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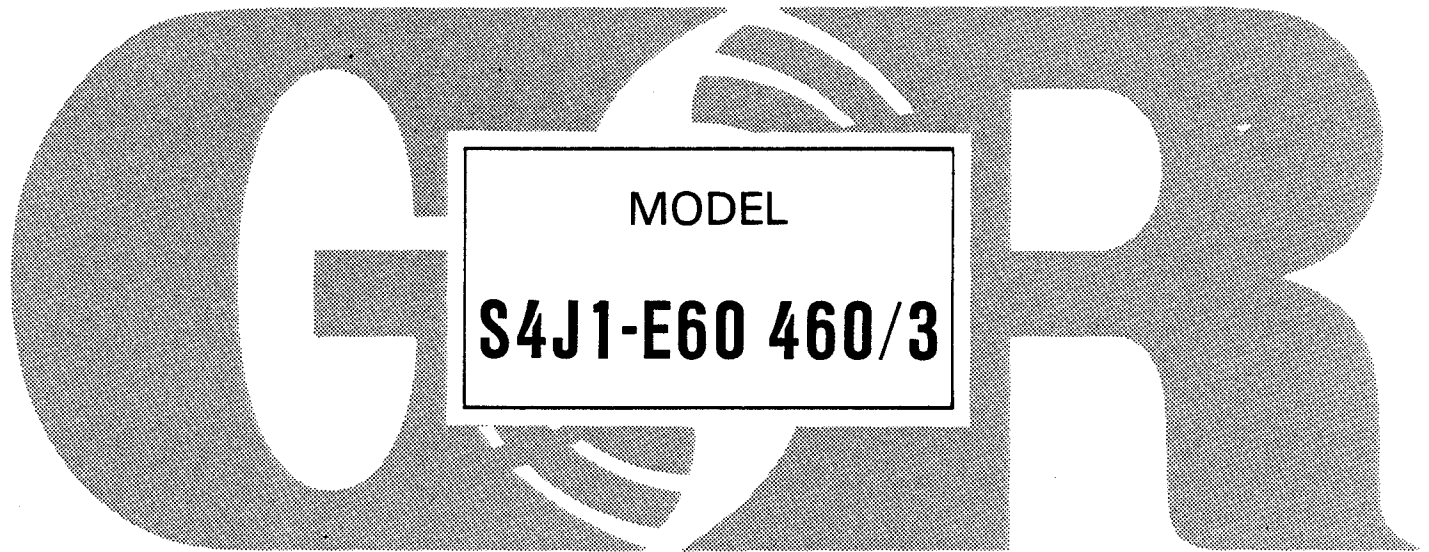
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March 31, 1987

REV. B

S**SERIES**

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



THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

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INTRODUCTION

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 designed to operate fully or partially submerged. It is capable of handling most nonvolatile and nonflammable liquids which are mildly corrosive and abrasive. The basic material of construction is aluminum, with hard iron impeller and wearing parts. The integral 460V, 60 Hertz electric motor must be operated through the control box furnished with the pump. Neither the pump nor the control box are explosion proof, and should not be operated in a hazardous atmosphere.

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

The Gorman-Rupp Company	or	Gorman-Rupp of Canada Limited
P.O. Box 1217		70 Burwell Road
Mansfield, Ohio 44901-1217		St. Thomas, Ontario N5P 3R7

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

NOTE

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

CAUTION

Instructions which must be followed to avoid causing damage to the product or other equipment incidental to the installation. These instructions describe the requirements and the possible damage which could result from failure to follow the procedures.

WARNING

```

////////////////////////////////////
//
// These instructions must be followed to avoid causing in- //
// jury or death to personnel, and describe the procedure //
// required and the injury which could result from failure //
// to follow the procedure. //
// //
////////////////////////////////////

```


WARNINGS

WARNINGS - SECTION A

THESE WARNINGS APPLY TO THE "S-SERIES" SUBMERSIBLE MOTOR OPERATED PUMPS.

WARNING

```

////////////////////////////////////
//
// Before attempting to open or service the pump:
//
// 1. Familiarize yourself with this manual.
// 2. Lock out the power supply to the control panel to
// ensure that the pump will remain inoperative.
// 3. Allow the pump to cool if overheated.
// 4. Close the discharge valve (if used).
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Do not attempt to pump volatile or flammable liquids for
// which this pump has not been designed.
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// After the pump has been installed, make certain that the
// pump and all piping or hose connections are secure be-
// fore operation.
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// The pump motor is designed to be operated through the
// control box furnished with the pump. The control box
// provides overload protection and power control. Do not
// connect the pump motor directly to the incoming power
// lines.
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Never attempt to alter the length or repair any power
// cable with a splice. The pump motor and cable must be
// completely waterproof. Injury or death may result from
// alterations.
//
////////////////////////////////////

```

WARNINGS

WARNING

```

////////////////////////////////////
//
// All electrical connections must be in accordance with //
// the National Electric Code and all local codes. If //
// there is a conflict between the instructions provided //
// and N.E.C. specifications, N.E.C. specifications shall //
// take precedence. All electrical equipment supplied with //
// this pump was in conformance with N.E.C. requirements in //
// effect on the date of manufacture. Failure to follow //
// applicable specifications, or substitution of electrical //
// parts not supplied or approved by the manufacturer, can //
// result in severe injury or death. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Make certain that the //
// control box is grounded, and that the power supply is //
// compatible with the motor phase and voltage, before con- //
// necting the power source. If the overload unit is //
// tripped during pump operation, correct the problem be- //
// fore restarting the pump. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// The pump motor is thermally protected and subject to au- //
// tomatic restart. Always terminate power to the pump and //
// control box before performing service functions. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Obtain the services of a qualified electrician to con- //
// nect the electrical circuits, and to service the control //
// box. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Do not attempt to lift the pump by the motor power cable //
// or the piping. Attach proper lifting equipment to the //
// hoisting bail fitted to the pump. //
//
////////////////////////////////////

```

INSTALLATION - SECTION B

This section is intended only to summarize recommended installation practices for the pump and control box. If there are any questions concerning your specific installation, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Automatic liquid level devices are not furnished with the standard pump, but are available from Gorman-Rupp as options (see **Liquid Level Devices**, Section B); for information on installing and operating these devices, see the technical data accompanying that option.

PREINSTALLATION INSPECTION

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

- a. Check the pump assembly for cracks, dents, damaged threads, and other obvious damage.
- b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.
- c. The standard pump is connected to the control box with 50 ft. of power cable. Inspect the cable for cuts or damage.
- d. Check the control box for cracks, dents, and other obvious damage.
- e. Check that all control box components are securely attached to their mounting surfaces, and that the electrical connections are tight and free of corrosion.
- f. Compare the amperes, phase, voltage, and hertz indicated on the motor name plate to the ratings indicated for the control box.
- g. Carefully read all tags, decals, and markings on the pump assembly and the control box, and perform all duties indicated.
- h. Check the pump and motor for any oil leaks. An oil leak may indicate a cut O-ring or other damage.
- i. If the pump and control box 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 insure 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.

Lubrication

This pump utilizes one lubrication cavity, located just behind the seal plate. It is filled with premium quality submersible pump oil which lubricates two shaft seals. The motor operates in air and requires no lubrication.

The lower shaft seal prevents liquid from entering the lubrication cavity, while the upper shaft seal prevents oil leakage into the motor. The upper seal also acts as backup protection in the event of lower seal failure.

The lubrication cavity was fully lubricated when shipped from the factory. Check the oil level before installing the pump (see **LUBRICATION** in **MAINTENANCE AND REPAIR**). An additional quart of oil has been provided with the pump to "top off" the oil cavities. If the oil level is abnormally low, determine the cause before putting the pump into service.

PUMP INSTALLATION

Pump Specifications

See Table 1 for the typical pump specifications motor data.

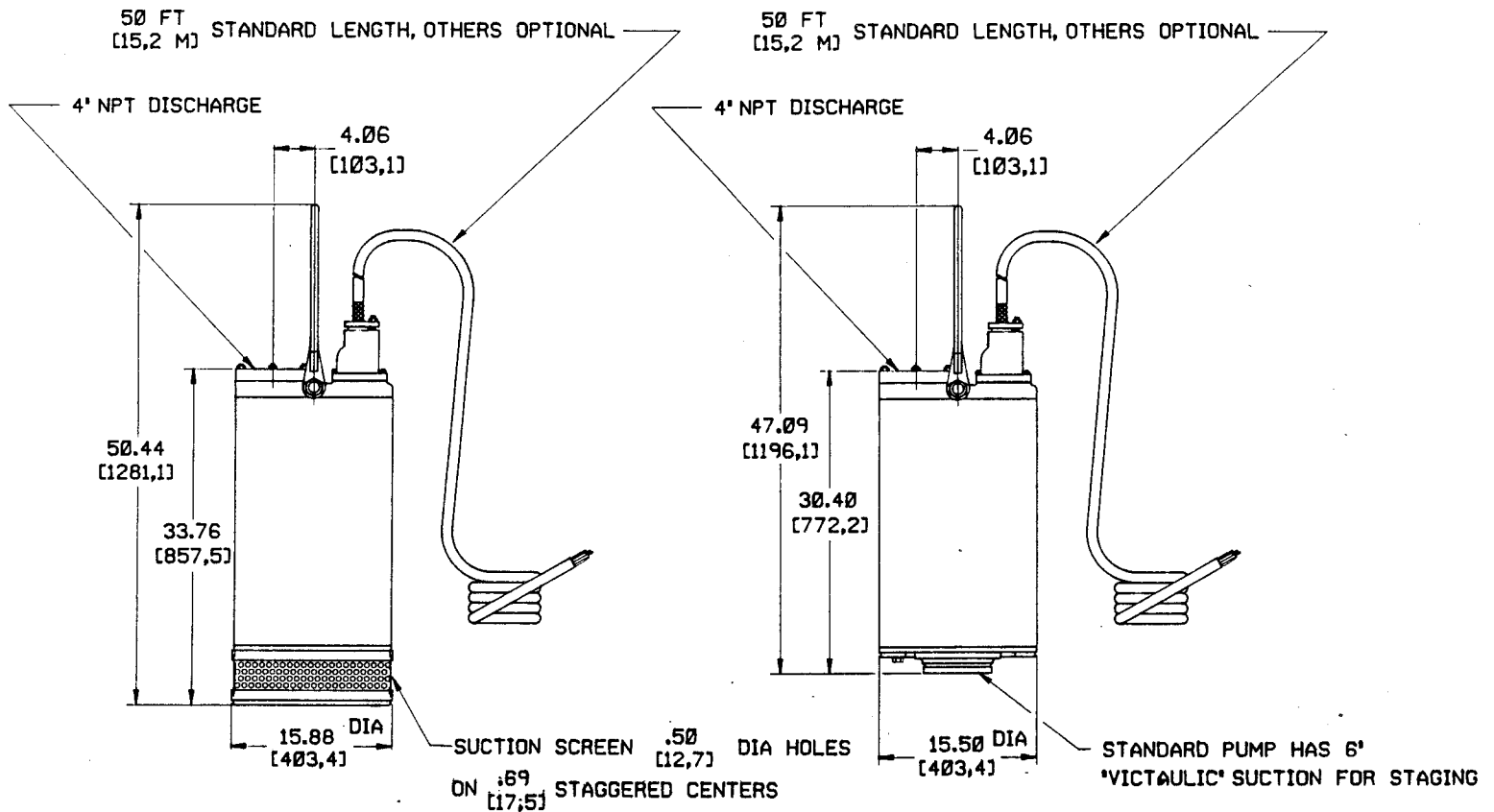
Table 1. Pump Specifications

Model Number	Voltage/Phase	Pump Horse-power	Motor Speed (RPM)	Full Load Amperes	No Load Amperes	Locked Rotor Amperes	Discharge Size (NPT)
S4J1	460/3	60	3450	66	18	500	4

Pump Dimensions

The standard pump is provided with a suction strainer to prevent large solids from clogging the impeller. On high discharge head applications, the strainer can be removed, and the pump suction "staged" to the discharge of another pump, allowing one pump to feed the other.

See Figure 1 on page B-3 for the approximate physical dimensions of the pump.



DIMENSIONS:

TOP - INCHES

BOTTOM - [MILLIMETERS]

Figure 1. Pump Model S4J1-E60 460/3

Lifting

Use lifting equipment with a capacity of at least **3,600 pounds**. This pump weighs approximately **718 pounds**, not including the weight of accessories and control box. Customer installed equipment such as rigid piping **must** be removed before attempting to lift.

WARNING

```

////////////////////////////////////
//
// Do not attempt to lift the pump by the motor power cable //
// or the piping. Attach proper lifting equipment to the //
// hoisting bail fitted to the pump. If chains or cable //
// are wrapped around the pump to lift it, make certain //
// that they are positioned so as not to damage pump, and //
// so that the load will be balanced. //
// //
////////////////////////////////////

```

Positioning The Pump

This pump is designed to operate fully or partially submerged. It may also be operated in air for extended periods. The rotating parts are oil lubricated, and the motor is cooled by a constant flow of liquid or air discharged through internal passage(s).

As a safeguard against rupture or explosion due to heat, the pump is equipped with a thermal overload protector which automatically shuts the motor down when the operating temperature exceeds designed limits.

WARNING

```

////////////////////////////////////
//
// The pump motor is thermally protected and subject to au- //
// tomatic restart. Always terminate power to the pump and //
// control box before performing service functions. //
// //
////////////////////////////////////

```

The pump will operate if positioned on its side, but this is not recommended because the motor torque could cause the pump to roll during operation.

The pump should be independently secured and supported by the hoisting bail. If the application involves a lot of debris, protect the pump from excessive wear and clogging by suspending it in a perforated barrel or culvert pipe. If the bottom is heavily sludge-covered, rest the pump on support blocks or suspend it from a raft or similar device near the surface of the liquid. See Figure 2 on page B-5 for typical pump installations.

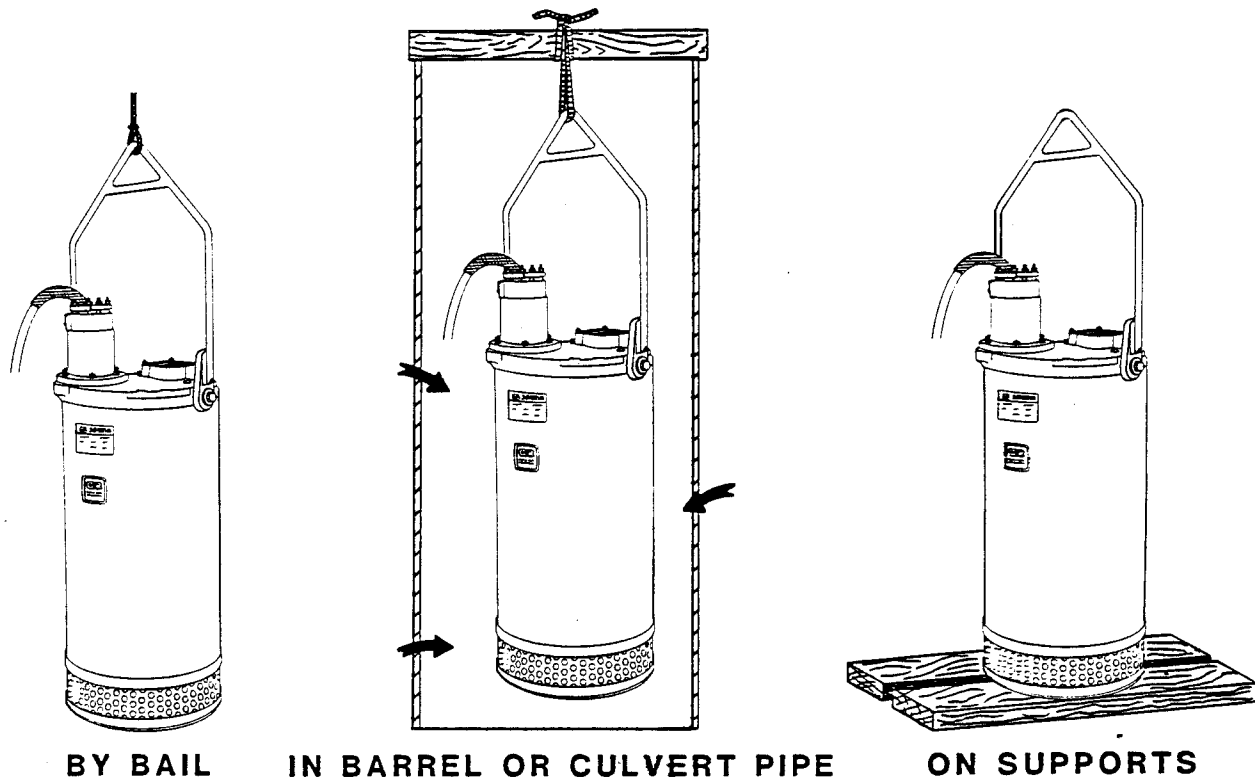


Figure 2. Typical Pump Installations.

All liquid entering the pump must pass through a strainer screen. Any spherical solids which pass through the screen will pass through the pump.

NOTE

Before actual operation, check the direction of impeller rotation to ensure that the pump is properly wired to the control box. See **Checking Pump Rotation** in **OPERATION** section.

Piping

No suction piping is required in a standard submerged application.

The suction port of this pump has a 6-inch "Victaulic" groove to allow it to be piped or "staged" to the discharge of another. To determine the size of the discharge connection, see Table 1, **PUMP SPECIFICATIONS**. Either hose or rigid pipe may be used. To facilitate mobility and maintenance, it is recommended that the discharge line be fitted with a quick disconnect fitting near the pump. The discharge line must be independently supported to avoid strain and vibration on the pump.

INSTALLATION

For maximum pumping capacity, keep the discharge as short and straight as possible. Minimize the use of elbows and fittings which increase friction losses through the discharge piping system.

It is recommended that a check valve or throttling valve be installed in the discharge line to control siphoning or back flow when the pump is shut off.

CONTROL BOX INSTALLATION

This pump is driven by an integral 460 VAC, 60 hertz, 3 phase, 60 HP motor. It is designed to operate through the control box furnished with the pump.

WARNING

Warning text enclosed in a double-line border with // symbols at the corners. The text reads: 'The pump motor is designed to be operated through the control box furnished with the pump. The control box provides overload protection and power control. Do not connect the pump motor directly to the incoming power lines.'

Enclosure

The control box is a rainproof enclosure with padlockable front cover. The enclosure is not designed to be watertight, and should not be submerged. See Figure 3 on page B-7 for enclosure dimensions and callouts.

Secure the control box vertically on a level surface, which is above flood level. It should be easily accessible to the operator, and located close enough to the pump to avoid excessive voltage drop due to cable length. (See Pump Power Cable Connections). After the box is installed, make certain the front cover latches properly.

CAUTION

Failure to mount the control box vertically on a level surface may affect operation of the pump controls.

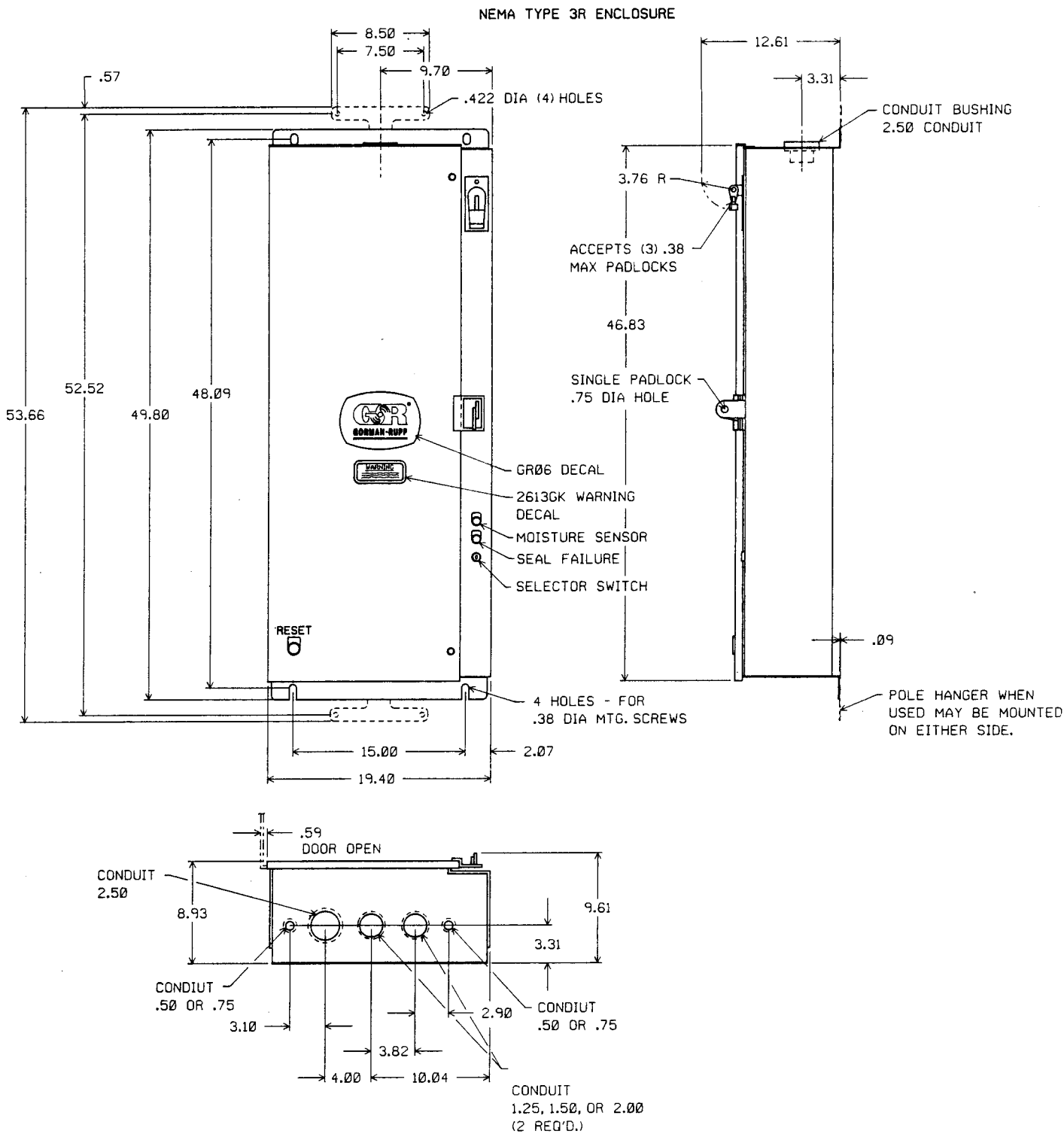


Figure 3. 27515-060 or 27515-160 Control Box Assembly

 INSTALLATION

Grounding Methods

Electrically ground the installation before connecting the field wiring to the control box. Install a grounding terminal to the enclosure and connect it to a properly imbedded electrode.

The material used for the electrode **must** be an excellent conductor of electricity, such as copper. If iron or steel is used, it must be galvanized or otherwise metal plated to resist corrosion. **Do not** coat the electrode with any material of poor conductivity such as paint or plastic.

The electrode must conform to the recommendations of N.E.C. Article 250. Follow all installation requirements of the N.E.C., and all applicable local codes. See Figure 4 for some suggested grounding methods.

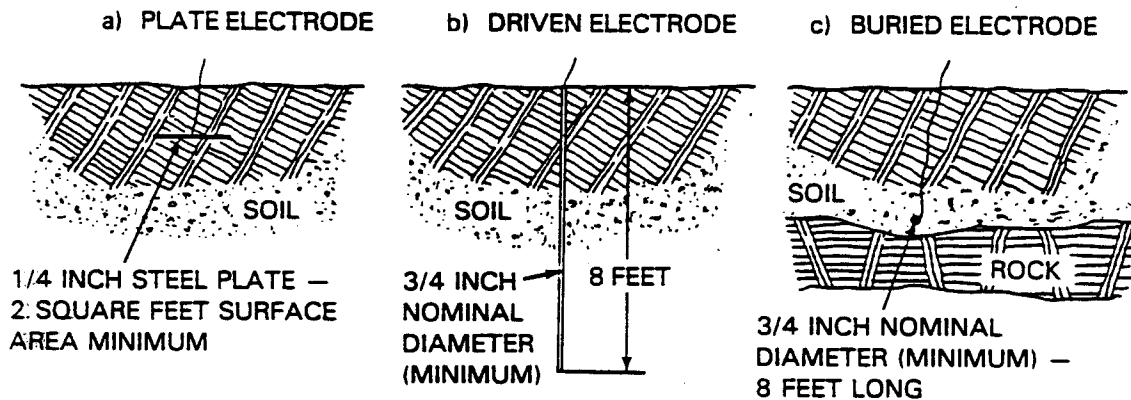


Figure 4. Suggested Grounding Methods

- a. **Plate Electrode:** An iron or steel plate, 1/4 inch thick, completely imbedded in the ground. The plate must present a surface of a least 2 square feet.
- b. **Driven Electrode:** A rod or pipe, 3/4 inch diameter minimum, 8 feet long, completely driven into the ground.
- c. **Buried Electrode:** If rock or stone prevents imbedding the full 8 foot length of the ground rod, bury it in a horizontal trench.

Space the ground rod or plates at least 6 feet from any other electrode or ground rod, such as those used for signal circuits, radio grounds, lightning rods, etc.

The earth surrounding the ground rod or plate **must** contain enough moisture to make a good electrical connection. In dry or sandy areas, pour water around the rod or consult qualified personnel to devise a method of improving the connection.

INSTALLATION

WARNING

```

////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Make certain that the //
// control box is properly grounded after installation. //
//
////////////////////////////////////

```

Field Wiring Connections (Incoming Power)

WARNING

```

////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Obtain the services of //
// a qualified electrician to make all electrical con- //
// nections. Make certain that the pump and enclosure are //
// properly grounded, and that the incoming power matches //
// the requirements of the pump and control. //
//
////////////////////////////////////

```

The pump control is designed to regulate a 460 volt, 3-phase, 60 hertz power supply. The field wiring must be properly sized to insure an adequate voltage supply. The voltage available at the motor must be within the range indicated in Table 2.

To calculate the voltage available at the motor proceed as follows:

- a. Measure the incoming voltage across lines (1 & 2, 2 & 3, and 1 & 3) while the pump is **operating at full capacity**. See Figure 5 on page B-12.
- b. Next, subtract the motor cable voltage drop (see Table 3, Motor Cable Specifications).
- c. Do not continue to operate the pump if this voltage is not within the recommended limits. Obtain the services of a qualified electrician to determine the correct field wiring size and other details to insure an adequate voltage supply to the pump.

Table 2. Pump Motor Voltage Limits

Nominal Voltage	Phase	Minimum Voltage	Maximum Voltage
460	3	420	500

Use conduit or cable clamps to secure the incoming field wiring to the control box. Make certain all connections are tight and that cable entry points are

rainproof. Support the cable weight, if required, to prevent excessive strain on cable clamps and cable.

Pump Power Cable Connections

WARNING

```

////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Make certain that in- //
// coming power is OFF and LOCKED OUT before connecting //
// power or accessory cables to the control box. Obtain //
// the services of a qualified electrician to make all //
// electrical connections. //
// //
////////////////////////////////////
    
```

The standard pump is provided with a 50-foot power cable sealed by heat-shrink tubing in the terminal housing assembly. (See Table 3 for cable specifications.) If a longer power cable is required, an optional cable assembly **must** be ordered from the factory. Splicing of the power cable is **not** recommended by the Gorman-Rupp Company due to safety and warranty considerations.

WARNING

```

////////////////////////////////////
//
// Never attempt to alter the length or repair any power //
// cable with a splice. The pump motor and cable must be //
// completely waterproof. Injury or death may result from //
// alterations. //
// //
////////////////////////////////////
    
```

Table 3. Cable Requirements for Pump Electrical Connections, Model S4J1

Voltage/ Phase	A.W.G. Cable Size	Cable OD (inches)	Conductor Dia. (inches)	Amp Rating* at 40°C (amperes)	DC Resist- ance at 25°C (ohms/ 1000 ft)	Voltage Drop at Max. Load per 100 ft
460/3	6	1.25	0.21	79	0.45	5.94

*Applies only to SPC type cable. Refer to manufacturer's specifications for other cable.

Before connecting the pump power cable to the control box, make certain the incoming power is **OFF** and **LOCKED OUT**. Make certain the control box is **PROPERLY GROUNDED** and that the electrical data on the control matches the motor name plate data.

Connect the pump power cable to the control box as shown in Figure 5 on page B-12. Use conduit or cable clamps to secure the power and accessory cables to

INSTALLATION

the control box. Make certain that all connections are tight and that cable entry points are rainproof.

NOTE

The power cable furnished with this pump includes three electrical conductors (white, red, and black), one grounding conductor (green) and one ground check conductor (yellow). The yellow ground check lead is used in conjunction with customer-supplied ground monitoring equipment. If this equipment is not used, the yellow lead should be used as a ground conductor.

LIQUID LEVEL DEVICES

The standard pump is **not** furnished with a means to automatically regulate liquid level. However, the pump may be controlled to perform filling, or dewatering functions by using **either** of the following optional sensing devices: (see Figure 5 on page B-12).

- **Diaphragm Type:** two fixed position sensors (upper and lower) each contain a diaphragm which flexes with changes in liquid level, thus activating an enclosed miniature switch.
- **Bulb (Float) Type:** a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch.

For added safety, the sensing devices operate through low voltage 24 volt circuitry which is specially designed to fit into the main pump control box.

The circuitry may be prewired as a factory option, or easily added in the field by qualified personnel. For installation and operation, see the detailed instructions included with the optional package.

CAUTION

Liquid level devices **MUST** be positioned far enough apart to allow 10 minutes between starts. If the pump motor cycles more than 6 starts per hour, it will overheat resulting in damage to the motor windings or control box components.

TYPICAL INSTALLATION

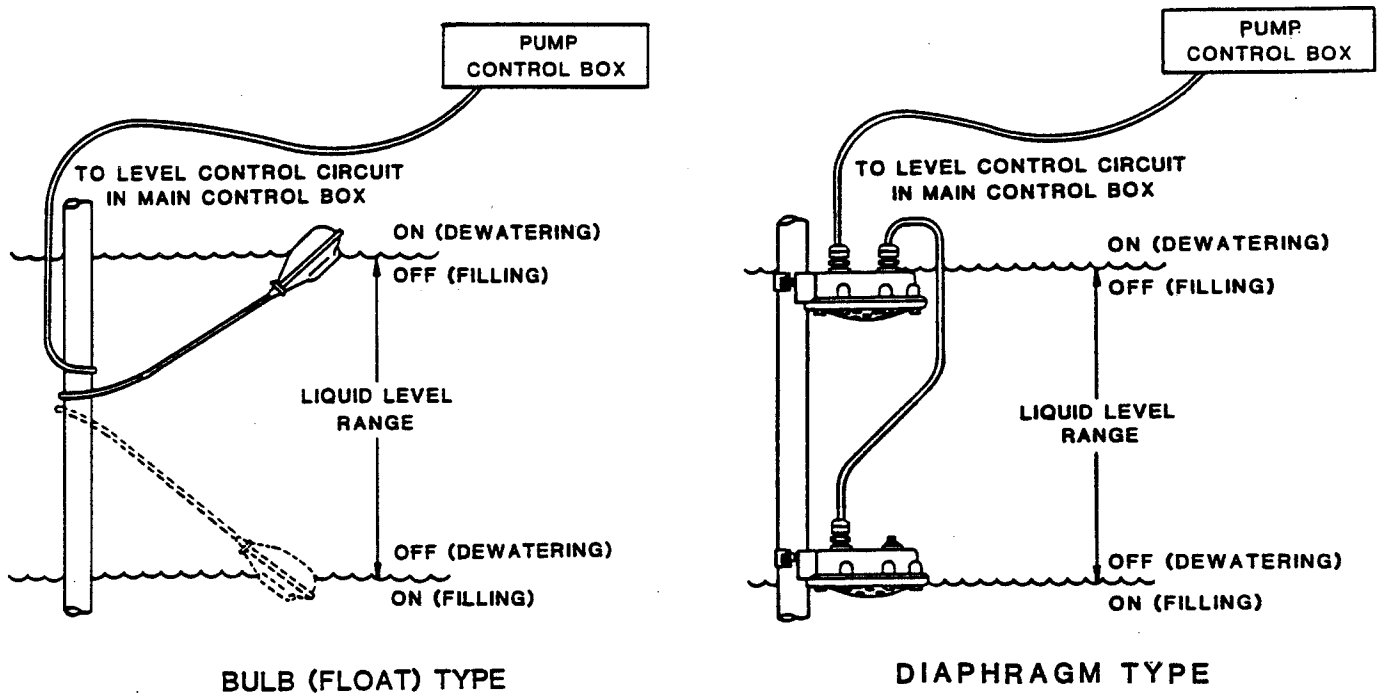


Figure 5. Liquid Level Devices

CAUTION

The internal wiring of the sensing devices are different for filling and dewatering functions. Be sure to follow the instructions included with the option before making wiring connections.

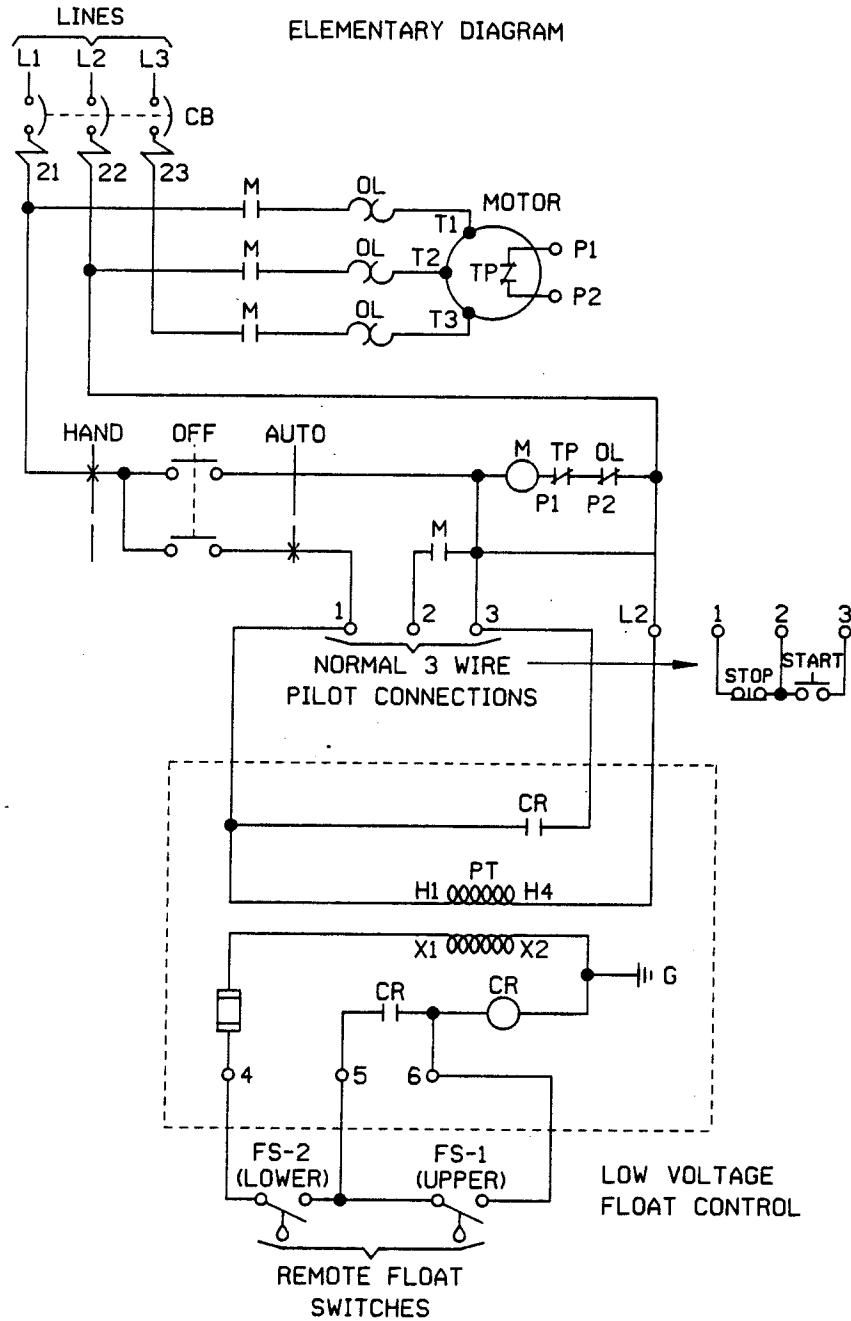


Figure 6. Elementary Diagram (27515-060 Standard Box With Liquid Level Controls Available)

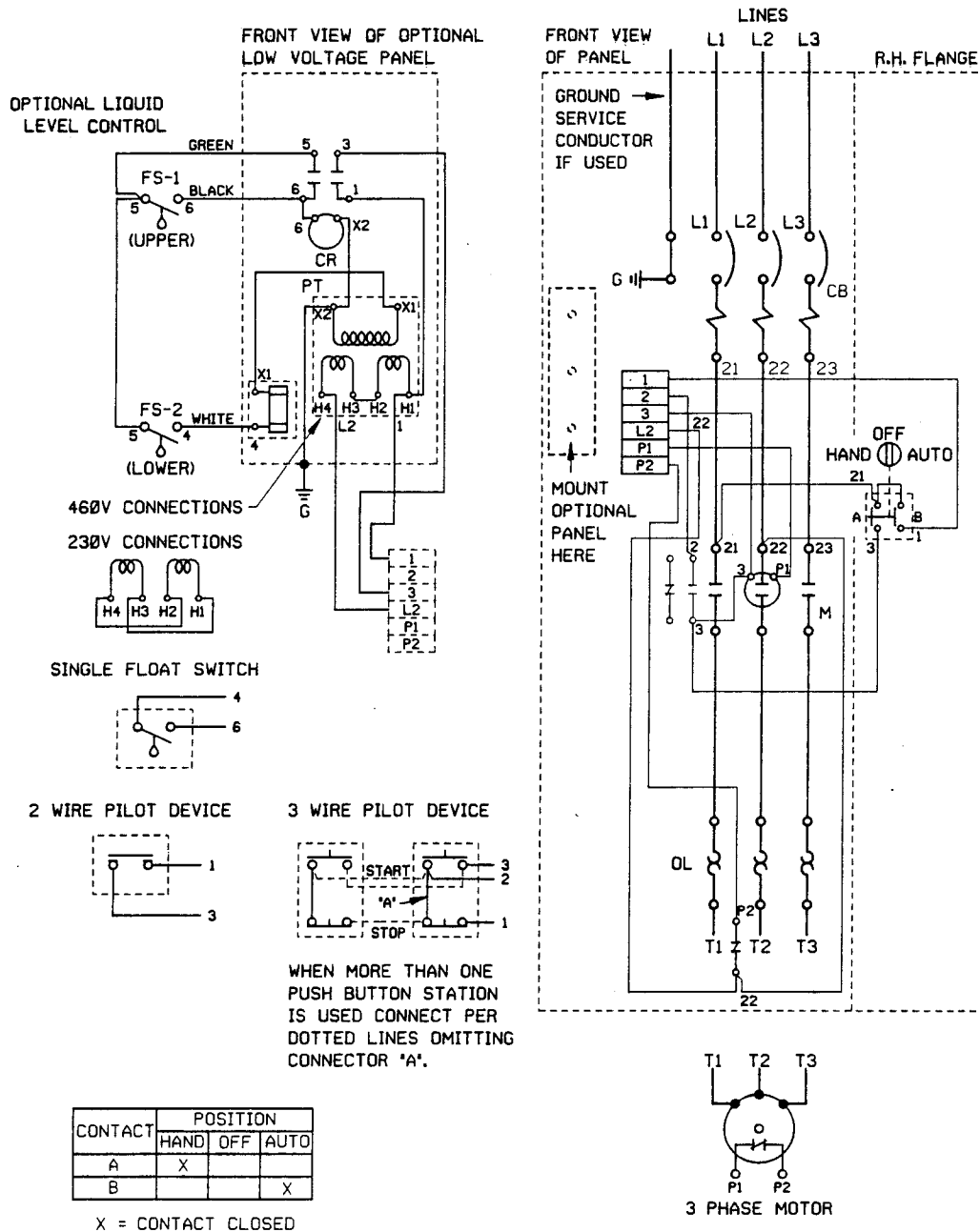


Figure 7. Pictorial Diagram And Control Box Data (27515-060 Standard Box With Liquid Level Controls Available)

Volts/Phase	Overload Relay				Breaker Size	Circuit Breaker	
	Heater Coil 10177-	Amps Hold	Amps Trip	LRA Trip Time		Cam Letter Setting	Cam Trip Amps*
460/3	H48	67	75	4.5 Sec.	100 Amp	E	700

*Maximum Setting Must Not Exceed 13 Times Full Load Amps

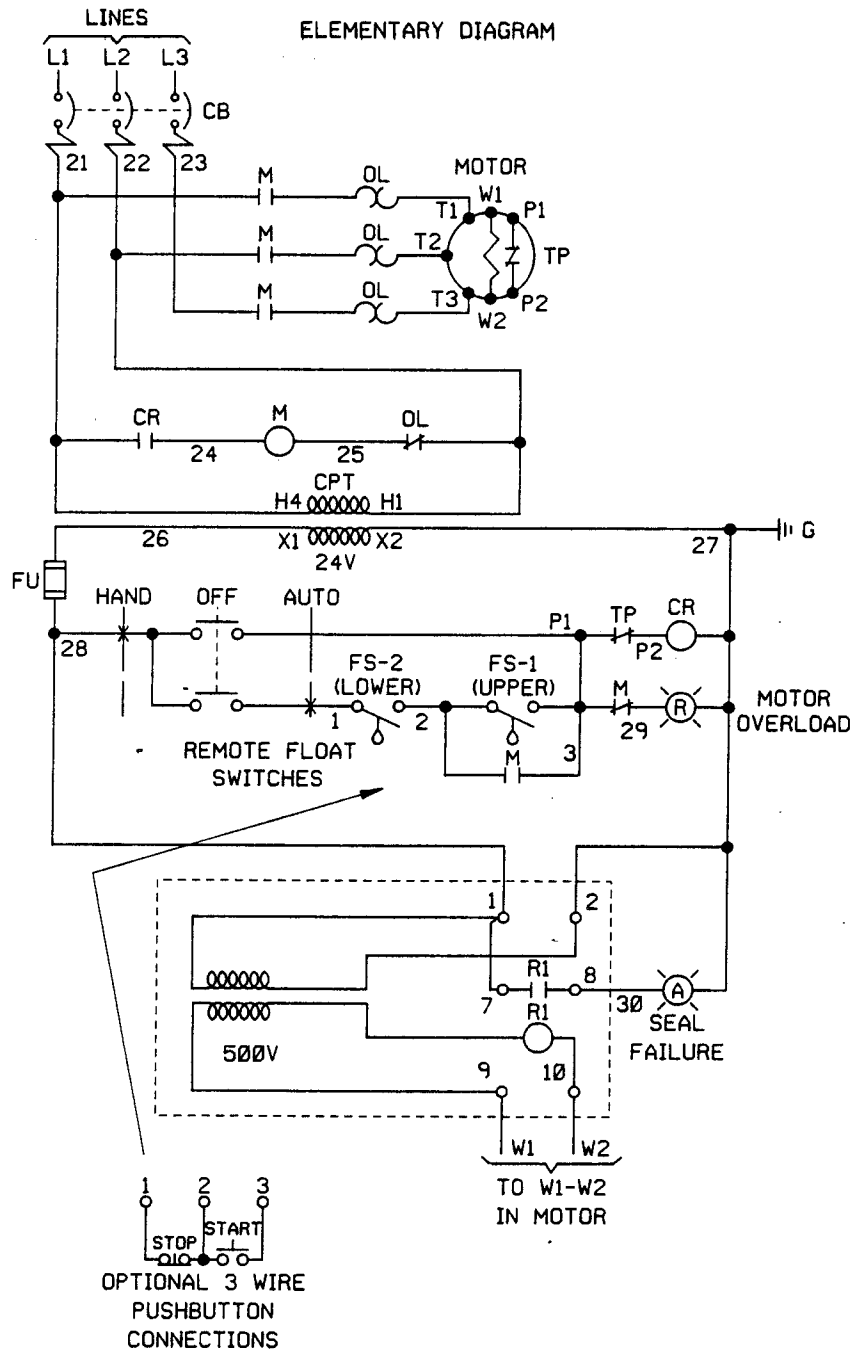


Figure 8. Elementary Diagram (27515-160 Optional Box With Liquid Level Controls Provided)

INSTALLATION

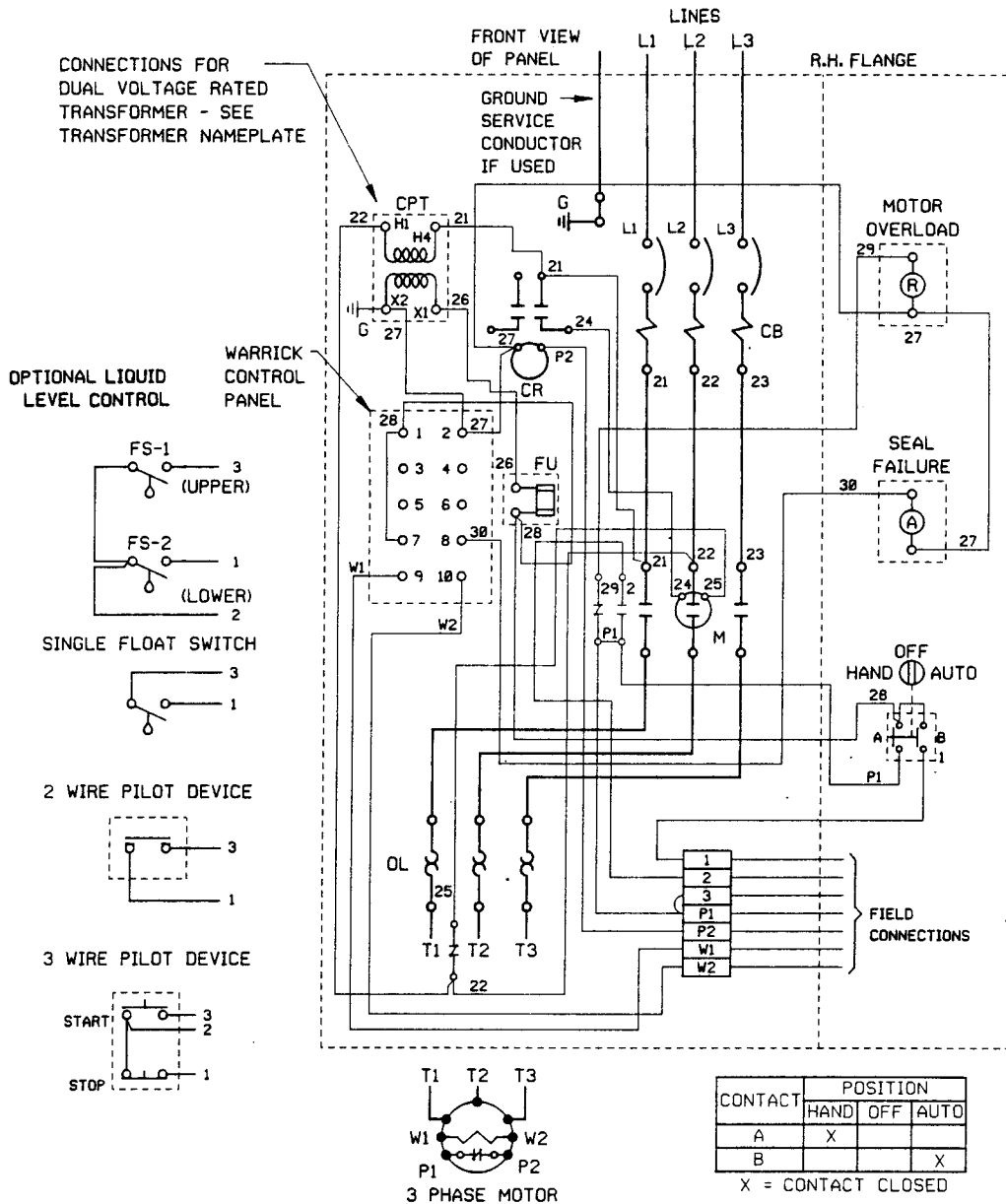


Figure 9. Pictorial Diagram And Control Box Data (27515-160 Optional Box With Liquid Level Controls Provided)

Volts/Phase	Overload Relay				Breaker Size	Circuit Breaker	
	Heater Coil 10177-	Amps Hold	Amps Trip	LRA Trip Time		Cam Letter Setting	Cam Trip Amps*
460/3	H48	67	75	4.5 Sec.	100 Amp	E	700

*Maximum Setting Must Not Exceed 13 Times Full Load Amps

REPAIR PARTS LIST, 27515-060 STANDARD CONTROL BOX

(Components Identified By Cutler Hammer Part Number - Series B1 Control)

ITEM NO.	PART NAME	PART NUMBER	MATL CODE	QTY
	CIRCUIT BREAKER - 100 AMP	C370HMCP3	-----	1
	CONTACTOR - 3 POLE	C10EN3	-----	1
*	RENEWAL CONTACTS	6-35-2	-----	3
	COIL	9-1889-3	-----	1
*	OVERLOAD RELAY	10-3099-13	-----	1
	HEATER COIL	10177-H48	-----	3
	COVER BOOT	32-524	-----	1
	SELECTOR SWITCH	10250T1423-2M51	-----	1
	CONTACT BLOCK	10250T2	-----	1

*INDICATES PARTS RECOMMENDED FOR STOCK.

REPAIR PARTS LIST, 27515-160 OPTIONAL CONTROL BOX

(Components Identified By Cutler Hammer Part Number - Series B1 Control)

ITEM NO.	PART NAME	PART NUMBER	MATL CODE	QTY
	CIRCUIT BREAKER - 100 AMP	C370HMCP3	-----	1
	CONTACTOR - 3 POLE	C10EN3	-----	1
*	RENEWAL CONTACTS	6-35-2	-----	3
	COIL	9-1891-3	-----	1
*	OVERLOAD RELAY	10-3099-13	-----	1
	HEATER COIL	10177-H48	-----	3
	COVER BOOT	32-524	-----	1
	SELECTOR SWITCH	10250T1423-2M51	-----	1
	CONTACT BLOCK	10250T2	-----	1
	PILOT LIGHT	10250T206	-----	2
	RED LENS	10250TC7	-----	1
	AMBER LENS	10250TC9	-----	1
	CONTROL TRANSFORMER	C340CNT	-----	1
	CONTROL RELAY	9575H2612	-----	1
	COIL	9-1811-14	-----	1
	WARRICK CONTROL	1D7E0	-----	1
	3.2 AMP, 250V FUSE	44-581	-----	1

*INDICATES PARTS RECOMMENDED FOR STOCK

OPERATION

OPERATION - SECTION C

CONTROL BOX FUNCTION

WARNING

```

////////////////////////////////////
//
// This pump motor and control box are not designed to be //
// explosion proof. Do not operate in an explosive atmos- //
// phere. //
// //
////////////////////////////////////

```

A control box is provided to facilitate operation of the pump. It contains controls for starting and stopping the pump, and provides overload protection for the pump motor. The pump control may be equipped with an optional automatic liquid level sensing device, in which case the low voltage circuits are also contained within the control box.

WARNING

```

////////////////////////////////////
//
// The pump motor is designed to be operated through the //
// control box furnished with the pump. The control box //
// provides overload protection and power control. Do not //
// connect the pump motor directly to the incoming power //
// lines. //
// //
////////////////////////////////////

```

CAUTION

Since operation of the pump motor is dependent upon the quality and performance of the electrical controls, the pump warranty is valid only when controls have been specified or provided by the Gorman-Rupp Company.

Component Function

The control box contains the following hand operated switches and controls:

- The **control handle** operates the control box circuit breakers. In the OFF position, the control handle opens the circuit breakers to interrupt incoming power through the control box and prevent pump operation. In the ON position, it closes the circuit breakers to permit pump operation. The circuit breakers will open or "TRIP" automatically in the event of a short circuit overload current, or thermal excess within the pump motor or electrical system. When tripped, move the control handle to OFF and back to ON to reset the circuit breakers.

OPERATION

- The **selector switch** (optional on some boxes) controls the mode of operation. In the OFF position, it prevents all operation of the pump. In the HAND position, it allows the pump to run continuously. In the AUTO position, it allows the pump to be controlled automatically by the optional liquid level control system, if used.
- The **reset** pushbutton resets the motor overload relay after it has been "TRIPPED" by an overload. The overload relay will trip automatically if the current drawn by the motor exceeds design specifications. (Do not confuse the function of the overload relay with that of the thermal overload protector within the motor. The reset pushbutton has no effect in restarting the pump after it has been shut down by the thermal overload protector within the pump motor).

NOTE

If the circuit breaker trips, do not reset it immediately. Wait at least ten minutes before resetting the control handle back to the ON position. If the overload unit continues to trip, operational problems exist. See TROUBLESHOOTING.

WARNING

```

////////////////////////////////////
//
// The motor will restart as soon as the RESET pushbutton //
// is pressed, unless the selector switch is in the OFF po- //
// sition. Turn the selector switch to OFF and move the //
// control handle to OFF before approaching the pump. //
//
////////////////////////////////////

```

- The **liquid level devices** (optional equipment) operate in conjunction with the 3-position switch (HAND-OFF-AUTO) supplied as a part of that option. After the level sensors and circuitry have been installed, pump operation may be automatically controlled for filling or dewatering functions. (See LIQUID LEVEL DEVICES, Section B.)

PUMP OPERATION

WARNING

```

////////////////////////////////////
//
// This pump is designed to handle most non-volatile and //
// non-flammable liquids which may be mildly corrosive and //
// abrasive. Do not attempt to pump liquids which may //
// damage the pump or endanger personnel as a result of //
// pump failure. //
//
////////////////////////////////////

```

Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 110°F. Do not apply it at a higher operating temperature.

Overheating can occur if the pump is misapplied, required to start repeatedly, or if the temperature of the liquid being pumped exceeds 110°F. Operating the pump against a closed discharge for an extended period will also cause the pump to overheat.

As a safeguard against rupture or explosion due to heat, this pump is equipped with a thermal overload protector which automatically shuts the motor down when the operating temperature exceeds designed limits. After the motor cools down, **it will automatically restart**. Always terminate power to the pump and control box before investigating pump or control box problems.

WARNING

```

////////////////////////////////////
//
// The pump motor is thermally protected and subject to au- //
// tomatic restart. Always terminate power to the pump and //
// control box before performing service functions. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Overheated pumps can cause severe burns and injury. If //
// overheating of the pump occurs: //
//
// 1. Stop the pump immediately. //
// 2. Allow the pump to cool. //
// 3. Refer to instructions in this manual before re- //
// starting the pump. //
//
////////////////////////////////////

```

Checking Pump Rotation

Check the direction of pump rotation before operation to ensure that the impeller is rotating in the correct direction.

Suspend the pump from the hoisting bail. Turn it on momentarily and note the direction of twist. For correct rotation and operation, the twist must be in the **counterclockwise** direction when viewed from the **top**.

CAUTION

Secure the pump during rotation check to prevent coiling of the power cable.

OPERATION

If the pump twists clockwise on start, interchange any two motor leads at the control box.

WARNING

```

////////////////////////////////////
//                               //
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Make certain that in- //
// coming power is OFF and LOCKED OUT before interchanging //
// motor leads.                                           //
//                                                       //
////////////////////////////////////

```

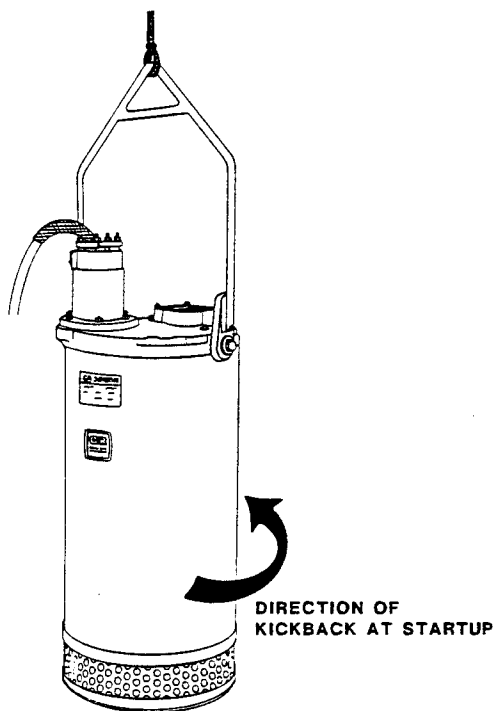


Figure 1. Checking Pump Rotation

STARTING

After the pump and control box have been installed, start the pump as follows.

NOTE

Before actual operation, check the direction of impeller rotation to ensure that the pump is properly wired. See Checking Pump Rotation in OPERATION section.

CAUTION

<p>Never start the pump more than 6 times per hour. If the motor does not cool between starts, it will overheat resulting in damage to the motor windings or control box components.</p>

Standard Pump (No Liquid Level Devices)

If no liquid level devices have been installed, move the control handle to the ON position and turn the selector switch to HAND. The pump motor will start and pumping should begin.

The pump will continue to operate until it is stopped by turning the selector switch to OFF.

With Automatic Liquid Level Devices

If optional liquid level devices have been installed, move the 3-position selector switch to OFF and the control handle to the ON position.

If desired to operate the pump in the manual mode, set the selector switch to HAND; the pump will continue to run until the switch is returned to OFF, or reset to AUTO.

If desired to operate the pump in the automatic mode, set the selector switch to AUTO; pump operation will be maintained by the optional liquid level control system. To terminate automatic mode, move the selector switch to OFF or HAND.

STOPPING

The pump is equipped with a thermal overload protector which automatically shuts the motor down when the operating temperature exceeds designed limits. After the motor cools down, it will automatically restart. Always terminate power to the pump and control box before investigating pump or control box problems.

WARNING

```

////////////////////////////////////
//
// The pump motor is thermally protected and subject to au- //
// tomatic restart. Always terminate power to the pump and //
// control box before performing service functions. //
//
////////////////////////////////////

```

To stop pump operation, turn the control handle OFF.

OPERATION

Power through the control box may be terminated by moving the control handle to the OFF position, thereby opening the circuit breakers. This **does not** terminate incoming power through the field wiring connected to the control box.

After stopping the pump, be sure to perform all required maintenance and preservation procedures.

NOTE

It is recommended that a check valve or throttling valve be installed in the discharge line if there is any possibility of siphoning or back flow when the pump is shut off.

Operation Checks

Check the pump for proper operation when it is first started and periodically thereafter to identify minor problems.

Check the pump for unusual noises or excessive vibration while it is operating. If noise or vibration is excessive, stop the pump and refer to the troubleshooting chart for possible causes.

Check the pump strainer screen for clogging caused by stones, sticks, or other debris. Clean the strainer screen when required. In some cases, stopping the pump momentarily may back flush the strainer screen, purging most of the debris from it. If this fails to clean the screen, remove the pump from the sump and remove the debris manually. See **PUMP DISASSEMBLY**.

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.

Check the pump for overheating. The pump could overheat if operated against a closed discharge valve, or subjected to repeated start cycles.

Cold Weather Preservation

In freezing temperatures, the pump will not freeze as long as it is submerged in liquid. If the pump casing is not submerged, or if the liquid begins to freeze, remove the pump from the sump or wet well and allow it to dry thoroughly. Run the pump for two or three minutes to dry the inner walls.

If the pump freezes, move it into a warm area until completely thawed, or submerge it into the liquid. If the liquid is near freezing, the pump must be submerged for an extended period of time. Start the pump and check for shaft rotation. If still frozen, allow additional thawing time before attempting to restart.

WARNING

////////////////////////////////////
//
// Do not attempt to thaw the pump by using a torch or oth- //
// er source of flame. This could damage gaskets or heat //
// the oil within the pump above the critical point and //
// cause the pump to rupture or explode. //
//
////////////////////////////////////

TROUBLESHOOTING - SECTION D

WARNING

```

//////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Obtain the services of //
// a qualified electrician to troubleshoot, test and/or //
// service the electrical components of this pump. //
//
//////////////////////////////////////
    
```

Many of the probable remedies listed in the troubleshooting chart below require use of electrical test instruments; for specific procedures, see **Electrical Testing** at the end of the troubleshooting chart.

TROUBLESHOOTING CHART

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO START, OVER-LOAD UNIT NOT TRIPPED (MANUAL MODE)	Power source incompatible with control box.	Correct power source.
	No voltage at line side of circuit breaker.	Check power source for blown fuse, open circuit breaker, broken lead, or loose connection.
	Open circuit in motor windings or power cable.	Check continuity.
	Defective motor power cable.	Replace cable.
	Thermal overload protection within the pump motor tripped (pump overheated).	Allow pump to cool. Correct cause of overheating.
	Motor defective.	Check for and replace defective unit.
	Liquid level device or control circuits improperly connected to main control box.	Check wiring diagrams; correct or tighten connections.
(AUTOMATIC MODE)	Level sensing device(s) improperly positioned.	Position device(s) at proper level.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO START, OVERLOAD UNIT NOT TRIPPED (AUTOMATIC MODE) (cont.)	<p>Level sensing device(s) fouled with mud or foreign material.</p> <p>Float type sensing device(s) tangled or obstructed.</p> <p>Defective liquid level sensing device(s) or control panel.</p>	<p>Clean sensing device(s).</p> <p>Check installation for free movement of float.</p> <p>Repair or replace defective unit(s).</p>
OVERLOAD UNIT TRIPS	<p>Low or high voltage, or excessive voltage drop between pump and control box.</p> <p>Defective insulation in motor windings or power cable; defective windings.</p> <p>Impeller jammed due to debris or insufficient clearance.</p> <p>Bearing(s) frozen.</p>	<p>Measure voltage at control box. Check that wiring is correct type, size, and length. (See Field Wiring Connection, Section B).</p> <p>Check insulation resistance; check continuity.</p> <p>Disassemble pump and check impeller.</p> <p>Disassemble pump and check bearing(s).</p>
MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE	<p>Discharge head too high.</p> <p>Low or incorrect voltage.</p> <p>Discharge throttling valve partially closed; check valve installed improperly.</p> <p>Discharge line clogged or restricted; hose kinked.</p> <p>Liquid being pumped too thick.</p> <p>Strainer screen or impeller clogged.</p>	<p>Reduce discharge head, or install staging adaptor and additional pump.</p> <p>Measure control box voltage, both when pump is running and when shut off.</p> <p>Open discharge valve fully; check piping installation.</p> <p>Check discharge lines; straighten hose.</p> <p>Dilute liquid if possible.</p> <p>Clear clog(s). Stop pump; back flow may flush away debris.</p>

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE (cont.)	Insufficient liquid in sump or tank. Worn impeller vanes; excessive impeller clear- ance. Pump running backwards.	Stop pump until liquid level rises. Check impeller and clearance. See PUMP END REASSEMBLY. Check direction of rotation and correct by interchanging any two motor leads at control box. (See Pump Rotation, Section C).
PUMP RUNS WITH EXCES- SIVE NOISE OR VIBRATION	Pumping entrained air. Damaged or unbalanced impeller. Discharge piping not properly supported. Impeller jammed or loose. Motor shaft or bearings defective. Pump cavitation.	Check liquid level in sump; check position of pump and liquid level sensing device(s). Replace impeller. Check piping installation. Check impeller. Disassemble pump and check motor and bearings. Reduce discharge head, or restrict flow on low head appli- cations.

ELECTRICAL TESTING

If you suspect that pump malfunctions are caused by defects in the motor, power cable or control box, perform the following checks to help isolate the defective part.

WARNING

```

////////////////////////////////////
//                               //
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Obtain the services of //
// a qualified electrician to troubleshoot, test and/or //
// service the electrical components of this pump.         //
//                               //
////////////////////////////////////

```

CAUTION

Be certain to refer to the wiring diagram(s) in the INSTALLATION section of this manual before reconnecting any electrical components which have been disconnected.

Test Equipment

A volt/amp/ohmmeter and megohmmeter of adequate range and quality will be required to conduct the following electrical tests. The suggested equipment indicated below is commercially available, or an equivalent substitute may be used.

Equipment	Manufacturer	Use
Amprobe Model 300 or Amprobe, Jr.	Pyramid Instrument Corp. Lynbrook, NY	To check AC Voltage and current (amperage)
Megohmer	Herman H. Sticht Co. 25 Bark Place New York, N.Y.	To measure resistance (ohms) to ground

Voltage Imbalance

Each phase of the incoming three-phase power must be balanced with the other two as accurately as a commercial voltmeter will read. If the phases are balanced, check out the motor as described below. If the phases are out of balance, contact your power company and request that they correct the condition.

TROUBLESHOOTING

- a. Use a voltmeter, Amprobe, or equivalent meter to read the voltage across terminals 1 & 2, 2 & 3, and 1 & 3 in the control box. All three measured voltages must be the same, as accurately as the meter will read. If possible, measure the voltage with the pump off, with the pump running but out of the water, and with the pump running in the water at full load. All the measured voltages at each condition must be the same.
- b. Use an Amprobe or equivalent meter to measure the current draw of each phase while the pump is running at full load and at no load. All three amperage readings must be the same at each condition, as accurately as the meter will read. Nominal amperage values are listed in Table 1, but these apply only when the actual voltage at the site is the nominal voltage listed.
- c. If the voltages are balanced with the pump off, but are unbalanced when the pump is running, a thorough check of the power source, all interconnecting cables, and the pump motor is required to isolate the defect.

Motor And Motor Power Cable Continuity

To check continuity, zero-balance the ohmmeter set at the RX1 scale, and test as follows:

- a. Disconnect the motor power cable leads from the control box and connect the test leads to any two of the three power cable leads (not to the green ground lead or yellow ground check lead). If there is a high resistance reading on the ohmmeter, there is an open or broken circuit caused by a break in the power cable or motor windings, or by a bad connection between the motor and the power cable. Switch one test lead to the third power lead, and test again.
- b. If an open or broken circuit is indicated, check the power cable for obvious damage, and replace as necessary (see **MAINTENANCE AND REPAIR**). If there is no apparent damage to the motor cable, remove the terminal housing (see **MAINTENANCE AND REPAIR**) and check the continuity of each power cable lead at the terminal posts.

NOTE

When shipped from the factory, the connections between the power cable leads and the terminal posts were encapsulated in heat-shrink tubing and bonded to the terminal plate with hot-melt adhesive. In service, these connections may have been potted by the pump operator. **Do not** cut the adhesive, tubing, or potting away unless absolutely necessary. Check the continuity of each lead from the **motor** side of the terminal plate. If the continuity reading is good, there is no need to remove the sealing material. If there is no continuity through the lead, remove the sealing material from only **that** terminal and check for a loose connection. After tightening the connection, recheck the continuity. **Be sure** to replace the tubing or potting and allow adequate drying time before putting the pump back into service. (See **Terminal Housing And Power Cable Reassembly**, Section E).

-
-
- c. If an open circuit still exists after each lead (terminal) has been tested and tightened, then the **entire** motor power cable must be replaced. Splicing or other means of repair are not recommended.
 - d. If no break is found in the power cable, check the motor leads for continuity. If the test reading indicates an open or broken circuit, there is an open circuit in the motor.

NOTE

It is recommended that a pump with a defective motor be returned to Gorman-Rupp, or to one of the Gorman-Rupp authorized Submersible Repair Centers.

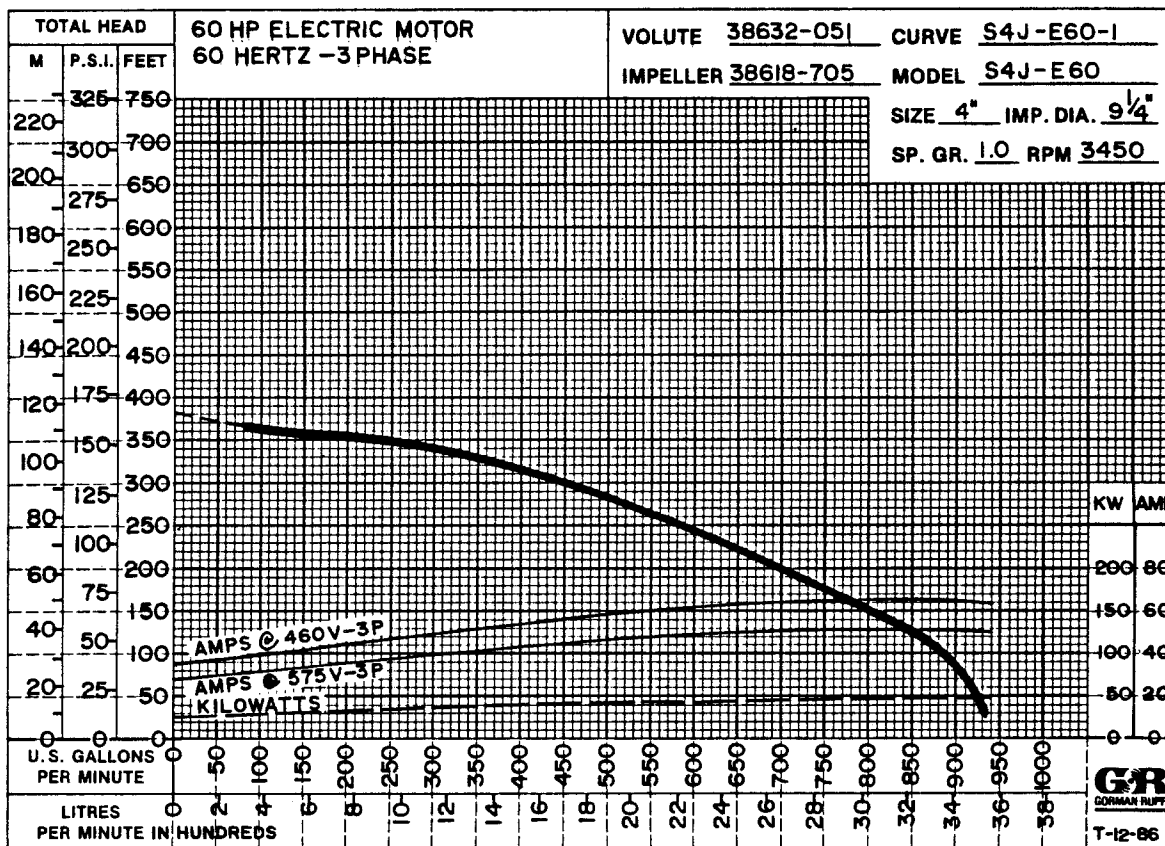
Insulation Resistance

To check insulation, zero-balance the ohmmeter set at the RX100K scale, and test as follows:

- a. Disconnect the motor power cable leads from the control box. Connect one test lead to the power cable green ground lead, and touch the other test lead to each of the three power leads in turn.
- b. The reading obtained will indicate resistance values in both the power cable and the motor windings. If the resistance reading is infinity (∞), the insulation is in good condition. If the reading is between infinity (∞) and 1 megohm, the insulation is acceptable but should be rechecked periodically. If the reading is less than 1 megohm, the insulation should be checked more closely; a reading of zero indicates that the power cable or the motor is grounded.
- c. To determine whether the power cable or the motor is grounded, remove the terminal housing (see **MAINTENANCE AND REPAIR**), disconnect the motor leads from the motor terminals, and test the power cable leads and motor leads separately.

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 S4J1-E60 460/3

*Based on 70°F clear water at sea level. 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.

SECTIONAL DRAWING

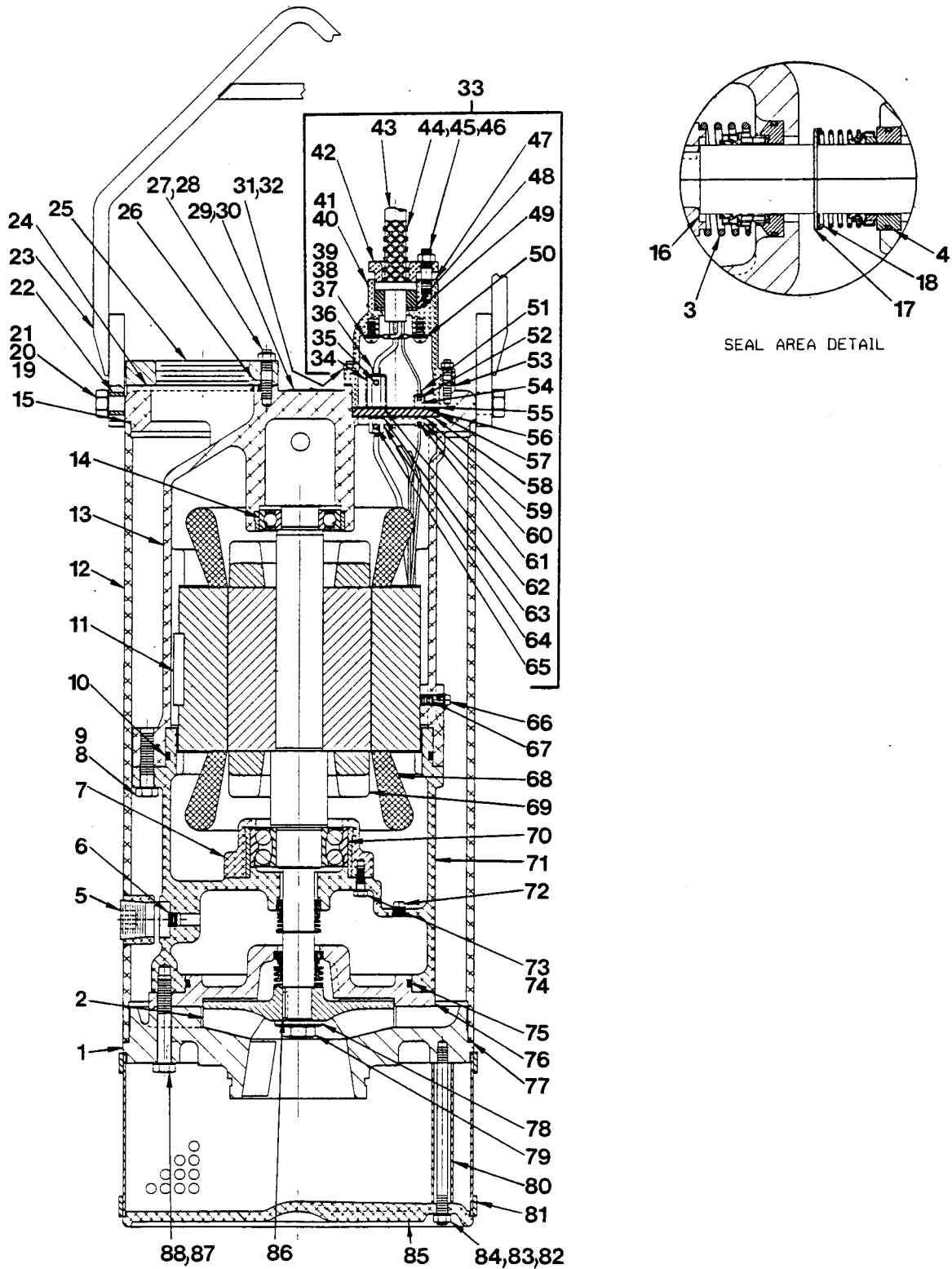


Figure 1. Pump Model S4J1-E60 460/3

PARTS LIST
Pump Model S4J1-E60 460/3
 (From S/N 806367 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	MATL CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MATL CODE	QTY
1	DIFFUSER	38632-051	1102H	1	56 *	-DYNA SEAL WSHR	S1590	-----	2
2	*IMPELLER	38618-705	1102H	1	57	-TERMINAL PLATE	38711-001	23010	1
3	*LOWER SEAL ASSY	46512-056	-----	1	58 *	-TERM PLATE GSKT	38687-529	20000	1
4	*UPPER SEAL ASSY	25284-961	-----	1	59 *	-DYNA SEAL WSHR	S1590	-----	2
5	SOC PIPE PLUG	PC24	17000	1	60	-TERMINAL POST	11181	14100	2
6	SEAL CAVITY DRAIN/FILL PLUG	PC06	17000	1	61	-A HD SETSCREW	GA#10-01-S	15991	2
7	BEARING CAP	38322-421	13040	1	62 *	-DYNA SEAL WSHR	S1586	-----	3
8	HEX HD CAPSCREW	B1008	17000	6	63 *	-DYNA SEAL WSHR	S1586	-----	3
9	LOCKWASHER	J10	17000	6	64	-TERMINAL POST	38724-009	14100	3
10	*LWR MOTOR HOUSING O-RING	S1676	-----	1	65	-A HD SETSCREW	GA0501 1/2	14990	3
11	KEY	N0812	17000	1	66	PIPE PLUG	P06	17000	2
12	OUTER MOTOR HOUSING	38311-809	13000	1	67	A HD SETSCREW	GA0802	15991	2
13	UPPER MOTOR HSG	38311-307	13040	1	68	STATOR ASSY	47113-047	-----	1
14	*UPPER BALL BRG	23282-010	-----	1	69	*ROTOR-SHAFT ASSY	47112-047	-----	1
15	*MOTOR HSG O-RING	25152-282	-----	1	70	*LOWER BALL BRG	23434-412	-----	1
16	*ADJ SHIM SET	37J	17090	1	71	LWR MOTOR HOUSING	38311-306	13040	1
17	UPPER SEAL RET RING	S245	-----	1	72	PIPE PLUG	P06	11990	1
18	SEAL SPRING WASHER	3929-C	17000	1	73	HEX HD CAPSCREW	B0605	15991	4
19	HEX HD CAPSCREW	B1208	15991	2	74	*DYNA SEAL WASHER	S1586	-----	4
20	LOCKWASHER	J12	15991	2	75	*SEAL PLT O-RING	S1990	-----	1
21	FLAT WASHER	K12	15991	2	76	SEAL PLATE	38272-525	1102H	1
22	BUSHING	10045	15071	2	77	*MOTOR HSG O-RING	25152-282	-----	1
23	HOISTING BAIL ASSY	44713-026	2415V	1	78	IMPELLER WASHER	31131-026	17000	1
24	*DISCH FLANGE GSKT	38687-049	20000	1	79	IMPELLER NUT	AT14-S	17000	1
25	DISCHARGE FLANGE	38641-303	10010	1	80	STRAINER SUPPORT	31412-034	15079	6
26	PIPE PLUG	P04	17000	1	81	STRAINER ASSY	46611-008	2415V	1
27	STUD	C0809	15991	6	82	STUD	C0834	15991	6
28	HEX NUT	D08	15991	6	83	LOCKWASHER	J08	15991	6
29	NAME PLATE	2613-GH	17020	1	84	HEX NUT	D08	15991	6
30	DRIVE SCREW	BM#04-03	17000	2	85	BASE PLATE	38352-306	13080	1
31	STUD	C0607	15991	4	86	*IMPELLER KEY	N0405	17000	1
32	DEFORM LOCKNUT	DD06	15991	4	87	HEX HD CAPSCREW	B1017	17000	6
33	TERM HOUSING AND POWER CABLE ASSY	47367-057	-----	1	88	LOCKWASHER	J10	17000	6
34	-TERMINAL COLLAR	10144	14100	3	NOT SHOWN:				
35	-A HD SETSCREW	GA0501 1/2	14990	3	460V CONTROL BOX	27515-060	-----	1	
36 *	-HEAT SHRINK TUBE	31413-014	19530	3	SUBMERSIBLE PUMP	9568	-----	1	
37	-TERMINAL	S1550	-----	1	OIL - 1 QT.				
38	-RD HD SETSCREW	X0603	14990	2	IMPELLER PULLER	48711-018	-----	1	
39	-T TYPE LOCKWASHER	AK06	15991	2	MOTOR VOLTAGE TAG	6588-BL	-----	1	
40	-DRIVE SCREW	BM#04-03	17000	4	OPTIONAL:				
41	-INFORMATION PLATE	38816-145	17050	1	6" DISCH FLANGE	38642-207	10010	1	
42	-TERMINAL GLAND	38381-614	13040	1	REPAIR GASKET KIT	11000-AD	-----	1	
43 *	-50 FT CABLE	47325-006	-----	1	HEAT SHRINK TUBE	48315-010	-----	1	
44 *	-CABLE GRIP	11227-K	-----	1	AND ADHESIVE KIT				
45	-STUD	C0808	15991	2	LIQUID LEVEL DEVICES:				
46	-HEX NUT	D08	15991	2	DIAPHRAGM TYPE	GRP48-03 or GRP48-06	1		
47	-TERMINAL HOUSING	38381-235	13040	1	FLOAT TYPE (50')	27471-155	-----	1	
48 *	-GLAND BUSHING	31143-067	19100	1	FLOAT TYPE (100')	27471-156	-----	1	
49	-TERMINAL WASHER	31133-122	15991	1	LOW VOLTAGE	S1657	-----	1	
50	-TERMINAL	27214-035	-----	1	CONTROL - 24 VOLT				
51 *	-HEAT SHRINK TUBE	31412-056	19530	2	MOISTURE DETECTION DEVICES:				
52	-A HD SETSCREW	GA#10-01-S	15991	2	PROBE DETECTOR	27479-003	-----	1	
53 *	-TERM HSG GSKT	38681-616	20000	1	PROBE WIRE ASSY	47335-030	-----	1	
54	-TERMINAL COLLAR	31811-057	14100	2	460V CONT BOX	27515-160	-----	1	
55 *	-TERM PLATE GSKT	38687-529	20000	1	TERM HSG/CBL ASSY	47367-058	-----	1	

*INDICATES PARTS RECOMMENDED FOR STOCK

Above Serial Numbers Do Not Apply To Pumps Made In Canada.

PUMP AND MOTOR DISASSEMBLY AND REASSEMBLY

The following maintenance and repair instructions are keyed to the sectional view (see Figure 1) and the accompanying parts list.

Before attempting to service the pump or control, cut off the power supply to the control box and close any valves in the discharge line.

The pump is equipped with a thermal overload protector which automatically shuts the motor down when operating temperature exceeds designed limits. After the motor cools down, it will automatically restart. Always terminate power to the pump and control box before investigating pump or control box problems.

WARNING

```

////////////////////////////////////
//
// The pump motor is thermally protected and subject to au- //
// tomatic restart. Always terminate power to the pump and //
// control box before performing service functions. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// The electrical power to operate this pump is high enough //
// to cause injury or death. Make certain that the control //
// handle on the control box is in the OFF position and //
// locked, or that the power supply to the control box has //
// been otherwise cut off and locked out, before attempting //
// to open or service the pump assembly. Tag electrical //
// circuits to prevent accidental start-up. //
//
////////////////////////////////////

```

WARNING

```

////////////////////////////////////
//
// Do not attempt to lift the pump by the motor power cable //
// or the piping. Attach proper lifting equipment to the //
// lifting device fitted to the pump. If chains or cable //
// are wrapped around the pump to lift it, make certain //
// that they are positioned so as not to damage pump, and //
// so that the load will be balanced. //
//
////////////////////////////////////

```

Use the hoisting bail to lift the pump from the wet well to a location where the discharge line can be removed. It is not necessary to disconnect a flexible discharge hose before removing the pump. If rigid discharge piping is used, disconnect the piping or remove the discharge flange (25) before attempting to lift the pump.

To remove the discharge flange, remove the nuts (28) and pull the flange off the studs (27). Remove the flange gasket (24).

Select a suitable location, preferably indoors, to perform the degree of maintenance required. If the motor housing is to be opened, the work must be done in a clean, well-equipped shop. All maintenance functions must be performed by qualified personnel.

Check the chart in **TROUBLESHOOTING** to determine the nature of the pump problem. If the problem is mechanical in nature, such as worn pump parts, seal replacement, lubrication, etc., refer to **PUMP END DISASSEMBLY** for instructions.

If the problem is electrical, complete disassembly may not be required. Refer to **Electrical Testing** and have a qualified electrician check out the control box, cable and terminal housing assembly. If the problem is determined to be in the motor, proceed with **PUMP END DISASSEMBLY** followed by **MOTOR DISASSEMBLY**. Otherwise, see **Control Box and Terminal Housing And Power Cable Disassembly**.

Carefully inspect any O-rings or gaskets before removal and cleaning to determine if a proper seal and compression existed prior to disassembly. If sealing was faulty or questionable, the cause must be determined and corrected before reassembly. All gaskets and O-rings **must** be replaced if disturbed. A repair gasket kit is listed on the parts list as an option.

PUMP END DISASSEMBLY

Base Plate And Strainer Assembly Removal

To remove the strainer (81) and base plate (85) raise the pump slightly, or lay it on its side and remove the hardware (83 and 84) securing the screen and base plate. Remove the strainer supports (80).

If the impeller is clogged, the debris can usually be removed without further pump disassembly.

Draining Oil From Seal Cavity

If any further disassembly is to be performed on the pump, the seal oil cavity must be drained.

CAUTION

Let the pump cool before removing the seal cavity drain plug. Pressure built up within a hot pump could cause the oil to spray out when the plug is removed. Remove the plug slowly and permit pressure to vent to atmosphere.

Lay the pump on its side with the pipe plug (5) facing up. Clean any dirt from around the plug before removing it.

Remove the seal cavity drain plug (6) and install a short 3/8-inch NPT nipple in the hole. Tip the pump and drain the seal oil into a **clean** container. Inspect it for water, dirt or cloudy condition which could indicate lower seal failure or poor gasket seal.

Positioning Pump For Disassembly

It is recommended that the pump be positioned upside down during disassembly. To hold the pump in the inverted position, secure the discharge studs (27) to a bench or work stand, or rest the pump securely on blocks. Be careful not to damage the terminal housing (47) or cable (43) while in this position. Use adequate equipment and personnel to safely handle the pump until it is secured.

If inverting the pump is not practical, lay the pump on its side and secure it.

Diffuser Removal

Remove the hardware (87 and 88) securing the diffuser (1) to the seal plate (76) and lower motor housing (71). Remove the diffuser, and remove and discard the lower motor housing O-ring (77).

Impeller Removal

Temporarily reinstall two of the capscrews (87). Wedge a piece of wood between the vanes of the impeller (2) and the capscrews to prevent shaft rotation. Remove the impeller nut (79) and washer (78).

Remove the wood from the impeller vanes, and remove the capscrews (87) temporarily installed in the seal plate and lower motor housing. Refer to Figure 2, install the impeller puller supplied with the pump, and pull the impeller from the shaft. Use caution when removing the impeller; tension on the seal spring will be released. Retain the impeller key (86).

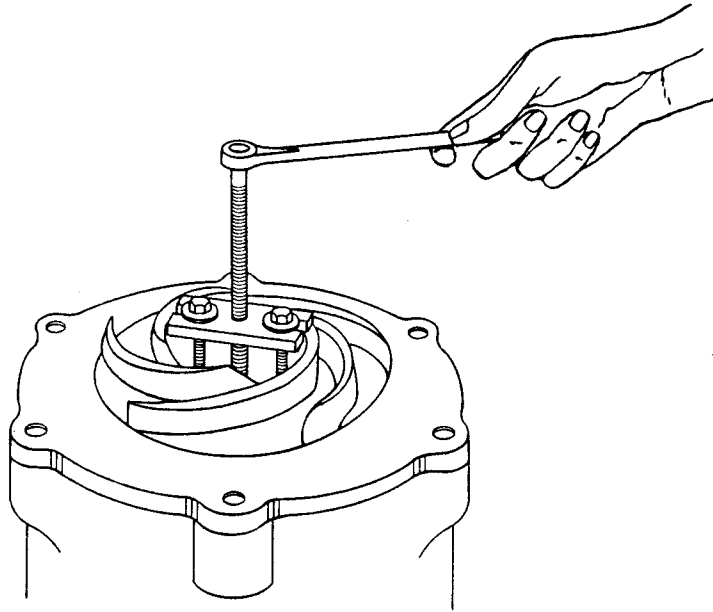


Figure 2. Removing Impeller With Puller

Remove the impeller adjusting shims (16); for ease of reassembly tie and tag the shims, or measure and record their thickness.

Lower Seal Removal

(Figures 1 and 3)

Remove the seal spring. Lubricate the rotor shaft adjacent to the seal, and work oil under the rubber bellows. If necessary, use a stiff wire with a hooked end to pull the rotating portion of the seal from the shaft.

To remove the stationary portion of the seal, slide the seal plate (76) off the shaft. Place the seal plate on a flat surface with the impeller side down. Use a dowel to press the stationary seat and O-rings out of the seal plate.

The rotating and stationary seal elements are precision finished and subject to wear. The complete seal should be replaced with each overhaul to ensure trouble-free operation. However, if the old seal must be reused, wrap the seal faces individually in tissue paper to prevent damage to the sealing surfaces.

Remove the seal plate O-ring (75).

If no further disassembly is required, proceed to the appropriate areas in **PUMP END REASSEMBLY**.

Upper Seal Removal

(Figures 1 and 3)

Unless cracked or otherwise worn, it is not necessary to remove the lower motor housing (71) for access to the upper seal assembly (4).

CAUTION

If lower motor housing removal is desired, see the procedure under Rotor Disassembly in MOTOR DISASSEMBLY in this section. DO NOT attempt to loosen the hardware (8 and 9) securing the lower motor housing or the hardware (73 and 74) securing the bearing cap (7) before referring to this section; otherwise, the rotor shaft and bearings could be damaged.

Remove the seal retaining ring (17) with snap ring pliers. Use caution when removing the snap ring; tension of the seal spring will be released. Remove the seal spring retainer and spring. Lubricate the rotor shaft adjacent to the seal, and work oil under the bellows. Position a screwdriver or other suitable device on each side of the bellows retaining flange and pry the bellows upward until the rotating portion is off the shaft.

Slide the hooked ends of two wires along the shaft and under the stationary seal seat. Hook the back side of the seat and pull it from the intermediate.

NOTE

Do not disassemble the motor unless it is necessary and a clean, well-equipped shop is available. If the motor housing components are to be serviced, see **MOTOR DISASSEMBLY** in this section. Do not reassemble the pump end components at this time.

If no further disassembly is required, proceed to the appropriate areas in **PUMP END REASSEMBLY**.

PUMP END REASSEMBLY

NOTE

Reuse of old O-rings, gaskets, or shaft seal parts may result in premature leakage or reduced pump performance. It is strongly recommended that an overhaul gasket kit and shaft seal assembly be used during reassembly (see the parts list for numbers).

MAINTENANCE AND REPAIR

Cleaning Old Parts

With the pump inverted, stuff a clean tissue into the seal bore of the lower motor housing (or wrap a small rag around the shaft) to prevent foreign material from entering the motor cavity.

Carefully inspect any O-rings or gaskets before removal and cleaning to determine if a proper seal and compression existed prior to disassembly. If sealing was faulty or questionable, the cause must be determined and corrected before reassembly. Replace any parts as required.

Thoroughly clean all reuseable parts. Remove all O-rings and gaskets and clean the sealing surfaces of dirt or gasket material. Be careful not to scratch gasket surfaces.

WARNING

```

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

```

Neither of the shaft seal assemblies should be reused because wear patterns on the finished faces cannot be realigned during reassembly. This could result in premature failure. If necessary to reuse an old seal in an emergency, **carefully** wash all metallic parts in fresh cleaning solvent and allow to dry thoroughly.

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

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. If any components are worn, replace the complete seal; **never mix old and new seal parts.**

Install the shaft seals as illustrated in Figure 3.

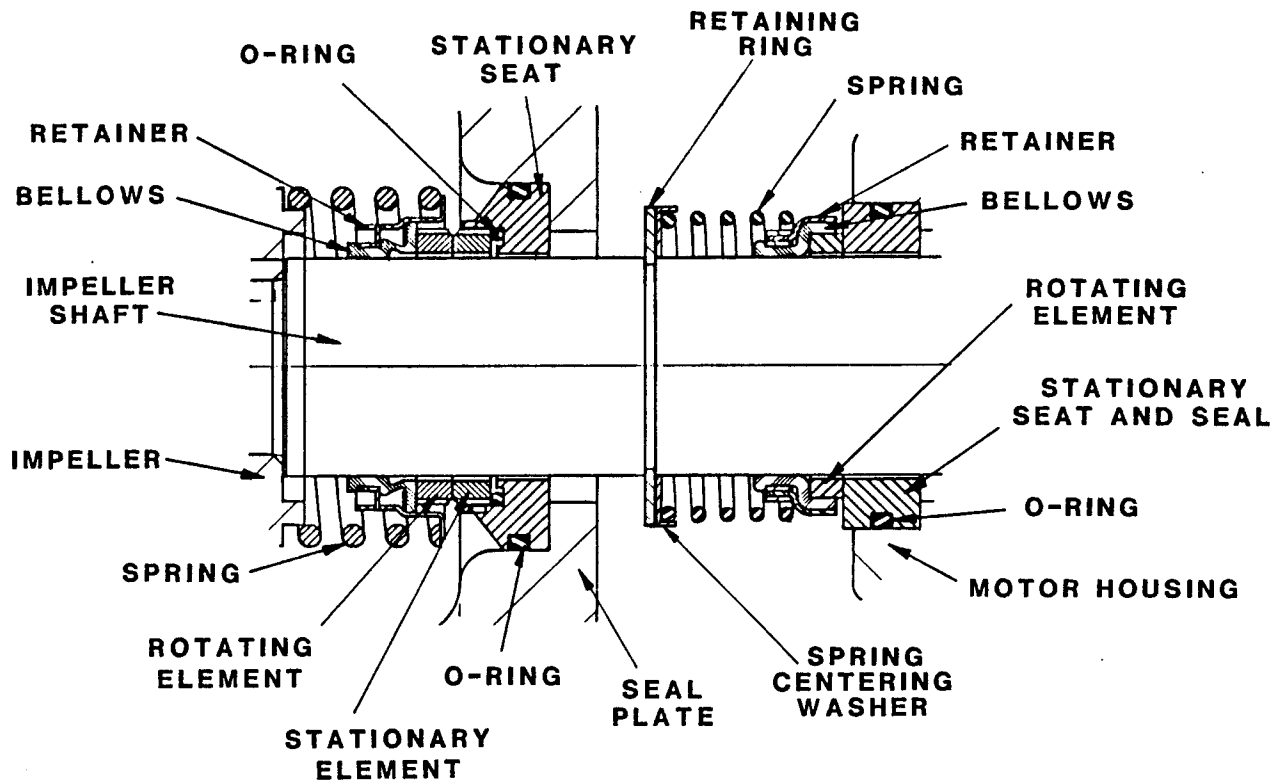


Figure 3. Seal Assemblies 46512-056 and 25284-961

Upper Seal Installation

Inspect the end of the rotor shaft for damaged threads, scoring, or a damaged keyway. Remove nicks and burrs with a fine file or hand honing stone to restore original contours. If the shaft is bent or damaged, the complete shaft and rotor assembly (69) must be replaced (see **MOTOR DISASSEMBLY**).

If a new seal is to be installed, do not unwrap it until time of installation. Cleanliness of all seal components is a must, especially the seal faces.

Carefully remove the material stuffed into the seat bore (or unwrap the shaft). **Be sure** no debris stopped by the material falls into motor cavity.

Clean the rotor shaft and seal cavity area of the lower motor housing (71). Be sure the area is dry and free of lint and dirt. Check the O-ring bore for burrs or nicks that might cut the seal O-ring or prevent a good seal. Apply a **light** coating of oil to the bore.

MAINTENANCE AND REPAIR

NOTE

When pressing seal components onto the impeller shaft, use hand pressure only. A push tube cut from a length of plastic pipe will aid in installing seal components. The I.D. of the push tube should be approximately the same as the I.D. of the seal spring.

Unpack the stationary seal seat and install the O-ring, taking care not to touch the sealing face. Apply a **light** coating of oil to the stationary seat O-ring. Keep the sealing face dry.

Position the seat in the bore with the sealing face up and cover it with a clean tissue. Use your thumbs to press the seal into the bore. Apply equal pressure on opposite sides of the seat until it contacts the bore shoulder. Remove the tissue and inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use clean tissue to wipe **lightly** in a concentric pattern.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. Place a **small** amount of grease at equal spaces on the back of the element and assemble the drive grooves of the rotating element into the drive lugs of the bellows retainer. The grease should hold the element in position until the seal is installed.

Apply a light coating of oil to the seal seating surface on the shaft, the groove for the retaining ring (17), and the I.D. of the bellows. Position the rotating seal portion on the shaft with the seal face down. Apply firm, steady pressure, with clean hands, on the seal retainer until it slides down the shaft and the seal faces contact. This step should be done in one continuous motion to prevent the bellows from sticking or rolling as it passes over the retaining ring groove.

Slide the seal spring over the shaft and bellows retainer, and install the spring retainer. Install the seal retaining ring (17). See Figure 3 for proper order of seal assembly.

Lower Seal Installation

Thoroughly clean the gasket surfaces and seal bore of the seal plate (76). The seal bore must be free of burrs and nicks which could damage the seal.

NOTE

When pressing seal components onto the impeller shaft, use hand pressure only. A push tube cut from a length of plastic pipe will aid in installing seal components. The I.D. of the push tube should be approximately the same as the I.D. of the seal spring.

Unpack the stationary seat, and check that the O-rings are properly installed (see Figure 3). Press the stationary element into the seat, making sure that the grooves in the element engage the lugs on the seat. Apply a light coating of oil to the seal plate bore and the outer O-ring.

Place a clean tissue over the sealing face of the stationary element and press the stationary subassembly into the seal plate bore until it bottoms squarely. Remove the tissue and inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use clean tissue to wipe lightly in a concentric direction.

Apply a light coating of oil to the seal plate O-ring (75) and the O-ring seating surface in the lower motor housing. Install the O-ring in the seal plate, align the holes for the capscrews (86), and carefully press the seal plate into the lower motor housing until squarely seated. **Be careful** not to damage the stationary seal face or seal plate O-ring.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. Place a **small** amount of grease at equal spaces on the back of the element and assemble the drive grooves of the rotating element into the drive lugs of the bellows retainer. The grease should hold the element in position until the seal is installed.

Apply a light coating of oil on the rotor shaft and the I.D. of the bellows. Place the rotating seal portion on shaft with the seal face down. Apply firm, steady pressure, with clean hands, on the bellows retainer until it slides down the shaft and the seal faces contact.

Slide the seal spring over the shaft and bellows retainer. See Figure 3 for proper order of seal assembly.

Impeller Installation

Install the same thickness of impeller shims (16) as originally removed.

NOTE

The clearance between the face of the impeller and the diffuser (1) can be measured only after the impeller and diffuser are installed.

Inspect the impeller (2), and replace it if cracked or worn. Clean the threads on the rotor shaft to remove any old thread locking material.

Install the impeller key (86) in the rotor shaft, align the impeller, and push it on until firmly seated against the impeller adjusting shims.

After the impeller has been installed, coat the threads of the rotor shaft with 'Loctite Threadlocker No. 242' or equivalent compound. Install the impeller washer (78) and nut (79).

Install two capscrews (87) in the seal plate and lower motor housing. Wedge a block of wood between the impeller vanes and capscrews to prevent shaft rotation, and torque the impeller nut to 175 ft. lbs. (2100 in. lbs.). After the impeller nut is installed, remove the capscrews and wood block.

Thoroughly clean the diffuser and its O-ring surface. Install the lower motor housing O-ring (77) on the motor housing shoulder. Align the holes in the diffuser with those in the seal plate and intermediate, and press the diffuser into the motor housing until fully seated.

MAINTENANCE AND REPAIR

Apply 'Never-Seez' or equivalent compound on the threads of the capscrews (87). Install the capscrews and lockwashers (88), and torque them evenly in a cross-sequence to 120 ft. lbs. (1440 in. lbs.).

For maximum pump efficiency, there should be clearance of .010 to .015 inch between the diffuser and the face of the impeller. Reach through the diffuser opening with a feeler gauge to measure this clearance.

If the impeller clearance is not within specified limits, remove the diffuser and impeller, then add or remove impeller adjusting shims (16) as required. Reinstall the impeller and suction head, and recheck clearance.

Base Plate And Strainer Assembly Installation

Position the strainer screen (81) against the diffuser shoulder. Slide the strainer supports (80) over the diffuser studs (82). Install the base plate (85), and secure it with the hardware (83 and 84).

See LUBRICATION and FINAL ASSEMBLY before putting the pump back into service.

MOTOR DISASSEMBLY

Disassembly of the motor is rarely required except to replace the rotor, stator, or bearings. Do not disassemble the motor unless it is necessary and a clean, well-equipped shop is available.

NOTE

It is recommended that a pump with a defective motor be returned to Gorman-Rupp, or to one of the Gorman-Rupp authorized Submersible Repair Centers.

WARNING

```

////////////////////////////////////
//
// The electrical power to operate this pump is high enough //
// to cause injury or death. Make certain that the control //
// handle on the control box is in the OFF position and //
// locked, or that the power supply to the control box has //
// been otherwise cut off and locked out, before attempting //
// to open or service the pump assembly. Tag electrical //
// circuits to prevent accidental start-up. //
//
////////////////////////////////////

```

Carefully inspect any O-rings or gaskets before removal and cleaning to determine if a proper seal and compression existed prior to disassembly. If sealing was faulty or questionable, the cause must be determined and corrected before reassembly. Replace any parts as required.

Terminal Housing And Power Cable Disassembly

Total disassembly of the terminal housing and power cable is not always required. Disassemble and replace only the parts proven defective by inspection or testing. See **Electrical Testing** in TROUBLESHOOTING.

The terminal housing and power cable assembly (33) can be serviced without disassembling the motor housing or pump end.

Secure the pump in an upright position. To remove the terminal housing (47), remove the locknuts (32) securing it to the upper motor housing (13). Raise the terminal housing for access to the motor terminal posts (60 and 64). Loosen the allen head setscrews (61 and 65), and disconnect the motor leads from the terminal posts. Separate the terminal housing and power cable assembly from the motor housing. Remove the terminal housing gasket (53).

To separate the power cable (43) from the terminal housing, remove the nuts (46) securing the terminal gland (42) to the terminal housing. Slide the gland back along the power cable. Compress the wire mesh of the cable grip (44) and move it back along the power cable. Oil the gland bushing (48) and terminal housing bore and pull firmly on the cable. (Allow the oil to leak in around the bushing by agitating the cable in the bore.) After the bushing has been loosened, the cable should pull out far enough to expose the gland bushing. Apply oil on the cable jacket and slide the bushing back along the cable. Quite often, pressure exerted on the bushing will deform the cable jacket. If such is the case, additional oil and effort will be required to remove the bushing.

NOTE

If the rubber bushing cannot be removed from the terminal housing as indicated, it may be necessary to cut the bushing into small pieces or cut the cable.

Push approximately 6 inches of the power cable into the terminal housing so that the terminal plate (57) comes free of the terminal housing. This should permit access to the power cable connections in the terminal plate.

To disconnect the power cable, remove the round head screws and lockwashers (38 and 39) securing the terminals (37 and 50) of the green and yellow ground leads.

When shipped from the factory, the connections between the power cable leads and the terminal collars (34 and 54) were encapsulated in heat-shrink tubing (36 and 51) and bonded to the terminal plate (57). (In service the heat-shrink tubing may have been replaced by potting compound during previous repair.) Cut away the tubing and adhesive (or potting) and loosen the allen head setscrews (35 and 52) in the terminal collars. Disconnect the power cable leads from the terminal collars and pull the power cable out of the terminal housing.

The terminal washer (49), bushing (48), cable grip (44) and terminal gland (42) can be removed from the cable.

If necessary to replace the terminal plate (57) or terminal components, unscrew the terminal collars (34 and 54), and remove the dyna-seal washers (56 and 62). Remove the terminal posts (60 and 64) from the terminal plate.

See **Terminal Housing And Power Cable Reassembly** if no further disassembly is required.

Rotor Removal And Disassembly

See **PUMP END DISASSEMBLY**, and remove all pump end and seal components.

With the pump end disassembled, secure the pump in an inverted position. Carefully slide the motor housing (12) off the upper and lower motor housings (13 and 71). Remove the upper motor housing O-ring (15).

Remove the hardware (8 and 9) securing the lower motor housing to the upper motor housing. Do **not** remove the four capscrews (73) around the rotor shaft.

See Figure 4, and install three 1/2-16 UNC lifting eyes (not supplied) in the tapped holes for the capscrews (87) in the lower motor housing, and hook a three-leg sling to the lifting eyes. Use a suitable hoist to support the pump.

Install two 3/8-16 UNC by 3 inch long capscrews (not supplied) in the jacking holes in the lower motor housing. Use the capscrews to jack the lower motor housing, rotor and shaft assembly (69), bearing cap (7) and both ball bearings (14 and 70) from the upper motor housing as an assembly. If necessary, tap around the parting surfaces with a soft-faced mallet to break the seal between the upper and lower motor housings. Remove the lower motor housing O-ring (10).

Remove the jacking screws from the lower motor housing.

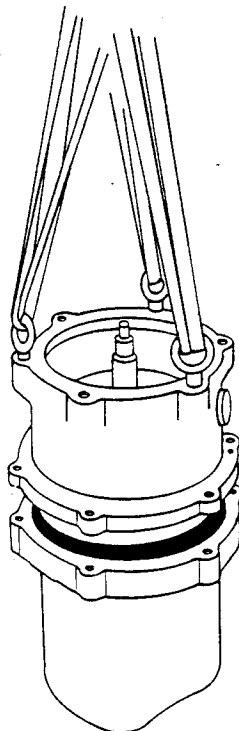


Figure 4. Separating Lower Motor Housing And Assembled Parts From Upper Motor Housing

Cover the upper motor housing with a clean, lint-free cloth to avoid contamination by dirt or other foreign material.

Set the lower motor housing and rotor assembly on a clean work area. Remove the hardware (73 and 74) securing the bearing cap (7) to the lower motor housing.

Steady the rotor and shaft assembly, and separate the lower motor housing. If necessary, tap the impeller end of the rotor shaft with a soft-faced mallet to loosen the seal between the bearing cap and the lower motor housing.

Use a bearing puller to remove the upper ball bearing from the rotor shaft. Use the bearing cap (7) and capscrews (73) in conjunction with the bearing puller to remove the lower ball bearing (70) from the shaft. Press the lower ball bearing out of the bearing cap.

Stator Removal

It is recommended that the stator (68) be left in place unless it is defective. If the stator must be removed, disconnect the motor leads from the terminal posts (60 and 64) as indicated in **Terminal Housing And Power Cable Disassembly**.

Remove the pipe plugs (66), and loosen the allen head setscrews (67).

With the pump end, lower motor housing, and rotor removed, position an expandable tool, such as a split disc, approximately two inches down inside the stator, and expand it tightly and squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and raise the assembly approximately 1 inch from the surface.

It is necessary to heat the motor housing with a torch to expand it enough for the stator to be removed. Apply heat evenly to the outside of the motor housing; excessive heat is not required. When the motor housing is sufficiently heated, use a soft-faced mallet to rap alternate edges of the upper motor housing (13), and "walk" the stator out. Continue this process until the stator clears the motor housing.

When the stator is free of the motor housing, remove the key (11).

MOTOR REASSEMBLY

NOTE

Reuse of old O-rings, gaskets, or shaft seal parts may result in premature leakage or reduced pump performance. It is strongly recommended that an overhaul gasket kit and shaft seal assemblies be used during reassembly (see the parts list for numbers.)

Stator Installation

CAUTION

Do not attempt to rewind the stator. Winding tolerances and materials are closely controlled by the manufacturer, and any deviation can cause damage or operating problems. Replace the stator, or return it to one of The Gorman-Rupp Authorized Submersible Repair Centers or The Gorman-Rupp factory, if defective.

NOTE

Stator installation involves application of heat to the upper motor housing, and insulating paint to the stator O.D.. Both processes must be done quickly and at approximately the same time, to allow the stator to slide into the motor housing before the paint dries or the housing cools; therefore, it is recommended that these steps be performed by two people, to promote efficient installation of the stator.

Clean all O-ring surfaces, and inspect the sealing surfaces for burrs, nicks and pits which could cause a poor seal, and replace defective parts as required.

Thoroughly clean the inside of the upper motor housing (13) with fresh solvent. The interior **must** be dry and free of dirt or lint.

WARNING

```

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

When assembled at the factory, the stator was painted with insulating paint just prior to installation in the motor housing. It may be necessary to use steel wool or a wire brush to remove excess paint from the I.D. of the motor housing before reassembly.

After the motor housing is thoroughly cleaned, position it on a flat surface with the discharge end down. Do not unwrap the stator until the motor housing has been prepared for stator installation. The stator **must** be kept clean and dry. When handling the stator, do not set it on the end windings; lay it on its side.

Test the new stator as indicated in **Electrical Testing** in **TROUBLESHOOTING** to ensure that no damage has occurred during transit or handling.

NOTE

Remove any drops of varnish from the ends of the stator to ensure proper stack-up height when assembled.

Position an expandable tool, such as a split disc, approximately 2 inches from the end of the stator (opposite the lead wire end) and expand it tightly on the stator I.D.. Carefully raise the stator with a lifting device attached to the lifting eye of the tool. Take care not to damage the stator end turns. Slip a sleeve over the stator lead wires to prevent damage to them.

The stator O.D. must be painted with insulating paint just prior to installation in the motor housing. With the stator suspended, apply a thin coat of "General Electric Glyptol Red Insulating Paint" (G.E. No. 1201), or equivalent, to the stator O.D.. The paint is fast-drying, so it must be applied quickly.

WARNING

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////////////////////////////////////
//                               //
// Insulating paint is HIGHLY FLAMMABLE. Keep the paint //
// and the stator away from open flame. Be sure to close //
// the container tightly after use, clean tools thoroughly, //
// and dispose of any paint-soaked rags properly.         //
//                               //
////////////////////////////////////

```

While the stator is being painted, another person should heat the motor housing with a torch to expand it enough for the stator to be installed; when heating the motor housing **make certain** that the stator is clear to avoid a fire hazard, or damage to the windings. Apply heat evenly to the inside of the motor housing; excessive heat is not required.

When the motor housing is sufficiently heated, position the stator above the housing so that the leads are in line with the opening for the terminal housing. Install the key (11), and carefully lower the stator into the motor housing until fully seated against the housing shoulder. Be careful not to damage the stator lead insulation during reassembly. If the stator "cocks" in the motor housing, remove it and try again.

After the stator is fully and squarely seated on the motor housing shoulder, lock it in place with the setscrews (67). Apply 'Loctite Pipe Sealant With Teflon No. 592' or equivalent on the threads of the pipe plugs (66), and install them in the motor housing. Remove the expandable disc tool.

NOTE

Because of the tight shrink fit between the stator and upper motor housing, excess paint will be forced out as the stator is installed in the housing. Use soft rags to absorb any paint that accumulates between the stator and the housing, then use paint thinner to thoroughly clean the housing I.D..

Cover the motor housing with a clean, lint-free cloth while the rotor is being assembled.

MAINTENANCE AND REPAIR

Rotor Reassembly And Installation

Inspect the seal and bearing areas of the shaft. Inspect the shaft for damaged threads, scoring and a damaged keyway. Remove nicks and burrs with a fine file or honing stone. If the shaft is bent or damaged, replace the shaft and rotor (a single assembly).

Clean the bearings thoroughly in fresh cleaning solvent. Dry the bearings with filtered compressed air.

WARNING

```

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

```

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.

CAUTION

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

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the upper motor housing and bearing cap. Replace the shaft and rotor (as an assembly), motor housing or bearing cap if the proper fit is not achieved.

Use an arbor (or hydraulic) press to install the upper ball bearing (14) onto the shaft until fully seated against the shaft shoulder.

CAUTION

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

Clean the bearing cap (7) and position it on an arbor (or hydraulic) press with the opening for the bearing facing up. Position the lower bearing (70) in the cap bore with the black seal on the bearing facing up, and press it into the cap until fully seated.

Press the assembled cap and bearing onto the shaft as shown in Figure 1, until the bearing seats squarely against the shaft shoulder.

If removed at disassembly, apply 'Loctite Pipe Sealant With Teflon No. 592' or equivalent compound on the threads of the moisture sensor pipe plug (72), and install the plug securely in the lower motor housing.

Apply 'Never-Seez' or equivalent compound to the threads of the capscrews (73). Secure the lower motor housing to the bearing cap with the capscrews and lockwasher (74); torque the capscrews evenly in a cross-sequence to 20 ft. lbs. (240 in. lbs.).

Use **fresh** solvent to clean the bearing seating bore of the upper motor housing (13).

Lubricate the O-ring (10) with light oil and install it in the groove on lower motor housing (71). Install a three-leg sling in the lower motor housing (see Figure 4) and lower the assembled housing, rotor shaft and bearings into the upper motor housing. Use caution to guide the upper ball bearing (14) into the bearing bore in the upper housing, and make sure the holes for the capscrews (8) are aligned. Tap the lower motor housing with a soft-faced mallet until fully seated in the upper motor housing. **Be careful** not to cut the O-ring (10) on the upper motor housing shoulder.

Apply 'Never-Seez' or equivalent compound to the threads of the capscrews (8). Install the capscrews and lockwashers (9), and torque the capscrews evenly in a cross-sequence to 120 ft. lbs. (1440 in. lbs.).

Apply a light coat of oil to the motor housing O-ring (15) and install it on the upper motor housing. Slide the outer motor housing (12) over the assembled motor until it seats against the O-ring and upper motor housing shoulder. **Be sure** the pipe plug (5) in the outer housing aligns with the pipe plug (6) in the lower motor housing.

See **PUMP END REASSEMBLY**, and reassemble the pump end components.

Terminal Housing And Power Cable Reassembly

WARNING

```

////////////////////////////////////
//
// The electrical power used to operate this pump is high //
// enough to cause injury or death. Make certain that the //
// control handle on the control box is in the OFF position //
// and locked, or that the power supply to the control box //
// has been otherwise cut off and locked out. Tag elec- //
// trical circuits to prevent accidental start-up. Obtain //
// the services of a qualified electrician and refer to the //
// wiring diagrams in INSTALLATION to make all electrical //
// connections. //
// //
////////////////////////////////////

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Clean the exterior of the pump power cable with warm water and mild detergent, and check for obvious physical damage. Check the cable for continuity and insulation resistance (see **Electrical Testing** in **TROUBLESHOOTING**).

CAUTION

Do not attempt repairs except at either end of the power cable. Splicing is not recommended.

Lubricate the upper bore of the terminal housing (47), outside of the power cable, and bores of the terminal gland (42), cable grip (44), gland bushing (48), and terminal washer (49) for ease of assembly. Slide the terminal gland, cable grip, gland bushing, terminal washer and terminal housing onto the power cable in that order (see Figure 1 to recheck order of assembly).

Work the cable components up the cable to allow approximately 3 ft. of cable to extend below the terminal housing. Temporarily tape the ground wires (green and yellow) to the cable.

Power Cable Potting

WARNING

Do not attempt to operate this pump unless the power cable terminals (except for the ground terminal) are properly potted or sealed with heat-shrink tubing and bonded to the terminal plate. Moisture entering the terminal housing could cause a short circuit, resulting in death or injury to personnel.

If the power cable leads were removed from the terminal collars (34 and 54), the connections must be resealed with a water-tight material such as electrical potting compound or heat-shrink tubing.

When shipped from the factory, the cable leads and terminal collars were encapsulated in heat-shrink tubing (36 and 51), and bonded to the terminal plate (57) with hot-melt adhesive to provide a water-tight seal. These materials are included in an optional repair kit listed in the parts list; however, since a glue gun with the required temperature range is not generally available in the field, it is recommended that a commercially available repotting kit (Products Research Corp., part no. PR-1201-Q Class 1 potting compound, or equivalent) be used to reseat the connections. See Figure 5 and the following instructions:

NOTE

Potting compound, heat-shrink tubing and adhesive have the same electrical properties when correctly applied. Heat-shrink tubing is used at the factory to ease production. The advantage of using potting compound for field repairs is greater availability, and elimination of special tools.

If heat-shrink tubing is used for field repairs, use **only** materials and heating equipment approved by Gorman-Rupp.

Clean and assemble all terminal components as indicated in the potting instructions.

Slide a length of heat-shrink tubing (available separately or as part of the shrink tube and adhesive kit, see the parts list) up over each of the cable leads. Insert the leads into the terminal collars and secure with the setscrews. Slide the shrink tubes down over the collars until they contact the terminal plate. Carefully heat each tube with a torch, or commercial hot air gun capable of producing 750° F, and shrink it around the cable leads, terminal posts, and collars.

After the tubing has shrunk and set, use a hot-melt adhesive tool (Terlan TM-80), set at 450° F to apply adhesive (also included in the shrink tube and adhesive kit, or available separately, G-R part number 18661-044) and completely seal the bottom portion of each tube to the terminal plate.

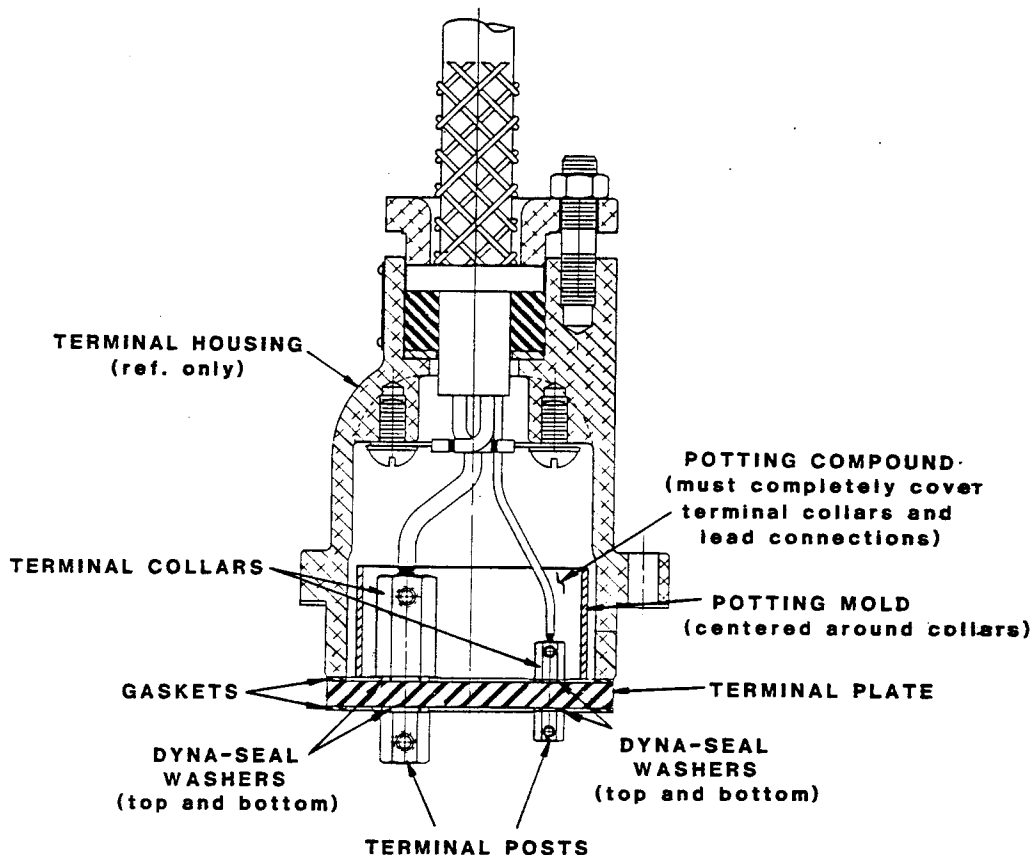


Figure 5. Potting Power Cable Leads In Terminal Housing

If the power cable is to be potted, a commercially available repotting kit (Products Research Corp. PR-1201-Q Class 1 potting compound, or equivalent) may be used.

Remove all the old tubing material or potting compound from the terminal collars (34 and 54), terminal posts (60 and 64), allen head setscrews, dyna-seal

washers, and terminal plate assembly (57). Inspect the terminal posts for damage and replace as required. Use a medium-grit sandpaper to prepare the surface of the terminal plate in the area of the potting molds.

NOTE

Clean the cable leads and terminal plate in the areas to be potted with cleaning solvent before potting. Potting compound will not adhere properly to oil or grease coated surfaces.

Assemble the terminal posts, dyna seal washers, setscrews, and terminal collars to the terminal plate assembly.

Slide the gasket (55), which seals the terminal plate assembly to the terminal housing, up over the cable leads, then proceed as follows:

Slide the potting mold up over the cable leads.

NOTE

If the mold provided with the kit is not large enough, fabricate one from heavy gauge plastic or cardboard. The mold must be large and deep enough to allow the terminal collars to be covered by at least 1/8 inch of potting all around.

Insert the three standard power cable leads into the terminal collars (34), and secure them with the allen head setscrews (35). Insert the three thermal sensor leads into the terminal collars (54), and secure them with the allen head setscrews (52). Slide the potting mold down over the terminal collars and onto the terminal plate.

Hang the cable vertically with the terminal plate horizontal. The cable leads and terminal collars should be centered in the potting mold. Use a quick-setting cement, such as '3-M Weather Seal' to secure the potting mold to the terminal plate.

WARNING

```

////////////////////////////////////
//
// Most potting base compounds contain toluene; use ade- //
// quate ventilation and avoid prolonged breathing of va- //
// pors. Most potting accelerators contain lead; avoid //
// ingestion or prolonged contact with the skin. Read and //
// follow all warnings and recommendations accompanying the //
// potting kit. //
// //
////////////////////////////////////

```

See the instructions with the potting kit regarding application life, and setting and curing time. Mix the base compound and accelerator and fill the mold completely. Tamp the potting material to eliminate air bubbles and ensure the material has completely covered the area around the terminal collars.

When potting has been completed, leave the terminal plate assembly undisturbed until the potting material has cured. Complete curing usually takes about 24 hours. Curing time can be shortened by using a heat lamp, but be careful not to

melt the potting or potting mold, or burn the cable. When the potting material is no longer "tacky" to the touch, it has cured.

Terminal Housing Reassembly

After the potting material has cured (or the heat-shrink tubing has been installed), untape the ground leads and slide the terminal housing down the cable. If removed, connect the green ground lead to the ground terminal (37), and connect the yellow ground check lead to the ground check terminal (50). Secure the terminals to the terminal housing with the machine screws and lockwashers (38 and 39) and **be sure** the terminals make good contact with the housing.

Pull gently on the power cable to remove any excess length from within the terminal housing. The terminal plate should fit loosely against the terminal housing.

Slide the terminal washer (49) down the cable and into the upper bore of the terminal housing. Oil the bore and cable and slide the gland bushing (48) into place. Compress the wire mesh of the cable grip (44) and slide it down the cable, making sure it comes in contact with the bushing. Slide the gland (42) into place, and engage the nuts (46) finger tight. Do not fully tighten the nuts at this time.

Position the lower gasket (58) against the terminal plate, then attach the motor leads and thermal sensor leads to the terminal posts (60 and 64) using the allen head setscrews (61 and 65). If required, rotate the terminal housing and twist the motor leads to remove excess slack. Coat the threads of terminal housing studs (31) with 'Never-Seez' or equivalent, and secure the terminal housing to the motor housing with the locknuts (32); torque the locknuts to 20 ft. lbs. (240 in. lbs.).

Tighten the nuts (46) drawing the terminal gland (42) down into terminal bore. **Do not** overtighten and damage the terminal gland or hardware.

See LUBRICATION and FINAL ASSEMBLY.

MOTOR LEAK TEST

After the pump has been completely reassembled, remove the pressure test plug (located next to the discharge flange), apply a vacuum of 20 inches of mercury to the motor cavity, and hold for five minutes. If the vacuum does not hold, check all sealing surfaces for leaks, and correct any that are found.

Repeat the test. When the vacuum holds, reinstall and tighten the pressure test plug.

Before starting the pump, see LUBRICATION.

LUBRICATION

Check the oil level in the seal cavity before initial startup, after the first two weeks of operation, and every month thereafter. If the oil level is abnor-

MAINTENANCE AND REPAIR

mally low, or the color milky or dark, refer to **Draining Oil From Seal Cavity** in this section for instructions and troubleshooting tips.

NOTE

To accurately check the oil level the pump must be cool.

The grade of lubricant used is critical to the operation of this pump. Use premium quality submersible pump oil of the grade specified in Table 1. Oil must be stored in a clean, tightly closed container in a reasonably dry environment.

Table 1. Typical Pump Oil Properties

Type	Premium high viscosity index, anti-wear hydraulic oil
Dielectric	26,000(volts-min)
Pour point	-20°F to -60°F
Viscosity @ 100°F	110 to 155
Viscosity @ 210°F	40 to 50
Recommended supplier:	
Gulf Oil Company	Gulf Harmony HVI AW 26
Acceptable alternate suppliers:	
Gulf Oil Company	Gulf Harmony 32 AW
SOHIO *	Energol - HLP 32
Shell Oil Company	Tellus 32, Tellus T-23 or T-32
Sun Oil Co.	Sunvis 816 or 916
Texaco	Rando HD 32 or HD AZ 32
A.R.CO.	Duro 32
Exxon	Nuto H 32

* Also Boron & B.P. (British Petroleum) Oil Companies

Seal Cavity

To fill the seal cavity, remove the large pipe plug (5) from the outer motor housing, then remove the seal cavity plug (6) from the lower motor housing. Add the recommended grade of submersible pump oil (approximately 4-1/2 quarts) until the level reaches the fill plug opening. Maintain the oil at this level. Apply 'Loctite Pipe Sealant With Teflon No. 592', or equivalent sealant to the threads of the both pipe plugs before reinstalling them.

Motor Housing Cavity

The motor is cooled by the constant flow of the liquid being discharged internal passages surrounding the motor housing. The rotor shaft bearings are permanently lubricated, and require no additional lubrication.

FINAL ASSEMBLY

If the discharge flange (25) has been separated from the motor housing, replace the gasket (24) and secure the flange with the nuts (28).

Connect the discharge hose using pipe sealant on the threads, and position the pump in the wet well. If rigid discharge piping is used, connect the piping after the pump has been positioned. Open any valves in the discharge line.

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Please Visit www.grpumps.com/warranty
or call:
U.S.: 419-755-1280
International: +1-419-755-1352**

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or call:
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