OM-07771-04
July 30, 2025

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

SUBMERSIBLE PUMPS

MODELS

S4E1-E20 460/3
and
S4E1-E20 575/3

GORMAN-RUPP PUMPS

www.grpumps.com

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Printed in U.S.A.

Register your new
Gorman-Rupp pump online at
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Valid serial number and e-mail address required.

RECORD YOUR PUMP MODEL AND SERIAL NUMBER

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

Pump Model: _____

Serial Number: _____

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INTRODUCTION

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

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

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

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

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

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 the S Series submersible motor driven pumps indicated on the front cover of this manual.

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

WARNING!

Before attempting to open or service the pump:

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

WARNING!

This pump is not designed to pump volatile, explosive, or flammable materials. Do not attempt to pump any liquids for which you 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.

WARNING!

Before connecting any cable to the control box, be sure to ground the control box. Refer to the Control Box Manual for the suggested grounding methods.

WARNING!

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

WARNING!

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.

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.

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.

WARNING!

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

WARNING!

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

WARNING!

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

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.

WARNING!

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

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.

CAUTION

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

INSTALLATION — SECTION B

GENERAL INFORMATION

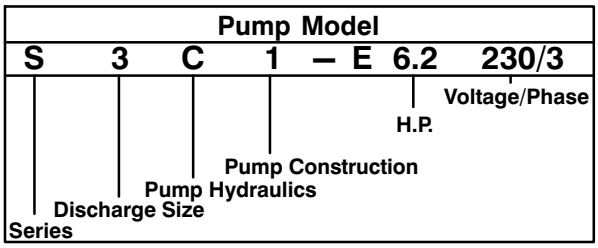
Review all SAFETY information in Section A.

Since pump installations are seldom identical, this section is intended only to summarize general recommendations and practices required to inspect, position, and arrange the pump and piping. If there are any questions concerning your specific installation, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Liquid level devices are available from Gorman-Rupp as optional equipment. For information on installing and operating these items, refer to the literature accompanying them.

Pump Model Designation

Following is a description of the model numbering system for S Series pumps. These submersible pumps are available in a range of sizes. Refer to the following chart to identify the size of your specific pump model.



PREINSTALLATION INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, check 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 loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at the mating surfaces.

c. Inspect the power cable for cuts or any other obvious damage.

d. Check that amperes, phase, voltage and hertz indicated on the name plate match the ratings on the control box and incoming power.

e. Carefully read all tags, decals, and markings on the pump, and perform all duties indicated.

f. Check for oil leaks. If there is any indication of an oil leak, see **LUBRICATION** at the end of this manual.

PUMP SEAL

There are two shaft seals in the 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.

LUBRICATION

These pumps utilize two lubrication cavities. The motor housing cavity provides lubrication to the motor assembly and bearings, while the intermediate cavity provides lubrication to the pump seal.

The pumps are fully lubricated when shipped from the factory. However, lubrication levels **must be checked** before installing the pump (see **LUBRICATION** in **MAINTENANCE AND REPAIR — SECTION E**). An additional quart (0,9 liter) of oil is provided to “top off” the oil level in the pump motor cavity. If the oil level is abnormally low, determine the cause before putting the pump into service.

Due to differences in pump design, the quantity of oil and manner in which oil is to be added to the seal cavity varies between pump models. Refer to Table B-2 for oil capacities and positions for filling the seal cavity in each pump. Motor cavities requiring lubrication should always be positioned vertically for filling. Refer to **LUBRICATION**, Section C for lubrication specifications and intervals.

PUMP INSTALLATION

WARNING!

When installing or servicing the pump or controls, follow all requirements for the installation of wiring or electrical

equipment as outlined in the National Electric Code. Follow all safety requirements. Failure to observe these requirements could result in injury or death to personnel.

CAUTION

Do not allow the free end of the power cable to enter the liquid being pumped. The free end of the cable **must** be kept dry to prevent liquid from wicking through the cable and into the motor.

NOTE

*Refer to the performance curve in **Maintenance and Repair — Section E** when determining the most efficient piping installation. **The recommended maximum submergence depth is 65 feet.***

Pump Motor Specifications

See Table B-1 for pump specifications.

Table B-1. Pump Specifications

Model	Voltage/ Phase	Dual Voltage	Pump HP/ KW	Motor Speed (RPM)	Full Load Amperes	No Load Amperes	Locked Rotor Amperes	Discharge Size (NPT)
S4E	460/3	NO	20 HP	3450	26	4.4	170	4 INCH
	575/3				20.8	3.5	136	

Table B-2. Additional Specifications

Pump Model	Voltage/ Phase	Approximate Weight — Lbs. (kg)		Oil Capacity Ounces (Liters)		Seal Cavity Filling Position (H)orizontal (V)ertical
		Pump	50 Ft. Cable	Seal Cavity	Motor Cavity	
S4E	460/3	302 (137)	38 (17)	32 (1)	---	H
	575/3					

Pump Dimensions

For the approximate physical dimensions of your pump, refer to the pump specification data sheet or contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Lifting

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

Refer to Table B—2 for the approximate maximum weight for your pump.

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

NOTE

Before installing and operating the pump, check the direction of impeller rotation to ensure that the pump is properly wired at the control box. See ***IMPELLER ROTATION****, Section C.*

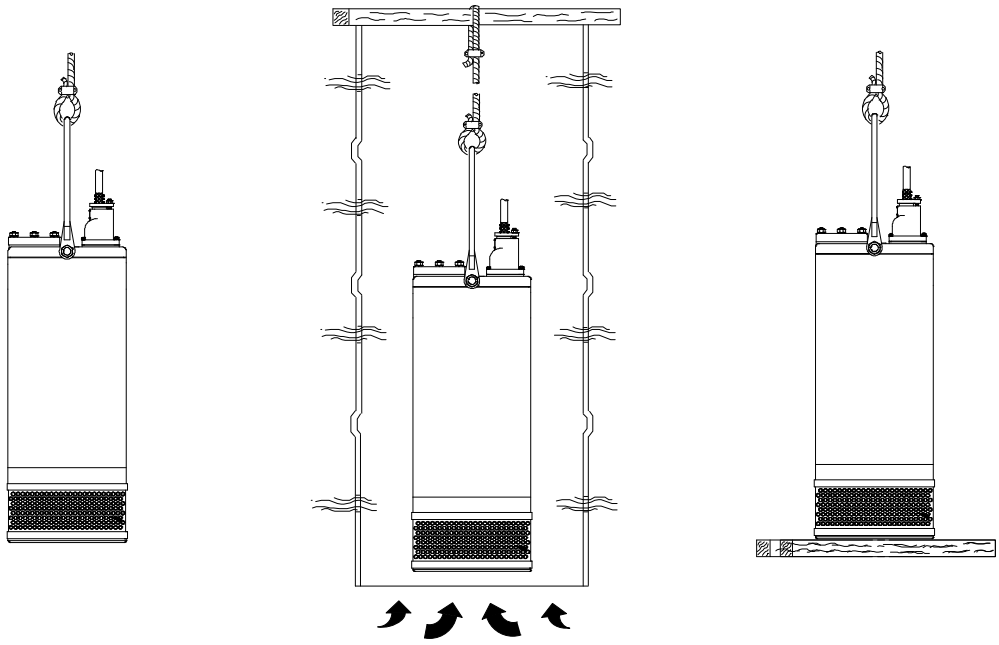
The pump is designed to operate fully or partially submerged. The rotating parts are oil lubricated, and the motor is cooled by a constant flow of liquid or air discharged through internal passages.

As a safeguard against rupture or explosion due to heat, models equipped with oil-lubricated motors are fitted with a pressure relief valve which will open if vapor pressure within the pump motor reaches a critical point.

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 B—1 for 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.



BY BAIL **IN PERFORATED CULVERT PIPE** **ON SUPPORTS**

Figure B—1 Typical Pump Installations

Piping

No suction piping is required in a standard installation.

These pumps are provided with a suction strainer to prevent large solids from clogging the impeller. If required, the strainer can be removed and the pump suction “staged” to the discharge of another pump, allowing one pump to feed the other on high discharge head applications.

To determine the size of the discharge connection, see **Table B—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 fit-

ting near the pump. The discharge line must be independently supported to avoid strain and vibration on the pump.

Either hose or rigid pipe may be used to make discharge connections. For maximum pumping capacity, keep the line as short and straight as possible. Elbows and fittings used in discharge lines increase friction loss, minimize their use.

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.

ELECTRICAL CONNECTIONS

WARNING!

Install and operate this pump in accordance with the National Electrical Code and all local codes. Have a qualified electrician perform all checks and connections in this section.

Never attempt to alter the length of the pump motor cable or to repair it with a splice. The power cable and pump motor must be kept completely waterproof. Serious damage to the pump and injury or death to personnel can result from any alteration to the cable.

Control Box Installation

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.

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.** Refer to the control box manual for enclosure dimensions and parts.

Secure the control 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 Connection**). 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.

Field Wiring Connections (Incoming Power)

WARNING!

The electrical power used to operate this pump is high enough to cause injury or death. Obtain the services of a qualified electrician to make all electrical 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.

WARNING!

Do not connect the pump motor directly to the incoming power lines. The pump motor is designed to operate through a Gorman-Rupp approved control box which provides overload protection and power control; otherwise, the pump warranty will be voided. Make certain that the pump and control box are properly grounded. Install and operate the control box in accordance with the National Electric Code and all local codes. Failure to follow these could result in injury or death to personnel.

Field wiring is **not** provided with the pump, and must be supplied by the user. The field wiring must

be of the proper size and type to ensure an adequate voltage supply to the pump. Voltage available **at the motor** must be within the range indicated in Table B-3.

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

a. Measure the voltage across the incoming lines (1 & 2 for single phase, 1 & 2, 2 & 3, and 1 & 3 for three phase) **while the pump is operating at full capacity**. Refer to the literature supplied with the control box 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 ensure an adequate voltage supply to the pump.

Table B-3. Pump Voltage Requirements

NOMINAL VOLTAGE	PHASE	MINIMUM VOLTAGE	MAXIMUM VOLTAGE
460	3	420	500
575	3	520	630

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.

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 B—3 for some suggested grounding methods.

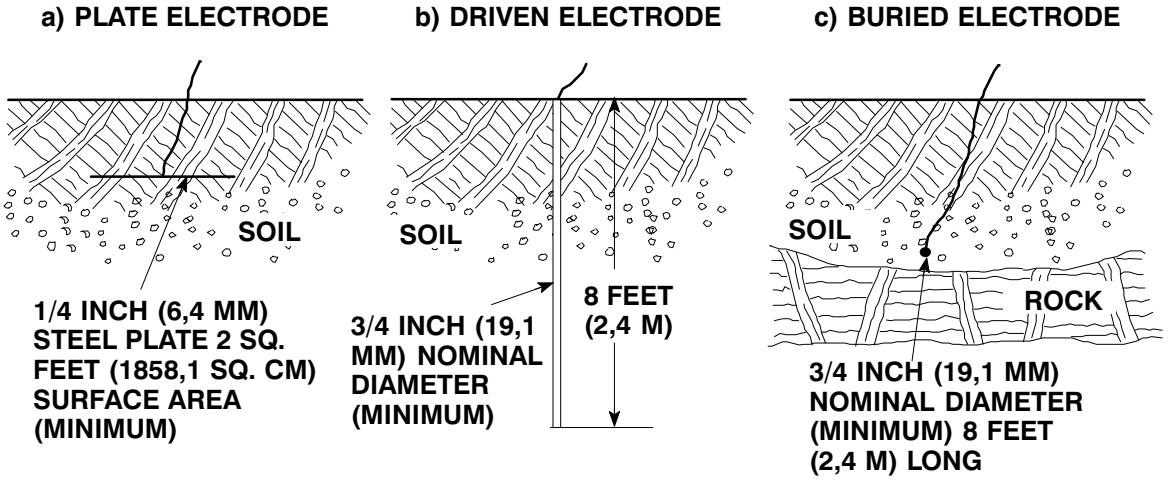


Figure B—3. Suggested Grounding Methods

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) 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 connections.

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.

Refer to the literature accompanying the control box for field wiring connections.

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 pump is provided with a 50 ft. (15,2 m) power cable (see Table B—4 for standard 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 alternations.

Table B-4. Pump Power Cable Specifications

Pump Model	Voltage/ Phase	A.W.G Cable Size	Cable O.D. Inches (mm)	Conductor Dia. Inches (mm)	Amp Rating (See Note Below)	Cable Type ➧	DC Resistance (ohms) at 25°C (77°F) per 1000 ft. (305 m)	Voltage Drop per 100 ft. (30,5m) at Max. Load
S4E	460/3	8	1.05 (27)	0.17 (4)	59**	SPC	0.71	3.69
	575/3							2.95

NOTE: * Amp Rating at 30°C (86°F) ➧ **Canada Use Type SOW Cable**
**** Amp Rating at 40°C (104°F)**

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 the control box manual. Use conduit or cable clamps to secure the power cable to the control box. Make certain that all connections are tight and that cable entry points are rainproof.

NOTE

The power cable furnished with the 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

WARNING!

Any control box used to operate the pump must be approved by the Gorman-Rupp Company for the application.

Motor Cable Grounding Test

WARNING!

Do not connect the pump control cable to the control box or incoming voltage before verifying the pump ground; otherwise, personnel will be exposed to serious injury or death.

Using a volt-ohm meter, connect one lead to the motor cable green/yellow ground lead. Connect the other lead to an **uninsulated** point on the pump body. The test circuit should close.

If the test circuit does not close, there is a defect in the cable or motor which must be corrected.

Control Box Connections

This pump is shipped completely wired for the voltage shown on the name plate, and is ready for operation through an approved control box.

Ground and wire the control box in accordance with the instructions accompanying it.

NOTE

*For reference, internal motor wiring connections are shown in **Maintenance and Repair — Section E**.*

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 the following optional sensing device (see Figure B—4):

- **Bulb (Float) Type:** a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch.

The liquid level circuitry may be prewired as a factory option, or easily added to the standard control box in the field by qualified personnel. The unit is complete except for the remote float switches. 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.

Other types of liquid level devices may also be used. Consult the factory for the liquid level device best suited for your application.

CAUTION

If the pump requires liquid level devices, install the liquid level devices and connect them to the control box in accordance with the instructions accompanying the devices.

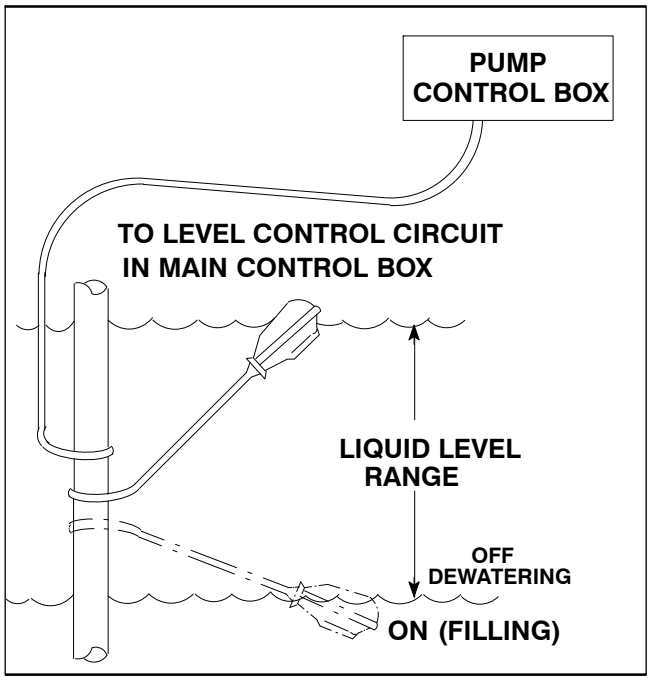


Figure B—4. Liquid Level Device

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

Refer to the appropriate wiring diagram in the literature accompanying the control box when making electrical connections.

OPERATION — SECTION C

GENERAL INFORMATION

Review all SAFETY information in Section A.

WARNING!

This pump is designed to handle most non-volatile, non-flammable liquids. 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.

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

Pump Performance

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.

Refer to the performance curve in **Maintenance and Repair — Section E** for the specific performance for your pump.

Control Box

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

WARNING!

The pump motor and control box are not designed to be explosion-proof. Do not operate in an explosive atmosphere. Any control box used to operate the pump must be approved by the Gorman-Rupp Company for the application. Improper location of a non-explosion proof control box could result in destruction of equipment, injury or death to personnel.

See the operating instructions furnished with the control box, and with other optional accessories and controls, before attempting to start the pump.

PUMP OPERATION

Liquid Temperature and Overheating.

WARNING!

Overheated pumps can cause severe burns and injury. If the pump becomes overheated:

1. **Stop the pump immediately.**
2. **Lock out the power to the control panel to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Close the discharge valve (if used).**
5. **Refer to instructions in this manual before restarting the pump.**

Overheating can occur if the pump is misapplied; if it is started more than 6 times within one hour; if the temperature of the liquid being pumped exceeds the temperature for which the pump was designed, if the control box fails to provide overload

or thermal protection, or if the pump is operated against a closed discharge valve for an extended period of time.

CAUTION

Do not start the pump more than 6 times per hour. If the motor does not cool between starts it will overheat, resulting in damage to the motor windings.

As a safeguard against rupture or explosion due to heat, models equipped with oil-lubricated motors are fitted with a pressure relief valve which will open if vapor pressure within the pump motor reaches a critical point. Always terminate power to the pump and control before investigating pump or control box problems.

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 completely 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.

Impeller Rotation

Check impeller rotation as follows before operation to ensure that the impeller is rotating in the correct direction.

CAUTION

While checking impeller rotation, secure the pump to prevent the power cable from coiling.

Suspend the pump from the lifting device fitted on the pump. Apply power briefly and note the direction of pump kickback. As viewed from the top, the pump should kick in a **counterclockwise** direction; this will indicate that impeller rotation is correct.

If the pump kicks in a **clockwise** direction, impeller rotation is incorrect. If the pump is powered by a three-phase motor, have a qualified electrician interchange the control box connections of any two pump motor power leads. Re-check pump kickback; it should now be in a counterclockwise direction.

If rotation is incorrect on a single-phase motor, contact the factory before installing the pump.

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.

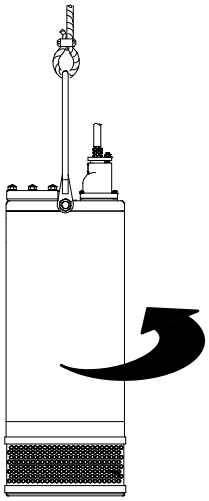


Figure C—1. Checking Pump Rotation

STARTING, STOPPING, AND OPERATIONAL CHECKS

Starting

CAUTION

Do not attempt to operate the pump until impeller rotation has been checked; improper rotation will affect pump performance and may damage the pump.

Follow the instructions accompanying the control box, start the pump, and run any recommended checks.

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.

Stopping

Follow the instructions accompanying the control box for stopping the pump.

WARNING!

On pumps equipped with a motor thermal protector, the integral thermal overload device will shut off the motor if the temperature rises above design limits. When the pump cools and the temperature falls below these limits, the motor will restart automatically. To avoid the hazards of an unexpected motor startup, do not attempt to handle or service the pump unless all power to the motor has been shut off and locked out at the control box; otherwise, serious personal injury could result.

During motor shutoff by the thermal overload device, control box circuits remain live. Do not attempt to service any control box components unless incoming power has been shut off.

To stop the pump, turn the control handle OFF, thereby opening the circuit breakers. This **does not** terminate incoming power through the field wiring connected to the control box.

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

Operational Checks

To detect minor problems, check the pump for proper operation when it is first started, and at periodic intervals during operation.

CAUTION

To avoid serious damage to the pump, check for unusual noises or excessive vibration while the pump is running. If noise or vibration is excessive, stop operation and refer to the troubleshooting chart in the maintenance and repair manual.

The suction inlet or impeller may become clogged with debris. In some cases, stopping the pump momentarily may backflush this blockage. If backflushing does not clear the debris, remove the pump from the sump or wet well and clear manually.

WARNING!

Never introduce air or steam pressure into the pump casing to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, limit liquid pressure input to 50% of the maximum permissible operating pressure shown in the pump performance curve (refer to the accompanying Parts List Manual).

Check the pump for overheating. Overheating can occur if the pump is misapplied, required to start repeatedly, if the control box fails to provide overload or thermal protection, or if the pump is operated against a closed discharge valve for an extended period of time.

CAUTION

Do not start the pump more than 6 times per hour. If the motor does not cool between starts it will overheat, resulting in damage to the motor windings.

Check the oil level(s) as indicated in the following **LUBRICATION** section.

COLD WEATHER PRESERVATION

WARNING!

Do not attempt to thaw the pump by using a torch or other source of flame. This could damage gaskets, O-rings or heat the oil in the seal housing above critical temperatures, causing the pump to rupture or explode.

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

If the pump does freeze while it is out of the liquid, submerge it until thawed; if the liquid is near freezing, the pump must be submerged for an extended period of time. Check thawing by starting the pump and checking that the shaft rotates freely. If the pump remains frozen, allow additional thawing time before attempting to restart.

If submerging does not thaw the pump, move it into a warm area until completely thawed.

LUBRICATION

WARNING!

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

On a new pump, check the oil level in both seal and motor cavities before initial startup, and drain and replace the oil after the first 200 hours of operation. Following this, check the oil level in the seal cavity after the first two weeks of operation, and every

month thereafter. Check the motor lubrication level any time the pressure relief valve is activated, and replace the oil annually.

Before installing or removing the lubrication plug(s), always clean the area around the plug(s) to prevent contamination.

Draining Oil

Refer to the Parts List in **Maintenance and Repair — Section E** for drain plug location.

Remove the drain plug slowly to release any pressure. Install a short pipe nipple in the hole. Place a clean container under the plug and, using a hoist, tilt the pump at an angle of approximately 60°.

Repeat the procedure for the motor housing oil.

Condition Of Oil

Check the condition of the oil drained from the pump. Clear oil indicates that the pump seal(s) are functioning properly. If the oil is milky or contains a small amount of water, it must be changed.

If the oil contains a large amount of water, it must be changed, and the seal(s) must be checked before the pump is put back in operation (refer to the Maintenance and Repair Manual).

Adding Oil

Refer to Table B—2 in **INSTALLATION** for oil capacities and positions for filling the seal cavity in your pump. Motor cavities requiring lubrication should always be positioned vertically for filling.

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.

When lubricating the seal cavity, remove the lubrication plug as indicated in **Draining Oil**, and position the pump as indicated in Table B—2. Add premium quality submersible pump oil through this plug hole. If the pump is to be positioned vertically or at an angle, fill the cavity to the bottom of the plug hole. If the pump is to be positioned horizontally, completely fill the cavity.

Install and tighten the lubrication plug.

When lubricating the motor cavity, add oil through the hole for the pressure relief valve. If the pump is equipped with a motor lubricant level plug, remove this plug and fill the cavity until oil escapes through the hole. If the pump is not equipped with a motor lubricant level plug, fill the cavity to the top of the hole.

Reinstall the pressure relief valve.

Table C—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
BP (Also Boron)	Energol-HLP 32
Shell Oil Company	Tellus 32, Tellus T-23 or T32
ARCO	Duro 32
Exxon (Also Esso)	Nuto H 32
Petro-Canada	Harmony HVI 22

TROUBLESHOOTING — SECTION D

Review all SAFETY information in Section A.

WARNING!

The following precautions should be taken before attempting to service the pump; otherwise, injury or death could result.

1. **Familiarize yourself with this manual and with all other literature shipped with the pump.**
2. **Lock out incoming power to the pump or control box to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature before opening any covers, plates or plugs.**
5. **Close the discharge valve (if used).**

WARNING!

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

NOTE

*Many of the probable remedies listed below require use of electrical test instruments; for specific procedures, see **ELECTRICAL TESTING** following the 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 beaker.	Check power source for blown fuse, open overload unit, 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).

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
(AUTOMATIC MODE) (CONT'D.)	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).
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).

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
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.
	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.

WARNING!

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

CAUTION

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

Test Equipment

A volt/amp/ohmmeter and 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	Use
Ammeter	To check AC Voltage and current (amperage)
Ohmeter	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 or yellow ground check lead). If there is a high resistance reading on the ohmmeter, there is an open or broken circuit caused by a break in the power cable or motor windings, or by a bad connection between the motor and the power cable. Switch one test lead to the third power lead, and test again.

b. If an open or broken circuit is indicated, check the power cable for obvious damage, and replace as necessary (see **MAINTENANCE AND REPAIR)**. If there is no apparent damage to the motor cable, remove the terminal housing (see **MAINTENANCE AND REPAIR)** and check the continuity of each power cable lead at the terminal posts.

NOTE

*When shipped from the factory, the connections between the power cable leads and the terminal posts were encapsulated in heat shrink tubing and bonded to the terminal plate 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:

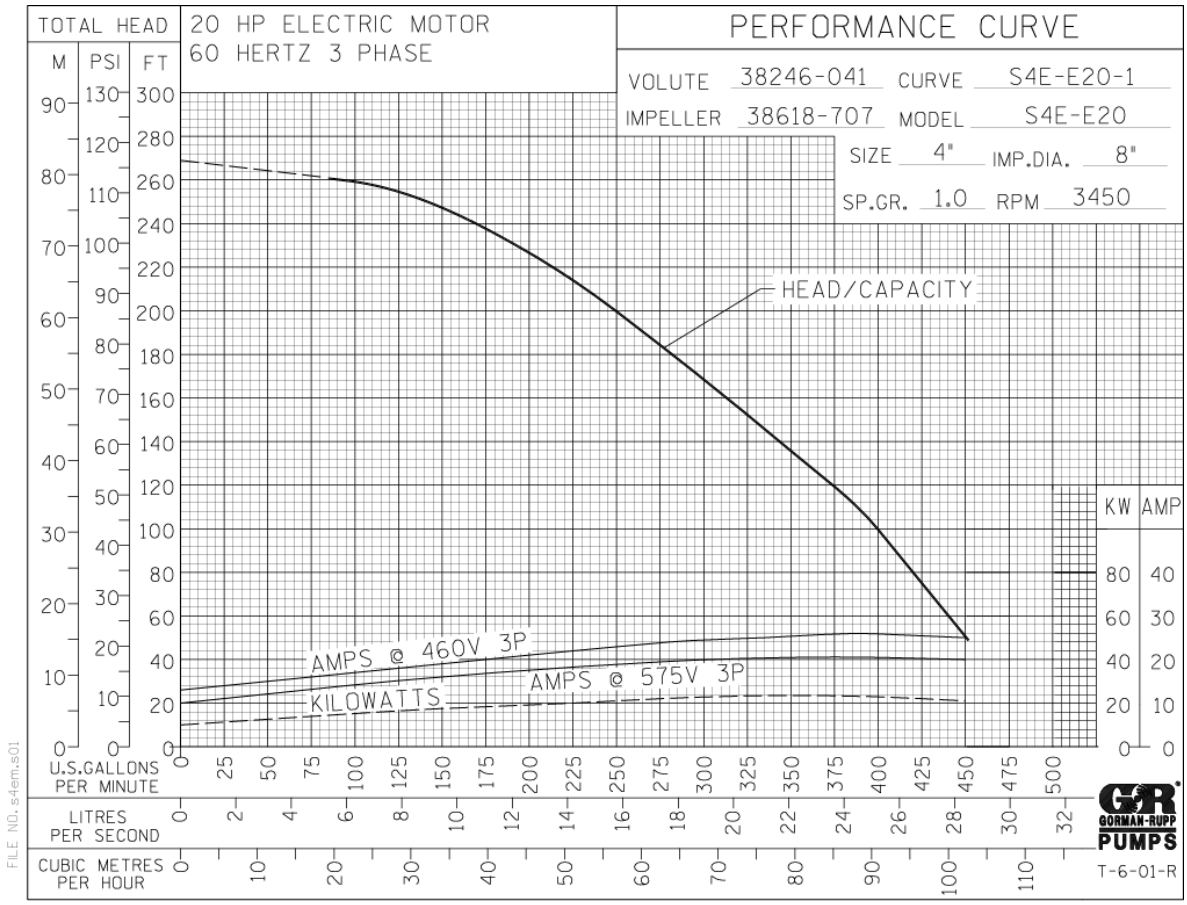
a. Disconnect the motor power cable leads from the control box. Connect one test lead to the power cable green ground lead, and touch the other test lead to each of the three power leads in turn.

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 S4E1—E20 460/3 AND S4E1—E20 575/3**

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

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

CAUTION

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

SECTION DRAWING

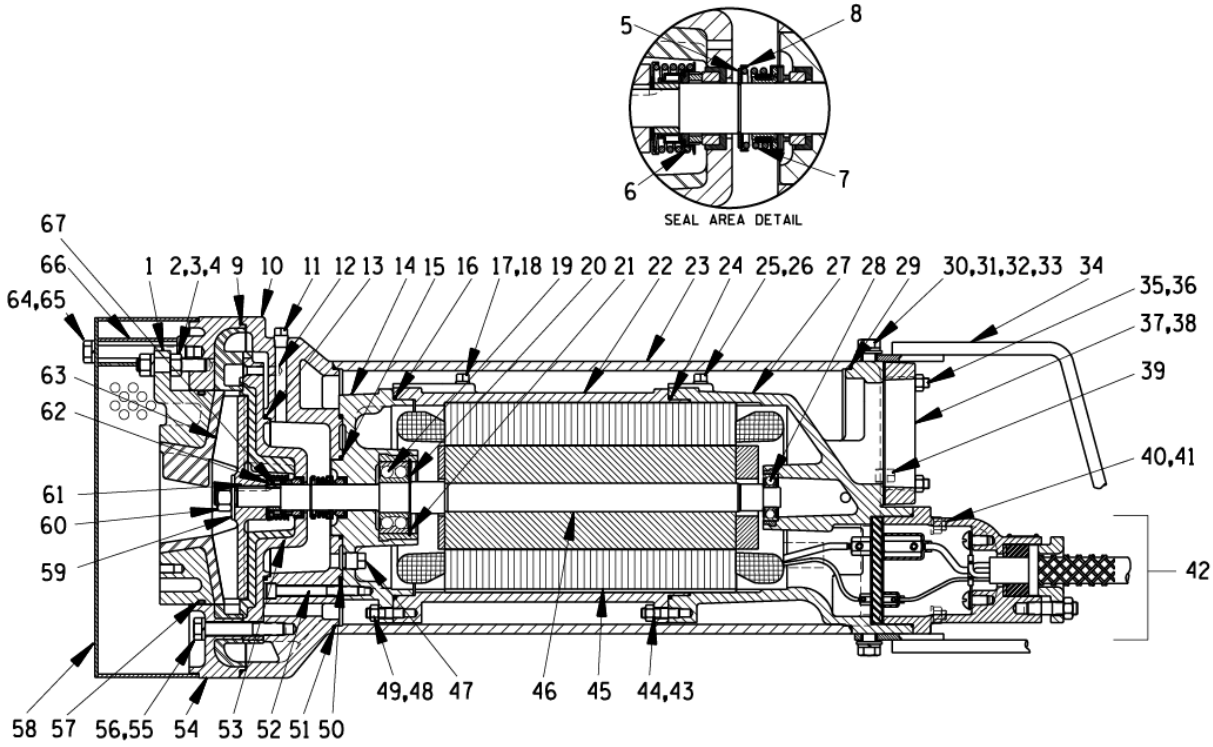


Figure E—1. S4E1—E20 460/3 And S4E1—E20 575/3 Pump Assemblies

S4E1-E20 460/3 And S4E1-E20 575/3 Pump Assemblies
Parts List
(From S/N 1887161 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	QTY
1	SUCTION HEAD	38246-041 24010	1
2	THREADED ROD 2.75" LG	31345-088 17000	6
3	HEX NUT	D08 17000	12
4	LOCK WASHER	J08 17000	6
5	RETAINING RING	S362	1
6	SEAL ASSY	46512-307	1
7	MECHANICAL SEAL	25271-866	1
8	SPRING HOLDER	25273-260	1
9	O-RING	25152-279	1
10	INTERMEDIATE	38261-029 13000	1
11	PIPE PLUG	P04 17000	1
12	FLAT HD MACH SCREW	Y0405 17000	3
13	O-RING	25152-259	1
14	LOWER MOTOR HSG	38311-055 13000	1
15	O-RING	25152-234	1
16	O-RING	25152-265	1
17	PIPE PLUG	38649-022 17030	2
18	A HD SET SCREW	GA0501-1/4 15990	2
19	BALL BEARING	23425-457	1
20	SNAP RING	S1831	1
21	RETAINING RING	24121-552	1
22	MIDDLE MOTOR HSG	38311-047 13000	1
23	PUMP CASING	38311-813 13005	1
24	O-RING	25152-265	1
25	PIPE PLUG	38649-022 17030	2
26	A HD SET SCREW	GA0501-1/4 15990	2
27	UPPER MOTOR HSG	38311-046 13000	1
28	BALL BEARING	23257-009	1
29	O-RING	S1830	1
30	BUSHING	9562 15991	2
31	HEX HD CAPSCREW	B0804 15991	2
32	LOCK WASHER	J08 15991	2
33	FLAT WASHER	KE08 15991	2
34	HOIST BAIL	11959 2400V	1
35	STUD	C0609 15991	4
36	HEX NUT	D06 15991	4
37	DISCHARGE FLANGE	11957 13040	1
38	GASKET	11957G 20000	1
39	PIPE PLUG	P04 17000	1
40	STUD	C0607 15991	4
41	DEFORM LOCKNUT	DD06 15991	4
42	TERM HSG & CABLE ASSY	47367-077	1
43	STUD	C0606 17000	8
44	DEFORM LOCKNUT	DD06 17000	8
45	STATOR		
	-460/3	47113-822	1
	-575/3	47113-823	1
46	ROTOR & SHAFT ASSY	47112-812	1
47	PIPE PLUG	P06 15079	1
48	STUD	C0606 17000	8
49	DEFORM LOCKNUT	DD06 17000	8
50	O-RING	25152-259	1
51	O-RING	S1830	1
52	SOC HD CAPSCREW	DM0613 17000	6
53	SEAL PLATE	38272-422 24010	1
54	DIFFUSER	38632-068 24010	1
55	HEX HD CAPSCREW	B0812 17000	6
56	LOCK WASHER	J08 17000	6
57	O-RING	25152-369	1
58	STRAINER ASSY	46611-012 2415V	1
59	FLAT WASHER	KB10 17000	1
60	HEX NUT	D10S 17000	1
61	KEY	N0304-1/2 17000	1
62	ADJ SHIM SET	2Y 17090	1
63	IMPELLER	38618-707 1102H	1
64	HEX HD CAPSCREW	B0815 15991	3
65	LOCK WASHER	J08 15991	3
66	SUPPORT PIPE	31412-064 15070	3
67	SLEEVE	13878 17020	1
NOT SHOWN			
	DRIVE SCREW	BM#04-03 17000	2
	HEAT-SHRINK TUBING	18763-248	1
	CONTROL PANEL		
	-460/3	48319-519	1
	-575/3	48319-520	1
	IMPELLER PULLER	48711-018	1
	NAME PLATE	2613GH 17020	1
	INSTRUCTION TAG	38817-073	1
	MOTOR VOLTAGE TAG		
	-460/3	6588BL	1
	-575/3	6588BM	1
	G-R DECAL	GR-03	1
OPTIONAL			
	HEAT SHRINK TERM KIT	48315-010	1
	REPAIR GASKET SET	48211-082	1
	STAGING ADAPTOR KIT	48272-017	1
	LIQUID LEVEL CONTROL		
	-FLOAT SWITCH	27471-180	1
	-120V LIQUID LVL CNTRL	27521-321	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

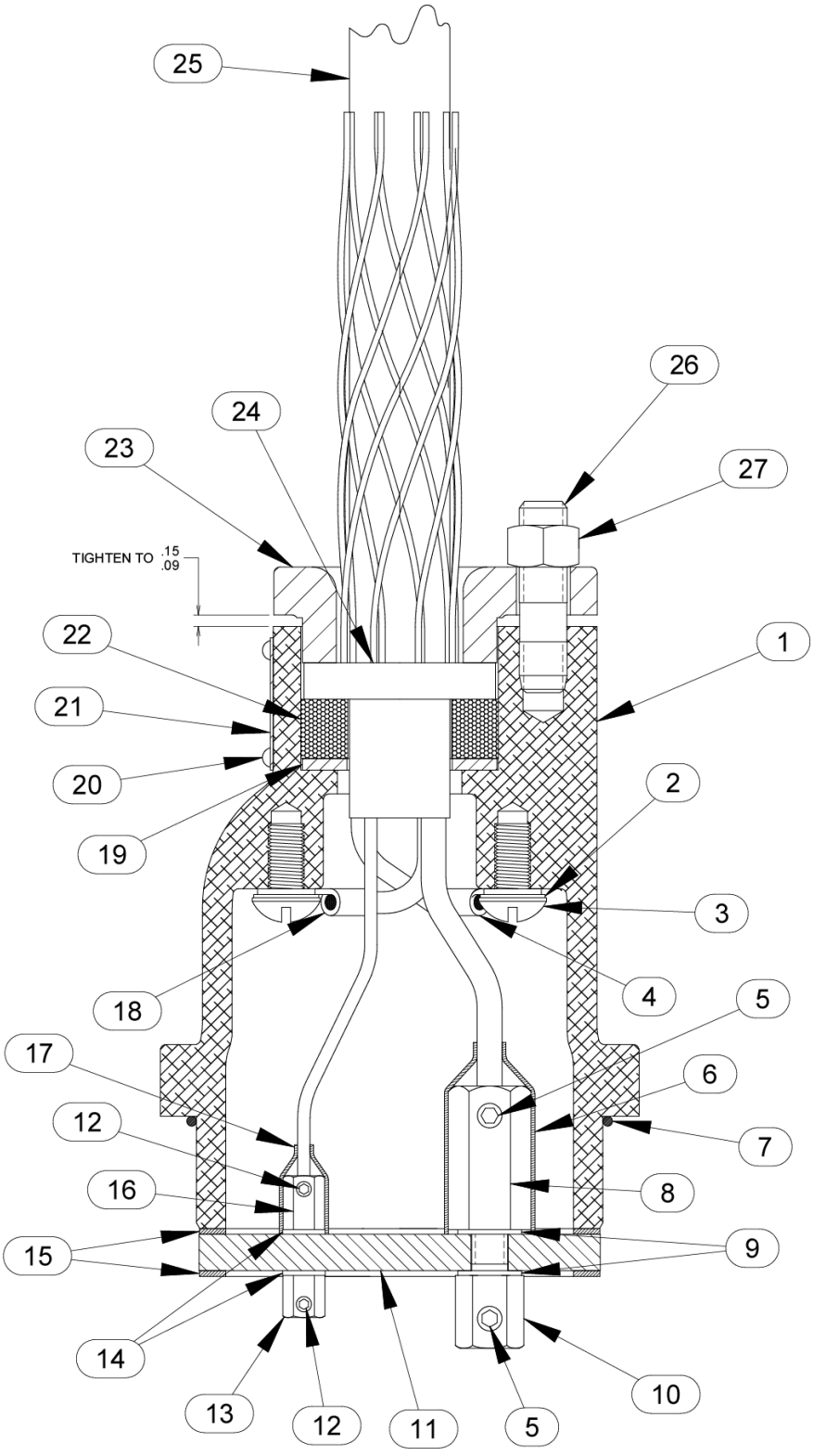


Figure E—2. Terminal Housing And Cable Assembly

Terminal Housing And Cable Assembly
Parts List

ITEM NO.		PART NAME	PART NUMBER	QTY
1		TERMINAL HOUSING	38381-237 13000	1
2		T TYPE LK WASHER	AK06 15991	2
3		RD HD MACHINE SCREW	X0603 14990	2
4		RING TERMINAL	S1550	1
5		A HD SET SCREW	GA0501-1/2 14990	6
6		HEAT-SHRINK TUBING	31413-014 19530	3
7	*	O-RING	25152-155	1
8		TERMINAL COLLAR	10144 14100	3
9	*	SEALING WASHER	S1586	6
10		TERMINAL POST	38724-009 14100	3
11		TERMINAL PLATE	38711-001 23010	1
12		A HD SET SCREW	GA#10-01S 15991	4
13		TERMINAL POST	11181 14100	2
14		SEALING WASHER	S1590	4
15	*	TERMINAL PLATE GASKET	38687-529 20000	2
16		TERMINAL COLLAR	31811-057 14100	2
17		HEAT-SHRINK TUBING	31412-056 19530	2
18		TERMINAL	27214-035	1
19		TERMINAL WASHER	10659 15991	1
20		DRIVE SCREW	BM#04-03 17000	4
21		INFORMATION PLATE	38816-145 17050	1
22		GLAND BUSHING	10758K 19100	1
23		TERMINAL CAP GLAND	11367 13040	1
24		CABLE GRIP	11227L	1
25		SUBMERSIBLE PUMP CABLE	47325-005	1
26		STUD	C0808 15991	2
27		HEX NUT	D08 15991	2
NOT SHOWN				
		RTV SEALANT - OUNCES	18771-106	1

* INDICATES PARTS RECOMMENDED FOR STOCK

PUMP END DISASSEMBLY

References are to Figure E–1 and Figure E–2.

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 E–1) and the Terminal Housing sectional views (Figure E–2), and the accompanying parts lists. Refer to the Parts List manual for the part number and quantity required.

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

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.

Use the hoisting bail to remove the pump from the wet well or sump, and move it to a location where the discharge line can be removed. It is not necessary to disconnect a flexible discharge hose before removing the pump. If rigid discharge piping is used, disconnect the piping before attempting to move the pump.

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.

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 B of this manual, 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 B, 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 in the Parts List manual.

PUMP END DISASSEMBLY

Strainer And Suction Head Removal

(Figure E–1)

To remove the strainer assembly (58), raise the pump slightly, or lay it on its side and disengage the hardware (64 and 65) securing the strainer assembly to the intermediate (10). Disengage the hardware (3 and 4) to remove the suction head (1). If the impeller (63) is clogged, the debris can usually be removed without further disassembly.

Draining Oil From Seal Cavity

(**Figure** E**—1)**

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

CAUTION

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

Lay the pump on its side with the seal cavity drain plug (11) facing up. Clean any dirt from around the plug. Remove the plug, and install a short 1/4-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.

Positioning Pump For Disassembly

(Figure E**—1)**

It is recommended that the pump be positioned upside-down during disassembly. To hold the pump in the inverted position, rest the pump securely on blocks. Be careful not to damage the terminal housing and cable assembly (42) while in this position. Use adequate equipment and personnel to safely handle the pump until it is secured. If inverting the pump is not practical, lay the pump on its side and secure it to prevent rolling.

Diffuser Removal

(Figure E**—1)**

To remove the diffuser, disengage the hardware (55 and 56) securing the diffuser (54) to the seal plate (53). Remove the diffuser and diffuser O-ring (9), and discard the diffuser O-ring.

Impeller Removal

(Figure E**—1)**

Temporarily install two of the capscrews (55). Wedge a block of wood between the vanes of the impeller (63) and the capscrews to prevent impeller rotation. Remove the impeller nut (60) and washer (59). Remove the piece of wood from between the vanes of the impeller.

Install the impeller puller (supplied with the pump) and pull the impeller from the rotor shaft. Use caution when removing the impeller; tension on the seal spring will be released. Retain the impeller key (61). Inspect the impeller for wear or damage and replace as required.

Remove the impeller adjusting shims (62). Tie and tag the shims or measure and record their thickness for ease of reassembly.

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

Lower Seal Removal

(Figures E**—1 and** E**—4)**

Carefully remove the spring retainer and seal spring. Lubricate the rotor shaft (46) and work oil under the bellows assembly. Slide the hooked ends of two stiff wires along the shaft and pull the sleeve (67) and the rotating portion of the seal from the shaft. Slide the retainer and bellows assembly off the sleeve.

To remove the stationary portion of the seal, remove the flat head machine screw (12) and separate the seal plate (53) from the intermediate (10). Remove and discard the seal plate O-ring (13). Place a **clean** cloth on a flat surface and place the seal plate on the cloth with the impeller side down. Use a drift pin or screwdriver to press on alternate sides of the stationary seat until the stationary element and seat are removed.

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

Upper Seal Removal

(Figures E**—1 and** E**—4)**

Unless cracked or otherwise worn, it is not necessary to remove the intermediate (10) for access to

the upper seal assembly (7). If intermediate removal is desired, remove the socket head capscrews (52). Remove and discard the O-rings (9 and 13).

Remove the seal retaining ring (5) using snap ring pliers. Use caution when removing the retaining ring; tension on the seal spring will be released. Remove the spring holder (8) and seal spring.

Lubricate the rotor shaft (46) and work oil under the bellows. Slide the bellows and retaining assembly off the shaft. Slide the hooked ends of two wires along the shaft and under the stationary seal seat. Hook the back side of the seat and pull it from the lower motor housing bore.

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

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 end components at this time.*

PUMP END REASSEMBLY

NOTE

Reuse of old O-rings, gaskets, or shaft seal parts will 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 E–1)

With the pump inverted, stuff a clean tissue into the stationary seal seat bore of the lower motor housing (14) or wrap a small rag around the shaft to prevent foreign material from entering the motor cavity.

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

Thoroughly clean all reuseable parts with a soft cloth soaked in cleaning solvent. Remove all O-rings and gaskets, and clean the sealing surfaces of dirt or gasket material. Be careful not to scratch gasket surfaces.

WARNING!

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

Inspect the rotor shaft (46) for damaged threads, scoring, or nicks. Remove nicks and burrs with a fine file or hand honing stone 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 (6 or 7) 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 circular pattern to avoid scratching the faces.

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

Install the shaft seals as illustrated in FigureE–3.

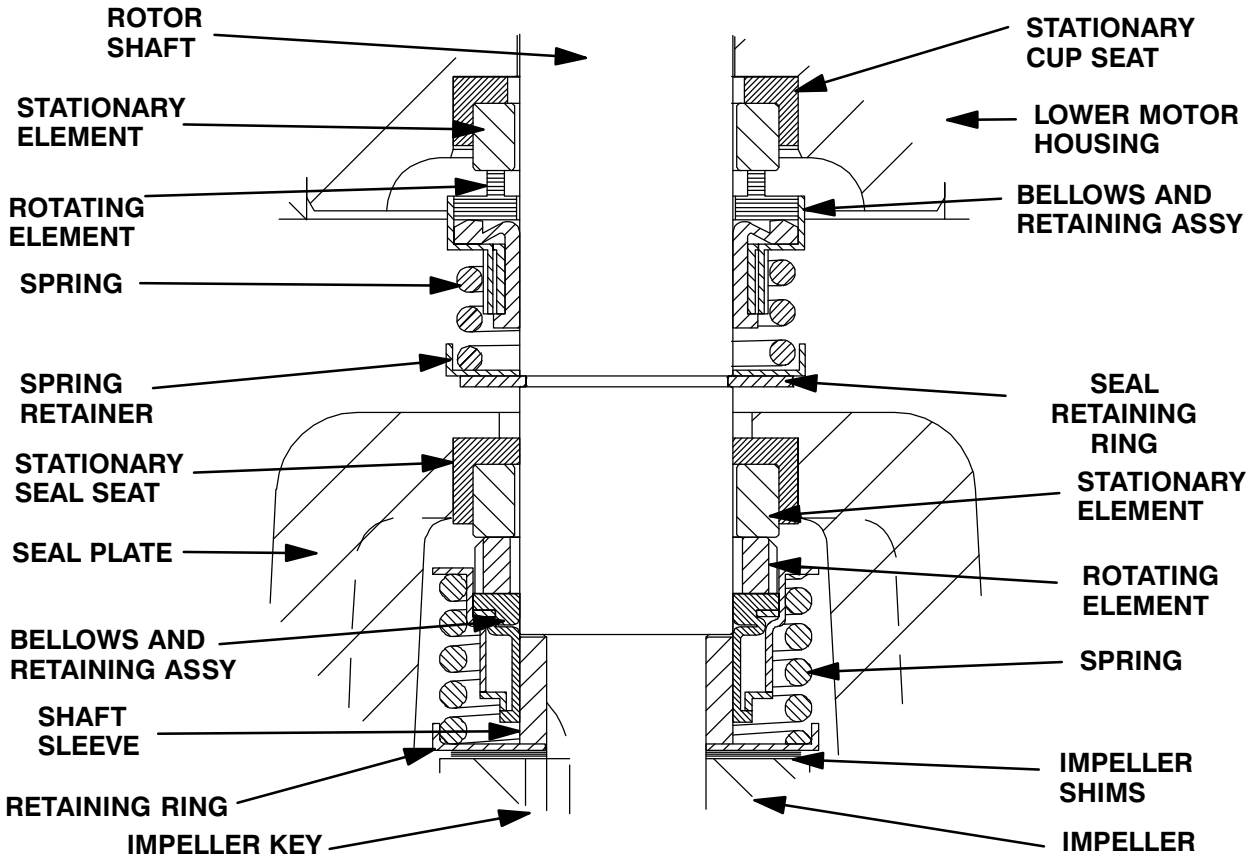


Figure E—3. Upper And Lower Seal Assemblies

CAUTION

This seal is not designed for operation at temperatures above 122° F (50° C). Do not use at higher operating temperatures.

Upper Seal Installation

(Figures E—1 and E—4)

Do not unwrap a new seal assembly until time of installation. Cleanliness of seal components is critical, especially the seal faces.

Clean the rotor shaft (46) and seal cavity area of the lower motor housing (14). Be sure the area is dry and free of lint and dirt. Check the seal bore for burrs or nicks that might prevent a good seal and a nicked or damaged keyway. Remove them with a fine file or hand honing stone to restore original contours. If the shaft is bent or damaged, the complete rotor and shaft must be replaced as an assembly. Apply a **light** coating of oil to the bore of the lower motor housing.

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

NOTE

When pressing seal components onto the 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.

Subassemble the stationary element in the stationary seat. Position this subassembly in the lower motor housing bore with the sealing face up and cover the seal face with a clean tissue. Use your thumbs to press the assembly into the bore. Apply equal pressure on opposite sides until the seat contacts the bore shoulder. Remove the tissue and inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use clean tissue to wipe **lightly** in a circular pattern.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. Because the rotating element may not stay in the bellows retainer when turned upside down, place a **small** amount of grease at equal spaces on the back of the element and position it in the bellows retainer. The grease should hold the element in position until the seal is installed. Assemble the drive grooves of the rotating element into the drive lugs of the bellows retainer.

Apply a **light** coating of oil to the seal seating surface on the shaft, the groove for the retaining ring (5), and I.D. of the bellows. Inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use a clean tissue to wipe in a circular pattern. Slide the seal rotating portion onto the lubricated shaft as shown in Figure E—4. Apply firm, steady pressure on the seal retainer until it slides down the shaft.

Slide the seal spring over the shaft and bellows retainer, and install the spring holder (8). Install the seal retaining ring (5). See Figure E—4 for the proper order of seal assembly.

Lower Seal Installation

(Figures E—1 and E—4)

Thoroughly clean the O-ring surfaces and seal bore of the seal plate (53). The seal bore must be free of burrs and nicks which could damage the seal. Inspect the seal plate for cracks, distortion, or erosion and replace it if defective.

If the intermediate (10) was removed, lubricate and install the O-rings (15, 50 and 51). Secure the intermediate to the lower motor housing using the socket head capscrews (52) and torquing evenly in a cross sequence to 22 ft. lbs. (264 in. lbs. or 3 m. kg.).

Position the seal plate on a clean flat surface with the impeller side up.

Unpack the stationary seat and element. Subassemble the stationary element in the stationary seat. Apply a **light** coating of oil to the seal plate bore and the O.D. of the seal seat and O-ring. Keep the sealing face dry.

Position the subassembly in the seal plate bore, 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 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 circular pattern.

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.

Install the seal plate O-ring (13) on the seal plate. Carefully position the seal plate and stationary seal components on the rotor shaft and against the intermediate. **Be careful** not to damage the stationary element already installed. Secure the seal plate to the intermediate using the flat head machine screws (12).

Install the shaft sleeve (67) with the chamfered end toward the shaft shoulder. Lubricate the O.D. with a light coating of oil.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. Because the rotating element may not stay in the bellows retainer when turned upside down, place a **small** amount of grease at equal spaces on the back of the element and position it in the bellows retainer. The grease should hold the element in position until the seal is installed. Assemble the drive grooves of the rotating element into the drive lugs of the bellows retainer. Apply a **light** coating of oil on the shaft and the I.D. of the bellows.

Slide the seal rotating portion onto the lubricated 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. See Figure E—3 for proper order of seal assembly.

Impeller Installation

(Figure E-1)

Inspect the impeller (63) for cracks, broken vanes, or wear from erosion, and replace it if damaged. Clean the threads on the rotor shaft to remove any old thread locking material. Be sure the impeller bore and the shaft are free of oily film and completely dry.

Install the same thickness of impeller adjusting shims (62) as previously removed. Install the impeller key (61). Align the keyway of the impeller (63) and push the impeller onto the shaft until seated firmly against the impeller shim set. Install the impeller washer (59) on the rotor shaft (46).

After the impeller clearance has been checked as described below, coat the threads of the rotor shaft with 'Loctite Threadlocker No. 242' or equivalent compound. Install the impeller nut (60). Wedge a block of wood between the vanes of the impeller and the threaded rod (2) and torque the impeller nut to 120 ft. lbs. (17 m. kg.).

Remove the block of wood. Turn the impeller to check for free rotation.

For maximum pump efficiency, there should be a clearance of .020 to .040 inch (0,5 to 1,02 mm) between the seal plate and the impeller. Use a feeler gauge to measure this clearance. If the clearance is not within the specific limits, remove the impeller. Add or remove adjusting shims (62) as required. Install the impeller and recheck impeller clearance.

NOTE

*The impeller and diffuser **must** be fully seated to obtain an accurate face clearance measurement.*

Diffuser Installation

(Figure E**—1)**

Inspect and thoroughly clean the diffuser (54). It must be clean and free of any flaws which could cut the O-ring or prevent a good seal. Lightly oil the O-ring (9) and install it over the groove of the diffuser.

Carefully position the diffuser against seal plate. Secure the diffuser with the hardware (55 and 56). After installing the diffuser, check the impeller for free rotation.

Suction Head Installation

(Figure E**—1)**

Lightly oil the O-ring (57) and install it in the groove of the suction head.

See Figure E-4 and install the suction head adjusting nuts (3) on the threaded rods (2). Position the suction head over the threaded rods and press it into the diffuser until fully seated against the adjusting nuts.

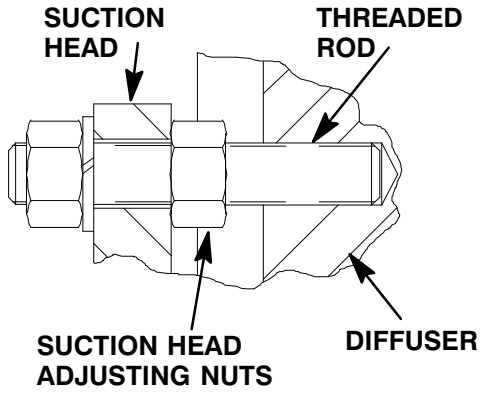


Figure E**—4. Suction Head Adjustment Detail**

For maximum pump efficiency, there should be a clearance of .008 to .015 inch (0,25 to 0,38 mm) between the suction head and the face of the impeller. Use a feeler gauge to measure this clearance. If the clearance is not within the specific limits, adjust the hardware (3 and 4) on the threaded rod (2) as needed.

Secure the suction head with the hardware (3 and 4).

Strainer Installation

(Figure E**—1)**

Inspect the strainer assembly (58) for cracks, distortion or erosion, and replace it if defective.

Install the hardware (64 and 65) in the strainer assembly (58). Fill the support pipes (66) with some grease and slide them over the capscrews. Carefully position the strainer on the suction head (1) and secure with the hardware (64 and 65). Make

certain that the strainer seats properly against the shoulder of the diffuser.

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 Removal

(Figure E–1)

Total disassembly of the terminal housing and power cable (42) is not always required. Disassemble and replace **only** the parts proven defective by inspection or testing. See **Electrical Testing** in **TROUBLESHOOTING**.

The terminal housing and power cable assembly (42) may be serviced without disassembling the motor housing or pump end.

Secure the pump in an upright position. Remove the deformed locknuts (41) securing the terminal housing assembly to the upper motor housing assembly (27).

Terminal Housing And Power Cable Disassembly

(Figure E–2)

Carefully raise the terminal housing (1) from the motor housing until the terminals (4 and 18) are accessible. Loosen the allen head setscrews (5 and 12), and disconnect the motor leads from the terminal posts. Separate the terminal housing and power cable assembly (25) from the motor housing. Remove the lower terminal plate gasket (15).

No further disassembly is required to test the stator or power cable.

To disconnect the power cable (25) from the terminal housing, pull the terminal plate (11) away from the terminal housing. Remove the hardware (2 and 3) securing the green and yellow ground lead terminals (4 and 18). Reinstall the hardware. When shipped from the factory, the connections between the power cable leads and the terminal collars (8 and 16) were encapsulated in heat-shrink tubing (6 and 17) and bonded to the terminal plate with silicone adhesive.

NOTE

***Do not** remove the heat shrink tubing from the power cable leads unless the terminals require replacement. If replacement is required, the connections between the leads and terminals **must be** sealed with heat shrink tubing before applying the silicone adhesive (see **Terminal Housing And Power Cable Reassembly**).*

If terminal replacement is required, carefully cut away the tubing and adhesive, and loosen the allen head setscrews (5 and 12). Disconnect the power cable leads from the terminal collars, and separate the terminal plate (11) from the terminal housing (1). Remove and discard the upper terminal plate gasket (15).

If it is necessary to replace the terminal plate (11) or terminal components, unscrew the terminal collars (8 and 16), and remove the terminal posts and dyna seal washers (9 and 14) from the terminal plate.

To disconnect the power cable, remove the nuts (27) securing the terminal gland (23) to the terminal housing (1). Slide the gland back along the power cable.

Compress the wire mesh of the cable grip (24) and move it back along the power cable. Oil the gland bushing (22) and terminal housing bore and pull firmly on the cable. (Allow the oil to leak in around the bushing by agitating the cable in the bore.) After the bushing has been loosened, the cable should pull out far enough to expose the gland bushing. Apply oil on the cable jacket and slide the bushing and washer (19) back along the cable. Pressure exerted on the bushing may deform the cable jacket. If such is the case, additional oil and effort will be required to remove the bushing.

NOTE

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

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

Pump Casing And Motor Housing Disassembly

(Figure E–1)

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

With the pump end disassembled, secure the pump in an inverted position. Remove the socket head capscrews (52) securing the intermediate (10) to the lower motor housing (14). Remove the O-rings (15, 50 and 51). Slide the pump casing (23) off the motor housing. Remove the pump casing O-ring (29).

Rotor Removal

(Figure E–1)

Remove the deformed locknuts (49). If necessary, tap the impeller end of the rotor shaft with a block of wood or soft-faced mallet to loosen the seal between the upper ball bearing (28) and the motor housing bore. Carefully pull the rotor (46), lower motor housing (14) and assembled bearings (19 and 28) from the stator (45) and upper motor housing (27). If necessary, pry the housings apart using two screwdrivers. Use caution when removing the rotor to prevent damaging the stator windings.

Remove the outer retaining ring (21) and slide the lower motor housing off the lower bearing (19). Remove the motor housing O-ring (16).

NOTE

If necessary, tap around the edge of the lower motor housing with a soft-faced mallet or block of wood to separate the motor housing from the bearing.

If no further disassembly is required, cover the middle and upper motor housings with a clean, lint-free cloth to avoid contamination of the stator by dirt or other foreign materials.

Bearing Removal

(Figure 1)

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.

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

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

If replacement is required, use a bearing puller to remove the upper and lower ball bearings from the rotor shaft. It is not necessary to remove the inner retaining ring (20) unless replacement is required. Use snap ring pliers to remove the ring.

Stator Removal

(Figure E–1)

Do not remove the stator (45) unless it is defective (open windings, insulation resistance low, or stator core damaged). If the stator must be removed, remove the terminal housing as indicated in **Terminal Housing And Power Cable Disassembly.**

Remove the pipe plugs (17 and 25) located in the motor housings, and loosen the allen head setscrews (18 and 26) located underneath the pipe plugs.

Position an expandable tool, such as a split disc, approximately 2 inches (51 mm) 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.

The motor housings (22 and 27) must be heated with a torch to expand them 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 motor housing, and “walk” the stator out. Continue this process until the stator clears the motor housing.

CAUTION

Take care not to damage the stator end turns during removal from the motor housing.

After the stator has been removed, wrap it 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.

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.

It is not necessary to separate the motor housings (22 and 27) unless the O-ring (24) or one of the motor housings require replacement. If required, remove the locknut (44) and separate the housings to remove the O-ring (24).

Hoisting Bail

(Figure E–1)

If the hoisting bail (34) requires replacement, remove the hardware (30, 31, 32 and 33) securing the bail to the motor housing. Make sure the bushings (30) are in place when installing the hoisting bail.

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 will 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 E–1)

NOTE

Stator installation involves heating the motor housing. This process must be done quickly. Therefore it is recommended that these steps be performed by two people to promote efficient installation of the stator.

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 housings (22 and 27) with fresh solvent. The interior **must** be dry and free of dirt or lint. Install a new O-ring (24) and secure the motor housings together with the locknut (44). Coat the threads of the studs (43) with 'Never-Seez' or equivalent compound, and torque evenly in a cross sequence to 20 ft. lbs. (240 in. lbs. or 3 m. kg.).

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.

After the motor housings are thoroughly cleaned, position them on a flat surface with the discharge end down. Do not unwrap the stator (45) until the motor housings have 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 B, 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 (51 mm) 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 over the stator leads, or tape them together to protect them during installation.

NOTE

Stator installation involves heating the motor housing. This process must be done quickly to allow the stator to slide into the motor housing before the housing cools.

Heat the motor housings (22 and 27) with a torch to expand them enough for the stator (45) to be installed. When heating the motor housing, **make sure** that the stator is clear to avoid a fire hazard, or damage to the windings. Apply heat evenly to the outside of the housings; excessive heat is not required.

When the motor housings are sufficiently heated, position the stator so that the leads are in line with the terminal opening. Carefully lower the stator into the motor housing until fully seated against the housing shoulder. Be careful not to damage the stator lead insulation during reassembly. If the stator "cocks" in the motor housing, remove it and try again.

After the stator is fully and squarely seated on the motor housing shoulder, remove the expandable disc tool. Install the allen head setscrews (18 and 26) securing the stator in place; torque the set-

screws to 7.5 ft. lbs. (90 in. lbs. or 1 m. kg.). Coat the threads of the pipe plugs (17 and 25) with 'Loctite Pipe Sealant with Teflon No. 592' or equivalent, and install the plugs over the allen head setscrews. Untape or remove the protective sleeve from the stator leads.

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

Bearing Installation

(Figure E—1)

Inspect the rotor shaft (46) for damaged threads, scoring in the seal area, and a nicked or damaged keyway. If the bearings were removed, inspect the bearing areas for scoring or galling. Remove nicks and burrs with a fine file or emery cloth. Inspect the rotor area for separated laminations. If the shaft is bent or damaged, or if the laminations are separated, replace the shaft and rotor (a single assembly).

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.*

Heat the bearings (19 and 28) to a uniform temperature **no higher than** 250°F (120°C). When installing bearings, slide them onto the shaft until fully seated. This should be done quickly, in one continuous motion, to prevent bearings from cooling and sticking on the shaft.

WARNING!

Use caution when handling hot bearings to prevent burns.

Slide the upper bearing (28) onto the shaft until fully seated.

If removed, install the lower bearing retaining ring (20) on the rotor shaft. With the beveled end toward the rotor, slide the beveled retaining ring (21) over the shaft.

CAUTION

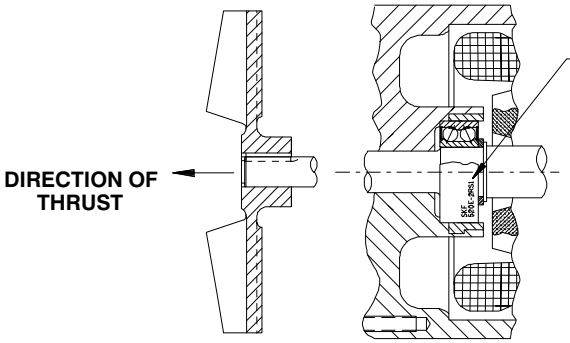
The beveled edge of the retaining ring **must** be positioned toward the rotor. Otherwise, damage to the bearing and/or motor will result.

With the impeller end of the shaft up, position the lower bearing (19) on the shaft as indicated in the instructions accompanying the bearing or as shown in Figure C—5. Slide the bearing onto the shaft until it seats squarely against the snap ring.

CAUTION

The bearing **must** be installed as indicated in the instructions accompanying the bearing or as shown in Figure E—5. Improper installation can cause premature bearing failure and/or damage to the pump or motor.

INSTALLATION OF SKF 5200 AND 5300 SERIES BEARINGS



NOTE:
THIS BEARING IS MANUFACTURED WITH TWO SEALS OR SHIELDS. WHEN INSTALLED ON THE SHAFT, THE MANUFACTURER'S PART NUMBER DESCRIPTION (LOCATED ON SIDE FACE OF BEARING OR BEARING O.D.) MUST BE LOCATED WITH THE TEXT AWAY FROM THE IMPELLER.

Figure E—5. Bearing Installation

After the bearings have been installed and allowed to cool, check to ensure that they have not moved out of position in shrinking. If movement has occurred, use a suitable sized sleeve and a press to reposition the bearings. Make certain that they are seated squarely 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.

If removed at disassembly, apply 'Loctite Pipe Sealant with Teflon No. 592' or equivalent compound of the threads of the pipe plug (47) and install the plug securely in the lower motor housing.

Install the motor housing O-ring (16) on the motor housing, and slide the housing over the lower bearing until the bearing seats squarely in the housing bore. Secure the retaining ring (21) in the lower motor housing.

Rotor Installation

(Figure E—1)

Use **fresh** solvent to clean all gasket and O-ring surfaces of the motor housings (22 and 27), completely removing any old gasket and cement material. Inspect the sealing surfaces for burrs, nicks and pits which could cause a poor seal. Repair or replace as require.

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.

Carefully ease the lower motor housing (14), rotor (46) and assembled bearings (19 and 28) into the motor housing (27) and through the stator so that the upper bearing (28) seats squarely in the motor housing bearing bore. Make sure the pipe plug (47) aligns with the terminal housing bore.

Tap the lower motor housing with a soft-faced mallet until fully seated in the upper motor housing. **Be careful** not to cut the O-ring (16) on the lower motor housing shoulder.

Apply 'Never-Seez' or equivalent compound to the threads of the studs (48). Install the locknuts (49), torquing evenly in a cross-sequence to 20 ft. lbs. (240 in. lbs. or 3 m. kg.).

Pump Casing Reassembly

(Figure E—1)

Use **fresh** solvent to clean all O-ring surfaces of the lower motor housing (14), completely removing any old cement material. Inspect the sealing sur-

faces for burrs, nicks and pits which could cause a poor seal, and repair or replace as required.

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.

Apply a light coating of oil to the O-ring (29) and install it on the upper motor housing. Slide the pump casing (23) over the assembled motor until it seats against the O-ring and upper motor housing shoulder.

Install the O-rings (15, 50 and 51). Lower the intermediate over the shaft. **Be careful** not to cut the O-rings. Secure the intermediate (10) to the motor housing (14). Apply 'Never-Seez' or equivalent compound on the threads of the socket head capscrew (52), torquing evenly in a cross sequence to 22 ft. lbs. (260 in. lbs. or 3 m. kg.).

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

Terminal Housing And Power Cable Reassembly

(Figure E–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 to make electrical connections.

Clean the exterior of the power cable with warm water and mild detergent. 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 upper bore of the terminal housing, outside of the pump power cable (25), and the bores of terminal gland (23), cable grip (24), gland bushing (22) and terminal washer (19) for ease of assembly. Slide the terminal gland, cable grip, gland bushing, terminal washer and terminal housing onto the power cable (25), allowing approximately 3 ft. (1 m) of cable to extend beyond the terminal housing. Temporarily tape the green and yellow ground wires to the cable.

Sealing Terminal Housing Connections With Silicone Adhesive

(Figure E–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 (8 and 16) were encapsulated in heat-shrink tubing (6 and 17), and bonded to the terminal plate (11) with silicone adhesive to provide a water-tight seal. If this insulating material has been damaged or removed during maintenance, **it must** be replaced using mate-

rials and equipment approved by Gorman-Rupp (see the Parts List Manual 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. If silicone adhesive is not available in the field, a commercially available potting kit may be used to bond the connections to the terminal plate. If this alternate sealing 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 from the leads, terminal collars, and terminal plate. Inspect all parts for damage, and replace as required. If the rubber bonding material on the terminal plate (11) is severely worn or cracked, the terminal plate must be replaced. If the bonding material has been noticeably compressed, it should be supplemented with two gaskets contained in the overhaul gasket kit (see Options listed in the Parts List manual).

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 dirt, oil or grease coated.

Slide the terminal housing (1) up the power cable (25) and temporarily secure it.

Assemble the terminal posts (10 and 13), dyna seal washers (9 and 14), and the upper terminal collars (8 and 16) to the terminal plate as shown in Figure C–2. Install the upper terminalplate gasket (15).

NOTE

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

If the terminal ends were removed for replacement, crimp a new terminal onto the appropriate power cable lead (see Figure E–6).

NOTE

Trim the brown leads off at both ends of the cable if the optional moisture sensor is not used.

Slide a length of heat-shrink tubing (6 and 17) up over each of the power cable leads. Install the leads on the terminal posts as shown in Figure E–6 and secure them using the setscrews (5 and 12). Slide the tubing down each lead until the terminals (4 and 18) are covered and the tubing contacts the terminal plate. The tubing **must** extend up the leads far enough to ensure a good seal.

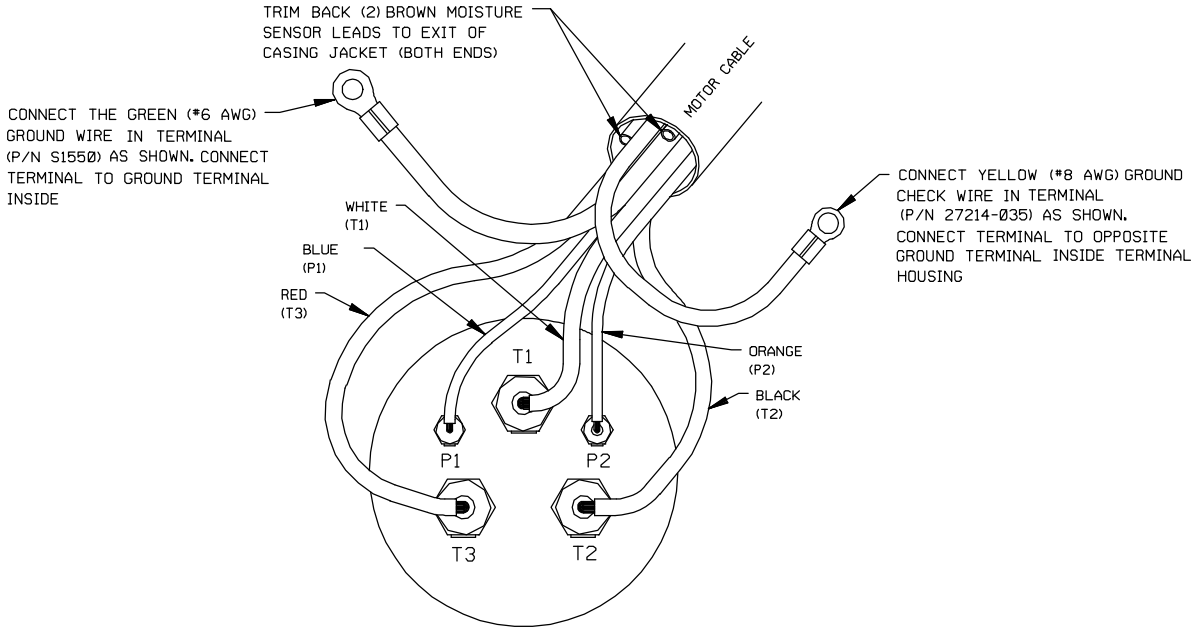


Figure E–6. Terminal Housing Wiring Connections

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 terminal collars.

CAUTION

Use **only** Dow-Corning 737 Silicone Adhesive (see the Parts List Manual for the part number) or potting compound for sealing terminal housing connections. Use of unapproved sealing products will void the pump warranty.

NOTE

Do not use *a mold or reservoir with the silicone adhesive.*

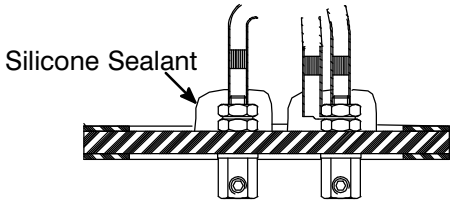


Figure E–7. Silicone Adhesive Sealing

See Figure E–6 and check terminal locations. Apply a 1/4 to 3/8 in. (6,4 to 9,7 mm) thick layer (maximum) of silicone adhesive around each of the terminal posts as shown in Figure E–7. Remove any adhesive from gasketed surfaces.

WARNING!

All air pockets, voids or gaps in the silicone sealant must be removed to ensure a water-tight seal in the terminal housing. Otherwise, moisture entering the terminal housing could cause a short circuit, resulting in pump damage and possible serious injury or death to personnel.

Allow the adhesive to cure for at least one hour before securing the terminal housing to the motor housing.

Terminal Housing Installation

(Figure E–2)

After the terminal plate has been sealed, slide the terminal housing down the cable. Untape the ground leads and secure them to the ground terminals with the hardware (2 and 3). **Be sure** the leads make good contact with the housing.

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

Lubricate the upper bore of the terminal housing, and slide the gland washer (19), bushing (22) and cable grip (24) into place. Slide the terminal gland (23) into place and install the nuts (27). Do not fully tighten the nuts at this time.

Position the lower terminal plate gasket (15) on the terminal plate (11).

NOTE

*A **small** amount of gasket adhesive may be used to hold the upper and lower terminal plate gaskets in place to ease assembly.*

Attach the appropriate motor lead (T1, T2, T3) to each terminal post (10 and 13) using the allen head setscrews (5 and 12).

Position the terminal housing and terminal plate against the upper motor housing. If required, rotate the terminal housing and twist the motor leads to remove excess slack.

Secure the terminal housing assembly to the motor housing with the hardware (40 and 41, Figure E–1); torque the nuts evenly in a cross sequence to 20 ft. lbs. (240 in. lbs. or 3 m. kg.).

Tighten the nuts (27) drawing the terminal gland (23) down into the terminal bore. **Do not** overtighten and damage the terminal gland or hardware.

NOTE

A .09 in. to .15 in. (2,29 to 3,81 mm) gap is required between the terminal gland cap flange and the terminal housing when tighten the nuts.

See **FINAL ASSEMBLY** and **VACUUM TESTING** followed by **LUBRICATION**.

FINAL ASSEMBLY

(Figure E–1)

If the discharge flange (37) was removed from the motor housing, replace the discharge flange gasket (38). Apply 'Anti-Seize' or equivalent compound on the flange studs (35), and secure the flange with the nuts (36).

If the hoisting bail (34) was removed, install the bail bushings (30) and secure the bail to the motor housing with the hardware (31, 32 and 33).

Connect the discharge hose, and reposition the pump. If rigid piping or long hose is used, reposition the pump, then connect the piping.

VACUUM TESTING

To ensure the water-tight integrity of the pump, it is recommended that the motor and seal cavities be vacuum tested any time the seal(s) and/or motor are serviced.

Drain **all** of the oil from **both** the seal and motor cavities before performing the test. Oil within the cavities will be drawn into the system, resulting in damage to the vacuum pump or manometer.

Use a manometer with a range of 30 to 0 to 30 inches of mercury to perform the test. **Do not** use a vacuum gauge. Vacuum gauges are not sensitive enough to detect minor leaks.

It is recommended that a vacuum pump be used to draw the vacuum on the cavities. If a vacuum pump is not available, a compressor/venturi system may be used. If the compressor/venturi cannot draw the higher vacuum level shown in Table E–1, draw the motor cavity vacuum down as far as the system will allow, then draw the seal cavity down so the differential between the two cavities is the same as the differential between the vacuum readings shown in the table.

Install full-closing ball-type shutoff valves with quick-disconnect fittings in the pipe plug holes in both the motor and seal cavities. Test the motor cavity for its full duration first, then use the shutoff valve to maintain the motor cavity vacuum while testing the seal cavity. The motor cavity vacuum **must** be higher than the vacuum in the seal cavity to prevent separation of the seal faces or unseating the stationary seal seat between the seal and motor cavities.

Figure E–8 shows a simple schematic for setting up either a vacuum pump or a venturi/compressor test system.

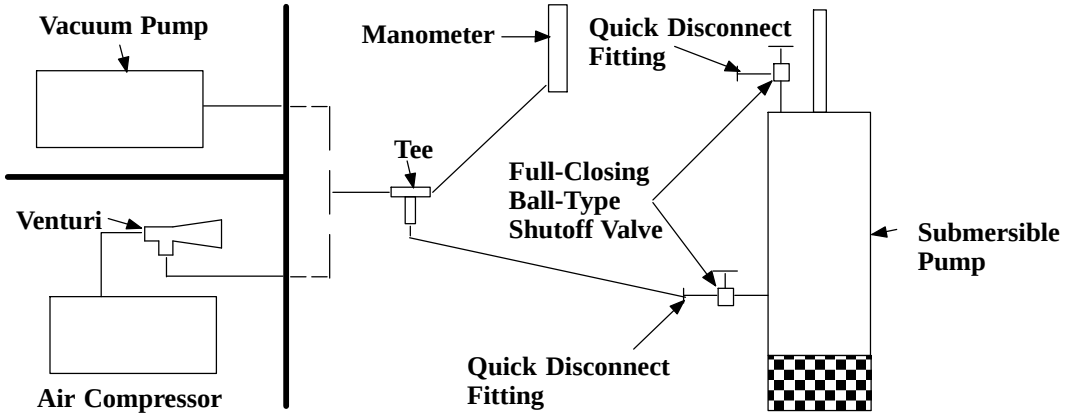


Figure E–8. Vacuum Test System

Table E–1 shows the vacuum to be drawn on each cavity, and the duration to maintain each vacuum reading. **Any** change in vacuum reading during the test indicates a leak which **must** be identified and corrected before putting the pump back into service.

Table E—1. Vacuum Test Data

Pump Model	Motor Cavity Vacuum (In. Hg.)	Duration (Minutes)	Seal Cavity Vacuum (In. Hg.)	Duration (Minutes)
S4E	30	2	20	1

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.

WARNING!

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 and remove the seal cavity plug (11) in the intermediate. Tip the pump and drain off a small amount of oil into a transparent cup. 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, apply 'Loctite Pipe Sealant With Teflon No. 592.' or equivalent to the threads of the pipe plug, before reinstalling the plug.

To fill the seal cavity, remove the pipe plug (11) and add the recommended grade of submersible pump oil. Apply 'Loctite Pipe Sealant With Teflon No. 592.' or equivalent to the threads of the pipe plug, before reinstalling the plug.

See Table E—2 for quantity of lubricant when lubricating a dry (overhauled) pump. See Table E—3 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 E—2. Oil Quantity

Pump Model	Seal Cavity
S4E (All Materials and Voltages)	32 ounces (1 liter)

Table E—3. 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
- BP (Also Boron) ..... Energol-HLP 32
- Shell Oil Company ..... Tellus 32, Tellus T-23 or T32
- ARCO ..... Duro 32
- Exxon (Also Esso) ..... Nuto H 32
- Petro-Canada ..... Harmony HVI 22

Motor Housing Cavity

The motor is cooled by the constant flow of the liquid being discharged thru internal passages surrounding the motor housing, not with oil. The rotor shaft bearings are permanently lubricated, and require no additional lubrication.

For Warranty Information, Please Visit
www.grpumps.com/warranty
or call:
U.S.: 419-755-1280
Canada: 519-631-2870
International: +1-419-755-1352