
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST



DIAPHRAGM PUMP

MODEL
4D-E3 1P

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

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

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INTRODUCTION

This Installation, Operation, and Maintenance manual is designed to help you achieve the best performance and longest life from your Gorman-Rupp pump.

This is a D Series, positive displacement pump utilizing a single-action diaphragm to produce a

straight-through flow of liquid. The pump is ideally suited to industrial and contractor's applications since it will handle liquids ranging from clear water to construction-site muck. The basic material of construction for wetted parts is aluminum, with neoprene flap valves and diaphragm.

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

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

or

Gorman-Rupp of Canada Limited
70 Burwell Road
St. Thomas, Ontario N5P 3R7

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:



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



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



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

NOTE

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

SAFETY - SECTION A

This information applies to D Series electric motor driven diaphragm pumps. Refer to the manual accompanying the motor before attempting to begin operation.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out incoming power to the motor to ensure that the pump will remain inoperative.



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



After the pump has been installed, block the wheels and secure the pump to prevent creeping. Make certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.

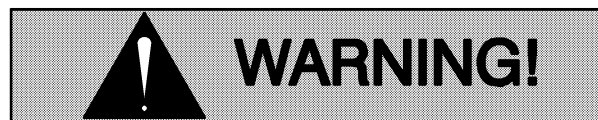


Do not operate the pump without the eccentric and coupling guards in place

over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.



The gearbox provided on this pump is designed for operation at 1750 RPM maximum input speed. If operated at a higher RPM, pump components may be destroyed.



Do not install and operate a non-explosion proof motor in an explosive atmosphere. Install, connect, and operate the motor in accordance with the National Electric Code and all local codes. If there is a conflict between the instructions in the manual accompanying the unit and the National Electric Code or the applicable local code, the National or local code shall take precedence.

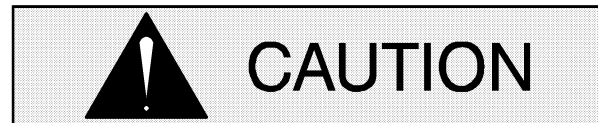


The electrical power used to operate this pump is high enough to cause injury or death. Obtain the services of a qualified electrician to make all electrical connections. make certain that the pump and motor are properly grounded; never use gas pipe as an electrical ground. Be sure that the incoming power matches the voltage and phase of the pump and motor before connecting the power source. Do not run the pump if the voltage is not within the limits.



All electrical connections must be in accordance with the National Electric Code. If there is a conflict between the instructions provided and N.E.C. specifications, N.E.C. specifications shall take precedence. All electrical equipment supplied with this pump was in conformance with N.E.C. requirements in effect on the date of manufacture. Failure to follow applicable specifications, or substitution of electrical parts not supplied or approved by the man-

ufacturer, can result in severe injury or death.



Never install a positive shut-off valve in the discharge line; discharge restrictions will cause excessive friction loss resulting in overloading and destruction of pump and drive components. It is strongly recommended that unless absolutely necessary, no positive shut-off valve be installed in the suction line; excessive restriction will cause incomplete filling of the diaphragm chamber and result in shortened diaphragm life.

INSTALLATION – SECTION B

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

For further assistance, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Since pump installations are seldom identical, this section offers only general recommendations and practices required to inspect, position, and arrange the pump and piping.

Pump Dimensions

See Figure 1 for the approximate physical dimensions of this pump.

OUTLINE DRAWING

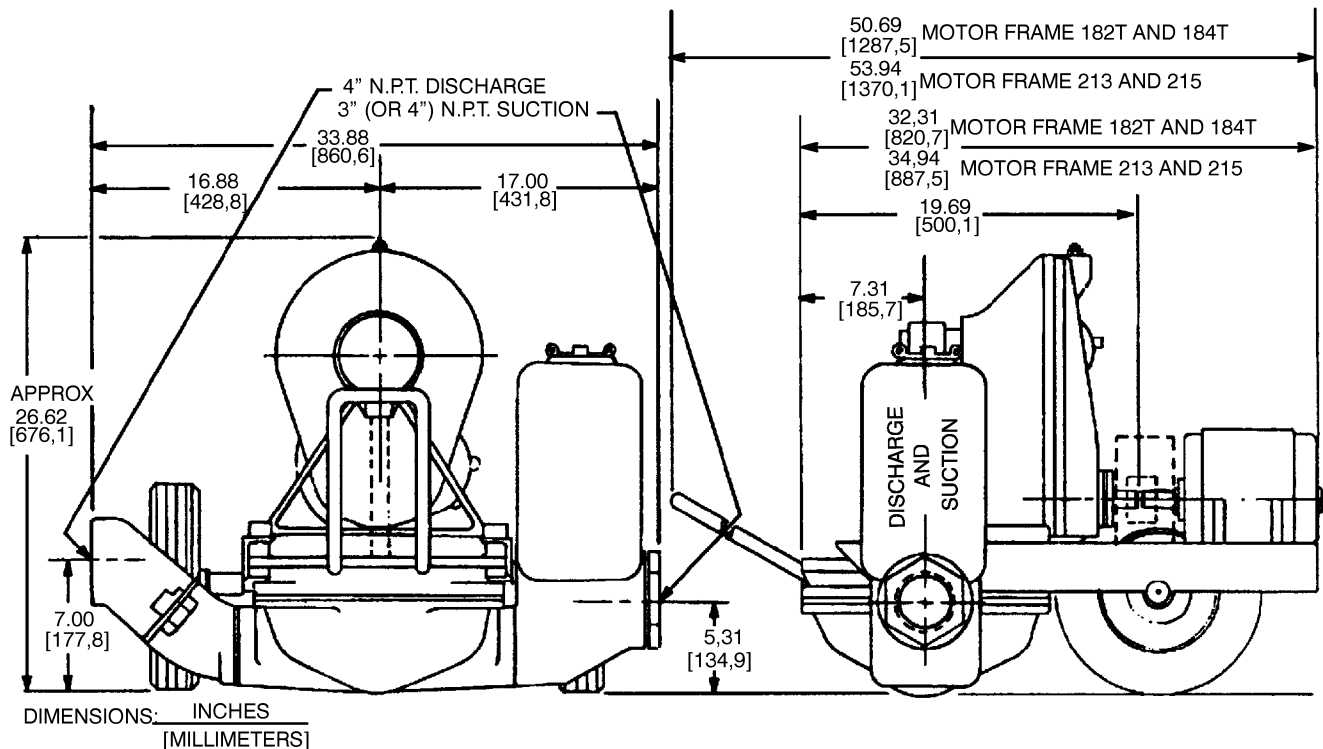


Figure 1. 4D Electric Motor Driven Pumps

PREINSTALLATION INSPECTION

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

- Inspect the pump for cracks, dents, damaged threads, and other obvious damage.
- Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

- Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated.
- Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **MAINTENANCE AND REPAIR** section of this manual and perform duties as instructed.
- If the pump and motor have been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected**

or replaced to ensure maximum pump service.

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

POSITIONING PUMP

Lifting

This pump is designed to be easily positioned for operation using the drawbar and wheels. The total pump weight is approximately **370 pounds (167,8 kg)**, not including accessories. Customer installed equipment such as suction and discharge piping **must** be removed before attempting to lift.



The pump assembly can be seriously damaged if the cables or chains used to lift and move the unit are improperly wrapped around the pump.

Mounting

Locate the pump in an accessible place as close as practical to the liquid being pumped. Level mounting is essential for proper operation.

The pump may have to be supported or shimmed to provide for level operation or to eliminate vibration.

After the pump has been positioned, block the wheels and secure the pump to prevent creeping.

SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See Page E-1 to be sure your overall application allows the pump to operate within the safe operation range.

Materials

Either pipe or hose may be used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. If hose is used in suction lines, it must be the rigid-wall, reinforced type to prevent collapse under suction. Using piping couplings in suction lines is not recommended.

Line Configuration

Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss.

Never pull a line into place by tightening connections at the pump. Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration and increased diaphragm and gear train wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

Fixed, Rigid Piping

This pump is equipped with an integral suction accumulator chamber which promotes an efficient flow of liquid and acts as an air cushion against shock. Since the air in this chamber will leak away during pump operation, the air must be replenished periodically. To introduce air into the chamber, stop the pump and remove the suction accumulator plug and integral gasket; this will break prime and allow the liquid in the chamber to drain away through the suction line.

If the pump is mounted in a system with fixed, rigid piping, it is recommended that a flexible connection be installed at or near the suction and discharge ports to absorb shock which would otherwise be transmitted through the drive train and greatly accelerate pump wear.

In a fixed piping installation, properly sized surge suppressors **must** be installed in both suction and discharge lines. If commercial surge suppressors are not readily available, air chambers may be fabricated from pipe as shown in Figure 2.

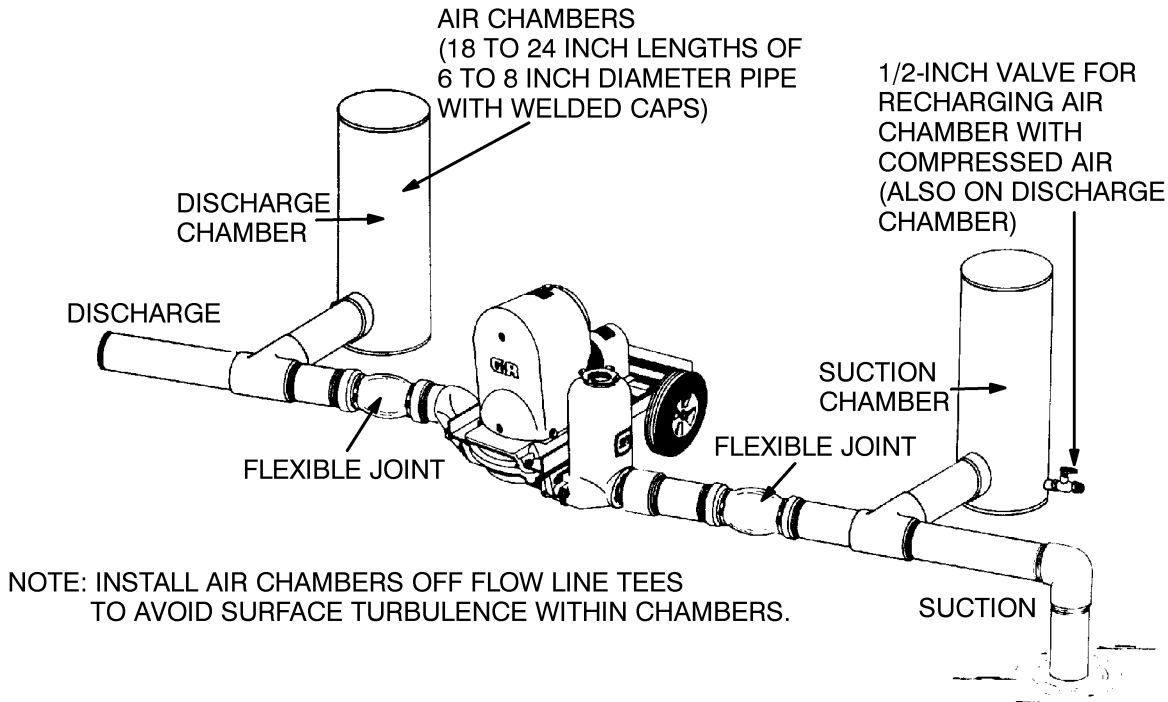


Figure 2. Fixed Piping Installation

Note that the air chambers have not been installed directly in the flow line, but have been installed off tees to avoid turbulence within the chambers. The air chambers are fitted with valves to permit introduction of small amounts of compressed air to further dampen shock; this compressed air will leak away during operation, and should be replaced from time to time. If the suction chamber floods, open the suction chamber valve to break prime and allow the liquid in chamber to drain through the suction line.

line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

NOTE

Maximum pump performance is realized at suction lifts of 5 feet (1,5 m) or less. Use the shortest possible length of suction hose or piping; lengths of 25 feet (7,6 m) or longer will reduce the capacity of the pump.

Gauges

If discharge pressure and vacuum suction gauges are desired, drill and tap the suction and discharge lines not less than 18 inches (457,2 mm) from the suction and discharge ports and install the lines. Installation closer to the pump may result in erratic readings.

It is strongly recommended that no positive shut-off valve be installed in the suction line; excessive restrictions will cause incomplete filling of the diaphragm chamber and result in short diaphragm life.

SUCTION LINES

To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the

Fittings

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost

to avoid creating air pockets. The suction line should not be restricted more than 1 inch below the nominal suction size.

The use of pipe couplings in the suction line is not recommended.

Strainers

If a strainer is furnished with the pump, be certain to use it; any spherical solids which pass through a strainer furnished with the pump will also pass through the pump itself.

If a strainer is not furnished with the pump, but is installed by the pump user, make certain that the total area of the openings in the strainer is at least three or four times the cross section of the suction line, and that the openings will not permit passage of solids larger than the solids handling capability of the pump.

This pump is designed to handle up to 2-1/4 inch (57 mm) diameter spherical solids.

Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an airtight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

DISCHARGE LINES



The discharge line must be the same size as, or larger than, the suction line. Never install or operate the pump with a discharge line smaller than the suction; a restricted discharge line will cause excessive friction loss resulting in overloading and destruction of pump and drive components.

Valves

The pump is provided with integral suction and discharge check valves.



Never install a positive shut-off valve in the discharge line; discharge restrictions will cause excessive friction loss resulting in overloading and destruction of pump and drive components. It is strongly recommended that unless absolutely necessary, no positive shut-off valve be installed in the suction line; excessive restriction will cause incomplete filling of the diaphragm chamber and result in shortened diaphragm life.

ALIGNMENT



Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut off incoming power to the motor and lock it out to ensure that the pump will remain inoperative.**
3. **Allow the pump to cool if overheated.**
4. **Close the discharge valve (if used).**
5. **Drain the pump.**



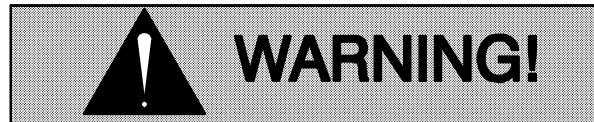
It is imperative that alignment be checked before the pump is operated.

The pump and motor were aligned and secured at the factory, but fastening hardware may have loosened during shipment. It is imperative that this

hardware and the alignment be checked after the pump is installed and **before** operation. Adjustments may be made by loosening the securing hardware and shifting or shimming components as required.

To check coupling alignment, use a feeler gauge or taper gauge between the coupling halves every 90°. The coupling is in alignment when the hubs are the same distance apart at all points.

To check parallel adjustment, lay a straightedge across both coupling halves at the top, bottom and sides. The horizontal parallel adjustment is correct when the straightedge rests evenly on both halves of the coupling at all points. Use a feeler gauge between the coupling to measure any misalignment.

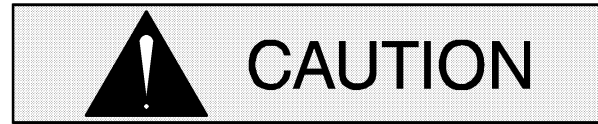


Do not operate the pump without the eccentric and coupling guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.

ELECTRICAL CONNECTIONS

Before connecting the motor to the incoming power, check that the electrical service available

matches the pump motor requirements stamped on the motor nameplate.



The pump must be operated in the direction indicated by the arrow on the gearbox and on the accompanying decals. Reverse rotation could cause pump components to be destroyed.

Never install a non-explosion proof motor in an explosive atmosphere. **Be sure** the motor is compatible with the intended application.



Do not install and operate a non-explosion proof motor in an explosive atmosphere. Install, connect, and operate the motor in accordance with the National Electric Code and all local codes. If there is a conflict between the instructions in the manual accompanying the unit and the National Electric Code or the applicable local code, the National or local code shall take precedence.

OPERATION – SECTION C

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

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



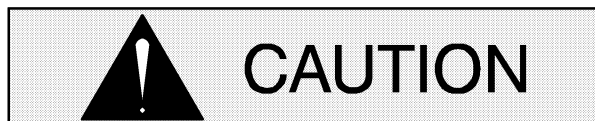
This pump is designed to handle non-volatile non-flammable liquids containing specified entrained solids. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.



After the pump has been installed, block the wheels and secure the pump to prevent creeping. Make certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.

Pump application will affect its performance, especially discharge velocities. Consult the Gorman-Rupp factory for actual performance levels for the pump.

Install the pump and piping as described in **INSTALLATION**. Make sure that the piping connections are tight, and that the pump is securely mounted. Check that components are properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).



Make certain that any positive shut-off valve installed in the suction line is open before operating the pump; excessive restriction will cause incomplete filling of the diaphragm chamber and result in shortened diaphragm life. No positive shut-off

valve should be installed in the discharge line.

STARTING

Consult the operations manual furnished with the motor before starting the pump. Open any valves installed in the suction line and start the pump.

OPERATION



The pump is designed to operate at approximately 52 cycles per minute through a gearbox with A 33.34:1 ratio and a 1750 RPM **maximum** input drive. Make certain that the electric motor installed does not exceed this rpm; otherwise, pump components may be destroyed.

Priming

The pump may not prime immediately because the suction line must first fill with liquid. If the pump fails to prime within five minutes, stop the motor and check the suction line for leaks.

OPERATION CHECKS

Gearbox Check

Check that the gearbox is properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

Leakage Check

No leakage should be visible at pump mating surfaces, connections or fittings. Keep all line connections and fittings tight to maintain maximum pump efficiency.

Strainer Check

If a suction strainer has been installed, check and clean it as necessary. It should be cleaned if pump flow begins to drop. If a vacuum suction gauge has been installed, monitor and record the readings regularly to detect strainer blockage.

Accumulator Chamber Check

Check periodically to ensure that there is sufficient air in the integral suction accumulator chamber. Replenish as required (see **Fixed, Rigid Piping** in Section B for details).

STOPPING

After stopping the pump, shut off incoming power to the motor and lock it out to ensure that the pump will remain inoperative.

If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, flush it with clean water.

Cold Weather Preservation



The primary construction materials of this pump are aluminum, with neoprene flap valves and diaphragm. Do not attempt to

clean or flush this pump with any liquid which would attack pump fittings or components. avoid cleaning with cleaning solvent.

In below freezing conditions, drain the water from the pump and the lines when the pump is not in operation. Also, clean out any solids by flushing with a hose.

GEARBOX TEMPERATURE CHECK

The gearbox runs higher than ambient temperatures because of heat generated by friction. Temperatures of approximately 200°F (93°C) are considered normal, and can operate intermittently at 250°F (121°C).

Checking gearbox temperatures by hand is inaccurate. Place a contact-type thermometer against the housing and record this temperature for future reference.

A sudden increase in gearbox temperature is a warning that the bearings are at the point of failing. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see **LUBRICATION** in Section E). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

When pumps are first started, the bearings may seem to run at temperatures above normal. Continued operation should bring the temperatures down to normal levels within 20 minutes or less.

TROUBLESHOOTING – SECTION D

Review all SAFETY information in Section A.



Before attempting to open or service the pump:

- 1. Familiarize yourself with this manual.**
- 2. Shut off incoming power to the motor and lock it out to ensure that the pump will remain inoperative.**
- 3. Allow the pump to completely cool if overheated.**
- 4. Close the discharge valve (if used).**
- 5. Drain the pump.**

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Air leak in suction line. Lining of suction hose collapsed. Integral suction or discharge check valve clogged, binding, or not seating properly. Cracked or broken diaphragm. Diaphragm not securely in place. Strainer clogged.	Correct leak. Replace suction hose. Clean valves, check that flange nuts are tight. Replace diaphragm. Secure diaphragm. Check strainer and clean if necessary
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Air leak in suction line. Suction intake not properly submerged Lining of suction hose collapsed. Cracked or broken diaphragm. Diaphragm not securely in place. Strainer clogged. Integral suction or discharge check valve clogged, binding, or not seating properly.	Correct leak. Check installation. Replace suction hose. Replace diaphragm. Secure diaphragm. Check strainer and clean if necessary Clean valves, check that flange nuts are tight.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP REQUIRES TOO MUCH POWER	<p>Liquid solution too thick.</p> <p>Integral discharge check valve clogged or binding.</p> <p>Bearings in motor or gearbox worn or binding.</p>	<p>Dilute if possible.</p> <p>Clean valve.</p> <p>Check bearings.</p>
PUMP CLOGS FREQUENTLY	<p>Integral suction or discharge check valve clogged, binding, or not seating properly.</p> <p>Liquid solution too thick.</p>	<p>Clean valves, check that flange nuts are tight.</p> <p>Dilute if possible.</p>
EXCESSIVE NOISE	<p>Pump, gearbox, or motor not securely mounted.</p> <p>Gearbox or motor not properly lubricated.</p>	<p>Check and tighten mounting bolts.</p> <p>See LUBRICATION in MAINTENANCE AND REPAIR.</p>
BEARINGS RUN TOO HOT	<p>Bearing temperature is high, but within limits.</p> <p>Low or incorrect lubricant.</p> <p>Drive misaligned.</p>	<p>Check bearing temperature regularly to monitor any increase.</p> <p>Check for proper type and level of lubricant.</p> <p>Align drive properly.</p>

PUMP MAINTENANCE AND REPAIR - SECTION E

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

IN GALLONS PER MINUTE AT 52 STROKES PER MINUTE						
STATIC LIFT IN FEET	STATIC DISCHARGE HEAD IN FEET					
	0	5	10	15	20	25
5	150	125	119	113	112	104
10	126	118	108	105	105	100
15	98	97	75	74	73	70
20	94	82	74	73	66	63
25	74	82	70	66	60	52

IN LITERS PER MINUTE AT 52 STROKES PER MINUTE						
STATIC LIFT IN METERS	STATIC DISCHARGE HEAD IN METERS					
	0	1,5	3,0	4,6	6,1	7,6
1,5	567,8	473,1	450,4	427,7	423,9	393,6
3,0	476,9	446,6	408,8	397,4	397,4	378,5
4,6	370,9	367,1	283,8	280,1	276,3	264,9
6,1	355,8	310,3	280,1	276,3	249,8	238,4
7,6	280,1	310,3	264,9	249,8	227,1	196,8

* STANDARD PERFORMANCE TEST DATA FOR 4D-E3 1P ELECTRIC MOTOR DRIVEN PUMPS

* Based on 70° F (21° C) clear water at sea level with minimum suction lift, using 3 inch (7,62 cm) suction hose and 4 inch (10,16 cm) non-collapsible discharge hose. Since pump installations are seldom identical, your performance may be difference due to such factors as viscosity, specific gravity, elevation, temperature, and impeller trim.

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

SECTION DRAWING

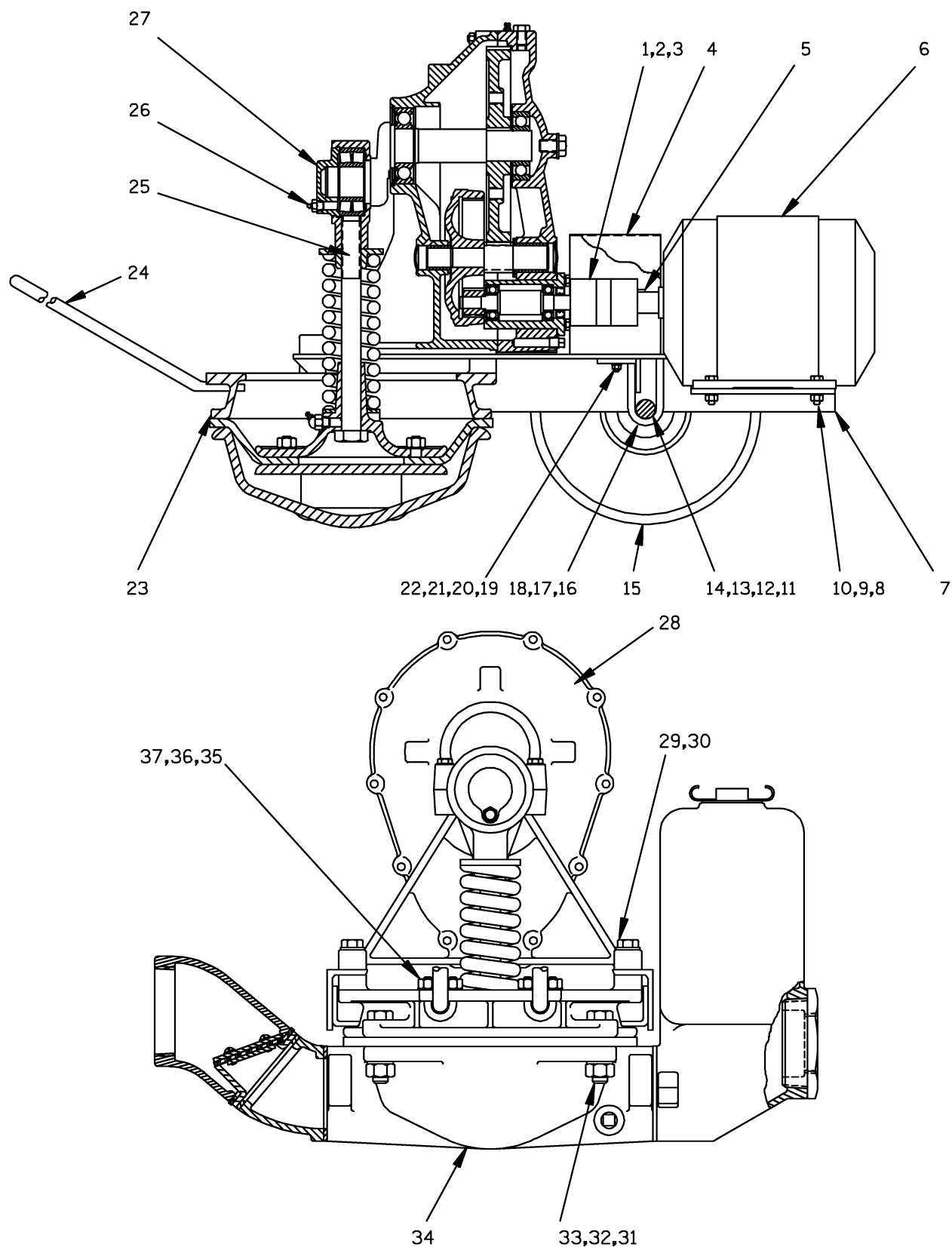


Figure 1. Pump Model 4D-E3 1P

PARTS LIST

Pump Model 4D-E3 1P

(From S/N 504867 Up)

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

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	DRIVE SHAFT CPLNG	24355-105	-----	1	24	DRAW BAR	5438	15990	1
2	MOTOR SHAFT CPLNG	24355-112	-----	1	25	PLUNGER ROD ASSY	6959	-----	1
3	SPIDER	24355-263	-----	1	26	LUB FITTING	S191	-----	1
4	COUPLING GUARD	34613-045	15020	1	27	END CAP	6643	10010	1
5 *	KEY	N0408	15990	1	28	GEARBOX ASSY	44161-009	-----	1
6	MOTOR	28216-040	-----	1	29	HEX HD CAPSCREW	B1010	15991	4
7	BASE	7041	24000	1	30	LOCKWASHER	J10	15991	4
8	HEX HD CAPSCREW	B0605	15991	4	31	HEX NUT	D12	15991	4
9	LOCKWASHER	J06	15991	4	32	LOCKWASHER	J12	15991	4
10	HEX NUT	D06	15991	4	33	HEX HD CAPSCREW	B1212	15991	4
11	AXLE	6619	15990	1	34	DIAPHRAGM POT ASSY	46475-702	-----	1
12	SPACER	6619A	15070	2	35	U-BOLT	5495	15991	2
13	COTTER PIN	M0306	15990	2	36	HEX NUT	D06	15991	2
14	FLAT WASHER	S1532	-----	4	37	LOCKWASHER	J06	15991	2
15 *	PNEUMATIC WHEEL	S263	-----	2	NOT SHOWN:				
16	U-BOLT	6945	15000	2		NAME PLATE	2613BP	13990	1
17	HEX NUT	D06	15991	4		DRIVE SCREW	BM#04-03	15990	4
18	LOCKWASHER	J06	15991	4		STRAINER	4917	24001	1
19	HEX HD CAPSCREW	B0404	15991	2		GUARD WARNING STK	38816-063	-----	1
20	FLAT WASHER	K04	15991	2		SUCTION STICKER	6588AG	-----	1
21	LOCKWASHER	J04	15991	2		WARNING DECAL	2613FF	-----	1
22	HEX NUT	D04	15991	2		4D-E3 WARNING DECAL	2613FE	-----	1
23	DIAPHRAGM RING	6621	13010	1	OPTIONAL:				
						STATIONARY BASE	8283	24000	1

* INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

NOTE:
CHECK VALVE ASSEMBLY SHOWN IN POSI-
TION ON DISCHARGE SIDE. SUCTION SIDE TO
OPEN IN SAME DIRECTION.

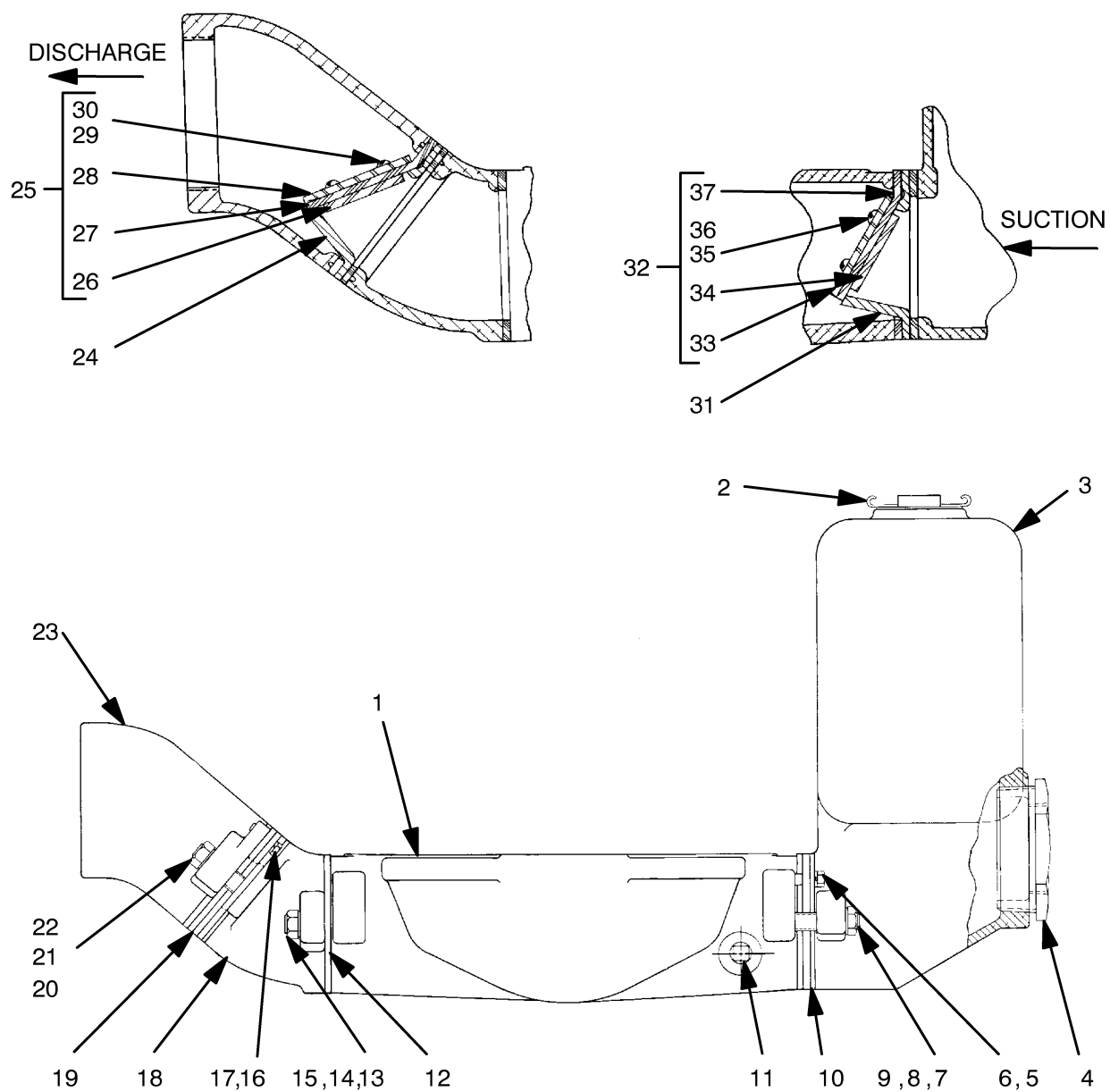


Figure 2. 46475-702 Diaphragm Pot Assembly

PARTS LIST **46475-702 Diaphragm Pot Assembly**

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	DIAPHRAGM POT	6622	13010	1
2	SUCT ACCUMULATOR PLUG AND GASKET	S591A	-----	1
3	SUCTION ACCUMULATOR	6625	13010	1
4	REDUCER PIPE BUSHING	AP6448	11990	1
5	HEX HD CAPSCREW	B0504	15991	2
6	LOCKWASHER	J05	15991	2
7	STUD	C1013	15991	2
8	FLAT WASHER	KE10	15991	2
9	HEX NUT	D10	15991	2
10	* SUCTION ACCUMULATOR GASKET	6625G	19100	1
11	DIAPHRAGM POT DRAIN PLUG	P06	11990	1
12	* DISCHARGE FLANGE GASKET	6625G	19100	1
13	STUD	C1010	15991	2
14	FLAT WASHER	KE10	15991	2
15	HEX NUT	D10	15991	2
16	HEX HD CAPSCREW	B0504	15991	2
17	LOCKWASHER	J05	15991	2
18	DISCHARGE FLANGE	6627	13040	1
19	* DISCHARGE ELBOW GASKET	6625G	19100	1
20	STUD	C1013	15991	2
21	FLAT WASHER	KE10	15991	2
22	HEX NUT	D10	15991	2
23	DISCHARGE ELBOW	6626	13040	1
24	VALVE SEAT	6635	10010	1
25	DISCHARGE CHECK VALVE ASSY	46413-007	-----	1
26	- VALVE WEIGHT	6801	15990	1
27	* -CHECK VALVE	6925	19100	1
28	- VALVE WEIGHT	6642	15990	1
29	-RD HD MACHINE SCREW	X0402 1/2	17090	4
30	-LOCKWASHER	J04	17090	4
31	VALVE SEAT	6635	10010	1
32	SUCTION CHECK VALVE ASSY	46413-007	-----	1
33	- VALVE WEIGHT	6642	15990	1
34	- VALVE WEIGHT	6801	15990	1
35	-RD HD MACHINE SCREW	X0402 1/2	17090	4
36	-LOCKWASHER	J04	17090	4
37	* -CHECK VALVE	6925	19100	1

* INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

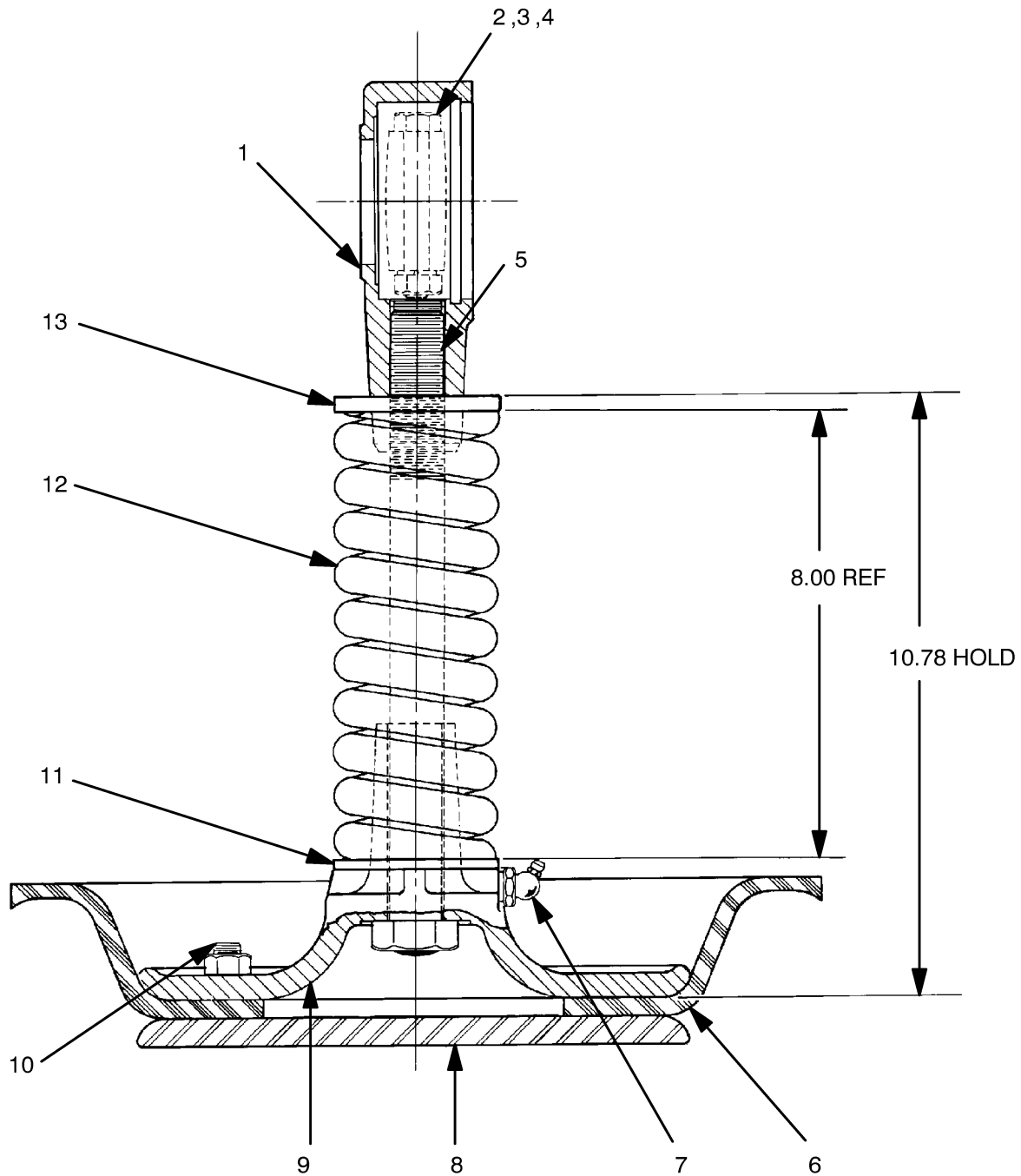


Figure 3. 6959 Plunger Rod Assembly

PARTS LIST
6959 Plunger Rod Assembly

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	BEARING CAP	6560	10010	1
2	–HEX HD CAPSCREW	B0813S	15991	2
3	–HEX NUT	D08S	15991	2
4	–LOCKWASHER	J08	15991	2
5	PLUNGER ROD ASSEMBLY	6633	15990	1
6	* DIAPHRAGM	S1017	-----	1
7	LUBRICATION FITTING	S194	-----	1
8	DIAPHRAGM PLATE	6629	15990	1
9	DIAPHRAGM PLATE	6628	10010	1
10	HEX NUT	D08	15991	4
11	SPRING WASHER	6639	15000	1
12	SPRING	6547	16080	1
13	SPRING RETAINING NUT	6638	11000	1

* INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

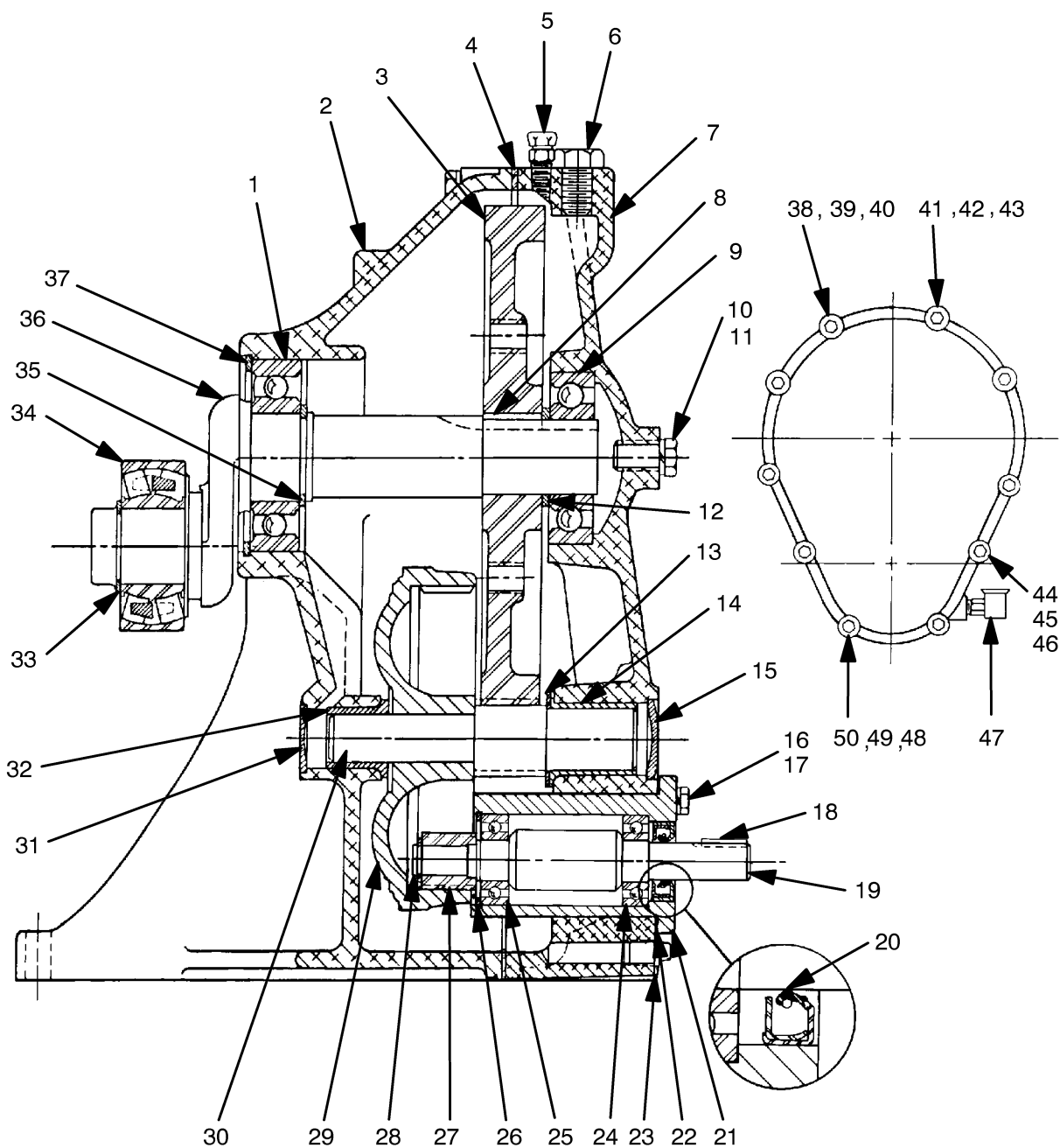


Figure 4. 44161-009 Gearbox Assembly

PARTS LIST

44161-009 Gearbox Assembly

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	CRANKSHAFT BEARING	S374	-----	1	26	RETAINING RING	S204	-----	1
2	GEAR HOUSING	6624	13040	1	27	DRIVE GEAR	6558	16040	1
3 *	CRANKSHAFT GEAR	6641	15060	1	28 *	SNAP RING	S1004	-----	1
4 *	GEAR HOUSING GSKT	6624G	18000	1	29	PINION GEAR	S1014	-----	1
5	AIR VENT FITTING	S2162	-----	1	30	PINION SHAFT	6634	16070	1
6	HEX HD CAPSCREW	B0803	15991	1	31	GEAR HOUSING PLUG	S1054	-----	1
7	GEAR COVER	6623	13010	1	32 *	PINION SHAFT BUSHING	S1015	-----	1
8 *	CRANKSHAFT GEAR KEY	N0605	15990	1	33 *	SNAP RING	S244	-----	1
9	CRANKSHAFT BEARING	S1080	-----	1	34 *	CRANKSHAFT ROLLER BEARING	S1011	-----	1
10	HEX HD CAPSCREW	B1004	15991	1	35	RETAINING RING	S442	-----	1
11	FLAT WASHER	KE10	15991	1	36 *	CRANKSHAFT	6550	11000	1
12	SPACER	6636	15990	1	37 *	SNAP RING	S1010	-----	1
13	WASHER	6637	15000	1	38	HEX HD CAPSCREW	B0511	15991	5
14 *	PINION BUSHING	S1016	-----	1	39	HEX NUT	D05	15991	5
15	GEAR COVER PLUG	S1053	-----	1	40	LOCKWASHER	J05	15991	5
16	HEX HD CAPSCREW	B0504	15991	4	41	SHOULDER BOLT	S1018	-----	1
17	LOCKWASHER	J05	15991	4	42	HEX NUT	D05	15991	1
18 *	DRIVE SHAFT KEY	N0304	15990	1	43	LOCKWASHER	J05	15991	1
19	DRIVE SHAFT	6631	15010	1	44	HEX HD CAPSCREW	B0518	15991	3
20 *	OIL SEAL	S1012	-----	1	45	HEX NUT	D05	15991	3
21	ECCENTRIC HOUSING	6632	10010	1	46	LOCKWASHER	J05	15991	3
22 *	ECC HOUSING GSKT	6632G	18000	1	47	OIL CUP	S617	-----	1
23	DRAIN PLUG	P04	11990	1	48	LOCKWASHER	J05	15991	1
24 *	DRIVE SHAFT BEARING	S1044	-----	1	49	HEX NUT	D05	15991	1
25 *	DRIVE SHAFT BEARING	S1044	-----	1	50	SHOULDER BOLT	S1019	-----	1

* INDICATES PARTS RECOMMENDED FOR STOCK

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

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

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

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the sectional views (see Figures 1, 2, 3 and 4) and the accompanying parts lists.

Most service functions may be performed without separating the pump and gearbox from the motor. If major repair is required, the pump, gearbox and motor must be disconnected.

Before attempting to service the pump, shut off incoming power to the motor and lock it out to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

For motor disassembly and repair, consult the literature supplied with the motor, or contact your local motor representative.



Before attempting to open or service the pump:

- 1. Familiarize yourself with this manual.**
- 2. Shut off incoming power to the motor and lock it out to ensure that the pump will remain inoperative.**
- 3. Allow the pump to cool if overheated.**
- 4. Close the discharge valve (if used).**
- 5. Drain the pump.**

Before attempting to service the pump, drain the pump by removing the drain plug (11, Figure 2). Clean and reinstall the drain plug.

Suction And Discharge Check Valve Removal (Figure 2)

To service the suction and discharge check valves, remove the suction and discharge piping.

To service the suction check valve assembly (32), remove the suction accumulator (3) by loosening the hardware (8 and 9) securing it to the diaphragm pot (1). Remove the hardware (5 and 6) securing the valve seat (31) and check valve assembly to the diaphragm pot. Pull the check valve assembly from the suction port.

To service the discharge check valve assembly (25), loosen the hardware (21 and 22) and remove the assembled outboard discharge elbow (23), check valve, and seat (24). Remove the gasket (19).

Remove the hardware (16 and 17) securing the valve seat (24) and discharge check valve assembly to the discharge elbow.

To remove the inboard discharge flange (18), loosen the hardware (14 and 15) securing the flange to the diaphragm pot. Remove the gasket (12).

The suction and discharge check valve assemblies are identical parts and operate in the same direction. For removal and/or replacement, remove the hardware (29, 30, 35 and 36) securing the check valve weights (26, 28, 33 and 34) to the check valves (27 and 37). Inspect and replace as required.

If no further disassembly is required, see **Suction And Discharge Check Valve Installation**.

Diaphragm Removal (Figure 1)

To remove the diaphragm (6, Figure 3), disengage the hardware (31, 32 and 33) and remove the diaphragm pot assembly (34). Inspect the diaphragm ring (23) for wear or damage. If replacement is required, the gearbox assembly (28) must be removed.

(Figure 3)

Remove the nuts (10). Separate the lower diaphragm plate assembly (8) from the diaphragm (6)

and the upper diaphragm plate (9). Inspect the diaphragm and replace as required.

If no further disassembly is required, see **Diaphragm Installation**.

Plunger Rod Removal And Disassembly

(Figure 3)

With the diaphragm pot assembly and diaphragm removed, loosen the hardware (2, 3 and 4) and remove the end cap (27, Figure 1). Slide the bearing cap (1) off the crankshaft roller bearing (34, Figure 4), and remove the plunger rod assembly.

Use a socket wrench to hold the plunger rod (5) securely, and unscrew the bearing cap assembly (1). Unscrew the spring retaining nut (13). **Use caution** when unscrewing the retaining nut; tension on the spring (12) will be released.

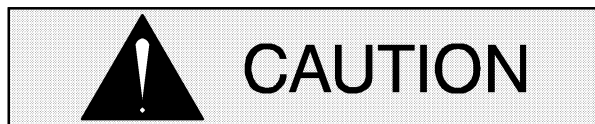
Remove the spring (12) and spring washer (11). Slide the plunger rod assembly (5) out of the upper diaphragm plate (9).

Inspect the component parts for excessive wear and replace as required.

Gearbox Removal And Disassembly

(Figure 1)

When properly operated and maintained, the gearbox assembly (28) should not require disassembly. Disassemble the gearbox **only** when there is evidence of wear or damage.



Shaft and bearing disassembly in the field is not recommended. These operations should be performed only in a properly equipped shop by qualified personnel.

Support the diaphragm ring (23) with wooden blocks. Disengage the hardware (29 and 30) and remove the diaphragm ring. Inspect the diaphragm ring for wear or damage and replace as necessary. It is not necessary to remove the drawbar (24) from the diaphragm ring unless replacement is required. Disengage the hardware (36 and 37) from the U-bolts (35) to remove the drawbar.

Disengage the hardware (19, 20, 21 and 22) and remove the coupling guard (4). Loosen the hardware securing the drive shaft coupling (1). Separate the gearbox assembly from the coupling by pulling straight away. Remove the shaft key (18, Figure 4).

(Figure 4)

Before attempting to disassemble the gearbox assembly, drain the lubricant by removing the drain plug (23) and turning the gearbox on its side. Clean and reinstall the drain plug.

Remove the hardware (16 and 17) securing the eccentric housing (21) and housing gasket (22) to the gear cover (7). Pull the complete drive shaft subassembly from the gear cover.

To disassemble the drive shaft subassembly, remove the snap ring (28) and slide the drive gear (27) off the drive shaft (19). Remove the retaining ring (26), and press the drive shaft and assembled bearings (24 and 25) out of the eccentric housing. Press the oil seal (20) from the housing bore. Cover the shaft and bearing with a clean cloth until ready to clean and inspect the gearbox components.

For access to the remaining gearbox drive components, the gear cover (7) and gear housing gasket (4) must be separated from the gear housing (2) by removing the two close-tolerance shoulder bolts (41 and 50), which act as pilots to ensure accurate concentric positioning of the cover, and the remaining hardware (38, 39, 40, 42, 43, 44, 45, 46, 48 and 49).

NOTE

The shoulder bolts and capscrews securing the gearbox cover to the gearbox housing are of different lengths. For ease of reassembly, record the positions of the shoulder bolts and capscrews at the time of removal.

Remove the gear housing gasket and clean all the mating surfaces.

NOTE

If the gear cover does not readily separate from the housing, remove the hardware (10 and 11), install a 5/8-11 UNC by 4-inch long capscrew, and jack the cover from the housing. Remove the jacking screw

and replace the hardware (10 and 11).

After the gear cover has been removed, inspect the pinion shaft bushing (14). If replacement is required, remove the cover plug (15) and press the pinion shaft bushing (14) from the cover bore. Slide the pinion shaft washer (13) off the pinion shaft (30) and tag it for reference during reassembly.

Use a bearing puller to remove the crankshaft bearing (9) from the crankshaft (36). Remove the spacer (12).

Install two 5/8-11 UNC capscrews in the tapped holes in the crankshaft gear (3), and use a gear puller to slide the gear off the crankshaft. Retain the crankshaft gear key (8). Remove the capscrews from the gear.

Remove the snap ring (37) and slide the crankshaft and crankshaft bearing (1) out of the gearbox housing.

To disassemble the pinion shaft and components, slide the shaft and assembled pinion gear (29) out of the shaft bushing (32). The pinion gear is retained on the shaft by tight friction fit and does not normally require removal. If removal is required, press the pinion gear from the shaft.

Inspect the pinion shaft bushing and, if replacement is required, remove the plug (31) and press the bushing from the gear housing bore.

After removing the shafts and bearings, clean and inspect the bearings **in place** as follows.



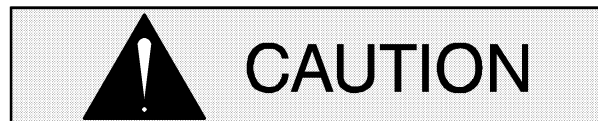
To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Clean the gear housing, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage and replace as necessary.



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.

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



Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. **Do not** spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

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

The bearing tolerances provide a tight press fit onto the shafts and a snug slip fit into the gear housing. Replace the bearings, shafts, eccentric housing, or gear housing if the proper bearing fit is not achieved.

If the bearings require replacement, remove the bearing retaining ring (35). Remove the bearing snap ring (33) and use a bearing puller to remove the bearings (1, 24, 25 and 34).

Gearbox Reassembly And Installation

(Figure 4)

Inspect the shafts (19, 30 and 36) for distortion, nicks or scratches. Dress small nicks and burrs with a fine file or emery cloth. Replace the shafts if defective.



To prevent damage during removal from

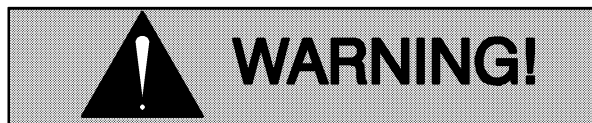
the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

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

NOTE

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

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



Use caution when handling hot bearings to prevent burns.

NOTE

The crankshaft bearing (9) must be installed after the crankshaft gear (3).

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.

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.

Secure the bearing (1) with the snap ring (35). Secure the crankshaft roller bearing (34) with the snap ring (33).

If removed, press the pinion shaft bushing (32) into the gear housing until fully seated.

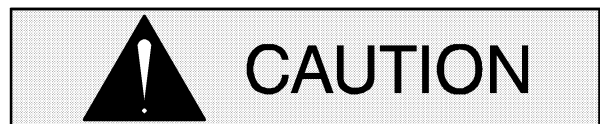
Use a hydraulic press to install the pinion gear (29) onto the pinion shaft (30).

NOTE

*The pinion gear is a tight interference fit on the pinion shaft. To ease installation, the gear may be heated (and the shaft cooled) to a temperature differential of 350°F (177°C). If the gear is heated, **use caution** when handling the gear to prevent burns.*

Slide the assembled pinion shaft and gear into the pinion shaft bushing until fully seated.

Slide the crankshaft and assembled bearing (1) into the gear housing and secure with the snap ring (37).



When installing the shaft and bearings into the bearing bore, push against the outer race. Never hit the balls or ball cage.

Install the crankshaft gear key (8) in the shaft keyway. Align the crankshaft gear teeth with those on the pinion shaft, and press the gear onto the crankshaft until fully seated against the shoulder. Install the spacer (12), and press the bearing (9) onto the shaft until fully seated against the spacer.

Tap the end of the crankshaft with a soft-faced mallet to ensure that all components are fully seated.

If removed, press the pinion shaft bushing (14) into the gear cover (7). Slide the pinion shaft washer (13) onto the pinion shaft (30). Install the gear housing gasket (4). Position the gear cover so that the respective bores slip over the crankshaft bearing and pinion shaft. Tap the cover into place with a soft-faced mallet.

Install the two close-tolerance shoulder bolts (41 and 50) (which act as pilots to ensure accurate

concentric positioning of the cover) through their respective holes, and secure them with the hardware (42, 43, 48 and 49). Secure the gear cover to the gear housing by tightening the remaining hardware (38, 39, 40, 42, 43, 44, 45, 46, 48 and 49) evenly.

Install the gear cover plug (15) and the gear housing plug (31).

Press the drive shaft and assembled bearings into the eccentric housing (21), and secure with the retaining ring (26).



When installing the shaft and bearings into the bearing bore, push against the outer race. Never hit the balls or ball cage.

Lubricate the lip of the oil seal (20) with light oil, and position it on the drive shaft with the lip positioned as shown in Figure 4. Press the oil seal into the eccentric housing bore until the face of the oil seal is **just flush** with the face of the eccentric housing. **Be careful** not to roll or cut the lip of the oil seal on the shaft keyway.

Install the drive gear (27) on the drive shaft, and secure with the snap ring (28).

Clean the mating surface of the eccentric housing and replace the eccentric housing gasket (22). Position the assembled eccentric housing and drive shaft in the gear cover bore with the word "top" on the eccentric housing flange facing up. Slide the housing and drive shaft into the gearbox, making certain the drive gear teeth fully engage those of the pinion gear. Secure the eccentric housing to the gear housing with the hardware (16 and 17).

Install the drive shaft key (18).

(Figure 1)

Position the gearbox on the base (7). Position the diaphragm ring (23) under the base, and secure the gearbox and diaphragm ring with the hardware (29 and 30).

If the drawbar (24) was removed, secure it to the diaphragm ring with the U-bolts (35) and hardware (36 and 37).

Secure the drive shaft coupling (1) to the drive shaft. Check the coupling alignment as described in **ALIGNMENT**, Section B. Install the coupling guard (4) and secure it with the hardware 19, 20, 21 and 22).

Lubricate the gearbox as described in **LUBRICATION**.

Plunger Rod Reassembly And Installation

(Figure 3)

Slide the plunger rod (5) through the upper diaphragm plate (9). Slide the spring washer (11) and spring (12) down over the plunger rod. Install the spring retaining nut (13), and tighten it to obtain the dimension shown in Figure 3.

Clean the bearing cap (1) with a cloth soaked in cleaning solvent.



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 bearing cap for wear or damage and replace if necessary.

NOTE

The bearing cap consists of an upper and lower half secured with the hardware (2, 3 and 4). The cap is machined as one piece before being split to ensure concentricity of the bore, and is available only as an assembly.

Screw the bearing cap assembly onto the plunger rod until fully seated against the spring retaining nut.

Loosen the hardware (2, 3 and 4), and position the bearing cap over the crankshaft roller bearing (34, Figure 4). Secure the plunger rod assembly by tightening the hardware (2, 3 and 4).

Lubricate the plunger rod assembly as described in **LUBRICATION**, Section E.

Diaphragm Installation

(Figure 3)

Position the diaphragm (6) on the upper diaphragm plate (9), making sure the lip is properly seated. Slide the studs in the lower diaphragm plate (8) through the holes in the upper diaphragm plate, and secure with the nuts (10).

(Figure 1)

Secure the diaphragm pot assembly (32) to the diaphragm ring (20) with the hardware (29, 30 and 31).

Suction And Discharge Check Valve Installation

(Figure 2)

Inspect the check valve components and replace as required. Subassemble the check valve weights (26, 28, 33 and 34) and check valves (27 and 37) with the hardware (29, 30, 35 and 36).

If the inboard discharge flange (18) was removed, clean the mating surfaces and install the gasket (12). Secure the flange to the diaphragm pot (1) with the hardware (14 and 15).

Subassemble the valve seat (24) and discharge check valve (25) to the discharge elbow (23) with the weights positioned as shown in Figure 2, and secure with the hardware (16 and 17).

Clean the mating surfaces of the valve seat and discharge flange. Install the gasket (19) and secure assembled discharge elbow, check valve, and seat to the discharge flange with the hardware (21 and 22).

Check the operation of the check valve to ensure proper seating and free movement.

Subassemble the suction check valve (32). Clean the mating surfaces, and position the gasket (10), check valve assembly, and valve seat (31) against the diaphragm pot with the weights positioned as shown in Figure 2. Secure with the hardware (5 and 6).

Check the operation of the check valve to ensure proper seating and free movement.

Secure the suction accumulator (3) to the diaphragm pot with the hardware (8 and 9).

Connect the suction and discharge piping as described in **INSTALLATION**, Section B.

Refer to **OPERATION**, Section C before starting the pump.

LUBRICATION

Plunger Rod Assembly

(Figure 1)



The crankshaft roller bearing (34, figure 4) should be lubricated thoroughly after each 8 hours of operation. Failure to do so may cause the bearing to overheat and fail.

Apply No. 2 lithium base grease to the upper lubrication fitting (23) until grease escapes from the end cap (24).

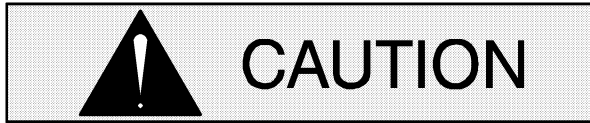
Apply No. 2 lithium base grease to the lower fitting (7, Figure 3) until grease escapes from the top of the upper diaphragm plate inside the spring.

Gearbox

(Figure 4)

The gearbox was fully lubricated when shipped from the factory. Check the oil level regularly at the oil cup (47), and keep the oil cup full. Lubricate with SAE No. 30 non-detergent when lubrication is required. **Do not** over-lubricate. Over-lubrication can cause the bearings to overheat, resulting in premature bearing failure.

Under normal conditions, change the oil after each 5000 hours of operation, or at 12 month intervals, whichever occurs first. Change the oil more frequently if the pump is operated continuously or installed in a dirty or humid environment with rapid temperature change.



Monitor the condition of the bearing lubricant regularly for evidence of rust or moisture condensation. This is especially important in areas where variable hot and cold temperatures are common.

When lubricating a dry (or overhauled) gearbox, add one ounce of 'Molykote M Gear Guard' and 'top off' with clean oil.

For cold weather operation, consult the factory or a lubricant supplier for the recommended grade of oil.

Motor

Refer to the motor manufacturer's recommendations or contact your local motor representative.

**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**

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