



S SERIES PUMPS

S12A

All Materials And Voltages

MANUAL
PART 3 of 3

MAINTENANCE
AND
REPAIR
WITH
TROUBLESHOOTING

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

www.grpumps.com

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

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Register your new
Gorman-Rupp pump online at
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

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.

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.



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 incoming power matches the voltage and

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



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



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



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

Table 1. Trouble Shooting Chart (cont.)

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
(AUTOMATIC MODE) (CONT'D.)	Float type sensing device(s) tangled or obstructed.	Check installation for free movement of float.
	Defective liquid level sensing device(s) or control panel.	Repair or replace defective unit(s).
OVERLOAD UNIT TRIPS	Low or high voltage, or excessive voltage drop between pump and control box.	Measure voltage at control box. Check that wiring is correct type, size, and length. (See Field Wiring Connections , Section B).
	Defective insulation in motor windings or power cable; defective windings.	Check insulation resistance; check continuity.
	Impeller jammed due to debris or insufficient clearance.	Disassemble pump and check impeller.
	Bearing(s) frozen.	Disassemble pump and check bearing(s).
MOTOR RUNS, BUT PUMP FAILS TO DELIVER RATED DISCHARGE	Discharge head too high.	Reduce discharge head, or install staging adaptor and additional pump.
	Low or incorrect voltage.	Measure control box voltage, both when pump is running and when shut-off.
	Discharge throttling valve partially closed; check valve is installed improperly.	Open discharge valve fully; check piping installation.
	Discharge line clogged or restricted; hose kinked.	Check discharge lines; straighten hose.
	Liquid being pumped too thick.	Dilute liquid by heating if possible.
	Strainer screen or impeller clogged.	Clear clog(s). Stop pump; back flow may flush away debris.
	Insufficient liquid in sump or tank.	Stop pump until liquid level rises.
	Worn impeller vanes; excessive impeller clearance.	Check impeller and clearance. See PUMP END REASSEMBLY .
Pump running backwards.	Check direction of rotation and correct by interchanging any two motor leads at control box. (See Pump Rotation , Section C).	

Table 1. Trouble Shooting Chart (cont.)

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

ELECTRICAL TESTING

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

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



WARNING!

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



CAUTION

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

Test Equipment

A volt/amp/ohmmeter and 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.

Voltage Imbalance

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

- a. Use a voltmeter, amprobe, or equivalent meter to read the voltage across terminals 1 & 2, 2 & 3, and 1 & 3 in the control box. All three measured voltages must be the same, as accurately as the meter will read. If possible, measure the voltage with the pump off, with the pump running but out of the water, and with the pump running in the water at full load. All the measured voltages at each condition must be the same.
- b. Use an amprobe or equivalent meter to measure the current draw of each phase while the pump is running at full load and at no load. All three amperage readings must

be the same at each condition, as accurately as the meter will read. Nominal amperage values are listed in Table 1, but these apply only when the actual voltage at the site is the nominal voltage listed.

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

Motor And Motor Power Cable Continuity

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

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

NOTE

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

*place the tubing or potting and allow adequate drying time before putting the pump back into service. (See **Power Cable Reassembly**, Section E).*

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

NOTE

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

Insulation Resistance

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

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

PUMP MAINTENANCE AND REPAIR – SECTION C

GENERAL INFORMATION

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

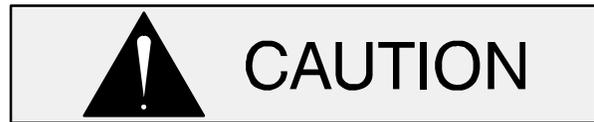


Do not attempt to service the pump assembly unless all power to the motor has been shut off at the control box; otherwise, injury or death could result.

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 and C-2, 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 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 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. Contact the factory or refer to the pump Specification Data Sheet for the weight of your pump. Discharge hose or piping **must** be removed before attempting to lift the pump.

SECTION DRAWING

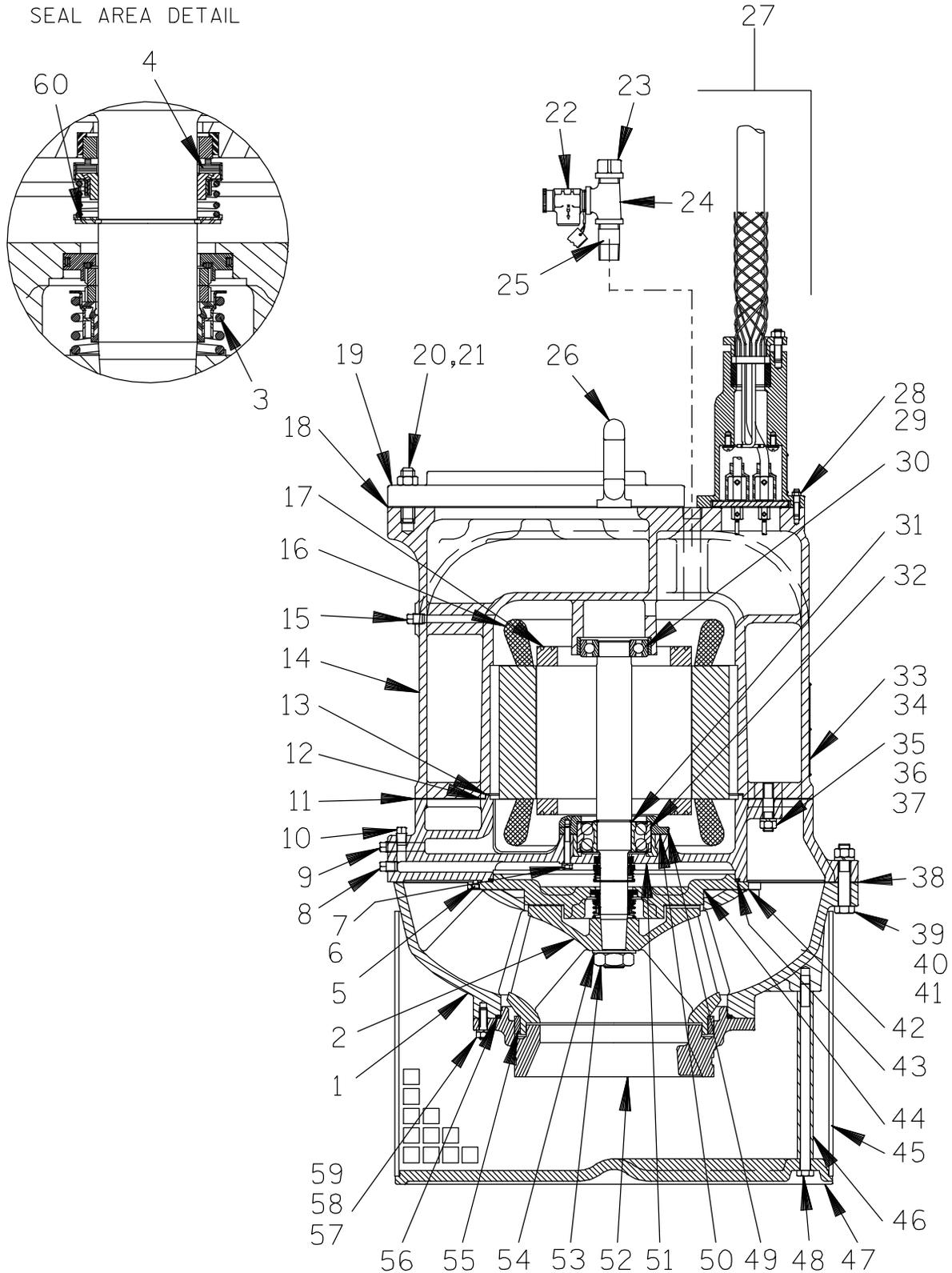


Figure C-1. Typical S12A Series Pump Assembly

Typical S12A 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	31	RETAINING RING
2	IMPELLER	32	LOWER BALL BEARING
3	LOWER SEAL ASSEMBLY	33	NAME PLATE
4	UPPER SEAL ASSEMBLY	34	DRIVE SCREW
5	SOCKET HEAD CAPSCREW	35	STUD
6	HEX HEAD CAPSCREW	36	LOCKWASHER
7	LOCKWASHER	37	HEX NUT
8	SEAL CAVITY DRAIN PLUG	38	DIFFUSER GASKET
9	MOTOR CAVITY DRAIN PLUG	39	HEX HEAD CAPSCREW
10	SEAL CAVITY FILL PLUG	40	HEX NUT
11	MOTOR HOUSING GASKET	41	LOCKWASHER
12	MOTOR HOUSING GASKET	42	SEAL PLATE GASKET
13	MOTOR HOUSING GASKET	43	SEAL PLATE O-RING
14	MOTOR HOUSING ASSEMBLY	44	SEAL PLATE
15	MOTOR CAVITY OIL LEVEL PLUG	45	STRAINER SCREEN
16	STATOR ASSEMBLY	46	HOSE
17	ROTOR ASSEMBLY	47	BASE PLATE
18	DISCHARGE FLANGE GASKET	48	HEX HEAD CAPSCREW
19	DISCHARGE FLANGE	49	BEARING CAP
20	STUD	50	BEARING CAP GASKET
21	HEX NUT	51	INTERMEDIATE
22	PRESSURE RELIEF VALVE	52	SUCTION HEAD
23	MOTOR CAVITY OIL FILL CAP	53	JAM LOCKNUT
24	STREET TEE ASSEMBLY	54	IMPELLER WASHER
25	HEAVY PIPE NIPPLE	55	WEAR RING
26	EYE BOLT	56	DIFFUSER O-RING
27	TERMINAL HOUSING AND CABLE ASSEMBLY	57	STUD
28	STUD	58	HEX NUT
29	DEFORM LOCK NUT	59	LOCKWASHER
30	UPPER BALL BEARING	60	RETAINING RING

Terminal Housing And Cable Assembly Parts Identification List

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

ITEM NO.	PART NAME
1	TERMINAL POST
2	TERMINAL COLLAR
3	HEAT SHRINK TUBE
4	T-TYPE LOCKWASHER
5	ROUND HEAD MACHINE SCREW
6	TERMINAL
7	WASHER
8	GLAND BUSHING
9	INFORMATION PLATE
10	DRIVE SCREW
11	CABLE GRIP
12	TERMINAL GLAND
13	POWER CABLE
14	HEX NUT
15	STUD
16	TERMINAL HOUSING
17	TERMINAL
18	ALLEN HEAD SETSCREW
19	TERMINAL PLATE ASSEMBLY
20	DYNA SEAL WASHER
21	ALLEN HEAD SETSCREW

PUMP END DISASSEMBLY

References are to Figure C-1 and Figure C-2.

Review all SAFETY information in Section A.

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

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

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



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 lifting eyes 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 screen and base plate (45 and 47), raise the pump slightly, or lay it on its side and disengage the capscrews (48) and hoses (46) securing the strainer (45) and base plate (47) 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 (8 and 9) facing up. Clean any dirt from around the plugs. Remove the seal cavity drain plug (8), and install a short 3/8-inch NPT nipple in the hole. Tip the pump and drain the seal oil into a **clean** container. Inspect the oil for water, dirt, or cloudy condition which could indicate lower seal failure or poor gasket seal.

Draining Oil From Motor Cavity

(Figure C-1)

If motor problems are suspected, remove the motor cavity drain plug (9), 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. With the pump on its side and the oil drained, remove the lifting eyes (26), pressure relief valve and piping (22, 23, 24 and 25, see **Relief Valve**, in this section), and terminal housing and power cable assembly (27) (see **Terminal Housing and Power Cable Removal and Disassembly** in **MOTOR DISASSEMBLY**). Install a pipe plug in the hole for the pressure relief valve piping.

To prevent contamination of the motor, and to provide a solid surface to support the pump when inverted, make a plate to the dimensions shown in Figure 3, and secure it to the terminal plate studs with the nuts (29).

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

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

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

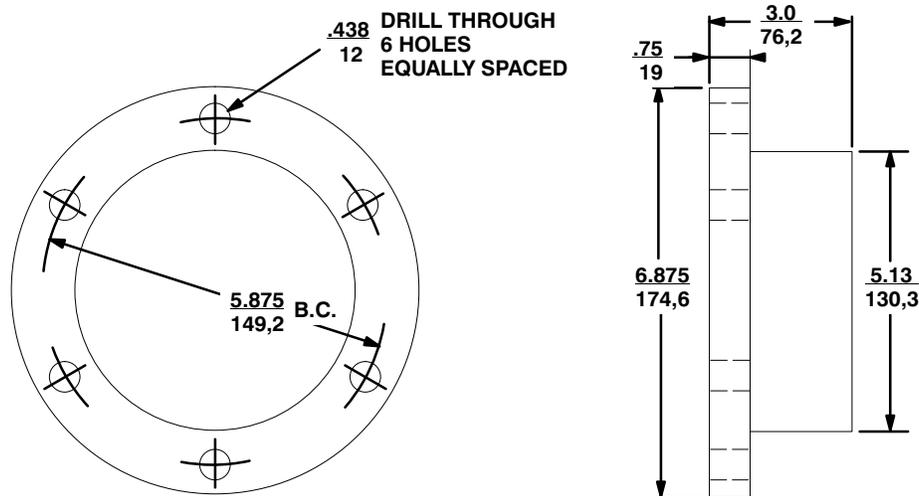


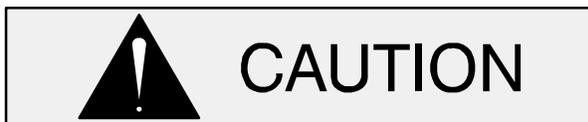
Figure 3. Terminal Cover Plate

Suction Head And Wear Ring Removal

(Figure C-1)

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

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



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

Diffuser Removal

(Figure C-1)

Remove the hardware (39, 40 and 41) securing the diffuser (1) to the intermediate (51). Remove the

diffuser, and remove and discard the diffuser and seal plate gaskets (38 and 42).

Impeller Removal

(Figure C-1)

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

Install the impeller puller (supplied with the pump) and pull the impeller from the rotor shaft. It may be necessary to strike the puller shaft sharply with a hammer to loosen the impeller. Use caution when removing the impeller; tension on the seal spring will be released. Inspect the impeller for wear or damage and replace as required.

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

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

Lower Seal Removal

(Figures C-1 and C-4)

Carefully remove the spring retainer and seal spring. Lubricate the rotor shaft (17) and work oil under the bellows assembly. Use the hooked ends of two stiff wires to hook the retainer and pull the rotating portion of the seal off the shaft.

To remove the stationary portion of the seal, remove the socket head capscrews (5), and separate the seal plate (44) from the intermediate (51). Remove and discard the seal plate O-ring (43). 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 seat is removed.

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

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

Upper Seal Removal

(Figures 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).

NOTE

Do not attempt to loosen the hardware (6,7, 36 and 37) securing the bearing cap (49) and the intermediate (51) at this time (see **Motor Disassembly). The rotor shaft and bearings could be damaged.**

Remove the seal retaining ring (60) 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 (17) and work oil under the bellows. Use the hooked ends of two stiff wires to hook the retainer and 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 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 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. Use a clean cloth lightly dampened with solvent to clean the intermediate, suction head, diffuser, and seal plate. Re-

move 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 (17) 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 precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a circular pattern to avoid scratching the faces.

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

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

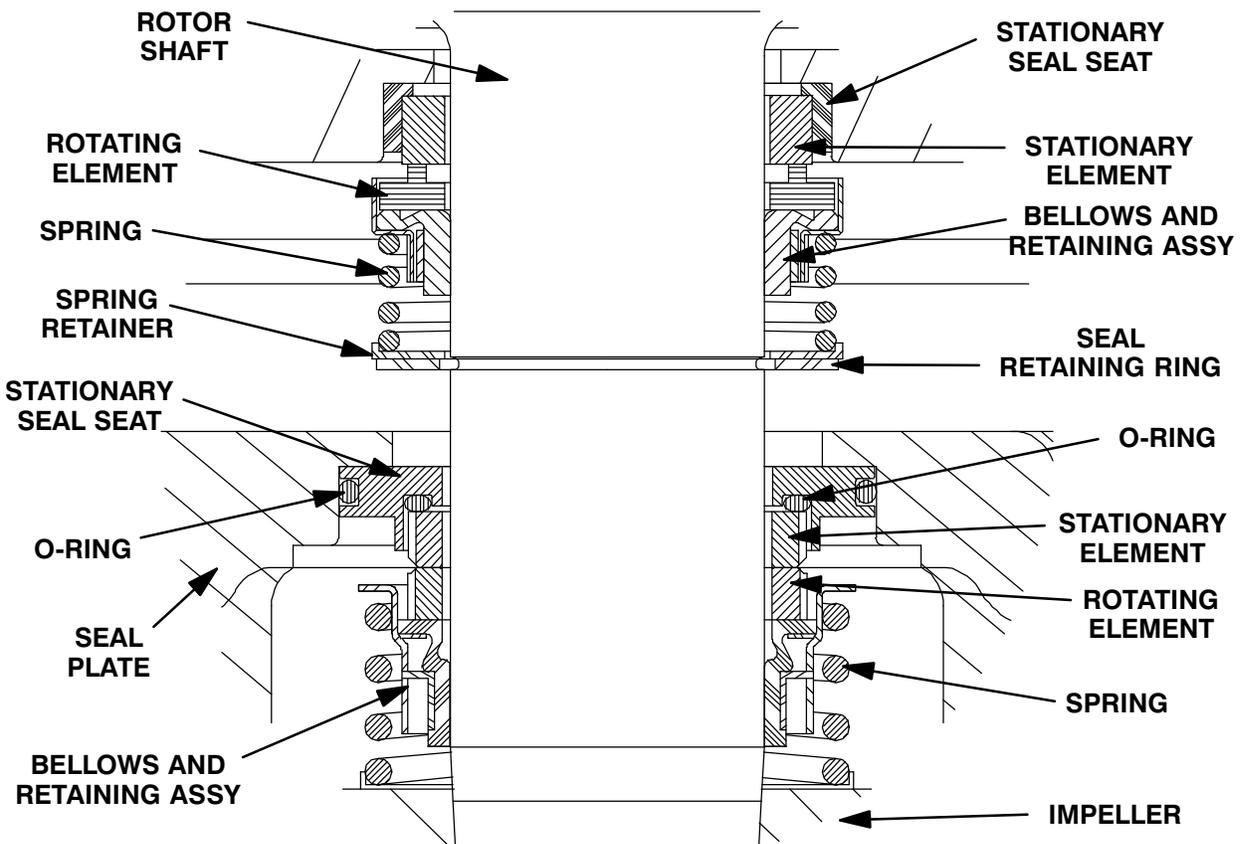


Figure C-4. Upper And Lower Seal Assemblies



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 (17) 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 and a nicked or damaged keyway. 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 of the intermediate.

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

NOTE

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

Subassemble the stationary element in the stationary seat. Position this subassembly in the 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 circular pattern.

Unpack the rotating portion of the seal. Be certain the seal face of the rotating element is free of grit or surface damage. Because the rotating element may not stay in the bellows retainer when turned

upside down, place a **small** amount of grease at equal spaces on the back of the element and position it in the bellows retainer. The grease should hold the element in position until the seal is installed. Assemble the drive grooves of the rotating element into the drive lugs of the bellows retainer.

Apply a **light** coating of oil to the seal seating surface on the shaft, the groove for the retaining ring (60), 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 and the seal faces contact.

Slide the seal spring over the shaft and bellows retainer, and install the spring retainer. Install the seal retaining ring (60). 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 (44). 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.

Coat the seal plate O-ring (43) with light oil and install it 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 and O-ring. Keep the sealing face dry.

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

NOTE

When pressing seal components onto the rotor shaft, use hand pressure only. A push tube cut from

a length of plastic pipe will aid in installing seal components. The I.D. of the push tube should be approximately the same as the I.D. of the seal spring.

Carefully position the seal plate and assembled stationary portion of the seal over the shaft and against the intermediate (51). **Be careful** not to damage the stationary element. Secure the seal plate to the intermediate with the socket head capscrews (5).

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

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

Slide the seal spring over the shaft and bellows retainer. See Figure 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 tapered section of the shaft. Install the impeller (2) and impeller washer (54) on the rotor shaft (17).

After the impeller is installed, coat the threads of the rotor shaft with 'Loctite Threadlocker No. 242'

or equivalent compound. Install the impeller nut (53).

Temporarily install two of the capscrews (39) in the intermediate (51). Wedge a piece of wood between the vanes of the impeller (2) and the capscrews to prevent shaft rotation, and torque the impeller nut to 300 ft. lbs. (3600 in. lbs or 41,5 m. kg.). Remove the wood and the capscrews and turn the impeller to check for free rotation.

NOTE

*If the impeller (2) is not fully seated and binds against the seal plate, the shaft and lower bearing have been driven out of position during impeller removal. If this occurs, the lower bearing must be pressed back into place. (See **Motor Disassembly and Motor Reassembly**.)*

Diffuser Installation

(Figure C-1)

Inspect and thoroughly clean the diffuser (1) and its gasket surfaces. Cement the intermediate gasket (38) in position using '3M Gasket Adhesive No. 847' or equivalent compound. Install the seal plate gasket (42) over the shoulder on the seal plate.



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

Carefully position the diffuser against the intermediate so that the six, one-inch bosses on the diffuser cover the seal plate capscrews (5). Apply 'Never-Seez' or equivalent compound on the threads of the capscrews (39), and secure the diffuser with the hardware (39, 40 and 41). Torque the capscrews evenly in a cross sequence to 120 ft. lbs. (1440 in. lbs or 17 m. kg.).

Suction Head And Wear Ring Installation

(Figure C-1)

Inspect and thoroughly clean the suction head (52) and its gasket surfaces. If removed, press a re-

placement wear ring (55) into the suction head bore with the chamfered end **toward the inside** of the suction head. Be sure the ring seats squarely against the bore shoulder.



The wear ring **must** seat squarely in the suction head bore or binding and/or excessive wear will result.

Install the O-ring (56) over the shoulder on the suction head (52) and carefully position the suction head over the studs (57). Coat the studs with 'Never-Seez' or equivalent compound. Install the hardware (58 and 59); torque the nuts evenly in a cross sequence to 40 ft. lbs. (480 in. lbs or 6 m. kg.).

Turn the impeller and check for free rotation. If the impeller scrapes, disassemble the suction head and check the wear ring for proper installation.

Strainer Installation

(Figure C-1)

Inspect the strainer screen (45) and base plate (47) for cracks, distortion or erosion, and replace it if defective.

Position the strainer screen on the shoulder of the diffuser. Pack the hoses (46) with heavy grease and assemble the hoses to the base plate (47) using the capscrews (48). (The grease will help to prevent the hoses from sliding off the capscrews.)

Remove any grease from the ends of the capscrews and apply 'Loctite Threadlocker No. 242' or equivalent compound to the threads of the capscrews. Secure the complete strainer assembly using the capscrews (48). Make certain that the strainer seats properly against the shoulder of the diffuser. Tighten the capscrews just enough to draw the strainer screen down tightly against the diffuser, but not tight enough to distort it.

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

MOTOR DISASSEMBLY

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

NOTE

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



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 (27) 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 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 deform locknuts (29) securing the terminal housing assembly to the motor housing assembly (14).

(Figure C-2)

Carefully raise the terminal housing (16) from the motor housing until the terminals (1) are accessible. Loosen the allen head setscrews (21), and disconnect the motor leads from the terminal posts. Separate the terminal housing and power cable assembly from the motor housing.

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

To disconnect the power cable (13), remove the nuts (14) securing the terminal gland (12) to the terminal housing (16). Slide the gland back along the power cable. Oil the bushing (8) 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 and washer (7) 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.

Push approximately 6 inches (152 mm) of the power cable into the terminal housing so that the terminal plate (19) 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 power 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** resealed with heat shrink tubing before applying the silicone adhesive (see **Terminal Housing And Power Cable Reassembly**).

To disconnect the power cable from the terminal housing, pull the terminal plate away from the terminal housing. When shipped from the factory, the connections between the power cable leads and the terminal collars (2) were encapsulated in heat-shrink tubing (3) and bonded to the terminal plate with silicone adhesive (not shown). (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 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. Unscrew the terminal posts (1), and remove the terminal collars (2), posts and dyna seal washers (20) from the terminal plate.

Remove the hardware (4 and 5) securing the green and yellow ground leads to the terminal housing. Reinstall the hardware.

Work oil in around the bushing (8). The terminal washer (7), bushing (8), cable grip (11) and gland (12) can now be removed from the cable.

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.

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

**Intermediate 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 of oil, secure the pump in an inverted position. Remove the hardware (36 and 37) securing the intermediate (51) to the motor housing (14). **Do not** remove the hardware (6 and 7) around the rotor shaft (17) at this time.

Hook a three-leg-sling in the intermediate flange holes and hoist the intermediate, rotor and shaft

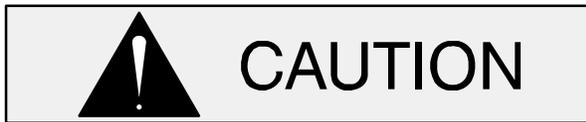
(17), bearing cap (49) and both ball bearings (30 and 32) from the motor housing as an assembly. If necessary, tap around the parting surfaces with a soft faced mallet to loosen the seal between the intermediate and motor housing. Remove the motor housing gaskets (11, 12 and 13).

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

Rotor And Bearing Removal

(Figure C-1)

Set the intermediate and rotor assembly on a clean work area. Leave the lifting slings attached and reduce the tension slightly. Remove the hardware (6 and 7) securing the bearing cap to the intermediate. Steady the rotor and separate the intermediate. If necessary, tap the impeller end of the rotor shaft with a soft faced mallet to loosen the seal between the lower ball bearing (32) and the intermediate bore.



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 ventilated area; free from excessive heat, sparks, and flame. Read and follow all

precautions printed on solvent containers.

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

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

The lower bearing (32) is secured to the shaft by a tight press fit. Install two 3/8-16 UNC x 6-inch long capscrews (not supplied) 180° apart in the tapped holes in the bearing cap (49). Use a bearing puller in conjunction with the capscrews to remove the lower bearing and bearing cap as an assembly.

If necessary, use snap ring pliers to remove the retaining ring (31).

Separate the bearing cap and gasket (50) from the lower ball bearing.

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

Stator Removal

(Figure C-1)

Do not remove the stator (16) unless it is defective (open windings, insulation resistance low, or stator core damaged). If the stator must be removed, remove the terminal housing as indicated in **Terminal Housing And Power Cable Disassembly**.

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 (14) 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 mo-

tor 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 (22) 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 heavy pipe nipple (25) to remove the pressure relief valve. If the nipple is removed, apply ‘Loctite Retaining Compound No. 680 or No. 620’ or equivalent compound on both ends of the nipple **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 (16, Figure C-2) so there is enough room for the terminal housing to clear.

Lifting Eyes

(Figure C-1)

If the lifting eyes (26) require replacement, unscrew the eyes and replace as required.

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 (14), 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 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 (16) 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 (51,0 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 with a torch to expand it enough for the stator 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.

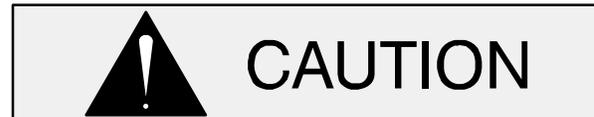
After the stator is fully and squarely seated on the motor housing shoulder, remove the expandable disc tool. Untape or remove the protective sleeve from the stator leads.

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 (17) for damaged threads, scoring in the seal area, and a nicked or damaged tapered end. 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.*

If removed, use snap ring pliers to install the retaining ring (31) in the groove on the shaft.

Heat the upper bearing (30) to a uniform temperature **no higher than** 250°F (120°C). Slide the bear-

ing onto the shaft until it is fully seated against the shaft shoulder. Do this quickly, in one continuous motion, to prevent the bearing from cooling and sticking on the shaft.

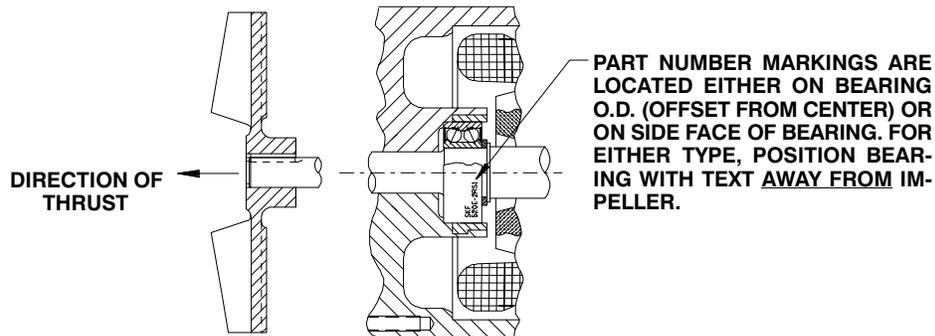


WARNING!

Use caution when handling hot bearings to prevent burns.

Clean the bearing cap (49) and position it over the lower bearing (32) **before** heating.

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 suitably sized sleeve and an arbor (or hydraulic) press to install the bearings on the shaft.



CAUTION

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

Secure the gasket (50) to the cap with a light coating of gasket adhesive.

Position the cap on the bearing so that when installed on the shaft, the bearing will be positioned as indicated in Figure C-5.

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

Rotor And Intermediate Reassembly

(Figure C-1)

Use **fresh** solvent to clean all gasket and O-ring surfaces of the motor housing (14) and intermediate (51), completely removing any old gasket and cement material. Inspect the sealing surfaces for burrs, nicks and pits which could cause a poor seal. Repair or replace as require.



WARNING!

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

Position the rotor (17), bearing cap (49) and assembled bearings (30 and 32) on a work surface with the impeller end up, and use blocks to secure it in this position.

To ease alignment of the bearing cap and intermediate, install two long studs, finger-tight only, 180° apart in the bearing cap mounting holes.

Using a three-leg sling and lifting eyes in the intermediate flange holes, carefully lower the intermediate over the shaft and lower bearing, guiding the studs in the bearing cap through the holes in the intermediate as it is lowered into place.

Apply 'Never-Seez' or equivalent compound to the threads of the capscrews (6). Use two of the capscrews and lockwashers (7) to draw the intermediate and bearing cap together. Remove the studs temporarily installed in the bearing cap and install the remaining two capscrews and lockwashers; torque the capscrews evenly in a cross-sequence to 20 ft. lbs. (240 in. lbs. or 2,8 m. kg.).

Rotor And Intermediate Installation

(Figure C-1)

Use **fresh** solvent to clean the bores and all gasket surfaces of the motor housing (14), 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.

Apply '3M Gasket Adhesive No. 847' or equivalent compound to the motor housing gaskets (11, 12 and 13). Position the gaskets on the motor housing, making sure the gaskets are properly seated and the adhesive holds them securely.

Using a three-leg sling and lifting eyes in the intermediate flange holes, carefully lower the assembled intermediate and rotor assembly (17) into the motor housing (14), guiding the upper bearing (30) into the motor housing bearing bore. Tap the

intermediate with a soft faced mallet until it mates tightly with the motor housing.

Remove the sling and lifting eyes from the intermediate.

Apply 'Never-Seez' or equivalent compound on the threads of the motor housing studs (35). Secure the intermediate to the motor housing with the hardware (36 and 37); torque the nuts evenly in a cross sequence to 120 ft. lbs. (1440 in. lbs. or 17 m. kg.).

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

Terminal Housing And Power Cable Reassembly And Installation

(Figure C-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, and refer to the wiring diagram(s) in INSTALLATION, Section B, to make electrical connections.

Clean the exterior of the power cable with warm water and mild detergent. 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 re-

pair 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 (13), rubber gland bushing (8), terminal washer (7), and the bores of the terminal housing (16), terminal gland (12) and cable grip (11) for ease of assembly. Slide the terminal gland, cable grip, gland bushing, terminal washer and terminal housing onto the cable, allowing approximately 3 ft. (1 m) of cable to extend beyond the terminal housing. Temporarily tape the green and yellow ground wires to the cable.

Sealing Terminal Housing Connections With Silicone Adhesive

(Figure C-2)



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

When shipped from the factory, the cable leads and terminal collars (2) were encapsulated in heat-shrink tubing (3), and bonded to the terminal plate (19) 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 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 equip-*

ment 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, terminal collars, and terminal plate. Inspect all parts for damage, and replace as required. If the rubber bonding material on the terminal plate is severely worn or cracked, the terminal plate must be replaced. If the bonding material has been noticeably compressed, it should be supplemented with two gaskets contained in the overhaul gasket kit (see Options listed in the Parts List manual).

NOTE

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

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

NOTE

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

Slide a length of heat-shrink tubing (3) up over each of the power cable leads. Insert the leads in the terminal collars and secure them using the allen head setscrews (18). 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 terminal collars.



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.

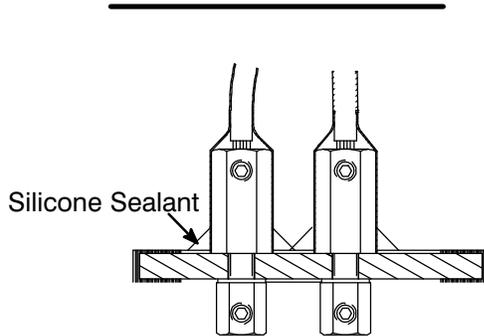


Figure C-6. Silicone Adhesive Sealing

See Figure C-7 and check terminal locations. Apply a 1/4 to 3/8 in. (6,4 to 9,7 mm) thick layer (maximum) of silicone adhesive around each of the ter-

minal 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.

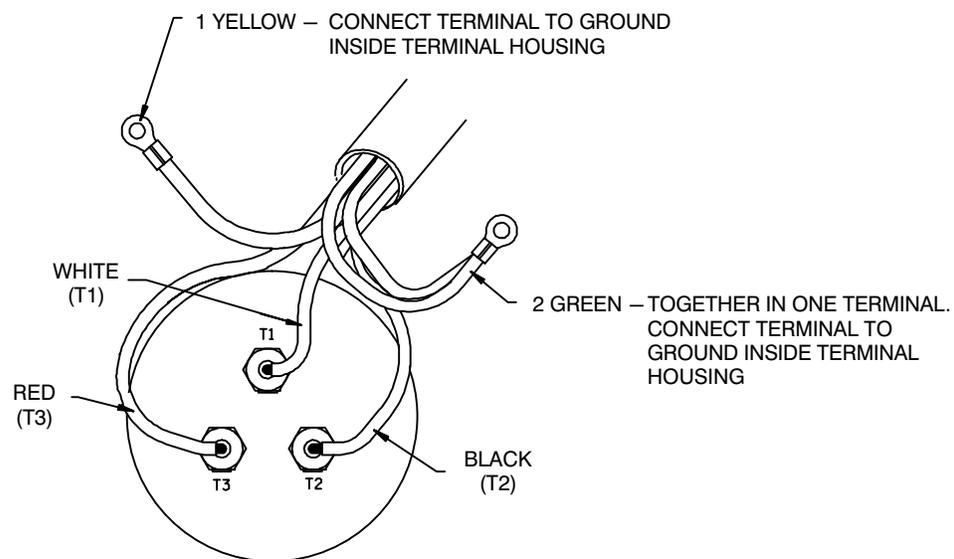


Figure C-7. Terminal Housing Wiring Connections

Sealing Terminal Plate Connections With Potting Compound

(Figure C-2)

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 collars. 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 collars 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 collar 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)

After the terminal plate has been sealed, slide the terminal housing down the cable. Untape the ground leads and secure them to the terminal housing with the hardware (4 and 5). **Be sure** the leads make good contact with the housing.

Pull gently on the cable to remove any excess length from within the terminal housing. The terminal plate (19) should fit loosely against the terminal housing.

Lubricate the upper bore of the terminal housing, and slide the gland washer (7), bushing (8) and cable grip (11) into place. Slide the terminal gland (12) into place and install the nuts (14). Do not fully tighten the nuts at this time.

Attach the appropriate motor lead (T1, T2, T3) to each terminal post (1) using the allen head set-screws (21).

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

(Figure C-1)

Coat the threads of the motor housing studs (28) with 'Never-Seez' or equivalent compound, and secure the terminal housing assembly to the motor housing with the hardware (29); torque the nuts evenly in a cross sequence to 20 ft. lbs. (240 in. lbs. or 2,8 m. kg.). Tighten the nuts (14, Figure C-2) drawing the terminal gland (12) down into the terminal bore. **Do not** overtighten and damage the terminal gland or hardware.

NOTE

A .12 in. (3,05 mm) gap is required between the terminal gland cap flange and the terminal housing when tighten the nuts.

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

FINAL ASSEMBLY

(Figure C-1)

If the discharge flange (19) was removed from the motor housing, replace the discharge flange gas-

ket (18). Apply 'Never-Seez' or equivalent compound on the flange studs (20), and secure the flange with the nuts (21).

If the eye bolts (26) were removed, install the bolts till they bottom out.

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.

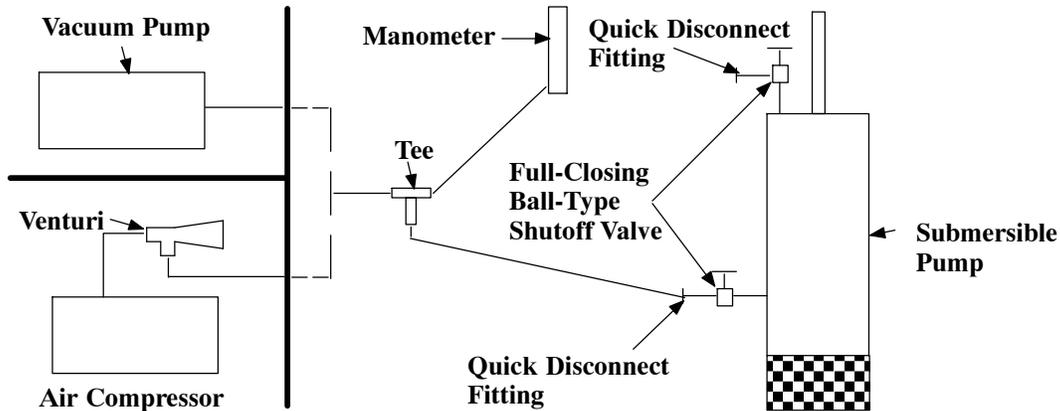


Figure C-8. Vacuum Test System

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)
S12A	30	8	20	2

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 (8) in the intermediate. Screw a short 3/8-inch NPT nipple into the hole. Tip the pump and drain off a small amount of

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

To fill the seal cavity, remove the pipe plug (10) 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 submersible pump oil as specified in the following table. Oil must be stored in a clean, tightly closed container in a reasonably dry environment.

Table C-2. Oil Quantity

Pump Model	Seal Cavity	Motor Cavity
S12A	3.2 quarts (3,0 liters)	24 quarts (22,7 liters)

Table C-3. Pump Oil Specifications

Specifications:	
Type	Premium high viscosity index, anti-wear hydraulic oil
Viscosity @ 100°F (38°C)	110 to 155
Viscosity @ 210°F (99°C)	40 to 50
Dielectric	26,000 (volts-min)
Recommended supplier:	
Gulf Oil Company	Gulf Harmony HVI AW 26
Acceptable alternate suppliers:	
Gulf Oil Company	Gulf Harmony 32 AW
Texas Oil Company	Rando HD 32 or HD AZ 32
Sun Oil Company	Sunvis 816 or 916
BP (Also Boron)	Energol-HLP 32
Shell Oil Company	Tellus 32, Tellus T-23 or T32
ARCO	Duro 32
Exxon (Also Esso)	Nuto H 32
Petro-Canada	Harmony HVI 22

Motor Housing Cavity

With the pump in an upright position, remove the pipe cap (15) on the top of the pump. See Table

C-2 and add the recommended grade of lubricant (Table C-3) 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 street tee assembly (24). Reinstall and tighten the cap.



Never attempt to fill the motor cavity through the drain plug (9) opening or the oil level plug (15). A volume of air must be trapped above the motor to permit thermal expansion of the motor oil.

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

**For Canadian Warranty Information,
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519-631-2870**