

# **OPERATING AND MAINTENANCE INSTRUCTIONS**

## **Christmas Pump Station**

### **City of Harriman, Tennessee**

Specification Section: **11310 – Factory-Built Base Mounted Pumps**

Equipment Item: **Centrifugal Non-Clog Sewage Pumps**

Manufacturer: **Gorman-Rupp**

Model: **T4A3S-B**

Owner: **City of Harriman, Tennessee**

Contractor: **Southern Constructors, Inc.  
1150 Maryville Pike  
Knoxville, TN 37920**

Engineer: **GRW, Inc.  
404 BNA Suite 201  
Nashville, TN 37217**

Equipment Supplier: **Southern Sales Company, Inc.  
2929 Kraft Drive  
Nashville, TN 37204  
Phone: 615-254-0066  
Fax: 615-254-0791**

Manufacturer: **Gorman-Rupp Company  
305 Bowman Street  
Mansfield, Ohio 44903**

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



**SUPER T-SERIES PUMP**

<p><b>MODEL</b></p>
<p><b>T4A3S-B</b></p> <p><b>INCLUDING: /F, /FM /WW, /WWS</b></p>

**THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO**

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Warranty  
WEG Motor Installation & Maintenance

## 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 Super T-Series, semi-open impeller, self-priming centrifugal model with a suction check valve. The pump also is designed with external shimless adjusters for setting the wear plate to impeller clearance. The pump is designed for handling liquids containing large entrained solids and slurries. The basic material of construction is cast iron, with ductile iron impeller and steel wearing parts.

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 write:

**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.

As described on the following page, 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 precau-

tions 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.



### 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.

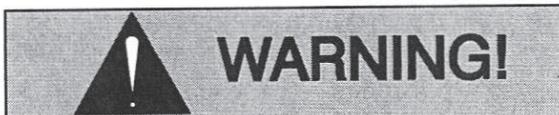
### NOTE

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

## SAFETY – SECTION A

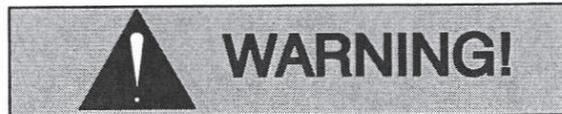
These warnings apply to the Super T-Series basic pumps. Gorman-Rupp has no control over or particular knowledge of the power source which will be used. Refer to the manual accompanying the power source before attempting to begin operation.

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

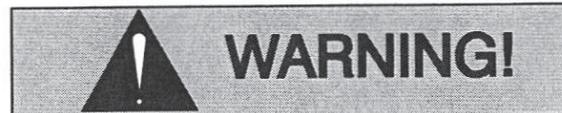


Before attempting to open or service the pump:

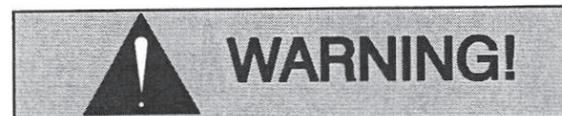
1. Familiarize yourself with this manual.
2. Disconnect or lock out the power source to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



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



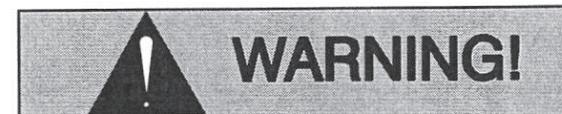
After the pump has been positioned, make certain that the pump and all piping connections are tight, properly supported and secure before operation.



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

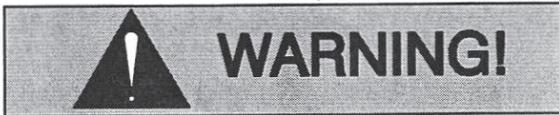


Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to cool before servicing.



Do not operate the pump against a closed discharge valve for long periods of time. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come

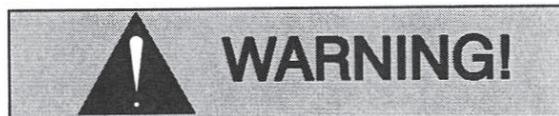
to a boil, build pressure, and cause the pump casing to rupture or explode.



Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Suction and discharge hoses and piping must be removed from the pump before lifting.

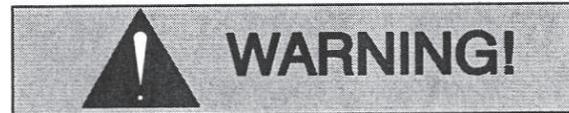


Do not operate an internal combustion engine in an explosive atmosphere. When operating internal combustion engines in an enclosed area, make certain that exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless, and odorless.

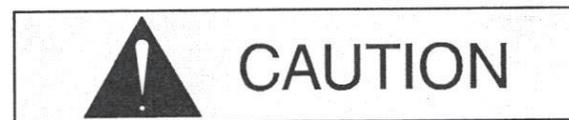


Fuel used by internal combustion engines presents an extreme explosion and fire hazard. Make certain that all fuel

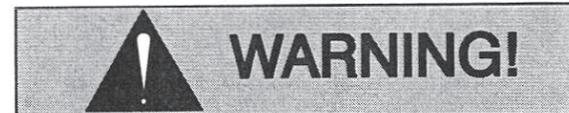
lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel tank. Always use the correct type of fuel.



Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. The maximum continuous operating speed for this pump is 1950 RPM.



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



Do not attempt to disengage any part of an overheated pump unit. Vapor pressure within the pump casing can eject these parts with great force when they are disengaged. Allow the pump to completely cool before servicing it.

## 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

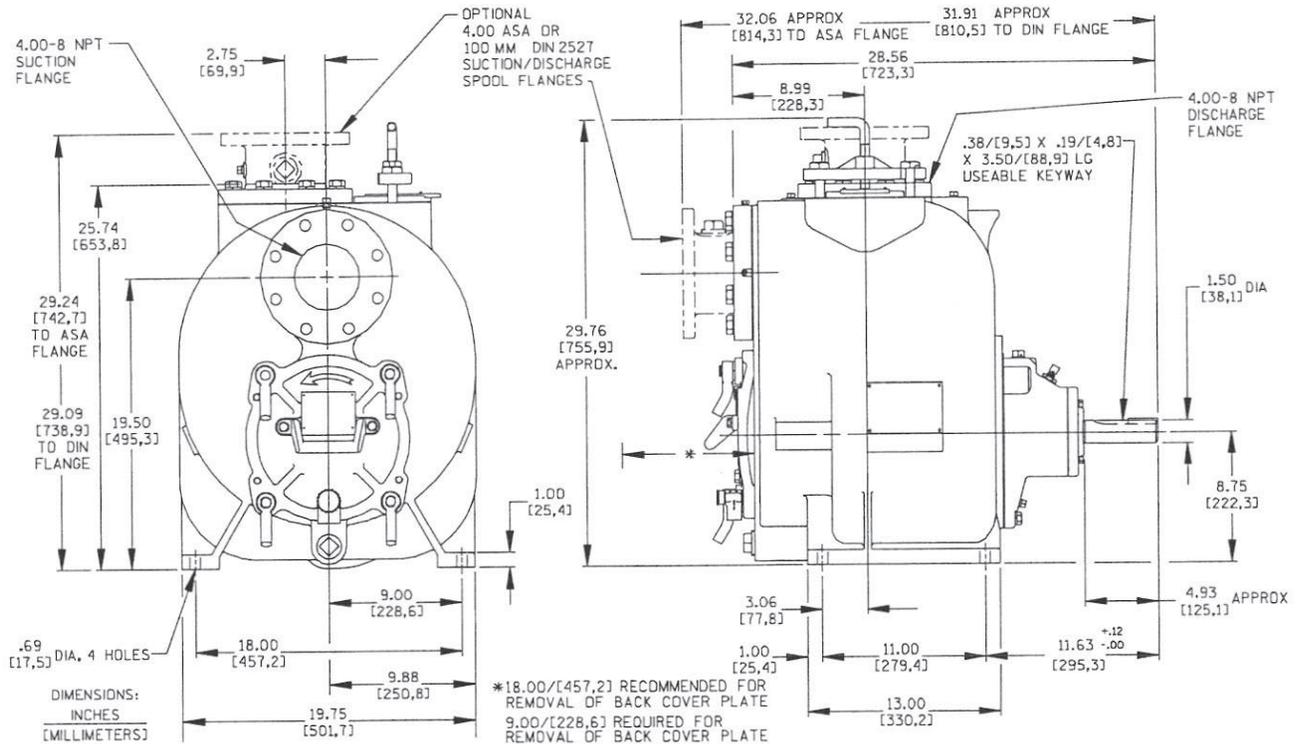
specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to **50%** of the maximum permissible operating pressure as shown on the pump performance curve.

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



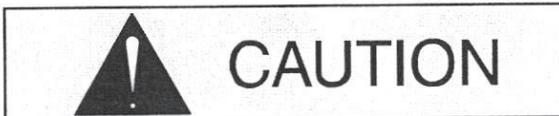
NOTE: OPTIONAL ASA OR DIN STANDARD SUCTION & DISCHARGE SPOOL FLANGES AVAILABLE

Figure 1. Pump Model T4A3S-B, Including /F, /FM /WW, /WWS

## 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 warnings and cautions contained in this manual or affixed to the pump, and perform all duties indicated. Note the direction of rotation indicated on the pump. Check that the pump shaft rotates counter-clockwise when facing the impeller.



Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Refer to **ROTATION** in **OPERATION**, Section C.

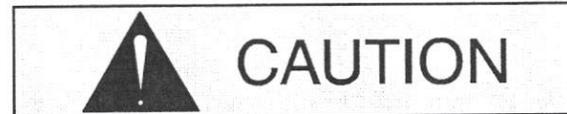
- d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **MAINTENANCE AND REPAIR** section of this manual and perform duties as instructed.
- e. If the pump and power source have been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum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

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

## 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.



The pump assembly can be seriously damaged if the cables or chains 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 or to eliminate vibration.

### Clearance

It is recommended that **18 inches (457 mm)** of clearance be provided in front of the back cover to permit removal of the cover and easy access to the pump interior. A **minimum** clearance of **10 inches (254 mm)** must be maintained to permit removal of the cover.

## 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

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

## SUCTION LINES

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

### Fittings

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

### Strainers

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

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

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

### Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an 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 In Sumps

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

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

If it is necessary to position inflow close to the suction inlet, install a baffle between the inflow and the suction inlet at a distance 1 1/2 times the diameter of the suction pipe. The baffle will allow entrained air to escape from the liquid before it is drawn into the suction inlet.

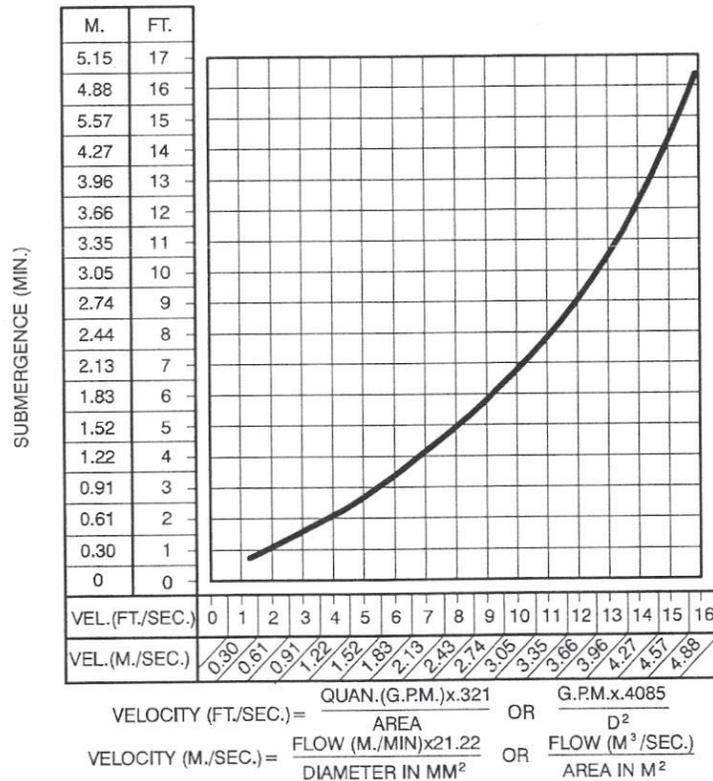
If two suction lines are installed in a single sump, the flow paths may interact, reducing the efficiency of one or both pumps. To avoid this, position the suction inlets so that they are separated by a distance equal to at least 3 times the diameter of the suction pipe.

**Suction Line Positioning**

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

**NOTE**

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



**Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity**

**DISCHARGE LINES**

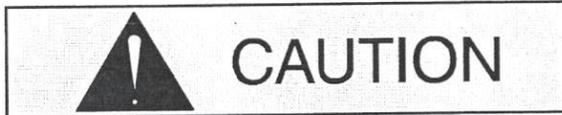
**Siphoning**

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

**Valves**

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

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



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

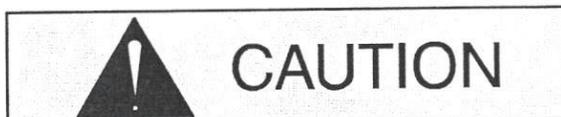
### Bypass Lines

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

### NOTE

*The bypass line should be sized so that it does not affect pump discharge capacity; however, the bypass line should be at least 1 inch in diameter to minimize the chance of plugging.*

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



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

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

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

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

If the installation involves a flooded suction such as a below-ground lift station. A pipe union and manual shut-off valve may be installed in the bleed line to allow service of the valve without shutting down the station, and to eliminate the possibility of flooding. If a manual shut-off valve is installed **anywhere** in the air release piping, it **must** be a full-opening **ball type** valve to prevent plugging by solids.



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

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

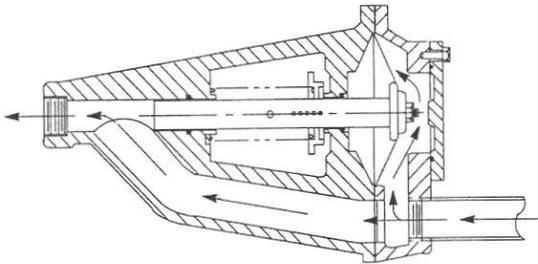
**moving the plug to prevent injury to personnel from hot liquid.**

## AUTOMATIC AIR RELEASE VALVE

When properly installed and correctly adjusted to the specific hydraulic operating conditions of the application, the Gorman-Rupp Automatic Air Release Valve will permit air to escape through the bypass line, and then close automatically when the pump is fully primed and pumping at full capacity.

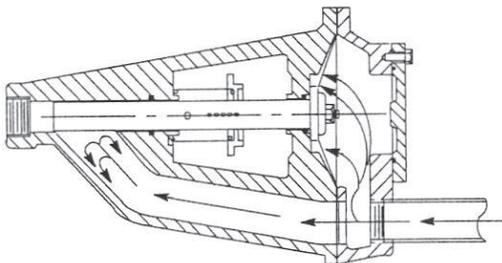
### Theory of Operation

Figures 3 and 4 show a cross-sectional view of the Automatic Air Release Valve, and a corresponding description of operation.



**Figure 3. Valve in Open Position**

During the priming cycle, air from the pump casing flows through the bypass line, and passes through the Air Release Valve to the wet well (Figure 3).



**Figure 4. Valve in Closed Position**

When the pump is fully primed, pressure resulting from flow against the valve diaphragm com-

presses the spring and closes the valve (Figure 4). The valve will remain closed, reducing the bypass of liquid to 1 to 5 gallons (3.8 to 19 liters) per minute, until the pump loses its prime or stops.



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

When the pump shuts down, the spring returns the diaphragm to its original position. Any solids that may have accumulated in the diaphragm chamber settle to the bottom and are flushed out during the next priming cycle.

### NOTE

*The valve will remain open if the pump does not reach its designed capacity or head. Valve closing pressure is dependent upon the discharge head of the pump at full capacity. The range of the valve closing pressure is established by the tension rate of the spring as ordered from the factory. Valve closing pressure can be further adjusted to the exact system requirements by moving the spring retaining pin up or down the plunger rod to increase or decrease tension on the spring. Contact your Gorman-Rupp distributor or the Gorman-Rupp Company for information about an Automatic Air Release Valve for your specific application.*

### Air Release Valve Installation

The Automatic Air Release Valve must be independently mounted in a horizontal position and connected to the discharge line of the self-priming centrifugal pump (see Figure 5).

### NOTE

*If the Air Release Valve is to be installed on a staged pump application, position the air release valve as close as possible to the discharge check valve.*

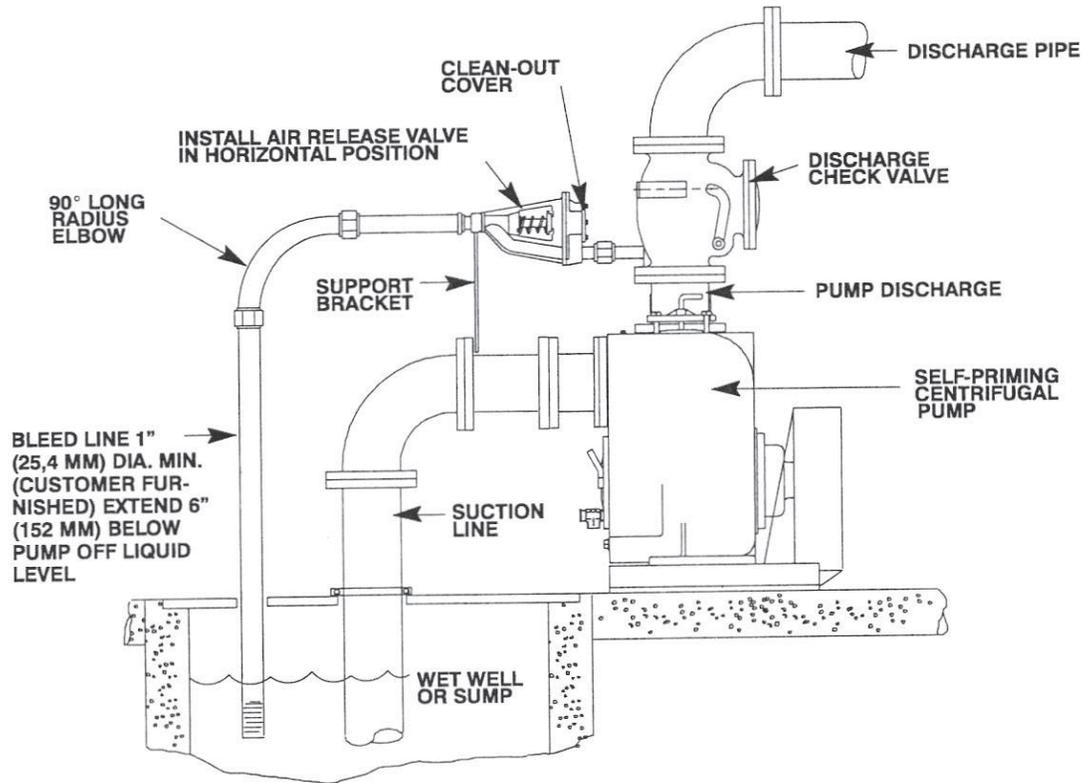


Figure 5. Typical Automatic Air Release Valve Installation

The valve inlet line must be installed between the pump discharge port and the non-pressurized side of the discharge check valve. The valve inlet is at the large end of the valve body, and is provided with standard 1-inch NPT pipe threads.

The valve outlet is located at the opposite end of the valve, and is also equipped with standard 1-inch NPT pipe threads. The outlet should be connected to a bleed line which slopes back to the wet well or sump. The bleed line must be the same size as the inlet piping, or larger. If **piping** is used for the bleed line, avoid the use of elbows whenever possible.

#### NOTE

*It is recommended that each Air Release Valve be fitted with an independent bleeder line directed back to the wet well. If multiple Air Release Valves are installed in a system, **do not** direct bleeder lines to a common manifold pipe. Contact your Gorman-Rupp distributor or the Gorman-Rupp Company for information about installation of an Automatic Air Release Valve for your specific application.*

#### ALIGNMENT

The alignment of the pump and its power source is critical for trouble-free mechanical operation. In either a flexible coupling or V-belt driven system, the driver and pump must be mounted so that their shafts are aligned with and parallel to each other. It is imperative that alignment be checked after the pump and piping are installed, and before operation.

#### NOTE

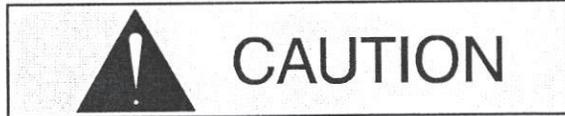
*Check **Rotation**, Section C, before final alignment of the pump.*

When mounted at the Gorman-Rupp factory, driver and pump are aligned before shipment. Misalignment will occur in transit and handling. Pumps **must** be checked and realigned before operation. Before checking alignment, tighten the foundation bolts. The pump casing feet and/or pedestal feet, and the driver mounting bolts should also be tightly secured.



**WARNING!**

When checking alignment, disconnect the power source to ensure that the pump will remain inoperative.



**CAUTION**

Adjusting the alignment in one direction may alter the alignment in another direction. Check each procedure after altering alignment.

**Coupled Drives**

When using couplings, the axis of the power source must be aligned to the axis of the pump shaft in both the horizontal and vertical planes. Most couplings require a specific gap or clearance between the driving and the driven shafts. Refer to the coupling manufacturer's service literature.

Align spider insert type couplings by using calipers to measure the dimensions on the circumference of the outer ends of the coupling hub every 90 degrees. The coupling is in alignment when the hub ends are the same distance apart at all points (see Figure 6).

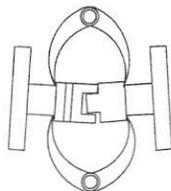


Figure 6. Aligning Spider-Type Couplings

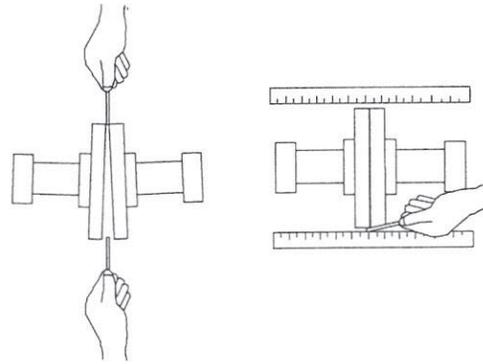


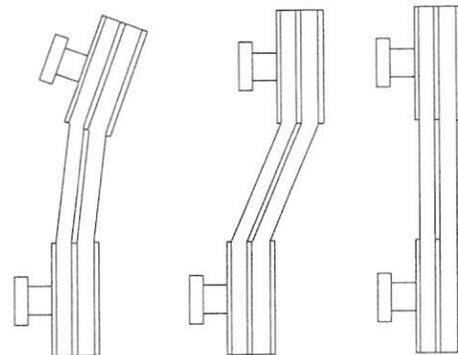
Figure 7. Aligning Non-Spider Type Couplings

Align non-spider type couplings by using a feeler gauge or taper gauge between the coupling halves every 90 degrees. The coupling is in alignment when the hubs are the same distance apart at all points (see Figure 7).

Check parallel adjustment by laying a straightedge across both coupling rims at the top, bottom, and side. When the straightedge rests evenly on both halves of the coupling, the coupling is in horizontal parallel alignment. If the coupling is misaligned, use a feeler gauge between the coupling and the straightedge to measure the amount of misalignment.

**Drive Belts**

When using drive belts, the power source and the pump must be parallel. Use a straightedge along the sides of the pulleys to ensure that the pulleys are properly aligned (see Figure 8). In drive systems using two or more belts, make certain that the belts are a matched set; unmatched sets will cause accelerated belt wear.



MISALIGNED: SHAFTS NOT PARALLEL      MISALIGNED: SHAFTS NOT IN LINE      ALIGNED: SHAFTS PARALLEL AND SHEAVES IN LINE

Figure 8. Alignment of V-Belt Driven Pumps

Tighten the belts in accordance with the belt manufacturer's instructions. If the belts are too loose, they will slip; if the belts are too tight, there will be excessive power loss and possible bearing failure. Select pulleys that will match the proper speed ratio; overspeeding the pump may damage both pump and power source.



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

## DRIVE BELT TENSIONING

### General Rules of Tensioning

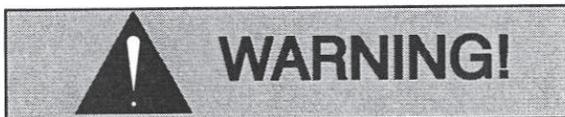
For new drive belts, check the tension after 5, 20 and 50 hours of operation and re-tension as required (see the following procedure for measuring belt tension). Thereafter, check and re-tension if required monthly or at 500 hour intervals, whichever comes first.

Ideal drive belt tension is the **lowest** tension at which the belt will not slip under peak load conditions. Do not over-tension drive belts. Over-tensioning will shorten both drive belt and bearing life. Under-tensioning will cause belt slippage. Always keep belts free from dirt, grease, oil and other foreign material which may cause slippage.

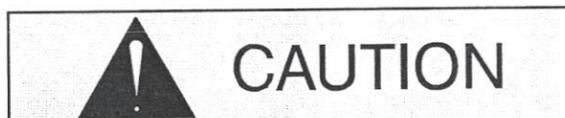
## OPERATION – SECTION C

Review all **SAFETY** information in Section A.

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



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

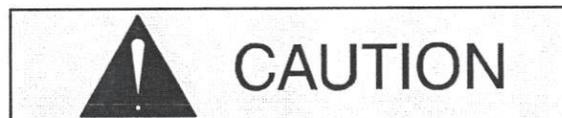


Pump speed and operating conditions must be within the performance range shown on page E-1.

### 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**).

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

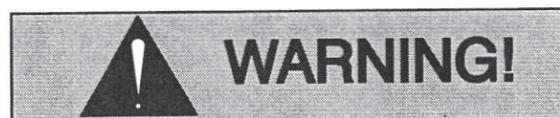


Never operate this pump unless there is liquid in the pump casing. The pump will not prime when dry. extended operation of a dry pump will destroy the seal assembly.

Add liquid to the pump casing when:

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

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



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

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

### STARTING

Consult the operations manual furnished with the power source.

#### Rotation

The correct direction of pump rotation is counter-clockwise when facing the impeller. The pump could be damaged and performance adversely affected by incorrect rotation. If pump performance is not within the specified limits (see the curve on page E-1), check the direction of power source rotation before further troubleshooting.

If an electric motor is used to drive the pump, remove V-belts, couplings, or otherwise disconnect the pump from the motor before checking motor rotation. Operate the motor independently while observing the direction of the motor shaft, or cooling fan.

If rotation is incorrect on a three-phase motor, have a qualified electrician interchange any two of the three phase wires to change direction. If rotation is incorrect on a single-phase motor, consult the literature supplied with the motor for specific instructions.

## OPERATION

### Lines With a Bypass

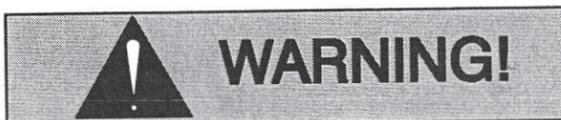
If a Gorman-Rupp Automatic Air Release Valve has been installed, the valve will automatically open to allow the pump to prime, and automatically close after priming is complete (see **INSTALLATION** for Air Release Valve operation).

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

### Lines Without a Bypass

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

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



**Do not operate the pump against a closed discharge throttling valve for long periods of time. If operated against a closed discharge throttling valve,**

**pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.**

### Leakage

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.

### 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 and allow it to cool before servicing it. Refill the pump casing with cool liquid.



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

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 overheating 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 overheats 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

If a suction strainer has been shipped with the pump or installed by the user, check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. If a vacuum suction gauge has been installed, monitor and record the 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.

### Pump Vacuum Check

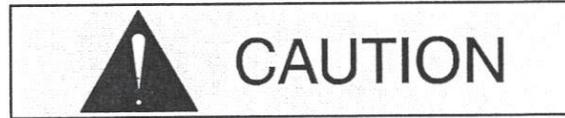
With the pump inoperative, install a vacuum gauge in the system, using pipe dope on the threads. Block the suction line and start the pump. At operating speed the pump should pull a vacuum of 20 inches (508,0 mm) or more of mercury. If it does not, check for air leaks in the seal, gasket, or discharge valve.

Open the suction line, and 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.

## STOPPING

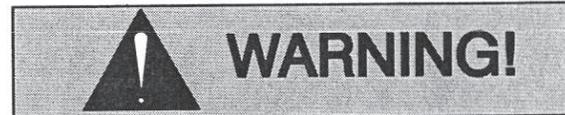
Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly.

On engine driven pumps, 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, lock out or disconnect the power source to ensure that the pump will remain inoperative.



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

### 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.

## 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 temperature 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 MAINTENANCE AND REPAIR**). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

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

## TROUBLESHOOTING – SECTION D

Review all SAFETY information in Section A.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out or disconnect the power source 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.

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

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

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

## PREVENTIVE MAINTENANCE

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

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

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

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

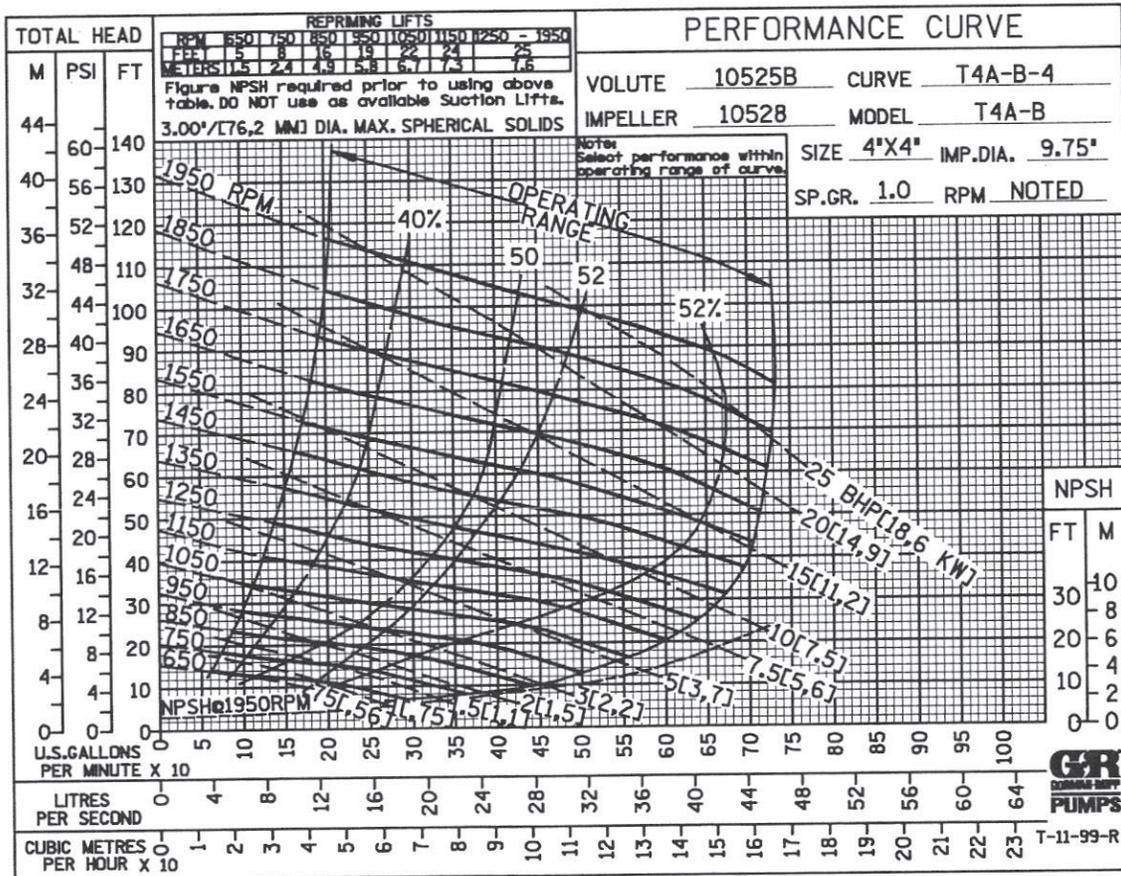
Preventive Maintenance Schedule					
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication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

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.

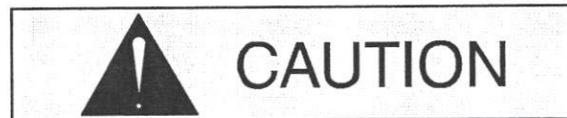


\* STANDARD PERFORMANCE FOR PUMP MODEL T4A3S-B

\*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.



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

SECTION DRAWING

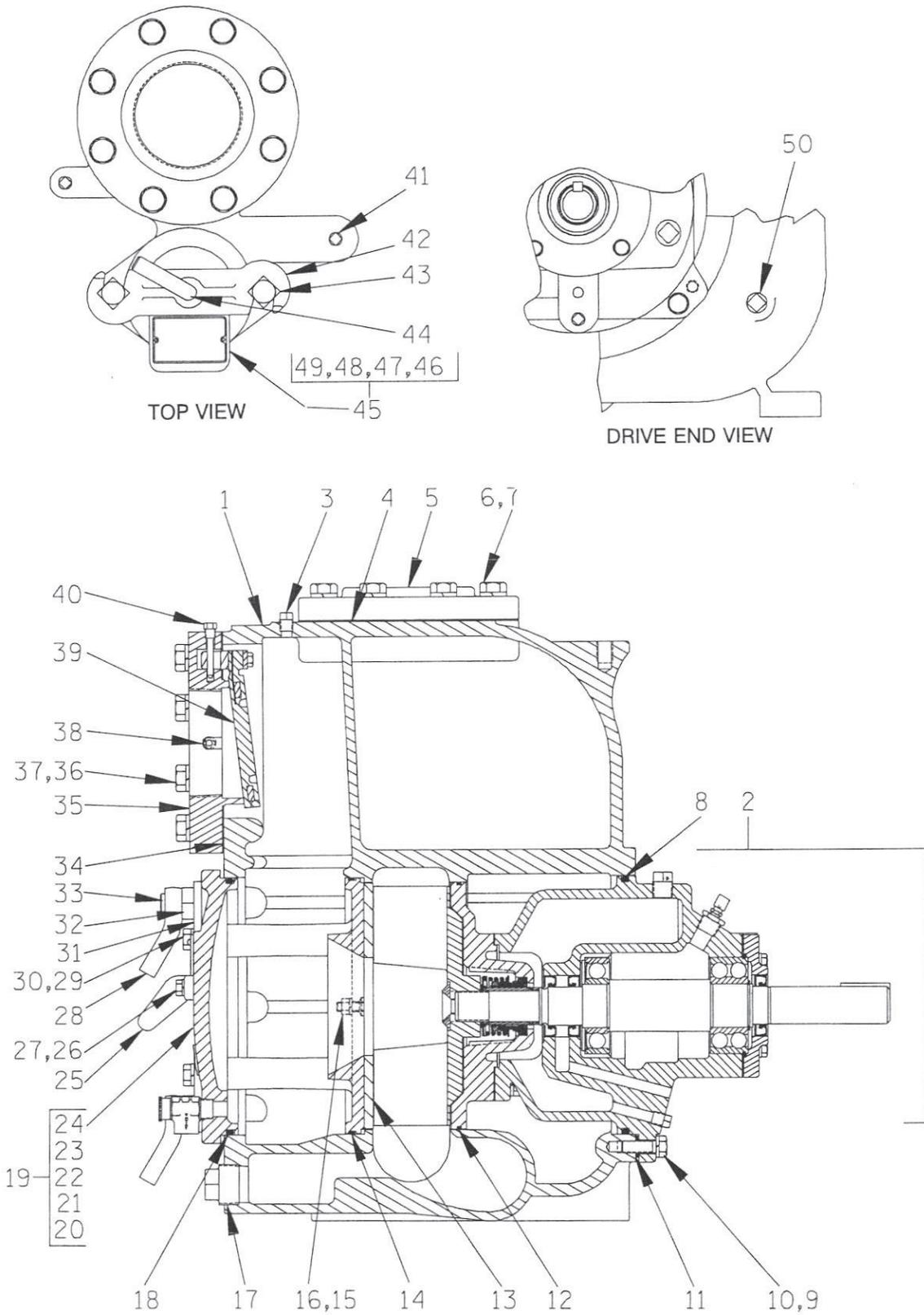


Figure 1. Pump Model T4A3S-B

**PARTS LIST**  
**Pump Model T4A3S-B**  
 (From S/N 1206396 up)

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

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	PUMP CASING	10525D	10000	1	48	-DRIVE SCREW	BM#04-03	17000	2
2 *	REPAIR ROTATING ASSY	44163-261	----	1	49	-COVER GASKET	50G	19210	1
	* /WW REPAIR ROT ASSY	44163-305	----	1	50	PIPE PLUG	P08	15079	1
	* /WWS REPAIR ROT ASSY	44163-276	----	1	NOT SHOWN:				
3	PIPE PLUG	P04	15079	1		DRIVE SCREW	BM#04-03	17000	4
4 *	DISCH FLANGE GSKT	25113-034	----	1		LUBE DECAL	38817-084	----	1
5	DISCHARGE FLANGE	1756	10010	1		INSTRUCTION LABEL	2613DK	----	1
6	HEX HD CAPSCREW	B1007	15991	8		ROTATION DECAL	2613M	----	1
7	LOCKWASHER	J10	15991	8		WARNING DECAL	2613FE	----	1
8 *	BEARING HSG O-RING	S1674	----	1		NAME PLATE	38818-040	13990	1
9	HEX HD CAPSCREW	B0806	15991	4		SUCTION STICKER	6588AG	----	1
10	LOCKWASHER	J08	15991	4		PRIMING STICKER	6588AH	----	1
11 *	ROT ASSY ADJ SHIMS	13130-3	17040	8		DISCHARGE STICKER	6588BJ	----	1
12 *	BEARING HSG O-RING	25152-273	----	1		SUPER "T" DECAL	38812-089	----	1
13 *	WEAR PLATE ASSY	10532A	15990	1		G-R DECAL	GR-03	----	1
14 *	BACK COVER O-RING	25152-273	----	1		INSTRUCTION TAG	38817-023	----	1
15	HEX NUT	D06	15991	2	OPTIONAL:				
16	LOCKWASHER	J06	15991	2		DISASSEMBLY TOOL	48711-020	----	1
17	CASING DRAIN PLUG	P20	10009	1		/F FLANGE KIT	48213-039	----	1
18 *	BACK COVER O-RING	S1674	----	1		-SUCTION	12066	10010	1
19	BACK CVR PLATE ASSY	42111-802	----	1		-DISCHARGE	12066A	10010	1
20	-BACK COVER PLATE	NOT AVAILABLE		1		/FM METRIC FLANGE KIT	48213-077	----	1
21	-WARNING PLATE	2613EV	13990	1		-SUCTION	38642-210	10000	1
22	-DRIVE SCREW	BM#04-03	17000	4		-DISCHARGE	38642-211	10000	1
23	-PRESS RELIEF VALVE	26662-005	----	1		WEAR PLATE ASSY:			
24	-WARNING DECAL	38816-302	----	1		-STAINLESS STEEL	10532A	1718H	1
25	CVR PLATE HANDLE	12354	13010	1		-ALLOY STEEL	46451-361	24160	1
26	HEX HD CAPSCREW	B0604	15991	2		CASING HEATERS:			
27	LOCKWASHER	J06	15991	2		-120V	47811-078	----	1
28	HAND NUT	38115-202	15040	4		-240V	47811-079	----	1
29	HEX HD CAPSCREW	B0804-1/2	15991	4		CHECK VALVE ASSYS:			
30	LOCKWASHER	J08	15991	4		-NEO SOLID TYPE	46411-020	----	1
31	LOCK COLLAR	38115-551	15001	4		-VITON BLOW-OUT	46411-072	----	1
32	ADJUSTING SCREW	31871-070	1500X	4		-BUNA-N	46411-104	----	1
33	STUD	C1213	15991	4		-EPDM	46411-114	----	1
34 *	SUCTION FLANGE GSKT	11389G	19370	1		PRESS RELIEF VALVES:			
35	SUCTION FLANGE	11389	10010	1		-SEWAGE TYPE	46431-628	----	1
36	HEX HD CAPSCREW					-STAINLESS STEEL	46431-629	----	1
	T4A3S-B	B1008	15991	8		HI TEMP SHUT-DOWN KITS:			
	/F, /FM, /WW, /WWS	B1007	15991	6		-145°F	48313-186	----	1
	/F, /FM, /WW, /WWS	B1008	15991	2		-130°F	48313-256	----	1
37	LOCKWASHER	J10	15991	8		-120°F	48313-257	----	1
38	PIPE PLUG	P04	15079	1		HI TEMP SHUT-DOWN THERMOSTAT KIT			
39 *	SUCT CHK VALVE ASSY	46411-062	----	1		-145°F	48313-172	----	1
40	CHECK VALVE PIN	11557	17010	1		AIR RELEASE VALVES:			
41	PIPE PLUG	P04	15079	1		-10# COMP SPRING	GRP33-07A	----	1
42	CLAMP BAR	38111-004	11010	1		-25# COMP SPRING	GRP33-07	----	1
43	MACHINE BOLT	A1014	15991	2		-80# COMP SPRING	GRP33-07B	----	1
44	CLAMP BAR SCREW	31912-009	15000	1		AIR REL VVL MNTG KIT	46331-515	----	1
45	FILL COVER ASSY	42111-344	----	1		BACK COVER O-RINGS			
46	-FILL COVER PLATE	NOT AVAILABLE		1		* -AFLAS	25150-409	----	1
47	-WARNING PLATE	38816-097	13990	1		✓ -VITON	25154-449	----	1

\* INDICATES PARTS RECOMMENDED FOR STOCK

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

\* AFLAS® IS A PRODUCT OF THE 3M CORP.

**COMPLETE GASKET/O-RING AND SHAFT REPAIR KITS AVAILABLE - CONSULT FACTORY.**

SECTION DRAWING

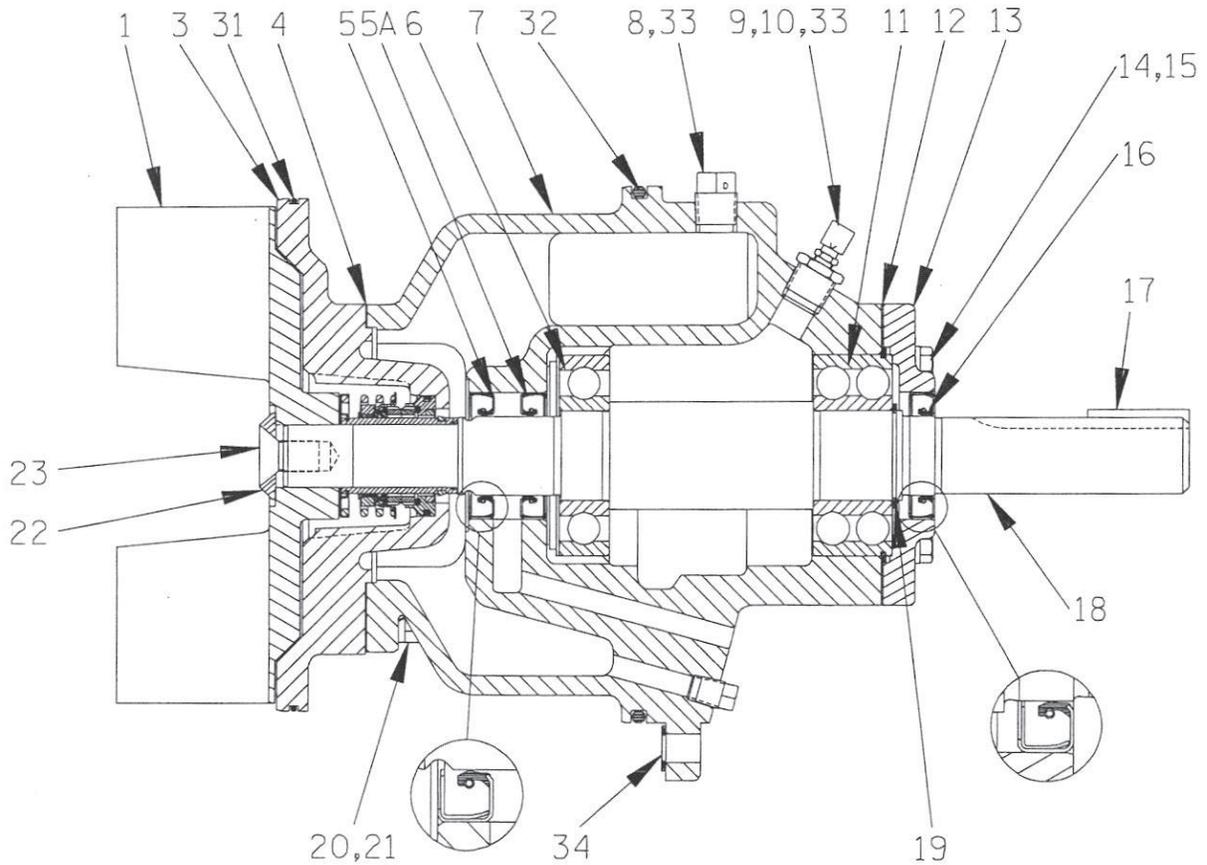
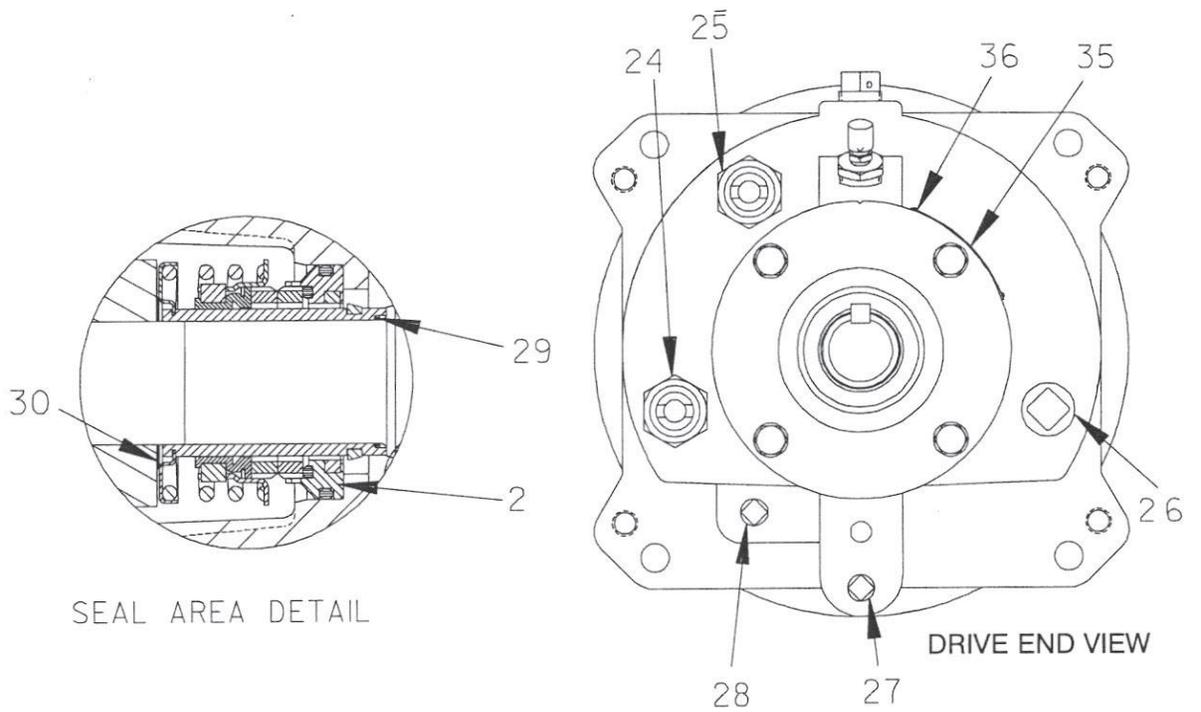


Figure 2. 44163-261 Repair Rotating Assembly

**PARTS LIST**  
**44163-261 Repair Rotating Assembly**

**Note:** Order complete Repair Rotating Assemblies for /WW and /WWS models from the Pump Model Assembly Parts List on page E-3. Repair Rotating Assemblies for /WW models include all of the standard parts listed below. Repair Rotating Assemblies for /WWS models include the stainless steel shaft, spacer washer, and seal assembly listed below under STAINLESS STEEL PARTS. All other parts are the same as the standard model.

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1 *	IMPELLER	10528	11010	1	35	ASSEMBLY PLATE	2613GG	13990	1
2 *	SEAL ASSEMBLY	46513-150	----	1	36	DRIVE SCREW	BM#04-03	17000	2
3	SEAL PLATE	38272-234	10010	1		NOT SHOWN:			
4 *	SEAL PLATE GASKET	10959G	20000	1		ROTATION DECAL	2613M	----	1
5 *	INBOARD OIL SEAL	S1352	----	1		INSTRUCTION TAG	6588U	----	1
5A *	INBOARD OIL SEAL	S1352	----	1		OPTIONAL:			
6 *	INBOARD BALL BEARING	S1088	----	1		ADI IMPELLER	10528	1102H	1
7	BEARING HOUSING	38251-411	10000	1		ADI SEAL PLATE	38272-234	1102H	1
8	VENTED PLUG	4823A	15079	1		IMP CLEAN-OUT KIT	48783-002	----	1
9	AIR VENT	S1530	----	1		STAINLESS STEEL PARTS:			
10	REDUCING PIPE BUSH	AP0802	15079	1		SEAL PLATE	38272-234	1718H	1
11 *	OUTBOARD BEARING	S375	----	1		IMP SHAFT			
12 *	BEARING CAP GASKET	38683-271	18000	1		(LESS SLEEVE)	38514-819	1706H	1
13	BEARING CAP	38322-220	10000	1		SPACER WASHER			
14	HEX HD CAPSCREW	B0605	15991	4		(FOR SST SHAFT)	38329-040	17130	1
15	LOCKWASHER	J06	15991	4		IMPELLER WASHER	10278	17090	1
16 *	BEARING CAP OIL SEAL	S1352	----	1		IMP CAPSCREW	DM1004S	17090	1
17 *	SHAFT KEY	N0608	15990	1		SEAL ASSEMBLY	12364D	----	1
18 *	IMPELLER SHAFT	38514-817	16040	1		SHAFT SLEEVE	11876A	1706H	1
19	BRG SNAP RING	S442	----	1		† STD MECH SEAL ASSY	12364A	----	1
20	HEX HD CAPSCREW	B0805 1/2	15991	4		† MECH SEAL SLEEVE	11876A	16000	1
21	LOCKWASHER	J08	15991	4		† ★ AFLAS SEAL (USE W/SST SLEEVE			
22 *	IMPELLER WASHER	31167-029	16000	1		OR SOLID SST SHAFT)	46512-194	----	1
23 *	IMPELLER CAPSCREW	F1004S	1500G	1		† METAL BELLOWS MECH SEAL ASSY			
24	SIGHT GAUGE	S1471	----	1		-SEAL PLATE	38272-241	10010	1
25	SIGHT GAUGE	S1471	----	1		✓ -VITON OR EQUAL	46512-147	----	1
26	PIPE PLUG	P12	15079	1		✓ -KALREZ	46512-142	----	1
27	SEAL CAV DRAIN PLUG	P04	15079	1		ROTATING ASSY O-RINGS			
28	BRG HSG DRAIN PLUG	P04	15079	1		★ -AFLAS	25150-409	----	1
29	SEAL SLEEVE O-RING	25154-022	----	REF		✓ -VITON	25154-449	----	1
30 *	IMPELLER ADJ SHIM SET	37J	17090	REF					
31 *	ROTATING ASSY O-RING	25152-273	----	1					
32 *	BEARING HSG O-RING	S1674	----	1					
33	SHIPPING PLUG	11495B	15079	2					
34 *	ROT ASSY ADJ SHIMS	13130-3	17040	8					

\* INDICATES PARTS RECOMMENDED FOR STOCK

† OPTIONAL MECHANICAL SEAL(S) MUST BE USED WITH MECHANICAL SEAL SHAFT SLEEVE OR SOLID SST SHAFT.

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**COMPLETE GASKET/O-RING AND SHAFT REPAIR KITS AVAILABLE - CONSULT FACTORY.**

## 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.

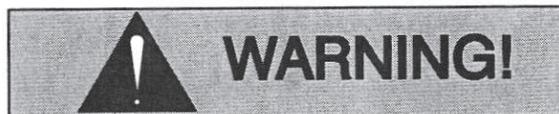
This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the sectional views (see Figures 1 and 2) and the accompanying parts lists.

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

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

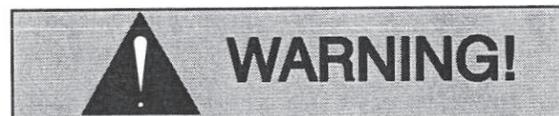
Before attempting to service the pump, disconnect or lock out the power source and take precautions to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

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



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Disconnect or lock out the power source 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.



Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment.

### Back Cover And Wear Plate Removal

(Figure 1)

The wear plate (13) is easily accessible and may be serviced by removing the back cover assembly (19). Before attempting to service the pump, remove the pump casing drain plug (17) and drain the pump. Clean and reinstall the drain plug.

Remove the hand nuts (28) and pry the back cover and assembled wear plate from the pump casing (1).

### NOTE

*An alternate method of removing the back cover from the pump casing is to remove the hand nuts (28) and two diagonally opposing locking collars (31). Install two 1/2-16 UNC x 2 inch long screws in the tapped holes in the back cover and use them to press the back cover out of the pump casing.*

Inspect the wear plate, and replace it if badly scored or worn. To remove the wear plate, disengage the hardware (15 and 16).

Inspect the back cover O-rings (14 and 18) and replace it if damaged or worn.

### Suction Check Valve Removal

(Figure 1)

If the check valve assembly (39) is to be serviced, remove the check valve pin (40), reach through the back cover opening and pull the complete assembly from the suction flange (35).

#### NOTE

*Further disassembly of the check valve is not required since it must be replaced as a complete unit. Individual parts are not sold separately.*

### Rotating Assembly Removal

(Figure 2)

The rotating assembly may be serviced without disconnecting the suction or discharge piping; however, the power source must be removed to provide clearance.

The impeller (1) should be loosened while the rotating assembly is still secured to the pump casing. Before loosening the impeller, remove the seal cavity drain plug (27) and drain the seal lubricant. This will prevent the oil in the seal cavity from escaping when the impeller is loosened. Clean and reinstall the seal cavity drain plug.

Immobilize the impeller by wedging a block wood between the vanes and the pump casing, and remove the impeller capscrew and washer (22 and 23).

Install the shaft key (17). Install a lathe dog on the drive end of the shaft (18) with the "V" notch positioned over the shaft key.

With the impeller rotation still blocked, see Figure 3 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.*

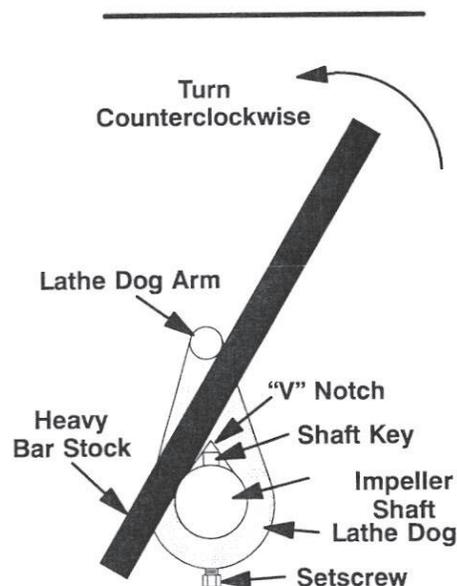


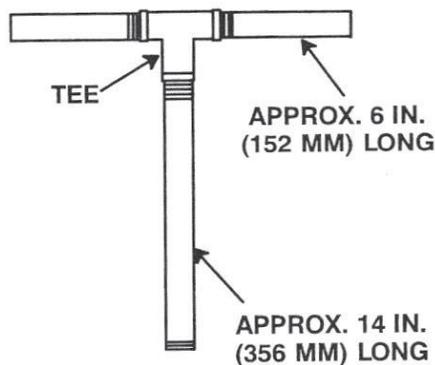
Figure 3. Loosening Impeller

(Figure 1)

Remove the hardware (9 and 10) securing the rotating assembly to the pump casing. Separate the rotating assembly by pulling straight away from the pump casing. Tie and tag the rotating assembly shims (11) for ease of reassembly.

#### NOTE

*An optional disassembly tool is available from the factory. If the tool is used, follow the instructions packed with it. A similar tool may be assembled using 1/2-inch pipe (schedule 80 steel or malleable iron) and a standard tee (see Figure 4). All threads are 1/2-inch NPT. **Do not pre-assemble the tool.***



**Figure 4. Rotating Assembly Tool**

To install the tool, remove the vented plug (8, Figure 2) from the bearing housing, and screw the longest length of pipe into the vent hole until fully engaged. Install the tee, and screw the handles into the tee. Use caution when lifting the rotating assembly to avoid injury to personnel or damage to the assembly.

Remove the bearing housing O-ring (8).

### Impeller Removal

(Figure 2)

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

Remove the impeller adjusting shims (30); tie and tag the shims, or measure and record their thickness for ease of reassembly.

### Seal Removal

(Figure 2)

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

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

An alternate method of removing the stationary seal components is to remove the hardware (20

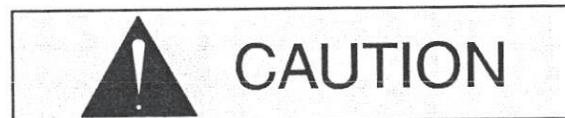
and 21) and separate the seal plate (3) and gasket (4) from the bearing housing (7). Position the seal plate on a flat surface with the impeller side down. Use a wooden dowel or other suitable tool to press on the back side of the stationary seat until the seat, O-rings, and stationary element can be removed.

Remove the shaft sleeve O-ring (29).

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

### Shaft and Bearing Removal and Disassembly (Figure 2)

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



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

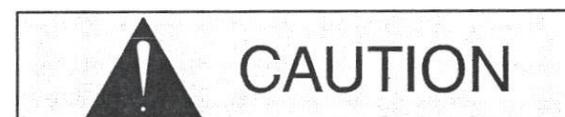
Remove the bearing housing drain plug (28) and drain the lubricant. Clean and reinstall the drain plug.

Disengage the hardware (14 and 15) and slide the bearing cap (13) and oil seal (16) off the shaft. Remove the bearing cap gasket (12), and press the oil seal from the bearing cap.

Place a block of wood against the impeller end of the shaft and tap the shaft (18) and assembled bearings (6 and 11) from the bearing housing.

Pry or press the oil seals (5 and 5A) from the bearing housing.

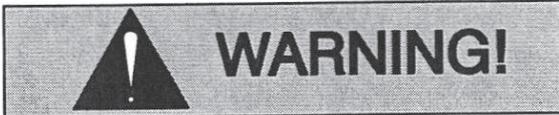
After removing the shaft and bearings, clean and inspect the bearings **in place** as follows.



To prevent damage during removal from the shaft, it is recommended that bearings

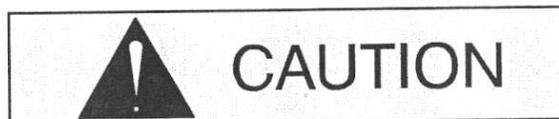
be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

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



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

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



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

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

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

If bearing replacement is required, remove the outboard bearing snap ring (19), and use a bearing puller to remove the bearings from the shaft.

### Shaft and Bearing Reassembly and Installation (Figure 2)

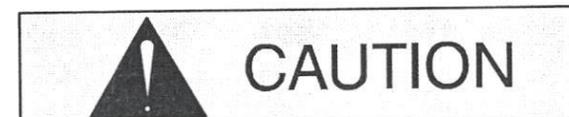
Clean the bearing housing, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage as necessary.



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

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

Position the inboard oil seal (5A) in the bearing housing bore with the lip positioned as shown in Figure 2. Press the oil seal into the housing until the face is **just flush** with the counterbored surface toward the inside of the housing.



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

#### NOTE

*Position the outboard bearing (11) on the shaft with the integral retaining ring on the bearing O.D. toward the drive end of the shaft.*

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

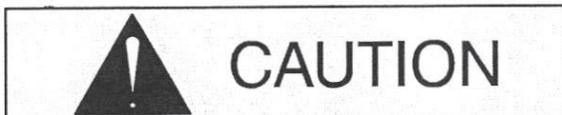
*If a hot oil bath is used to heat the bearings, both the*

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 suitable sized sleeve and a press to reposition the bearings against the shaft shoulders.

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

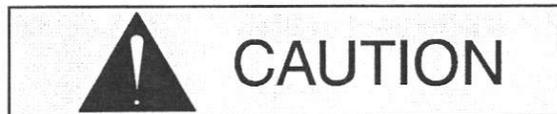


When installing the bearings onto the shaft, **never** press or hit against the outer race, balls, or ball cage. Press **only** on the inner race.

Secure the outboard bearing on the shaft with the bearing snap ring (19).

It is recommended that a sleeve be positioned against the inboard oil seal (5A) to prevent the lip of the oil seal from rolling as the shaft and bearings are installed in the bearing housing. The O.D. of the sleeve should be just smaller than the bearing housing bore, while the I.D. of the sleeve should be just larger than the O.D. of the lip seal area of the shaft.

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



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

Press the inboard oil seal (5) into the bearing housing (7) with the lip positioned as shown in Figure 2. Press the oil seal into the housing until the face is **just flush** with the housing surface toward the outside of the housing.

Press the outboard oil seal (16) into the bearing cap (13) with the lip positioned as shown in Figure 2. Replace the bearing cap gasket (12), and secure the bearing cap with the hardware (14 and 15). **Be careful** not to damage the oil seal lip on the shaft keyway.

Lubricate the bearing housing as indicated in **LUBRICATION**.

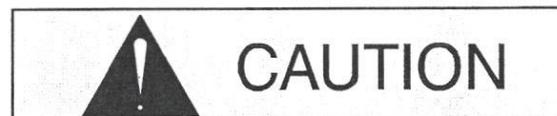
#### Seal Installation

(Figures 2, 5, 6 and 7)



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

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



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



1/2-inch square steel bar into the slot in the shaft as shown in Figure 3.

Clean and inspect the impeller as described in **Impeller Installation and Adjustment**. Install the full set of impeller shims (30) provided with the seal, and screw the impeller onto the shaft until it is seated against the seal (see Figure 6).

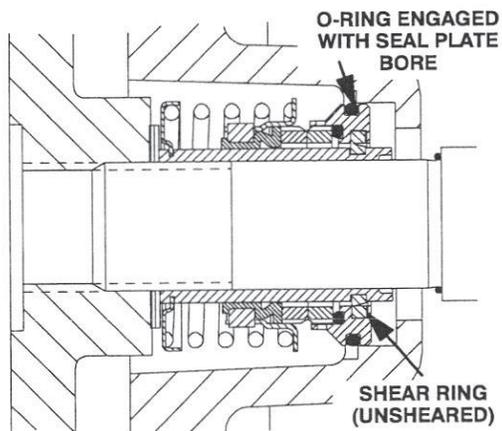


Figure 6. Seal Partially Installed

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

#### NOTE

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

As the stationary seat becomes fully seated, the seal spring compresses, and the shaft sleeve will break the nylon shear ring. This allows the sleeve to slide down the shaft until seated against the shaft shoulder. Continue to screw the impeller onto the shaft until the impeller, shims, and sleeve are fully seated against the shaft shoulder (see Figure 7).

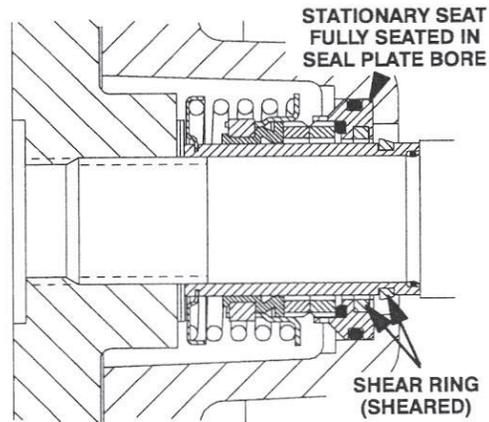
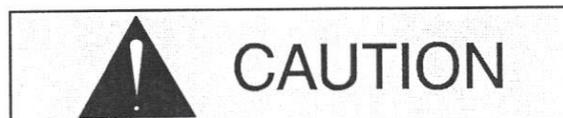


Figure 7. Seal Fully Installed

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

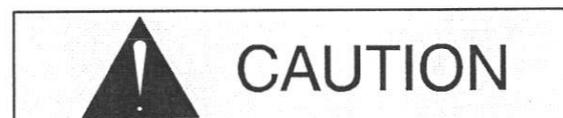
**If necessary to reuse an old seal** in an emergency, carefully separate the rotating and stationary seal faces from the bellows retainer and stationary seat.



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

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

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



**Do not** attempt to separate the rotating portion of the seal from the shaft sleeve

when reusing an old seal. The rubber bellows will adhere to the sleeve during use, and attempting to separate them could damage the bellows.

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

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

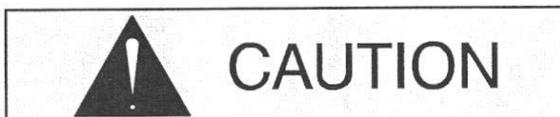
Slide the rotating portion of the seal (consisting of the integral shaft sleeve, spring centering washer, spring, bellows and retainer, and rotating element) onto the shaft until the seal faces contact.

Proceed with **Impeller Installation and Adjustment.**

### Impeller Installation

(Figure 2)

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



The shaft and impeller threads **must** be completely clean before reinstalling the impeller. Even the slightest amount of dirt on the threads can cause the impeller to seize to the shaft, making future removal difficult or impossible without damage to the impeller or shaft.

Install the same thickness of impeller adjusting shims (30) as previously removed. Apply 'Never-Seez' or equivalent to the shaft threads and screw

the impeller onto the shaft until tight. Be sure the seal spring seats squarely on the back side 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 recommended for maximum pump efficiency. Measure this clearance, and add or remove impeller adjusting shims as required.

### NOTE

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

*Proceed with **Rotating Assembly Installation** before installing the impeller capscrew and washer (22 and 23). The rotating assembly must be installed in the pump casing in order to torque the impeller capscrew.*

After the rotating assembly is installed in the pump casing, coat the threads of the impeller capscrew (23) with 'Never-Seez' or equivalent compound, and install the impeller washer (22) and capscrew; torque the capscrew to 90 ft. lbs. (1080 in. lbs. or 12,4 m. kg.).

### Rotating Assembly Installation

(Figure 1)

Install the bearing housing O-ring (8) and lubricate it with light grease. Ease the rotating assembly into the pump casing using the installation tool. **Be careful** not to damage the O-ring.

Install the same thickness of rotating assembly adjusting shims (11) as previously removed, and secure the rotating assembly to the pump casing with the hardware (9 and 10).

To set the impeller and wear plate clearance, refer to the **Back Cover Installation And Adjustment.**

### Suction Check Valve Installation

#### (Figure 1)

Inspect the check valve assembly (39), and replace it if badly worn.

#### NOTE

*The check valve assembly must be replaced as a complete unit. Individual parts are not sold separately.*

Reach through the back cover opening with the check valve and position the check valve adaptor in the mounting slot in the suction flange (35). Align the adaptor with the flange hole, and secure the assembly with the check valve pin (40).

#### NOTE

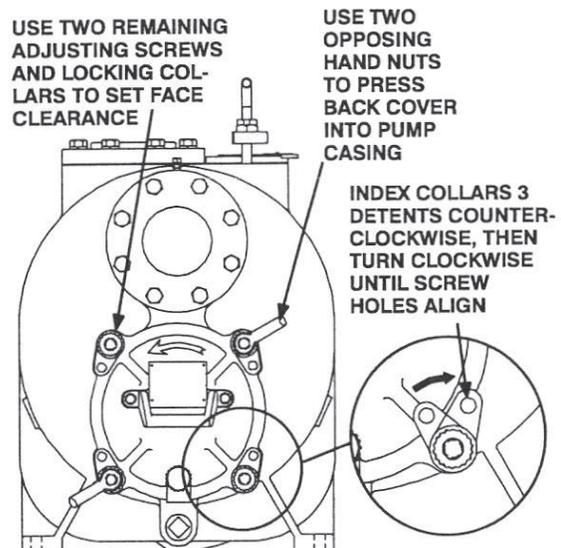
*If the suction or discharge flanges were removed, replace the respective gaskets, apply 'Permatex Aviation No. 3 Form-A-Gasket' or equivalent compound to the mating surfaces, and secure them to the pump casing with the attaching hardware.*

### Back Cover Installation And Adjustment

#### (Figure 1 and 5)

If the wear plate (13) was removed for replacement, carefully center it on the back cover and secure it with the hardware (15 and 16). The wear plate **must** be concentric to prevent binding when the back cover is installed.

Clearance between the impeller and wear plate is adjusted using four adjusting screws and locking collars. There are 18 detents on the I.D. of each locking collar. Indexing the collars one detent on the adjusting screws represents approximately .005 inch (0,13 mm) of wear plate clearance. The recommended clearance between the wear plate and the impeller is .010 to .020 inch (0,25 to 0,50 mm).



**Figure 8. Installing and Adjusting Back Cover**

Replace the back cover O-rings (14 and 18), and lubricate them with a generous amount of No. 2 grease. Clean any scale or debris from the contacting surfaces in the pump casing that might interfere or prevent a good seal with the back cover.

Screw the four adjusting screws (32) into the tapped holes in the back cover plate until they are **just flush** with the machined surface on the back side of the cover plate.

Align the back cover plate over the studs (33) and slide it into the pump casing. Use two hand nuts (28) on diagonally opposing studs to press the back cover into the pump casing until the wear

plate **just touches** the impeller when the shaft is turned by hand. **Tighten the hand nuts evenly to avoid binding.**

With the wear plate just touching the impeller, turn the two free adjusting screws until they engage the pump casing. Position the locking collars over the adjusting screws so the holes in the collars for the locking screws align approximately with the holes in the cover plate.

Loosen the hand nuts used to press the back cover into the pump casing one full turn.

Pull the collars off the adjusting screws, index them three detents counterclockwise, and reinstall the collars on the adjusting screws. Use the collars to turn the adjusting screws clockwise until the holes in the locking collars realign with the tapped screw holes in the back cover plate. Secure the locking collars to the back cover plate with the hardware (29 and 30). Install the two remaining hand nuts snugly against the adjusting screws.

Remove the first two hand nuts from their studs. Turn the adjusting screws clockwise until they engage the pump casing. Install the locking collars and hardware (29 and 30). Reinstall the hand nuts.

Be sure the wear plate does not scrape against the impeller.

Over time it may be necessary to repeat the adjustment process to compensate for normal wear between the impeller and wear plate. When all of the adjustment has been used on the back cover side of the pump, an additional 0.125 inch (3,2 mm) of adjustment may be obtained by removing the rotating assembly adjusting shims (11).

Allow an installed pump to completely cool before draining liquid from the pump casing. Remove the back cover. Remove the rotating assembly adjusting shims, then reinstall the hardware securing the rotating assembly to the pump casing. Perform the back cover adjustment procedure described above to obtain the proper face clearance.

## PRESSURE RELIEF VALVE MAINTENANCE

(Figure 1)

The back cover is equipped with a pressure relief valve (23) to provide additional safety for the pump

and operator (refer to **Liquid Temperature And Overheating** in **OPERATION**).

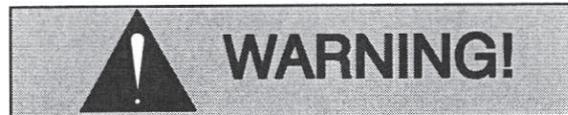
It is recommended that the pressure relief valve assembly be replaced at each overhaul, or any time the pump overheats and activates the valve. **Never** replace this valve with a substitute which has not been specified or provided by the Gorman-Rupp Company.

Periodically, the valve should be removed for inspection and cleaning. When reinstalling the relief valve, apply 'Loctite Pipe Sealant With Teflon No. 592', or equivalent compound, on the relief valve threads. Position the valve as shown in Figure 1 with the discharge port pointing down.

### Final Pump Assembly

(Figure 1)

Install the shaft key (17, Figure 2) and reconnect the power source. Be sure to install any guards used over the rotating members.



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

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 power source have been properly lubricated, see **LUBRICATION**.

Remove the fill cover assembly (44) and fill the pump casing with clean liquid. Reinstall the fill cover and tighten it. Refer to **OPERATION**, Section C, before putting the pump back into service.

## LUBRICATION

### Seal Assembly

(Figure 2)

Before starting the pump, remove the vented plug (8) and fill the seal cavity with approximately 58 ounces (1,7 liter) SAE No. 30 non-detergent oil to the middle of the sight gauge (25) and maintain it at

the middle of the gauge. Clean and reinstall the vented plug. Maintain the oil at this level.

**NOTE**

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

---

**Bearings****(Figure 2)**

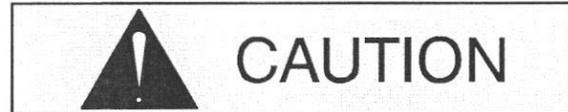
The bearing housing was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (24) and maintain it at the middle of the gauge. When lubrication is required, add SAE No. 30 non-detergent oil through the hole for the air vent (9). **Do not** over-lubricate. Over-lubrication can cause the bearings to over-heat, resulting in premature bearing failure.

**NOTE**

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

---

Under normal conditions, drain the bearing housing once each year and refill with approximately 11 ounces (0,3 liter) clean oil. Change the oil more frequently if the pump is operated continuously or installed in an environment with rapid temperature change.



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

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

**Power Source**

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

**THE GORMAN-RUPP COMPANY AND  
GORMAN-RUPP OF CANADA LIMITED  
60 MONTH LIMITED WARRANTY**

**EXTENT AND DURATION OF WARRANTY**

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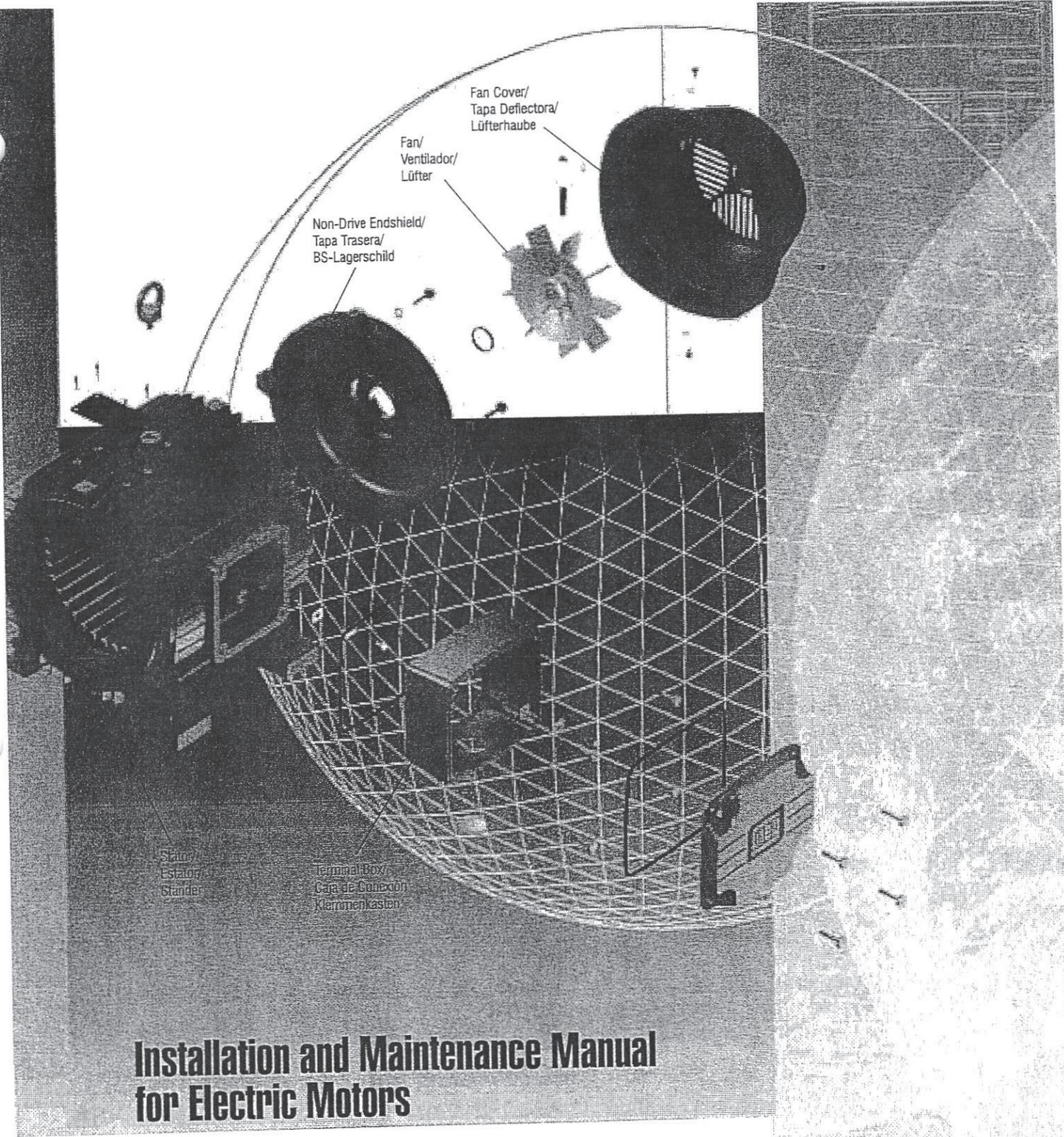
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Some states do not allow the exclusion or limitation of incidental or consequential damages. Accordingly, the above may not apply to you. This Limited Warranty gives you specific legal rights, and you may also have other rights which vary from state to state and province to province.

**THE GORMAN-RUPP COMPANY**  
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70 Burwell Road  
St. Thomas, Ontario N5P 3R7  
Phone: (519) 631-2870



# Installation and Maintenance Manual for Electric Motors

Christmas Pump Station  
City of Harriman TN

11310 - Factory-Built Base Mounted Pumps

WEG 15 HP - TEFC W21 Severe Duty -  
High Efficiency - Ball Bearing - 4 Pole - 60 Hz  
Three Phase - 254T Frame Electric Motor

Catalog # 01518EP3E254T



Motors

◆ Products : Motors : W21 Severe Duty and General Purpose - High Efficiency : Three-Phase : W21 TEFC (IP55) - Ball Bearings : Product Information

REFINE YOUR SEARCH

HP  RPM  Voltage

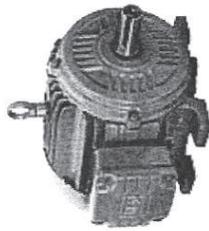
Enter WEG's Catalog Number

- General Information
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**Motors**  
: W21 Severe Duty and General Purpose - High Efficiency  
: Three-Phase : W21 TEFC (IP55) - Ball Bearings

Choose the rate below:  
▶ **15 HP - 60Hz - 460V**

▶ **Characteristics**      ▶ **Catalog Number: 01518EP3E254T**



- Output: 15 HP
- Poles: 4
- Frequency: 60 Hz
- Torque: 44.2 lb.ft
- Voltage: 208-230/460 V
- Frame: 254T
- RPM: 1760
- Full Load Amps: 39.4-35.6/17.8 A
- Efficiency (100%): 91.0
- Power factor (100%): 0.85
- Insulation: F
- Noise: 69 dB(A)
- No load current: 14.6/7.30 A
- In Rush (Times): 6.4

■ W21 Severe Duty and General Purpose - High Efficiency

Output HP	Frame	Full Load Amps	In Rush (Times)	Locked Rotor Torque	Break Down Torque
15 HP	254T	39.4-35.6/17.8 A	6.4	250 %	250 %

Efficiency (%)	Power factor (%)		Service Factor	Inertia	L.R. Time	Weight
	50	75				
89.5	91.0	0.70	1.25	2.3818 sq.ft.lb	27 s	263 lb

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## FOREWORD

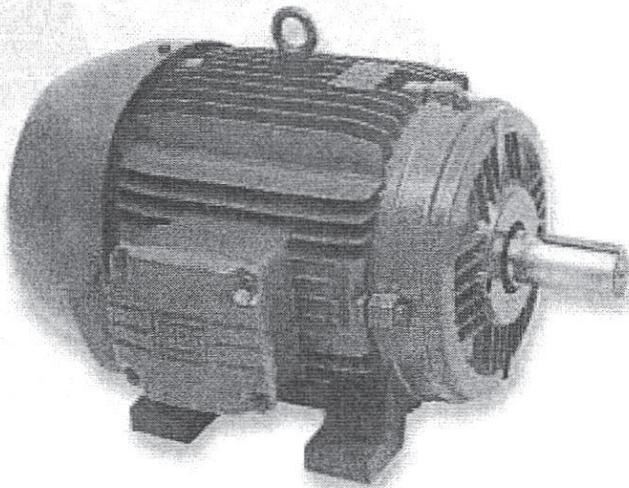
The electric motor is an equipment widely used by man in the industrial development as most of the machines he has been inventing depend on it.

Taking into consideration the prominent role the electric motor plays on people's life, it must be regarded as a prime power unit embodying features that require special care including its installation and maintenance in order to ensure perfect operation and longer life to the unit. This means that the electric motor should receive particular attention.

The **INSTALLATION AND MAINTENANCE MANUAL FOR LOW VOLTAGE THREE-PHASE INDUCTION MOTORS** intends to assist those who deal with electric machines facilitating their task to preserve the most important item of the unit:

THE ELECTRIC MOTOR.

**WEG**



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# 1 - INTRODUCTION

This manual covers all WEG asynchronous induction squirrel cage motors, that is, three phase motors in frames 63 to 355, and single-phase motors.

The motors mentioned in this manual are subject to continuous improvement. Therefore, any information is subject to change without prior notice.

For further details, please contact WEG.

# 2 - BASIC INSTRUCTIONS

## 2.1 - GENERAL INSTRUCTIONS

All personnel involved with electrical equipment, either installation, operation or maintenance should be well-informed and updated concerning the safety norms and principles that govern the work and, furthermore, they are advised to heed them. Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and to alert his personnel of the inherent hazards of the job in hand.

It is recommended that these tasks be undertaken by qualified personnel.

Fire fighting equipment, and notices concerning first aid should not be lacking at the work site; these should be visible and accessible at all times.

## 2.2 - DELIVERY

Prior to shipment, motors are factory-tested and dynamically balanced. With half key to ensure perfect operation.

Upon receipt, we recommend careful handling and a physical checking for any damage which may have occurred during transportation.

In the event of any damage, both the nearest WEG sales office and the carrier should be informed immediately.

## 2.3 - STORAGE

Motors should be lifted by their eyebolts and never by the shaft. Raising and lowering must be steady and joltless, otherwise bearings may be damaged.

When motors are not immediately installed, they should be stored in their normal upright position in a dry even temperature place, free of dust, gases and corrosive smoke. Other objects should not be placed on or against them.

Motors stored over long periods are subject to loss of insulation resistance and oxidation of bearings.

Bearings and the lubricant deserve special attention during long periods of storage. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings. The weight of the rotor in an inactive motor tends to expel grease from the bearing surfaces thereby removing the protective film that impedes metal-to-metal contact. As a preventive measure against the formation of corrosion by contact, motors should not be stored near machines which cause vibrations, and their shaft should be rotated manually at least once a month.

### Recommendations for Storage of Bearings:

- Ambient must be dry with relative humidity not exceeding 60%.
- Clean room with temperature ranging from 10°C to 30°C.
- Maximum stacking of 5 boxes.
- Far from chemical products and tubes conducting steams, water and compressed air.
- They should not be stacked over stone floors or against walls.
- Stock should follow the first-in-first-out principle.
- Double shielded bearings should not remain in stock for more than 2 years.

### Storage of motors:

- Mounted motors which are kept in stock must have their shaft turned periodically, at least once a month, in order to renew the grease on the bearing races.

It is difficult to prescribe rules for the actual insulation resistance value of a machine as the resistance varies according to the type, size and rated voltage and the state of the insulation material used, method of construction and the machine's insulation antecedents. A lot of experience is necessary to decide when a machine is ready or not to be put into service. Periodical records are useful to take such decision.

The following guidelines show the approximate values that can be expected of a clean and dry machine when, at 40°C, test voltage is applied over a period of one minute.

Insulation resistance  $R_m$  is obtained by the formula:

$$R_m = U_n + 1$$

where:  $R_m$  - minimum recommended insulation resistance in  $M\Omega$  with winding at 40°C.  
 $U_n$  - machine rated voltage in kV.

In case that the test is carried out at a temperature other than 40°C, the reading must be corrected to 40°C using a curve of insulation resistance vs. temperature for the particular machine. If such curve is not available, an approximation is possible with the aid of Figure 2.1; it is possible to verify that resistance practically doubles every 10°C that insulating temperature is lowered.

On new machines, lower values are often attained due to solvents present in the insulating varnishes that later evaporate during normal operation. This does not necessarily mean that the machine is not operational, since insulating resistance will increase after a period of service.

On motors which have been in service for a period of time, much larger values are often attained. A comparison of the values recorded in previous tests on the same machine, under similar load, temperature and humidity conditions, serves as a better indication of insulation condition than that of the value coming from a single test. Any substantial or sudden reduction is suspect.

Insulation resistance is usually measured with a MEGGER. In the event that insulation resistance be inferior to the values coming from the above formula, motors should be submitted to a drying process.

This drying process should be carried out in a stove, where the rate of temperature rise should not exceed 5°C per hour and the temperature should not exceed 110°C.

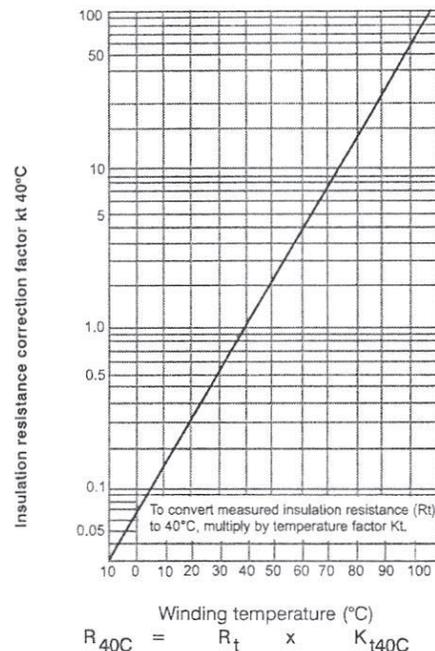


Fig. 2.1 Approximate calculation curve of the insulation resistance.

### 3 - INSTALLATION

Electric machines should be installed in such a way to allow easy access for inspection and maintenance. Should the surrounding atmosphere be humid, corrosive or containing flammable substance or particles, it is essential to ensure an adequate degree of protection. The installation of motors on ambients where there are steams, gases or dusts, flammable or combustible materials, subject to fire or explosion, should be undertaken according to appropriate and governing codes, such as ABNT/IEC 7914, NBR 5418, VDE 0165, NEC-ART. 500, UL-674.

Under no circumstances motors can be enclosed in boxes or covered with materials which may impede or reduce the free circulation of cooling air.

Machines fitted with external ventilation should be at least 50cm far from the wall to permit air movement.

The place of installation should allow for air renewal at a rate of 20 cubic meter per minute for each 100kW of motor output considering ambient temperature of 40°C and altitude of 1000 m.a.s.l.

#### 3.1 - MECHANICAL ASPECTS

##### 3.1.1 - FOUNDATION

The motor base must be level and as far as possible free of vibrations. A concrete foundation is recommended for motors over 100 HP (75kW).

The choice of base will depend upon the nature of the soil at the place of installation or of the floor capacity in the case of buildings. When designing the motor base, keep in mind that the motor may occasionally be run at a torque above that of the rated full load torque.

Based upon Figure 3.1, foundation stresses can be calculated by using the following formula:

$$F1 = 0.5.g.G - \frac{4 T_{max}}{A} \quad F2 = 0.5.g.G + \frac{4 T_{max}}{A}$$

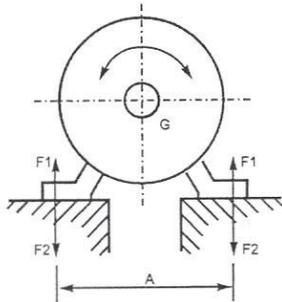


Fig. 3.1 - Base Stresses

Where:

- F1 and F2 - Lateral Stress (N)
- g - Gravity Force (9.8m/s<sup>2</sup>)
- G - Motor Weight (kg)
- Tmax - Breakdown torque (Nm)
- A - Obtained from the dimensional drawing of the motor(m)

Sunken bolts or metallic base plates should be used to secure the motor to the base.

##### 3.1.2 - TYPES OF BASES

###### a) Slide Rails

When motor drive is by pulleys the motor should be mounted on slide rails and the lower part of the belt should be pulling to avoid belt sleppage during operation and also to avoid the belts to operate sideways causing damage to bearing shoulders.

The rail nearest the drive pulley is positioned in such a way that the adjusting bolt be between the motor and the driven machine. The other rail should be placed with the bolt in the opposite position, as shown in Fig. 3.2.

The motor is bolted to the rails and set on the base. Drive and driven pulley centers must be correctly aligned on the same way, motor and driven machine shafts must be parallel.

The belt should not be overly stretched, see Fig. 3.10. After the alignment, the rails are fixed, as shown below:

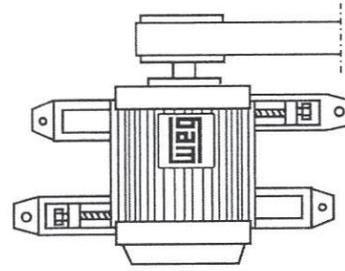


Fig. 3.2 - Positioning of slide rails for motor alignment.

###### b) Foundation Studs

Very often, particularly when drive is by flexible coupling, motor is anchored directly to the base with foundation studs.

This type of coupling does not allow any thrust over the bearings and it is of low cost.

Foundation studs should neither be painted nor rusted as both interfere with the adherence of the concrete, and bring about loosening.

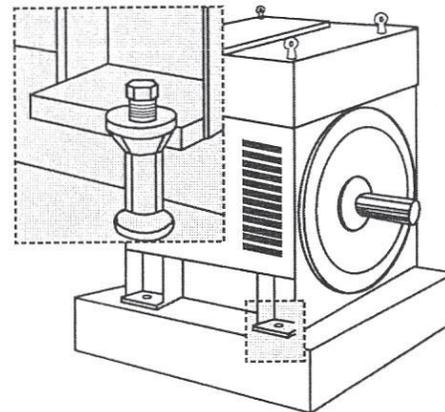


Fig. 3.3 - Motor mounted on a concrete base with foundation studs.

###### c) Metallic Base

Motor-generator sets are assembled and tested at the factory prior to delivery. However, before putting into service at site, coupling alignment should be carefully checked as the metallic base could have suffered displacement during transit due to internal stresses of the material.

The metallic base is susceptible to distortion if secured to a foundation that is not completely flat.

Machines should not be removed from their common metallic base for alignment; the metallic base should be level on the actual foundation with the aid of a spirit level (or similar instrument).

When a metallic base is used to adjust the height of the motor shaft end with the machine shaft end, the latter should be level on the concrete base.

After the base has been levelled, foundation studs tightened, and the coupling checked, the metal base and the studs are cemented.

##### 3.1.3 - ALIGNMENT

The electric motor should be accurately aligned with the driven machine, particularly in cases of direct coupling. An incorrect alignment can cause bearing failure, vibrations and even shaft rupture.

The best way to ensure correct alignment is to use dial gauges

placed on each coupling half, one reading radially and the other axially. Thus, simultaneous readings are possible and allow checking for any parallel (Fig. 3.4) and concentricity deviations (Fig. 3.5) by rotating the shafts one turn. Gauge readings should not exceed 0.05 mm.

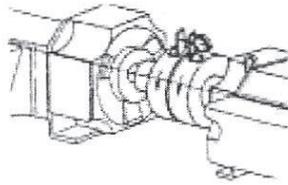


Fig. 3.4 - Deviation from parallelism

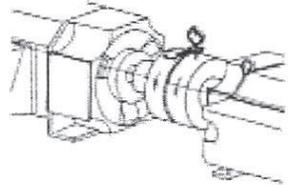


Fig. 3.5 - Deviation from concentricity

### 3.1.4- COUPLING

#### a) Direct Coupling

Direct coupling is always preferable due to low cost, space economy, no belt slippage and lower accident risk. In cases of speed ratio drives, it is also common to use a direct coupling with a reducer (gear box).

**CAUTION:** Carefully align the shaft ends using, whenever feasible, a flexible coupling, leaving a minimum tolerance of 3 mm between the couplings (GAP).

#### b) Gear Coupling

Poorly aligned gear couplings are the cause of jerking motions which cause vibrations on the actual drive and on the motor. Therefore, due care must be taken for perfect shaft alignment: exactly parallel in the case of straight gears and at the correct angle for bevel or helical gears.

Perfect gear engagement can be checked by the insertion of a strip of paper on which the teeth marks will be traced after a single rotation.

#### c) Belt and Pulley Coupling

Belt coupling is most commonly used when a speed ratio is required.

**Assembly of Pulleys:** To assemble pulleys on shaft ends with a keyway and threaded end holes the pulley should be inserted halfway up the keyway merely by manual pressure.

On shafts without threaded end holes, the heating of the pulley to about 80°C is recommended, or alternatively, the devices illustrated in Figure 3.6 may be employed.

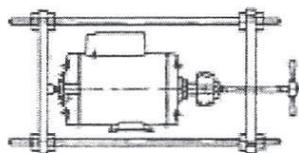


Fig. 3.6 - Pulley mounting device

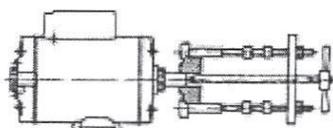


Fig. 3.7 - Pulley extractor

Hammers should be avoided during the fitting of pulleys and bearings. The fitting of bearings with the aid of hammers leaves blemishes on the bearing races. These initially small flaws increase with usage and can develop to a stage that completely impairs the bearing.

The correct positioning of a pulley is shown in Figure 3.8.

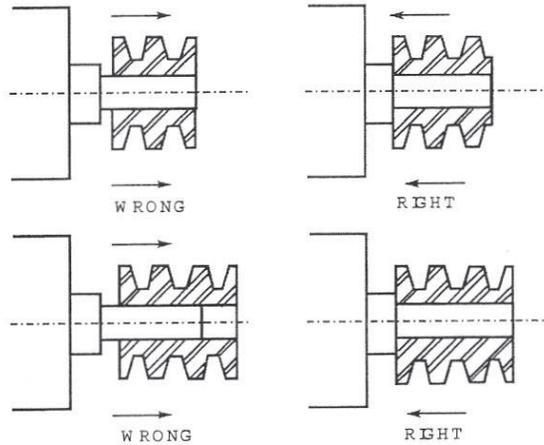


Fig. 3.8 - Correct positioning of pulley on the shaft.

**RUNNING:** To avoid needless radial stresses on the bearings it is imperative that shafts are parallel and the pulleys perfectly aligned. (Figure 3.9).

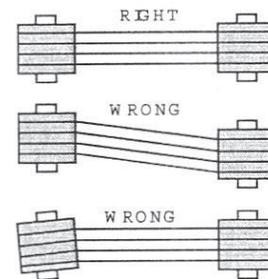


Fig. 3.9 - Correct pulley alignment

Pulleys that are too small should be avoided; these cause shaft flexion because belt traction increases in proportion to a decrease in the pulley size. Table 1 determines minimum pulley diameters, and Table 2 and 3 refer to the maximum stresses acceptable on motor bearings up to frame 355.

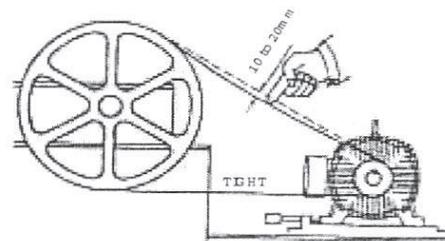


Fig. 3.10 - Belt tensions

Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin (rosin for example). Belt tension should be sufficient to avoid slippage during operation.

TABLE 1

MINIMUM PITCH DIAMETER OF PULLEYS							
Frame	BALL BEARINGS						
	Bearing	Size X ( mm )					
		20	40	60	80	100	120
63	6201-ZZ	40	---	---	---	---	---
71	6203-ZZ	40	40	---	---	---	---
80	6204-ZZ	40	40	---	---	---	---
90	6205-ZZ	63	71	80	---	---	---
100	6206-ZZ	71	80	90	---	---	---
112	6307-ZZ	71	80	90	---	---	---
132	6308-ZZ	---	100	112	125	---	---
160	6309-Z-C3	---	140	160	180	200	---
180	6311-Z-C3	---	---	160	180	200	224
200	6312-Z-C3	---	---	200	224	250	280

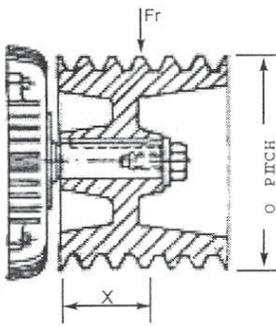


TABLE 1.1

Frame	Poles	BALL BEARINGS				
		Bearing	Size X ( mm )			
			50	80	110	140
225	IV-VI-VIII	6314	250	265	280	300
250	IV-VI-VIII	6314	375	400	425	450
280	IV-VI-VIII	6316	500	530	560	600
315	IV-VI-VIII	6319	-----	-----	-----	-----
355	IV-VI-VIII	6322	-----	-----	-----	-----

For 11 pole motors, contact WEG.

TABLE 1.2

Frame	Poles	Roller Bearings						
		Bearing	Size x (mm)					
			50	80	100	140	170	210
225	IV-VI-VIII	NU 314	77	80	110	136	-----	-----
250	IV-VI-VIII	NU 314	105	115	145	175	-----	-----
280	IV-VI-VIII	NU 316	135	140	170	210	-----	-----
315	IV-VI-VIII	NU 319	-----	170	185	225	285	-----
355	IV-VI-VIII	NU 322	-----	-----	345	410	455	565

TABLE 2

MAXIMUM ACCEPTABLE RADIAL LOAD (N) - IP55 MOTORS - 60Hz				
FRAME	POLES			
	II	IV	VI	VIII
63	245	294	-----	-----
71	294	392	-----	-----
80	343	491	-----	-----
90	392	540	589	687
100	589	785	883	981
112	1040	1275	1472	1668
132	1275	1570	1864	1962
160	1570	1962	2256	2551
180	2060	2649	3041	3434
200	2354	3139	3630	4120
225	3041	4120	4415	5003
250	2845	3728	4316	4807
280	3532	4513	5101	5690
315	3335	4905	5690	6475
355	----	15402	15402	15402

MAXIMUM ACCEPTABLE RADIAL LOAD (N) - IP55 MOTORS - 50Hz				
FRAME	POLES			
	II	IV	VI	VIII
63	245	294	-----	-----
71	294	392	-----	-----
80	343	491	-----	-----
90	392	589	638	687
100	589	834	932	1079
112	1079	1373	1570	1766
132	1373	1668	1962	2060
160	1668	2060	2403	2698
180	2158	2796	3237	3630
200	2502	3335	3826	4365
225	3237	4365	4709	5297
250	3041	3924	4611	5101
280	3728	4807	5396	5984
315	3532	5199	5984	6867
355	----	16285	16285	16285

TABLE 2.1

MAXIMUM ACCEPTABLE RADIAL LOAD (Kgf) - 60Hz AND 50Hz				
NEMA 56 MOTORS (SINGLE-PHASE)				
FRAME	RADIAL FORCE (N)			
	POLES			
	II	IV	VI	VIII
56 A	245	343	-----	-----
56 B	294	343	-----	-----
56 D	343	441	-----	-----
SAW ARBOR MOTORS (THREE-PHASE)				
80 S - MS	981	-----	-----	-----
80 H - MS	981	-----	-----	-----
80 L - MS	981	-----	-----	-----
90 L - MS	1275	1570	-----	-----

Concerning ODP NEMA 48 & 56 fractional motors, these have the following features:

- Rotor: Squirrel cage
- Protection: Open drip proof
- Insulation: Class "B" (130°C) - IEC 34
- Cooling system: internal

- Bearings: Ball
- Standards: NEMA MG-1
- Voltage: Single phase: 110/220V  
Three phase: 220/380V
- Frequency: 60Hz and 50Hz

For more information referring to motor features, please contact WEG.

TABLE 3

MAXIMUM ACCEPTABLE AXIAL LOAD (N) - f = 60 Hz																
TOTALLY ENCLOSED FAN COOLED MOTORS - IP55																
F R A M E	POSITION / MOUNTING CONFIGURATION															
	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII
63	275	363	422	-	275	363	422	-	265	343	412	-	265	343	412	-
71	294	402	471	530	363	491	579	647	284	383	451	520	353	481	559	638
80	353	481	559	638	471	647	755	844	334	451	530	608	461	618	726	824
90	451	618	746	834	491	667	824	922	422	569	706	785	461	628	775	873
100	481	657	795	903	687	932	1128	1275	432	589	726	834	638	873	1069	1207
112	677	912	1109	1275	1197	1628	1972	2227	608	824	1020	1187	1138	1540	1874	2139
132	834	1158	1383	1570	1422	1982	2364	2659	706	1010	1207	1364	1305	1825	2178	2453
160	1197	1648	1884	2168	2040	2747	3178	3620	952	1383	1560	1884	1795	2482	2855	3335
180	-	2178	2492	2815	-	3718	4307	4846	-	1825	1991	2315	-	3375	3806	4365
200	1668	2207	2659	3041	3129	4130	4895	5552	1197	1579	2040	2472	2659	3483	4277	4983
225	3983	5278	6200	6985	3983	5278	6200	6985	3335	4454	5297	6082	3335	4454	5297	6082
250	3895	5180	6053	6828	3895	5180	6053	6828	3129	4169	4876	5651	3129	4169	4876	5651
280	3747	5964	7073	7985	3747	5964	7073	7985	2541	4424	5307	6239	2541	4424	5307	6239
315	3424	5562	6622	7514	3424	5562	6622	7514	1579	3208	3924	4836	1579	3208	3924	4836
355	3120	6259	7338	8299	3120	6259	7338	8299	451	2109	2443	2659	451	2109	2443	2659

MAXIMUM ACCEPTABLE AXIAL LOAD (N) - f = 50 Hz																
TOTALLY ENCLOSED FAN COOLED MOTORS - IP55																
F R A M E	POSITION / MOUNTING CONFIGURATION															
	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII
63	294	392	441	-	294	392	441	-	284	363	441	-	294	392	441	-
71	314	432	491	559	392	520	618	687	304	402	481	549	373	510	589	677
80	373	510	589	677	491	687	785	893	353	481	559	647	491	657	765	873
90	481	657	785	883	520	706	873	981	441	618	746	834	491	667	824	922
100	510	697	844	961	726	981	1197	1354	461	628	765	883	677	922	1128	1275
112	716	961	1177	1354	1275	1727	2090	2354	647	873	1079	1256	1207	1628	1982	2266
132	883	1226	1472	1668	1511	2080	2502	2815	765	1069	1275	1442	1383	1933	2305	2600
160	1275	1746	1991	2296	2158	2914	3375	3836	1010	1472	1658	1991	1903	2629	3021	3532
180	-	2305	2649	2982	-	3944	4562	5131	-	1933	2109	2453	-	3581	4032	4630
200	1766	2335	2815	3227	3316	4375	5189	5886	1275	1668	2158	2619	2815	3689	4532	5278
225	4218	5592	6573	7407	4218	5592	6573	7407	3532	4719	5611	6445	3532	4719	5611	6445
250	4120	5494	6416	7230	4120	5494	6416	7230	3316	4415	5160	5984	3316	4415	5160	5984
280	3973	6318	7505	8466	3973	6318	7505	8466	2688	4689	5621	6612	2688	4689	5621	6612
315	3630	5886	7014	7966	3630	5886	7014	7966	1668	3404	4159	5121	1668	3404	4159	5121
355	3306	6632	7779	8790	3306	6632	7779	8790	481	2237	2590	2815	481	2237	2590	2815

TABLE 3.1

MAXIMUM ACCEPTABLE AXIAL LOAD (N) - f = 60 Hz and 50Hz								
F R A M E	POSITION / MOUNTING CONFIGURATION FRAME							
	II	IV	II	IV	II	IV	II	IV
56 A	294	392	363	491	275	373	343	471
56 B	294	392	353	481	275	363	343	461
56 D	275	383	461	638	255	353	441	608

### 3.2 - ELECTRICAL ASPECTS

#### 3.2.1- POWER SUPPLY SYSTEM

Proper electric power supply is very important. The choice of motor feed conductors, whether branch or distribution circuits, should be based on the rated current of the motors as per IEC 34 Standard.

NOTE: In the case of variable speed motors, the highest value among the rated currents should be considered. When motor operation is intermittent the conductors should have a current carrying capacity equal or greater, to the product of the motor rated current times the running cycle factor shown in Table 4.

**IMPORTANT:** For a correct choice of motor feed conductors, we recommend to check the standards requirements for industrial installations.

TABLE 4

Classification	Service Duty Factor				
	Motor Rated Service Time	5 min.	15 min.	30 to 60 min.	Continuous
Short (valve operation, contact operation, etc.)		1.10	1.20	1.50	
Intermittent (load or building elevators, tools, pumps, rolling bridges, etc.)		0.85	0.85	0.90	1.40
Periodical (Rolling mill, mining machines, etc.)		0.85	0.90	0.95	1.40
Variable		1.10	1.20	1.50	2.00

#### 3.2.2 - STARTING OF ELECTRIC MOTORS

Induction motors can be started by the following methods:

##### DIRECT STARTING

Whenever possible a three phase motor with a squirrel cage should be started directly at full voltage supply by means of contactors. It has to be taken into account that for a certain motor, torque and current curves are fixed, independently of the load, for constant voltage.

In cases where motor starting current is high, this can cause interference to the following:

- a) Significant voltage drop in the power supply feeding system. As a consequence, other equipment connected to the same system can suffer interference.
- b) The protection system (cables and contactors) must be oversized leading to a high cost.
- c) Power supply utilities will limit the supply voltage drop.

In cases where DOL starting is not feasible due to above given reasons, then indirect system can be used in order to reduce the starting current such as:

- Star-delta starting
- Starting with compensating switch (auto-transformer starting)
- Series-parallel starting
- Electronic starting (soft-start)

##### STAR-DELTA STARTING

It is fundamental for star-delta starting that three phase motor have the required number of leads to allow connection on both voltages, that is, 220/380V, 380/660V or 440/760V.

These motors should have at least 6 connecting leads. The starting has to be made at no load. The star-delta starting can be used when the motor torque curve is sufficiently high to guarantee acceleration of the load at reduced voltage. At star connection, current is reduced to 25% to 30% of the starting current in comparison to delta connection.

Torque curve is also reduced proportionally. For this reason, every time a star-delta starting is required, a high torque curve motor must be used.

WEG motors have high starting and breakdown torque. Hence, they are suitable in most cases for star-delta starting.

The load resistant torque can not exceed the motor starting torque, neither the current when switching to delta connection can not be of an unacceptable value.

There are cases where this starting method can not be used. For example, when the resistant torque is too high. If the starting is made at star, motor will accelerate the load up to approximately 85% of the rated speed. In this point, the switch must be connected at delta. In this case, the current which is about the rated current jumps, suddenly, which is in fact not advantageous, as the purpose is to reduce the starting current.

Table 5 shows the most common multiple rated voltages for three phase motors and their use to the usual power supply voltages.

The DOL or compensating switch starting is applicable to all cases of table 5.

TABLE 5

Normal connections for three phase motors		
Winding design	Operation Voltage	Star-delta starting
220V/380V	220 V 380 V	yes no
220/440/230/460	220V/230V 440V/760V	no yes
380V/660V	380V	yes
220/380/440/760	220V 380V 440V	yes no yes

### STARTING WITH COMPENSATING SWITCH (AUTO-TRANSFORMER)

This starting method can be used to start motors hooked to the load. It reduces the starting current avoiding in this way overload giving the motor enough torque for the starting and acceleration. The voltage in the compensating switch is reduced through an auto-transformer which normally has TAPS of 50, 65 and 80% of the rated voltage.

### SERIES - PARALLEL STARTING

For series-parallel starting, motor must allow reconnection for two voltages:

The lowest to be equal to the power supply voltage and the other twice higher.

This starting method requires 9 connecting leads in the motor, and the most common voltage is 220/440V, that is, during the starting, motor is series connected until it reaches the rated speed and then it is switched to parallel connection.

### ELECTRONIC STARTING (SOFT START)

The advance of the electronics has allowed creation of the solid state starting switch which is composed of a set of pairs of tiristors (SCR) (or combination of tiristors/diodes), one on each motor output borne.

The trigger angle of each pair of tiristors is controlled electronically to apply a variable voltage to the motor terminals during the acceleration. At the final moment of the starting, typically adjusted between 2 and 30 seconds, voltage reaches its full load value after a smooth acceleration or an increasing ramp, instead of being submitted to increasing or sudden jumps.

Due to that it is possible to keep the starting current (in the power supply) close to the rated current and with slight variation.

Besides the advantage of controlling the voltage (current) during the starting, the electronic switch has also the advantage of not having moving parts or those that generate arc, as it happens with mechanical switches. This is a strong point of the electronic switches as their useful life is extended.

### 3.2.3 - MOTOR PROTECTION

Motors in continuous use should be protected from overloads by means of a device incorporated into the motor, or by an independent device, usually a fixed or adjustable thermal relay equal or less than to the value originated from the multiplication of the rated feed current at full load by:

- 1.25 for motors with a service factor equal or superior to 1.15; or
- 1.15 for motors with service factor equal to 1.0 (IEC 34)

Some motors are optionally fitted with overheating protective devices such as thermoresistances, thermistors, thermostats or thermal protectors.

The type of temperature detector to be used are selected taking into consideration the motor insulation temperature, type of motor and customer requirement.

### THERMOSTAT (THERMAL PROBE)

They are bimetallic thermal detectors with normally closed silver contacts. They open as the temperature increases and then return to the original position as soon as the temperature acting on the bimetallic decreases, allowing new closing of the contacts.

Thermostats can be used for alarm, tripping systems or both (alarm and tripping) of three phase electric motors when requested by the customer. Thermostats are series connected directly to the contactor coil circuit.

Depending on the safety level and customer requirement, three thermostats (one per phase) or six thermostats (two per phase) can be installed. In order to operate as alarm and tripping (two thermostats per phase), the alarm thermostats must be suitable to act at the motor predetermined temperature, while the tripping thermostats must act at the maximum temperature of the insulating material.

Thermostats are also used on special applications of single phase motors. On these applications, the thermostat can be series connected with the motor power supply as long as the motor current does not exceed the maximum acceptable current of the thermostat.

If this occurs, connect the thermostat in series with the contactor coil.

Thermostats are installed in the coil heads of different phases.

### THERMISTORS (PTC and NTC)

These are semi-conductor heat detectors which sharply change their resistance upon reading a set temperature.

PTC - Positive temperature coefficient.

NTC - Negative temperature coefficient.

The PTC type is a thermistor whose resistance increases sharply to a temperature defined value specified for each type. This sudden variation of the resistance interrupts the current in the PTC by acting an outlet relay which switches off the main circuit. It can also be used for alarm and tripping systems (two per phase).

NTC thermistors, which act adversily of PTC's, are not normally used on WEG motors as the control electronic circuits available commonly apply to PTC's.

Thermistors have reduced size, do not suffer mechanical wear and act quicker in relation to other temperature detectors.

Fitted with control electronic circuits, thermistors give complete protection for overheating, overload, sub or overvoltages or frequent reversing or on - off operations.

It is a low cost device, similar to a PT-100, but it requires a commanding relay for alarm or operation.

### RESISTANCE TEMPERATURE DETECTORS (RTD) PT-100

The RTD operates on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. It is an element usually made of copper, platinum or nickel which allows a continuous follow up of the motor heating process through a control panel of high precision and acting sensibility. Highly used in the industry in general where temperature measuring and automation techniques are required. Also widely used on applications that require irregular intermittent duty.

A single detector can be used for alarm and tripping purposes.

### THERMAL PROTECTORS

These are bimetallic thermal detectors with normally closed silver contacts. Mainly used as protection of single phase motors against overheating caused by overloads, locked rotor, voltage drop, etc. They are normally fitted in the motors when requested by the customer. The basic components are a bimetallic disc, two flexible contacts, a resistance and a pair of fixed contacts.

It is series connected with the supply voltage and, due to a thermal dissipation caused by the current pass through its internal resistance, the disc is deformed enough to open the contacts, and then motor feeding is interrupted. As soon as the temperature comes down, the protector should react.

Based on the resetting, there are two types of thermal protectors:

- a) Automatic overload protector where the resetting is done automatically.

b) Manual overload protector when the resetting is done through a manual release.

Table 6 shows a comparison between motor protection systems.

TABLE 6

COMPARISON BETWEEN MOTOR PROTECTION SYSTEMS			
Causes of overheating	Current-based protection		Protection with probe thermistor in motor
	Fuse only	Fuse and thermal protector	
Overload with 1.2 times rated current	○	●	●
Duty cycles S1 to S10	○	●	●
Brakings, reversals and frequent starts	○	○	●
Operation with more than 15 starts p/hour	○	○	●
Locked rotor	●	○	●
Fault on one phase	○	○	●
Excessive voltage fluctuation	○	●	●
Frequency fluctuation on main supply	○	●	●
Excessive ambient temperature	○	●	●
External heating caused by bearings, belts, pulleys, etc.	○	○	●
Obstructed ventilation	○	○	●

CAPTION ○ Unprotected  
 ● Partially protected  
 ● Totally protected

### 3.3 - START-UP

#### 3.3.1 - PRELIMINARY INSPECTION

Before starting a motor for the first time, check the following:

- Remove all locking devices and blocks used in transit and check that the motor rotates freely;
- Check if the motor is firmly secured and that coupling elements are correctly mounted and aligned;
- Ascertain that voltage and frequency correspond to those indicated on the nameplate. Motor performance will be satisfactory as long as voltage and frequency remain in the range determined by IEC Standard.
- Check if connections are in accordance with the connection diagram shown on the nameplate and be sure that all terminal screws and nuts are tight;

e) Check the motor for proper grounding. Providing that there are no specifications calling for ground-insulated installation, the motor must be grounded in accordance with prevalent standard for grounding electrical machines. The screw identified by the symbol (⊥) should be used for this purpose. This screw is generally to be found in the terminal box or on the motor foot.

f) Check if motor leads correspond with the main supply as well as the control wires, and the overload protection device are in accordance with IEC Standards;

g) If the motor has been stored in a humid place, or has been stopped for some time, measure the insulating resistance as recommended under the item covering storage instructions;

h) Start the motor uncoupled to ascertain that it is running freely and in the desired direction.

To reverse the rotation of a three-phase motor, invert two terminal leads of the main power supply.

Medium voltage motors having an arrow on the frame indicating rotation direction can only turn in the direction shown;

### 3.3.2 - THE FIRST START-UP

#### THREE-PHASE MOTOR WITH SQUIRREL CAGE ROTOR

After careful checking of the motor, follow the normal sequence of starting operations listed in the control instructions for the initial start-up.

### BEARING SPECIFICATION BY MOTOR TYPE

TABLE 7

FRAMES	Mounting Config.	BEARINGS	
		DE	ODE
TEFC motors			
63	all mounting configurations	6201-ZZ	6201-ZZ
71		6203-ZZ	6202-ZZ
80		6204-ZZ	6203-ZZ
90 S		6205-ZZ	6204-ZZ
90 L		6205-ZZ	6204-ZZ
100 L		6206-ZZ	6205-ZZ
112 M		6307-ZZ	6206-ZZ
132 S		6308-ZZ	6207-ZZ
132 M		6308-ZZ	6207-ZZ
160 M		6309-Z-C3	6209-Z-C3
160 L		6309-Z-C3	6209-Z-C3
180 M		6311-Z-C3	6211-Z-C3
180 L		6311-Z-C3	6211-Z-C3
200 L		6312-Z-C3	6212-Z-C3
200 M		6312-Z-C3	6212-Z-C3
225 S/M		6314-C3	6314-C3
250 S/M		6314-C3	6314-C3
280 S/M		6314-C3**	6314-C3
		6316-C3	6316-C3
315 S/M		6314-C3**	6314-C3
	6319-C3	6316-C3	
355 M/L	6314-C3	6314-C3	
	NU322-C3	6319-C3	

\*\* Only valid for 2 pole motors.

### 3.3.3 - OPERATION

Drive the motor coupled to the load for a period of at least one hour while watching for abnormal noises or signs of overheating. Compare the line current with the value shown on the nameplate. Under continuous running conditions without load fluctuations, this should not exceed the rated current times the service factor, also shown on the nameplate.

All measuring and control instruments and apparatus should be continuously checked for any deviation and any irregularities corrected.

### 3.3.4 - STOPPING

Warning:

To touch any moving part of a running motor, even though disconnected, is a danger to life and limb.

Three-phase motor with squirrel cage rotor:  
Open the stator circuits switch. With the motor at a complete stop, reset the auto-transformer, if any, to the "start" position.

### BEARING SPECIFICATION BY MOTOR TYPE

TABLE 8

FRAMES	Mounting Config.	BEARINGS	
		DE	ODE
<b>TEFC motors</b>			
143 T	all mounting configurations	6205-ZZ	6204-ZZ
145 T		6205-ZZ	6204-ZZ
182 T		6307-ZZ	6206-ZZ
184 T		6307-ZZ	6206-ZZ
213 T		6308-ZZ	6207-ZZ
215 T		6308-ZZ	6207-ZZ
254 T		6309-C3	6209-C3
256 T		6309-C3	6209-C3
284 T/TS		6311-C3	6211-C3
286 T/TS		6311-C3	6211-C3
324 T/TS		6312-C3	6212-C3
326 T/TS		6312-C3	6212-C3
364 T/TS		6314-C3	6314-C3
365 T/TS		6314-C3	6314-C3
404 T		6314-C3	6314-C3
405 TS		6314-C3	6314-C3
444 T		6316-C3	6316-C3
444 TS		6314-C3**	6314-C3
445 T		6316-C3	6316-C3
445 TS		6314-C3**	6314-C3
504 Z	6319-C3	6316-C3	
505 U	6314-C3**	6314-C3	
505 Z	6319-C3	6316-C3	
586 T	6314-C3	6314-C3	
587 T	NU 322-C3	6319-C3	

\*\* Only valid for 2 pole motors.

### BEARING SPECIFICATION BY MOTOR TYPE

#### BEARINGS FOR SAW ARBOR MOTORS

TABLE 8A

SAW ARBOR	Mounting Config.	BEARINGS	
		DE	ODE
80 S MS	B 3	6307-ZZ	6207-ZZ
80 M MS		6307-ZZ	6207-ZZ
80 L MS		6307-ZZ	6207-ZZ
90 L MS		6308-ZZ	6208-ZZ

#### NEMA FRAME MOTORS

TABLE 8B

NEMA Frames	Mounting Config.	BEARINGS	
		DE	ODE
<b>ODP motors</b>			
48B	all mounting configurations	6203-ZZ	6202-ZZ
56 A		6203-ZZ	6202-ZZ
56 B		6203-ZZ	6202-ZZ
56 D		6204-ZZ	6202-ZZ
56 H		6204-ZZ	6202-ZZ

## BEARING LUBRICATION INTERVALS AND AMOUNT OF GREASE

**TABLE 9**

BALL BEARINGS - SERIES 62/63													
Relubrication intervals (running hours - horizontal position)													
	II pole		IV pole		VI pole		VIII pole		X pole		XII pole		Amount of grease
<b>Serie 62</b>													
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
6209	18400	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	9
6211	14200	16500	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	11
6212	12100	14400	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
<b>Serie 63</b>													
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
6309	15700	18100	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
6311	11500	13700	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	18
6312	9800	11900	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	21
6314	3600	4500	9700	11600	14200	16400	17300	19700	19700	20000	20000	20000	27
6316	-	-	8500	10400	12800	14900	15900	18700	18700	20000	20000	20000	34
6319	-	-	7000	9000	11000	13000	14000	17400	17400	18600	18600	20000	45
6322	-	-	5100	7200	9200	10800	11800	15100	15100	15500	15500	19300	60

**TABLE 10**

ROLLER BEARINGS - SERIES NU 3													
Relubrication intervals (running hours - horizontal position)													
	II pole		IV pole		VI pole		VIII pole		X pole		XII pole		Amount of grease
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
NU 309	9800	13300	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
NU 311	6400	9200	19100	20000	20000	20000	20000	20000	20000	20000	20000	20000	18
NU 312	5100	7600	17200	20000	20000	20000	20000	20000	20000	20000	20000	20000	21
NU 314	1600	2500	7100	8900	11000	13100	15100	16900	16900	19300	19300	20000	27
NU 316	-	-	6000	7600	9500	11600	13800	15500	15500	17800	17800	20000	34
NU 319	-	-	4700	6000	7600	9800	12200	13700	13700	15700	15700	20000	45
NU 322	-	-	3300	4400	5900	7800	10700	11500	11500	13400	13400	17300	60
NU 324	-	-	2400	3500	5000	6600	10000	10200	10200	12100	12100	15000	72

**Notes:**

- The ZZ bearings from 6201 to 6307 do not require relubrication as its life time is about 20.000 hours.
- Tables 9 and 10 are intended for the lubrication period under bearing temperature of 70°C (for bearings up to 6312 and NU 312) and temperature of 85°C (for bearings 6314 and NU 314 and larger).
- For each 15°C of temperature rise, the relubrication period is reduced by half.
- The relubrication periods given above are for those cases applying Polyrex® EM grease.
- When motors are used on the vertical position, their relubrication interval is reduced by half if compared to horizontal position motors.

**Compatibility of Polyrex® EM grease with other types of grease:**

Containing polyurea thickener and mineral oil, the Polyrex® EM grease is compatible with other types of grease that contain:

- Lithium base or complex of lithium or polyurea and highly refined mineral oil.
- Inhibitor additive against corrosion, rust and anti-oxidant additive.

**Notes:**

- Although Polyrex® EM is compatible with types of grease given above, we do not recommended to mix it with any other greases.
- If you intend to use a type of grease different than those recommended above, first contact WEG.
- On applications (with high or low temperatures, speed variation, etc), the type of grease and relubrication interval are given on an additional nameplate attached to the motor.

## 4 - MAINTENANCE

A well-designed maintenance program for electric motors, when correctly used, can be summed up as: periodical inspection of insulation levels, temperature rise, wear, bearing lubrication at the occasional checking of fan air flow. Inspection cycles depend upon the type of motor and the conditions under which it operates.

### 4.1 - CLEANLINESS

Motors should be kept clean, free of dust, debris and oil. Soft brushes or clean cotton rags should be used for cleaning. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins. Terminal boxes fitted to motors with IP-55 protection should be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free. Motors with IP(W) 55 protection are recommended for use under unfavourable ambient conditions.

### 4.2 - LUBRICATION

Motors made up to frame 160 are not fitted with grease fitting, while larger frames up to frame 200 this device is optional. For frame 225 to 355 grease fitting is supplied as standard. Proper Lubrication extends bearing life. Lubrication Maintenance Includes:

- a) Attention to the overall state of the bearings;
- b) Cleaning and lubrication;
- c) Careful inspection of the bearings.

Bearing temperature control is also part of routine maintenance. The temperature of bearings lubricated with suitable grease as recommended under item 4.2.2 should not exceed 70°C. Constant temperature control is possible with the aid of external thermometers or by embedded thermal elements. WEG motors are normally equipped with grease lubricated ball or roller bearings. Bearings should be lubricated to avoid the metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and mechanical operation and, furthermore, all lubricants are subject to contamination under working conditions. For this reason, lubricants must be renewed and any lubricant consumed needs replacing from time to time.

#### 4.2.1 - LUBRICATION INTERVALS

To apply correct amount of grease is an important aspect for a good lubrication.

Relubrication must be made based on the relubrication intervals Table. However, when a motor is fitted with a lubrication instructions plate, these instructions must be followed.

For an efficient initial bearing lubrication, the motor manual or the Lubrication Table must be followed. If this information is not available, the bearing must be greased up to its half (only the empty space between the moving parts).

When performing these tasks, care and cleanliness are recommended in order to avoid penetration of dust into the bearings.

#### 4.2.2 - QUALITY AND QUANTITY OF GREASE

Correct lubrication is important!

Grease must be applied correctly and in sufficient quantity as both insufficient or excessive greasing are harmful.

Excessive greasing causes overheating brought about by the greater resistance caused on the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.

This can cause seepage with the grease penetrating the motor and dripping on the coils or other motor components.

A lithium based grease is commonly used for the lubrication of electric motor bearings as it has good mechanical stability, insoluble in water.

### Greases for standard motors

Type	Supplier	Frame
Polyrex®EM	Esso	63 to 355M/L

This grease should never be mixed with different base greases. More details about the greases mentioned above can be obtained at an authorized service agent or you can contact WEG directly. For special greases, please contact WEG.

### 4.2.3. LUBRICATION INSTRUCTIONS

- Inject about half the estimated amount of grease and run the motor at full speed for approximately a minute; switch off the motor and inject the remaining grease.

The injection of all the grease with the motor at rest could cause penetration of a portion of the lubricant through the internal seal of the bearing case and hence into the motor.

Nipples must be clean prior to introduction of grease to avoid entry of any alien bodies into the bearing.

For lubricating, use only a manual grease gun.

### BEARING LUBRICATION STEPS

1. Clean the area around the grease nipples with clean cotton fabric.
2. With the motor running, add grease with a manual grease gun until the quantity of grease recommended in Tables 9 or 10 has been applied.
3. Allow the motor to run long enough to eject all excess of grease.

### 4.2.4 - REPLACEMENT OF BEARINGS

The opening of a motor to replace a bearing should only be carried out by qualified personnel.

Damage to the core after the removal of the bearing cover is avoided by filling the gap between the rotor and the stator with stiff paper of a proper thickness.

Providing suitable tooling is employed, disassembly of a bearing is not difficult (Bearing Extractor).

The extractor grips should be applied to the sidewall of the inner ring to the stripped, or to an adjacent part.

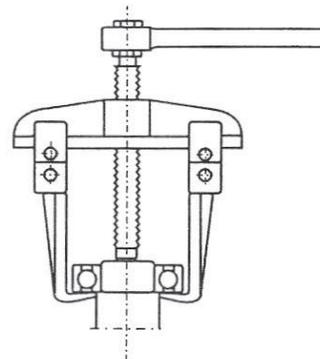


Fig. 4.2 - Bearing Extractor

To ensure perfect functioning and no injury to the bearing parts, it is essential that the assembly be undertaken under conditions of

complete cleanliness and by competent personnel. New bearings should not be removed from their packages until the moment of assembly. Prior to fitting a new bearing, ascertain that the shaft has no rough edges or signs of hammering. During assembly bearings cannot be subjected to direct blows. The aid used to press or strike the bearing should be applied to the inner ring. Protect all machined parts against oxidation by applying a coating of vaseline or oil immediately after cleaning.

**STRIPPING OF WINDINGS** - This step requires great care to avoid knocking and/or denting of enclosure joints and, when removing the sealing compound from the terminal box, damage or cracking of the frame.

**IMPREGNATION** - Protect all frame threads by using appropriate bolts, and terminal box support fitting with a non-adhesive varnish (ISO 287 - ISOLASIL). Protective varnish on machined parts should be removed soon after treating with impregnation varnish. This operation should be carried out manually without using tools.

**ASSEMBLY** - Inspect all parts for defects, such as cracks, joint incrustations, damaged threads and other potential problems. Assemble using a rubber headed mallet and a bronze bushing after ascertaining that all parts are perfect by fitted. Bolts should be positioned with corresponding spring washers and evenly tightened.

**TESTING** - Rotate the shaft by hand while examining for any drag problems on covers or fastening rings.

**MOUNTING THE TERMINAL BOX** - Prior to fitting the terminal box all cable outlet on the frame should be sealed with a self extinguishible sponge compound (1st layer) and on Explosion Proof Motors an Epoxy resin (ISO 340) mixed with ground quartz (2nd layer).

Drying time for this mixture is two hours during which the frame should not be handled and cable outlets should be upwards. When dry, see that the outlets and areas around the cables are perfectly sealed. Mount the terminal box and paint the motor.

#### 4.3- MISCELLANEOUS RECOMMENDATIONS

- Any damaged parts (cracks, pittings in machined surfaces, defective threads) must be replaced and under no circumstances should attempt be made to recover them.
- Upon reassembling explosion proof motors IP(W) 55, the replacement of all seals is mandatory.

### SINGLE PHASE MOTORS

#### SINGLE PHASE ASYNCHRONOUS INDUCTION MOTORS:

**ADVANTAGES:**  
WEG single phase motors, totally enclosed fan cooled (degree of protection IP55) are highly resistant to bad weather, any external contamination and action and penetration of rodents, and they offer more additional advantages in relation to standard motors. The capacitors - start and run-supply superior power factor and high efficiency, offering significant energy saving. The energy saving obtained by using this new single phase motors can be calculated comparing the efficiency and power factor curves in order to know the investment payback. These motors are built with an efficient starting method. The centrifugal switch mounted on a rigid base is fitted with special steel helicoidal springs, resistant to fatigue, driven by counter-weights designed in such a way to ensure the closing and opening under minimum and maximum established speeds.

### FRACTIONAL MOTORS

#### FRACTIONAL ODP NEMA 48 AND 56 MOTORS:

**SINGLE PHASE:** Built with high starting torque which are suitable for heavy loads. They are supplied with starting capacitor.

**APPLICATIONS:** Compressors, pumps, industrial air conditioning equipment, general machines and tooling, other industrial and commercial components requiring high starting torque.

**THREE PHASE:** Designed with torque suitable to drive industrial machines as well as optimized breakdown torques to operate under instantaneous overload conditions.

**APPLICATIONS:** Compressors, pumps, fans, chippers and general use machines powered by three phase network and continuous duty.

#### THREE PHASE ODP FRACTIONAL MOTOR "JET PUMP"

This type of motor can be used where three phase power supply is applicable. It has high starting torque, and breakdown torque approximately 3 times the rated current.

#### FRACTIONAL ODP "JET PUMP" MOTOR - START CAPACITOR

It is a single phase motor designed with a main winding and a capacitor series connected with the auxiliary winding. The centrifugal switch disconnects the auxiliary winding when motor reaches about 80% of the synchronous speed. Then the motor operates continuously with the main winding. The start capacitor motors present high torques. The starting torque varies between 200 and 350% of the rated torque, and the breakdown torque between 200% and 300% of the rated torque. Based on these features, this type of motor is recommended for heavy starting load and it is used for the range of output up to 3HP (2.2kW).

**APPLICATIONS:** Water pumping systems by jet pumps, commercial and industrial pumps, domestic use pumps, centrifugal pumps and hydraulic pumps.

#### FRACTIONAL ODP MOTOR "JET PUMP PLUS" - SPLIT PHASE

It is a single phase motor built with two windings: main and starting auxiliary. The centrifugal switch disconnects the auxiliary winding when the motor reaches about 70% of the synchronous speed. Then the motor operates continuously with the main winding. The "Jet Pump Plus - Split Phase" has moderated torques. The starting torque varies between 150% and 200% of the rated torque, and the breakdown torque between 200% and 300% of the rated torque. It is a type of motor recommended for applications that require few starts and low starting torque.

These are the mechanical characteristics for this line of motors:

- Squirrel cage rotor
- Ball bearings
- 1045 steel shaft or stainless steel (optional)
- Feet and thermal protector (optional)
- CCW rotation direction
- Voltages: single-phase: 110V, 220V or 110/220V  
split-phase: without capacitor
- Standard painting is Red Oxid Primer.
- Degree of Protection is IP21.

## THREE PHASE MOTOR - PREMIUM HIGH EFFICIENCY

### Standard Features:

- Frequency: 60Hz and 50Hz
- Voltages: 220/380V, 380/660V, 440/760V or 220/380/440V
- Service Factor: 1.0
- Class of insulation: "F"
- Degree of Protection: IP55
- Design N (IEC 85)
- Speeds: 60Hz: 3600, 1800, 1200 and 900 rpm  
50Hz: 3000, 1500, 1000 and 750 rpm
- Temperature rise: below 80°C

### Optional Features:

- Class of insulation: "H"
- Degree of Protection: IP(W)55
- Thermal protection: Thermostats or thermistors
- Space heaters
- Routine and type test (IEC 34-2), witnessed or not.

### Optional Features on Request:

- Design: H
- Hazardous location motors
- Explosion proof motors
- Increased safety
- Marine duty motors

## THREE PHASE BRAKE MOTORS - Single Disc

### GENERAL DESCRIPTION:

The brake motor is composed of an induction motor coupled to a single disc brake forming an integral and compact unit. The induction motor is a totally enclosed fan cooled motor with the same mechanical and electrical performance of the WEG standard motors.

The brake is built with few movable parts which gives long life with reduced maintenance. The two faces of the brake pads create a large contact area which reduces the pressure over them, reduces the heating and the wear is minimum.

Besides, the brake is cooled by the same motor cooling.

The electromagnet drive coil, protected with epoxy resin, operates continuously with voltages varying 10% above and below the rated voltage. It is DC powered, supplied by a bridge rectifier made of silicon diodes and varistors which avoid sudden voltage peaks and allow a quick current switching off.

The DC power supply gives the brake a quicker and uniform operation.

### APPLICATIONS:

Brake motors are commonly used on: tooling-machines, sewing machines, packing machines, conveyors, bottle washing machines, winding machines, folding machines, hoists, rolling bridges, elevators, printing machines and others. In general terms, on equipment requiring quick stops based on safety, positioning and time saving factors.

### BRAKE OPERATION:

When motor is switched off from power supply, the control also interrupts the coil current and then the electromagnet stops operating. The pressure springs force the armature towards the motor non drive endshield. The braking pads, which are fitted in the braking disc, are compressed between the two friction surfaces, the armature and the endshield braking the motor until it stops.

The armature is pulled against the electromagnet frame by eliminating the spring resistance. Once they are free, the braking pads move axially in their fittings and they stay out of the friction area.

In this way, the braking is finished permitting the motor to start freely.

As an option, WEG can supply lining braking disc.

### INSTALLATION:

Brake motors can be mounted in any position as long as it is not subject to penetration of water, oil, abrasive dust, etc through the air inlet.

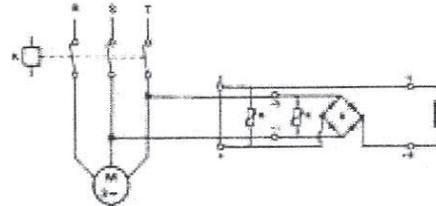
When normally mounted, the brake motor complies with Degree of Protection IP54 of IEC.

### CONNECTION DIAGRAM

The WEG Brakemotor allows 3 types of connection diagram supplying slow, medium and quick brakings.

#### a) Slow Braking

The feeding of the brake coil bridge rectifier is done directly from the motor terminals, without interruption, as shown below:

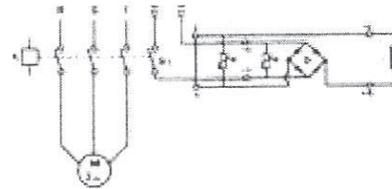


- D - Bridge rectifier
- R - Varistors
- L - Electromagnet coil
- K - Contactor

Fig. 1 - Connection diagram for slow braking

#### b) Medium Braking:

In this case a contact for interruption of the bridge rectifier feeding current in the AC circuit is fitted. It is essential that this be a NO auxiliary contact of the contactor itself or motor magnetic switch in order to allow switch on and off of brake and motor simultaneously.



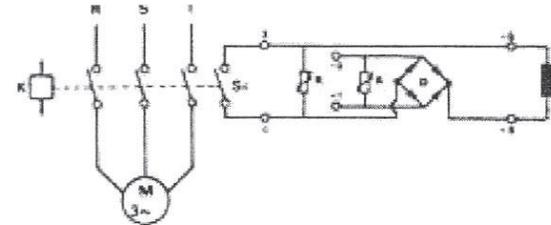
- D - Bridge rectifier
- R - Varistors
- L - Electromagnet coil
- K - Contactor
- S1 - NO auxiliary contact.

Fig. 2 - Connection diagram for medium braking

#### c) Quick Braking:

A contact for interruption is directly fitted in one of the coil feeding cables in the DC circuit.

It is essential that this is a NO auxiliary contact of the contactor itself or motor magnetic switch.



- D - Bridge rectifier
- R - Varistors
- L - Electromagnet coil
- K - Contactor
- S1 - NO auxiliary contact

Fig. 3 - Connection Diagram for quick braking.

## BRAKE COIL FEEDING:

The medium and quick braking allow two feeding alternatives:

a) Through motor terminals:

Motor 220/380V: Connect motor terminals 2 and 6 to terminals 1 and 2 of the bridge rectifier.

Motor 220/380/440/760V: connect motor terminals 1 and 4 to terminals 1 and 2 of the bridge rectifier.

Two speed motor 220V.

- High Speed: Connect motor terminals 4 and 6 to terminals 1 and 2 of the bridge rectifier.

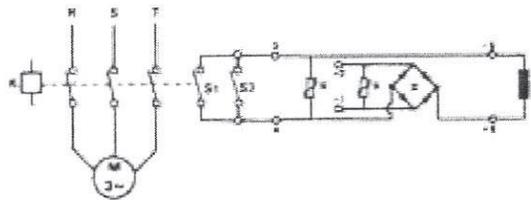
- Low Speed: Connect motor terminals 1 and 2 to terminals 1 and 2 of the bridge rectifier.

- Motor 440V: Connect two of the motor terminals to terminals 1 and 2 of the bridge rectifier.

b) Independent Feeding:

For motor built for other voltages, connect the brake coil terminals to the independent 24ADC power supply. However, always with simultaneous interruption with motor feeding. With independent feeding it is possible to electrically release the brake, as shown in Fig. 4.

D - Bridge rectifier



R - Varistors

L - Electromagnet coil

K - Contactor

S1 - NO auxiliary contact

S2 - Electric release switch

Fig. 4 - Connection Diagram for independent feeding.

## BRAKING TORQUE

It is possible to obtain a smoother motor stop by reducing the braking torque value. This is done by removing the brake pressure springs.

### IMPORTANT:

The springs must be removed in such a way the remaining ones stay symmetrically disposed, avoiding in this way any friction even after operating the motor, and uneven wear of the braking pads.

## BRAKE MAINTENANCE

As they are of simple construction, brake motors require low maintenance. What it is required to do is a periodical airgap adjustment.

It is recommended to clean internally the brake motor in cases of penetration of water, dust, etc. or at the time motor periodical maintenance is carried out.

### AIRGAP ADJUSTMENT

WEG brake motors are supplied with an initial factory set air gap, that is, a gap between the armature and the frame with the brake energized, pre-adjusted at the factory to the minimum value as

indicated in Table 1.

TABLE 1

FRAME	Initial (factory set) Air gap (mm)	Maximum air gap (mm)
71	0.2 - 0.3	0.6
80	0.2 - 0.3	0.6
90 S - 90 L	0.2 - 0.3	0.6
100 L	0.2 - 0.3	0.6
112 M	0.2 - 0.3	0.6
132 S - 132 M	0.3 - 0.4	0.8
160M - 160L	0.3 - 0.4	0.8

Due to the natural wear of the braking pads, the size of the air gap gradually increases without affecting the performance of the brake until it reaches the maximum value shown on Table 1.

To adjust the air gap to its initial value, proceed as follows:

a - Unfasten the bolts and remove the fan cover

b - Remove the protective band

c - Measure the air gap in three places, near the adjustment screws, using a set of feeler gauges.

d - If the width of the gap is equal to or greater than the maximum indicated, or if the three readings are not the same, proceed to adjust as follows:

1) Loosen the fixing bolts and the adjustment screws.

2) Adjust the air gap to the initial value indicated in Table 1 by equally adjusting the three adjustment screws.

The value of the air gap must be uniform at the three measured points, and be such that the feeler gauge corresponding to the minimum gap, moves freely and the feeler gauge corresponding to the maximum gap cannot be introduced to any of the measured points.

3) Adjust the adjustment screws until the ends touch the motor endshield. Do not adjust any further.

4) Tighten the fixing bolts.

5) Re-check the air gap to ensure the measurements are as per Point 2 above.

6) Replace the protective band.

7) Replace the fan cover

### Periodical Inspection and Re-adjustment of the air gap

The time interval between periodical adjustments of the air gap, that is, the number of braking operations until the wear of pads leads the air gap to its maximum value depends on the load, the frequency of operations, and the condition of the working environment, etc. The ideal interval can only be determined by closely observing the performance of the brake motor during the first months of its operating under actual working conditions. As a guide, Table 2 indicates the typical values which can be expected under normal working conditions. The wear of the brake linings depends on the moment of inertia of the load.

## EXPLOSION PROOF MOTORS

The motors are designed to operate in ambients considered as dangerous.

These are areas where inflammable gases, steams or combustible gas are or can be in the environment continuous, intermittent or periodically in amount enough to produce explosive mixture or inflammable originated from seepage, repairs or maintenance.

Due to this, the design and manufacturing criteria of the motor components are differentiated from standard motor lines, specially in reference to mechanical aspects.

This motor line follows the recommendations of the following standards: ABNT (Brazilian Association of Technical Standards), IEC (International Electrical Code), UL (Underwriters Laboratories Inc.), CSA (Canadian Standards Association).

The special features of an explosion proof motor are the following:

- Mechanical resistance strong enough to withstand the impact of an internal explosion.

- Dimensional geometric tolerances and controlled rugosity level to avoid passage of flames to the outside and to control the amount of

gases exchanged between inside and outside of the motor. Below you will find an explanation of the features which make a motor to become explosion proof:

### CONSTRUCTION FEATURES:

The features described above, by themselves, do not guarantee that the motor meets the Standard specifications. Then suitable

<b>MECHANICAL RESISTANCE</b>	<ul style="list-style-type: none"><li>- Cast iron rugged construction (walls are thicker); corrosion resistant.</li><li>- Fixation of endshields made with tempered internally hexangled bolts, with high resistance to traction.</li><li>- More bolts to fix the endshield</li></ul>
<b>TIGHTNESS</b>	<ul style="list-style-type: none"><li>- Use of epoxy base sealing compound between frame and terminal box</li><li>- Fitting between endshields and frame with larger dimensions in comparison to standard motors, as per IEC 34-7 Standard.</li><li>- Use of an internal DE and NDE bearing cap.</li><li>- Touching surface between T-box and frame and T-box and endshield are machined (which does not require rubber sealing ring).</li></ul>

procedures and tools are required. Therefore, explosion proof motors can not be assembled or serviced by personnel not authorized.

#### WARNING:

The operation place of an electric explosion proof motor is harmful to life.

**5 - ABNORMAL SITUATIONS DURING OPERATION**  
**ANALYSIS OF SOME ABNORMAL SITUATIONS AND**  
**POSSIBLE CAUSES ON ELECTRIC MOTORS:**

ABNORMAL SITUATION	POSSIBLE CAUSES
MOTOR DOES NOT START	<ul style="list-style-type: none"> <li>- Lack of voltage on motor terminals</li> <li>- Low feeding voltage</li> <li>- Wrong connection</li> <li>- Incorrect numbering of leads</li> <li>- Excessive load</li> <li>- Open stationary switch</li> <li>- Damaged capacitor</li> <li>- Auxiliary coil interrupted</li> </ul>
LOW STARTING TORQUE	<ul style="list-style-type: none"> <li>- Incorrect internal connection</li> <li>- Failed rotor</li> <li>- Rotor out of center</li> <li>- Voltage below the rated voltage</li> <li>- Frequency below the rated frequency</li> <li>- Frequency above the rated frequency</li> <li>- Capacitance below that specified</li> <li>- Capacitors series connected instead of parallel</li> </ul>
LOW BREAKDOWN TORQUE	<ul style="list-style-type: none"> <li>- Failed rotor</li> <li>- Rotor with bar inclination above that specified</li> <li>- Rotor out of center</li> <li>- Voltage below the rated voltage</li> <li>- Run capacitor below that specified</li> </ul>
HIGH NO LOAD CURRENT	<ul style="list-style-type: none"> <li>- Air gap above that specified</li> <li>- Voltage above that specified</li> <li>- Frequency below that specified</li> <li>- Wrong internal connection</li> <li>- Rotor out of center</li> <li>- Rotor rubbing on the stator</li> <li>- Defective bearing</li> <li>- Endbells fitted under pressure or badly fitted</li> <li>- Steel magnetic lamination without treatment</li> <li>- Run capacitor out of that specified</li> <li>- Stationary/centrifugal switch do not open</li> </ul>
HIGH CURRENT UNDER LOAD	<ul style="list-style-type: none"> <li>- Voltage out of the rated voltage</li> <li>- Overload</li> <li>- Frequency out of the rated frequency</li> <li>- Belts excessively tightened</li> <li>- Rotor rubbing on the stator</li> </ul>
LOW INSULATION RESISTANCE	<ul style="list-style-type: none"> <li>- Damaged slot insulating materials</li> <li>- Cut leads</li> <li>- Coil head touching the motor frame</li> <li>- Humidity or chemical agents present</li> <li>- Dust on the winding</li> </ul>

ABNORMAL SITUATION	POSSIBLE CAUSES
BEARING HEATING	<ul style="list-style-type: none"> <li>- Excessive amount of grease</li> <li>- Excessive axial thrust or radial force of the belt</li> <li>- Bent shaft</li> <li>- Loose endbells or out of center</li> <li>- Lack of grease</li> <li>- Foreign bodies in the grease</li> </ul>
MOTOR OVERHEATING	<ul style="list-style-type: none"> <li>- Obstructed ventilation</li> <li>- Smaller size fan</li> <li>- Voltage or frequency out of that specified</li> <li>- Rotor rubbing on the shaft</li> <li>- Failed rotor</li> <li>- Stator with insufficient impregnation</li> <li>- Overload</li> <li>- Defective bearing</li> <li>- Consecutive starts</li> <li>- Air gap below that specified</li> <li>- Improper run capacitor</li> <li>- Wrong connections</li> </ul>
HIGH NOISE LEVEL	<ul style="list-style-type: none"> <li>- Unbalancing</li> <li>- Bent shaft</li> <li>- Incorrect alignment</li> <li>- Rotor out of center</li> <li>- Wrong connections</li> <li>- Foreign bodies in the air gap</li> <li>- Foreign bodies between fan and fan cover</li> <li>- Worn bearings</li> <li>- Improper slots combination</li> <li>- Inadequate aerodynamic</li> </ul>
EXCESSIVE VIBRATION	<ul style="list-style-type: none"> <li>- Rotor out of center</li> <li>- Unbalance power supply voltage</li> <li>- Failed rotor</li> <li>- Wrong connections</li> <li>- Unbalanced rotor</li> <li>- Bearing housing with excessive clearance</li> <li>- Rotor rubbing on the stator</li> <li>- Bent shaft</li> <li>- Stator laminations loose</li> <li>- Use of fractional groups on run capacitor single-phase winding</li> </ul>

## SERVICE

Leaving the factory in perfect conditions is not enough for the electric motor. Although the high quality standard assured by Weg for several years of operation, there will be a day when the motor will require service: This can be corrective, preventive or orientative.

Weg gives great importance to service as this makes part of a successful sale.

Weg service is immediate and efficient.

At the moment you buy a Weg electric motor, you are also receiving an incomparable know-how developed in the company and you will count on our authorized services during the whole motor operating life, carefully selected and strategically located in more than fifty countries.

# **OPERATING AND MAINTENANCE INSTRUCTIONS**

## **Christmas Pump Station**

### **City of Harriman, Tennessee**

Specification Section: **11315 – Submersible Sewage Sump Pump**

Equipment Item: **Sump Pump**

Manufacturer: **Barnes®**

Model: **EHV412AT**

Owner: **City of Harriman, Tennessee**

Contractor: **Southern Constructors, Inc.  
1150 Maryville Pike  
Knoxville, TN 37920**

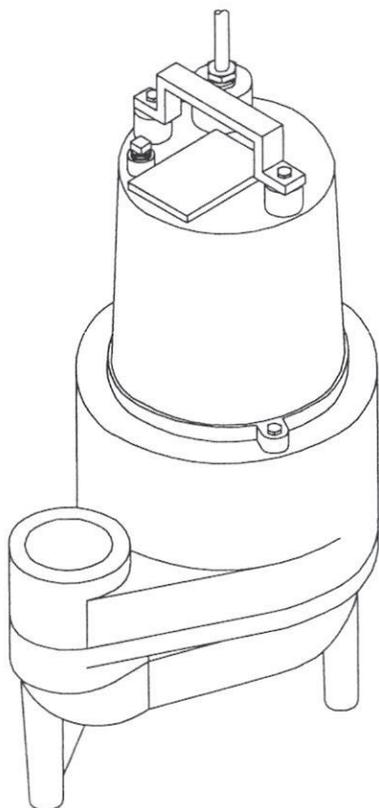
Engineer: **GRW, Inc.  
404 BNA Suite 201  
Nashville, TN 37217**

Equipment Supplier: **Southern Sales Company, Inc.  
2929 Kraft Drive  
Nashville, TN 37204  
Phone: 615-254-0066  
Fax: 615-254-0791**

Manufacturer: **Crane Pumps & Systems  
420 Third Street  
Piqua, Ohio 45356**

# BARNES®

## INSTALLATION MANUAL Submersible Effluent & Sewage Ejector



**Series: SEV412  
EHV412**

**1/2 HP, 3450 RPM, 60 Hz.**

**IMPORTANT!**

*Read all instructions in this manual before operating pump.  
As a result of Crane Pumps & Systems, Inc., constant product improvement program,  
product changes may occur. As such Crane Pumps & Systems reserves the right to  
change product without prior written notification.*

**CRANE**

A Crane Co. Company

PUMPS & SYSTEMS

420 Third Street  
Piqua, Ohio 45356  
Phone: (937) 778-8947  
Fax: (937) 773-7157  
www.cranepumps.com

83 West Drive, Bramton  
Ontario, Canada L6T 2J6  
Phone: (905) 457-6223  
Fax: (905) 457-2650



Form No. 102075-Rev. V

# SAFETY FIRST!

Please Read This Before Installing Or Operating Pump. This information is provided for **SAFETY** and to **PREVENT EQUIPMENT PROBLEMS**. To help recognize this information, observe the following symbols:



**IMPORTANT!** Warns about hazards that can result in personal injury or indicates factors concerned with assembly, installation, operation, or maintenance which could result in damage to the machine or equipment if ignored.

**CAUTION!** Warns about hazards that can or will cause minor personal injury or property damage if ignored. Used with symbols below.

**WARNING!** Warns about hazards that can or will cause serious personal injury, death, or major property damage if ignored. Used with symbols below.



Hazardous fluids can cause fire or explosions, burns or death could result.



Extremely hot - Severe burns can occur on contact.



Biohazard can cause serious personal injury.



Hazardous fluids can cause hazardous pressure, eruptions or explosions could cause personal injury or property damage.

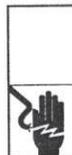


Rotating machinery Amputation or severe laceration can result.



Hazardous voltage can shock, burn or cause death.

Only qualified personnel should install, operate and repair pump. Any wiring of pumps should be performed by a qualified electrician.



**WARNING!** To reduce risk of electrical shock, pumps and control panels must be properly grounded in accordance with the National Electric Code (NEC) or the Canadian Electrical Code (CEC) and all applicable state, province, local codes and ordinances. Improper grounding voids warranty.



**WARNING!** To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing. Lock out power and tag.



**WARNING!** Operation against a closed discharge valve will cause premature bearing and seal failure on any pump, and on end suction and self priming pump the heat build may cause the generation of steam with resulting dangerous pressures. It is recommended that a high case temperature switch or pressure relief valve be installed on the pump body.



**CAUTION!** Never operate a pump with a plug-in type power cord without a ground fault circuit interrupter.



**CAUTION!** Pumps build up heat and pressure during operation-allow time for pumps to cool before handling or servicing.



**WARNING!** Do not pump hazardous materials (flammable, caustic, etc.) unless the pump is specifically designed and designated to handle them.



**CAUTION!** Do not block or restrict discharge hose, as discharge hose may whip under pressure.



**WARNING!** Do not wear loose clothing that may become entangled in moving parts.



**WARNING!** Keep clear of suction and discharge openings. **DO NOT** insert fingers in pump with power connected.



Always wear eye protection when working on pumps.



Make sure lifting handles are securely fastened each time before lifting. **DO NOT** operate pump without safety devices in place. Always replace safety devices that have been removed during service or repair. Secure the pump in its operating position so it can not tip over, fall or slide.



**DO NOT** exceed manufacturers recommendation for maximum performance, as this could cause the motor to overheat.



**DO NOT** remove cord and strain relief. **DO NOT** connect conduit to pump.



**WARNING!** Cable should be protected at all times to avoid punctures, cut, bruises and abrasions. Inspect frequently. Never handle connected power cords with wet hands.



**WARNING!** To reduce risk of electrical shock, all wiring and junction connections should be made per the NEC or CEC and applicable state or province and local codes. Requirements may vary depending on usage and location.



**WARNING!** Submersible Pumps are not approved for use in swimming pools, recreational water installations decorative fountains or any installation where human contact with the pumped fluid is common.



**WARNING!** Products returned must be cleaned, sanitized, or decontaminated as necessary prior to shipment, to insure that employees will not be exposed to health hazards in handling said material. All Applicable Laws And Regulations Shall Apply.



Bronze/brass and bronze/brass fitted pumps may contain lead levels higher than considered safe for potable water systems. Lead is known to cause cancer and birth defects or other reproductive harm. Various government agencies have determined that leaded copper alloys should not be used in potable water applications. For non-leaded copper alloy materials of construction, please contact factory.



Crane Pumps & Systems, Inc. is not responsible for losses, injury, or death resulting from a failure to observe these safety precautions, misuse or abuse of pumps or equipment.

Other brand and product names are trademarks or registered trademarks of their respective holders.

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1998, 2000, 2001, 2002, 2003, 8/05, 2/06, 9/06

Alteration Rights Reserved

## PUMP SPECIFICATIONS - SEV412 SERIES:

DISCHARGE..... 2" NPT, Female, Vertical  
 LIQUID TEMPERATURE .... 77°F (25°C) Continuous  
 MOTOR HOUSING ..... Cast Iron  
 PUMP BODY ..... Cast Iron  
 IMPELLER:

*Design* ..... Multi-vane, vortex  
*Material* ..... Cast Iron

SHAFT..... 416 Stainless Steel

O-RINGS ..... Buna-N

HARDWARE ..... 300 Series Stainless Steel

PAINT ..... Air dry enamel

SEAL *Design*..... Single Mechanical, Oil Filled reservoir  
*Material* ..... Carbon/Ceramic/Buna-N

CORD ENTRY ..... 20 Ft. (6m) Quick disconnect cord with plug, pressure grommet for sealing and strain relief.

UPPER BEARING:

*Design*..... Single Row, Ball, Oil Lubricated  
*Load*..... Radial

LOWER BEARING:

*Design*..... Single Row, Ball, Oil Lubricated  
*Load*..... Radial & Thrust

MOTOR: *Design*..... Oil Filled  
*Insulation* ..... Class B

SINGLE PHASE..... Permanent Split Capacitor (PSC)  
 Includes Thermal Overload Protection in motor

LEVEL CONTROLS:

SEV412..... None

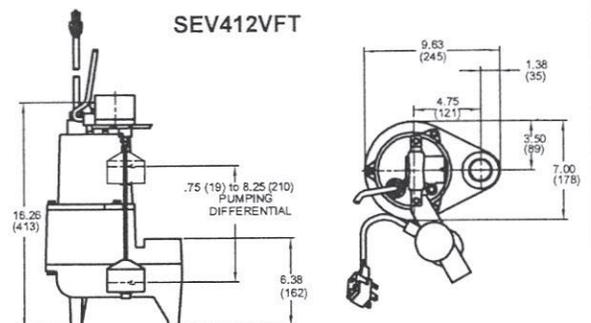
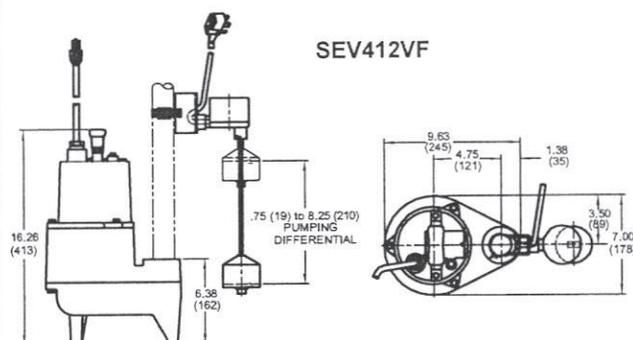
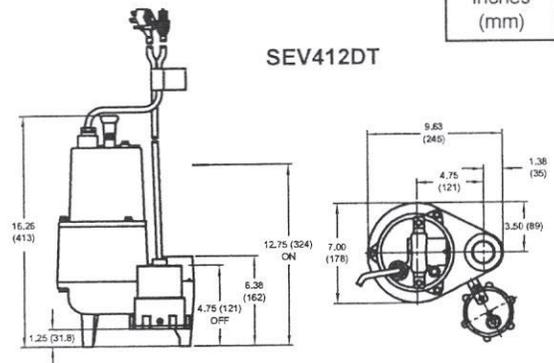
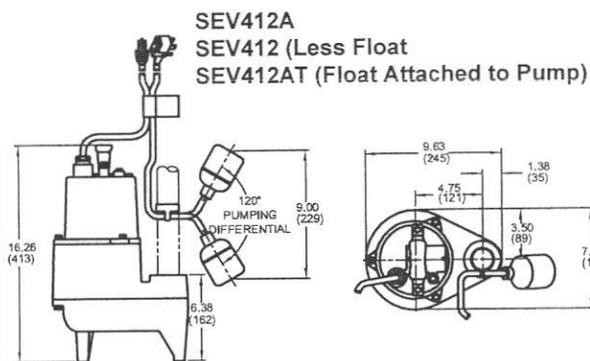
SEV412A ..... Wide Angle, PVC, Mechanical, 20 Ft. (6m) Cord w/Piggy-back plug N/O, Pipe Mounted

SEV412AT ..... Wide Angle, PVC, Mechanical, 20 Ft. (6m) Cord w/Piggy-back plug N/O, Pump Mounted

SEV412VF ..... Vertical Float, PVC, Snap Action, 20 Ft. (6m) Cord.w/Piggy-back plug OFF Point only is Adjustable

SEV412DT ..... Diaphragm Switch, Pressure Operated, Snap Action, Normally Open, 20 Ft. (6m) Cord

OPTIONAL EQUIPMENT.... Seal Material, Additional Cord



### IMPORTANT !

- 1.) PUMP MAY BE OPERATED "DRY" FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
- 2.) THIS PUMP IS APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION II HAZARDOUS LOCATIONS.
- 3.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
- 4.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.

## PUMP SPECIFICATIONS - EHV412 SERIES:

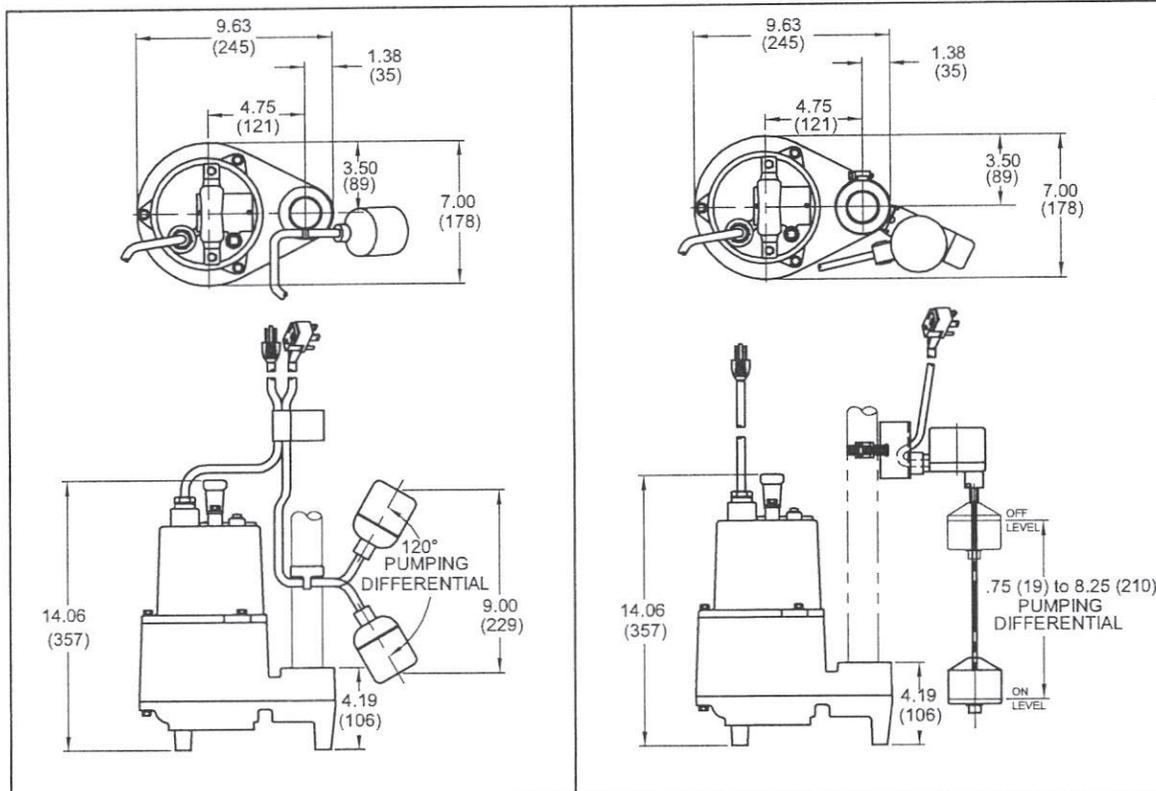
**DISCHARGE**..... 2" NPT, Female, Vertical  
**LIQUID TEMPERATURE** .... 77°F (25°C) Continuous  
**MOTOR HOUSING** ..... Cast Iron  
**PUMP BODY**..... Cast Iron  
**IMPELLER:**  
     *Design* ..... Multi-Vane, Vortex  
     *Material*..... Cast Iron  
**SHAFT**..... 420 Stainless Steel  
**O-RINGS** ..... Buna-N  
**HARDWARE** ..... 300 Series Stainless Steel  
**PAINT** ..... Air dry enamel  
**SEAL**     *Design*..... Single Mechanical, Oil Filled reservoir  
           *Material*..... Carbon/Ceramic/Buna-N  
                     Hardware - 300 series stainless steel  
**CORD ENTRY**..... 20 Ft. (6m) Quick disconnect cord  
                     with plug, pressure grommet for  
                     sealing and strain relief.  
**UPPER BEARING:**  
     *Design*..... Single Row, Ball, Oil Lubricated  
     *Load*..... Radial

**LOWER BEARING:**  
     *Design*..... Single Row, Ball, Oil Lubricated  
     *Load*..... Radial & Thrust  
**MOTOR:**     *Design*..... Oil Filled  
                   *Insulation* ..... Class B  
**SINGLE PHASE**..... Permanent Split Capacitor (PSC)  
                     Includes Thermal Overload  
                     Protection in motor  
**LEVEL CONTROLS:**  
     EHV412 ..... None  
     EHV412A..... Wide Angle, PVC, Mechanical,  
                     20 Ft. (6m) Cord w/Piggy-back plug  
                     N/O, Pipe Mounted  
     EHV412AT ..... Wide Angle, PVC, Mechanical,  
                     20 Ft. (6m) Cord w/Piggy-back plug  
                     N/O, Pump Mounted  
     EHV412VF ..... Vertical Float, PVC, Snap Action,  
                     20 Ft. (6m) Cord w/Piggy-back plug  
                     OFF Point only is Adjustable  
**OPTIONAL EQUIPMENT**.... Seal Material, Additional Cord

EHV412A  
 EHV412 (Less Float)  
 EHV412AT (Float Attached to Pump)

EHV412VFT

inches  
 (mm)



### IMPORTANT !

- 1.) PUMP MAY BE OPERATED "DRY" FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
- 2.) THIS PUMP IS APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION II HAZARDOUS LOCATIONS.
- 3.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
- 4.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.

## SECTION B: GENERAL INFORMATION

### B-1) To The Purchaser:

Congratulations! You are the owner of one of the finest pumps on the market today. Barnes® Pumps are products engineered and manufactured of high quality components. Over one hundred years of pump building experience along with a continuing quality assurance program combine to produce a pump which will stand up to the toughest applications.

Check local codes and requirements before installation. Servicing should be performed by knowledgeable pump service contractors or authorized service stations.

The pump is packaged ready for installation and no connections or adjustments are necessary except for attaching discharge piping and plugging in service cord.

### B-2) Receiving:

Upon receiving the pump, it should be inspected for damage or shortages. If damage has occurred, file a claim immediately with the company that delivered the pump. If the manual is removed from the crating, do not lose or misplace.

### B-3) Storage:

**Short Term-** Barnes Pumps are manufactured for efficient performance following long inoperative periods in storage. For best results, pumps can be retained in storage, as factory assembled, in a dry atmosphere with constant temperatures for up to six (6) months.

**Long Term-** Any length of time exceeding six (6) months, but not more than twenty four (24) months. The units should be stored in a temperature controlled area, a roofed over walled enclosure that provides protection from the elements (rain, snow, wind blown dust, etc.), and whose temperature can be maintained between +40 deg. F and +120 deg. F. Pump should be stored in its original shipping container and before initial start up, rotate impeller by hand to assure seal and impeller rotate freely.

### B-4) Service Centers:

For the location of the nearest Barnes Service Center, check your Barnes representative or Crane Pumps & Systems, Inc., Service Department in Piqua, Ohio, telephone (937) 778-8947 or Crane Pumps & Systems Canada, Inc., Bramton, Ontario, (905) 457-6223.

## SECTION C: INSTALLATION

### C-1) Location:

These pumping units are self-contained and are recommended for use in a sump or basin. The sump or basin shall be vented in accordance with local plumbing codes. This pump is designed to pump effluent or wastewater, nonexplosive and noncorrosive liquids and shall **NOT** be installed in locations classified as hazardous in accordance with the National Electrical Code (NEC),

ANSI/NFPA 70 or the Canadian Electrical Code. Never install the pump in a trench, ditch, or hole with a dirt bottom; the legs will sink into the dirt and the suction will become plugged.

### C-1.1) Submergence:

The pump should always be operated in the submerged condition. The minimum sump liquid level should never be less than A Dimension, A = 6.50 inches on SEV Series and A=4.50 inches on EHV Series above the pump bottom. The recommended level should not drop below the top of the motor housing (see Fig. 1).

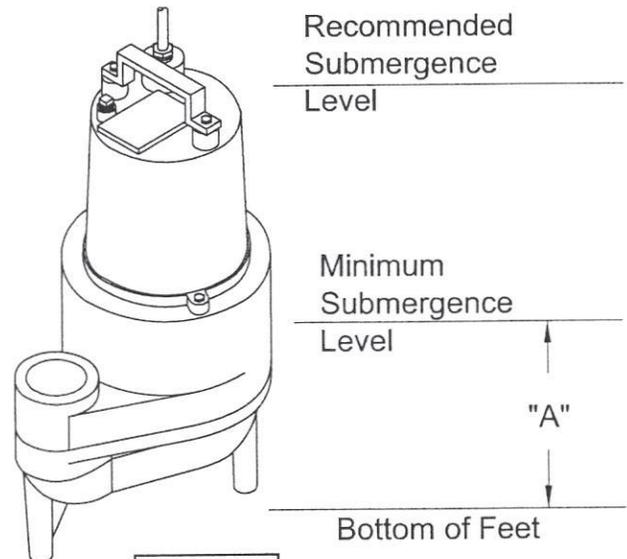


FIGURE 1

### C-2) Discharge:

Discharge piping should be as short as possible. Both a check valve and a shut-off valve are recommended for each pump being used. The check valve is used to prevent backflow into the sump. Excessive backflow can cause flooding and/or damage to the pump. The shut-off valve is used to stop system flow during pump or check valve servicing.

### C-3) Liquid Level Controls

Figure 2 shows a typical installation for any submersible pump using a level control mounted to the discharge piping with a piggy-back plug.

### General Comments:

- 1) Never work in the sump with the power on.
- 2) Level controls are factory set for a pumping differential of 9 inches. If that is the cycle desired, simply circle the discharge pipe with the pipe mounting strap, feed the end through the worm drive, and tighten with a screwdriver. Be certain that the level control cannot hang up or foul in its swing. Also, make certain the pump impeller is still submerged when the level control is in the "OFF" mode.

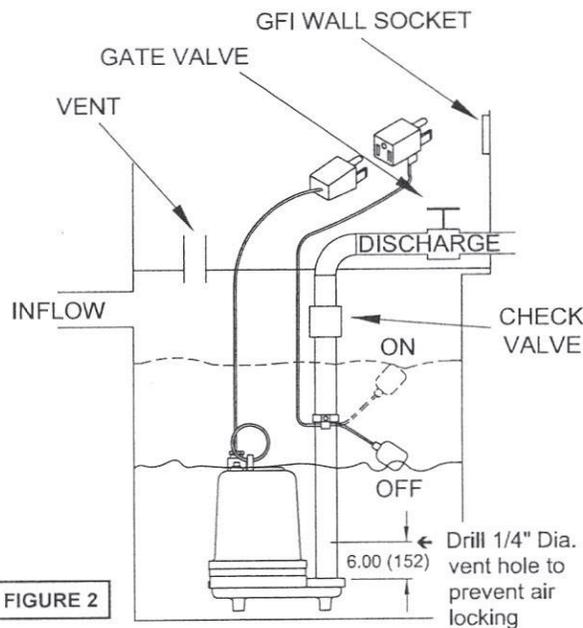


FIGURE 2

- 3) If a higher pump differential is needed, grip the cord near the neck of the float, then using the other hand, exert a steady force on the lower edge of the cable clamp. The cable clamp should slide up to the new pivot point. Attach the level control to the discharge hose in the manner described above.
- 4) Plug the level control plug into the GFI receptacle, then plug the pump into the piggyback plug. One cycle of operation should be observed, so that any potential problems can be corrected.
- 5) It is recommended that the float should be set to insure that the sump well liquid level never drops below the top of the motor housing or a minimum level of 4.50 inches on EHV Series and 6.50 inches on SEV Series above the pump bottom.

6.) Figure 3 shows a typical connection for pumps with the wide angle float and piggy-back plug, for manual and automatic operations.

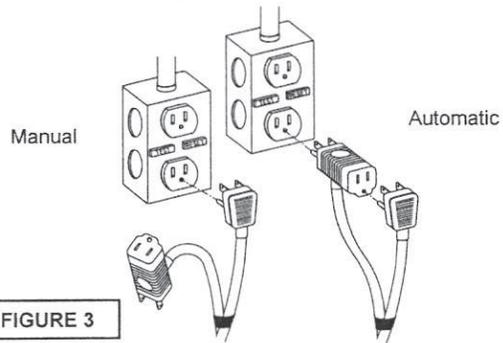


FIGURE 3

**Automatic** - Plug float cord into GFI outlet, then plug pump cord into float cord.

**Manual** - Plug pump cord directly into GFI outlet.

#### C-4) Electrical Connections:

##### C-4.1) Power Cable:

The cord assembly mounted to the pump must not be modified in any way except for shortening to a specific application. Any splice between the pump and the control panel must be made in accordance with local electric codes. It is recommended that a junction box, if used, be mounted outside the sump or be of at least NEMA 4 (EEMAC-4) construction if located within the wet well. Do not use the power cable to lift pump.



**WARNING!** - The white wire is not a neutral or ground lead, but a power carrying conductor.

MODEL NO	HP	VOLT/PH	Hz	RPM (Nom)	NEMA START CODE	FULL LOAD AMPS	CORD SIZE	CORD TYPE	WINDING RESISTANCE MAIN - START
SEV412	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
SEV412A	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
SEV412VF	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
SEV412AT	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
SEV412VFT	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
SEV412DT	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
EHV412	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
EHV412A	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
EHV412VF	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
EHV412AT	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43
EHV412VFT	0.5	115/1	60	3450	H	10.50	14/3	SJTOW	3.5 - 43

Winding Resistance  $\pm$  5%.

Pump rated for operation at  $\pm$  10% voltage at motor.

**C-4.2) Overload Protection:**

**Single Phase** - The type of in-winding overload protector used is referred to as an inherent overheating protector and operates on the combined effect of temperature and current. This means that the overload protector will trip out and shut the pump off if the windings become too hot, or the load current passing through them becomes too high. It will then automatically reset and start the pump up after the motor cools to a safe temperature. In the event of an overload, the source of this condition should be determined and rectified immediately. **DO NOT LET THE PUMP CYCLE OR RUN IF AN OVERLOAD CONDITION OCCURS !**

If current through the temperature sensor exceeds the values listed, an intermediate control circuit relay must be used to reduce the current or the sensor will not work properly.

TEMPERATURE SENSOR ELECTRICAL RATINGS		
Volts	Continuous Amperes	Inrush Amperes
110-120	3.00	30.0

**C-4.3) Wire Size:**

Consult a qualified electrician for proper wire size. See table for electrical information.

**SECTION D: SERVICE AND REPAIR**

**NOTE:** All item numbers ( ) refer to Figure 8.

**D-1) Lubrication:**

Anytime the pump is removed from operation and at least every twelve (12) months, the cooling oil in the motor housing must be checked visually for oil level and contamination.

**D-1.1) Checking Oil:**

To check oil, set unit upright. Remove pipe plug. With a flashlight, visually inspect the oil in the motor housing to make sure it is clean, clear and that the oil level is above all internal componentry. If oil appears satisfactory, replace pipe plug. If oil is low or appears contaminated, test oil as per section D-1.2

**D-1.2) Testing Oil:**

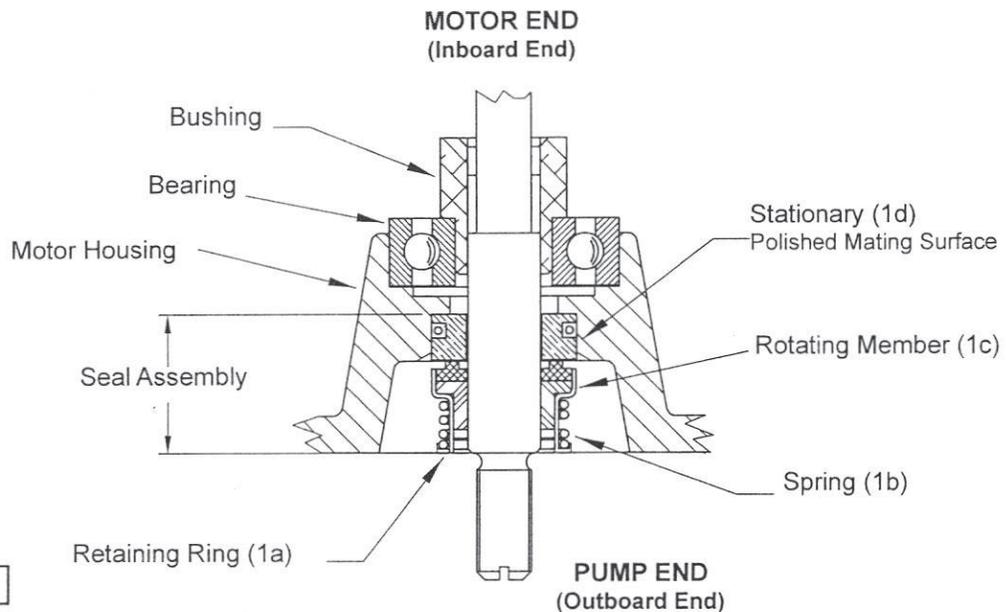
1. Place pump on its side, remove pipe plug and drain oil into clean, dry container.
2. Check oil for contamination using an oil tester with a range to 30 kilovolts breakdown.
3. If oil is found to be clean and uncontaminated (measures above 15 kilovolts breakdown), refill the motor housing with oil.
4. If oil is found to be dirty or contaminated (measures below 15 kilovolts breakdown), then the pump must be carefully inspected for leaks at the shaft seal (1), cord inlet (2), square ring and pipe plug before refilling with oil.

**D-1.3 Replacing Oil in Motor Housing:**

Drain all oil from motor housing and dispose of properly. Refill with 32 ounces of new cooling oil as per Table 1. An air space must remain in the top of the motor housing to compensate for air expansion. Set unit upright and fill only until oil level from top of pipe plug boss is 3" ± 1/4".



**WARNING ! - DO NOT overfill oil. Overfilling of motor housing with oil can create excessive and dangerous hydraulic pressure which can destroy the pump and create a hazard. Overfilling oil voids warranty.**



**FIGURE 4**

TABLE 1 - COOLING OIL - Dielectric	
SUPPLIER	GRADE
BP	Enerpar SE100
Conoco	Pale Paraffin 22
Mobile	D.T.E. Oil Light
G & G Oil	Circulating 22
Imperial Oil	Voltesso-35
Shell Canada	Transformer-10
Texaco	Diala-Oil-AX
Woco	Premium 100

### E-1 SHAFT SEAL SERVICE:

Disconnect power, remove screws and lockwashers, and vertically lift motor assembly from body. Clean out body if necessary. Clean and examine impeller for pitting or wear. The impeller is threaded onto the shaft and to remove, unscrew impeller, holding shaft with a large screwdriver.



**CAUTION:** - Handle seal parts with extreme care. **DO NOT** scratch or mar lapped surfaces.

To expose shaft seal (1) disassemble volute and impeller as outlined in above paragraph. Remove rotating member (1b) from shaft (See Fig. 4). Examine all seal parts and especially contact faces. Inspect seal for signs of wear such as uneven wear pattern on stationary members, chips and scratches on either seal face. **DO NOT** interchange seal components, replace the entire shaft seal (1). If replacing seal, remove stationary (1a) by prying out with flat screw driver.

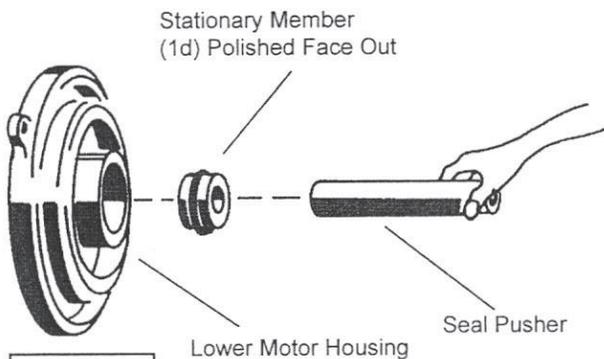


FIGURE 5

Clean and oil seal cavities in lower motor housing. Lightly oil (**DO NOT use grease**) outer surface of stationary member (1a). Press stationary member (1a) firmly into lower motor housing, using a seal pusher, nothing but the seal pusher is to come in contact with seal face (See Fig. 5).



**IMPORTANT!** - **DO NOT** hammer on the seal pusher- it will damage the seal face.

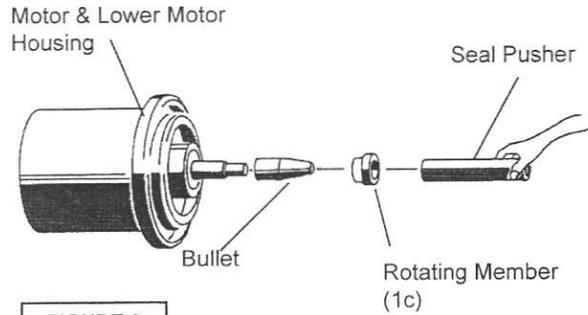


FIGURE 6

Make sure the stationary member is in straight. Slide a bullet (see parts list-seal tool kit) over motor shaft. Lightly oil (**DO NOT use grease**) shaft, bullet and inner surface of bellows on rotating member (1b) See Fig. 6. With lapped surface of rotating member (1b) facing inward toward stationary member (1a), slide rotating member (1b) over bullet and onto shaft, using seal pusher, until lapped faces of (1a) and (1b) are together (See Fig. 4).

It is extremely important to keep seal faces clean during assembly. Dirt particles lodged between these faces will cause the seal to leak. Place spring (1b) over shaft and in place on rotating member (1c), making sure it is seated. Slide retaining ring (1a) over shaft and let rest on spring (1b).

Before installing impeller, inspect threads on shaft and impeller to assure that they are clean. Apply a thread-locking compound to shaft threads and screw impeller onto shaft and tighten. Rotate impeller to check for binding. Install motor housing assembly on pump body. Apply thread locking compound to each cap screw, thread into body with lockwashers, and torque to 11 ft. lbs. Check for free rotation of impeller. Assemble impeller and volute replace oil

SINGLE PHASE - 115 VOLTS  
MANUAL & AUTOMATIC

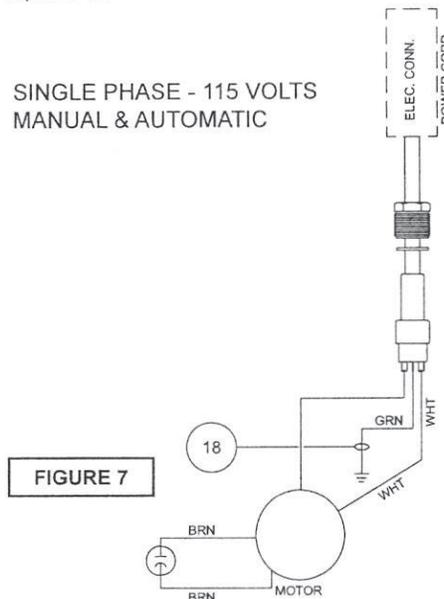


FIGURE 7

**SECTION: F REPLACEMENT PARTS**

**F-1 ORDERING REPLACEMENT PARTS:**

When ordering replacement parts, ALWAYS furnish the following information:

1. Pump Part Number
2. Pump model number
3. Pump date code

<b>BARNES</b> 3		BARNES PUMPS, INC. Mansfield, Ohio		THERMALLY PROTECTED	
MODEL	PART No.	MAX AMB. TEMP. 25°C			
2 SEV412	101292	INS. CLASS: B			
SEV412A	101293	HP: 0.5			
SEV412VF	101294	FLA: 10.5			
SEV412AT	103544	RPM: 3450			
SEV412VFT	110404	VOLTS: 115			
		HZ: 60			
		PH: 1			
USE WITH APPROVED MOTOR CONTROL THAT MATCHES MOTOR INPUT IN FULL LOAD AMPS & HP. (UTILISER UND? MARREUR APPROUV? CONVENANT AU COURANT? PLEINE CHARGE DU MOTEUR ET HP.)					
		02	03	04	1
1 2 3 4 5 6 7 8 9 10 11 12					
					105509

<b>BARNES</b> 3		BARNES PUMPS, INC. Mansfield, Ohio		THERMALLY PROTECTED	
MODEL	PART No.	MAX AMB. TEMP. 25°C			
2 EHV412	101298	INS. CLASS: B			
EHV412	101298G	HP: 0.5			
EHV412A	103542	FLA: 6.4			
EHV412AT	103543	RPM: 3450			
		VOLTS: 115			
		HZ: 60			
		PH: 1			
USE WITH APPROVED MOTOR CONTROL THAT MATCHES MOTOR INPUT IN FULL LOAD AMPS & HP. (UTILISER UND? MARREUR APPROUV? CONVENANT AU COURANT? PLEINE CHARGE DU MOTEUR ET HP.)					
		02	03	04	1
1 2 3 4 5 6 7 8 9 10 11 12					
					105509A

**F-2 Part Number:**

The part number consists of a six (6) digit number, which appears in the catalog. A one or two letter suffix may follow this number to designate the design configuration. This number is used for ordering and obtaining information.

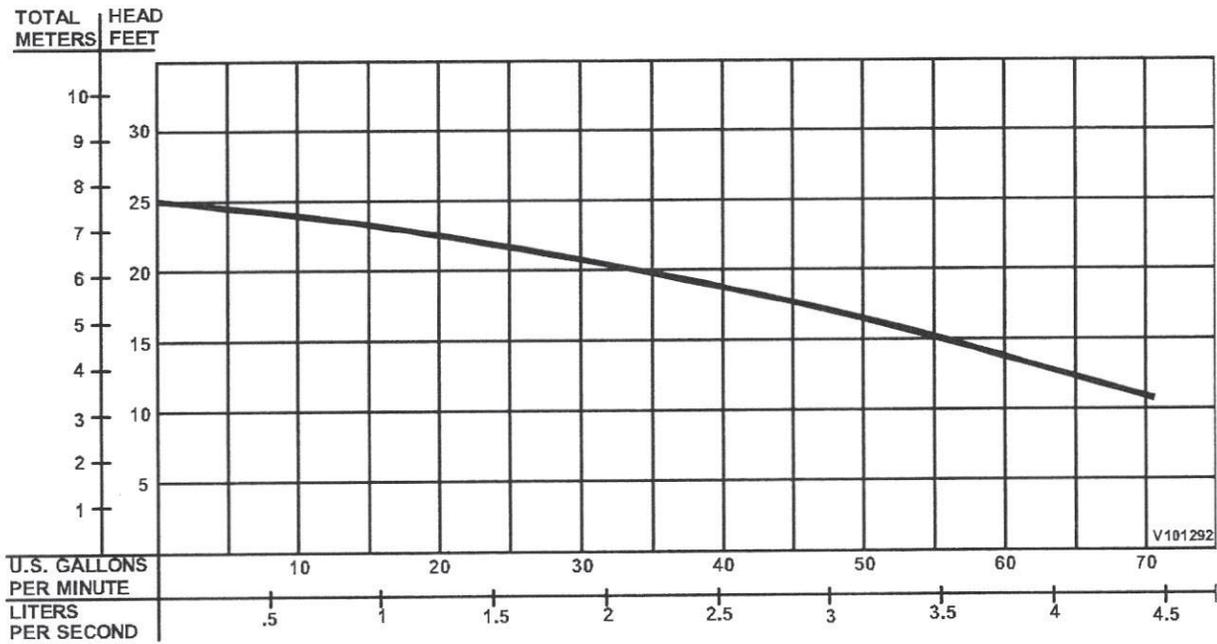
**F-2 Model Number:**

This designation consists of numbers and letters which represents the horsepower, motor phase and voltage, and pump design. This number is used for ordering and obtaining information.

**F-3 Date Code:**

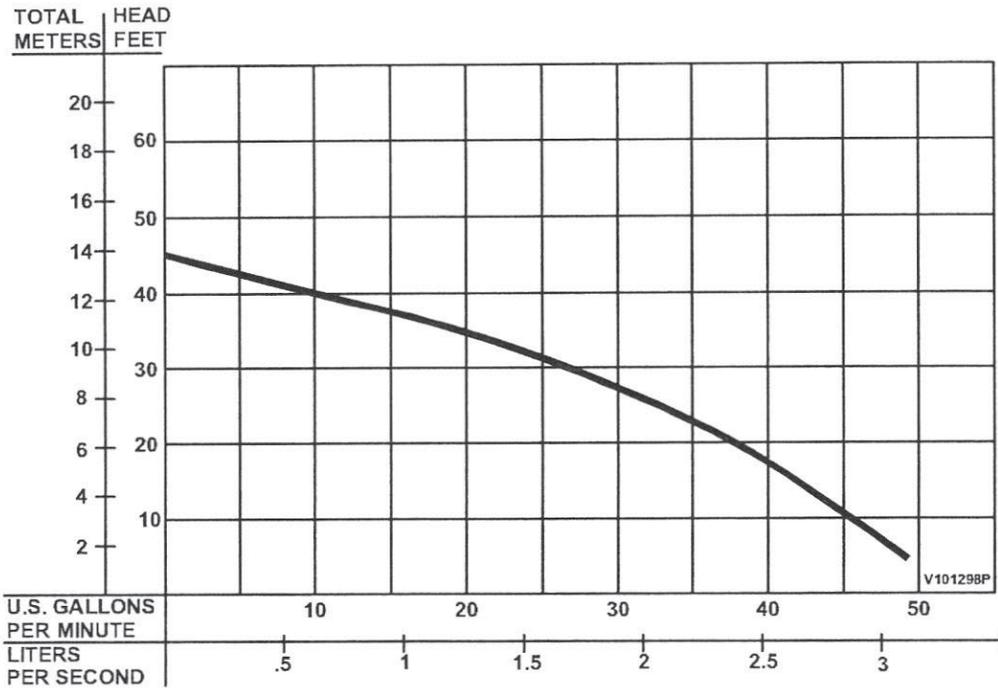
The Date Code consists of two numbers which are punched holes in the nameplate. This specifies the month and year which indicates the date the unit was built.

# SEV412



Testing is performed with water specific gravity of 1.0 @ 68°F (20°C), other fluids may vary performance

# EHV412



## TROUBLE SHOOTING

**CAUTION !** Always disconnect the pump from the electrical power source before handling.  
 If the system fails to operate properly, carefully read instructions and perform maintenance recommendations.  
 If operating problems persist, the following chart may be of assistance in identifying and correcting them:  
**MATCH "CAUSE" NUMBER WITH CORRELATING "CORRECTION" NUMBER.**

**NOTE:** Not all problems and corrections will apply to each pump model.

PROBLEM	CAUSE	CORRECTION
Pump will not run	1. Poor electrical connection, blown fuse, tripped breaker or other interruption of power, improper power supply. 2. Motor or switch inoperative (to isolate cause, go to manual operation of pump). 2a. Float movement restricted. 2b. Switch will not activate pump or is defective. 2c. Defective motor 3. Insufficient liquid level.	1. Check all electrical connections for security. Have electrician measure current in motor leads, if current is within $\pm 20\%$ of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current. 2a. Reposition pump or clean basin as required to provide adequate clearance for float. 2b. Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch. (Float Switch). 2c. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions.
Pump will not turn off	2a. Float movement restricted. 2b. Switch will not activate pump or is defective. 4. Excessive inflow or pump not properly sized for application. 9. Pump may be airlocked 14. H-O-A switch on panel is in "HAND" position	2b. Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch. (Float Switch). 2c. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions.
Pump hums but does not run	1. Incorrect voltage 8. Impeller jammed or loose on shaft, worn or damaged, impeller cavity or inlet plugged.	2c. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions.
Pump delivers insufficient capacity	1. Incorrect voltage. 4. Excessive inflow or pump not properly sized for application. 5. Discharge restricted. 6. Check valve stuck closed or installed backwards. 7. Shut-off valve closed. 8. Impeller jammed or loose on shaft, worn or damaged, impeller cavity or inlet plugged. 9. Pump may be airlocked. 10. Pump running backwards	3. Make sure liquid level is at least equal to suggested turn-on point. 4. Recheck all sizing calculations to determine proper pump size. 5. Check discharge line for restrictions, including ice if line passes through or into cold areas. 6. Remove and examine check valve for proper installation and freedom of operation. 7. Open valve.
Pump cycles too frequently or runs periodically when fixtures are not in use	6. Check valve stuck closed or installed backwards. 11. Fixtures are leaking. 15. Ground water entering basin.	8. Check impeller for freedom of operation, security and condition. Clean impeller and inlet of any obstruction. 9. Loosen union slightly to allow trapped air to escape. Verify that turn-off level of switch is set so that the suction is always flooded. Clean vent hole.
Pump shuts off and turns on independent of switch, (trips thermal overload protector). <b>CAUTION!</b> Pump may start unexpectedly. Disconnect power supply.	1. Incorrect voltage. 4. Excessive inflow or pump not properly sized for application. 8. Impeller jammed, loose on shaft, worn or damaged, impeller cavity or inlet plugged. 12. Excessive water temperature. (internal protection only)	10. Check rotation. If power supply is three phase, reverse any two of three power supply leads to ensure proper impeller rotation.. 11. Repair fixtures as required to eliminate leakage.
Pump operates noisily or vibrates excessively	2c. Worn bearings, motor shaft bent. 8. Debris in impeller cavity or broken impeller 10. Pump running backwards 13. Piping attachments to building structure too rigid or too loose.	12. Check pump temperature limits & fluid temperature. 13. Replace portion of discharge pipe with flexible connector. 14. Turn to automatic position. 15. Check for leaks around basin inlet and outlets.

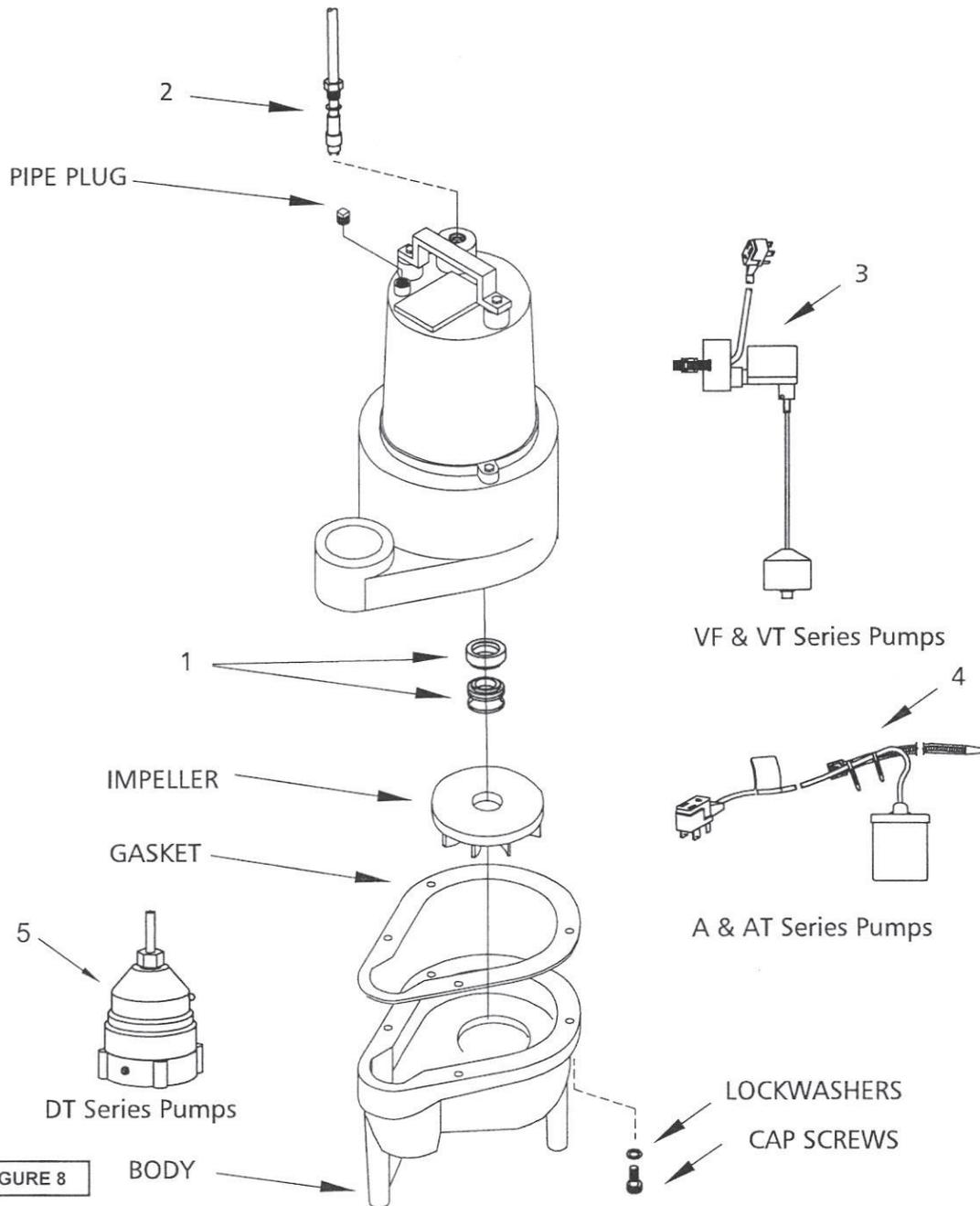


FIGURE 8

PARTS LIST

ITEM	QTY	DESCRIPTION	PART NO.
1	1	Shaft Seal	128260
2	1	Cord Set Assy, 20 Ft.	111143XA
3	1	Vertical Float, 20 Ft. Cord - VF Series	103476
		Vertical Float, 20 Ft. Cord - VFT Series	103475A
4	1	Wide Angle Float, Piggy-Back Plug	101758XA
5	1	Diaphragm Switch, 20 Ft. Cord - DT Series	115359XA

PUMPS ARE SOLD AS COMPLETE UNITS ONLY, Except for the above listed parts.

**BARNES®****burks®****WEINMAN®****DEMING®****PROSSER®**

## Limited 24 Month Warranty

Crane Pumps & Systems warrants that products of our manufacture will be free of defects in material and workmanship under normal use and service for twenty-four (24) months after manufacture date, when installed and maintained in accordance with our instructions. This warranty gives you specific legal rights, and there may also be other rights which vary from state to state. In the event the product is covered by the Federal Consumer Product Warranties Law (1) the duration of any implied warranties associated with the product by virtue of said law is limited to the same duration as stated herein, (2) this warranty is a LIMITED WARRANTY, and (3) no claims of any nature whatsoever shall be made against us, until the ultimate consumer, his successor, or assigns, notifies us in writing of the defect, and delivers the product and/or defective part(s) freight prepaid to our factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply. **THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY AND ALL WARRANTIES WITH RESPECT TO ANY PRODUCT SHALL BE TO REPLACE OR REPAIR AT OUR ELECTION, F.O.B. POINT OF MANUFACTURE OR AUTHORIZED REPAIR STATION, SUCH PRODUCTS AND/OR PARTS AS PROVEN DEFECTIVE. THERE SHALL BE NO FURTHER LIABILITY, WHETHER BASED ON WARRANTY, NEGLIGENCE OR OTHERWISE.** Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by us, if any, are subject to laboratory tests corrected for field performance. Any additional guarantees, in the nature of performance specifications must be in writing and such writing must be signed by our authorized representative. Due to inaccuracies in field testing if a conflict arises between the results of field testing conducted by or for user, and laboratory tests corrected for field performance, the latter shall control. **RECOMMENDATIONS FOR SPECIAL APPLICATIONS OR THOSE RESULTING FROM SYSTEMS ANALYSES AND EVALUATIONS WE CONDUCT WILL BE BASED ON OUR BEST AVAILABLE EXPERIENCE AND PUBLISHED INDUSTRY INFORMATION. SUCH RECOMMENDATIONS DO NOT CONSTITUTE A WARRANTY OF SATISFACTORY PERFORMANCE AND NO SUCH WARRANTY IS GIVEN.**

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage (c) lightning (d) excessive sand or other abrasive material (e) scale or corrosion build-up due to excessive chemical content. Any modification of the original equipment will also void the warranty. We will not be responsible for loss, damage or labor cost due to interruption of service caused by defective parts. Neither will we accept charges incurred by others without our prior written approval.

This warranty is void if our inspection reveals the product was used in a manner inconsistent with normal industry practice and/or our specific recommendations. The purchaser is responsible for communication of all necessary information regarding the application and use of the product. **UNDER NO CIRCUMSTANCES WILL WE BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTOR FEES, UNAUTHORIZED REPAIR SHOP EXPENSES, LOST PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND/OR WORKMANSHIP AND/OR DAMAGE OR DELAYS IN SHIPMENT. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

No rights extended under this warranty shall be assigned to any other person, whether by operation of law or otherwise, without our prior written approval.

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Phone: (905) 457-6223  
Fax: (905) 457-2650

**IMPORTANT!**  
**WARRANTY REGISTRATION**

Your product is covered by the enclosed Warranty.  
To complete the Warranty Registration Form go to:

<http://www.cranepumps.com/ProductRegistration/>

If you have a claim under the provision of the warranty, contact your local  
Crane Pumps & Systems, Inc. Distributor.

**RETURNED GOODS**

**RETURN OF MERCHANDISE REQUIRES A "RETURNED GOODS AUTHORIZATION".  
CONTACT YOUR LOCAL CRANE PUMPS & SYSTEMS, INC. DISTRIBUTOR.**



Products Returned **Must** Be Cleaned, Sanitized,  
Or Decontaminated As Necessary Prior To Shipment,  
To Insure That Employees Will Not Be Exposed To Health  
Hazards In Handling Said Material. All Applicable Laws  
And Regulations Shall Apply.

# **OPERATING AND MAINTENANCE INSTRUCTIONS**

## **Christmas Pump Station**

### **City of Harriman, Tennessee**

Specification Section: **02515 – Valves – Utility Service**

Equipment Item: **2.03 Check Valves**

Manufacturer: **Val-Matic Valve & Manufacturing Corp.**

Model: **6" Model 506A**

Owner: **City of Harriman, Tennessee**

Contractor: **Southern Constructors, Inc.  
1150 Maryville Pike  
Knoxville, TN 37920**

Engineer: **GRW, Inc.  
404 BNA Suite 201  
Nashville, TN 37217**

Equipment Supplier: **Southern Sales Company, Inc.  
2929 Kraft Drive  
Nashville, TN 37204  
Phone: 615-254-0066  
Fax: 615-254-0791**

Manufacturer: **Val-Matic Valve & Manufacturing Corp.  
905 Riverside Drive  
Elmhurst, IL 60126**

# Swing-Flex<sup>®</sup> Check Valve

## Operation, Maintenance and Installation Manual

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# VAL-MATIC'S SWING-FLEX® CHECK VALVE OPERATION, MAINTENANCE AND INSTALLATION

## INTRODUCTION

The Swing-Flex® Check Valve has been designed to give years of trouble-free operation. This manual will provide you with the information needed to properly install and maintain the valve and to ensure a long service life. The valve is opened by the fluid flow in one direction and closes automatically to prevent flow in the reverse direction.

An optional backflow actuator may be mounted on the bottom of the valve to allow manual backflow through the valve in the reverse direction.

Optional Mechanical Indicators and Limit Switches may be mounted on the valve cover to provide local and remote position indication.

An oil dashpot may be mounted on the bottom of 6" and larger valves to provide slow closure over the last 10% of travel.

The valve is of the swing check type utilizing an angled seat and fully encapsulated, resilient disc. It is capable of handling a wide range of fluids including flows containing suspended solids. The Size, Flow Direction, Maximum Working Pressure, and Series No. are stamped on the nameplate for reference.

### **CAUTION:**

Do not use valve for line testing at pressures higher than nameplate rating or damage to valve may occur.

The "Maximum Working Pressure" is the non-shock pressure rating of the valve at 150°F. The valve is not intended as an isolation valve for line testing above the valve rating.

## RECEIVING AND STORAGE

Inspect valves upon receipt for damage in shipment. Unload all valves carefully to the ground without dropping. Do not allow lifting slings or chains to come in contact with the seat area; use eyebolts or rods through the flange holes on large valves.

### **WARNING**

Do not use threaded holes in cover for lifting the valve. Serious injury may result.

Valves should remain crated, clean and dry until installed to prevent weather related damage. For long term storage greater than six months, the rubber surfaces of the disc should be coated with a thin film of FDA approved grease such as Lubriko #CW-606. Do not expose disc to sunlight or ozone for any extended period.

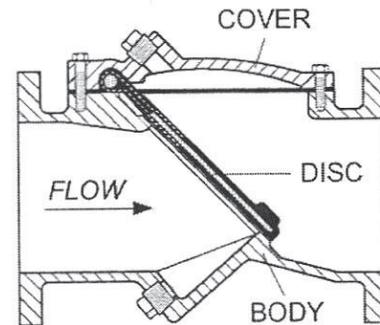


FIGURE 1. SWING FLEX® CHECK VALVE

## DESCRIPTION OF VALVE OPERATION

The valve is designed to prevent reverse flow automatically. During system flow conditions, the movement of the fluid forces the disc to the open position allowing 100% un-restricted flow area through the valve. Under reverse flow conditions, the disc automatically returns to the closed position to prevent reverse flow.

Several optional features are a backflow actuator, mechanical indicator, limit switch and bottom oil dashpot. All of these options ship loose of the valve and require field installation.

## INSTALLATION

Correct installation of the Swing-Flex® is important for proper operation. It may be installed in either horizontal or vertical flow-up applications. However, when horizontal, the valve must be installed with the nameplate facing up and the cover level. In all installations, the flow arrow cast in the valve cover must be pointed in the direction of flow during normal system operation.

### WARNING

Do not use threaded holes in cover for lifting the valve. Serious injury may result.

**FLANGED ENDS:** Flanged valves can be mated with raised or flat-faced pipe flanges equipped with full-face or ring-type resilient gaskets. The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve. Once the flange bolts or studs are lubricated and inserted around the flange, tighten them uniformly hand tight.

The tightening of the bolts should then be done in graduated steps using the **crossover tightening** method. Recommended lubricated torque values for use with resilient gaskets (75 durometer) are given in Table 1. If leakage occurs, allow gaskets to absorb fluid and check torque and leakage after 24 hours. Do not exceed bolt rating or extrude gasket.

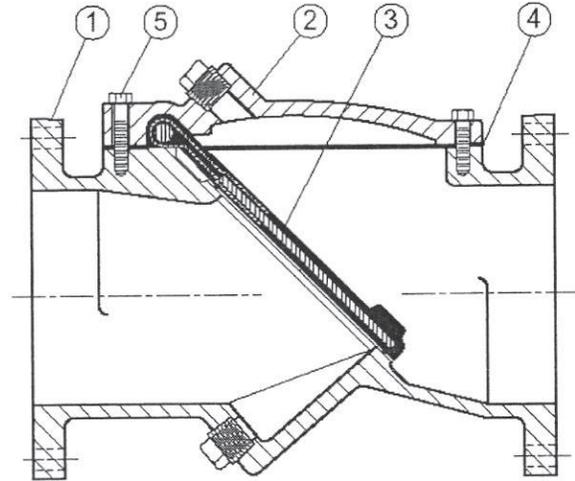
**CAUTION:** The use of ring gaskets or excessive bolt torque may damage valve flanges.

FLANGE BOLTS			
VALVE SIZE	BOLT DIA	RECOM. TORQUE	MAX. TORQUE
(in)	(in)	(ft-lbs)	(ft-lbs)
3	5/8	25	90
4	5/8	25	90
6	3/4	30	150
8	3/4	40	150
10	7/8	45	205
12	7/8	65	205
14	1	80	300
16	1	80	300
18	1 1/8	100	425
20	1 1/8	100	425
24	1 1/4	150	600
30	1 1/4	160	600
36	1 1/2	300	900

TABLE 1. FLANGE BOLT TORQUES

## VALVE CONSTRUCTION

The standard Swing-Flex® Check Valve is constructed of rugged cast iron with a rubber encapsulated disc. See the specific Materials List submitted for the order if other than standard cast iron construction. The disc is the only moving part assuring long life with minimal maintenance. The general details of construction are illustrated in Figure 2. The body (1) is flanged for connection to the pipeline with an open top sealed with a cast cover (2). The disc (3) is retained by the cover.



ITEM	DESCRIPTION	MATERIAL
1	Body	Cast Iron
2	Cover	Cast Iron
3	Disc*	Steel With Buna-N Facing
4	Gasket*	Non-Asbestos
5	Cover Bolt	Alloy Steel
*RECOMMENDED SPARE PART		

FIGURE 2. CHECK VALVE CONSTRUCTION

## MAINTENANCE

The Swing Flex® Check Valve requires no scheduled lubrication or maintenance. For service or inspection, the valve can be serviced without removal from the line.

**VALVE INSPECTION:** If inspection of the valve is required, follow the Disassembly Instructions given on page 3.

## TROUBLESHOOTING

Several problems and solutions are presented below to assist you in troubleshooting the valve assembly in an efficient manner.

- Leakage at Bottom Actuator: Remove line pressure and exercise actuator. If leak persists, replace seals in actuator; see the Backflow Actuator Seal Replacement Procedure on page 4.
- Leakage at Cover or Flanges: Tighten bolts, replace gasket.
- Valve Leaks when Closed: Inspect disc for damage and replace. Inspect metal seating surface and clean if necessary.
- Valve Does not Open: Check for obstruction in valve or pipeline; see Disassembly procedure on page 4. Operating pressure may be less than cracking pressure. If less than 0.5 psig, review application with factory.

## DISASSEMBLY

The valve can be disassembled without removing it from the pipeline. Or for convenience, the valve can be removed from the line. All work on the valve should be performed by a skilled mechanic with proper tools and a power hoist for larger valves. Disassembly may be required to inspect the disc for wear or the valve for deposits.

**WARNING:** The line must be drained before removing the cover or pressure may be released causing bodily harm.

1. Relieve pressure and drain the pipeline. Refer to Figure 2 on page 2. Remove the cover bolts (5) on the top cover.
2. Pry cover (2) loose and lift off valve body. 12" and larger valves have tapped holes in cover for lifting eyes.
3. Remove disc (3) and inspect for cracks, tears or damage in rubber sealing surface.
4. Clean and inspect parts. Replace worn parts as necessary and lubricate parts with FDA grease such as Lubriko #CW-606.

## RE-ASSEMBLY

All parts must be cleaned. Gasket surfaces should be cleaned with a stiff wire brush in the direction of the serrations or machine marks. Worn parts, gaskets and seals should be replaced during reassembly.

1. Lay disc (3) over seat with beaded seating surface directed down.
2. Lay cover gasket (4) and cover (2) over bolt holes and disc hinge.
3. Insert lubricated bolts (5) noting that the bolts in the hinge area are longer than the other cover bolts.
4. Cover bolts should be tightened to the following specifications during assembly.

COVER BOLTS		
VALVE	SIZE	TORQUE (FT-LBS)
2"-2.5"	1/2"	75
3"	7/16"	50
4"	1/2"	75
6"	7/16"	50
8"	9/16"	100
10"	3/4"	200
12"-20"	7/8"	250
24"	1"	300
30"	1 1/8"	500
36"	1 1/4"	700

TABLE 2. VALVE COVER BOLT TORQUES

## BACKFLOW ACTUATOR FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

### BACKFLOW ACTUATOR OPERATION:

An optional **backflow actuator** assembly is available which can be easily installed in the field. The actuator is not designed to operate at the valve's Maximum Working Pressure rating. Therefore, prior to using the actuator, close the pump isolation valve and bleed off line pressure. To operate, turn the handle clockwise. This will open the valve disc allowing backflow through the valve. The handle should turn easily. When resistance is felt, the disc has reached its body stop and is in the full open position. Upon completion of the back flushing operation, turn the handle counter-clockwise and the valve will automatically return to the closed position. Lock the actuator in the closed position with the jam nut provided. The system is again ready for normal operation

**WARNING:** Relieve line pressure before using backflow actuator or damage may occur.

### BACKFLOW ACTUATOR FIELD INSTALLATION:

The backflow actuator is supplied as an optional assembly from the factory, which is shipped loose with the valve.

**WARNING:** Removal of the bottom plug while under pressure may cause bodily harm.

1. Depressurize and drain the pipeline.
2. Remove the pipe plug in the bottom boss of the valve.
3. Inspect the backflow rod and place in the non-extended position. (The rod should extend about 1" past the end of the brass bushing.) Apply Teflon thread sealant to brass threads.
4. Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit.

### BACKFLOW ACTUATOR SEAL REPLACEMENT:

There are two parts (8 & 9) on the backflow actuator that are subject to wear. To replace the seals, the pipeline must first be depressurized and drained. Next, remove the backflow assembly from the valve by turning the brass bushing (6) counter-clockwise. Disassemble the actuator as follows:

1. Remove one of the vinyl caps (12) .
2. Remove the T-Handle (10) and jam nut (11) from the rod (7).
3. Remove the rod (7) from the bushing (6) by screwing in the rod fully clockwise and pull the rod through the valve end of the bushing (6).
4. Lubricate new seals with FDA approved grease such as Lubriko #CW-606 and install in the bushing end grooves.
5. Clean, lubricate, and reinstall rod in bushing.
6. Re-install jam nut (11) and T-Handle (10).
7. Place vinyl cap (12) on handle (10).
8. Apply Teflon thread sealant to bushing and carefully thread into valve taking care not to cross-thread the bushing

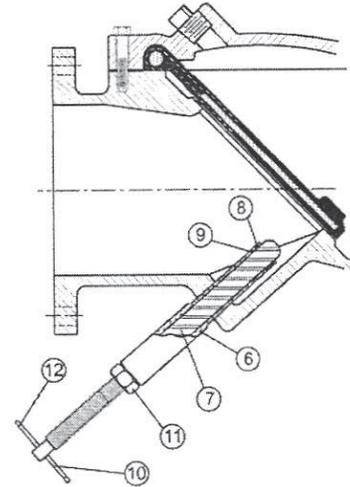


FIG. 3. BACKFLOW ACTUATOR ASSEMBLY

ITEM	DESCRIPTION	MATERIAL
6	Bushing	Brass
7	Rod	Stainless Steel
8	Rod Wiper*	Molythane
9	O-Ring*	Buna-N
10	Handle	Stainless Steel
11	Jam nut	Brass
12	Cap*	Vinyl

\*RECOMMENDED SPARE PART

### BACKFLOW ACTUATOR PARTS LIST

## MECHANICAL INDICATOR (OPTIONAL)

The mechanical indicator is an option that fits into the cover and can easily be installed in the field by going through the following steps. The mechanical indicator is used to visually indicate when the valve is opened or closed.

1. Remove line pressure and drain valve.

**WARNING: REMOVAL OF THE PIPE PLUG WHILE UNDER PRESSURE MAY CAUSE BODILY HARM.**

2. Remove the pipe plug from the cover.
3. Connect indicator adapter (24) to indicator rod (23).
4. Disconnect indicator spring (28) from plate (27).
5. Loosen the top indicator bushing (22) from the bottom bushing (21).  
Note: The bushings do not have to be completely removed from each other.
6. Apply pipe joint compound to the bottom bushing (21) threads.
7. Insert the indicator assembly into the valve cover boss.
8. Tighten the bottom bushing (21) into the valve cover boss.
9. Align indicator plate (27) with valve and tighten the top bushing (22).
10. Reconnect indicator spring (28).

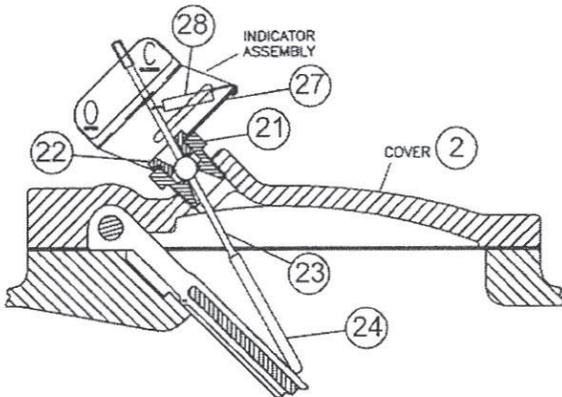


FIG. 4. MECHANICAL INDICATOR ASSEMBLY

Mechanical Indicator Parts List		
Item	Description	Material
21	Body	Brass
22	Bushing	Brass
23	Rod	Stainless Steel T316
24	Adapter	Stainless Steel T316
27	Plate	Stainless Steel T316
28	Spring	Stainless Steel T302

## LIMIT SWITCH (OPTIONAL)

The limit switch is used in conjunction with the Mechanical Indicator. The standard limit switch is MICROSWITCH Model Number 914CE20-3. The limit switch is SCADA (Supervisory Control and Data Acquisition) compatible for applications requiring open/close indication.

Nema Ratings: 1, 2, 4, 6, 6P, 12, 13  
UL Ratings: 5 AMPS, 1/10 HP, 125 or 250 VAC, SPDT

### Installation:

1. Attach limit switch assembly to indicator using the supplied screws (34) and bracket (31).
2. Position the assembly so that the switch trips when the valve is closed.
3. Connect wiring to either the normally open or normally closed contact as shown in the schematic diagram.

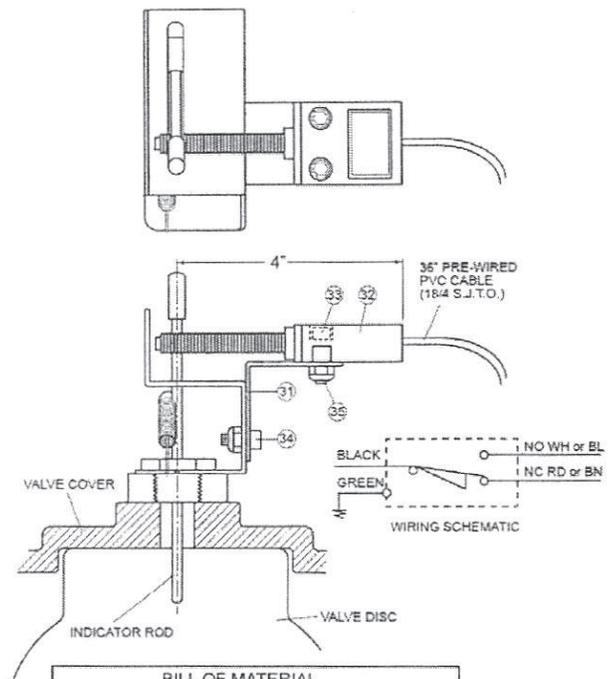


FIGURE 5. LIMIT SWITCH ASSEMBLY

## BOTTOM MOUNTED OIL DASHPOT FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

**DASHPOT FIELD INSTALLATION:** The bottom dashpot is supplied as an optional assembly from the factory. This unit provides control of the disc's final 10% travel to the closed position to reduce valve slam and water hammer. The 10% travel time is adjustable between 1 and 5 seconds.

1. Depressurize and drain the valve and pipeline.

**WARNING: Removal of the bottom plug in the valve while under pressure may cause bodily harm.**

2. Remove the pipe plug in the bottom boss of the valve. Apply Teflon thread sealant or tape to brass threads on the dashpot.
3. Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit and so that the tank is upright.
4. Adjust the air pressure in the tank to be a minimum of 50 psi over the line pressure. Set the flow control valve in the mid position (i.e. 1 turn open). The dashpot rod should be extended and hold the disc open about 1 inch. The water line pressure will close the disc.

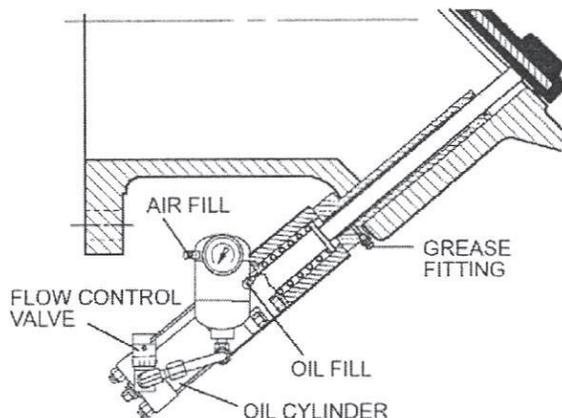


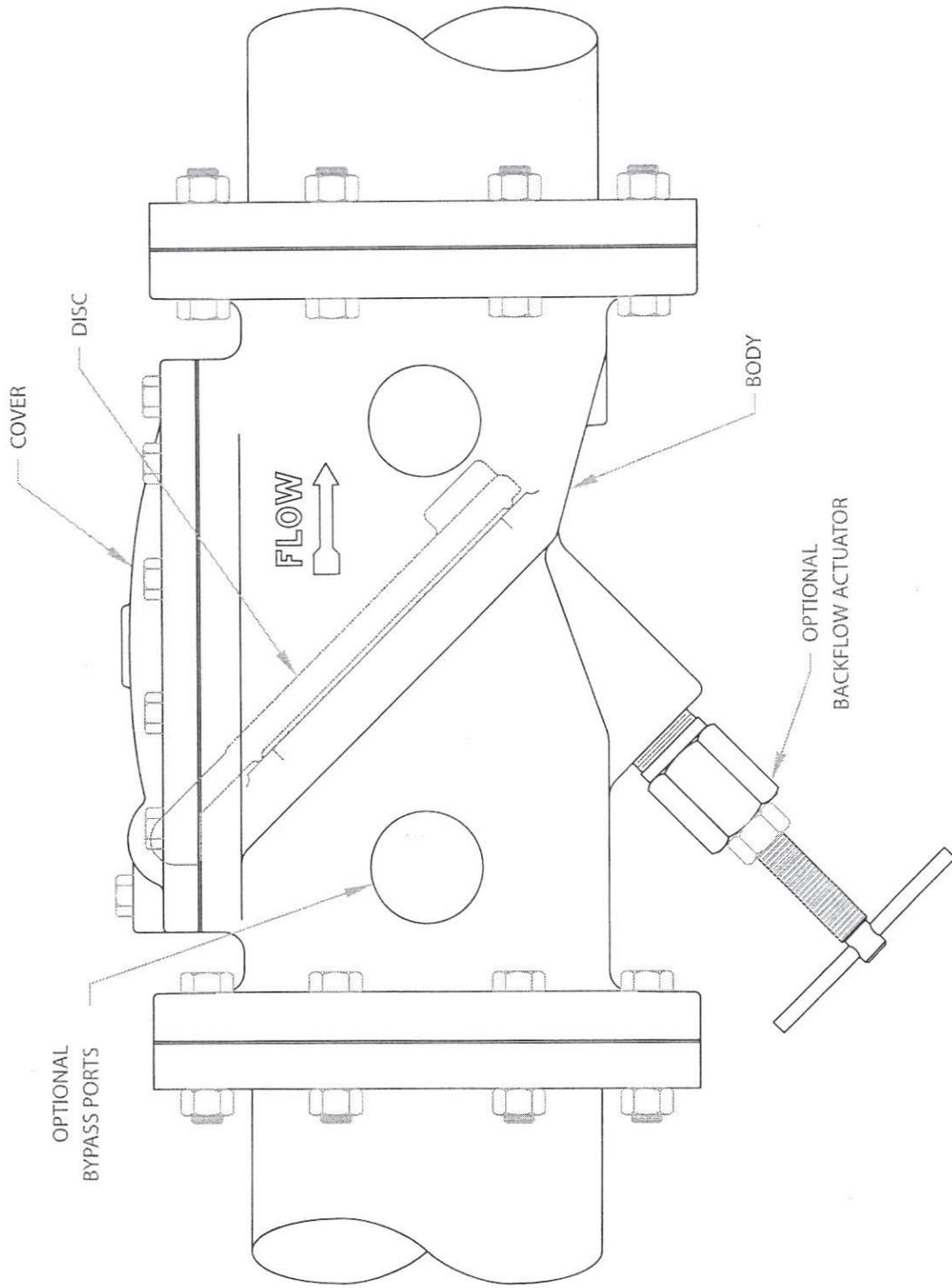
FIGURE 6. BOTTOM MOUNTED OIL DASHPOT

### CHECKING OIL AND GREASE LEVELS:

1. The check valve should be closed.
2. The air in the oil reservoir must be bled from the reservoir, using the air fill valve mounted on the reservoir.
3. Remove the pipe plug from the oil reservoir fill port.
4. Add hydraulic fluid equal to Mobil #DTE 24 until fluid is up to level indicated on the reservoir. Replace pipe plug.
5. Recharge the reservoir with air pressure to a minimum of 50 psi over the water line pressure.
6. The grease level can not be checked but it is recommended that the grease fitting be charged with grease twice a year. Use a cartridge grease gun and pump grease into the fitting using two full strokes. An FDA approved grease such as Lubriko #CW-606 should be used (Master Lubricants Company, Philadelphia, PA)

**DASHPOT SEAL REPLACEMENT:** There are several seals in the unit that may require replacement.

1. Depressurize and drain the valve and pipeline.
2. Unscrew the dashpot from the valve and remove the 4 bolts holding the dashpot spacer.
3. Replace the (2) rod wipers and o-ring seal.
4. If the oil cylinder is leaking oil, tighten the tie rod nuts. The cylinder should be returned to the factory for rebuilding.
5. Reinstall the unit as listed above for a new unit..



SWING FLEX CHECK VALVE DETAIL

NO SCALE

VM-SF01-001-0

## **PARTS AND SERVICE**

Parts and service are available from your local representative or the factory. Make note of the valve Model No and Working Pressure located on the valve nameplate and contact:

Val-Matic Valve and Mfg. Corp.  
905 Riverside Drive  
Elmhurst, IL 60126  
PH: 630/941-7600  
FAX: 630/941-8042

A sales representative will quote prices for parts or arrange for service as needed.

### **LIMITED WARRANTY**

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to the limitations below.

If the purchaser believes a product is defective, the purchaser shall: (a) Notify the manufacturer, state the alleged defect and request permission to return the product; (b) if permission is given, return the product with transportation prepaid. If the product is accepted for return and found to be defective, the manufacturer will, at his discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or refund the purchase price. Other than to repair, replace or refund as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER. These products are not manufactured, sold or intended for personal, family or household purposes.

# **OPERATING AND MAINTENANCE INSTRUCTIONS**

## **Christmas Pump Station**

### **City of Harriman, Tennessee**

Specification Section: **02515 – Valves – Utility Service**

Equipment Item: **2.02 Plug Valves**

Manufacturer: **Henry Pratt Company**

Model: **6” Ballcentric® Plug Valves**

Owner: **City of Harriman, Tennessee**

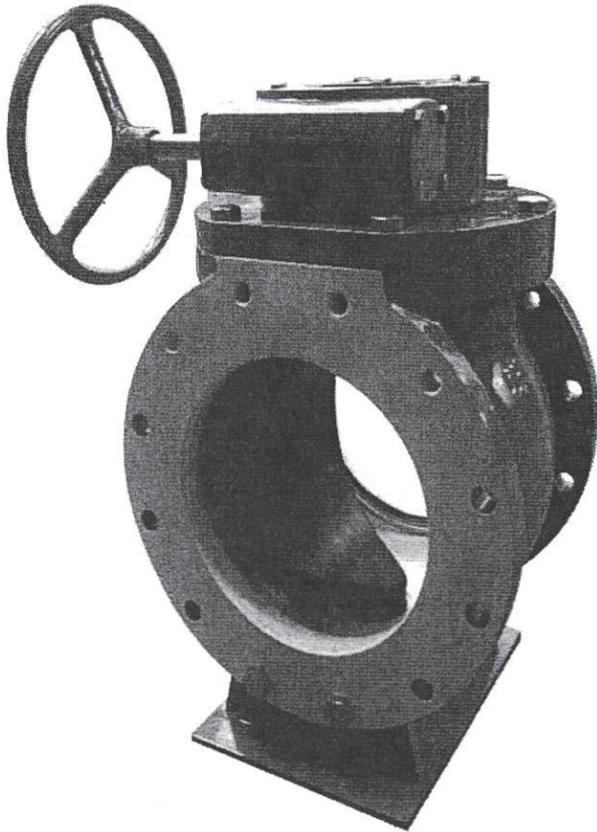
Contractor: **Southern Constructors, Inc.  
1150 Maryville Pike  
Knoxville, TN 37920**

Engineer: **GRW, Inc.  
404 BNA Suite 201  
Nashville, TN 37217**

Equipment Supplier: **Southern Sales Company, Inc.  
2929 Kraft Drive  
Nashville, TN 37204  
Phone: 615-254-0066  
Fax: 615-254-0791**

Manufacturer: **Henry Pratt Company  
401 S. Highland Avenue  
Aurora, Illinois 60506-5563**

Henry Pratt  
Ballcentric Plug  
Valve



Operation and  
Maintenance Manual

Job Name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Date: \_\_\_\_\_

## Henry Pratt Ballcentric Plug Valve

### SAFETY MESSAGES

All safety messages in the instructions are flagged with an exclamation symbol and the word "Warning". These messages indicate procedures that must be followed exactly to avoid equipment damage, physical injury, or death. Safety labels on the product indicate hazards that can cause equipment damage, physical injury, or death.



#### **WARNING**

*Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials.*

### PARTS

Order parts from your local Henry Pratt sales representative or directly from Henry Pratt Company. When ordering parts, please include the serial number located on the valve tag.

### WARRANTY ISSUE

Seller warrants that, at its option, it will repair, replace, or refund the unit purchase price of any products which are non-conforming due to Seller's material or workmanship during the warranty period. The warranty period shall be twelve (12) months for parts and eighteen (18) months for all other goods after date of shipment. This shall be Buyer's sole remedy. In order to maintain this product warranty, Buyer must give written notice to Seller's Field Service Supervisor prior to any work being performed.

IN CONSIDERATION OF THE FOREGOING, SELLER EXCLUDES ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Seller does not warrant water operated metallic cylinders against damage caused by corrosion, electrolysis or mineral deposits. In no event shall warranty include valve removal or reinstallation.



#### **WARNING**

*Read all applicable directions and instructions prior to any maintenance, troubleshooting or installation*

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## Henry Pratt Ballcentric Plug Valve

### FUNCTIONAL DESCRIPTION

Plug valves are designed with eccentric rubber disc seating surfaces. The plug rotates 1/4 turn to provide shutoff in pipes. The eccentric seating action provides for tighter shutoff as the actuator is adjusted to provide for more rotation. The valve can be adjusted to a maximum of 10 degrees over travel. The valves can be used to regulate flow rate by positioning the plug between 15 and 90 degrees open

Manually operated plug valves are powered with one of the following: 2" direct nut, lever handle or gear actuators, which convert multiple handwheel, chainwheel, or nut input turns into 1/4 turn valve operation. In a gear actuator, the travel of the valve plug is limited by physical stops in the actuator housing.



#### **WARNING**

***CAUTION: Forcing the handwheel, chainwheel, or nut against the stops will not provide tighter shutoff of the valve and may damage the actuator. Only actuator adjustments will affect valve shutoff.***

Motor operated valves are powered with gear actuators, which convert multiple motor input turns into 1/4 turn valve operation. The travel of the valve plug is limited by limit switches in the motor housing and physical stop in the actuator housing. Valve shutoff is affected by limit switch and physical stop settings.



#### **WARNING**

***CAUTION: Improperly set limit switches and/or physical stops may damage the motor and/or actuator.***

Hydraulically operated valves are powered with a gear box and double acting cylinder. The linear stroke of the cylinder is converted to 1/4 turns operation by the gear box. Auxiliary controls are provided to direct hydraulic power to the cylinder and to control the operating speed of the cylinder.

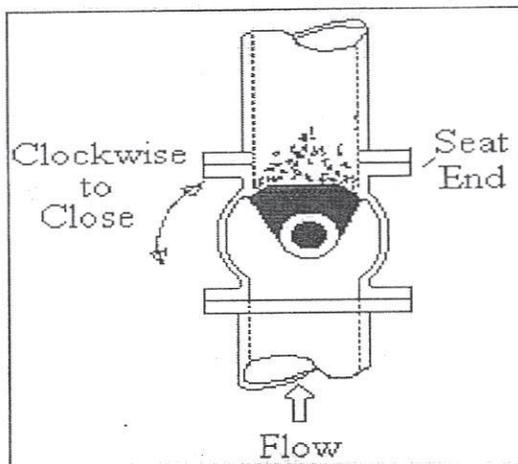
## Henry Pratt Ballcentric Plug Valve

### INSTALLATION

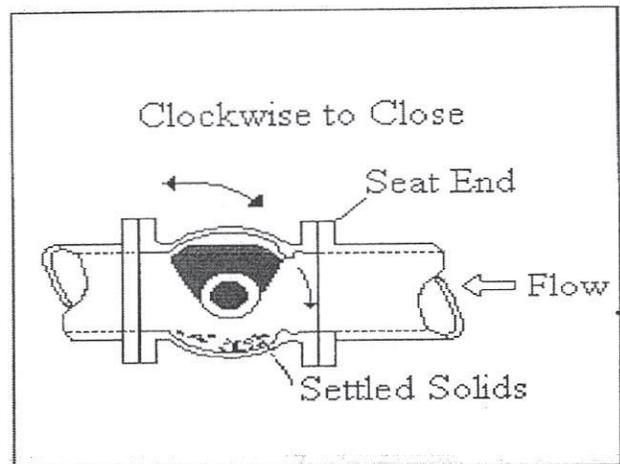
When installing the plug valves, the seat end should be noted. The seat end of the valve is cast in raised letters on the appropriate flange of the valve. Generally, straightway valves should be installed with the highest pressure applied from the opposite end from the seat. This will tend to push the plug into the seat. On pump discharge installations the seat end should be towards the pump.

In cases where shut-off is required in both directions, the valve should be installed so that the highest differential pressure at shut-off is opposite the seat end.

When the service is of a clogging type, with suspended solids likely to build up in the valve body, it is recommended that the valve be installed with the media entering the seat end first. In extreme cases, the valve should be installed with the plug horizontal and rotating upward into the top portion of the valve body cavity to open.



**Vertical Pipeline**



**Horizontal Pipeline**

Class 125 flanged end valves have ANSI B16.1 flat faced 125/150 flanges. Standard ANSI B16.21 flanges and gaskets should be used to install the valves in the pipeline. Certain size valves utilize tapped holes on the top and bottom of the flange where a backing nut is not possible. Please check specific drawings for detailed information on sizes and quantities of hexagon head screws required on these valves.

Prior to installing valves, they should be cycled open and closed several times to ensure they are in good working order and have not been damaged during shipment or storage.

## Henry Pratt Ballcentric Plug Valve

### OPERATION

#### *Wrench Operated Plug Valves*

Wrench operated eccentric plug valves close by turning the valve 90 degrees clockwise. All wrench operated eccentric valves are equipped with a multifunction device referred to here as a torque collar. This device serves as:

1. Wrench Adapter – 2" Square
2. Position Indicator
3. Open Memory Stop
4. Closed Memory Stop
5. Running Torque Adjustment

*Position Indicator:* The top of the plug has an indicator plate to show the approximate plug position. Cast onto the torque collar is an indicator mark which corresponds to a graduated scale cast on the bonnet of the valve. This scale is divided into 15 degree lines and indicates the exact valve opening from full open to full closed.

*Open Memory Stop:* The torque collar also incorporates an open memory stop feature. The plug can be set by tightening the open memory stop adjustment bolt after the correct flow is achieved. The valve can then be closed for maintenance and reopened to the proper position without resetting the flow.

*Closed Memory Stop:* The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.

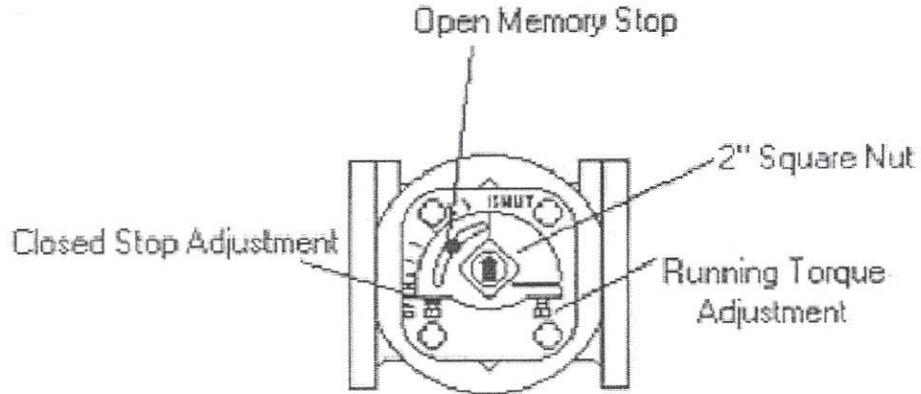
To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counter-clockwise then rotate the plug (clockwise) further into the seat and check the flow. Should this movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

*Running Torque Adjustment:* The nature of eccentric plug valves "camming" action eliminates the majority of the torque prior to seating. To prevent the plug from creeping open or slamming closed, the torque collar maintains a constant drag on the shoulder of the valve bonnet. This component is factory adjusted. However, once the valve has been installed, it is recommended that the torque adjustment nut be further tightened to assure proper friction exists to prevent unwanted closure.

To prevent the plug from unnecessary movement, rotate the hex head bolt clockwise until there is a substantial drag on the plug but not so much as to prevent the movement of the plug with the supplied wrench.

## Henry Pratt Ballcentric Plug Valve

### Wrench Operated Valve With Torque Collar



## Henry Pratt Ballcentric Plug Valve

### *Gear Operated Plug Valves*

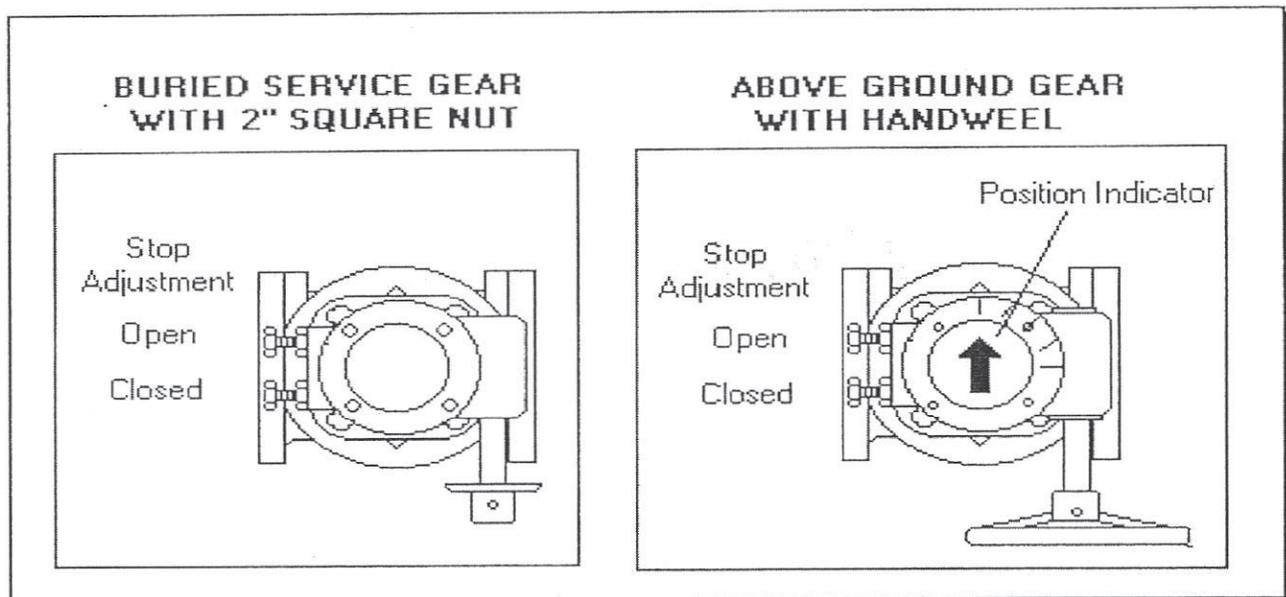
Gear operated eccentric valves close by turning the gear input shaft clockwise until closed. Please see specific valve drawing for the exact number of turns to close.

*Position Indicator (above ground units only):* The top of the gear operator has an indicator plate to show the plug position. This scale, cast onto the gear housing, is divided into 15 degree lines and indicates the exact valve opening from full open to full closed. Buried service units are totally enclosed and sealed for use below grade.

*Open and Closed Memory Stops:* The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.

To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counterclockwise then rotate the handwheel or nut (clockwise) to move the plug further into the seat and check the flow. Should movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

### **Gear Operated Valve**



## Henry Pratt Ballcentric Plug Valve

### *Actuated Plug Valves*

Described below are the operating instructions for an eccentric plug valve equipped with an electric motor actuator. General arrangement drawings are provided in conjunction with this manual to illustrate the fitup and installation of the valve and wiring of the motor. Specific wiring details are contained in the electric motor actuator manual. As with any plug valve, the actuator will cause the valve plug to rotate through  $\frac{1}{4}$  turn to open or close the valve.

The output motion of the actuator is limited to about 100 degrees of output rotation by mechanical stops in the gearing. These are factory set and should not need adjustment. The actual positioning of the valve plug will be done by limit switches in the motor actuator. The switches are also set at the factory, but adjustment is sometimes required if the motor unit is installed on a separate mounting base or floorstand. Detailed procedures are given in the motor manual if adjustment is needed for the mechanical stops or the limit switches. The wiring and power requirements are noted on the wiring diagrams included with this instruction manual.

## Henry Pratt Ballcentric Plug Valve

### MAINTENANCE

The eccentric valve is designed and manufactured to be a long life valve under normal circumstances. It does not require any routine maintenance. Cycling the valve from full open to full closed on an annual basis will increase the life of the valve and operator components.

However, if maintenance is required due to unusual wear or service conditions, the following procedure should be followed:



### WARNING

**CAUTION:** Valve should be depressurized for all maintenance activities

### DISASSEMBLY PROCEDURE

**Body:** The plug valve is a top entry valve; therefore the body can remain in line during this operation. Remove the star washer fastening the torque collar to the plug stem. Remove the torque collar and set aside.

With the valve de-pressurized, remove the hexagonal head cap screws that hold the bonnet to the valve body. Remove the bonnet, leaving the plug in the body. At this point, the plug, PTFE thrust washers, journal bearings and bonnet "O"rings are accessible and can be removed and replaced.

Care should be taken not to damage the plug elastomer or bonnet "O"rings upon reassembly.

Reverse the above process for reassembling the valve.

**Stem Seals:** Remove the star washer fastening the torque collar to the plug stem. Remove the torque collar and set aside.

With the valve de-pressurized, using internal snap ring pliers, remove the snap ring and thrust washer. The "U" cup seals can now be pried out of the seal cavity. To replace, reverse the above process.

**"U" Cup Seals:** To replace "U" cup seals on actuated eccentric plug valves, remove the actuator, and remove internal bolts fastening the actuator to the valve body. Remove the actuator and set aside. Remove the external snap ring and support collar.

Apply a small amount of silicone or grease to the new "U" cup seals. This will help them slide in the packing cavity. Put a piece of shim stock into the cavity and put the "U" cup over it. Slide the "U" cup over the stem with shim stock against the stem. This will let any trapped air out of the packing cavity. Now, using two screwdrivers, coax the outer lip of the "U" cup into the cavity while pressing down on the top of the "U" cup with the other screwdriver (see figure below). Continue to do this all the way around until the "U" cup is at the bottom of the packing cavity.

Repeat the procedure with the second "U" cup, and replace the thrust washer and snap ring. Now you can remount the actuator on the valve.

## Henry Pratt Ballcentric Plug Valve

### TROUBLESHOOTING

#### *Wrench Operated Plug Valves*

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedies</b>
Valve will not open	<ul style="list-style-type: none"> <li>• broken or misadjusted torque collar</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• adjust or replace torque collar</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve will not close	<ul style="list-style-type: none"> <li>• broken or misadjusted torque collar</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• adjust or replace torque collar</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve will not shutoff flow	<ul style="list-style-type: none"> <li>• improper stop adjustment</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• adjust closed stop</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve leaks at plug stem	<ul style="list-style-type: none"> <li>• damaged "U" cup seal</li> </ul>	<ul style="list-style-type: none"> <li>• replace "U" cups</li> </ul>

#### *Gear Operated Plug Valves*

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedies</b>
Valve will not open	<ul style="list-style-type: none"> <li>• bent input shaft</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• replace worm shaft</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve will not close	<ul style="list-style-type: none"> <li>• bent input shaft</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• replace worm shaft</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve will not shutoff flow	<ul style="list-style-type: none"> <li>• improper stop adjustment</li> <li>• obstruction in line</li> <li>• excessive line pressure</li> <li>• elastomer damage</li> </ul>	<ul style="list-style-type: none"> <li>• adjust closed stop</li> <li>• remove obstruction</li> <li>• reduce pressure</li> <li>• replace plug</li> </ul>
Valve leaks at plug stem	<ul style="list-style-type: none"> <li>• damaged "U" cup seal</li> </ul>	<ul style="list-style-type: none"> <li>• replace "U" cups</li> </ul>

## Henry Pratt Ballcentric Plug Valve

### *Actuated Plug Valves*

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedies</b>
Valve will not close/ Valve will not open	<ul style="list-style-type: none"> <li>• no power source</li> <li>• improper signal</li> <li>• burned out or impaired component</li> </ul>	<ul style="list-style-type: none"> <li>• Check incoming power source and/or replace fuses</li> <li>• Check actuating signal sequence</li> <li>• Check and repair or replace motor or relay devices</li> </ul>
Valve will not shut off flow	<ul style="list-style-type: none"> <li>• Improperly set limit switch</li> <li>• Actuator torques out</li> </ul>	<ul style="list-style-type: none"> <li>• Re-set limit switch</li> <li>• Check for obstructions in valve</li> </ul>



## Henry Pratt Ballcentric Plug Valve

### HOW TO CONTACT PRATT

#### HOW TO ORDER PARTS:

To order parts, contact our Parts Department:

Write: - Henry Pratt Company  
401 South Highland Avenue  
Aurora, IL 60506-5563

Attn: Parts Manager

Call - (630) 844-4144

Fax - (630) 844-4191

Please include valve serial number and description of part requested.

#### HOW TO OBTAIN SERVICE:

To obtain further information or secure field service, contact our Field Service Department:

Write: - Henry Pratt Company  
401 South Highland Avenue  
Aurora, IL 60506-5563

Attn: Field Service Manager

Call - (630) 844-4163

Fax - (630) 844-4160

Please include the following with your inquiry for service:

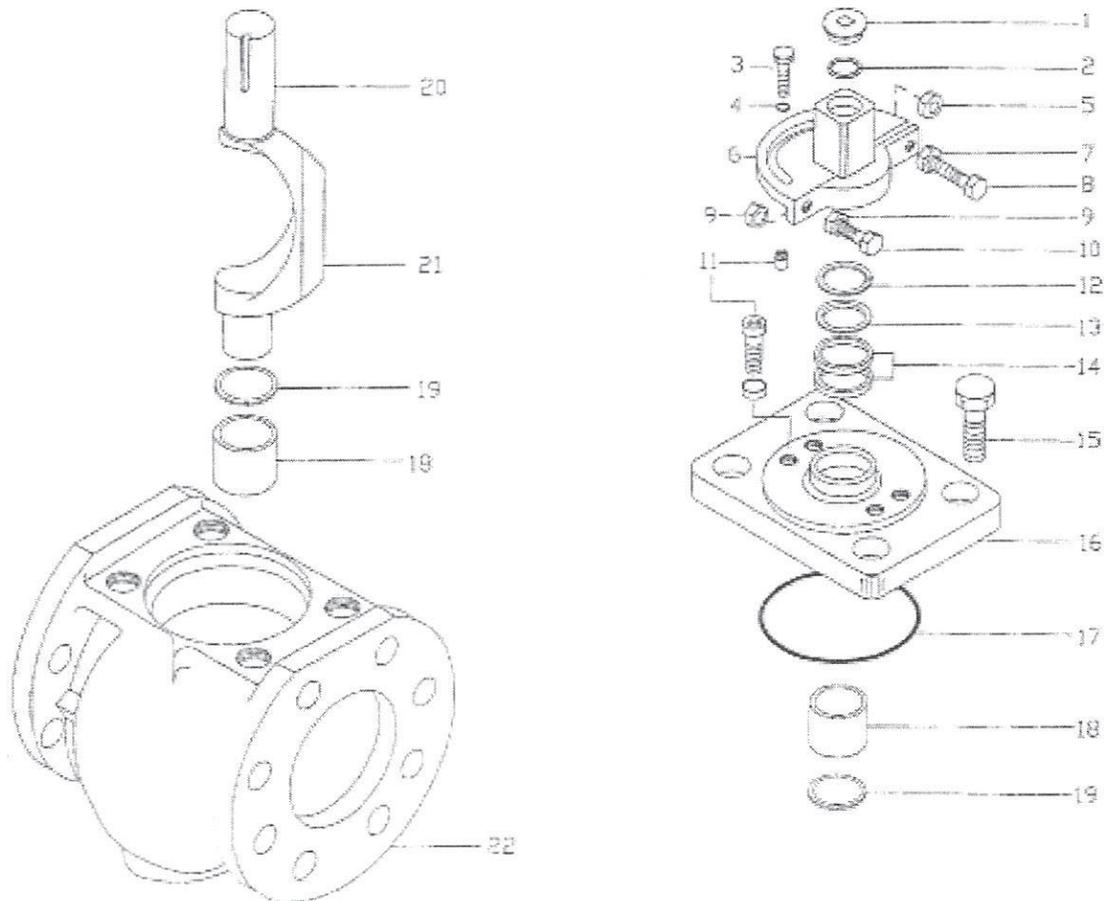
Henry Pratt Order Number:  
Henry Pratt Item Number:  
Valve Serial Number:  
Type of Service Requested

## Henry Pratt Ballcentric Plug Valve

### 2"-12" Ballcentric Plug Valve Parts and Materials

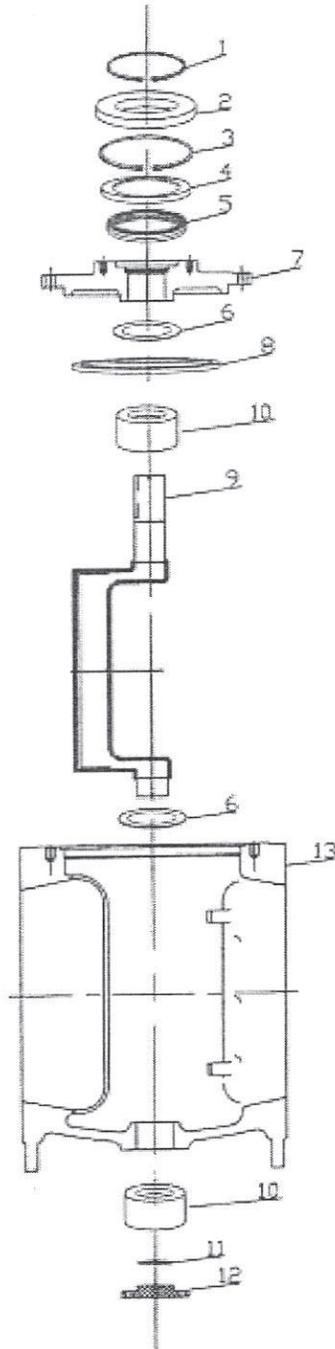
#### MATERIALS OF CONSTRUCTION

Item	Component	Material	Specification	Item	Component	Material	Specification
1	Indicator Cap	Plastic		12	Snap Ring	Spring Steel	
2	Star Nut	Steel		13	Washer	Brass	ASTM B-138-675
3	Open Stop	Steel		14	U-Cup Seal	Elastomer	Same as Plug
4	Washer	Steel		15	Capscrew	Steel	
5	Nut	Steel		16	Bonnet	Cast Iron	ASTM A-126 Class B
6	Tongue Collar	Ductile Iron	ASTM A-536	17	"D" Ring	Elastomer	Same as Plug
7	Lock Nut	Steel		18	Journal Bearing	Stainless Steel Bronze	ANSI 316 SAE 941
8	Torque Bolt	Steel		19	Thrust Washer	PTFE	
9	Lock Nut	Steel		20	Plug	Ductile Iron Cast Iron	ASTM A-536 ASTM A-126 CLB
10	Closed Stop	Steel		21	Plug Coating	Elastomer	As Specified
11	Travel Stop			22	Body	Cast Iron	ASTM A-126 Class B



## Henry Pratt Ballcentric Plug Valve

### 14"-36" Ballcentric Plug Valve Parts and Materials



\*NOTE 1: SEAL RETAINING RING BRASS DN 14"- 20"  
STEEL DN 24"- 36"

\*NOTE 2: PLUGS: DUCTILE DN 14"- 20"  
CAST IRON DN 24"- 36"

ITEM	QTY	DESCRIPTION	MATERIAL
13	1	BODY	CAST IRON
12	1	BOTTOM CAP	CAST IRON
11	1	BOTTOM O-RING	BUNA N
10	2	BEARINGS	SINTERED BRONZE
9#	1	PLUG	SEE NOTE 2
8	1	CAP O-RING	BUNA N
7	1	CAP	EAST IRON
6	2	PIPE WASHER	TEFLON
5	2	STEM SEAL	BUNA N
4#	1	SEAL RETAINING RING	SEE NOTE 1
3	1	INTERNAL SNAP RING	SPRING STEEL
2	1	SUPPORT WASHER	STEEL
1	1	EXTERNAL SNAP RING	SPRING STEEL