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



S SERIES PUMPS

MODELS
S3C65-E6 ALL VOLTAGES

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

www.grpumps.com

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

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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 pump is an S Series model. The basic material of construction is CD4MCu stainless steel, with 316 stainless steel rotor shaft, motor housing and hardware. The pump is designed to handle industrial chemical and low pH resistance materials. The integral electric motor must be operated through the control box furnished with the pump as standard equipment. Neither the pump nor the control box are explosion-proof, and should not be operated in a hazardous atmosphere.

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:

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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

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:



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.



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.



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

NOTE

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

SAFETY – SECTION A

This information applies to S Series submersible motor driven pumps.

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



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. 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).



This pump is designed to handle industrial chemical and low pH resistance materials. 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.



The electrical power used to operate this pump is high enough to cause injury or death. Obtain the services of a qualified electrician to make all electrical connections. Make certain that the pump and enclosure are properly grounded; never use gas pipe as an electrical ground. Be sure that the incoming power matches the voltage and phase of the pump and control before connecting the power source. Do not run the pump if the voltage is not within the limits. If the overload unit is tripped during pump operation, correct the problem before restarting the pump.



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



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.

**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.

**WARNING!**

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

**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 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 posi-

tioned so as not to damage pump, and so that the load will be balanced.



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

INSTALLATION – SECTION B

Review all SAFETY information in Section A.

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

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

PREINSTALLATION INSPECTION

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

- a. Inspect the pump assembly for cracks, dents, damaged threads, and other obvious damage.
- b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.
- c. The standard pump is furnished with 50 feet (15,2 m) of power cable. Inspect the cable for cuts or damage.
- d. Inspect the control box for cracks, dents, and other obvious damage.
- e. Check that all control box components are securely attached to their mounting surfaces, and that the electrical connections are tight and free of corrosion.
- f. Compare the amperes, phase, voltage and hertz indicated on the motor nameplate to the ratings indicated for the control box.

- g. Carefully read all tags, decals, and markings on the pump assembly and the control box, and perform all duties as indicated.
- h. Check the pump and motor for any oil leaks. An oil leak may indicate a cut O-ring or other damage.
- i. If the pump and control box have been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected or replaced** to ensure maximum pump service.

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

Lubrication

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

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

Both cavities are fully lubricated when the pump is shipped from the factory. Check lubrication levels before installing the pump (see **LUBRICATION in MAINTENANCE AND REPAIR**). An additional quart (0,95 liter) of oil has been provided with the pump to “top off” the oil cavities. If either oil level is abnormally low, determine the cause before putting the pump into service.

PUMP INSTALLATION

Pump Specifications

See Tables 1 and 2 for pump specifications.

Table 1. Pump Specifications

Voltage/ Phase	Motor Horsepower	Motor Speed (RPM)	Full Load Amperes	No Load Amperes	Locked Rotor Amperes	Discharge Size (NPT)
230/1	6	3450	34	8	95	3 INCH
230/3	6	3450	23	12	100	3 INCH
460/3	6	3450	11.5	6	50	3 INCH
575/3	6	3450	9.2	4.8	40	3 INCH

Table 2. Additional Specifications

Pump Weight (All Voltages)	154 lbs. (69,9 kg)
Control Box Weight Only	22 lbs. (9,98 kg)
Seal oil cavity capacity	1 U.S. pint (0,5 liters)
Motor oil cavity capacity	3 U.S. quarts (2,8 liters)
Cable	10 AWG., 4 Conductor, Type SOW or SOWA

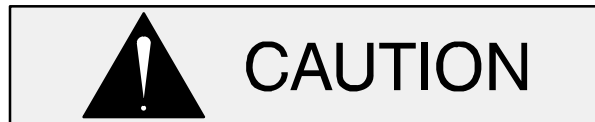
Pump Dimensions

The standard pump is provided with a suction strainer to prevent large solids from clogging the impeller. On high discharge head applications, the strainer can be removed, and the pump suction “staged” to the discharge of another pump, allowing one pump to feed the other. See Figure 1 for the approximate physical dimensions of this pump.



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 require-

ments could result in injury or death to personnel.



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 the Maintenance and Repair, Section E, when determining the most efficient piping installation. **The recommended maximum submergence depth is 65 feet.***

OUTLINE DRAWING

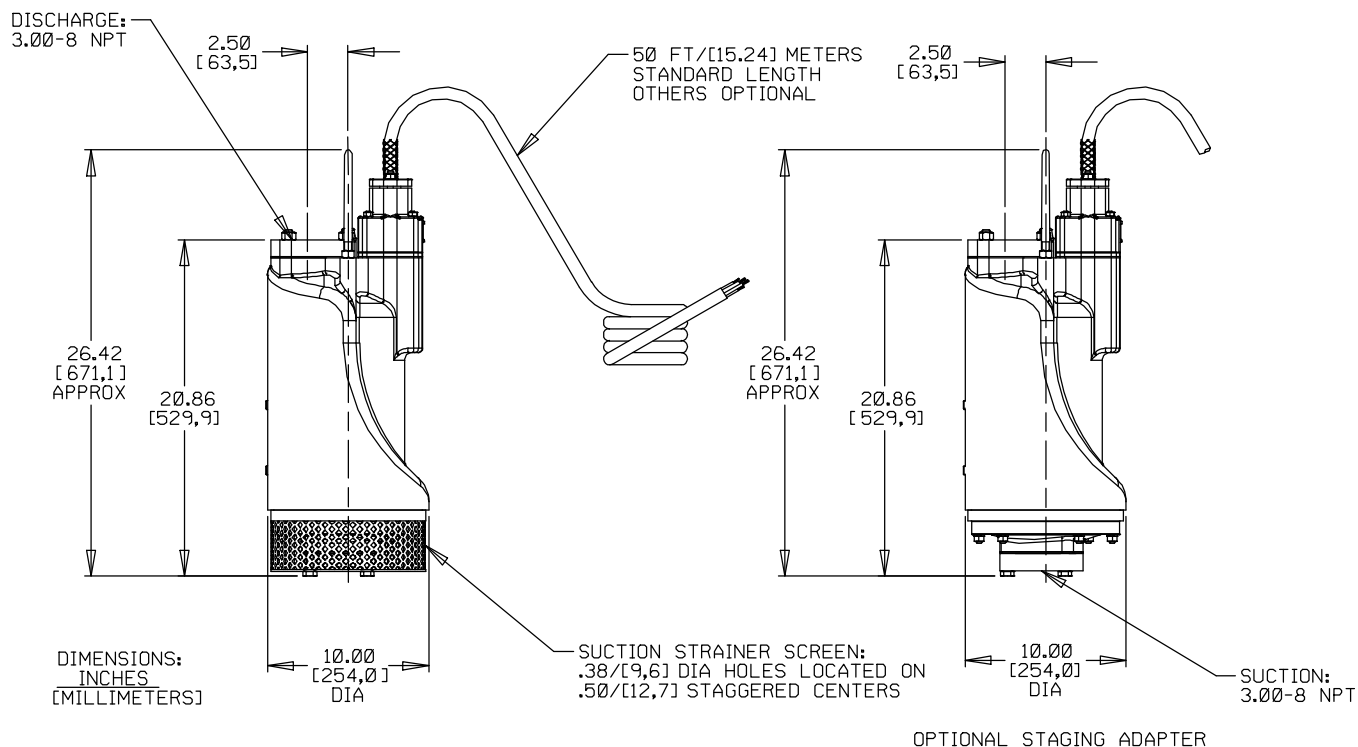


Figure 1. Pump Models S3C65-E6 All Voltages

Lifting

Pump unit weights can vary depending on the material of construction and length of cable on the unit. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.



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.*

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

As a safeguard against rupture or explosion due to heat, the pump is 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 2 for typical pump installations.

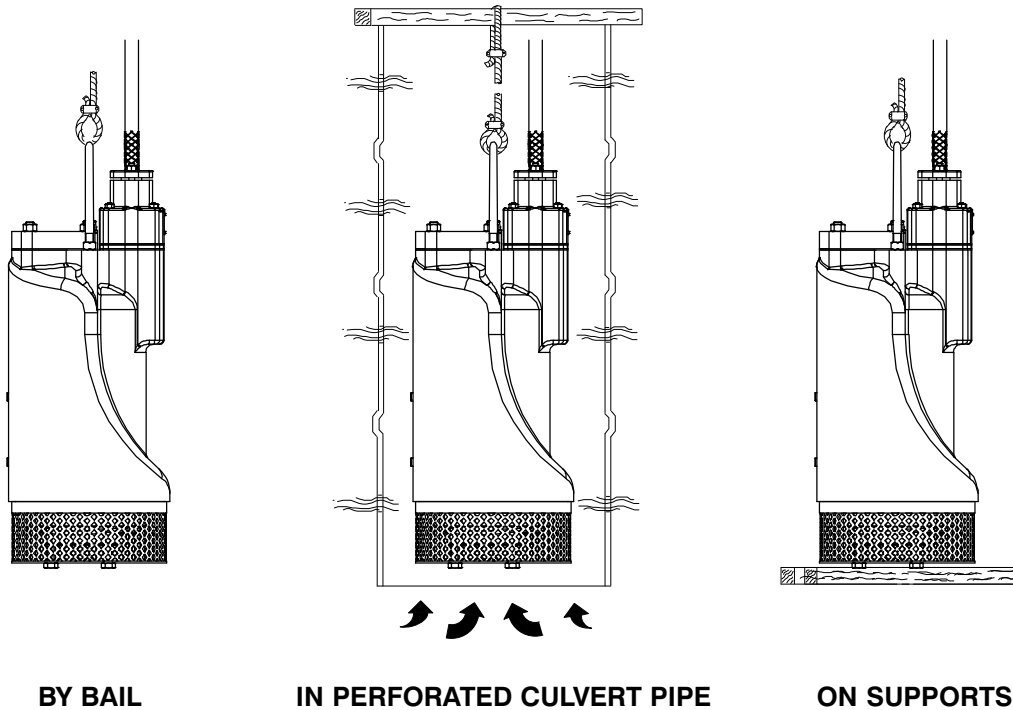


Figure 2. Typical Pump Installations

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

PIPING

No suction piping is required in a standard submerged application.

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

To determine the size of the discharge connection, see Table 1, **Pump Specifications**. Either hose or rigid pipe may be used. To facilitate mobility and maintenance, it is recommended that the discharge line be fitted with a quick disconnect fitting near the pump. The discharge line must be inde-

pendently supported to avoid strain and vibration on the pump.

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

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

CONTROL BOX

This pump is driven by an integral 60 hertz, 6 HP motor. It is designed to operate through the control box furnished with the pump. Refer to the manual accompanying the control box for control box installation and operation.



WARNING!

The pump motor is designed to be oper-

ated 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.

Dual Voltage Motor Wiring (230/460/3 Voltage Only)

230 and 460 volt models are powered by a dual-voltage motor which permits utilization of high or low voltage. The motor was originally wired and shipped for the voltage indicated as "Factory Wired" on the pump name plate. The name plate also indicates the dual voltage pertaining to this motor. If alternate voltage must be utilized, certain wiring and control box modifications are required.

The control box assembly provided with this pump has been designed to accommodate **only** the voltage indicated on the front of the box. This voltage coincides with the "Factory Wired" voltage of the motor. If the alternate voltage is utilized, the control box must be replaced with another box designed for the appropriate voltage. Consult the Parts List, Section E, to determine the part number of the alternate control box.

The motor wiring **must** also be changed before utilizing the alternate voltage. For detailed instructions on disassembly and reassembly of the terminal housing, see **Terminal Housing and Power Cable Disassembly** and **Terminal Housing and Power Cable Reassembly**, Section E, in this manual. Change the motor leads as indicated on the

wiring diagram plate affixed to the side of the terminal housing, see Figure 3. Be sure to tag the revised voltage on the pump.

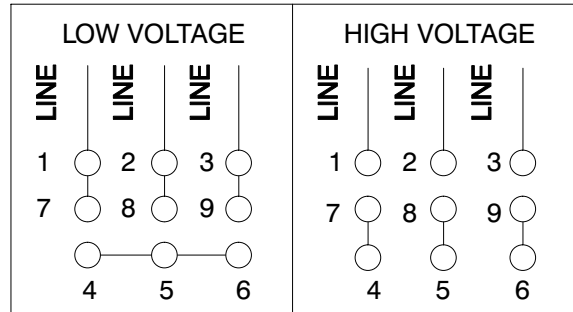


Figure 3. Motor Wiring Diagram

Grounding Methods

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

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

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

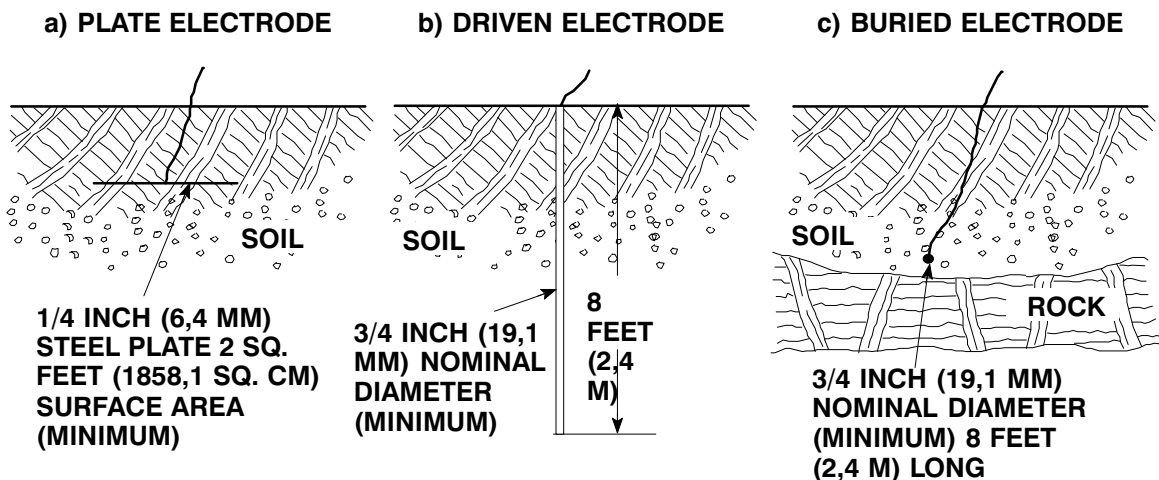


Figure 4. Suggested Grounding Methods

- a. **Plate Electrode:** An iron or steel plate, 1/4 inch (6,4 mm) thick, completely impeded in the ground. The plate must present a surface area of at least 2 square feet (1858,1 sq. cm).
- b. **Driven Electrode:** A rod or pipe, 3/4 inch (19,1 mm) in diameter minimum, 8 feet (2,4 m) long, completely driven into the ground.
- c. **Buried electrode:** If rock or stone prevents embedding the full 8 foot (2,4 m) length of the ground rod, bury it horizontally in a trench.

Space the ground rod or plates at least 6 feet (1,8 m) from any other electrode or ground rod, such as those used for signal circuits, radio grounds, lightning rods, etc.

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



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

Field Wiring Connections (Incoming Power)



The 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.

Field wiring must be properly sized to ensure an adequate voltage supply to the pump. The voltage available **at the motor** must be within the range indicated in Table 3.

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

- a. Measure the incoming voltage across lines 1 & 2, 2 & 3, and 1 & 3 **while the pump is operating at full capacity.** See the wiring diagrams in this section for power supply connections.
- b. Next, subtract the motor cable voltage drop (see Table 4, **Pump Power Cable Specifications**).
- c. Do not continue to operate the pump if this voltage is not within the recommended limits. Obtain the services of a qualified electrician to determine the correct field wiring size and other details to insure an adequate voltage supply to the pump.

Table 3. Pump Motor Voltage Limits

Nominal Voltage	Phase	Minimum Voltage	Maximum Voltage
230	1	210	250
230	3	210	250
460	3	420	500
575	3	517	632

Pump Power Cable Connections



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

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

The standard pump is provided with a 50 foot (15,2 meters) power cable (see table 4 for power cable specifications). If a longer cable is required, an optional cable assembly **must** be ordered from the factory. Splicing of the power cable is **not** recom-

mended by the Gorman-Rupp Company due to safety and warranty considerations.



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

Table 4. Pump Power Cable Specifications Model S3C65

Voltage/Phase	A.W.G Cable Size	Cable O.D. (max) Inches [mm]	Conductor Diameter Inches [mm]	Amp Rating at 30°C	DC Resistance at 25°C (ohms/1000 ft. or 304,8 m)	Voltage Drop at Max. Load per 100 ft. (30,5 m)
230/1	10	.775 [19,7]	.12 [3,1]	25	1.11	7.55
230/3	10	.775 [19,7]	.12 [3,1]	25	1.11	5.10
460/3	10	.775 [19,7]	.12 [3,1]	25	1.11	2.55
575/3	10	.775 [19,7]	.12 [3,1]	25	1.11	2.04

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

Connect the pump power cable to the control box as shown in the wiring diagrams in this section. Use conduit or cable clamps to secure the power and accessory cables to the control box. Make certain that all connections are tight and that cable entry points are rainproof.

NOTE

The power cable furnished with this pump includes three electrical conductors (black, white and red),

and one grounding conductor (green).

LIQUID LEVEL DEVICES

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

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

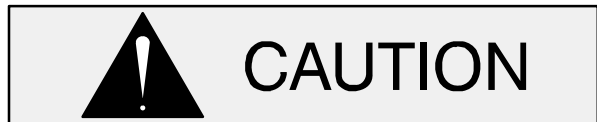
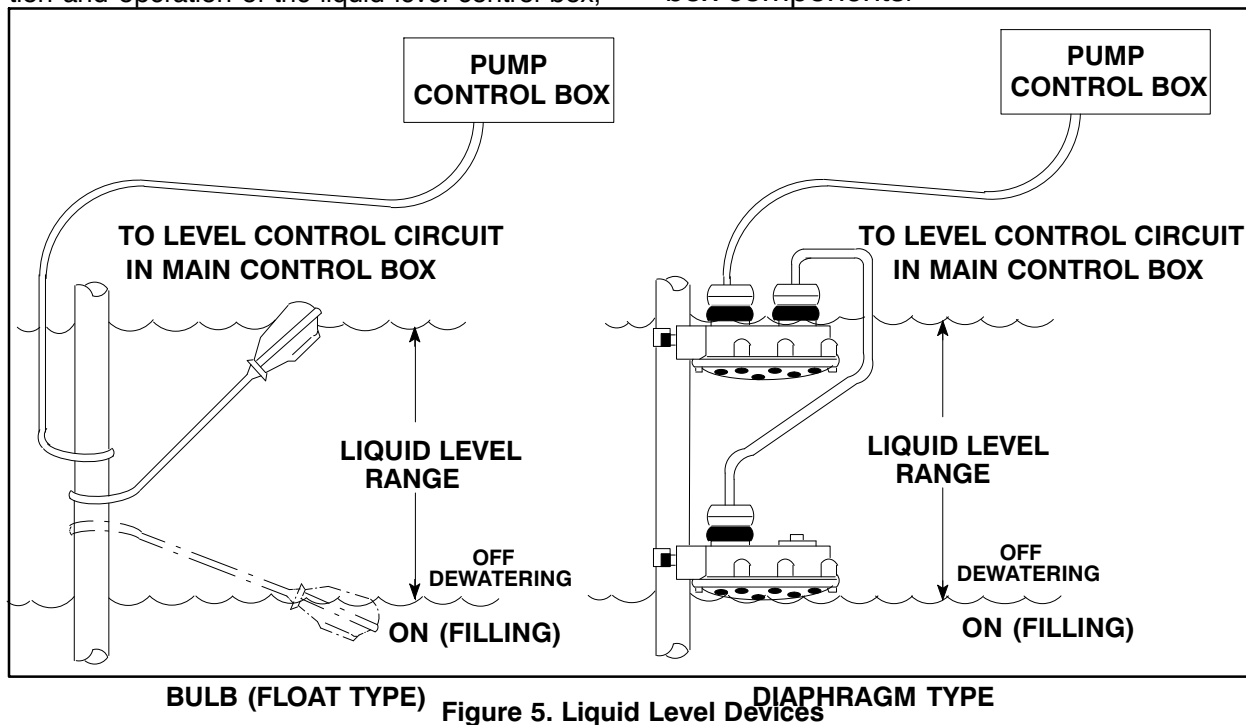
- **Bulb (Float) Type:** a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch.

see the detailed instructions included with the control box.

Liquid level devices operate through a separate control box wired between the main control box and the pump. The liquid level control box may be purchased with the pump or easily added in the field by qualified personnel. The unit is complete except for remote float switches, which must be specified and purchased separately. For installation and operation of the liquid level control box,



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



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.

OPERATION – SECTION C

Review all SAFETY information in Section A.

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

CONTROL BOX FUNCTION



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

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



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.



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

Component Function

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

- The **tie handle** operates the control box overload unit. In the OFF position, the tie handle opens the overload unit to interrupt incoming power through the control box and prevent pump operation. In the ON position, it closes the overload unit to permit pump operation. The overload unit will open or “trip” automatically in the event of a short circuit overload current, or thermal excess within the pump motor or electrical system. When tripped, move the tie handle to OFF and back to ON to reset the overload unit.
- The **selector switch** (optional on some boxes) controls the mode of operation. In the OFF position, it prevents all operation of the pump. In the HAND position, it allows the pump to run continuously. In the AUTO position, it allows the pump to be controlled automatically by the optional liquid level control system, if used.

NOTE

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



The motor will restart as soon as the tie handle is reset, unless the selector switch is in the OFF position. Turn the selector switch to OFF and move the tie handle to OFF before approaching the pump.

- The **liquid level devices** (optional equipment) operate in conjunction with the 3-position switch (HAND-OFF-AUTO) supplied as

part of that option. After the level sensors and circuitry have been installed, pump operation may be automatically controlled for filling or dewatering functions (see **LIQUID LEVEL DEVICES**, Section B).

PUMP OPERATION



This pump is designed to handle industrial chemical and low pH resistance materials. **Do not** attempt to pump any liquids for which your pump is not approved, or which may damage the pump or endanger personnel as a result of pump failure. Consult the factory for specific application data.

Liquid Temperature And Overheating

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

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



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.

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

pump motor reaches a critical point. Always terminate power to the pump and control box before investigating pump or control box problems.

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



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

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

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

Checking Pump Rotation

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

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



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

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



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

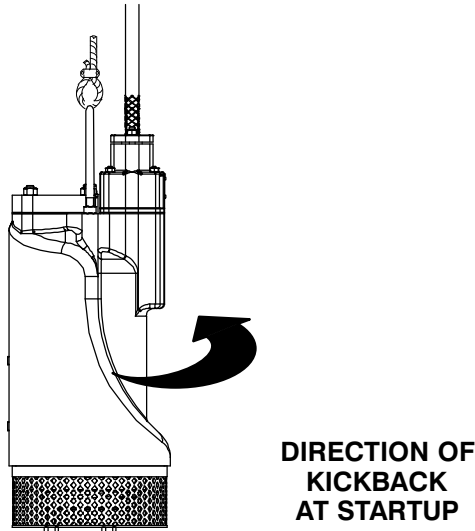


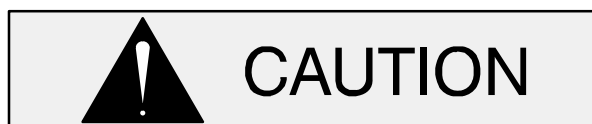
Figure 1. Checking Pump Rotation

STARTING

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

NOTE

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



Never start the pump more than 6 times per hour. If the pump motor does not cool between starts, it will overheat, resulting in

damage to the motor windings or control box components.

Standard Pump (No Liquid Level Devices)

If no liquid level devices have been installed, move the tie handle to the ON position. The pump motor will start and pumping should begin. Since the pump is submerged, priming is not required.

The pump will continue to operate until it is stopped by moving the tie handle to OFF.

With Automatic Liquid Level Devices

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

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

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

STOPPING

To stop the pump, turn the tie handle OFF. Power going to the pump from the control box is terminated by moving the tie handle to the OFF position, thereby opening the overload unit. This **does not** terminate incoming power through the field wiring connected to the control box.

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

NOTE

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

Operational Checks

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

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

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

Never introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown on the pump performance curve (see **MAINTENANCE AND REPAIR**, Section E).

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

Cold Weather Preservation

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

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



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

TROUBLESHOOTING – SECTION D

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

NOTE

*Many of the probable remedies listed in the **TROUBLESHOOTING CHART** require use of electrical test instruments; for specific procedures, see **ELECTRICAL TESTING** at the end of the chart.*

TROUBLESHOOTING CHART

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO START, OVERLOAD UNIT NOT TRIPPED (MANUAL MODE).	<p>Power source incompatible with control box.</p> <p>No voltage at line side of circuit breaker.</p> <p>Open circuit in motor windings or power cable.</p> <p>Defective motor power cable.</p> <p>Defective motor.</p>	<p>Correct power source.</p> <p>Check power source for blown fuse, open circuit breaker, broken lead or loose connections.</p> <p>Check continuity.</p> <p>Replace cable.</p> <p>Check for and replace defective motor components.</p>
PUMP FAILS TO START, OVERLOAD UNIT NOT TRIPPED (AUTOMATIC MODE).	<p>Liquid level device or control circuits improperly connected to main control box.</p> <p>Level sensing device(s) improperly positioned.</p> <p>Level sensing device(s) fouled with mud or foreign material.</p> <p>Float type sensing device(s) tangled or obstructed.</p> <p>Defective liquid level sensing device(s) or control panel.</p>	<p>Check wiring diagrams: correct or tighten connections.</p> <p>Position device(s) at proper level.</p> <p>Clean sensing device(s).</p> <p>Check installation for free movement of float.</p> <p>Repair or replace defective unit(s).</p>
OVERLOAD UNIT TRIPS	<p>Low or high voltage, or excessive voltage drop between pump and control box.</p> <p>Defective insulation in motor windings or power cable; defective windings.</p> <p>Impeller jammed due to debris or insufficient clearance.</p> <p>Bearings frozen.</p>	<p>Measure voltage at control box. Check that wiring is correct type, size, and length (see Field Wiring Connection, Section B).</p> <p>Check insulation resistance; check continuity.</p> <p>Disassemble pump and check impeller.</p> <p>Disassemble pump and check bearings.</p>

TROUBLESHOOTING CHART (cont'd)

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
<p>MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE.</p>	<p>Discharge head too high.</p> <p>Low or incorrect voltage.</p> <p>Discharge throttling valve partially closed; check valve installed improperly.</p> <p>Discharge line clogged or restricted; hose kinked.</p> <p>Liquid being pumped too thick.</p> <p>Strainer screen or impeller clogged.</p> <p>Insufficient liquid in sump or tank.</p> <p>Worn impeller vanes.</p> <p>Pump running backwards.</p>	<p>Reduce discharge head or install staging adaptor and additional pump.</p> <p>Measure control box voltage, both when pump is running and when shut off.</p> <p>Open discharge valve fully; check piping installation.</p> <p>Check discharge lines; straighten hose.</p> <p>Dilute liquid if possible.</p> <p>Clear clog(s). Stop pump; back flow may flush away debris.</p> <p>Stop pump until liquid level rises.</p> <p>Check impeller (see PUMP END REASSEMBLY in Maintenance and Repair, Section E).</p> <p>Check direction of rotation. If incorrect, interchange any two motor leads at the control box (3 phase models, see Pump Rotation, Section C).</p>
<p>PUMP RUNS WITH EXCESSIVE NOISE OR VIBRATION</p>	<p>Pumping entrained air.</p> <p>Damaged or unbalanced impeller.</p> <p>Discharge piping not properly supported.</p> <p>Impeller jammed or loose.</p> <p>Motor shaft or bearings defective.</p> <p>Pump is cavitating.</p>	<p>Check liquid level in sump; check position of pump and liquid level sensing device(s).</p> <p>Replace impeller.</p> <p>Check piping installation.</p> <p>Check impeller.</p> <p>Disassemble pump and check motor and bearings.</p> <p>Reduce discharge head or restrict flow on low head applications.</p>

ELECTRICAL TESTING

Make the electrical checks which follow to determine if pump malfunctions are being caused by problems in the motor or in the motor cable.

Test Equipment

A volt/amp/ohmmeter and megohmmeter of adequate range and quality are required to conduct the electrical tests which follow.

Equipment	Use
Ammeter	To check AC Voltage and current (amperage)
Ohmmeter	To measure resistance (ohms) to ground



Refer to the wiring diagram(s) accompanying the motor and control box before reconnecting any electrical leads which have been disconnected. Connections to the wrong terminals may damage the motor and/or control devices.

Voltage Imbalance

Use a voltmeter to read each phase of the incoming 3 phase power. Each phase must balance with the other two as closely as can be measured with a commercial instrument. If the phases are out of balance, contact your power company. If the phases are balanced, check out the motor as described in the following steps:

- a. Use a voltmeter, Amprobe, or equivalent instrument to read the voltage of incoming power lines 1 and 2, 2 and 3, and 1 and 3 at the control box. Voltage must match as closely as can be measured. If possible, measure the voltage at the control box with:
 1. The pump shut off.
 2. The pump running in air.

3. The pump submerged and running under full load.

The voltage measured under each condition must be the same.

- b. If voltage is balanced when the pump is off but is imbalanced when the pump is running, thoroughly check the power source, all interconnecting cables, and the pump motor to isolate the defect.
- c. Use an Amprobe or equivalent instrument to measure the current draw (amperage) of each phase while the pump is running under full load, and with no load. In each condition, the amperage readings for all three phases must match as closely as can be measured. Normal amperage values are listed in Table B-1 in **INSTALLATION**; these values apply only when the voltage at the site is the normal voltage listed.

Power Cable Continuity

Set the megohmmeter at R x 1 scale and zero-balance it. Test as follows:

- a. Shut off incoming power to the control box, and disconnect the motor power cable leads. Connect the megohmmeter test leads to any two cable leads, and note the megohmmeter reading. A high resistance reading indicates an open or broken circuit in the power cable or motor windings, or a bad connection between the motor and cable.
- b. Repeat Step a. with each set of leads. The three readings should be as close as can be measured.
- c. If readings indicate that continuity problems exist in the motor or power cable, the motor and/or terminal housing assembly must be repaired before putting the pump into service.

Insulation Resistance

Set the megohmmeter at R x 100, and zero-balance it. Test as follows:

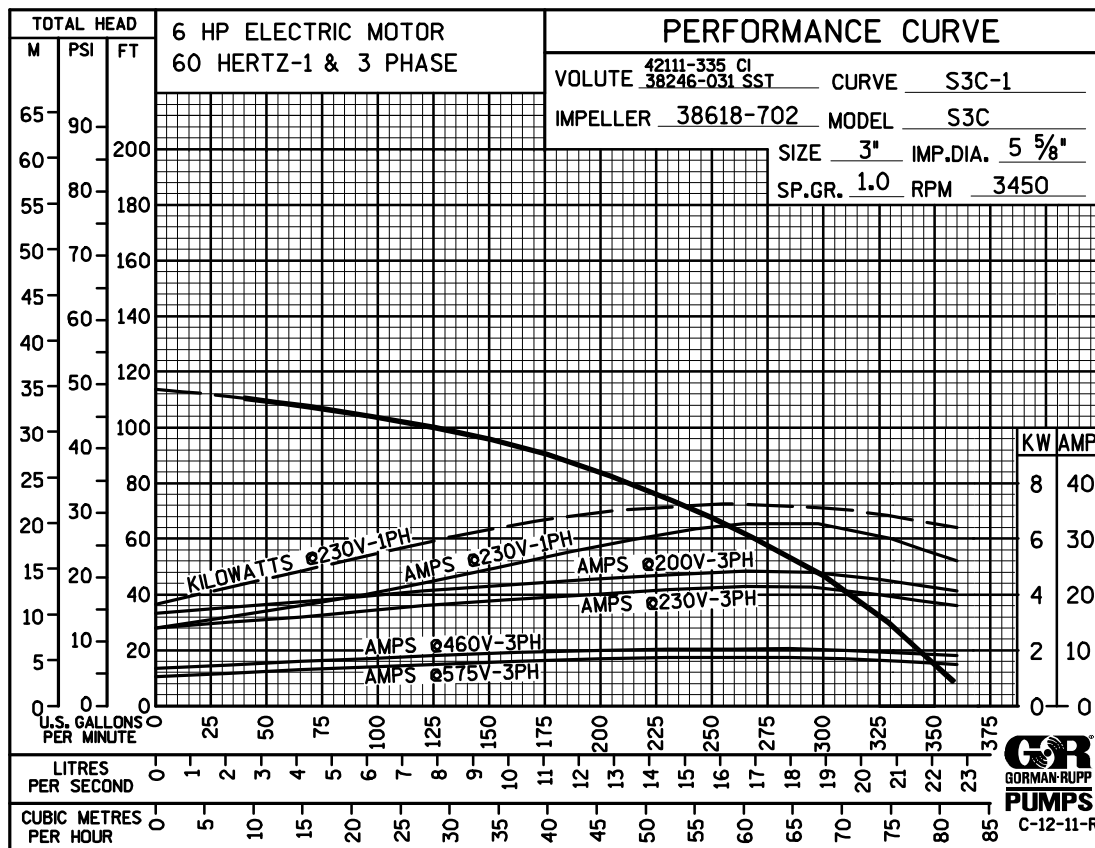
- a. Shut off incoming power to the control box, and disconnect the motor power cable leads. Connect one megohmmeter test lead to the

motor cable green/yellow ground lead. Touch the other test lead to each of the motor cable leads in turn. Note the readings.

- b. Readings will indicate resistance values in both the power cable and motor windings. If resistance reads infinity (∞), insulation is good. If resistance reads between infinity (∞), and 1 megohm, insulation is acceptable but should be rechecked regularly. If resistance reads less than 1 megohm, insulation should be checked more closely and frequently.
- c. If readings indicate that a ground exists, test the stator and motor power cable separately. Replace as required.

PUMP MAINTENANCE AND REPAIR – SECTION E

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



* STANDARD PERFORMANCE FOR PUMP MODEL
S3C65-E6 (All Voltages)

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

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

ILLUSTRATION

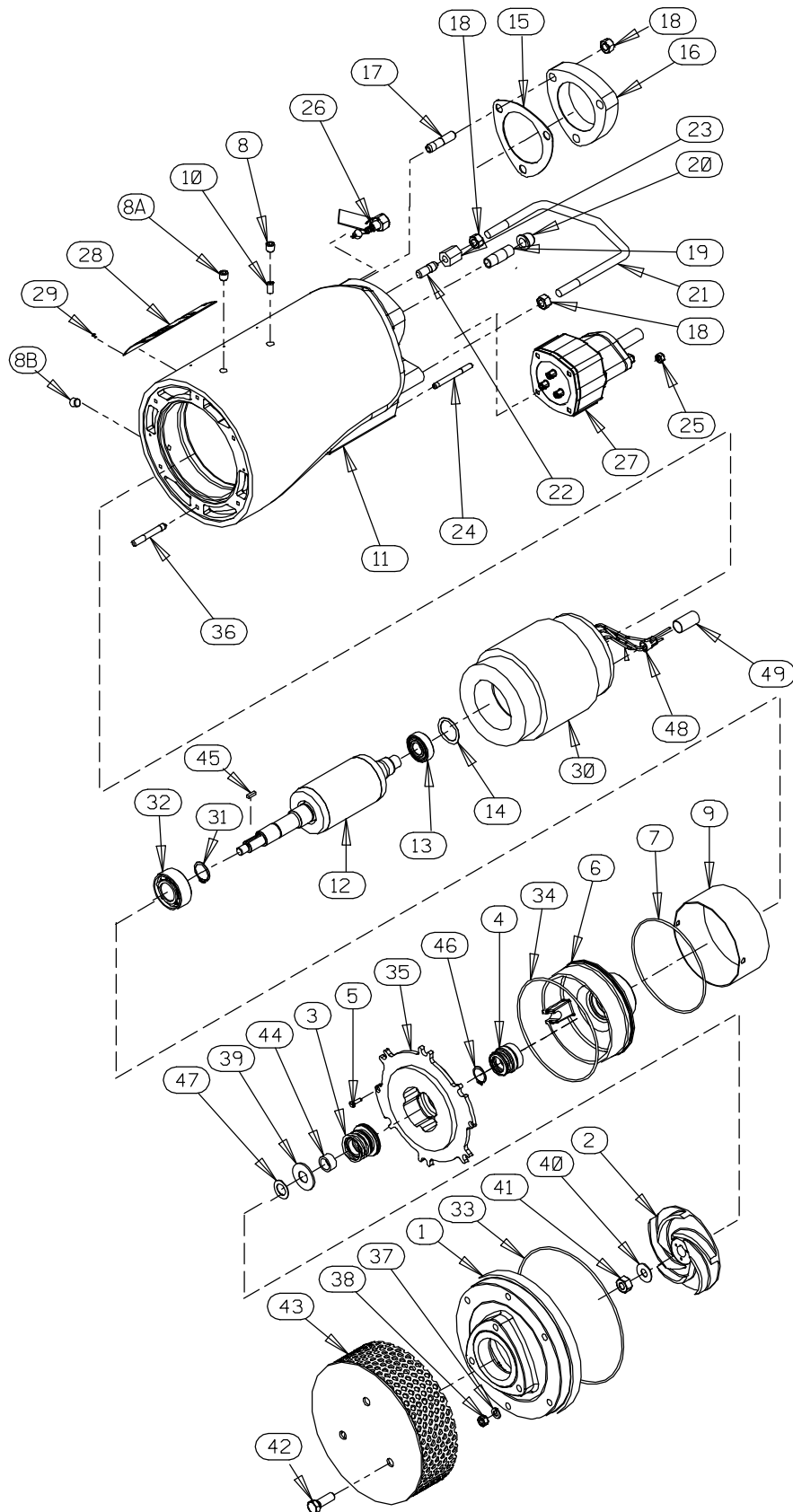


Figure 1. Pump Model S3C65-E6 (All Voltages)

PARTS LIST
Pump Model S3C65-E6 (All Voltages)
 (From S/N 1509692 Up)

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

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	SUCTION HEAD	38246-031	1718H	1	39 *	SPRING RETAINER	8793	17090	1
2 *	IMPELLER	38618-702	1718H	1	40	FLAT WASHER	KB08	17090	1
3 *	LOWER SEAL ASSY	46512-071	----	1	41	HEX NUT	22561-165	----	1
4 *	UPPER SEAL ASSY	S1832	----	1	42 *	NYLOCK CAP SCREW	BT0806	17090	3
5	FLAT HD MACH SCREW	Y#10-03	17090	2	43	STRAINER SCREEN ASSY	46611-010	24170	1
6	INTERMEDIATE	38311-803	13040	1	44 *	SEAL SLEEVE	13878	17090	1
7 *	INTERMEDIATE O-RING	25152-258	----	1	45 *	IMPELLER KEY	N0302-1/2	17090	1
8	SOC HD PIPE PLUG	PC04	17090	1	46	RETAINING RING	24124-332	----	1
8A	MOTOR CAVITY OIL PLUG	PC04	17090	1	47 *	IMP ADJ SHIM SET	2Y	17090	1
8B	SEAL CAVITY OIL PLUG	PC04	17090	1	48	WIRE CONNECTOR:			
9	MOTOR BUSHING	31173-017	23010	1		230/3	S1718	----	1
10	ALLEN HD SET SCREW	GA0603	15990	1		460/3	S1718	----	3
11	MOTOR HOUSING:				49	HEAT SHRINK TUBING:			
	1 PH	38311-070	17040	1		230/3	31411-235	19450	1
	3 PH	38311-064	17040	1		460/3	31411-235	19450	3
12	ROTOR & SHAFT ASSY:				NOT SHOWN:				
	1 PH	47112-811	----	1		MOTOR VOLTAGE TAG			
	3 PH	47112-810	----	1		S3B65-E6 230/1	38816-098	----	1
13 *	UPPER BALL BEARING	S1044	----	1		S3B65-E6 230/3	38816-094	----	1
14	SPRING WASHER	S1554	----	1		S3B65-E6 460/3	38816-093	----	1
15 *	FLANGE GASKET	38687-045	19370	1		S3B65-E6 575/3	38816-128	----	1
16	DISCHARGE FLANGE	38641-006	17070	1		QT. SUB PUMP OIL	9568	----	1
17	STUD	C0809	17090	3		CABLE TIE	27111-212	----	1
18	HEX NUT	D08	17090	5		CONTROL BOX ASSY			
19	PIPE NIPPLE	THA0608	17090	1		S3B65-E6 230/1	27511-107	----	1
20	PIPE CAP	25471-223	----	1		S3B65-E6 230/3	27515-564	----	1
21	HOISTING BAIL	31926-009	17130	1		S3B65-E6 460/3	27515-562	----	1
22	STUD	C0806	17090	1		S3B65-E6 575/3	27515-565	----	1
23	COUPLING NUT	31811-019	17130	1		IMPELLER PULLER	10285	----	1
24	STUD	C0513	17090	4		HEATER PACK			
25	HEX NUT	D05	17090	4		S3B65-E6 230/3	27521-206	----	1
26 *	RELIEF VALVE ASSY	46431-646	----	1		S3B65-E6 460/575/3	27521-203	----	1
27	TERM HSNQ & CBL ASSY:				OPTIONAL:				
	230/1 & 575/3	47367-042	----	1		* REPAIR GASKET SET	11000AA	----	1
	230/3 & 460/3	47367-043	----	1		STAGING ADAPTOR	48272-015	----	1
28	INFORMATION PLATE	38818-039	17090	1		FLANGE	38641-006	17070	1
29	DRIVE SCREW	BM#04-03	17090	6		GASKET	38687-045	19370	1
30	STATOR ASSY:					HEAT SHRINK TERM KIT	48315-003	----	1
	230/1	47113-860	----	1		DIAPHRAGM TYPE LIQUID LEVEL DEVICES:			
	230/3 & 460/3	47113-861	----	1		(DEWATERING)	GRP48-03	----	1
	575/3	47113-862	----	1		(FILLING)	GRP48-06	----	1
31	SNAP RING	S1831	----	1		FLOAT TYPE LIQUID LEVEL DEVICE:			
32 *	LOWER BALL BEARING	23425-007	----	1					
33 *	MOTOR HSG O-RING	25154-270	----	1		120V CONTROL SWITCH:			
34 *	SEAL PLATE O-RING	25154-261	----	1		1 PHASE MODEL	27521-324	----	1
35	SEAL PLATE	38272-350	1718H	1		3 PHASE MODELS	27521-322	----	1
36	STUD	C0611	17090	6					
37	LOCK WASHER	J06	17090	6					
38	HEX NUT	D06	17090	6					

* INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

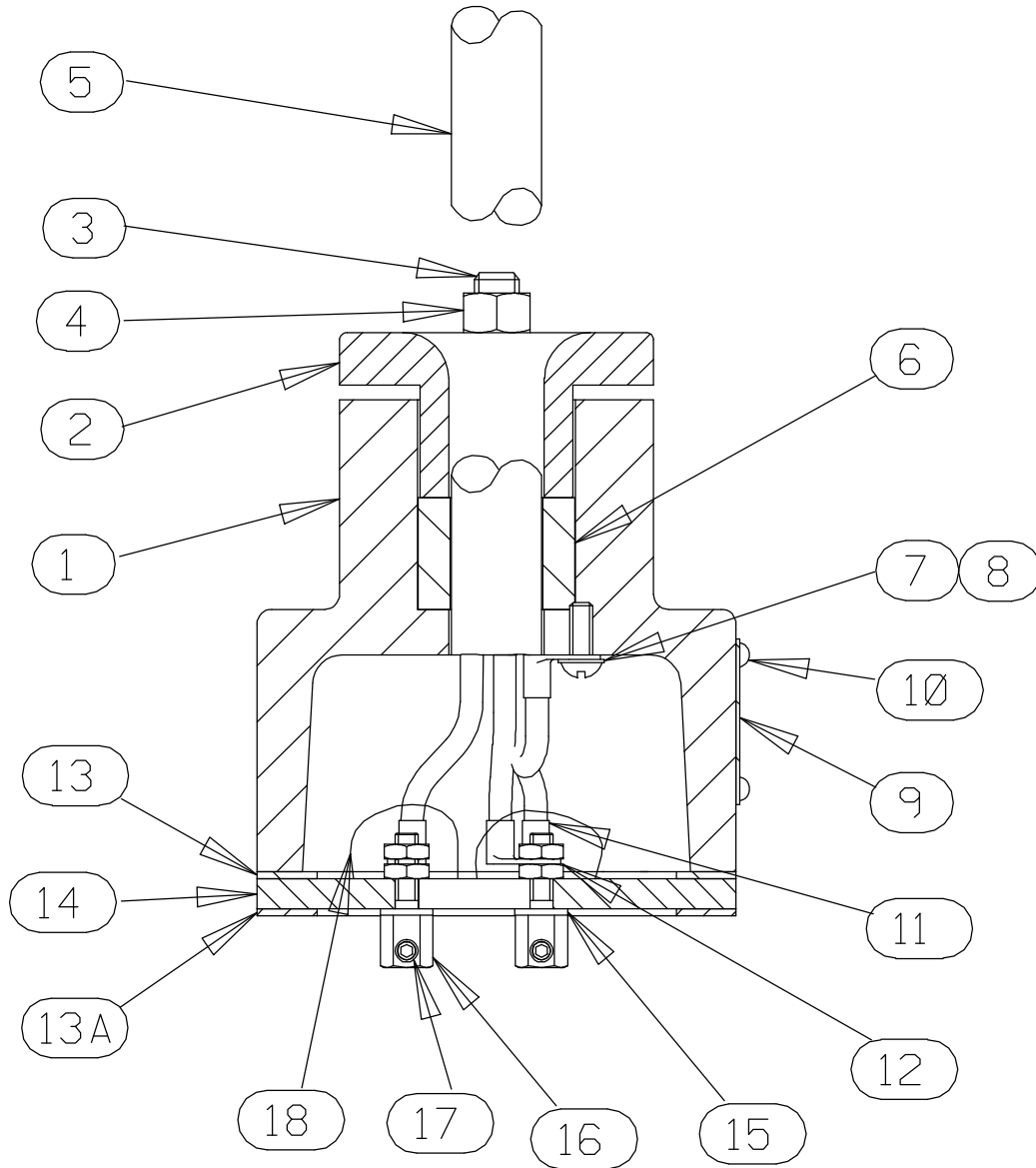


Figure 2. Terminal Housing And Cable Assemblies

PARTS LIST
Terminal Housing And Cable Assemblies

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	TERMINAL HOUSING	38381-233	17070	1
2	TERMINAL CAP	38381-626	17070	1
3	STUD	C0606	17090	2
4	HEX NUT	D06	17090	2
5	CABLE ASSY	47351-055	---	1
6	* GLAND BUSHING	10758F	19540	1
7	RD HD MACH SCREW	X#10-02	14990	1
8	T-TYPE LOCKWASHER	AK#10	15991	1
9	INFORMATION PLATE	38816-047	17050	1
10	DRIVE SCREW	BM#04-03	17090	4
11	HEAT SHRINK TUBE	31412-053	19530	3
12	HEX NUT	D#10	14990	6
13	* UPPER TERMINAL PLATE GASKET	38687-525	19370	1
13A	* LOWER TERMINAL PLATE GASKET	38687-525	19370	1
14	TERMINAL PLATE	38713-008	23010	1
15	* DYNA SEAL WASHER	S1590	---	3
16	TERMINAL POST	11181	14100	3
17	ALLEN HEAD SET SCREW	GA#10-01S	15991	3
18	3 OZ. TUBE RTV SEALANT	18771-107	---	1

NOT SHOWN:

MOTOR PLATE (230/3 & 460/3)	10436	17050	1
DRIVE SCREW (230/3 & 460/3)	BM#04-03	17090	4

OPTIONAL:

HEAT SHRINK TERMINAL KIT	48315-003	---	1
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* INDICATES PARTS RECOMMENDED FOR STOCK

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

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

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

The following maintenance and repair instructions are keyed to the illustrations (see Figures 1 and 2) and the accompanying parts lists.

Before attempting to service the pump or control, lock out incoming power to the control box. Close the discharge throttling valve, if so equipped.



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



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.



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

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

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

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

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

PUMP END DISASSEMBLY

Strainer Removal

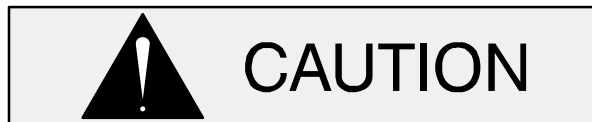
(Figure 1)

To remove the strainer assembly (43), raise the pump slightly, or lay it on its side and disengage the strainer hardware (42). Remove the strainer. If the impeller is clogged, the debris can usually be removed without further disassembly.

Draining Oil From Seal Cavity

(Figure 1)

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



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 (8B) 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.

Draining Oil From Motor Cavity

(Figure 1)

If motor problems are suspected, remove the motor cavity drain plug (8A) and install a short nipple in the hole. Tip the pump and drain the motor oil into a **clean** container. Inspect the oil for dark color which could indicate motor overheating, water or dirt contamination. The presence of dirt or water could indicate a breakdown in the waterproof integrity of the motor cavity, probably due to poor gaskets or seals.

Positioning Pump For Disassembly

(Figure 1)

It is recommended that the pump be positioned upside-down during disassembly. To hold the pump in the inverted position, screw a pipe in the discharge flange (16) and clamp it in a large vise. If the discharge flange has been removed, the pump may also be secured by the discharge flange studs (17) to a bench or work table. Be careful not to damage the terminal housing or cable 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.

After the strainer screen has been removed, remove the hardware (37 and 38) securing the suction head (1) to the motor housing (11). Remove the suction head. Remove and discard the motor housing O-ring (33).

Impeller Removal

(Figure 1)

Wedge a piece of wood between the vanes of the impeller (2) and the motor housing studs (36) to prevent shaft rotation.

Remove the impeller nut (41) and flat washer (40).

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 shaft. Use caution when removing the impeller from the shaft, tension on the lower seal spring will be released. Retain the impeller key (45).

Remove the impeller shim set (47). For ease of reassembly, tie and tag the shims or measure and record their thickness.

Lower Seal Removal

(Figures 1 and 3)

Carefully remove the spring retainer (39) and seal spring.

Remove the screws (5) securing the seal plate (35) to the motor housing. Pry the seal plate and remaining seal parts out of the motor housing as a unit.

Remove the shaft sleeve (44) and rotating portion of the seal from the seal plate.

To remove the stationary portion of the seal, place the seal plate on a clean cloth with the impeller side down. Use a drift pin or wooden dowel to press on alternate sides of the stationary seat until the stationary element, seat, and O-rings are removed.

Remove and discard the seal plate O-ring (34).

Upper Seal Removal

(Figures 1 and 3)

Unless cracked or otherwise worn, it is not necessary to remove the intermediate (6) for access to the upper seal assembly (4).

Remove the seal retaining ring (46) using snap ring pliers. Use caution when removing the snap ring; tension of the seal spring will be released. Remove the seal spring retainer and spring.

Lubricate the rotor shaft adjacent to the seal and work oil up under the rubber bellows. Use a pair of stiff wires with hooked ends to pull the rotating portion of the seal off the shaft.

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

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

Cleaning And Inspection Of Pump Parts

(Figure 1)

With the pump inverted, stuff a clean tissue into the stationary seal seat bore of the intermediate (6) 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.



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.

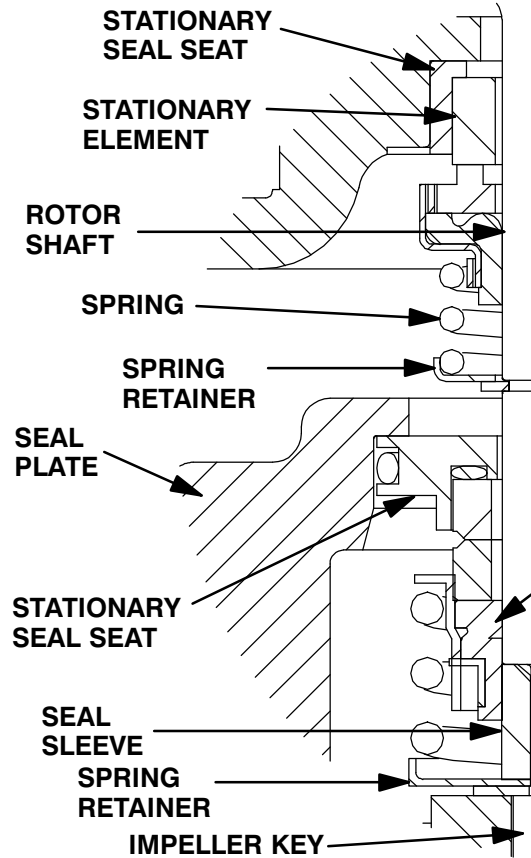
Inspect the rotor shaft for damaged threads, scoring, or nicks. Remove nicks and burrs with a fine file or hand honing stone to restore original contours. If the shaft is bent or severely damaged, the rotor and shaft must be replaced as an assembly (see **MOTOR DISASSEMBLY**).

Neither of the shaft seal assemblies 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 preci-

sion finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring,



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

Install the shaft seals as illustrated in Figure 3.

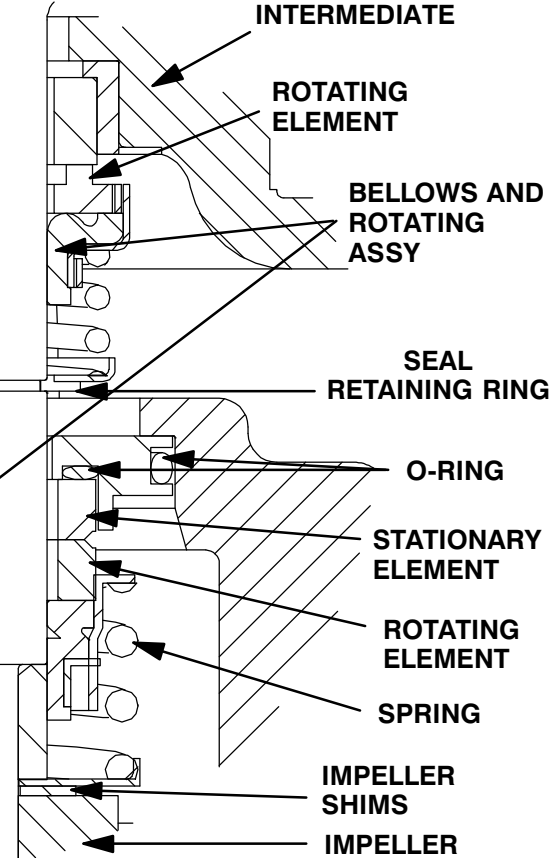


Figure 3. Upper and Lower Seal Assemblies



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

Upper Seal Reassembly

(Figures 1 and 3)

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

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

Clean the rotor shaft and seal cavity area of the intermediate (6). 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. Apply a **light** coating of oil to the bore.

Lightly lubricate the O.D. of the stationary seat, and subassemble the stationary element in the seat. Position this subassembly in the intermediate 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 subassembly is fully seated in the bore. Remove the tissue and inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use clean tissue to wipe **lightly** in a concentric pattern.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. 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.

Slide the seal rotating portion onto the lubricated shaft with the seal face down. Apply firm, steady pressure on the seal retainer until it slides down the shaft and the seal faces contact.

NOTE

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

Slide the seal spring over the shaft and bellows retainer, and install the spring retainer. Compress the spring and install the seal retaining ring (46). See Figure 3 for proper order of seal assembly.

Lower Seal Reassembly

(Figures 1 and 3)

Clean and inspect the seal plate (35) for cracks, distortion or erosion and replace if defective. Lightly oil the O-ring (34) and install it on the seal plate. Position the seal plate on a clean, flat surface with the impeller side facing up.

Unpack the stationary portion of the seal and check that the O-rings are properly installed (see Figure 3). Apply a **light** coating of oil to the O.D. of the outer stationary seat O-ring. Keep the sealing face dry.

Position the stationary 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 concentric pattern.

NOTE

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

Position the seal plate and stationary subassembly over the rotor shaft so that the seal plate is fully seated against the motor housing (11) and secure it with the flat head machine screws (5). Be careful not to cut the seal plate O-ring (34).

Clean and inspect the shaft sleeve (44) and replace it if there are nicks or cuts on either end. Lightly oil the sleeve and install it on the shaft with the chamfered end toward the shaft shoulder.

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.

Slide the seal rotating portion onto the lubricated shaft sleeve with the seal face toward the stepped end. Apply firm, steady pressure on the seal retainer until it slides down the sleeve and the seal faces contact.

Install the seal spring over the shaft and bellows retainer, and install the spring retainer (39).

Impeller Installation

(Figure 1)

Inspect the impeller (2) 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.

Install the same thickness of impeller adjusting shims (47) as previously removed. Install the im-

impeller key (45) in the rotor shaft keyway, align the impeller keyway, and push the impeller onto the shaft until it seats firmly against the adjusting shims.

NOTE

The clearance between the face of the impeller and the suction head can only be measured after the impeller and suction head are fully installed.

Coat the threads of the rotor shaft with 'Loctite Threadlocker No. 242' or equivalent compound. Install the impeller washer (40) and nut (41). Wedge a block of wood between the impeller vanes and motor housing studs to prevent shaft rotation, and torque the impeller nut to 60 ft. lbs. (720 in. lbs. or 8,3 m. kg.).

Remove the block of wood and turn the impeller to check for free rotation. Check front clearance after installing the suction head (1).

NOTE

After the impeller has been properly positioned, check for free rotation. Correct any scraping or binding before further reassembly.

Suction Head Installation

(Figure 1)

Inspect and thoroughly clean the suction head (1) and its O-ring surface. Lubricate and install the O-ring (33).

Install the suction head over the motor housing studs (36). Apply 'NeverSeez' or equivalent compound to the threads of the studs. Install the hardware (37 and 38) and torque the nuts (38) to 20 ft. lbs. (240 in. lbs. or 2,8 m. kg.).

Impeller Clearance

(Figure 1)

There should be a clearance of .008 to .015 inches (0,2 to 0,38 mm) between the suction head and the face of the impeller. Reach into the suction head with a feeler gauge and measure this clearance.

If the impeller clearance is not within specified limits, remove the suction head and the impeller, then add or remove impeller adjusting shims (47) as required. Reinstall the impeller and suction head, and recheck clearance.

Strainer Installation

(Figure 1)

Inspect the strainer assembly (43) for cracks, broken weld, distortion or erosion, and replace if defective.

Install the strainer squarely against the shoulder of the suction head. Align the holes for the capscrews (42) in the strainer with those in the suction head (1) and secure with the nylock capscrews (42).

NOTE

It is recommended that the nylock capscrews (42) be replaced any time the strainer is removed and reinstalled. The nylon locking patches in the capscrews can lose their locking capacity when removed, which could result in the hardware and strainer coming loose from the pump during operation.

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.



The electrical power used to operate this pump is high enough to cause injury or death. Make certain that the control

handle on the control box is in the off position and locked out, or that the power supply to the control box has been otherwise cut off and locked out, before attempting to open or service the pump assembly. Tag electrical circuits to prevent accidental start-up.

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

Terminal Housing And Power Cable Removal And Disassembly

(Figure 1)

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

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

Secure the pump in an upright position. To remove the terminal housing, disengage the hardware (25) securing the terminal housing assembly (27) to the motor housing (11).

(Figure 2)

Carefully raise the terminal housing from the motor housing until the terminal posts (16) are accessible. Loosen the set screws (17) and disconnect the motor leads from the terminal posts. Separate the terminal housing (1) and power cable assembly (5) from the motor housing. Remove the lower terminal housing gasket (13A).

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

To separate the power cable (5) from the terminal housing, remove the nuts (4) securing the terminal cap (2) to the terminal housing. Slide the cap back along the power cable.

Oil the gland bushing (6) and terminal housing bore, and pull firmly on the cable. Allow the oil to leak in around the bushing by agitating the cable in the bore. After the bushing has been loosened, it should be possible to pull the cable out far enough to expose the gland bushing. Apply oil to the cable jacket and slide the bushing back along the cable. Pressure exerted on the bushing may deform the cable jacket. If this occurs, additional oil and effort will be required to remove the bushing.

NOTE

Sometimes pressure exerted on the gland bushing (6) will deform the power cable jacket. If this occurs, additional oil and effort will usually free the power cable. If the cable cannot be separated from the gland bushing, it may be necessary to cut the bushing into small pieces or cut the cable.

Push approximately 6 inches (152,4 mm) of power cable into the terminal housing so that the terminal plate (16) comes free of the terminal housing. This will permit access to the power cable connections in the terminal plate.

To disconnect the power cable, remove the hardware (7 and 8) securing the green ground lead. Reinstall the hardware.

When shipped from the factory, the connections between the power cable leads and the terminal posts (16) were encapsulated in heat shrink tubing (11) and bonded to the terminal plate with hot-melt adhesive (18). Cut away the tubing and adhesive and remove the upper hex nuts (12). Disconnect the power cable leads from the terminal posts, and separate the terminal plate (14) from the terminal housing (1).

Pull the power cable out of the terminal housing. The gland bushing (6) and terminal cap (2) can now be removed from the cable.

It is not necessary to remove the heat-shrink tubing from the power cable leads unless the terminals require replacement. If replacement is required, carefully cut the tubing from around the leads and terminals.

If it is necessary to replace the terminal plate (14) or terminal components, unscrew the lower hex nuts (12) and remove the terminal posts and dyna seal

washers (15). Remove and discard the upper terminal plate gasket (13).

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

Rotor Removal

(Figure 1)

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

With the pump end disassembled and the motor cavity drained, grasp the threaded end of the rotor (12) and pull the shaft and assembled intermediate (6), rotor and ball bearings (13 and 32) out of the motor housing (11). Use caution to prevent the rotor from falling on the stator windings. If necessary, screw on the impeller locknut and use a commercial slide hammer puller to remove the assembly. Remove the intermediate, motor bushing (9) and discard the intermediate O-ring (7)

Remove the spring washer (14) from the upper bearing bore.

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



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

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



Most cleaning solvents are toxic and flammable. Use them only in a well-ventilated area free from excessive heat, sparks, and flame. Read and fol-

low all precautions printed on solvent containers.

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

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

If replacement is required, use a bearing puller to remove the ball bearings from the rotor shaft.

It is not necessary to remove the snap ring (31) unless replacement is required. Use snap ring pliers to remove the ring.

Stator Removal

(Figure 1)

Do not remove the stator (30) 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 plug (8) located in the motor housing and loosen the allen head setscrew (10) located underneath the pipe plug.

Position an expandable tool, such as a split disc, approximately 2 inches (51 mm) down inside the stator, and expand it tightly and squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and raise the assembly approximately 1 inch (25 mm) off the work surface. Take care not to damage the stator end turns.

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

dling the stator, **do not** set it on the end windings; lay it on its side.

Relief Valve

(Figure 1)

It is recommended that the relief valve assembly (26) be replaced at each overhaul, or at 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.

When installing the relief valve, use 'Loctite Pipe Sealant With Teflon No. 567' or equivalent compound on the threads.

Hoisting Bail

(Figure 1)

If the hoisting bail (21) requires replacement, loosen the jam nut (18) and coupling nut (23) securing the bail to the stud. Loosen the other jam nut (18) and unscrew the bail from the motor housing.

MOTOR REASSEMBLY



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

NOTE

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

Stator Installation

(Figure 1)

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 housing (11) with fresh solvent. The interior **must** be dry and free of dirt or lint.



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

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

NOTE

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

Position an expandable tool, such as a split disc, approximately 2 inches down inside the stator (opposite the lead wire end), and expand it tightly and

squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and carefully lift the assembly. Take care not to damage the stator end turns. Slip a sleeve over the stator leads, or tape them together to protect them during installation.

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 housing (11) with a torch to expand it enough for the stator (30) 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 housing; excessive heat is not required.

When the motor housing is 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 upper motor housing shoulder, remove the expandable disc tool. Use ‘Never-Seez’ on the threads of the allen head setscrew (10) and secure the stator in place by torquing the setscrew to 20 ft. lbs. (1240 in. lbs. or 2,77 m. kg.).

Coat the threads of the pipe plug (8) with ‘Loctite Pipe Sealant With Teflon No. 567’ or equivalent sealant and install the plug over the allen head setscrew. 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.

Shaft And Rotor Installation

(Figure 1)

Inspect the rotor shaft 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).



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.

If removed, install the snap ring (31) in the groove on the shaft.

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

NOTE

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

NOTE

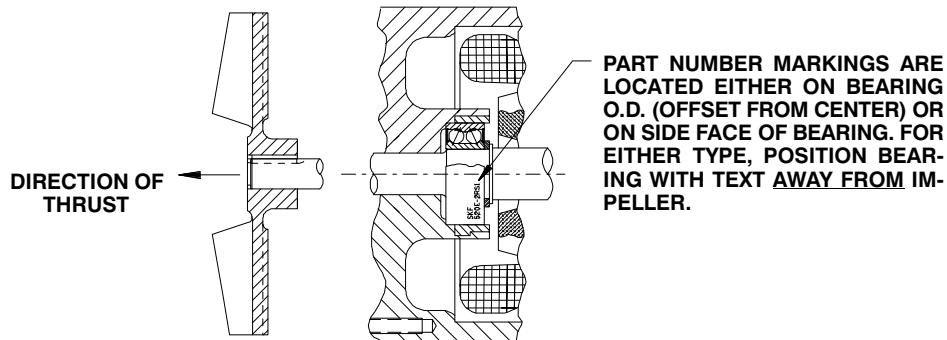
Position the lower bearing (32) on the shaft as indicated in Figure 4.

Heat the bearings to a uniform temperature **no higher than** 250°F (120°C). Slide the upper bearing (13) onto the shaft until it is fully seated against the shaft shoulder. This should be done quickly, in one continuous motion, to prevent the bearing from cooling and sticking on the shaft.



Use caution when handling hot bearings to prevent burns.

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 4. 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 suitably sized sleeve and an arbor (or hydraulic) press to reposition the bearings.

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



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

Use **fresh** solvent to clean the bearing bore, and all gasket and O-ring surfaces of the intermediate (6) and the motor housing (11), 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.



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.

Install the spring washer (14) in the motor housing bore.

Carefully ease the rotor and assembled bearings through the stator until the upper bearing (13) is firmly seated in the motor housing bearing bore.

Position the motor bushing (9) in the motor housing so one of the two drain holes is aligned with the motor cavity drain plug (8A). Install the intermediate O-ring (7) and lubricate the I.D. of the intermediate bearing bore.

Position the bearing bore of the intermediate (11) over the lower ball bearing (32) and press the intermediate over the bearing until it seats squarely on the motor bushing and the shoulder of the motor housing. Use caution not to cut the O-ring (7).

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

Terminal Housing And Power Cable Reassembly And Installation

(Figure 2)



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, and check for obvious physical damage. Check the cable for continuity and insulation resistance (see **Electrical Testing in TROUBLESHOOTING**). **Do not** attempt repairs except to cut off either end of the cable; **splicing is not recommended**. Reinstall any wire tags or terminals which may have been removed.



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

Use oil to lightly lubricate the outside of the pump power cable (5), upper bore of the terminal housing (1), the rubber gland bushing (6), and the bore of the terminal cap (2) for ease of assembly. Slide the terminal cap, gland bushing and terminal housing onto the power cable in that order (see Figure 2 to recheck order of assembly).

Work the cable components up the cable, allowing approximately 3 ft. (0,9 m) of cable to extend below the terminal housing. Temporarily tape the green ground wire to the cable.



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 terminals (16) were encapsulated in heat-shrink tubing (11) and bonded to the terminal plate (14) with hot-melt adhesive to provide a wa-

ter-tight seal. If this insulating material has been damaged or removed during maintenance, **it must** be replaced using materials and equipment approved by Gorman-Rupp (see the parts list for repair kits).

Before resealing the power and control cables, remove all the old adhesive material from the terminals, terminal posts, and terminal plate. Inspect all parts for damage, and replace as required.

NOTE

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

Assemble the terminal posts (16), dyna seal washers (15), and lower terminal nuts (12) to the terminal plate as shown in Figure 2. Install the upper terminal plate gasket (13).

NOTE

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

If the terminal ends were removed for replacement, crimp a new terminal on each power cable lead. Slide a length of heat-shrink tubing (13) up over each of the power cable leads. The tubing must cover the crimped part of the terminals and extend up the leads far enough to ensure a good seal.

NOTE

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

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

After the tubing has shrunk and set, secure the power cable leads to the terminals with the upper nuts (12).

NOTE

To ensure adhesion of the hot-melt adhesive to the terminal plate, pre-heat the adhesive gun to at least 400°F (204°C). It is also recommended that the ter-

terminal plate be preheated to 125°F - 150°F (52°C - 66°C) to ensure adhesion. Use a commercially available hot-air gun to heat the terminal plate at this point.

After the wire terminals have been secured and locations checked for correctness, hold the terminal plate horizontally. Apply the adhesive (G-R part number 18771-107) neatly around each terminal and over the terminal posts with a hot-melt adhesive tool (Terlan model TM-80, or equivalent) set at 400°F (204°C). The adhesive **must not** have any air pockets, voids or gaps in order to ensure water-tight integrity.

Remove any adhesive that may have gotten on gasketed surfaces and allow the adhesive to cure for at least one hour and a skin to form before reassembling the terminal housing.



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.

After the heat-shrink tubing and adhesive have been installed and allowed to cure, untape the ground lead, and slide the terminal housing (1) down the cable. Secure the green ground lead to the ground terminal with the hardware (7 and 8). **Be sure** the lead makes good contact with the housing.

Pull gently on the power cable to remove any excess length from within the terminal housing. The terminal plate (14) should fit loosely against the terminal housing.

Lubricate the upper bore of the terminal housing, and slide the gland bushing (6) into place. Slide the terminal cap (2) into place and engage the nuts (4) finger tight. Do not fully tighten the nuts at this time.

Attach the cable leads to the terminal posts as follows, depending on the voltage of the pump.

NOTE

*In the following instructions, a **small** amount of gasket adhesive may be used to hold the upper and lower terminal plate gaskets in place to ease assembly.*

230/1 and 575/3 Voltage

Position the lower gasket (13A) against the terminal plate, then attach the motor leads T1, T2 and T3 to the correspondingly-marked terminal posts (16) using the set screws (17).

230/3 Voltage

Position the lower gasket (13A) against the terminal plate, then attach the motor leads T1 to T7, T2 to T8 and T3 to T9. Attach paired leads T1 and T7 to the terminal post T1. Attach paired leads T2 and T8 to terminal post T2. Attach paired leads T3 and T9 to terminal post T3. Secure the leads in the terminal posts using the set screws (17).

Group motor leads T4, T5 and T6 and install and tighten the connector (48, Figure 1) on the leads. Slide the heat-shrink tubing (49, Figure 1) over the connector and shrink the tubing around the connector using the hot air gun.

460/3 Voltage

Position the lower gasket (13A) against the terminal plate, then attach the motor leads T1, T2 and T3 to the correspondingly-marked terminal posts (16) using the set screws (17). Group motor leads T4 to T7, T5 to T8 and T6 to T9. Install and tighten the connectors (48, Figure 1) on each group of leads. Slide the heat-shrink tubing (49, Figure 1) over each connector and shrink the tubing around the connectors using the hot air gun.

All Voltages

If required, rotate the terminal housing and twist the motor leads to remove excess slack. Coat the threads of the motor housing studs (24, Figure 1) with 'Never-Seez' or equivalent compound and secure the terminal housing assembly to the motor housing with the nuts (25, Figure 1); torque the nuts to 11 ft. lbs. (132 in. lbs. or 1,5 m. kg.).

Tighten the nuts (4), drawing the terminal cap down into the terminal bore. **Do not** over tighten and damage the terminal gland or hardware.

See **FINAL ASSEMBLY** and **LUBRICATION**.

FINAL ASSEMBLY

(Figure 1)

If the hoisting bail (21) was removed, install a jam nut (18) on each side of the bail. Screw the nut up onto the threads by hand as far as they will go. Screw the coupling nut (23) onto threads on the shorter side of the bail as far as it will go.

Screw the longer side of the bail into the hole in the top of the motor housing as far as it will go and the coupling nut (23) is aligned over the stud (22). Screw the coupling nut down onto the stud. Tighten the jam nuts (18) against the coupling nut and motor housing to secure the lifting bail.

If the discharge flange (16) was removed from the motor housing, replace the discharge flange gasket (15). Apply 'Never-Seez' or equivalent compound on the flange studs (17) and secure the flange with the nuts (18).

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

LUBRICATION

Seal Cavity

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



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

To check the seal cavity oil, lay the pump on its side with the seal cavity oil plug (8B) up. Remove the plug and screw a short 1/4-inch NPT nipple into the hole. Plug the open end of the nipple with your finger. Tip the pump upright, drain off a small amount of oil into a transparent cup, and lay the pump on its side again. If the oil level is abnormally low, or the color milky or dark, refer to **Draining Oil From Seal Cavity** in this section for instructions and troubleshooting tips. If the oil is clear, remove the nipple and top off the seal cavity with oil. Apply 'Loctite Pipe Sealant With Teflon No. 567.' or equivalent to the threads of the pipe plug before reinstalling the plug.

When lubricating a dry (overhauled) pump, add approximately 16 ounces (0,5 liters) of lubricant (see Table 1 for lubricant specifications).

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

Table 1. Pump Oil Specifications

Specifications:	
Type	Premium high viscosity index, anti-wear hydraulic oil
Viscosity (SSU @ 104°F [40°C])	110 to 155
Viscosity (SSU @ 210°F [100°C])	40 to 50
Dielectric	26,000 (volts-min)
Recommended supplier:	
Gulf Oil Company	Gulf Harmony AW Hydraulic Fluid MG 32
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

Remove the pipe cap (20) and add the recommended grade of lubricant, approximately 3 quarts (2,8 liters), to the motor cavity. **Maintain the oil at this level.** Apply 'Loctite Pipe Sealant With Teflon

No. 567' or equivalent sealant to the threads of the heavy pipe nipple (19). Install and tighten the cap. If the heavy pipe nipple was removed, coat the threads with 'Loctite Retaining Compound No. 680 or No. 620' or equivalent compound and reinstall it in the motor housing.

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