



# S SERIES PUMPS S4C, S4D and S4H

All Materials And Voltages

**MANUAL  
PART 3 of 3**

**MAINTENANCE  
AND  
REPAIR  
WITH  
TROUBLESHOOTING**

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

[www.grpumps.com](http://www.grpumps.com)

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Register your new  
Gorman-Rupp pump online at  
**[www.grpumps.com](http://www.grpumps.com)**

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: \_\_\_\_\_

## INTRODUCTION

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

A set of three manuals accompanies your pump. The Installation/Operation Manual contains essential information on installing and operating the pump, and on making electrical connections. The Parts List Manual provides a performance curve, a pump model cross-section drawing, and parts list for your pump.

This Maintenance and Repair Manual provides troubleshooting and maintenance instructions required to properly diagnose operational problems, and to service the pump components. Pump motor maintenance may be performed **only** by a Gorman-Rupp authorized Submersible repair facility, or the factory. Otherwise, the pump warranty will be negated, and damage to the pump, and injury or death to personnel can result. Contact the factory for the authorized repair facility closest to you.

As described on the following page, this manual will alert personnel to known procedures which re-

quire 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 which are not covered in this manual or in other literature accompanying the unit, please contact your Gorman-Rupp distributor or the Gorman-Rupp Company:

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

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**RECORDING MODEL AND SERIAL NUMBERS**

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

Pump Model: \_\_\_\_\_  
 Serial Number: \_\_\_\_\_  
 Voltage: \_\_\_\_\_  
 Phase: \_\_\_\_\_

**WARRANTY INFORMATION**

The warranty provided with your pump is part of Gorman-Rupp’s support program for customers

The following are used to alert 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.**

who operate and maintain their equipment as described in this and the other accompanying literature. The integral electric motor must be operated through the control furnished with the pump as standard equipment. Please note that should the equipment be abused or modified to change its performance beyond the original factory specifications, the warranty will become void and any claim will be denied.

All repairs to the pump motor **must** be performed by a Gorman-Rupp authorized Submersible repair facility or the factory. Any repairs to the motor assembly performed by the customer or an unauthorized repair facility negates motor warranty.



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

The following information applies throughout this manual to Gorman-Rupp S Series submersible motor driven pumps.

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.

This manual contains essential information on troubleshooting and maintaining the pump. In addition to this manual, see the separate literature covering installation and operation, pump parts, and any optional equipment shipped with the pump.



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 not designed to pump volatile, explosive, or flammable 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.



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



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



The electrical power used to operate this pump is high enough to cause injury or death. Obtain the services of a qualified electrician to make all electrical connections. Make certain that the pump and enclosure are properly grounded; never use gas pipe as an electrical ground. Be sure that the in-

coming power matches the voltage and phase of the pump and control before connecting the power source. Do not run the pump if the voltage is not within the limits. If the overload unit is tripped during pump operation, correct the problem before restarting the pump.



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



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



All electrical connections must be in accordance with The National Electric Code and all local codes. If there is a conflict between the instructions provided and N.E.C. Specifications, N.E.C. Specifications shall take precedence. All electrical equipment supplied with this pump was in conformance with N.E.C. requirements in effect on the date of manufacture. Failure to follow applicable specifications, or substitu-

tion of electrical parts not supplied or approved by the manufacturer, can result in severe injury or death and void warranty.



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



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.



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.



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

## TROUBLESHOOTING – SECTION B

Review all SAFETY information in Section A.



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

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

5. Close the discharge valve (if used).



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

### NOTE

Many of the probable remedies listed below require use of electrical test instruments; for specific procedures, see **ELECTRICAL TESTING** following the chart.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
<p><b>PUMP FAILS TO START, OVERLOAD UNIT NOT TRIPPED (MANUAL MODE)</b></p> <p><b>(AUTOMATIC MODE)</b></p>	Power source incompatible with control box.	Correct power source.
	No voltage at line side of circuit breaker.	Check power source for blown fuse, open overload unit, broken lead, or loose connection.
	Open circuit in motor windings or power cable.	Check continuity.
	Defective motor power cable.	Replace cable.
	Motor defective.	Check for and replace defective unit
	Liquid level device or control circuits improperly connected to main control box.	Check wiring diagrams; correct or tighten connections.
	Level sensing device(s) improperly positioned.	Position device(s) at proper level.
Level sensing device(s) fouled with mud or foreign material.	Clean sensing device(s).	

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
<b>(AUTOMATIC MODE ) (CONT'D.)</b>	<p>Float type sensing device(s) tangled or obstructed.</p> <p>Defective liquid level sensing device(s) or control panel.</p>	<p>Check installation for free movement of float.</p> <p>Repair or replace defective unit(s).</p>
<b>OVERLOAD UNIT TRIPS</b>	<p>Low or high voltage, or excessive voltage drop between pump and control box.</p> <p>Defective insulation in motor windings or power cable; defective windings.</p> <p>Impeller jammed due to debris or insufficient clearance.</p> <p>Bearing(s) frozen.</p>	<p>Measure voltage at control box. Check that wiring is correct type, size, and length. (See <b>Field Wiring Connections</b>, Section B).</p> <p>Check insulation resistance; check continuity.</p> <p>Disassemble pump and check impeller.</p> <p>Disassemble pump and check bearing(s).</p>
<b>MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE</b>	<p>Discharge head too high.</p> <p>Low or incorrect voltage.</p> <p>Discharge throttling valve partially closed; check valve is 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; excessive impeller clearance.</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 by heating 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 and clearance. See <b>PUMP END REASSEMBLY</b>.</p> <p>Check direction of rotation and correct by interchanging any two motor leads at control box. (See <b>Pump Rotation</b>, Section C).</p>

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
<b>PUMP RUNS WITH EXCESSIVE NOISE OR VIBRATION</b>	Pumping entrained air.	Check liquid level in sump; check position of pump and liquid level sensing device(s).
	Damaged or unbalanced impeller.	Replace impeller.
	Discharge piping not properly supported.	Check piping installation.
	Impeller jammed or loose.	Check impeller.
	Motor shaft or bearings defective.	Disassemble pump and check motor and bearings.
	Pump cavitation.	Reduce discharge head, or restrict flow on low head applications.

## ELECTRICAL TESTING

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



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



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

### Test Equipment

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

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

### Voltage Imbalance

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

- Use a voltmeter, amprobe, or equivalent meter to read the voltage across terminals 1 & 2, 2 & 3, and 1 & 3 in the control box. All three measured voltages must be the same, as accurately as the meter will read. If possible, measure the voltage with the pump off, with the pump running but out of the water, and with the pump running in the water at full load. All the measured voltages at each condition must be the same.
- Use an amprobe or equivalent meter to measure the current draw of each phase

while the pump is running at full load and at no load. All three amperage readings must be the same at each condition, as accurately as the meter will read. Nominal amperage values are listed in Table 1, but these apply only when the actual voltage at the site is the nominal voltage listed.

- c. If the voltages are balanced with the pump off, but are unbalanced when the pump is running, a thorough check of the power source, all interconnecting cables, and the pump motor is required to isolate the defect.

### Motor And Motor Power Cable Continuity

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

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

### NOTE

*When shipped from the factory, the connections between the power cable leads and the terminal posts were encapsulated in heat shrink tubing and bonded to the terminal plate to provide a water tight seal. In service, these connections may have been potted by the pump operator. Do not cut the tubing or potting away unless absolutely necessary. Check the continuity of each lead from the motor side of the terminal plate. If the continuity is good, there is no need to remove the tubing or potting material. If there is no continuity through the lead, re-*

*move the tubing or potting from only that terminal, and check for a loose connection. Be sure to replace the tubing or potting and allow adequate drying time before putting the pump back into service. (See **Power Cable Reassembly**, Section E).*

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

### NOTE

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

### Insulation Resistance

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

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

## PUMP MAINTENANCE AND REPAIR – SECTION C

### GENERAL INFORMATION

Review all SAFETY information in Section A.

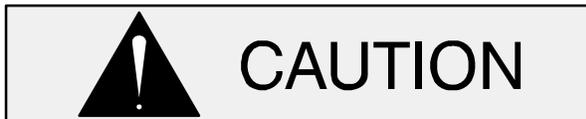


**Do not attempt to service the pump assembly unless all power to the motor has been shut off at the control box; otherwise, injury or death could result.**

**Use a lifting device with sufficient capacity. If slings or chains are used to move the pump or components, make sure that the load is balanced; otherwise serious personal injury or death could result.**

The maintenance and repair instructions in this manual are keyed to the sectional views, Figures C-1, C-2 or C-3, and the corresponding parts identification lists. Refer to the separate Parts List Manual for replacement parts.

Select a suitable location, preferably indoors, to perform required maintenance. All work must be performed by qualified personnel.



All repairs to the pump motor must be per-

formed by a Gorman-Rupp authorized Submersible repair facility or the factory. Any repairs to the motor assembly performed by the customer or an unauthorized repair facility negates the warranty.

This Maintenance and Repair Manual provides troubleshooting and maintenance instructions required to properly diagnose operational problems, and to service the pump components. Pump motor maintenance may be performed **only** by a Gorman-Rupp authorized Submersible repair facility, or the factory. Otherwise, the pump warranty will be negated, and damage to the pump, and injury or death to personnel can result. Contact the factory for the authorized repair facility closest to you.

Check **TROUBLESHOOTING**, Section B to determine causes and remedies of pump problems. Disassemble the pump only as far as required.

#### Lifting

Use lifting equipment with a capacity of **at least five times the weight of the pump**, including the weight of any options or customer-installed accessories. The approximate maximum weight for this group of pumps is **206 lbs. (93,4 kg.)**. Discharge hose or piping **must** be removed before attempting to lift the pump.

SECTION DRAWING

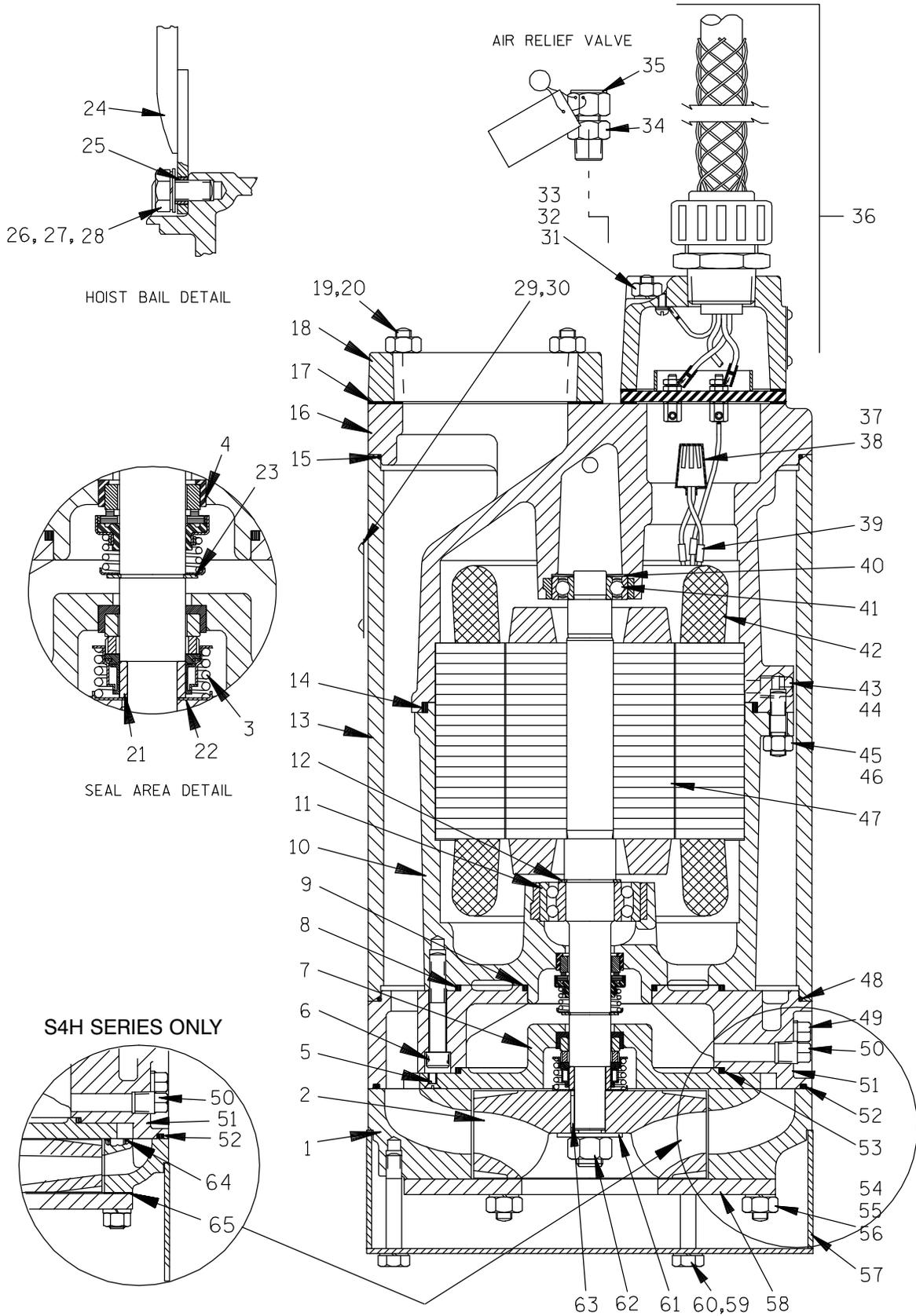


Figure C-1. Typical S4C, S4D And S4H Series Pump Assembly

### Typical S4C, S4D And S4H Series Pump Assembly Parts Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME	ITEM NO.	PART NAME
1	DIFFUSER	34	RED PIPE BUSHING
2	IMPELLER	35	RELIEF VALVE ASSY
3	LOWER SEAL ASSY	36	TERMINAL HOUSING/CABLE ASSY
4	UPPER SEAL ASSY	37	CONNECTOR
5	FLAT HEAD MACHINE SCREW	38	HEAT SHRINK TUBE
6	SOCKET HD CAPSCREW	39	WIRE MARKER KIT
7	SEAL PLATE	40	BEARING SPRING WASHER
8	INTERMEDIATE GASKET	41	UPPER BALL BEARING
9	INTERMEDIATE GASKET	42	STATOR
10	MOTOR HOUSING	43	ALLEN HD SETSCREW
11	LOWER BALL BEARING	44	PIPE PLUG
12	BEARING SNAP RING	45	STUD
13	PUMP CASING	46	DEFORM LOCKNUT
14	MOTOR HOUSING O-RING	47	ROTOR W/SHAFT
15	PUMP CASING O-RING	48	INTERMEDIATE O-RING
16	UPPER MOTOR HOUSING	49	MOTOR CAVITY DRAIN PLUG
17	DISCHARGE FLANGE GASKET	50	SEAL CAVITY DRAIN/FILL PLUG
18	DISCHARGE FLANGE	51	INTERMEDIATE
19	STUD	52	DIFFUSER O-RING
20	HEX NUT	53	SEAL PLATE GASKET
21	SHAFT SLEEVE	54	STUD
22	IMPELLER ADJ SHIM SET	55	LOCKWASHER
23	SEAL RETAINING RING	56	HEX NUT
24	HOIST BAIL	57	STRAINER ASSY
25	BAIL BUSHING	58	WEAR PLATE
26	HEX HD CAPSCREW	59	HEX HD CAPSCREW
27	LOCKWASHER	60	LOCKWASHER
28	FLAT WASHER	61	FLAT WASHER
29	NAME PLATE	62	IMPELLER NUT
30	DRIVE SCREW	63	IMPELLER KEY
31	STUD	64	O-RING (S4H's ONLY)
32	LOCKWASHER	65	WEAR PLATE GASKET (S4H's ONLY)
33	HEX NUT		

SECTION DRAWING

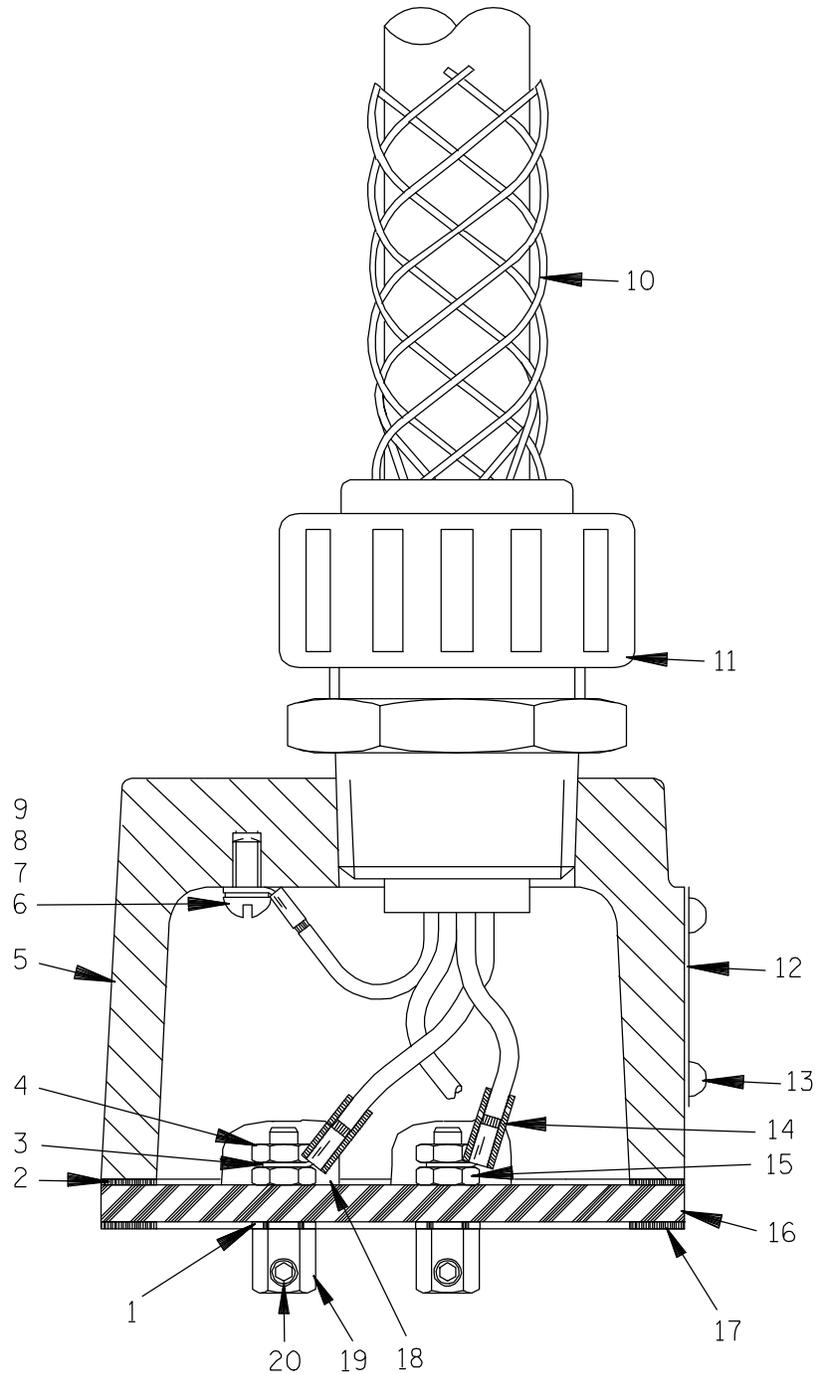


Figure C-2. S4C,S4D And S4H Terminal Housing And Cable Assembly  
Standard and SST-Fitted Models

**Terminal Housing And Cable Assembly**  
**Standard and SST-Fitted Models**  
**Parts Identification List**

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	DYNA SEAL WASHER
2	UPPER TERMINAL PLATE GASKET
3	WIRE TERMINAL
4	HEX NUT
5	TERMINAL HOUSING
6	ROUND HEAD MACHINE SCREW
7	T TYPE LOCKWASHER
8	TERMINAL
9	TERMINAL
10	CABLE ASSEMBLY
11	CABLE GRIP
12	INFORMATION PLATE
13	DRIVE SCREW
14	HEAT SHRINK TUBE
15	HEX NUT
16	TERMINAL PLATE
17	LOWER TERMINAL PLATE GASKET
18	RTV SEALANT
19	TERMINAL
20	ROUND HEAD NYLOCK MACHINE SCREW

SECTION DRAWING

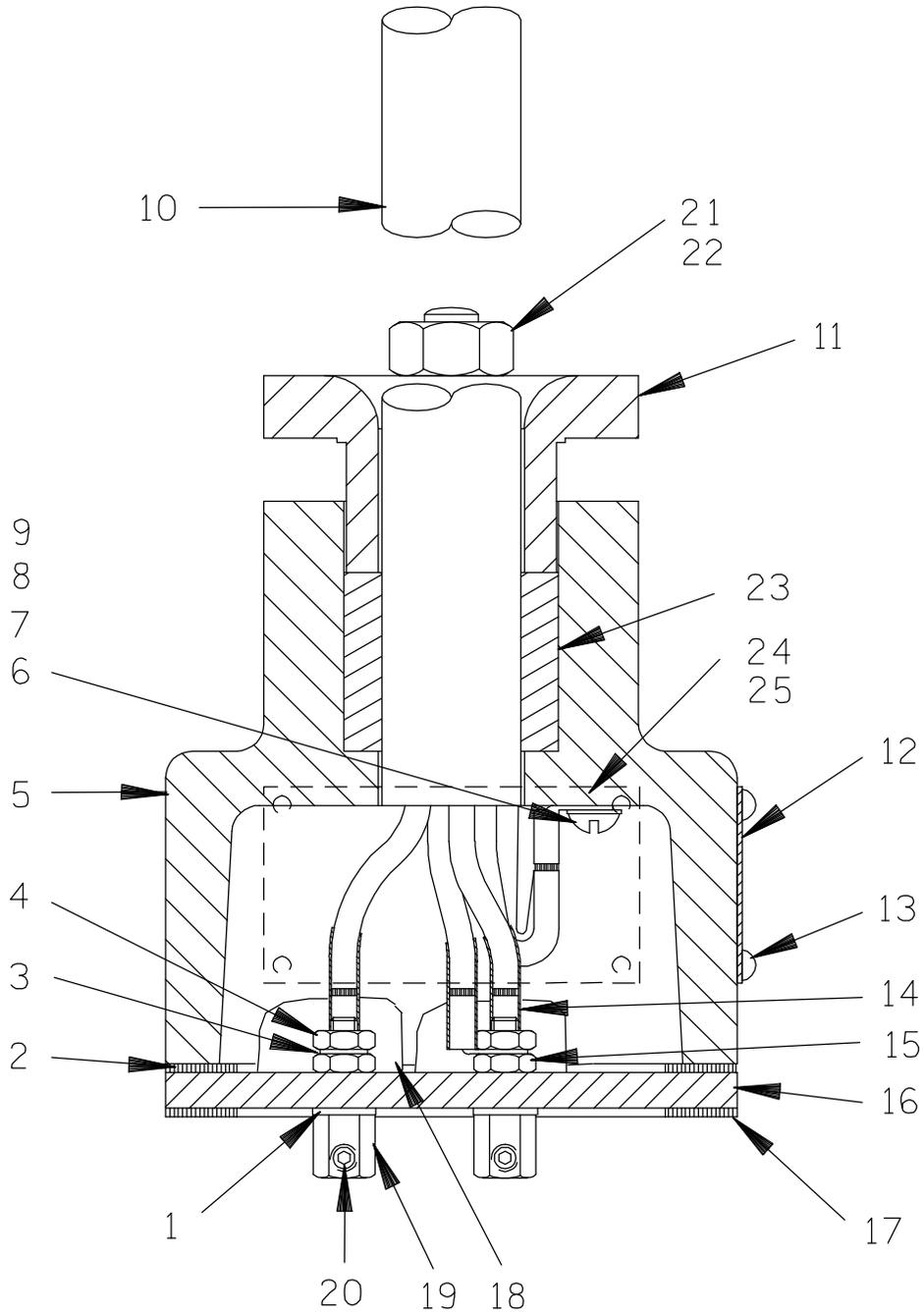


Figure C-3. Terminal Housing And Cable Assembly  
All-SST Models Only

**Terminal Housing And Cable Assembly  
All-SST Models Only  
Parts Identification List**

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	DYNA SEAL WASHER
2	UPPER TERMINAL PLATE GASKET
3	WIRE TERMINAL
4	HEX NUT
5	TERMINAL HOUSING
6	ROUND HEAD MACHINE SCREW
7	T TYPE LOCKWASHER
8	TERMINAL
9	TERMINAL
10	CABLE ASSEMBLY
11	TERMINAL CAP
12	INFORMATION PLATE
13	DRIVE SCREW
14	HEAT SHRINK TUBE
15	HEX NUT
16	TERMINAL PLATE
17	LOWER TERMINAL PLATE GASKET
18	RTV SEALANT
19	TERMINAL
20	ROUND HEAD NYLOCK MACHINE SCREW
21	STUD
22	HEX NUT
23	TERMINAL BUSHING
24	MOTOR PLATE
25	DRIVE SCREWS

## PUMP END DISASSEMBLY

Review all SAFETY information in Section A.

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

The following maintenance and repair instructions are keyed to the Pump Model sectional view (Figure C-1) and the Terminal Housing sectional views (Figure C-2 or C-3), and the accompanying parts lists. Refer to the Parts List manual for the part number and quantity required.

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



**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 the pump, and so that the load will be balanced.**

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

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

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

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

## PUMP END DISASSEMBLY

### Strainer Removal

(Figure C-1)

To remove the strainer assembly (57), raise the pump slightly, or lay it on its side and disengage the hardware (59 and 60) securing the strainer to the diffuser (1). If the impeller (2) is clogged, the debris can usually be removed without further disassembly.

### Draining Oil From Seal Cavity

(Figure C-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 pipe plugs (49 and 50) facing up. Clean any dirt from around the plugs. Remove the seal cavity drain plug (50), 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 C-1)

If motor problems are suspected, remove the motor cavity drain plug (49), 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 C-1)

It is recommended that the pump be positioned upside-down during disassembly. To hold the pump in the inverted position, rest the pump securely on blocks. Be careful not to damage the terminal housing and cable assembly (36) while in this position. Use adequate equipment and personnel to safely handle the pump until it is secured.

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

### Diffuser And Wear Plate Removal

(Figure C-1)

It is not necessary to remove the wear plate (58) unless complete pump disassembly is required. To remove the wear plate, disengage the hardware (55 and 56) securing the wear plate and diffuser (1) to the intermediate (51). Remove the wear plate and diffuser. Remove and discard the O-ring (52).

**S4H Series Only** – Remove and discard the O-rings (64) and the wear plate gasket (65).

### Impeller Removal

(Figure C-1)

Wedge a piece of wood between the vanes of the impeller (2) and the intermediate studs (54). Remove the impeller nut (62) and washer (61).

Remove the wood and use a suitable puller to remove the impeller from the shaft. Use caution when removing the impeller; tension on the seal spring will be released. Retain the impeller key (63).

### NOTE

*An alternate method of removing the impeller is to pry the impeller off the shaft using two screwdrivers against the back side of the impeller.*

Remove the impeller adjusting shim set (22). For ease of reassembly, tie and tag the shims or measure and record their thickness.

### Lower Seal Removal

(Figures C-1 and C-4)

Carefully remove the spring retainer and the seal spring. Lubricate the rotor shaft (47) and work oil under the bellows assembly. Use the hooked ends of two stiff wires to hook the retainer and pull the sleeve and rotating portion of the seal off the shaft. Slide the retainer and bellows assembly off the sleeve (21).

To remove the stationary portion of the seal, remove the flat head machine screws (5) and sepa-

rate the seal plate (7) from the intermediate (51). Remove and discard the seal plate gasket (53). Place a **clean** cloth on a flat surface and place the seal plate on the cloth with the impeller side down. Use a drift pin or screwdriver to press on alternate sides of the stationary seat until the stationary element and seat are removed.

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

### Upper Seal Removal

(Figures C-1 and C-4)

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

Remove the seal retaining ring (23) using snap ring pliers. Use caution when removing the retaining ring; tension on the seal spring will be released. Remove the spring retainer and seal spring.

Lubricate the rotor shaft (47) and work oil under the bellows. Use the hooked ends of two stiff wires to hook the retainer and slide the rotating portion of the seal off the shaft.

Slide the hooked ends of the two wires along the shaft and under the stationary seal seat. Hook the back side of the seat and pull it 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 pump end components at this time.*

## PUMP END REASSEMBLY

### NOTE

*Reuse of old O-rings, gaskets, or shaft seal parts will result in premature leakage or reduced pump performance. It is strongly recommended that new*

*gaskets and shaft seal assemblies be used during reassembly (see the parts lists for numbers).*

## Cleaning And Inspection Of Pump Parts

(Figure C-1)

With the pump inverted, stuff a clean tissue into the stationary seal seat bore of the intermediate (51) 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.**

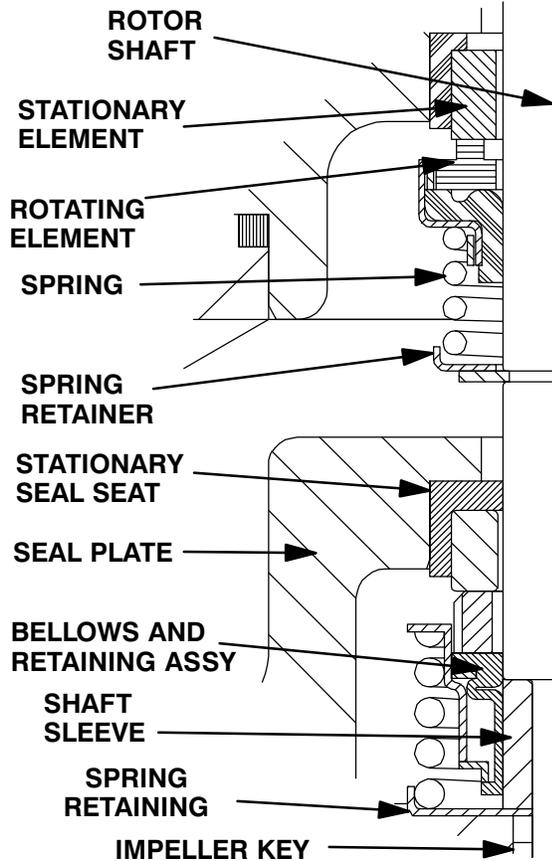
Inspect the rotor shaft (47) for damaged threads, scoring, or nicks. Remove nicks and burrs with a fine file or hand honing stone to restore original contours. If the shaft is bent or severely damaged, the rotor and shaft must be replaced as an assembly (see **MOTOR DISASSEMBLY**).

Neither of the shaft seal assemblies (3 or 4) 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 circular pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring,



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

Install the shaft seals as illustrated in Figure C-4.

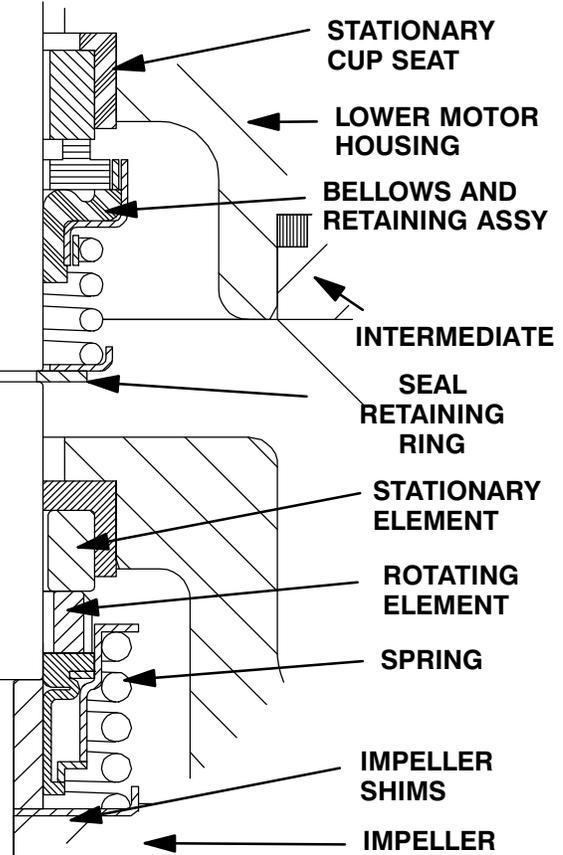
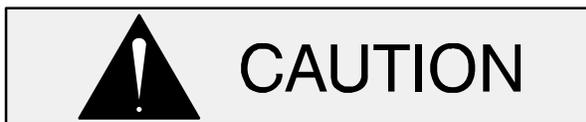


Figure C-4. Upper And Lower Seal Assemblies



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

### Upper Seal Installation

(Figures C-1 and C-4)

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

Clean the rotor shaft (47) and seal cavity area of the intermediate (51). 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. Remove them with a fine file or emery cloth to restore original contours. If the shaft is bent or damaged, the complete rotor and shaft must be replaced as an assembly. Apply a **light** coating of oil to the bore.

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.

### NOTE

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

Subassemble the stationary element in the stationary seat. Position this subassembly in the 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 seat contacts the bore shoulder. Remove the tissue and inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use clean tissue to wipe **lightly** in a 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.

Apply a **light** coating of oil to the seal seating surface on the shaft, the groove for the retaining ring (23), and I.D. of the bellows. Inspect the seal face to ensure that it is clean and dry. If cleaning is necessary, use a clean tissue to wipe in a circular pattern. Slide the seal rotating portion onto the lubricated shaft as shown in Figure C-4. Apply firm, steady pressure on the seal retainer until it slides down the shaft.

Slide the seal spring over the shaft and bellows retainer, and install the spring retainer. Install the seal retaining ring (23). See Figure C-4 for the proper order of seal assembly.

### Lower Seal Installation

(Figures C-1 and C-4)

Thoroughly clean the gasket surfaces and seal bore of the seal plate (7). The seal bore must be free of burrs and nicks which could damage the seal. Inspect the seal plate for cracks, distortion, or erosion and replace it if defective.

Install the seal plate gasket (53) on the seal plate. Position the seal plate on a clean flat surface with the impeller side up.

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

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

### NOTE

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

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Carefully position the seal plate and stationary seal components on the rotor shaft and against the intermediate. **Be careful** not to damage the stationary element already installed. Secure the seal plate to the intermediate using the flat head machine screws (5).

Install the shaft sleeve (21) with the chamfered end toward the shaft shoulder. Lubricate the O.D. with a light coating of oil.

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

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

Slide the seal spring over the shaft and bellows retainer and install the spring retainer. See Figure C-4 for proper order of seal assembly.

### Impeller Installation

#### (Figure C-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.

Be sure the impeller bore and the shaft are free of oily film and completely dry. **Do not** apply lubricants of any kind to the impeller bore or the impeller section of the shaft. Install the same thickness of impeller adjusting shims (22) as previously removed on the rotor shaft. Install the impeller key (63) in the shaft keyway, align the impeller keyway, and press the impeller onto the shaft until it seats firmly against the adjusting shims.

**After** the impeller is installed, coat the threads of the rotor shaft with 'Loctite Threadlocker No. 242' or equivalent compound. Install the impeller washer (61) and nut (62). Place a block of wood between the vanes of the impeller to prevent shaft rotation, and torque the impeller nut to 120 ft. lbs. (1440 in. lbs. or 16,6 m. kg.).

Remove the block of wood and turn the impeller to check for free rotation. Check the front clearance after installing the wear plate (58).

### NOTE

*The impeller (2) and wear plate (58) **must** be fully seated to obtain an accurate face clearance measurement. Do not coat the threads of the rotor shaft with 'Loctite threadlocker No. 242' until the impeller face clearance has been checked.*

### Diffuser And Wear Plate Reassembly

#### (Figure C-1)

Inspect and thoroughly clean the diffuser (1) and its O-ring surfaces. Lightly oil the O-ring (52) and install it in the groove in the intermediate (51).

Inspect the wear plate (58). If one side is eroded, flip it over and install the smooth side next to the impeller. Replace the wear plate if both sides are badly scored or worn.

**S4H Series Only** – Before installing the diffuser (1) install the O-rings (64) over the studs (54). Before installing the wear plate (58) install the wear plate gasket (65) over the studs.

Carefully position the diffuser and wear plate over the studs (54) of the intermediate (51). Secure them with the hardware (55 and 56). After installing the diffuser and wear plate, check the impeller for free rotation.

### Impeller Clearance

#### (Figure C-1)

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

If the impeller clearance is not within specified limits, remove the wear plate, diffuser and the impeller, then add or remove impeller adjusting shims (22) as required. Reinstall the impeller, diffuser and wear plate, and recheck clearance.

### Strainer Installation

#### (Figure C-1)

Inspect the strainer assembly (57) for cracks, distortion or erosion, and replace it if defective.

Carefully position the strainer on the diffuser (1). Apply 'Never-Seez' or equivalent compound to the threads of the capscrews (59). Secure with the hardware (59 and 60). Make certain that the strainer seats properly against the shoulder of the diffuser.

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

### MOTOR DISASSEMBLY

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

**NOTE**

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



**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 C-1)**

Total disassembly of the terminal housing and power cable (36) is not always required. Disassemble and replace **only** the parts proven defective by inspection or testing. See **Electrical Testing** in **TROUBLESHOOTING**.

The terminal housing and power cable assembly (36) may be serviced without disassembling the motor housing or pump end or without draining the oil from the motor cavity. However, the oil **must** be drained before attempting to disassemble the motor housing and components.

Secure the pump in an upright position. Remove the hardware (32 and 33) securing the terminal housing assembly to the upper motor housing (16).

#### **(Figure C-2 or C-3)**

Carefully raise the terminal housing (5) from the motor housing until the terminals (19) are accessible. Loosen the nylock machine screws (20), and disconnect the motor leads from the terminal posts. Separate the terminal housing and power cable assembly (10) from the motor housing. Remove the lower terminal plate gasket (17).

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

#### **(Figure C-2)**

To disconnect the power cable, unscrew the cable grip (11) and pull the cable assembly (10) and grip from the terminal.

To move the cable grip (11) on the cable, compress the wire mesh of the cable grip and slide it up the power cable.

#### **(Figure C-3)**

To disconnect the power cable (10), remove the nuts (22) securing the terminal cap (11) to the terminal housing (5). Slide the cap back along the power cable. Oil the bushing (23) and terminal housing bore and pull firmly on the cable. (Allow the oil to leak in around the bushing by agitating the cable in the bore.) After the bushing has been loosened, the cable should pull out far enough to expose the bushing. Apply oil on the cable jacket and slide the bushing back along the cable. Quite often, pressure exerted on the bushing will deform the cable jacket. If such happens, additional oil and effort will be required to remove the bushing.

**NOTE**

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

#### **(Figure C-2 or C-3)**

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

**NOTE**

**Do not** remove the heat shrink tubing from the pow-

er cable leads unless the power cable or terminals require replacement. If replacement is required, the connections between the power cable leads and the terminals **must be** sealed with heat shrink tubing before applying the silicone adhesive (see **Terminal Housing And Power Cable Reassembly**).

To disconnect the power cable (10) from the terminal housing, pull the terminal plate (16) away from the terminal housing. When shipped from the factory, the connections between the power cable leads and the terminal posts (19) were encapsulated in heat-shrink tubing (14) and bonded to the terminal plate with silicone adhesive (18). (In service, the adhesive may have been replaced by potting compound during previous repair.) If damage is extensive and the terminal plate and terminals are to be replaced, simply cut the power cable leads above the terminal collars and heat-shrink tubing, and discard the terminal plate and terminals.

If damage is not extensive and it is necessary to replace the terminal plate (16) or terminal components, carefully cut away the tubing and adhesive. Disconnect the power cable leads from the terminal posts, and separate the terminal plate from the terminal housing (5). Unscrew the nuts (15), and remove the terminal posts (19), and dyna seal washers (1) from the terminal plate.

Remove the hardware (6 and 7) securing the green and yellow ground leads to the terminals (8 and 9). Reinstall the hardware.

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

### **Pump Casing And Motor Housing Disassembly** (Figure C-1)

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

With the pump end disassembled and the motor cavity drained, secure the pump in an inverted position. Remove the socket head capscrews (6) securing the intermediate (51) to the motor housing (10). Remove the intermediate from the pump casing (13). Remove the O-rings (8, 9 and 48). Slide

the pump casing (13) off the upper motor housing (16). Remove the O-ring (15).

Remove the deform locknuts (46), and separate the lower motor housing (10) from the upper motor housing. If necessary, pry the housings apart using two screwdrivers. Remove the motor housing O-ring (14).

### **Rotor Removal**

#### **(Figure C-1)**

Carefully pull the rotor (47) and the assembled bearings (11 and 41) from the stator. (Use caution to prevent the rotor from falling on the stator windings.) If necessary, tap the impeller end of the rotor shaft with a block of wood or soft-faced mallet to loosen the seal between the upper ball bearing (41) and the motor housing bore. Pull the rotor and assembled bearings from the motor housing.

With the rotor removed, reach into the upper housing and remove the spring washer (40) from the bearing bore.

### **Bearing Removal**

#### **(Figure C-1)**



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

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

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



**Most cleaning solvents are toxic and flammable. Use them only in a well ven-**

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

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

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the motor housing and bearing bore. Replace the shaft and rotor (as an assembly) 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 (12) unless replacement is required. Use snap ring pliers to remove the ring.

### Stator Removal

#### (Figure C-1)

Do not remove the stator (42) unless it is defective (open windings, insulation resistance low, or stator core damaged). If the stator must be removed, remove the terminal housing as indicated in **Terminal Housing And Power Cable Disassembly**.

Remove the pipe plugs (44) located in the upper motor housing, and loosen the allen head set-screws (43) located underneath the pipe plugs.

Position an expandable tool, such as a split disc, approximately 2 inches (51 mm) inside the stator, and expand it tightly and squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and raise the assembly approximately 1 inch (25 mm) off the work surface.

The motor housing (16) 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. 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.



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

After the stator has been removed, wrap it in clean, dry rags or other suitable material until reassembly. The stator **must** be kept clean and dry. When handling the stator, **do not** set it on the end windings; lay it on its side.



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.

### Relief Valve

#### (Figure C-1)

It is recommended that the relief valve assembly (35) 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.

It is not necessary to remove the reducer pipe bushing (34) to remove the pressure relief valve. If the bushing is removed, apply ‘Loctite No. 680 or No. 620’ or equivalent compound on the male threads of the bushing **only**.

When installing the relief valve, use ‘Loctite Pipe Sealant With Teflon No. 592’ or equivalent compound on the threads. Position the valve out of the way, next to the terminal housing (5, Figure C-2 and C-3) so that there is enough room for the terminal housing to clear.

**Hoisting Bail****(Figure C-1)**

If the hoisting bail (24) requires replacement, remove the hardware (26, 27 and 28) securing the bail to the motor housing. Make sure the bushings (25) are in place when installing the hoisting bail.

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

**Stator Installation****(Figure C-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 of the motor housing (16), 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 (16) 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 (42) 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 (51 mm) down inside the stator (opposite the lead wire end), and expand it tightly and squarely on the I.D. Attach a lifting device to the lifting eye of the tool, and carefully lift the assembly. Take care not to damage the stator end turns. Slip a sleeve over the stator leads, or tape them together to protect them during installation.

**NOTE**

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

Heat the motor housing (16) with a torch to expand it enough for the stator (42) 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 motor housing shoulder, remove the expandable disc tool. Install the allen head setscrews (43) securing the stator in place; torque the setscrews to 7.5 ft. lbs. ( 90 in. lbs. or 1,04 m. kg.). Coat the threads of the pipe plugs (44) with ‘Loctite Pipe Sealant with Teflon No. 592’ or equivalent, and install the plugs over the allen head setscrews. Untape or remove the protective sleeve from the stator leads.

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

### Bearing Installation

#### (Figure C-1)

Inspect the rotor shaft (47) 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.

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

### NOTE

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

Heat the upper bearing (41) to a uniform temperature **no higher than** 250°F (120°C). Slide the bearing 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.**

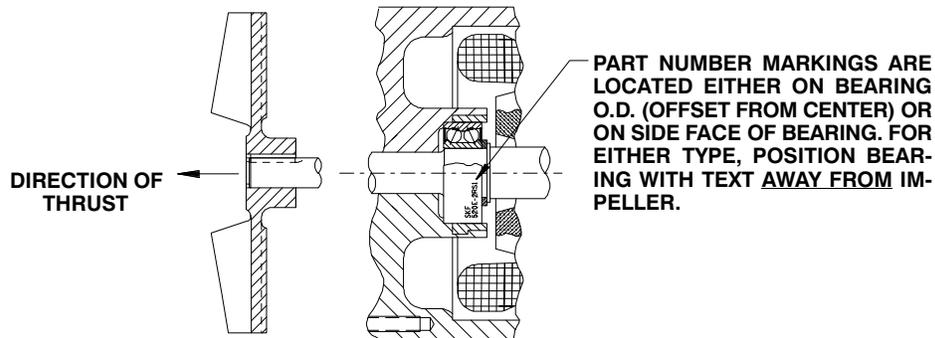
If removed, install the lower bearing snap ring (12) on the rotor shaft.

### NOTE

*Position the bearing (11) on the shaft as indicated by the following illustrations.*

Heat the lower bearing to a uniform temperature **no higher than** 250°F (120°C). Slide the bearing onto the shaft until the bearing is fully seated against the bearing snap ring (12). Do this quickly, in one continuous motion, to prevent the bearing from cooling and sticking on the shaft.

## 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 C-5. Bearing Installation**

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

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



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.

### Rotor Installation

(Figure C-1)

Use **fresh** solvent to clean all gasket and O-ring surfaces of the motor housing (16), 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.

Use **fresh** solvent to clean the bearing bore of the upper motor housing (16) and install the spring washer (40) in the bore.



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

Carefully ease the rotor and assembled bearings into the motor housing (16) and through the stator so that the upper bearing (41) seats squarely in the motor housing bearing bore.

### Motor Housing And Pump Casing Reassembly (Figure C-1)

Use **fresh** solvent to clean both bores and all gasket and O-ring surfaces of the lower motor housing (10), completely removing any old gasket and cement material. Inspect the sealing surfaces for burrs, nicks and pits which could cause a poor seal, and repair or replace as required.



**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.**

Replace the motor housing O-ring (14). Position the lower motor housing (10) down over the stator, rotor shaft and assembled bearings so that it seats squarely against the upper motor housing (16). Be careful not to cut the motor housing O-ring.

Apply 'Never-Seez' or equivalent compound on the threads of the upper motor housing studs (45). Secure the upper and lower motor housings with the deform locknuts (46); torque the nuts evenly in a cross sequence to 20 ft. lbs. (240 in. lbs. or 2,8 m. kg.).

Clean the sealing surfaces at each end of the pump casing (13). Replace the O-ring (15), and slide the pump casing into position around the motor housings.

Install the intermediate O-rings (8, 9 and 48). Position the intermediate (51) against the pump casing and lower motor housing. Be careful not to damage the gaskets or O-ring.

Coat the threads of the socket head capscrews (6) with 'Never-Seez' or equivalent compound and torque evenly in a cross sequence to 22 ft. lbs. (264 in. lbs. or 3,0 m. kg.).

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

### Terminal Housing And Power Cable Reassembly And Installation

(Figure C-2 or Figure C-3)



**The electrical power used to operate this pump is high enough to cause injury or death. Make certain that the control handle on the control box is in the OFF position and locked out, or that the power supply to the control box has been otherwise cut off and locked out, before attempting to open or service the pump assembly. Tag electrical circuits to prevent accidental startup. Obtain the services of a qualified electrician, and refer to the wiring diagram(s) in INSTALLA-**

### **TION, Section B, to make electrical connections.**

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



**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.**

(Figure C-2)

Use oil to lightly lubricate the outside of the pump power cable (10) and the bore of the cable grip (11) for ease of assembly. Compress the wire mesh and slide the cable grip, terminal housing, and terminal plate gasket (2) onto the cable, allowing approximately 3 ft. (1 m) of cable to extend beyond the cable grip. Temporarily tape the green and yellow (if supplied) ground wires to the cable.

(Figure C-3)

Use oil to lightly lubricate the outside of the pump power cable (10), and the bores of the terminal housing (5), terminal cap (11) and gland bushing (23) for ease of assembly. Slide the terminal cap, gland bushing, terminal housing, and terminal plate gasket (2) onto the cable, allowing approximately 3 ft. (1 m) of cable to extend beyond the terminal housing. Temporarily tape the green and yellow (if supplied) ground wires to the cable.

### Sealing Terminal Housing Connections With Silicone Adhesive

(Figure C-2 or Figure C-3)



**Do not attempt to operate this pump un-**

**less 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 (3) were encapsulated in heat-shrink tubing (14), and bonded to the terminal plate (16) with silicone adhesive to provide a water-tight seal. If this insulating material has been damaged or removed during maintenance, **it must** be replaced using materials and equipment approved by Gorman-Rupp (see the parts list for repair kits).

#### NOTE

*Heat-shrink tubing **must** be used to seal the power and control cable leads to the terminals before bonding the leads to the terminal plate. If the silicone adhesive is not available in the field, a commercially available potting kit may be used to bond the connections to the terminal plate. If this alternate sealing method is used, refer to the instructions in **Sealing Terminal Plate Connections With Potting Compound**. Use **only** materials and heating equipment approved by Gorman-Rupp for field repairs.*

Before resealing the power and control cables, remove all the old adhesive material (or potting compound) from the leads, 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. Incomplete sealing will occur if the surfaces are dirt, oil or grease coated.*

Assemble the terminal posts (19), dyna seal washers (1), and lower terminal nuts (15) to the terminal plate as shown in Figure C-2 or C-3.

#### NOTE

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

Slide a length of heat-shrink tubing (14) up over each of the power cable leads. Install the leads on the terminal posts as shown in Figure C-7 and secure them using the hex head nuts (4). Slide the tubing down each lead until the terminals are covered and the tubing contacts the terminal plate. The tubing **must** extend up the leads far enough to ensure a good seal.

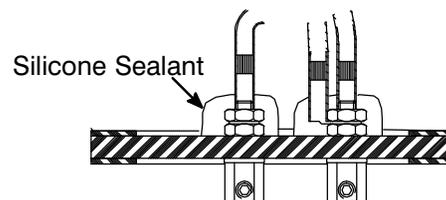
Carefully heat each tube with a commercially available hot air gun capable of producing 750°F (399°C), and shrink the tubes around the cable leads and terminals.



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

#### NOTE

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



**Figure C-6. Silicone Adhesive Sealing**

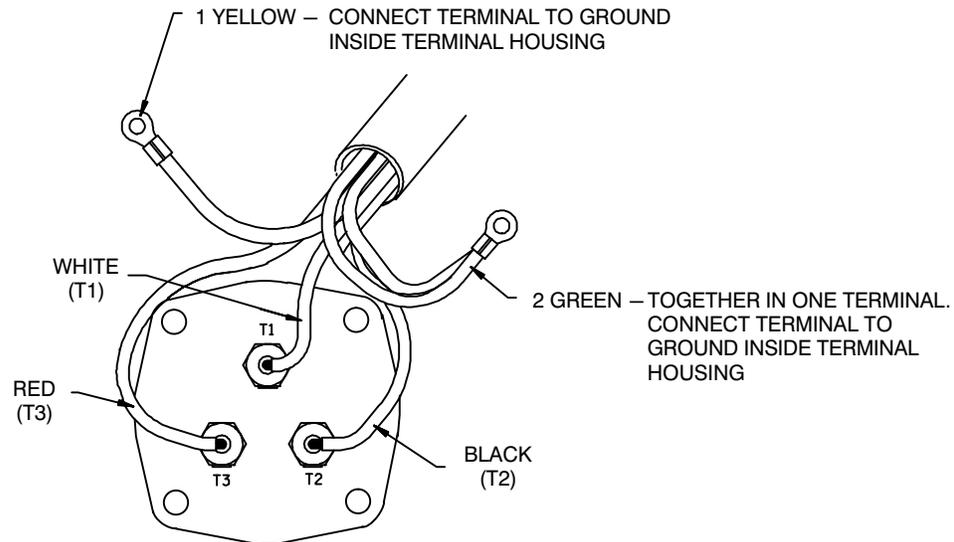
See Figure C-7 and check terminal locations. Apply a 1/4 in. (6,4 mm) thick layer (maximum) of silicone adhesive (18) around each of the terminal posts as shown in Figure C-6. Remove any adhesive from gasketed surfaces.



**All air pockets, voids or gaps in the silicone sealant must be removed to ensure a water-tight seal in the terminal housing. Otherwise, moisture entering the terminal housing could cause a**

**short circuit, resulting in pump damage and possible serious injury or death to personnel.**

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



**Figure C-7. Terminal Housing Wiring Connections**

### Sealing Terminal Plate Connections With Potting Compound

(Figure C-2 or Figure C-3)

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

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

#### NOTE

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

Trim the potting mold so it is just long enough to cover the terminal post studs. Slide the potting

mold up over the leads of the power cable and control cable.

Secure each cable lead as described in the previous section. Slide the potting mold down over the terminal posts and onto the terminal plate. Hang the cable in a vertical position with the terminal plate horizontal. The cable leads and terminals should be centered in the potting mold. Use quick-setting cement, such as '3-M Weather Seal' to secure the potting mold to the terminal plate.



**Most potting base compounds contain toluene; use adequate ventilation and avoid prolonged breathing of vapors. Most potting accelerators contain lead; avoid ingestion or prolonged contact with the skin. Read and follow all warnings and recommendations accompanying the potting kit.**

See the instructions with the potting kit regarding application life and setting and curing time. Mix the base compound and accelerator and fill the mold until the electrical connections are completely insulated. Tamp the potting material to eliminate air

bubbles and ensure the material has completely covered the area around the terminal posts.

### NOTE

*The potting compound must completely cover the terminal posts and lead connections.*

When potting has been completed, leave the terminal plate assembly undisturbed until the potting material has cured. Complete curing usually takes about 24 hours. Curing time can be shortened by using a heat lamp, but be careful not to melt the potting or potting mold, or burn the cable. When the potting material is no longer “tacky” to the touch, it has cured.

### Terminal Housing Installation

#### (Figure C-2 or C-3)

After the terminal housing has been sealed, slide the housing down the cable. Untape the ground leads and secure them to the ground terminals with the hardware (6 and 7). Secure the green ground leads to the ground terminal (8) and the yellow ground check lead to the ground check terminal (9)). **Be sure** the leads make good contact with the housing.

Pull gently on the power cable to remove any excess length from within the terminal housing. Apply ‘Loctite Pipe Sealant With Teflon 592’ to the threads of the cable grip (11, Figure C-2). The terminal plate should fit loosely against the terminal housing.

#### (Figure C-2)

Compress the wire mesh and slide the cable grip down the cable. Screw the cable grip into the terminal housing until fully seated.

#### (Figure C-3)

Lubricate the upper bore of the terminal housing, and slide the gland bushing (23) into place. Slide the terminal cap (11) into place and install the nuts (22). **Do not** overtighten and damage the terminal gland cap or hardware.

### NOTE

*A .12 in. (3,05 mm) gap is required between the ter-*

*минаl gland cap flange and the terminal housing when tighten the nuts.*

#### (Figure C-2 or C-3)

Position the lower terminal plate gasket (17) on the terminal plate (16).

### NOTE

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

#### (Figure C-1)



**For 230 or 460 volt service, motor leads must be secured with the wire nut connector(s) and heat shrink tubing. Failure to properly secure and insulate these leads could cause an electrical shortage, resulting in injury or death to personnel.**

**230V 3P** – Strip motor leads T4, T5 and T6 about 3/4-inch (19 mm). Joins leads T4, T5 and T6, and secure using the wire nut connector (37). Slide a piece of heat shrink tubing (38) over the connector and shrink the tubing using a commercially available hot air gun capable of producing 750°F (399°C).

See Figure 2 or 3 and connect leads 7, 8 and 9 to the terminals (19) using the nylock set screws (20).

**460V 3P** – Strip motor leads T4, T5, T6, T7, T8 and T9 about 3/4-inch (19 mm). Join lead T4 to T7, T5 to T8 and T6 to T9, and secure using the wire nut connectors (37). Slide a piece of heat shrink tubing (38) over each connector and shrink the tubing using a commercially available hot air gun capable of producing 750°F (399°C).

See Figure 2 or 3 and connect leads 7, 8 and 9 to the terminals (19) using the nylock machine screws (20).

**575V 3P** – Strip motor leads T1, T2 and T3 about 3/4-inch (19 mm). See Figure 2 or 3 and connect

the motor leads to the terminals (19) using the nylock machine screws (20).

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

Coat the threads of the motor housing studs (31) with 'Never-Seez' or equivalent, and secure the terminal housing assembly to the motor housing with the hardware (32 and 33); torque the nuts evenly in a cross sequence to 11 ft. lbs. (132 in. lbs. or 1,5 m. kg.).

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

## FINAL ASSEMBLY

### (Figure C-1)

If the discharge flange (18) was removed from the motor housing, replace the discharge flange gasket (17). Apply 'Never-Seez' or equivalent compound on the flange studs (19), and secure the flange with the nuts (20).

If the hoisting bail (24) was removed, install the bail bushing (25) and secure the bail to the motor housing with the hardware (26, 27 and 28).

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

## VACUUM TESTING

To ensure the water-tight integrity of the pump, it is recommended that the motor and seal cavities be

vacuum tested any time the seal(s) and/or motor are serviced.

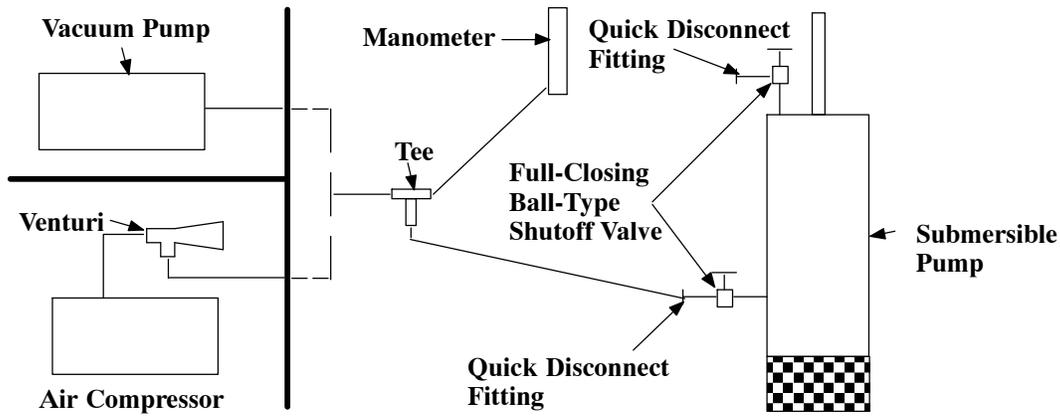
Drain **all** of the oil from **both** the seal and motor cavities before performing the test. Oil within the cavities will be drawn into the system, resulting in damage to the vacuum pump or manometer.

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

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

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

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



**Figure C-8. Vacuum Test System**

Table C-1 shows the vacuum to be drawn on each cavity, and the duration to maintain each vacuum reading. **Any** change in vacuum reading during

the test indicates a leak which **must** be identified and corrected before putting the pump back into service.

**Table C-1. Vacuum Test Data**

Pump Model	Motor Cavity Vacuum (In. Hg.)	Duration (Minutes)	Seal Cavity Vacuum (In. Hg.)	Duration (Minutes)
S4C/S4D/S4H	30	3	20	1

**LUBRICATION**

**Seal Cavity**

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



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

To check the seal cavity oil, lay the pump on its side and remove the seal cavity plug (50) in the intermediate. Tip the pump and drain off a small amount of oil into a transparent cup. If the oil level is abnor-

mally low, or the color milky or dark, refer to **Draining Oil From Seal Cavity** in this section for instructions and troubleshooting tips. If the oil is clear, apply 'Loctite Pipe Sealant With Teflon No. 592.' or equivalent to the threads of the pipe plug, before reinstalling the plug.

To fill the seal cavity, remove the pipe plug (50) and add the recommended grade of submersible pump oil. Apply 'Loctite Pipe Sealant With Teflon No. 592.' or equivalent to the threads of the pipe plug, before reinstalling the plug.

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

Pump Model	Seal Cavity	Motor Cavity
S4C/S4D/S4H (All Voltages)	20 ounces (0,6 liter)	96 ounces (2,8 liters)

Table C-3. 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**

With the pump in an upright position, remove the pressure relief valve (35) on the top of the pump. See Table C-2 and add the recommended grade of lubricant to the motor cavity. **Maintain the oil at this level.** Apply 'Loctite Pipe Sealant With Teflon No. 592' or equivalent sealant to the threads of the pipe busing (34). Reinstall and tighten the bushing.



Never attempt to fill the motor cavity through the drain plug (49) opening. A volume of air must be trapped above the motor to permit thermal expansion of the motor oil.

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