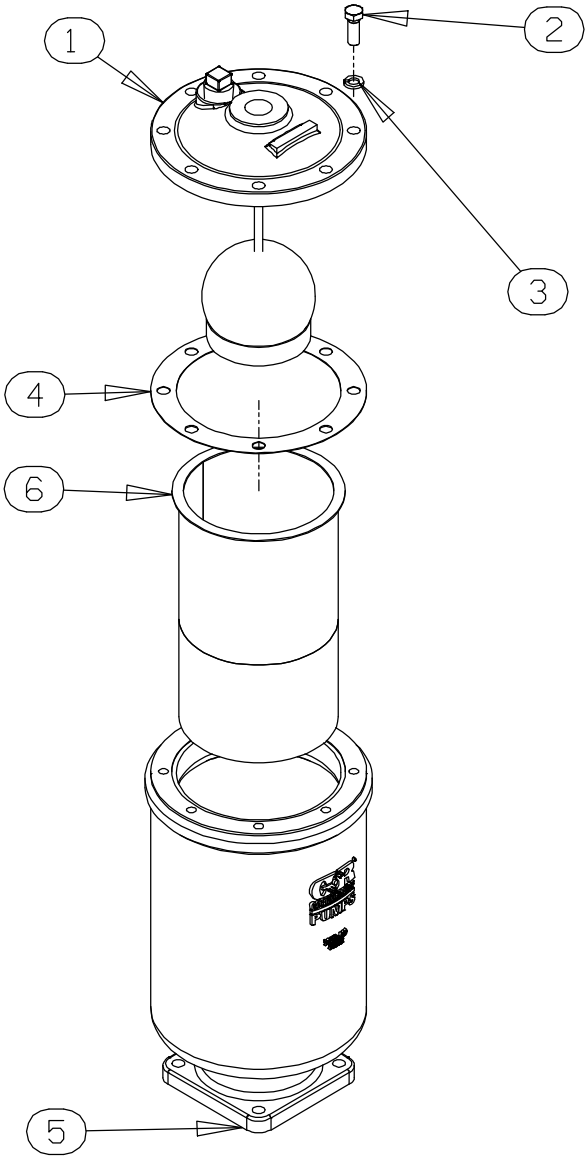


Figure 7. 46112−709 Priming Chamber Assembly

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

ILLUSTRATION

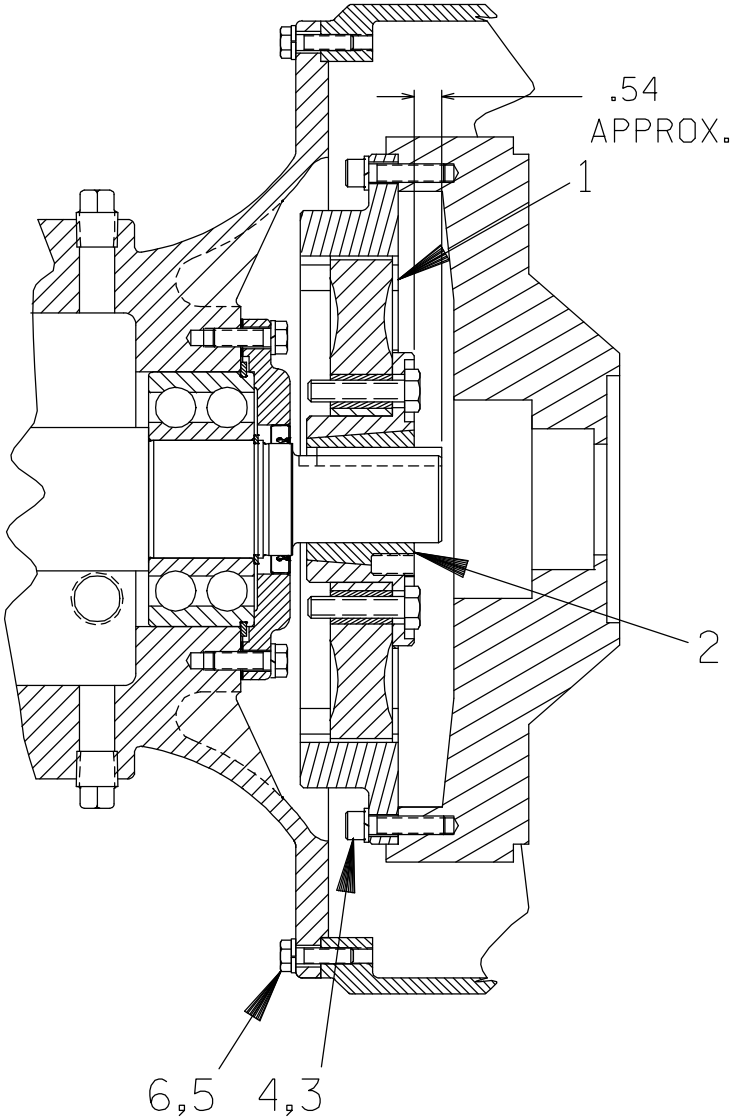


Figure 8. 44162−157 Drive Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1		COUPLING	24391−102	1
2		BUSHING	24131−497	1
3	☞	SOCKET HEAD CAPSCREW	BD0606 15990	8
	◗	SOCKET HEAD CAPSCREW	22644−220	8
4	☞	LOCK WASHER	J06 15991	8
	◗	LOCK WASHER	21171−511	8
5	☞	HEX HEAD CAPSCREW	B0605 15991	12
	◗	HEX HEAD CAPSCREW	22645−164	12
6	☞	LOCK WASHER	J06 15991	12
	◗	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 illustrations (see Figures 1 through 8) and the corresponding Parts Lists. Maintenance and repair instructions for the engine is covered separately in the specific literature supplied by the manufacturer.

Many pump service functions may be performed without separating the pump end assembly from the engine. However, the priming chamber assembly and discharge piping 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 lowermost pipe plug (10, Figure 4) from the pump casing. 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.

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 dis-

charge 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.

CAUTION

Use **only** replacement parts provided or approved by Gorman-Rupp. Use of non-authorized parts may result in damage to the equipment and/or injury to personnel and **will invalidate the warranty**.

Priming Chamber Removal And Disassembly

(Figure 6)

Disconnect 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 spool (8, Figure 4).

(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 lock washer securing the orifice button to the linkage bar and unscrew the orifice button from the linkage bar.

Discharge Check Valve Removal and Disassembly

(Figure 4)

Support the discharge check valve assembly using a sling and a suitable lifting device. Remove the hardware securing the discharge check valve assembly and gasket to the piping.

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

Suction Spool Flange Removal

(Figure 4)

Before attempting to disassemble the pump, remove the lowermost pipe plug (30, Figure 5) from the pump casing and drain the pump. Clean and reinstall the pipe plug.

Disconnect the suction piping from the suction spool flange (8).

Support the suction spool flange using a suitable hoist and sling. Disengage the hardware (not shown) securing the suction spool flange to the base.

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.

Remove the hardware (5) and separate the suction spool flange and gasket (4) from the pump.

Suction Head And Wear Ring Removal

(Figure 5)

Support the suction head (34) using a suitable hoist and sling.

Remove the hardware (9 and 10). Use a pair of pry bars or large screwdrivers to pry the suction head and wear ring (35) from the pump casing (1).

Inspect the wear ring. If replacement is required, or if the O-rings (7 and 31) require replacement, remove the hardware (15 and 16) securing the suction head to the wear ring.

Use a set of pry bars or large screwdrivers to pry the suction head and wear plate out of the volute casing.

Remove the adjusting screws and jam nuts (32 and 33). Remove the jam nuts from the adjusting screws and reinstall the adjusting screws. Use the adjusting screws to push the wear ring out of the suction head.

Remove the adjusting screws, install the jam nuts, and reinstall the adjusting screws in the suction head.

Separating Intermediate And Drive Assembly From Engine

(Figure 8)

Further disassembly of the pump requires separating the pump end and drive assembly from the engine. Disconnect the discharge piping from the pump casing.

Remove the hardware (5 and 6) securing the intermediate to the bellhousing. Separate the assemblies by pulling the pump end straight away from the engine.

As the assemblies separate, the flexible portion of the coupling assembly (1) 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 (19, Figure 5).

It is not necessary to remove the outer ring of the coupling from the flywheel unless the coupling must be replaced. To remove the ring, disengage the hardware (3 and 4) securing it to the flywheel.

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

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 (1 gallon [4 liter] minimum), under the seal cavity drain plug (27A). Remove the drain plug and drain the oil from the seal cavity into the container. Clean and reinstall the drain plug. Inspect the oil for water, dirt or a cloudy condition which could indicate seal failure.

Loosening Impeller

(Figures 5 and 9)

With the pump end separated from the power source, position the pump end on a flat surface with the drive end facing up. Insert a block of wood through the pump discharge and wedge it between the vanes of the impeller and the pump casing to prevent rotation.

Install the shaft key (19) in the shaft keyway. Install a lathe dog on the drive end of the shaft (20) 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.

NOTE

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

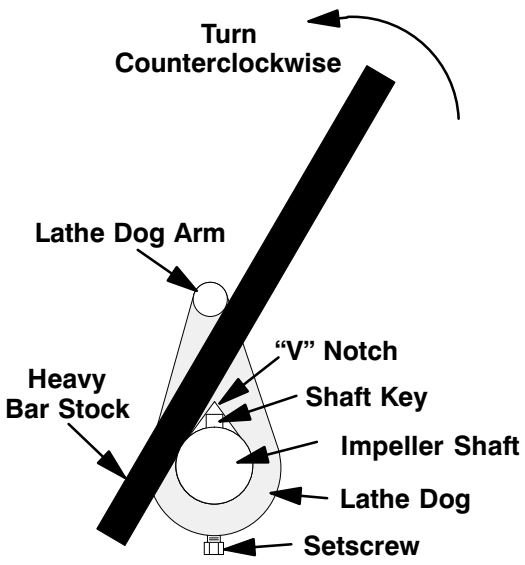


Figure 9. Loosening Impeller

Pump Casing Removal

(Figure 5)

With the pump end resting on a flat surface and the drive end facing up, secure a suitable lifting device to the bellhousing mounting holes in the intermediate (14).

Remove the hardware (9 and 10). Apply tension on the lifting device and use a pair of pry bars or large screwdrivers to separate the pump casing at the gasket (29).

Remove the rotating portion of the pump and place it on a clean work surface. Discard the pump casing gasket.

Impeller Removal

(Figure 5)

To remove the impeller (2), unscrew it in a counterclockwise direction (when facing the impeller). Use caution when removing the impeller; tension on the shaft seal spring will be released as the impeller is unscrewed. Inspect the impeller and replace it if cracked or badly worn.

Seal Removal

(Figures 5 and 10)

Slide the impeller adjusting shims (4) off the impeller shaft. Tie and tag the shims or measure and record their thickness for ease of reassembly.

Remove the seal spring. Lubricate the shaft in the area adjacent to the seal with light oil and work it up under the bellows. Slide the rotating portion of the seal (consisting of the bellows, retainer, and rotating element) off the shaft as a unit.

Slide the seal plate and stationary portion of the seal off the shaft. 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, element and O-rings can be removed.

Remove the seal plate O-ring (7).

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

Disengage the hardware (15 and 16) and remove the bearing cover (17), gasket (24) and oil seal (22). Use a suitably sized dowel to press the oil seal from the bearing cover.

Place a block of wood against the impeller end of the shaft (20) and tap the shaft and assembled bearings (18 and 28) from the intermediate. Press

the inboard oil seals (22A and 22B) out of the intermediate.

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 retaining ring (21) and thrust washer (23). 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 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.*

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

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.

Install the thrust washer (23) and secure the outboard bearing (18) to the shaft with the retaining ring (21).

Apply a light coating of oil to the lips of the inboard oil seals (22A and 22B) and press them into the intermediate with the lips positioned as shown in Figure 4. Press the oil seals into the housing until they are centered in the intermediate bore.

Slide the shaft and assembled bearings into the intermediate bore until the retaining ring on the outboard bearing (18) is fully seated against the intermediate. Use caution not to damage the lip seals (22A and 22B) on the shaft threads.

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 (22) and press it into the bearing cover (17) with the lip positioned as shown in Figure 4. The face of the oil seal should be just flush with the outer face of the bearing cover.

Install the bearing cover gasket (24) and secure the bearing cover to the intermediate with the hardware (15 and 16). **Be careful** not to damage the lip of the oil seal (22) on the shaft keyway.

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

Securing Intermediate And Drive Assembly To Engine

(Figure 8)

Install the shaft key (19, Figure 5) in the shaft keyway. Position the flexible portion of the coupling assembly (1) on the shaft as shown in Figure 8.

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 away from the pump end of the shaft****.*

Align the keyway in the bushing (2) with the shaft key, and slide it onto the shaft to the dimension shown in Figure 8. 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 8. **This is critical.** If the coupling is not properly positioned on the shaft, the coupling parts may not fully engage, or a pre-load condition can cause premature bearing failure.

The coupling must be positioned 0.54 inches (13,7 mm) from the end of the shaft. This will allow the two portions of the coupling to fully engage when the drive flange is secured to the bellhousing, without preloading 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 (3 and 4), and secure the outer ring of the coupling to the 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 rotating assembly and coupling so the flexible portion of the coupling seats inside the outer ring attached to the 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.*

Secure the intermediate to the bellhousing with the previously removed hardware (5 and 6). Make sure the intermediate guards (not shown) are installed over the openings in the intermediate.

Seal Reassembly and Installation

(Figures 5 and 10)

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 there are nicks or cuts on either end. 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 O-rings and bellows 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 10).

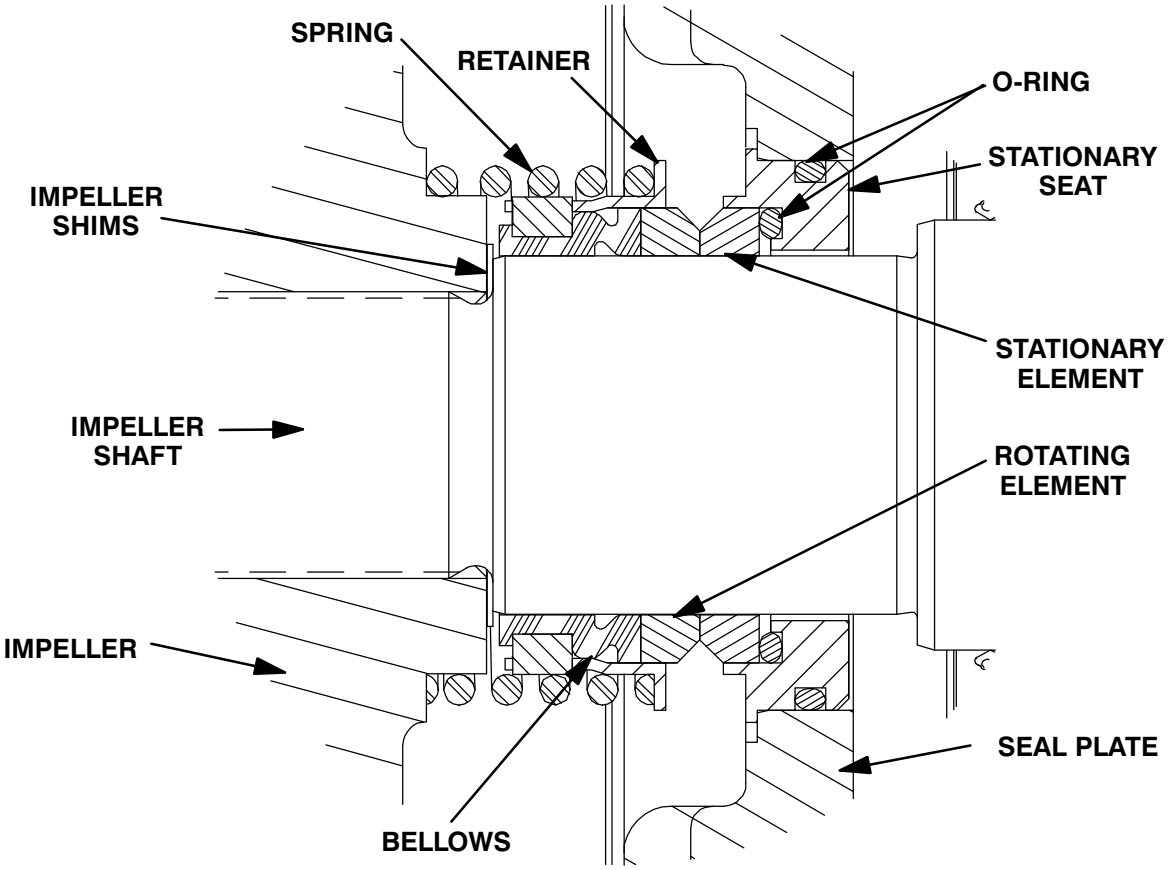


Figure 10. Seal Assembly

CAUTION

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

Lubricate the stationary seat O-ring with water or light oil. Press the stationary seat and element into the seal plate (6) until fully seated.

Position the seal plate over the shaft and temporarily secure it to the intermediate (14) with four 1/2—UNC x 2-inch long capscrews and hex nuts (not supplied). **Be careful** not to damage the stationary portion of the seal on the shaft threads.

Lubricate the shaft with a **small** amount of light oil and slide the rotating subassembly (consisting of rotating element, bellows and retainer), onto the shaft until the seal faces touch.

Install the seal spring. Lubricate the seal as indicated in **LUBRICATION** after the impeller is installed.

Impeller Installation And Adjustment

(Figure 5)

Inspect the impeller (2) 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.

Install the same thickness of impeller adjusting shims (4) as previously removed and screw the impeller assembly onto the shaft until tight, making sure the seal spring seats squarely over the shoulder on the back of the impeller.

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 Installation

(Figure 5)

Remove the four capscrews and hex nuts (not supplied) securing the seal plate to the intermediate. With the volute casing (1) resting on a flat surface and the suction opening facing down, secure a suitable lifting device to the bellhousing mounting holes in the intermediate (14).

Install a new gasket (29) over the volute studs (8). Use the lifting device to carefully lower the rotating portion of the pump over the volute studs until fully seated against the volute.

NOTE

Position the rotating portion of the pump over the volute studs so the air vent (13) is properly oriented with the volute casing.

Secure the volute casing to the intermediate with the hardware (9 and 10).

Suction Head And Wear Ring Installation And Adjustment

(Figure 5)

Lubricate the O-rings (7 and 31) with grease and install them in the grooves in the wear ring (35).

Make sure the adjusting screws (32) are fully retracted, and press the wear ring into the suction head until fully seated and the mounting holes in the wear ring align with the mounting holes in the suction head. Secure the wear ring to the suction head with the hardware (35 and 36). Do not over-tighten the mounting hardware. Over-tightening the hardware can deform the wear ring, resulting in uneven clearance with the impeller.

Slide the assembled suction head and wear ring into the pump casing and secure the suction head to the pump casing with the hardware (9 and 10).

Reach through the suction opening and use a feeler gauge to measure the gap between the wear ring and the impeller. This clearance should be between .010 and .020 inch (to mm).

To adjust the clearance, loosen the hardware (15 and 16) securing the wear ring to the suction head. Loosen the jam nuts (33) and turn the adjusting screws (32) clockwise in an alternating pattern until the proper clearance is achieved. When the clearance is correct, tighten the jam nuts and the securing hardware.

Suction Spool Flange Installation

(Figure 4)

Apply a light coating of grease to one side of the suction spool flange gasket (4) and use the grease to secure the gasket to the pump casing flange.

Use a suitable lifting device to position the suction spool flange (8) against the gasket and suction head (34, Figure 5). Secure the flange to the pump casing with the hardware (5, 6 and 7).

Secure the flange to the base with the previously removed hardware (not shown).

Discharge Check Valve Assembly And Installation

(Figure 4)

The flapper and cover gasket are the only serviceable parts of the check valve. If the flapper requires replacement, remove the hardware securing the cover and gasket. Separate the valve cap and replace the flapper.

Install the cover gasket and secure the cover with the previously removed hardware.

Install the discharge check valve assembly in the discharge piping.

LUBRICATION

Seal Assembly

(Figure 5)

Fill the seal cavity through the hole for the vented plug (11) with SAE No. 30 non-detergent oil to the line on the sight gauge (25). Check the oil level regularly and refill as required. When lubricating a dry seal cavity, add approximately approximately 112 U.S. ounces (3,3 liters) of oil to level indicated.

Bearings

(Figure 5)

The bearing housing was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (25A) and maintain it at the midpoint of the gauge. When lubrication is required, remove the air vent (13) and add SAE No. 30 non-detergent oil through the opening. When lubricating a dry (overhauled) bearing housing, fill the bearing cavity with approximately 18 ounces (532 ml) of oil. 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.

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 power unit representative.

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