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OM-03686-OM01
November 1, 1991
Rev. B

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

SUBMERSIBLE PUMPS

MODELS

S12A1-E140 460/3

S12A1-E140 575/3

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

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

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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 non-volatile, non-flammable liquids which are mildly corrosive and abrasive. The basic material of construction is aluminum with cast iron seal plate and suction head and ductile iron impeller and diffuser. The integral 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 its application which are not covered in this manual or in other literature accompanying this unit, please contact your Gorman-Rupp distributor, or write:

The Gorman-Rupp Company
P.O. Box 1217
Mansfield, Ohio 44901-1217

or

Gorman-Rupp of Canada Limited
70 Burwell Road
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:

DANGER!

Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.

WARNING!

Hazards or unsafe practices which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury which could result from failure to follow the procedure.

CAUTION

Hazards or unsafe practices which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage which could result from failure to follow the procedure.

NOTE

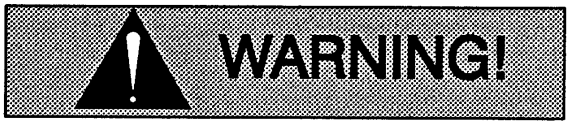
Instructions to aid in installation, operation,and maintenance, or which clarify a procedure.

SAFETY - SECTION A

This information applies to S Series submersible motor driven pumps and control boxes.

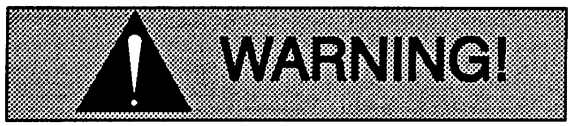
Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out incoming power to the control box to ensure that the pump will remain inoperative.
3. Allow the pump to cool if overheated.
4. Close the discharge valve (if used).



This pump is designed to handle most non-volatile, non-flammable liquids. Do not attempt to pump volatile, corrosive, or flammable materials, or any liquids which may damage the pump or endanger personnel as a result of pump failure.

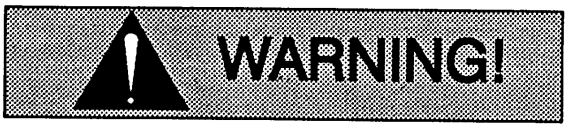
After the pump has been installed, make certain that the pump and all piping or hose connections are secure before operation.



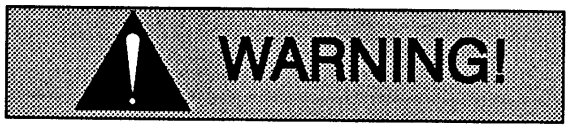
The pump motor is designed to be operated through the control box furnished with the pump. The control box provides overload protection and power control. Do not connect the pump motor directly to the incoming power lines.

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 connections. Make certain that the pump and enclosure are properly grounded; never use gas pipe as an electrical ground. be sure that the incoming power matches the voltage and phase of the pump and control before connecting the power source. Do not run the pump if the voltage is not within the limits. If the overload unit is tripped during pump operation, correct the problem before restarting the pump.

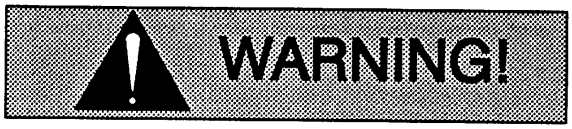
The electrical power used to operate this pump is high enough to cause injury or death. Make certain that the control handle on the control box is in the off position and locked out, or that the power supply to the control box has been otherwise cut off and locked out, before attempting to open or service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



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.



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.



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.

INSTALLATION - SECTION B

Review all SAFETY information in Section A.

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

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

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.

PREINSTALLATION INSPECTION

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

a. Inspect the pump assembly for cracks, dents, damaged threads, and other obvious damage.

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

c. The standard pump is furnished with 50 feet of power cable. Inspect the cable for cuts or damage.

d. Inspect 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 nameplate 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 as 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 ensure maximum pump service.

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

Lubrication

There are two lubrication cavities in this pump, both contain premium quality submersible pump oil. The motor housing cavity provides lubrication to the motor assembly and rotor shaft bearings. The intermediate cavity provides lubrication to the seal assembly.

There are two shaft seals in this pump. The lower seal prevents liquid from entering the intermediate cavity at the impeller end. The upper seal prevents oil leakage from the motor housing cavity and acts as back-up protection in the event of lower seal failure.

Both cavities are fully lubricated when the pump is shipped from the factory. Check lubrication levels 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 either oil level is abnormally low, determine the cause before putting the pump into service.

PUMP INSTALLATION

Pump Specifications

See Tables 1 and 2 for pump specifications.

Table 1. Pump Specifications

Model	Voltage/ Phase	Motor Horse-power	Motor Speed (RPM)	Full Load Amperes	No Load Amperes	Locked Rotor Amperes	Discharge Size (NPT)
S12A	460/3	140	1750	165	50	697	12 INCH
S12A	575/3	140	1750	128	40	558	12 INCH

Table 2. Additional Specifications

Approximate Weights:	
Pump:	
Models S12A1-E30 460/3 & 575/3	1441 lbs. (654 kg)
Control Box Only	142 lbs. (64 kg)
50 ft. of Cable (460V)	150 lbs. (68 kg)
(575V)	105 lbs. (48 kg)
Seal oil cavity capacity	3.19 U.S. quarts (3 liters)
Motor oil cavity capacity	24 U.S. quarts (22,7 liters)
Motor Cable (460V)	#2/0 AWG., 6 Conductor, 600/2000V,Type GGC, Yellow Jacket 1.75 $\pm$ 0.03 O.D.
Motor Cable (575V)	#1 AWG., 6 Conductor, 600/2000V,Type GGC, Yellow Jacket 1.51 $\pm$ 0.03 O.D.

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 for the approximate physical dimensions of this pump and control box.

OUTLINE DRAWING

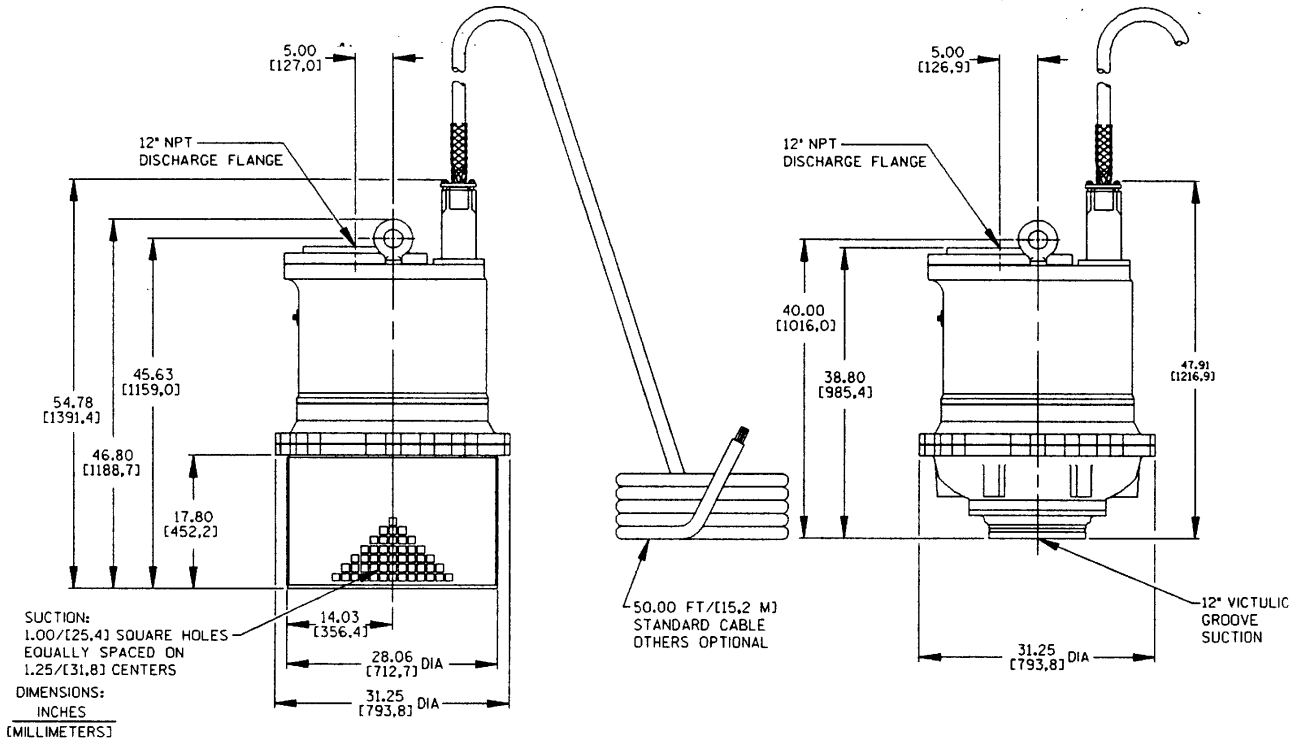


Figure 1. S12A1-E140 460/3 and S12A1-E140 575/3 Pump Models

Lifting

Use lifting equipment with a capacity of at least **5 times the weight of the complete unit** (include the weight of any customer-installed accessories, the power cable, and the control box if all are to be lifted). Refer to Table 2 for weights. Customer-installed equipment such as discharge 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 lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced.

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 air discharged through internal passages.

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 lifting device fitted on the pump. 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 for typical pump installations.

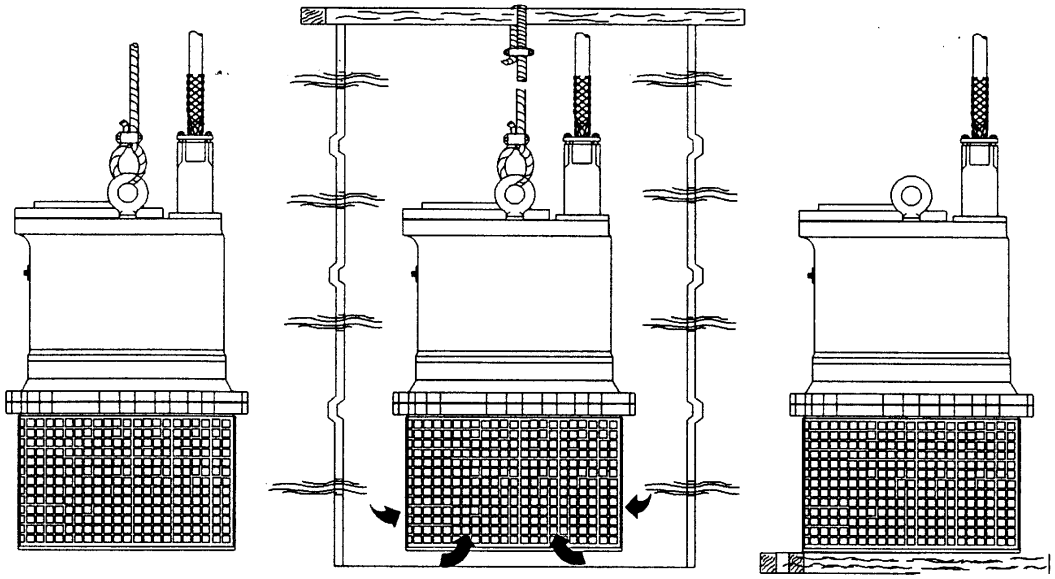


Figure 2. Typical Pump Installations

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 C.*

PIPING

No suction piping is required in a standard submerged application.

The 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.

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.

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 140 horsepower motor. It is designed to operate through the control box furnished with the pump.

WARNING!

The pump 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 a padlockable front cover. **The enclosure is not designed to be watertight, and should not be submerged.** See Figure 3 for enclosure dimensions and callouts.

Secure the control box vertically on a level surface, above flood level. The box 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.

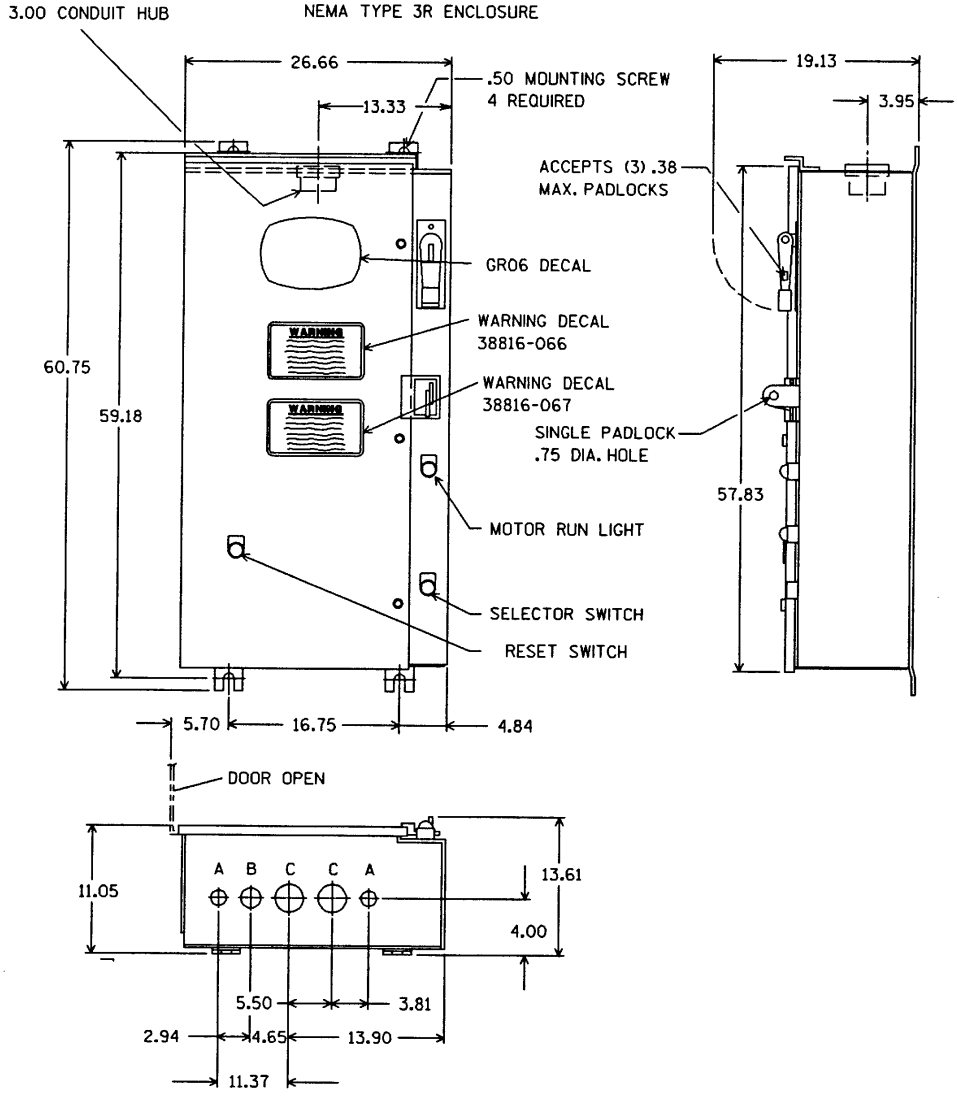


Figure 3. Control Box Dimensions (Both Voltages)

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 embedded 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 codes. See Figure 4 for some suggested grounding methods.

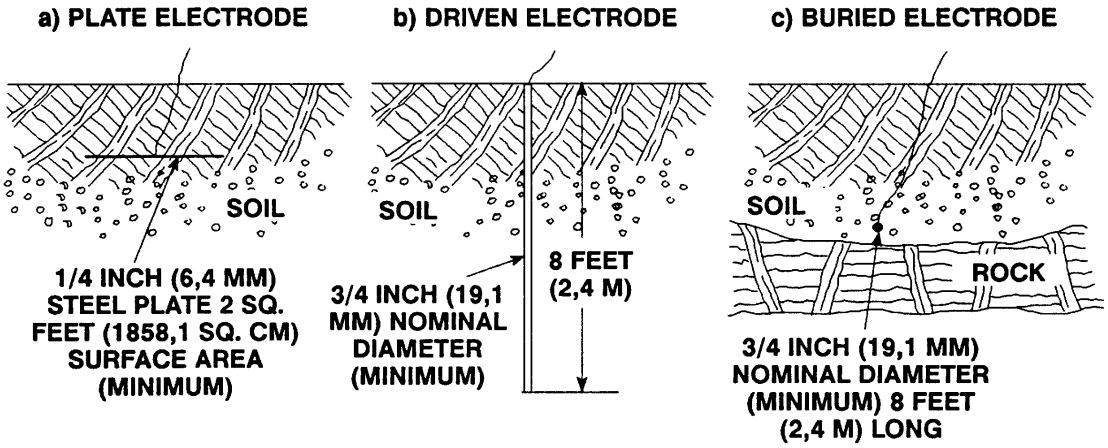


Figure 4. Suggested Grounding Methods

a. **Plate Electrode:** An iron or steel plate, 1/4 inch (6,4 mm) thick, completely impeded in the ground. The plate must present a surface area of at least 2 square feet (1858,1 sq. cm).

b. **Driven Electrode:** A rod or pipe, 3/4 inch (19,1 mm) in diameter minimum, 8 feet (2,4 m) long, completely driven into the ground.

c. **Buried electrode:** If rock or stone prevents embedding the full 8 foot (2,4 m) length of the ground rod, bury it horizontally in a trench.

   Space the ground rod or plates at least 6 feet (1,8 m) 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.

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)

The trailing cable from the power source to the control box must be furnished by the customer.

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 connections. Make certain that the pump and enclosure are properly grounded; Never use gas pipe as an electrical ground. Be sure that the incoming power matches the voltage and phase of the pump and control before connecting the power source. Do not run the pump if the voltage is not within the limits.

The pump control is designed to regulate a 460 or 575 volt, 3 phase, 60 hertz power supply. The field wiring must be properly sized to ensure an adequate voltage supply. The voltage available **at the motor** must be within the range indicated in Table 3.

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 the wiring diagrams in this section for power supply connections.

b. Next, subtract the motor cable voltage drop (see Table 4, **Pump Power 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 3. Pump Motor Voltage Limits

Nominal Voltage	Phase	Minimum Voltage	Maximum Voltage
460	3	420	500
575	3	520	630

Use the packing gland nuts to secure and seal 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.

NOTE

*After the power cables have been connected to the control box, the packing gland nuts must be wired and sealed before operation. See **Terminal Housing And Power Cable Reassembly** in Section E for instructions.*

Pump Power Cable Connections

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 connections. Make certain that incoming power to the control box is in the off position and locked out, or that the power supply to the control box has been otherwise cut off and locked out, before connecting power or accessory cables.

The standard pump is provided with a 50 foot (15,2 meter) power cable (see table 4 for power cable specifications). If a longer 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 4. Pump Power Cable Specifications Model S12A

Voltage/ Phase	A.W.G Cable Size	Cable O.D. (Inches) [mm]	Conductor Dia. (Inches) [mm]	Amp Rating * at 40°C (Amperes)	DC Resistance at 25°C (ohms/ 1000 ft. [304,8 m])	Voltage Drop at Max. Load per 100 ft. [30,5 m]
460/3	2/0	1.75 [44,5]	0.48 [12,2]	215	0.09	3.04
575/3	1	1.51 [38,4]	0.38 [9,7]	161	0.13	3.52

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

When necessary to change or connect 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 the wiring diagrams in this section. Use conduit or cable clamps to secure the power and accessory cables to 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), two grounding conductors (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.

Control Box Specifications

The circuit breakers within the control box are magnetic trip only, set to trip at approximately 2 to 3 times the locked rotor starting current (LRA). Motors are of special design and don not require higher settings. A tripped breaker strongly indicates a fault condition is present.

WARNING!

After being placed in service, the tripping of the instantaneous trip circuit breaker is an indication that a fault current has been interrupted. Current carrying component parts of the magnetic motor controller should be examined and replaced if damaged to provide continued protection against fire or shock hazard. If burnout of the heater coil of the overload relay occurs, the complete overload relay must be replaced.

After replacing heater coils, press the reset button to set the relay. Allow 10 seconds for the relay to cool after tripping before pressing the reset. Increasing heater coil size **Is not** recommended. **Do not** mount heater coils between terminal ends having turned up edges, as this will damage the coil.

Table 5. Control Box Specifications

NEMA SIZE	CONTROL P/N		VOLTAGE	HERTZ	CONTINUOUS CURRENT RATING	REFERENCE DATA			CONTROL TRANSFORMER C-H PART NO.	OPTIONAL LIQUID LEVEL CONTROL RELAY
	G-R PART NO.	C.H. CAT. NO.				HEATER PACK	HEATER SETTING	RANGE (AMPS) *		
5	27515-507	AN801SRY3-5	460	60	270 Amps	27521-220	A	152.0/224.0	C340EG1	27521-321
5	27515-517	AN801SRY2-5	575	60	270 Amps	27521-219	A	123.0/182.0	C340ED1	27521-321

* CURRENT TRANSFORMER 300:5

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):

- **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 volts) circuitry which is specially designed to fit into the main pump control (see the parts list in Section E for part numbers).

The circuitry may be prewired as a factory option, or easily added in the field by qualified personnel. The unit is complete except for the remote float switches, and is available for both 460 and 575 volt applications. 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 over-heat, resulting in damage to the motor windings or control box components.

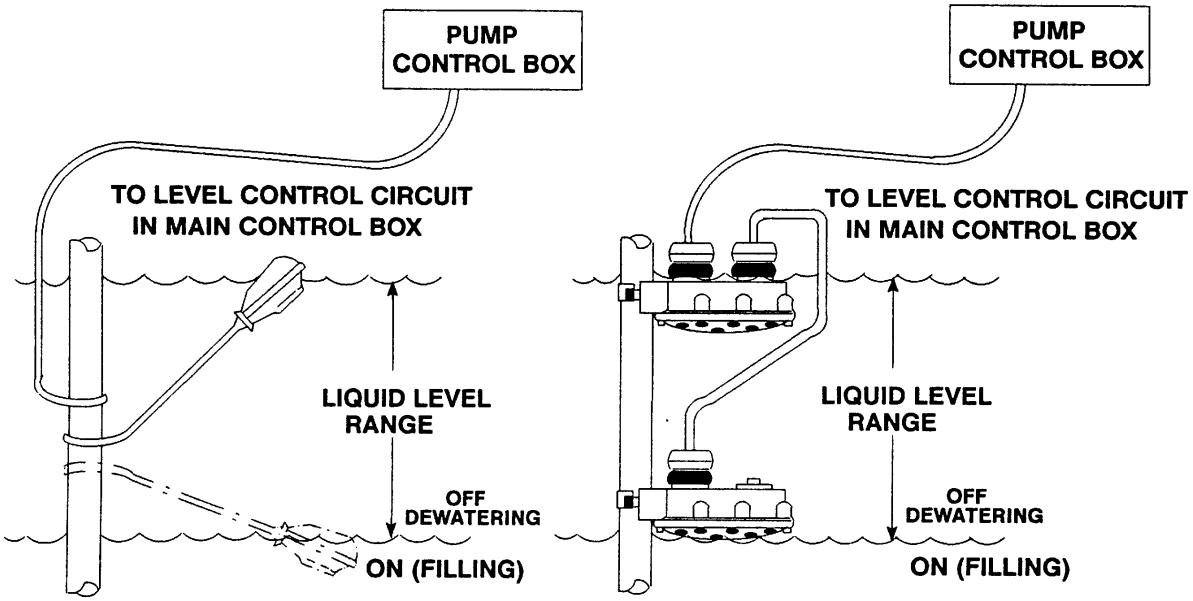


Figure 5. Liquid Level Devices

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.

WIRING DIAGRAMS

Consult the following elementary and pictorial wiring diagrams for the standard and optional control boxes, for both 460 and 575 volt applications.

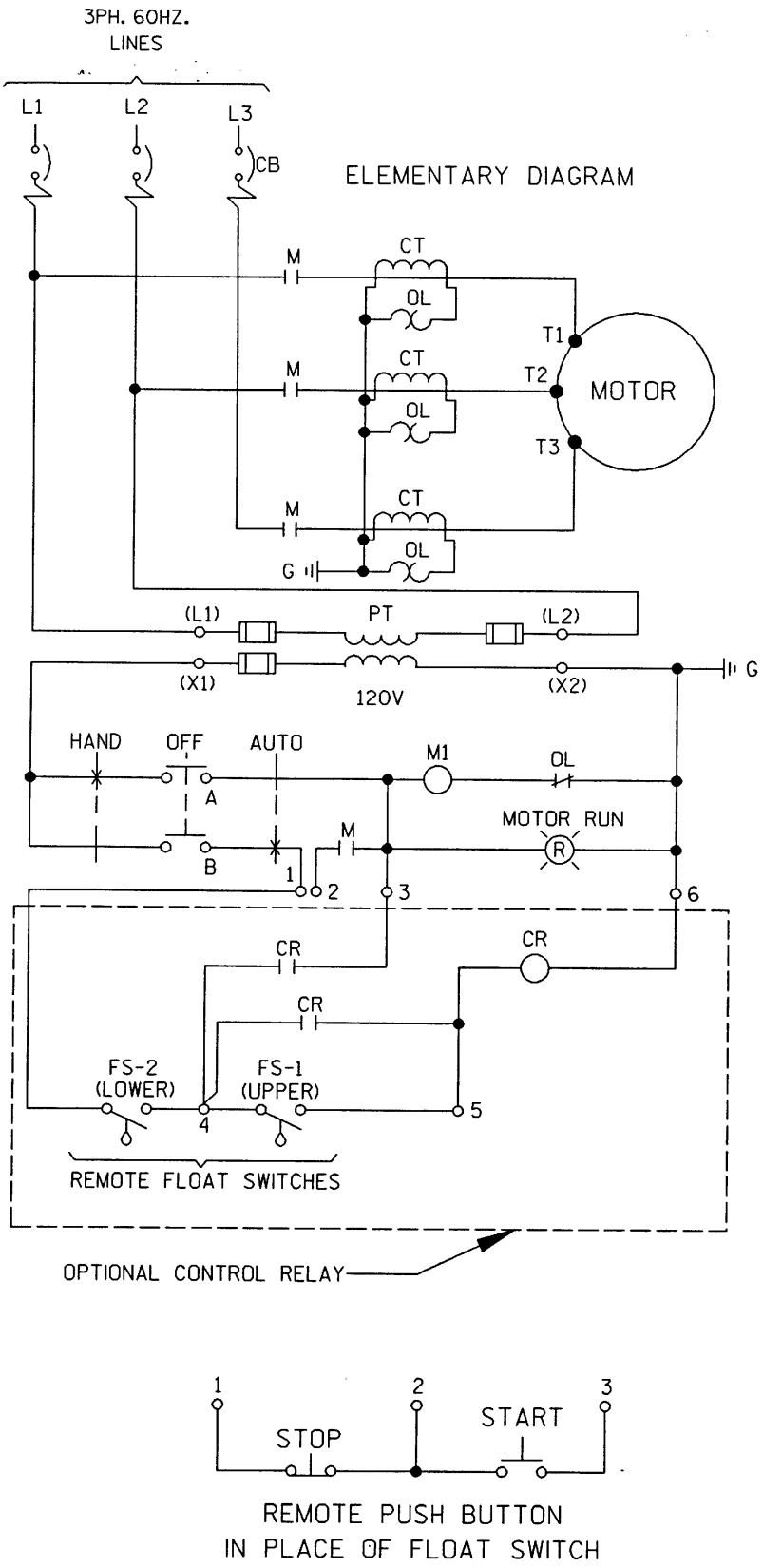
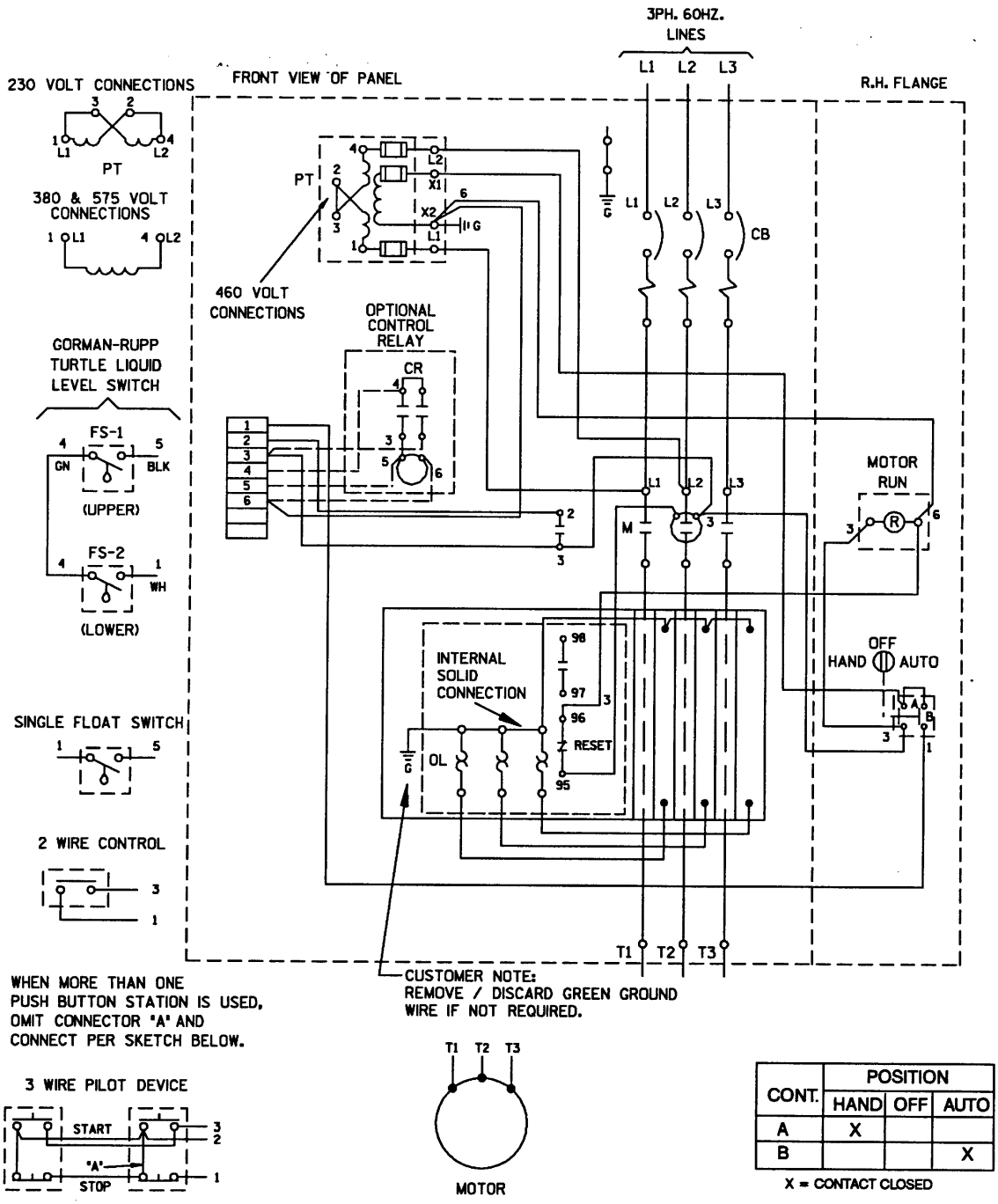


Figure 6. Elementary Diagram - 27515-507 (460V) and 27515-517 (575V) (With Optional Liquid Level Controls Available)



CONT.	POSITION		
	HAND	OFF	AUTO
A	X		
B			X

X = CONTACT CLOSED

NEMA SIZE	CONTROL P/N		VOLTAGE	HERTZ	CONTINUOUS CURRENT RATING	REFERENCE DATA			CONTROL TRANSFORMER C-H PART NO.	OPTIONAL LIQUID LEVEL CONTROL RELAY
	G-R PART NO.	C.H. CAT. NO.				HEATER PACK	HEATER SETTING	RANGE (AMPS) *		
5	27515-507	AN801SRY3-5	460	60	270 Amps	27521-220	A	152.0/224.0	C340EG1	27521-321
5	27515-517	AN801SRY2-5	575	60	270 Amps	27521-219	A	123.0/182.0	C340ED1	27521-321

* CURRENT TRANSFORMER 300:5

Figure 7. Pictorial Diagram - 27515-507 (460V) and 27515-517 (575V) (With Optional Liquid Level Controls Available)

REPAIR PARTS LIST, INTERNAL PARTS
27515-507 (460V) and 27515-517 (575V) CONTROL BOXES

(Unless Otherwise Specified, Components Identified By Cutler Hammer Part Numbers)

ITEM NO.	PART NAME	PART NUMBER	QTY
1	CIRCUIT BREAKER - 250 AMPS	C370HMCP5	1
2	MOTOR STARTER	AN16SNOA	1
3	CONTACTOR - 3 POLE	CN15SN3A	1
4	RENEWAL CONTACT SET	6-45-8	1
5	COIL	9-1891-1	1
6	OVERLOAD RELAY	C306DN3	1
7	460V HEATER PACK (G-R PART NUMBER)	27521-220	1
	575V HEATER PACK (G-R PART NUMBER)	27521-219	1
8	CONTROL TRANSFORMER (460V)	C340EG1	1
	CONTROL TRANSFORMER (575V)	C340ED1	1
9	"MOTOR RUN" PILOT LIGHT	10250T34R	1
10	"MOTOR RUN" LEGEND PLATE	10250TM81	1
11	TERMINAL BLOCK	80-5817	2
12	H-O-A SELECTOR SWITCH	10250T21KB	1
13	"HAND-OFF-AUTO" LEGEND PLATE	10250TM51	1
14	CURRENT TRANSFORMER	42-3564-2	1

OPERATION - SECTION C

Review all SAFETY information in Section A.

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

CONTROL BOX FUNCTION

WARNING!

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

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.

WARNING!

The pump 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.
- 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.***

- The **liquid level devices** (optional equipment) operate in conjunction with the 3-position switch (HAND-OFF-AUTO) supplied as 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 not designed to pump volatile, explosive, or flammable materials. Refer to the chart in INSTALLATION, Section B for the basic materials of construction for each pump covered in this manual. Do not attempt to pump any liquids for which your pump is not approved, or which may damage the pump or endanger personnel as a result of pump failure. Consult the factory for specific application data.

Liquid Temperature And Overheating

The maximum liquid temperature for this pump is 120° F (49° C). Do not apply the pump at higher operating temperatures.

Overheating can occur if the pump is misapplied, required to start repeatedly, or if the temperature of the liquid being pumped exceeds 120° F (49° C). Operating the pump against a closed discharge for an extended period of time will also cause the pump to overheat.

As a safeguard against rupture or explosion due to heat, this pump is equipped with a pressure relief valve which will open if vapor pressure within the pump motor reaches a critical point.

WARNING!

Approach the pump cautiously after it has been running. Although the motor is cooled by the liquid being pumped, normal operating temperatures can be high enough to cause burns. The temperature will be especially high if operated against a closed discharge valve. Never operate against a closed discharge valve for long periods of time.

If overheating does occur, stop the pump immediately and allow it to cool before servicing it. **Approach any overheated pump cautiously.**

WARNING!

Overheated pumps can cause severe burns and injuries. if overheating of the pump occurs:

1. **Stop the pump immediately.**
2. **Ventilate the area.**
3. **Allow the pump to cool.**
4. **Check the temperature before servicing.**
5. **Vent the pump slowly and cautiously.**
6. **Refer to instructions in this manual before restarting the pump.**

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

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 lifting device fitted on the pump. Turn the pump on momentarily and note the direction of twist. For correct rotation and operation, the twist must be in a **counterclockwise** direction when viewed from the **top** (see Figure 1).

CAUTION

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

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 incoming power is off and locked out before interchanging motor leads.

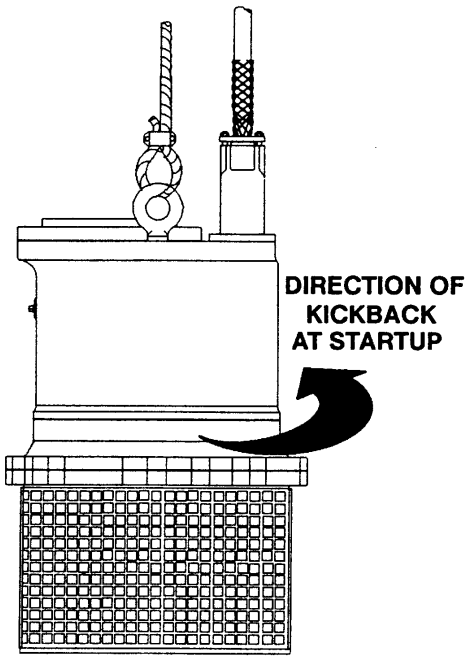


Figure 1. Checking Pump Rotation

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 this section.*

CAUTION

Never start the pump more than 6 times per hour. If the pump motor does not cool between starts, it will over-heat, resulting in damage to the motor windings or control box components.

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 the 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 ON.

If desired to operate 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

To stop the pump, turn the control handle OFF, thereby opening the circuit breaker. 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.

Operational 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 END DISASSEMBLY** in Section E).

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 (see **MAINTENANCE AND REPAIR**, Section E).

Check the pump for overheating. The pump could overheat if operated against a closed discharge valve, or if 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.

Do not attempt to thaw the pump by using a torch or other 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

Review all SAFETY information in Section A.

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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO START, OVERLOAD 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.
	Motor defective.	Check for and replace defective unit.
(AUTOMATIC MODE)	Liquid level device or control circuits improperly connected to main control box.	Check wiring diagrams; correct or tighten connections.
	Level sensing device(s) improperly positioned.	Position device(s) at proper level.
	Level sensing device(s) fouled with mud or foreign material.	Clean sensing device(s).
	Float type sensing device(s) tangled or obstructed.	Check installation for free movement of float.
	Defective liquid level sensing device(s) or control panel.	Repair or replace defective unit(s).

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
OVERLOAD UNIT TRIPS	Low or high voltage, or excessive voltage drop between pump and control box.	Measure voltage at control box. Check that wiring is correct type, size, and length. (See **Field Wiring Connections**,Section B).
	Defective insulation in motor windings or power cable; defective windings.	Check insulation resistance; check continuity.
	Impeller jammed due to debris or insufficient clearance.	Disassemble pump and check impeller.
	Bearing(s) frozen.	Disassemble pump and check bearing(s).
MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE	Discharge head too high.	Reduce discharge head, or install staging adaptor and additional pump
	Low or incorrect voltage.	Measure control box voltage, both when pump is running and when shut-off.
	Discharge throttling valve partially closed; check valve is installed improperly.	Open discharge valve fully; check piping installation.
	Discharge line clogged or restricted; hose kinked.	Check discharge lines; straighten hose.
	Liquid being pumped too thick.	Dilute liquid by heating if possible.
	Strainer screen or impeller clogged.	Clear clog(s). Stop pump; back flow may flush away debris.
	Insufficient liquid in sump or tank.	Stop pump until liquid level rises.
	Worn impeller vanes; excessive impeller clearance.	Check impeller and clearance. See **PUMP END REASSEMBLY**.
	Pump running backwards.	Check direction of rotation and correct by interchanging any two motor leads at control box. (See **Pump Rotation**, Section C).
PUMP RUNS WITH EXCESSIVE NOISE OR VIBRATION	Pumping entrained air.	Check liquid level in sump; check position of pump and liquid level sensing device(s).
	Damaged or unbalanced impeller.	Replace impeller.
	Discharge piping not properly supported.	Check piping installation.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP RUNS WITH EXCESSIVE NOISE OR VIBRATION (CONT'D.)	Impeller jammed or loose.	Check impeller.
	Motor shaft or bearings defective.	Disassemble pump and check motor and bearings.
	Pump cavitation.	Reduce discharge head, or restrict flow on low head applications.

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.

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.

WARNING!

Obtain the services of a qualified electrician to troubleshoot, test and/or service the electrical components of this pump.

Test Equipment

A volt/amp/ohmmeter and megohmeter 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. Megohmer	**Pyramid Instrument Corp. Lynbrook, NY Herman H. Sticht Co. 25 Bark Place**	**To check AC Voltage and current (amperage) 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.

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). If there is a high resistance reading on the ohmmeter, there is an open or broken circuit cause 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 to provide a water tight seal. In service, these connections may have been potted by the pump operator. Do not cut the tubing or potting away unless absolutely necessary. Check the continuity of each lead from the motor side of the terminal plate. If the continuity is good, there is no need to remove the tubing or potting material. If there is no continuity through the lead, remove the tubing or potting from only that terminal, and check for a loose connection. Be sure to replace the tubing or potting and allow adequate drying time before putting the pump back into service. (See **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:

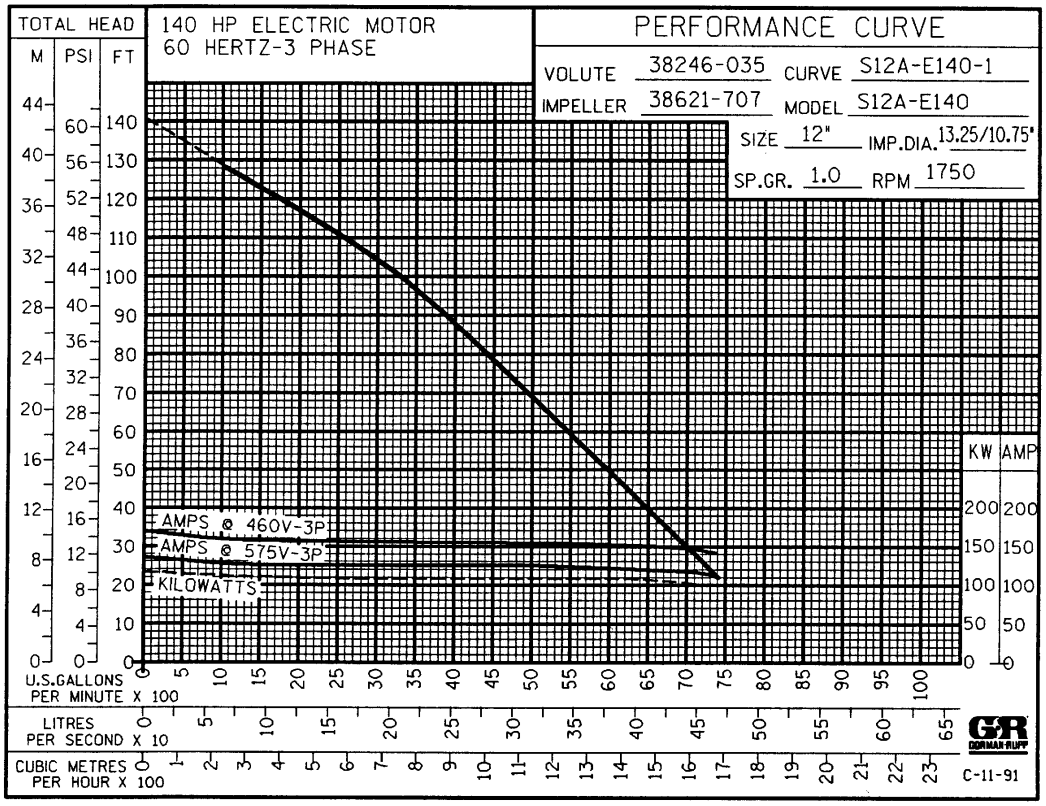
a. Disconnect the motor power cable leads from the control box. Connect one test lead to the power cable green ground lead, and touch the other test lead to each of the three power leads in turn.

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.

PUMP MAINTENANCE AND REPAIR - SECTION E

MAINTENANCE AND REPAIR OF THE WEARING PARTS OF THE PUMP WILL MAINTAIN PEAK OPERATING PERFORMANCE.



*** STANDARD PERFORMANCE FOR PUMP MODELS S12A1-E140 460/3 and S12A1-E140 575/3**

* Based on 70° F (21° C) clear water at sea level. Since pump installations are seldom identical, your performance may be difference 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.

SECTION DRAWING

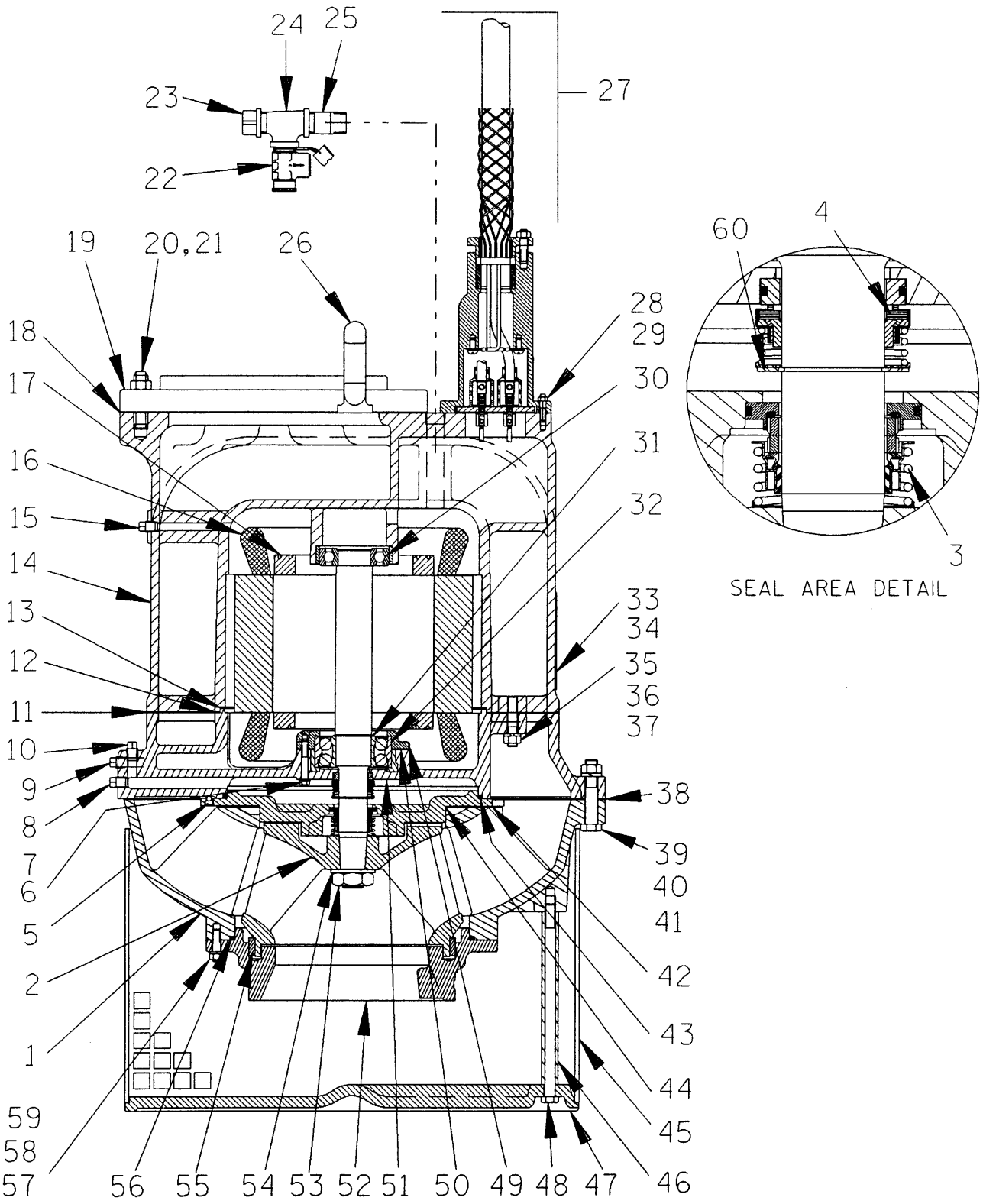


Figure 1. Pump Models S12A1-E140 460/3 and S12A1-E140 575/3

PARTS LIST
Pump Model S12A1-E140 460/3 and S12A1-E140 575/3
(From S/N 996345 up)

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

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		DIFFUSER	38632-112	11030	1
2	*	IMPELLER	38621-707	11000	1
3	*	LOWER SEAL ASSY	46512-055	-----	1
4	*	UPPER SEAL ASSY	25271-947	-----	1
5		SOCKET HD CAPSCREW	BD0503	17000	6
6		HEX HD CAPSCREW	B0610	15991	4
7		LOCKWASHER	J06	15991	4
8		SEAL CVTY DRAIN PLUG	P06	17000	1
9		MTR CAVITY DRAIN PLUG	P06	17000	1
10		SEAL CAVITY FILL PLUG	P06	17000	1
11	*	MOTOR HOUSING GSKT	38682-816	20000	1
12	*	MOTOR HOUSING GSKT	10062G	20000	1
13	*	MOTOR HOUSING GSKT	10038G	20000	1
14		MOTOR HOUSING ASSY	42822-018	24130	1
15		MTR CVIY OIL LVL PLUG	P06	17000	1
16		460V STATOR ASSY	47113-011	-----	1
		575V STATOR ASSY	47113-044	-----	1
17		ROTOR ASSY	47112-033	-----	1
18	*	DISCH FLANGE GASKET	4991G	18000	1
19		DISCHARGE FLANGE	4991A	10010	1
20		STUD	C1414	15991	12
21		HEX NUT	D14	15991	12
22		PRESS RELIEF VALVE	14139	-----	1
23		MTR CVTY OIL FILL CAP	V16	11999	1
24		STREET TEE ASSY	14138	-----	1
25		HVY PIPE NIPPLE	THA16	15079	1
26		EYE BOLT	AR2414	1505V	2
27		460V TERMINAL HSG AND CABLE ASSY	47367-061	-----	1
		575V TERMINAL HSG AND CABLE ASSY	47367-028	-----	1
28		STUD	C0607	15991	6
29		DEFORM LOCK NUT	DD06	15991	6
30	*	UPPER BALL BEARING	S1077	-----	1
31		RETAINING RING	S215	-----	1
32	*	LOWER BALL BEARING	23425-462	-----	1
33		NAME PLATE	2613CY	17020	1
34		DRIVE SCREW	BM#04-03	17000	6
35		STUD	10443	17000	12
36		LOCKWASHER	J10	17000	12
37		HEX NUT	D10	17000	12
38	*	DIFFUSER GSKT	38682-813	20000	1
39		HEX HD CAPSCREW	B1216	15991	20
40		HEX NUT	D12	15991	20
41		LOCKWASHER	J12	15991	20
42	*	SEAL PLATE GSKT	38682-817	20000	1
43	*	SEAL PLATE O-RING	S2207	-----	1
44		SEAL PLATE	38272-712	10000	1
45		STRAINER SCREEN	38661-706	2415V	1
46		HOSE	31412-068	19060	6
47		BASE PLATE	10036	13080	1
48		HEX HD CAPSCREW	B1048	15991	6
49		BEARING CAP	38322-424	10000	1
50		BEARING CAP GSKT	38683-463	20000	1
51		INTERMEDIATE	38261-112	13000	1
52		SUCTION HEAD	38246-035	10000	1
53		JAM LOCKNUT	AT20S	-----	1
54	*	IMPELLER WASHER	11199	17000	1
55	*	WEAR RING	4181A	14000	1
56	*	DIFFUSER O-RING	S1914	-----	1
57		STUD	C0808	17000	5
58		HEX NUT	D08	17000	5
59		LOCKWASHER	J08	17000	5
60		RETAINING RING	S264	-----	1
NOT SHOWN:					
		460V CONTROL BOX	27515-507	-----	1
		575V CONTROL BOX	27515-517	-----	1
		QT. SUB PUMP OIL	9568	-----	1
		IMPELLER KNOCKER	2177C	14070	1
		MOTOR VOLTAGE TAG			
		-460V	6588BL	-----	1
		-575V	6588BM	-----	1
		INSTRUCTION TAG	6588AC	-----	1
		460V HEATER PACK	27521-220	-----	1
		575V HEATER PACK	27521-219	-----	1
OPTIONAL:					
		LOW VOLT CONTROL (24 VOLT):			
		460V & 575V	S1657	-----	1
		LIQUID LEVEL DEVICES:			
		DIAPHRAGM TYPE	GRP48-03 or GRP48-06		1
		FLOAT TYPE	27471-155	-----	1
		LIQ LVL CONT. RELAY	27521-321	-----	1

* INDICATES PARTS RECOMMENDED FOR STOCK

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

CANADIAN SERIAL NO. ..... AND UP

SECTION DRAWING

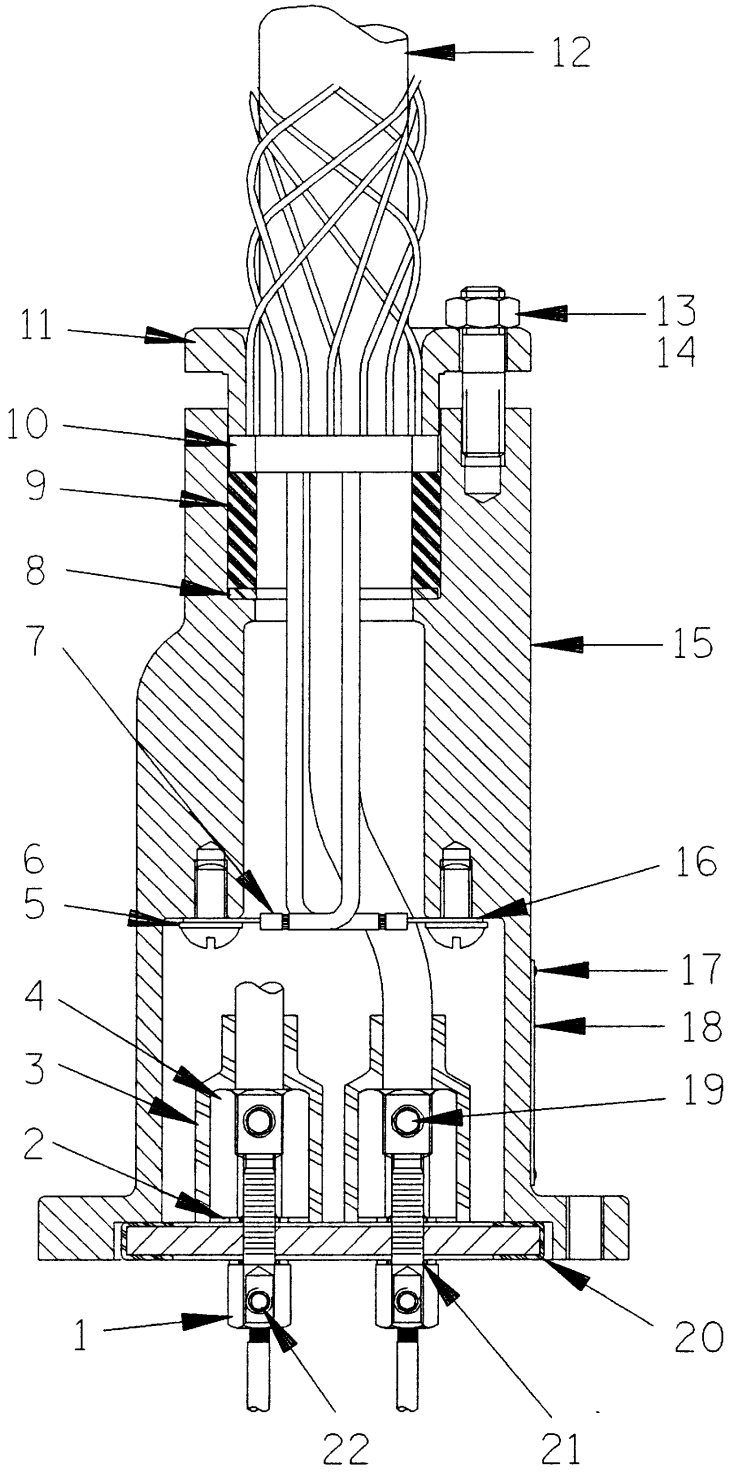


Figure 2. 47367-061 (460V) and 47367-028 (575V) Terminal Housing And Cable Assemblies

PARTS LIST
47367-061 (460V) and 47367-028 (575V)
Terminal Housing And Cable Assemblies

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		TERMINAL POST	38724-009	14100	3
2	*	UPPER DYNA SEAL WASHER	S1586	-----	3
3		HEAT SHRINK TUBE	31417-030	19530	3
4		TERMINAL COLLAR	10052A	14100	3
5		T TYPE LOCKWASHER	AK06	15991	2
6		RD HD MACH SCREW	X0603	14990	2
7		TERMINAL (460V)	27214-058	-----	1
		TERMINAL (575V)	27214-062	-----	1
8		WASHER (460V)	10659B	15991	1
		WASHER (575V)	31133-110	15991	1
9	*	GLAND BUSHING (460V)	10758E	19100	1
	*	GLAND BUSHING (575V)	31144-001	19100	1
10		CABLE GRIP (460V)	11227F	-----	1
		CABLE GRIP (575V)	11227H	-----	1
11		TERMINAL GLAND	10658	13040	1
12	*	POWER CABLE (460V)	10325A	-----	1
	*	POWER CABLE (575V)	10325L	-----	1
13		HEX NUT	D08	15991	2
14		STUD	C0808	15991	2
15		TERMINAL HOUSING	10088B	13040	1
16		TERMINAL (460V)	27214-065	-----	1
		TERMINAL (575V)	S1550	-----	1
17		INFORMATION PLATE	38816-047	17990	1
18		ALLEN HEAD SETSCREW	GA0602	14990	3
19		DRIVE SCREW	BM#04-03	17000	4
20		TERMINAL PLATE ASSY	11163	24010	1
21	*	LOWER DYNA SEAL WASHER	S1586	-----	3
22		ALLEN HEAD SETSCREW	GA0501 1/2	14990	3
NOT SHOWN:					
		1 OZ. HOT MELT ADHESIVE STICK	18661-045	-----	2
OPTIONAL:					
		HEAT SHRINK TERM KIT	48315-004	-----	1

* INDICATES PARTS RECOMMENDED FOR STOCK

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Review all SAFETY information in Section A.

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

The following maintenance and repair instructions are keyed to the Pump Model sectional view (Figure 1) and the Terminal Housing sectional view (Figure 2), and the accompanying parts lists.

Before attempting to service the pump or control, terminate the power supply to the control box. Close the discharge throttling valve, if so equipped. Always terminate power to the pump and control box before investigating pump or control box problems.

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 out, 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.

It is not necessary to disconnect a flexible discharge hose before removing the pump. If rigid discharge piping is used, disconnect the piping before attempting to move the pump. Affix a suitable lifting device to the lifting eyes in the top of the pump to remove the pump from the wet well or sump, and move it to a suitable location for the degree of maintenance to be performed.

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.

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 done by qualified personnel.

Check the chart in **TROUBLESHOOTING**, Section D, 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** in **TROUBLESHOOTING**, Section D, and have a qualified electrician check the control box, cable and terminal housing. If the problem is determined to be in the motor, proceed with **PUMP END DISASSEMBLY**, followed by **MOTOR DISASSEMBLY**. Otherwise, see **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 most O-rings **must** be replaced if disturbed. Repair gaskets and O-rings are listed on the parts list.

PUMP END DISASSEMBLY

Strainer Removal

(Figure 1)

To remove the strainer (45), lay the pump on its side and disengage the capscrews (48). Remove the base plate (47), hoses (46), and strainer. If the impeller is clogged, the debris can usually be removed without further disassembly.

Draining Oil From Seal and Motor Cavities

(Figure 1)

If the impeller (2) or lower seal (3) require replacement, the seal oil cavity must be drained. If the upper

seal (4) or motor components must be removed, the motor cavity must also be drained.

CAUTION

Let the pump cool before removing either the seal or motor cavity drain plugs. 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 seal cavity drain plug (8) facing up. Clean any dirt from around the plug. Remove the plug, 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 the oil for water, dirt, or cloudy condition which could indicate lower seal failure or poor gasket seal.

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

Lay the pump on its side with the motor cavity drain plug (9) facing up. Clean any dirt from around the plug. Remove the plug, and install a short 3/8-inch NPT nipple in the hole. Tip the pump and drain the motor oil into a **clean** container. Inspect the oil for dark color which could indicate motor overheating, dirt, or water contamination. The presence of dirt or water could indicate a breakdown in the waterproof integrity of the motor cavity, probably due to poor gaskets or seals.

Positioning Pump For Disassembly

(Figure 1)

It is recommended that the pump be positioned upside-down during disassembly. With the pump on its side and the oil drained, remove the lifting eyes (26), pressure relief valve and piping (22, 23, 24 and 25, see **Relief Valve**, in this section), and terminal housing and power cable assembly (27) (see **Terminal Housing and Power Cable Removal and Disassembly** in **MOTOR DISASSEMBLY**). Install a pipe plug in the hole for the pressure relief valve piping.

To prevent contamination of the motor, and to provide a solid surface to support the pump when inverted, make a plate to the dimensions shown in Figure 4, and secure it to the terminal plate studs with the nuts (29).

Remove two of the capscrews, lockwashers and hex nuts (39, 40 and 41) from opposite sides of the pump, and install lifting eyes in the holes with the eyes toward the strainer end of the pump. Use a suitable hoist and sling through the lifting eyes to carefully raise the pump to the inverted position. When moving the pump, always use adequate equipment and personnel to safely handle the pump until it is secured.

Position the pump on a solid surface and shim or support it as required to ensure that it remains stable during disassembly.

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

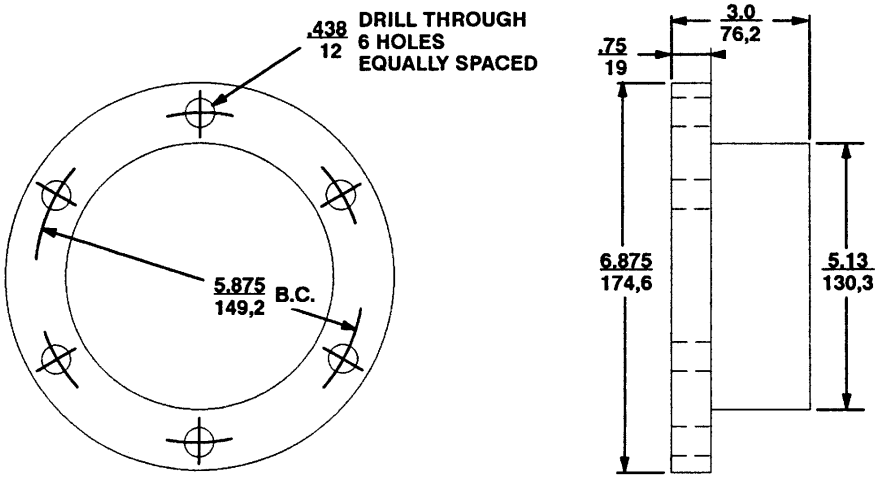


Figure 4. Terminal Cover Plate

Suction Head And Wear Ring Removal

(Figure 1)

Remove the hardware (58 and 59) securing the suction head (52) to the diffuser (1). Remove the suction head, and remove and discard the suction head O-ring (56).

CAUTION

Use caution not to damage the suction head when removing the wear ring.

Inspect the wear ring (55) for excessive wear or scoring. The wear ring is secured in the suction head by a press fit. If replacement is required, use a small bit to drill two holes through the ring horizontally, 180° apart. Use a chisel to complete the cuts through the ring, and remove it from the suction head. **Be careful** not to damage the suction head bore.

Diffuser Removal

(Figure 1)

Remove the hardware (39, 40 and 41) securing the diffuser (1) to the intermediate (51). Remove the diffuser, and remove and discard the diffuser gasket (38) and seal plate gasket (42).

Impeller Removal

(Figure 1)

Temporarily reinstall two of the capscrews (39) in the intermediate (51). Wedge a piece of wood between the vanes of the impeller (2) and the capscrews to prevent shaft rotation. Remove the impeller nut and washer (53 and 54). Remove the wood from the impeller vanes, and remove the capscrews (39) temporarily installed in the intermediate (51).

Use a suitable puller to remove the impeller from the shaft. It may be necessary to strike the puller shaft sharply with a hammer to loosen the impeller. Use caution when removing the impeller; tension on the seal spring will be released.

An alternate method of removing the impeller is to pre-load the impeller using two large screwdrivers or wedges 180° apart between the impeller and the seal plate. Using a soft-faced mallet or a hammer and wood block, strike the end of the impeller shaft sharply until the impeller breaks loose.

Lower Seal Removal

(Figures 1 and 5)

Remove the spring retainer and seal spring. Lubricate the shaft, and work oil up under the rubber bellows of the rotating portion of the seal. Carefully slide the rotating portion of the seal assembly off the shaft.

To remove the stationary portion of the seal, remove the socket head capscrews (5), and slide the seal plate (44) and stationary portion of the seal off the shaft as a unit. Remove and discard the seal plate O-ring (43).

Place the seal plate on a flat surface with the impeller side down. Use a dowel to press the stationary seat and element out of the seal plate from the back side.

An alternate method of removing the stationary portion of the seal without removing the seal plate is to slide a pair of stiff wires with hooked ends along the shaft and hook the stationary seat from the back side. Use the wires to pull the stationary portion of the seal from 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 clean tissue paper to prevent damage to the sealing surfaces.

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

Upper Seal Removal

(Figures 1 and 5)

Unless cracked or otherwise worn, it is not necessary to remove the intermediate (51) for access to the upper seal assembly (4).

CAUTION

If the intermediate must be removed, see

the procedure under **MOTOR DISASSEMBLY** in this section. **Do not** attempt to loosen the hardware (6 and 7) securing the bearing cap (49) before referring to this section; otherwise, the rotor shaft and bearings could be damaged.

Remove the seal retaining ring (60) with snap ring pliers. Use caution when removing the retaining ring; tension on the seal spring will be released. Remove the seal spring retainer and spring.

Lubricate the shaft adjacent to the seal, and work oil up under the rubber bellows. Position a screwdriver or other suitable device on each side of the bellows retaining flange, and pry the rotating portion of the seal upward until it is off the shaft.

Slide the hook 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.

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

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 **PUMP END REASSEMBLY**.

PUMP END REASSEMBLY

NOTE

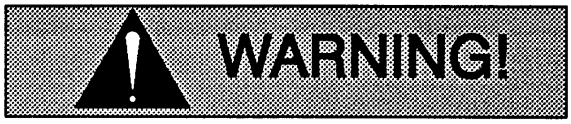
Reuse of old O-rings, gaskets, or shaft seal parts may result in premature leakage or reduced pump performance. It is strongly recommended that new gaskets and shaft seal assemblies be used during reassembly (see the parts lists for numbers).

Cleaning And Inspection Of Pump Parts

(Figure 1)

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 with a soft cloth soaked in cleaning solvent. Use a clean cloth lightly dampened with solvent to clean the intermediate, suction head, diffuser, and seal plate. **Do not** allow the solvent to enter the motor.



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

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

Inspect the rotor shaft for damaged threads, scoring, or nicks. Remove nicks and burrs with a fine file or emery cloth to restore original contours. If the shaft is bent or severely damaged, the rotor and shaft must be replaced as an assembly (see **MOTOR DISASSEMBLY**).

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 the 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 leak-

age. If any components are worn, replace the complete seal; **never mix old and new seal parts.**

Install the shaft seals as illustrated in Figure 5.

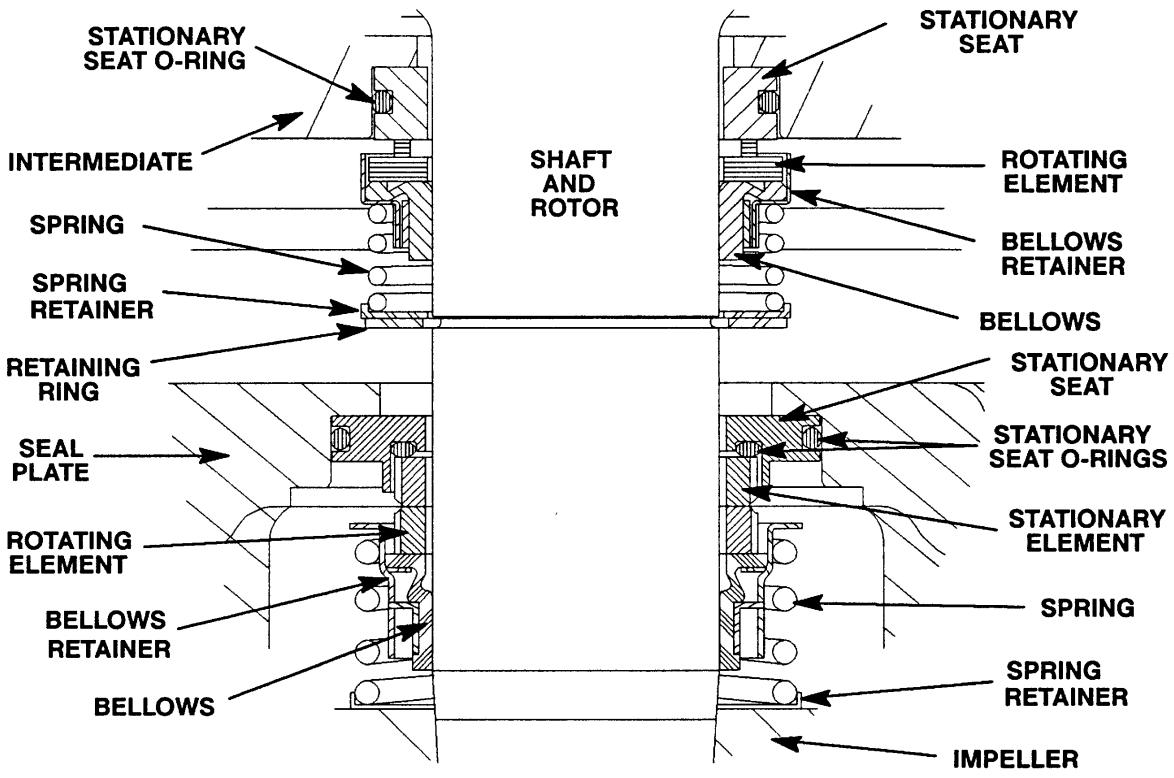


Figure 5. 46512-055 (Lower) And 25271-947 (Upper) Seal Assemblies

CAUTION

This seals are not designed for operation at temperatures above 120°F (49°C). Do not use at higher operating temperatures.

Upper Seal Installation

(Figures 1 and 5)

If a **new** upper seal assembly is to be installed, do not unwrap it until time of installation. Cleanliness of seal components is critical, especially the seal faces.

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

Clean the rotor shaft and seal cavity area of the intermediate. Be sure the area is dry and free of lint and dirt. **Do not** permit cleaning solvent or debris to fall into the intermediate cavity. Check the seal bore for burrs or nicks that might prevent a good seal. Apply a **light** coating of oil to the bore.

Unpack the stationary seat. Apply a **light** coating of oil to the stationary seat O-ring. Keep the sealing face dry.

NOTE

When pressing seal components onto the rotor 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.

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 is fully seated in the bore. 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 (33), and the I.D. of the bellows. Apply a single drop of **light** lubricating oil to the precision-finished seal face. Position the rotating portion of the seal on the shaft with the seal face down. Apply firm, steady pressure on the bellows 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. Using snap ring pliers, install the seal retaining ring (60). See Figure 5 for proper order of seal assembly.

Lower Seal Installation

(Figures 1 and 5)

Thoroughly clean the sealing surfaces and seal bore of the the seal plate (44). The seal bore must be free of burrs and nicks which could damage the seal.

NOTE

When pressing seal components onto the rotor 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 5). 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. Keep the sealing face dry.

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

Lubricate the O-ring (43) with light oil, and install it over the seal plate shoulder. Apply a light coating of oil on the O-ring seating surface in the intermediate (51). Carefully position the seal plate and assembled stationary portion of the seal over the shaft and against the intermediate (51). **Be careful** not to damage the stationary element. Secure the seal plate to the intermediate with the socket head capscrews (5).

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 I.D. of the bellows, and the seal seating surface on the shaft. Position the rotating portion of the seal on the shaft with the seal face down. Apply firm, steady pressure 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, and install the spring retainer. See Figure 5 for proper order of seal assembly.

Impeller Installation

(Figure 1)

Inspect the impeller (2) for cracks, broken vanes, or wear from erosion, and replace it if damaged.

Be certain that the impeller bore and the tapered section of the shaft are free of oily film and completely dry. **Do not** apply lubricants of any kind to the impeller bore or tapered section of the shaft. Install the impeller and washer (54) on the shaft.

After the impeller has been installed, apply 'Never-Seez' or equivalent compound to the threads of the

rotor shaft. (Do this **only** after the impeller has been installed.) Install the impeller nut (53) on the shaft.

Temporarily reinstall two of the capscrews (39) in the intermediate (51). Wedge a piece of wood between the vanes of the impeller (2) and the capscrews to prevent shaft rotation, and torque the impeller nut to 300 ft. lbs. (3600 in. lbs or 41,5 m. kg.). Remove the wood from the impeller vanes, and remove the capscrews (39) temporarily installed in the intermediate (51).

NOTE

*If the impeller is not fully seated, and binds against the diffuser, the shaft and lower bearing have been driven out of position during impeller removal. If this occurs, the lower bearing must be pressed back into place. (See **Motor Disassembly**, followed by **Motor Reassembly**.)*

Diffuser Installation

(Figure 1)

Thoroughly clean the diffuser (1) and its gasket surfaces. Inspect the diffuser and replace it if defective. Cement the intermediate gasket (38) in position using '3M Weather Strip Adhesive No. 8001' or equivalent compound. Install the seal plate gasket (42) over the shoulder on the seal plate.

CAUTION

When installing the diffuser, align the six, one-inch bosses on the diffuser over the seal plate socket head capscrews (5) to protect them from abrasion.

Carefully position the diffuser against the seal plate so that the six, one-inch bosses on the diffuser cover the seal plate capscrews (5). Apply 'Never-Seez' or equivalent compound on the threads of the capscrews (39), and secure the diffuser with the hardware (39, 40 and 41). Torque the capscrews to120 ft. lbs. (1440 in. lbs or 17 m. kg.).

Suction Head And Wear Ring Installation

(Figure 1)

Clean the suction head gasket surfaces. If the wear ring (55) was removed, position the replacement ring in the suction head with the chamfered end toward the bore shoulder. Press the wear ring into the suction head until fully seated.

NOTE

*The wear ring **must** seat squarely in the suction head to prevent binding and/or excessive wear.*

Install the O-ring (56) onver the shoulder on the suction head (52). Position the suction head against the diffuser. Apply 'Never-Seez' or equivalent compound on the threads of the studs (57), and secure the suction head to the diffuser with the hardware (58 and 59) . Torque the nuts to 40 ft. lbs. (480 in. lbs or 6 m. kg.).

NOTE

*Turn the impeller and check for free rotation. If the impeller binds, disassemble the suction head and check the wear ring for proper installation. The wear ring **must** seat squarely in the suction head to prevent binding and/or excessive wear.*

Strainer Installation

(Figure 1)

Inspect the strainer screen (45) for cracks or broken welds. Straighten or weld as required.

Position the strainer screen on the shoulder of the diffuser.

Pack heavy grease into the strainer hoses (46) and assemble the hoses to the base plate (47) by installing the long capscrews (48). The grease should prevent the hoses from sliding off the capscrews. Remove any grease from the end of the capscrews and apply 'Loctite Threadlocker No. 242' or equivalent compound on the threads of the capscrews. Tighten the capscrews just enough to draw the strainer screen down tightly against the diffuser, but not tight enough to distort it.

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 motor 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 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 out, 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 Removal And Disassembly

(Figure 1)

If the pump is maintained in an upright position, the terminal housing may be serviced without draining the oil from the motor cavity. However, the oil must be drained before attempting to disassemble the motor housing and components. To drain the oil see **Draining Oil From Seal And Motor** in **PUMP END 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 may be serviced without disassembling the motor housing or pump end.

Secure the pump in an upright position. To remove the terminal housing assembly (27), disengage the locknuts (29) securing the terminal housing to the upper motor housing (14).

(Figure 2)

Carefully raise the terminal housing from the motor housing until the terminal posts (1) are accessible. Loosen the allen head setscrews (22), and disconnect the motor leads from the terminal posts. Separate the terminal housing and power cable assembly from the motor housing. No further disassembly is required to test the stator or power cable.

To separate the power cable (12) from the terminal housing (15), remove the nuts (13), and slide the terminal gland (11) back along the power cable.

Compress the wire mesh of the cable grip (10) and move it back along the power cable. Oil the gland bushing (9) 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, it should be possible to pull the cable out far enough to expose the gland bushing. Apply oil on the cable jacket and slide the bushing back along the cable.

NOTE

Sometimes pressure exerted on the gland bushing (9) will deform the power cable jacket. If this occurs, additional oil and effort will usually free the power cable. If the cable cannot be separated from the gland bushing, it may be necessary to cut the cable.

Push approximately 6 inches (150 mm) of the cable into the terminal housing so that the terminal plate (20) comes free of the terminal housing. This should permit access to the power cable connections in the terminal plate.

When shipped from the factory, the connections between the power cable leads and the terminal collars (4) were encapsulated in heat-shrink tubing (3) and bonded to the terminal plate with hot-melt adhesive. In service, the adhesive may have been replaced by potting compound during previous repair.

Do not remove the adhesive (or potting) and heat shrink tubing unless the terminals or terminal plate require replacement. If replacement is required, cut away the tubing and adhesive, and loosen the allen head setscrews (19). Disconnect the power cable leads from the terminal collars (4), and separate the terminal plate from the terminal housing (15).

To remove the power cable from the terminal housing, disengage the hardware (5 and 6) securing the green and yellow ground lead terminals (16) to the terminal housing. Pull the power cable out of the terminal housing. The cable grip (10) and terminal gland (11) can be removed from the cable.

To remove the gland bushing (9), work oil in around the bushing. Invert the terminal housing, and press the bushing and terminal washer (8) out of the bore from the back side.

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.

If it is necessary to replace the terminal plate (20) or terminal components, unscrew the terminal collars (4), and remove the collars, dyna seal washers (2 and 21), and terminal posts (1).

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

Shaft And Rotor Removal

(Figure 1)

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

With the pump end disassembled, the terminal housing removed, and the pump secured in an inverted position, remove the hardware (36 and 37) securing the intermediate (51) to the motor housing (14). **Do not** remove the four capscrews (6) around the rotor shaft.

Install at least three lifting eyes equally spaced in the intermediate flange holes. Hook a sling through the eyes, and lift the intermediate, rotor and shaft (17), bearing cap (49), and both ball bearings (30 and 32) from the motor housing as an assembly. If necessary, tap around the parting surfaces with a soft-faced mallet to break the seal between the intermediate and motor housing. Remove the motor housing gaskets (11, 12 and 13).

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

Set the intermediate and rotor assembly on a clean work surface. Leave the lifting sling attached and reduce the tension slightly. Remove the hardware (6 and 7) securing the bearing cap (49) to the intermediate.

Steady the rotor and shaft assembly, and lift the intermediate off the lower bearing (32). If necessary, tap the impeller end of the rotor shaft with a soft-faced mallet to loosen the seal between the bearing and the intermediate bore.

Before removing the bearings from the rotor shaft, clean and inspect the bearings **in place** as follows.

CAUTION

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

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

WARNING!

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

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

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the motor housing

and bearing cap. Replace the shaft and rotor (as an assembly), the bearing cap, or the motor housing if the proper bearing fit is not achieved.

If the bearings require replacement, use a bearing puller to remove the upper and lower bearings (30 and 32) from the shaft. Remove the bearing cap and gasket (50) from the rotor shaft.

Stator Removal

(Figure 1)

Do not remove the stator (16) unless it is defective (open windings, insulation resistance low, or stator core damaged).

If the stator must be removed, position an expandable tool, such as a split disc, approximately 2 inches (51 mm) 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 (25 mm) off the work surface. Take care not to damage the stator end turns.

The motor housing must be heated 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, and "walk" the stator out. Continue this process until the stator clears the motor housing.

Wrap the stator in clean, dry rags or other suitable material until reassembly. 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.

Relief Valve

(Figure 1)

It is recommended that the relief valve assembly (22) be replaced at each overhaul, or any time the pump motor overheats and activates the valve. **Never** replace this valve with a substitute which has not been specified or provided by the Gorman-Rupp Company.

It is not necessary to remove the heavy pipe nipple (25) to remove the pressure relief valve. If the pipe nipple is removed, use 'Loctite Retaining Compound No, 680' or equivalent compound on the threads on both ends of the pipe nipple **only. Do not use** this compound on the pipe plugs, cap or relief valve.

When installing the relief valve assembly, use 'Loctite Pipe Sealant With Teflon No. 592' on the threads. Position the valve out of the way, next to the terminal housing (27) so that there is enough room for the terminal housing to clear.

MOTOR REASSEMBLY

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

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

Stator Installation

(Figure 1)

Clean all gasket and O-ring surfaces, completely removing any old gasket and cement material. 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 motor housing (14) 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-ven-

tilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

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 and block it from rolling.

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

NOTE

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

Position an expandable tool, such as a split disc, approximately 2 inches down inside the stator (opposite the lead wire end), and expand it tightly and squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and carefully lift the assembly. Take care not to damage the stator end turns. Slip a sleeve or heat shrink tubing (do not heat shrink) over the stator leads, or tape them together to protect them during installation.

Invert the motor housing. Position the stator so that the leads ar in line with the opening for the terminal housing, and carefully lower the stator into the motor housing. If the stator "cocks" in the motor housing, remove it and try again. If necessary, 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 damage to the windings**. Apply heat evenly to the inside of the motor housing; excessive heat is not required. Be careful not to damage the stator lead insulation during reassembly.

After the stator is fully and squarely seated on the motor housing shoulder, remove the expandable disc tool, and untape or remove the protective sleeve or heat shrink tubing from the stator leads. Cover the motor housing with a clean, lint-free cloth while the rotor is being assembled.

Shaft And Rotor Installation

(Figure 1)

Inspect the rotor shaft for damaged threads or scoring on the impeller taper. If the bearings were removed, inspect the bearing areas for scoring or galling and inspect the seal area. Remove nicks and burrs with a fine file or emery cloth. If the shaft is bent or damaged, replace the shaft and rotor (a single assembly).

Clean the bearing cap (49) and secure the gasket (50) to the cap with a light coating of gasket adhesive. Position the cap and gasket on the rotor shaft with the gasket and screw holes toward the threaded end of the shaft.

CAUTION

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

The bearings may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearings. Bearings should **never** be heated with a direct flame or directly on a hot plate.

NOTE

*If a hot oil bath is used to heat the bearings, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

NOTE

When installing bearings, position the lower bearing (32) on the shaft with the bearing manufacturer's part number description (located on the O.D. of the bearing) toward the inside of the cap and toward the stator-rotor assembly.

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

WARNING!

Use caution when handling hot bearings to prevent burns.

After the bearings have been installed and allowed to cool, check to ensure that they have not moved away from the shaft shoulders in shrinking. If movement has occurred, use a suitable sized sleeve and a press to reposition the bearings against the shaft shoulders.

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

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.

Use solvent to clean all gasket surfaces of the intermediate (51) and motor housing (14), completely removing old gasket and cement material. Inspect the sealing surfaces for burrs, nicks and pits which could cause a poor seal, and repair or replace as required.

Use **fresh** solvent to clean the bearing seating bore of the motor housing (14) and seal seating bore of the intermediate. Slide the rotor and assembled ball bearings into the intermediate until the lower bearing seats squarely in the intermediate bearing bore. Position the assembled bearing cap and gasket on the intermediate. Apply 'Never-Seez' or equivalent compound to threads of the capscrews (6). Install the capscrews and lockwashers (7), and secure the bearing cap to the intermediate by torquing the capscrews evenly in a cross-sequence to 20 ft. lbs. (240 in. lbs. or 3 m. kg.).

Apply '3M Weather Strip Adhesive No. 8001' or equivalent compound to the motor housing gaskets (11, 12 and 13), and position them on the motor housing. Make certain that the gaskets are properly seated and that the adhesive holds them securely.

Install at least three lifting eyes equally spaced in the intermediate flange holes. Hook a sling through the eyes, and lower the intermediate and rotor and shaft assembly into the motor housing. Use caution to guide the upper ball bearing (30) into the motor housing bearing bore. Tap the intermediate with a soft-faced mallet until it mates tightly with the motor housing.

Remove the sling and lifting eyes from the intermediate.

Apply 'Never-Seez' or equivalent compound to the threads of the motor housing studs (35). Install the hardware (36 and 37) securing the intermediate to the motor housing, and torque the nuts to 120 ft. lbs. (1440 in. lbs. or 17 m. kg.).

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

Terminal Housing And Power Cable Reassembly And Installation

(Figure 2)

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 out, 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 startup. Obtain the services of a qualified electrician, and refer to the wiring diagram(s) in INSTALLATION, Section B, to make electrical connections.

Clean the exterior of the 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**). **Do not** attempt repairs except to cut off either end of the cable; **splicing is not recommended**. Reinstall any wire tags or terminals which may have been removed.

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.

Use oil to lightly lubricate the outside of the pump power cable (12), the rubber gland bushing (9), terminal washer (8), and the bores of the terminal gland (11) and cable grip (10) for ease of assembly. Slide the terminal gland (11) onto the power cable. Compress the wire mesh on the cable grip, and slide it onto the cable, allowing approximately 3 ft. (1 m) of cable to extend beyond the terminal housing (15). Slide the rubber cable grip bushing and washer (8) onto the cable. Temporarily tape the ground wires (green and yellow) to the cable.

Sealing Terminal Housing Connections With Hot Melt Adhesive

(Figure 2)

WARNING!

Do not attempt to operate this pump unless the power cable leads are properly sealed in the terminal housing. Moisture entering the terminal housing could cause a short circuit, resulting in pump damage and possible serious injury or death to personnel.

When shipped from the factory, the cable leads and terminal collars (4) were encapsulated in heat-shrink tubing (3), and bonded to the terminal plate (20) with hot-melt adhesive to provide a water-tight seal. If this insulating material has been damaged or removed during maintenance, **it must** be replaced using materials and equipment approved by Gorman-Rupp (see the parts list for repair kits).

NOTE

*Heat-shrink tubing **must** be used to seal the power and control cable leads to the terminals before bonding the leads to the terminal plate. However, a commercially available potting kit may be used to bond the connections to the terminal plate. If this alternate seal method is used, refer to the instructions in **Sealing Terminal Plate Connections With Potting Compound**. Use **only** materials and heating equipment approved by Gorman-Rupp for field repairs.*

Before resealing the power and control cables, remove all the old adhesive material (or potting compound) from the terminal collars (4), terminal posts (1), and terminal plate (20). Inspect all parts for damage, and replace as required.

NOTE

Clean the cable leads and terminal plate in the areas to be sealed with cleaning solvent. Use a medium grit sandpaper to prepare the surface of the terminal plate. Incomplete sealing will occur if the surfaces are oil or grease coated.

Slide the terminal housing (15) up the power cable (12) and temporarily secure it with the cable grip (10).

Assemble the terminal collars (4), dyna-seal washers (2 and 21), and lower terminal posts (1) to the terminal plate (20) as shown in Figure 2.

NOTE

Both the power cable and motor conductor leads should be tinned prior to reassembly.

Slide a length of heat-shrink tubing (3) up over each of the power cable leads. Insert the power cable leads into the terminal collars (4), and secure them with the setscrews (19). Slide the heat-shrink tubing down the leads and over the terminal collars until they seat against the terminal plate. The tubing must extend up the leads far enough to ensure a good seal.

Carefully heat each tube with a commercially available hot air gun capable of producing 750°F (399°C), and shrink the tubes around the cable leads and terminals.

NOTE

To ensure adhesion of the hot-melt adhesive to the terminal plate, pre-heat the adhesive gun to at least 400°F (204°C). It is also recommended that the terminal plate be preheated to 125°F - 150°F (52°C - 66°C) to ensure adhesion. Use a commercially

available hot-air gun to heat the terminal plate at this point.

After the wire terminals have been secured and locations checked for correctness, hold the terminal plate horizontally and apply the hot-melt adhesive (G-R part number 18661-045) over the terminal posts with a hot-melt adhesive tool (Terlan model TM-80, or equivalent) set at 400°F (204°C). The adhesive must **completely** insulate electrical connections. Allow the adhesive to cool before securing the terminal housing to the motor housing.

WARNING!

Do not attempt to operate this pump unless the power cable leads are properly sealed in the terminal housing. Moisture entering the terminal housing could cause a short circuit, resulting in pump damage and possible serious injury or death to personnel.

Sealing Terminal Plate Connections With Potting Compound

(Figure 2)

Potting compound and hot-melt adhesive have the same electrical properties when correctly applied. Hot-melt adhesive is used at the factory to facilitate production. A commercially available potting kit (Products Research Corp., part number PR-1201-Q Class 1 potting compound, or Chemseal potting compound, part number GS3100, or equivalent) may also be used to seal the connections.

Clean and assemble all terminal components as indicated in **Sealing Terminal Plate With Hot-Melt Adhesive**. Use medium grit sandpaper to prepare the surface of the terminal plate in the area where the potting mold will be installed.

NOTE

Clean the cable leads and terminal plate in the areas to be sealed with cleaning solvent. Incomplete sealing will occur if the surfaces are oil or grease coated.

Trim the potting mold so it is just long enough to cover the terminal post studs. Slide the potting mold up over the leads of the power cable and control cable.

Secure the cable leads to the terminals as described in the previous section, and install and shrink the heat-shrink tubing around each terminal.

Hang the cable in a vertical position with the terminal plate horizontal. Slide the potting mold down over the terminal posts and center it around the terminals and against the terminal plate. Use quick-setting cement, such as '3M Weather Seal' to secure the potting mold to the terminal plate.

WARNING!

Most potting base compounds contain toluene; use adequate ventilation and avoid prolonged breathing of vapors. 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 until the electrical connections are completely insulated. Tamp the potting material to eliminate air bubbles and ensure the material has completely covered the area around the terminal posts.

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

(Figure 2)

After the heat-shrink tubing has been installed or after the potting material has cured, untape the ground leads, and slide the terminal housing (15) down the cable. If removed, connect the green ground lead to the ground terminal (16), and connect the yellow ground check lead to the ground check terminal (7).

Secure the terminals to the terminal housing with the hardware (5 and 6); **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 (20) should fit loosely against the terminal housing.

Slide the terminal washer (8) down the cable (12) and into the upper bore of the terminal housing. Oil the bore and cable, and slide the gland bushing (9) into place. Compress the wire mesh of the cable grip (10), and slide it down the cable, making sure it contacts the bushing. Slide the terminal gland (11) into place, and engage the nuts (13) finger tight. Do not fully tighten the nuts at this time.

Refer to the wiring diagrams in **INSTALLATION**, Section B, and attach the motor leads to the terminal posts (1) using the allen head setscrews (22).

If required, rotate the terminal housing and twist the motor leads to remove excess slack. Coat the threads of the terminal housing studs (28, Figure 1) with 'Never-Seez' or equivalent compound, and secure the terminal housing assembly to the motor housing with the hardware (29, Figure 1); torque the nuts to 20 ft. lbs. (240 in. lbs. or 3 m. kg.).

Tighten the nuts (13), drawing the terminal gland down into the terminal bore. **Do not** overtighten and damage the terminal gland or hardware.

See **FINAL ASSEMBLY** and **LUBRICATION,** followed by **MOTOR LEAK TEST**.

LUBRICATION

Seal Cavity

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

Check the oil level only when the pump is cool. If The oil level plug is removed when the pump is hot, pressure in the seal cavity can cause hot oil to be ejected as the plug is removed.

To check the seal cavity oil, lay the pump on its side with the pipe plug (8) up. Remove the plug and the seal cavity plug (10), and screw a short 3/8-inch NPT nipple into the hole. Plug the open end of the nipple with your finger. Tip the pump upright, drain off a small amount of oil into a transparent cup, and lay the pump on its side again. If the oil level is abnormally low, or the color milky or dark, refer to **Draining Oil From Seal Cavity** in this section for instructions and troubleshooting tips. If the oil is clear, remove the nipple and top off the seal cavity with oil. Apply 'Loctite Pipe Sealant With Teflon No. 592', or equivalent to the threads of the pipe plug, before reinstalling the plugs (8 and 10).

When lubricating a dry (overhauled) pump, add approximately 3.2 quarts (3 liters) of lubricant (see Table 1 for lubricant specifications).

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

Table 1. Pump Oil Specifications

Specifications:	
Type	Premium high viscosity index, anti-wear hydraulic oil
Viscosity @ 100°F (38°C)	110 to 155
Viscosity @ 210°F (99°C)	40 to 50
Dielectric	26,000 (volts-min)
Recommended supplier:	
Gulf Oil Company	Gulf Harmony HVI AW 26
Acceptable alternate suppliers:	
Gulf Oil Company	Gulf Harmony 32 AW
Texas Oil Company	Rando HD 32 or HD AZ 32
Sun Oil Company	Sunvis 816 or 916
SOHIO (Also Boron & British Petroleum Oil Companies)	Energol-HLP 32
Shell Oil Company	Tellus 32, Tellus T-23 or T32
ARCO	Duro 32
Exxon	Nuto H 32

Motor Housing Cavity

Remove the motor cavity oil level plug (15). Remove the motor cavity fill cap (23) on the street tee (24) where the pressure relief valve (22) is secured, and add approximately 24 quarts (22,7 liters) of the recommended grade of submersible pump oil until it escapes from the oil level plug opening (15). Maintain the oil at this level. Apply 'Loctite Pipe Sealant With Teflon No. 592', or equivalent compound to the threads of the fill cap and the level plug. Reinstall and tighten the cap and plug.

CAUTION

Never attempt to fill the motor cavity through the drain plug (9) or oil level plug (15) openings. The fill cap (23) and oil level plug (19) are designed to prevent over-filling of the motor cavity. A volume of air must be trapped above the motor to permit thermal expansion of the motor oil.

FINAL ASSEMBLY

(Figure 1)

If the discharge flange (19) was removed from the motor housing (14), replace the discharge flange gasket (18) and secure the flange with the nuts (21).

Connect the discharge hose, and position the pump in the wet well. If rigid piping or long hose is used, position the pump, then connect the piping. Open any valves in the discharge line.

THE GORMAN-RUPP COMPANY AND GORMAN-RUPP OF CANADA LIMITED 12 MONTH LIMITED WARRANTY

EXTENT AND DURATION OF WARRANTY

Coverage: The Gorman-Rupp Company or Gorman-Rupp of Canada Limited (herein individually referred to as "GR") each individually warrant that its products and parts shall be free from defects in material and workmanship for twelve (12) months from the date of purchase by the original end user.

Exceptions: This Limited Warranty shall not apply to the following products and parts: engines, motors, trade accessories and other products, components or materials not manufactured by GR. With respect to submersible pumps, the pump and motor are an integral unit and are therefore warranted as a unit. However, with respect to the electrical components in submersible pumps, this warranty is valid **only** when electrical controls for the pump have been specified and/or provided by GR. Wear and tear on any product resulting from normal use is not covered by this Limited Warranty.

LIMITATIONS

GR'S SOLE AND EXCLUSIVE WARRANTY WITH RESPECT TO ITS PRODUCTS AND PARTS IS THIS LIMITED WARRANTY. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER EXPRESS AND/OR IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

EXCLUSIVE REMEDY AND DAMAGES

The sole and exclusive remedy for breach of this Limited Warranty by GR, and the entire extent of its liability for such breach or for damages arising and/or resulting from the use of the products and parts covered by this Limited Warranty shall be as follows:

1. **Repair or replacement:** If inspection shows that any GR product or part covered under this LimitedWarranty is defective in materials or workmanship, GR shall repair or replace the defective product or part at its option, without charge. You must have properly installed, maintained and used the product or part claimed to be defective in accordance with the maintenance schedule and/or manual which comes with the product. *No allowance will be made for labor, transportation or other charges incurred by you in connection with such repair or replacement.*

2. **To obtain the above remedy:**

   a) Immediately notify GR at the address below of the claimed defect in materials or workmanship and provide the serial number or date code of the product and/or part and provide a copy of the invoice or bill of sale referencing the product and/or part by no later than the expiration date of the Limited Warranty period.

   b) GR will advise whether inspection of the product and/or part will be necessary and whether and how repair or replacement will be effected. If inspection by GR is necessary, the product or part must be sent freight prepaid to GR at the address stated below. Return shipment of the repaired product or part will be F.O.B. the address stated below.

3. **Damages:** GR's liability for damages for breach of this Limited Warranty shall not exceed the amount of the purchase price of the product or part in respect to which damages are claimed. **IN NO EVENT SHALL GR BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES FOR BREACH OF THIS LIMITED WARRANTY OTHER THAN AS STATED HEREIN.**

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

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