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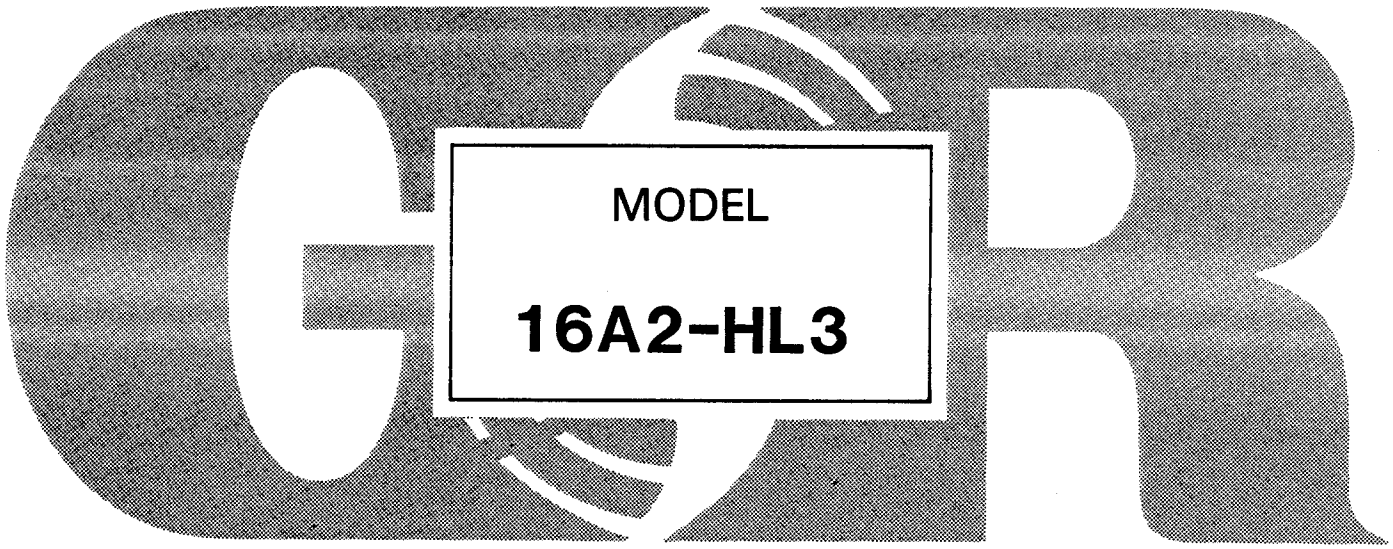
10 SERIES™

INSTALLATION, OPERATION, PARTS LIST, AND MAINTENANCE MANUAL



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 pump is a 10 Series, semi-open impeller, self-priming centrifugal model with a suction check valve. The pump is designed for pumping non-volatile, non-flammable liquids containing specified entrained solids. The basic material of construction for wetted parts is gray iron, with ductile iron impeller and steel wearing parts.

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

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

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

NOTE

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

CAUTION

Instructions which must be followed to avoid causing damage to the product or other equipment incidental to the installation. These instructions describe the requirements and the possible damage which could result from failure to follow the procedures.

WARNING

These instructions must be followed to avoid causing injury or death to personnel, and describe the procedure required and the injury which could result from failure to follow the procedure.

WARNINGS - SECTION A

THESE WARNINGS APPLY TO 10 SERIES ENGINE DRIVEN PUMPS. REFER TO THE MANUAL ACCOMPANYING THE ENGINE BEFORE ATTEMPTING TO BEGIN OPERATION.

WARNING

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.
3. Allow the pump to cool if overheated.
4. Vent the pump slowly and cautiously.
5. Close the suction and discharge valves.
6. Check the temperature before opening any covers, plates, or plugs.
7. Drain the pump.

WARNING

This pump is designed to handle 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.

WARNING

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

WARNING

Do not operate the pump against a closed discharge valve for long periods of time. This could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode.

WARNING

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

1. Stop the pump immediately.
2. Allow the pump to cool.
3. Refer to instructions in this manual before re-starting the pump.

WARNING

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

WARNING

Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. The maximum continuous operating speed is 1800 RPM.

WARNING

Fuel used by internal combustion engines presents an extreme explosion and fire hazard. Make certain that all fuel lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel tank. Always use the correct type of fuel.

WARNING

Do not operate an internal combustion engine in an explosive atmosphere. When operating internal combustion engines in an enclosed area, make certain that exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless, and odorless.

WARNING

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping MUST be removed from the pump when lifting the pump by the bail.

INSTALLATION - SECTION B

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

Most of the information pertains to a standard **static lift application** where the pump is positioned above the free level of liquid to be pumped.

If installed in a **flooded suction application** where the liquid is supplied to the pump under pressure, some of the information such as mounting, line configuration, and priming must be tailored to the specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to 50% of the maximum permissible operating pressure as shown on the pump performance curve. (See Section E, Page 1). If the pump is fitted with a Gorman-Rupp double grease lubricated seal, the maximum incoming pressure must be reduced to 10 p.s.i..

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

Pump Dimensions

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

OUTLINE DRAWING

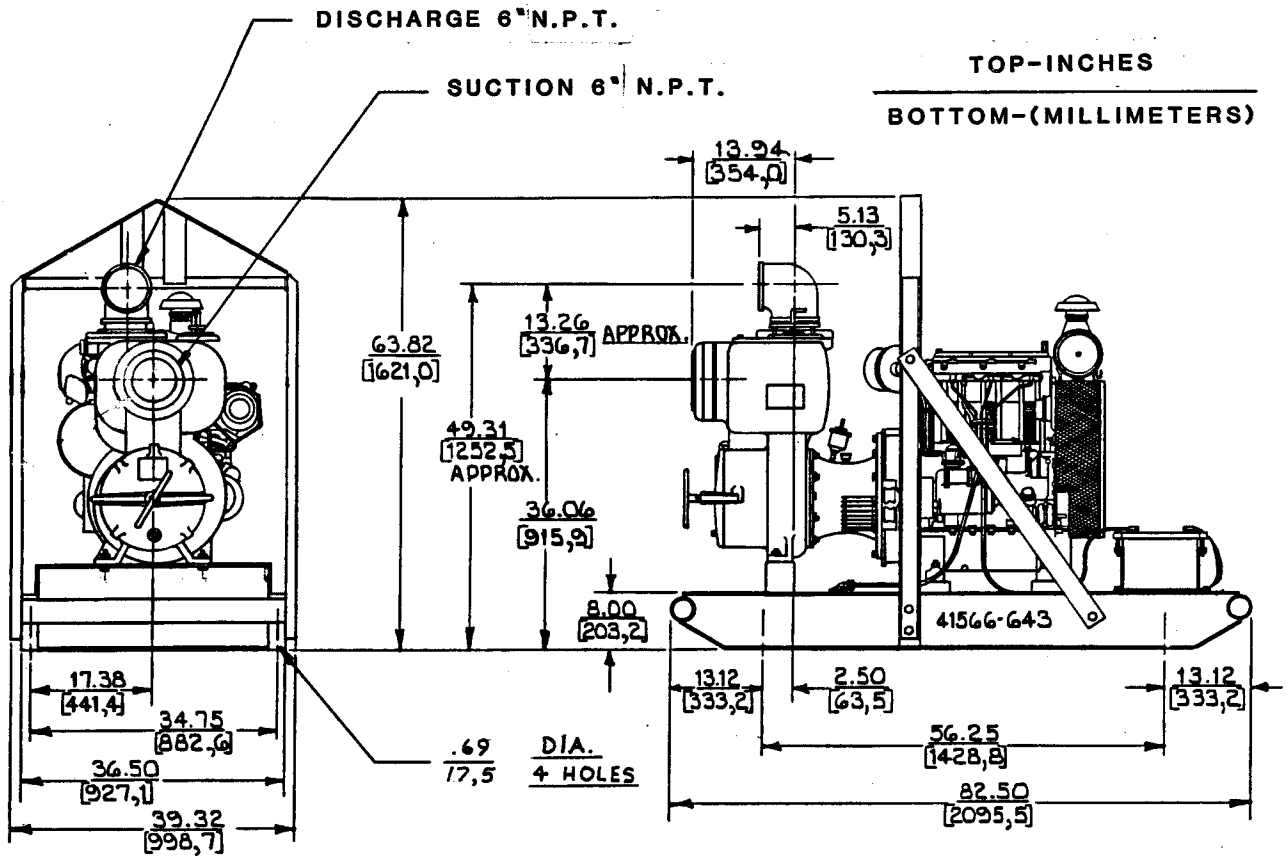


Figure 1. Pump Model 16A2-HL3

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:

a. Inspect the pump and engine for cracks, dents, damaged threads, and other obvious damage.

b. Check for and tighten loose bolts, nuts, capscrews, and other attaching hardware. Since gaskets tend to shrink after drying, check for and tighten loose nuts and capscrews securing mating surfaces.

c. Carefully read all tags, decals, and markings on the pump assembly, and follow the instructions indicated.

d. Check all lubricant levels and lubricate as necessary. Refer to LUBRICATION in the MAINTENANCE AND REPAIR section of this manual and perform duties as instructed.

e. If the pump and engine 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

To ensure sufficient lubrication and fuel supply to the engine, **do not** position the pump and engine more than 15° off horizontal for continuous operation. The pump and engine may be positioned up to 30° off horizontal for **intermittant operation only**; however, the engine manufacturer should be consulted for continuous operation at angles greater than 15°.

Lifting

Use lifting equipment with a capacity of a least **8,125 pounds**. This pump weighs approximately **1,625 pounds**, not including the weight of accessories and the optional wheel kit. Customer installed equipment such as hoses and piping **must** be removed before attempting to lift.

CAUTION

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.

If the pump has been mounted on a moveable base, make certain the base is stationary by setting the brake and blocking the wheels before attempting to operate the pump.

Clearance

A minimum clearance of **18 inches** in front of the cover plate is required to permit removal of the cover and easy access to the pump interior.

SUCTION AND DISCHARGE PIPING

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.

Connections to Pump

Before tightening a connecting flange, align it exactly with the pump port. Never pull a pipe line into place by tightening the flange bolts and/or couplings.

Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration, decreased bearing life, and increased shaft and seal wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

Gauges

Most pumps are drilled and tapped for installing discharge pressure and vacuum suction gauges. If these gauges are desired for pumps that are not tapped, drill and tap the suction and discharge lines not less than 18 inches from the suction and discharge ports and install the lines. Installation closer to the pump may result in erratic readings.

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 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.

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. Valves are not normally used in suction lines, but if a valve is used, install it with the stem horizontal to avoid air pockets.

This pump is designed to handle up to 2 1/2 inch 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. The pipe dope should be compatible with the liquid being pumped.

Suction Line Positioning

The depth of submergence of the suction line is critical to efficient pump operation. Figure 2 shows recommended minimum submergence vs. velocity.

NOTE

The pipe submergence required may be reduced by installing a standard pipe increaser fitting at the end of the suction line. The larger opening size will reduce the inlet velocity. Calculate the required submergence using the following formula based on the increased opening size (area or diameter).

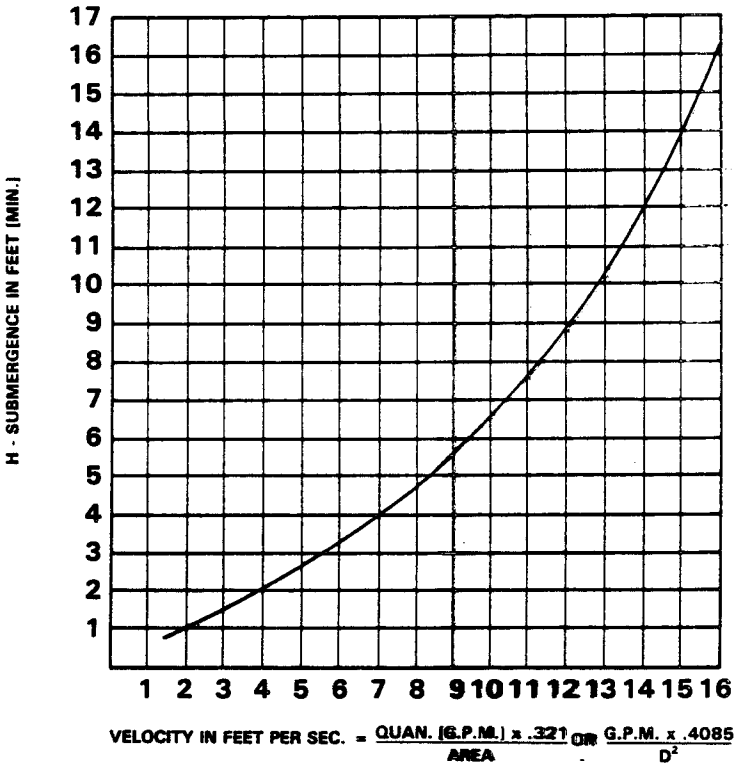


Figure 2. Recommended Minimum Suction Line Submergence Vs. Velocity

DISCHARGE LINES

Siphoning

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action causing damage to the pump could result.

Valves

A check valve in the discharge line is normally recommended, but it is not necessary in low discharge head applications.

If a throttling valve is desired in the discharge line, use a valve as large as the largest pipe to minimize friction losses. Never install a throttling valve in a suction line.

With high discharge heads, it is recommended that a throttling valve and a system check valve be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.

CAUTION

If application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

Bypass Lines

If it is necessary to permit the escape of air to atmosphere during initial priming or in the repriming cycle, install a bypass line between the pump and the discharge check valve. The bypass line should be sized so that it does not affect pump discharge capacity.

Either a Gorman-Rupp automatic air release valve - which will automatically open to allow the pump to prime, and automatically close when priming is accomplished - or a hand-operated shutoff valve should be installed in the bypass line.

NOTE

The bypass line may clog frequently, particularly if the valve remains closed. If this condition occurs, either use a larger bypass line or leave the shutoff valve open during the pumping operation.

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action could result, causing damage to the pump.

OPERATION - SECTION C

WARNING

This pump is designed to handle 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.

WARNING

Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. The maximum continuous operating speed is 1800 RPM.

PRIMING

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 the pump is properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

This pump is self-priming, but the pump should never be operated unless there is liquid in the casing.

CAUTION

Never operate a self-priming pump unless there is liquid in the casing. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.

Add liquid to the pump casing when:

1. The pump is being put into service for the first time.
2. The pump has not been used for a considerable length of time.
3. The liquid in the pump casing has evaporated.

Once the pump casing has been filled, the pump will prime and reprime as necessary.

WARNING

After filling the pump casing, reinstall and tighten the fill plug. Do not attempt to operate the pump unless all connecting piping is securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.

To fill the pump, remove the pump casing fill cover or fill plug at the top of the casing and add clean liquid until the pump is filled. Replace the fill cover or fill plug before operating the pump.

STARTING

Consult the operations manual furnished with the engine.

OPERATION

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve. See Section E, Page 1.

Lines With a Bypass

Either a Gorman-Rupp automatic air release valve or a hand operated shutoff valve may be installed in a bypass line.

If a Gorman-Rupp automatic air release valve has been installed, close the throttling valve in the discharge line. The Gorman-Rupp valve will automatically open to allow the pump to prime, and automatically close when priming has been accomplished. After the pump has been primed, and liquid is flowing steadily from the bypass line, open the discharge throttling valve.

If a hand operated shutoff valve has been installed, close the throttling valve in the discharge line, and open the bypass shutoff valve so that the pump will not have to prime against the weight of the liquid in the discharge line. When the pump has been primed, and liquid is flowing steadily from the bypass line, close the bypass shutoff valve and open the discharge throttling valve.

Lines Without a Bypass

Open all valves in the discharge line and start the power source. Priming is indicated by a positive reading on the discharge pressure gauge or by a quieter operation. 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 it and check the suction line for leaks.

After the pump has been primed, partially close the discharge line throttling valve in order to fill the line slowly and guard against excessive shock pressure which could damage pipe ends, gaskets, sprinkler heads, and any other fixtures connected to the line. When the discharge line is completely filled, adjust the throttling valve to the required flow rate.

Leakage

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

Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 110°F. Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump and allow it to cool before servicing it. Refill the pump casing with cool liquid.

WARNING

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

Strainer Check

If a suction strainer has been shipped with the pump or installed by the user, check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. If a vacuum suction gauge has been installed, monitor and record the readings regularly to detect strainer blockage.

Never introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown on the pump performance curve. (See Section E, Page 1). If the pump is fitted with a Gorman-Rupp double grease lubricated seal, the maximum incoming pressure must be reduced to 10 p.s.i..

Pump Vacuum Check

With the pump inoperative, install a vacuum gauge in the system, using pipe dope on the threads. Block the suction line and start the pump. At operating speed the pump should pull a vacuum of 20 inches or more of mercury. If it does not, check for air leaks in the seal, gasket, or discharge valve.

Open the suction line, and read the vacuum gauge with the pump primed and at operating speed. Shut off the pump. The vacuum gauge reading will immediately drop proportionate to static suction lift, and should then stabilize. If the vacuum reading falls off rapidly after stabilization, an air leak exists. Before checking for the source of the leak, check the point of installation of the vacuum gauge.

STOPPING

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly. On engine driven pumps, reduce the throttle speed slowly and allow the engine to idle briefly before stopping.

CAUTION

If application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

After stopping the pump, remove the engine ignition key or take other action to ensure that the pump will remain inoperative.

Cold Weather Preservation

In below freezing conditions, drain the pump to prevent damage from freezing. Also, clean out any solids by flushing with a hose. Operate the pump for approximately one minute; this will remove any remaining liquid that could freeze the pump rotating parts.

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, drain the pump, and flush it thoroughly with clean water. To prevent large solids from clogging the drain port and preventing the pump from completely draining, insert a rod or stiff wire in

the drain port, and agitate the liquid during the draining process. Clean out any remaining solids by flushing with a hose.

BEARING TEMPERATURE CHECK

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160°F are considered normal for bearings, and they can operate safely to at least 180°F.

Checking bearing temperatures by hand is inaccurate. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the housing. Record this temperature for future reference.

A sudden increase in bearing temperatures is a warning that the bearings are at the point of failing to operate properly. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see LUBRICATION in MAINTENANCE AND REPAIR). 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.

PUMP TROUBLESHOOTING - SECTION D

WARNING

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.
3. Allow the pump to cool if overheated.
4. Vent the pump slowly and cautiously.
5. Close the suction and discharge valves.
6. Check the temperature before opening any covers, plates, or plugs.
7. Drain the pump.

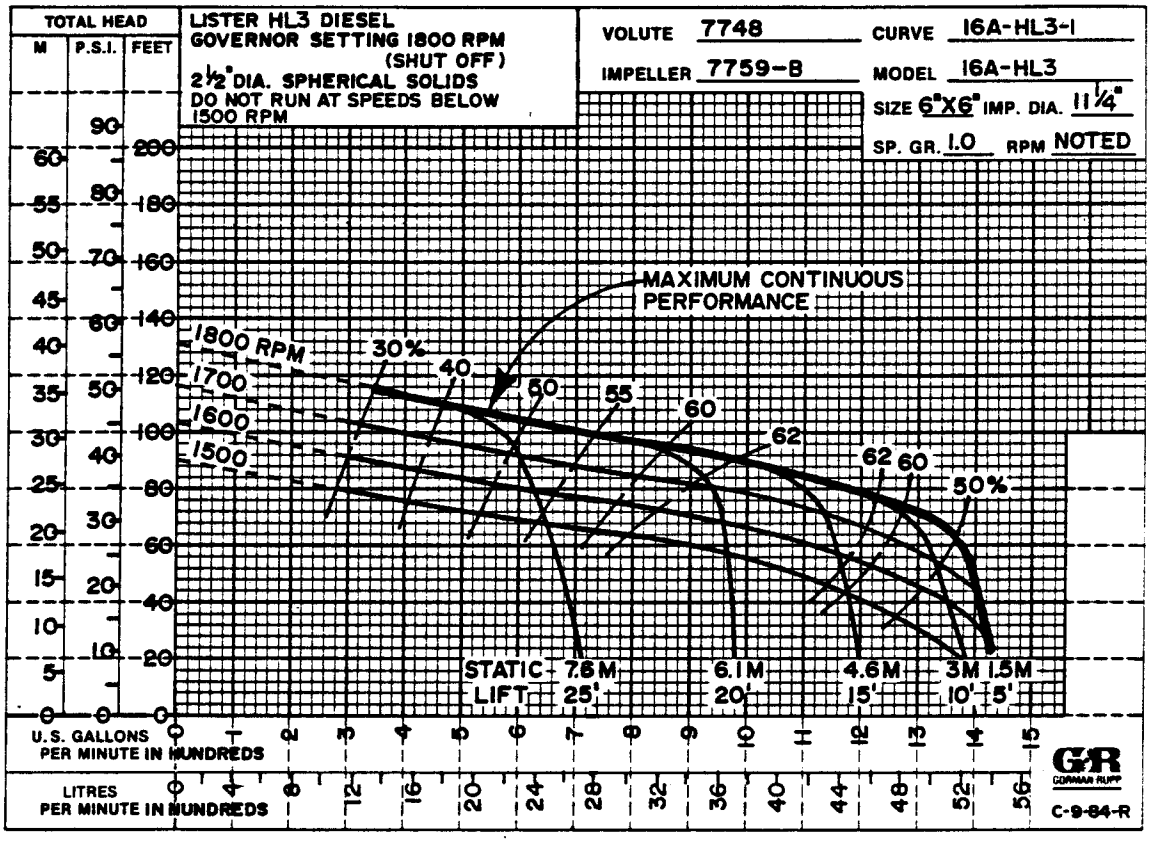
TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See INSTALLATION.
	Strainer clogged.	Check strainer and clean if necessary.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Air leak in suction line.	Correct leak.
	Suction intake not submerged at proper level or sump too small.	Check installation and correct submergence as needed.
	Lining of suction hose collapsed.	Replace suction hose.
	Impeller or other wearing parts worn or damaged.	Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE(cont.)	Impeller clogged.	Free impeller of debris.
	Pump speed too slow.	Check engine output; consult engine operation manual.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See INSTALLATION.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Strainer clogged.	Check strainer and clean if necessary.
PUMP REQUIRES TOO MUCH POWER	Pump speed too high.	Check engine output.
	Discharge head too low.	Adjust discharge valve.
	Liquid solution too thick.	Dilute if possible.
PUMP CLOGS FREQUENTLY	Discharge flow too slow.	Open discharge valve fully to increase flow rate, and run engine at maximum governed speed.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Discharge line clogged or restricted; hose kinked.	Check discharge lines; straighten hose.
EXCESSIVE NOISE	Cavitation in pump.	Reduce suction lift and/or friction losses in suction line. Record vacuum and pressure gauge readings and consult local representative or factory.
	Pumping entrained air.	Locate and eliminate source of air bubble.
	Pump or drive not securely mounted.	Secure mounting hardware.
	Impeller clogged or damaged.	Clean out debris; replace damaged parts.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits.	Check bearing temperature regularly to monitor any increase.
	Low or incorrect lubricant.	Check for proper type and level of lubricant.
	Suction and discharge lines not properly supported.	Check piping installation for proper support.
	Drive misaligned.	Align drive properly.

PUMP MAINTENANCE AND REPAIR - SECTION E

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



*STANDARD PERFORMANCE FOR PUMP MODEL 16A2-HL3

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

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

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve. See Section E, Page 1.

SECTIONAL DRAWING

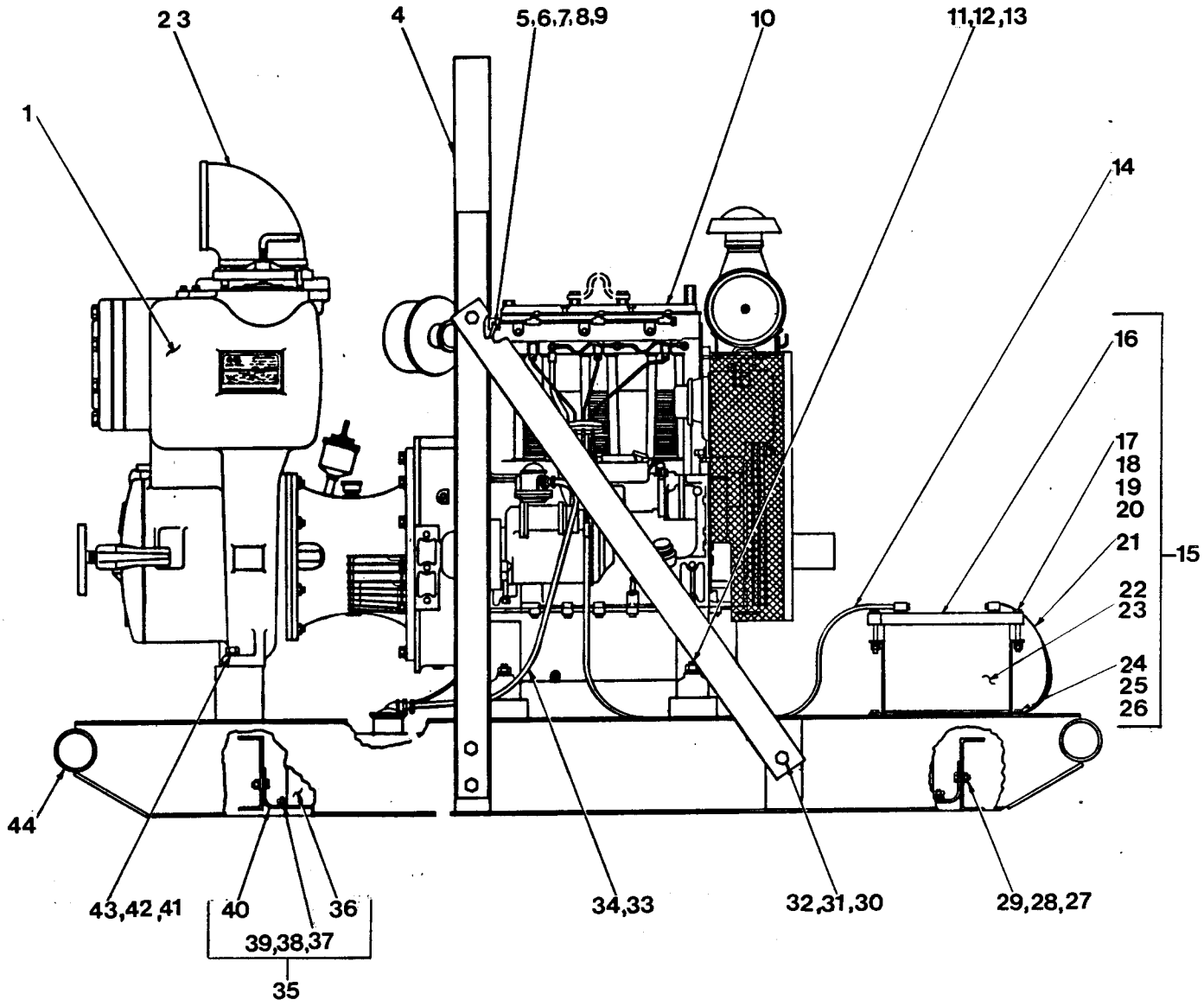


Figure 1. Pump Model 16A2-HL3

PARTS LIST
Pump Model 16A2-HL3
(From S/N 831132 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	MATL CODE	QTY
1	PUMP END ASSY	(SEE FIGURE 2)		1
2	PIPE ELBOW	R00096	11990	REF
3	PIPE NIPPLE	T00096	15070	REF
4	HOIST BAIL ASSY	13351-BC	24000	1
5	FUEL LINE	11308-A	-----	1
6	HOSE CLAMP	26518-642	-----	2
7	HOSE CONNECTOR	26523-402	-----	1
8	REDUCING ELBOW	Q00402	11990	1
9	HOSE END	S02065	-----	1
10	LISTER HL3 ENGINE	29231-252	-----	1
11	HEX HD CAPSCREW	B00812	15991	4
12	LOCKWASHER	J00008	15991	4
13	HEX NUT	D00008	15991	4
14	*POS CABLE ASSY	6926-B	24040	1
15	BATTERY BOX ASSY	GRP40-02-A	-----	1
16	-BATTERY FRAME	8355-B	24000	1
17	-HEX HD CAPSCREW	B00612	15991	2
18	-FLAT WASHER	K00006	15991	2
19	-LOCKWASHER	J00006	15991	2
20	-HEX NUT	D00006	15991	2
21	* -GRND CABLE ASSY	5795-AC	24040	1
22	* -BATTERY	29331-513	-----	1
23	-BATTERY BOX	8356-B	24000	1
24	-HEX HD CAPSCREW	B00604	15991	2
25	-LOCKWASHER	J00006	15991	2
26	-HEX NUT	D00006	15991	2
27	HEX HD CAPSCREW	B00604	15991	10
28	LOCKWASHER	J00006	15991	10
29	HEX NUT	D00006	15991	10
30	HEX HD CAPSCREW	B01006	15991	8
31	LOCKWASHER	J00010	15991	8
32	HEX NUT	D00010	15991	8
33	MALE UNION	26351-024	-----	1
34	FUEL RET HOSE	46341-777	-----	1
35	FUEL TANK & GUARD ASSY	46711-041	-----	1
36	-FUEL TANK ASSY	46711-042	24150	1
37	-HEX NUT	D00006	15991	4
38	-FLAT WASHER	K00006	15991	4
39	-LOCKWASHER	J00006	15991	4
40	-GUARD ASSY	42381-046	24150	1
41	HEX HD CAPSCREW	B01209	15991	2
42	HEX NUT	D00012	15991	2
43	LOCKWASHER	J00012	15991	2
44	COMBINATION BASE	41566-643	24150	1
NOT SHOWN:				
	BATTERY TAG	6588-S	-----	1
OPTIONAL:				
	WHEEL KIT	GRP30-30	-----	1

*INDICATES PARTS RECOMMENDED FOR STOCK

Above Serial Numbers Do Not Apply To Pumps Made In Canada.

CANADIAN SERIAL NO ..... AND UP

SECTIONAL DRAWING

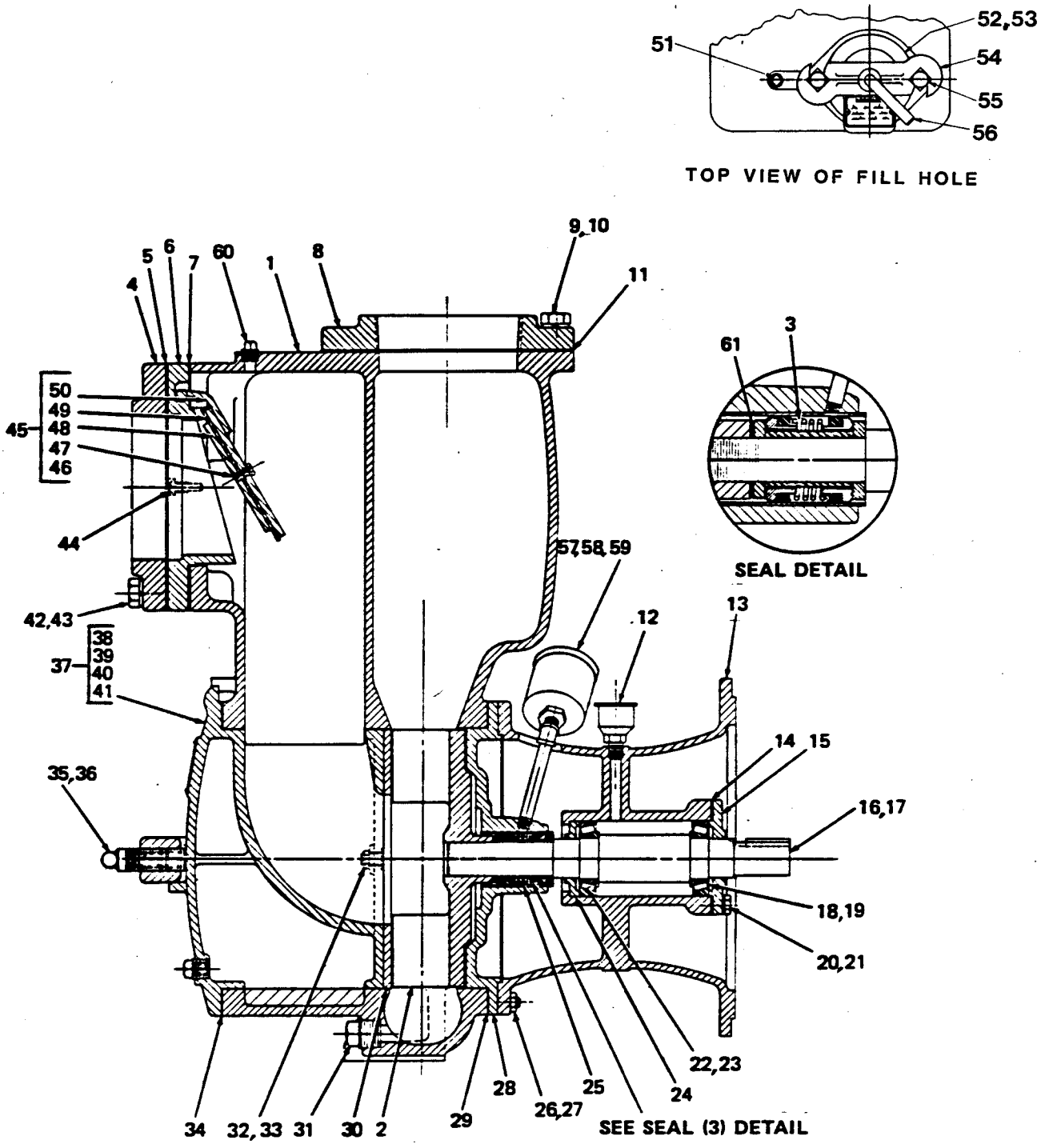


Figure 2. Pump End Assy 16A2-HL3

PARTS LIST
Pump End Assy 16A2-HL3

ITEM NO.	PART NAME	PART NUMBER	MATL CODE	QTY
1	PUMP CASING	7748	10010	1
2	*IMPELLER	7759-B	11000	1
3	*SEAL ASSY	GS01500	-----	1
4	SUCTION FLANGE	1758	10010	1
5	*SUCT FLANGE GSKT	1679-G	18000	1
6	CHECK VALVE SEAT	7261	10010	1
7	*VALVE SEAT GSKT	7261-G	18000	1
8	DISCHARGE FLANGE	1758	10010	1
9	HEX HD CAPSCREW	B01208	15991	8
10	LOCKWASHER	J00012	15991	8
11	*DISCH FLANGE GSKT	1679-G	18000	1
12	*INTERM GREASE CUP	S00035	-----	1
13	INTERMEDIATE	36-C	10010	1
14	*BEARING SHIM SET	48261-031	-----	1
15	BEARING CAP	43-X	10010	1
16	*IMP SHAFT	45	15010	REF
17	*IMP SHAFT KEY	N00607	15990	REF
18	*BEARING CUP	S01086	-----	1
19	*BEARING CONE	S01087	-----	1
20	HEX HD CAPSCREW	B00604	15991	4
21	LOCKWASHER	J00006	15991	4
22	*BEARING CUP	S01086	-----	1
23	*BEARING CONE	S01087	-----	1
24	BEARING CLOSURE	44	10010	1
25	*SEAL LINER	7408	14010	REF
26	STUD	C00809	15991	8
27	HEX NUT	D00008	15991	8
28	SEAL PLATE	11895-A	10010	1
29	*CASING GSKT SET	34-G	18000	1
30	*WEAR PLATE ASSY	2545	15990	1
31	CASING DRAIN PLUG	P00016	11990	1
32	HEX NUT	D00008	15991	2
33	LOCKWASHER	J00008	15991	2
34	*BACK CVR PLATE GSKT	7668-G	20000	1
35	COVER CLAMP SCREW	2536	24000	1
36	COVER CLAMP BAR	2547	11000	1
37	*BACK COVER PLATE ASSY	42111-932	-----	1
38	-WARNING PLATE	2613-EV	13990	1
39	-BACK COVER PLT	NOT AVAILABLE		1
40	-DRIVE SCREW	BM#04-03	15990	4
41	-DRAIN PLUG	P00008	11990	1
42	HEX HD CAPSCREW	B01212	15991	8
43	LOCKWASHER	J00012	15991	8
44	RD HD MACH SCREW	X00404	17090	1
45	*CHECK VALVE ASSY	7265	-----	1
46	-HEX HD CAPSCREW	B00403	17000	2
47	-LOCKWASHER	J00004	17090	2
48	* -VALVE WEIGHT	7263	15990	1
49	* -CHECK VALVE	7264	19070	1
50	* -VALVE WEIGHT	7262	24000	1
51	PIPE PLUG	P00004	11990	1
52	*FILL COVER PLATE ASSY	42111-344	-----	1
53	*FILL COVER GSKT	50-G	19210	1
54	CLAMP BAR	38111-004	11000	1
55	MACHINE BOLT	A01014	15991	2
56	CLAMP BAR SCREW	31912-009	15000	1
57	HVY PIPE NIPPLE	THA00416	15070	1
58	PIPE ELBOW	AG00004	11990	1
59	*SEAL GREASE CUP	S01509	-----	1
60	PIPE PLUG	P00004	11990	1
61	*IMP ADJ SHIM SET	5091	17090	REF
NOT SHOWN:				
	WARNING DECAL	38816-096	-----	1
	PIPE ELBOW	R00096	11990	1
	PIPE NIPPLE	T00096	11990	1
	NAME PLATE	38818-023	13990	1
	DRIVE SCREW	BM#04-03	15990	4
	STRAINER	7823	24000	1

*INDICATES PARTS RECOMMENDED FOR STOCK

SECTIONAL DRAWING

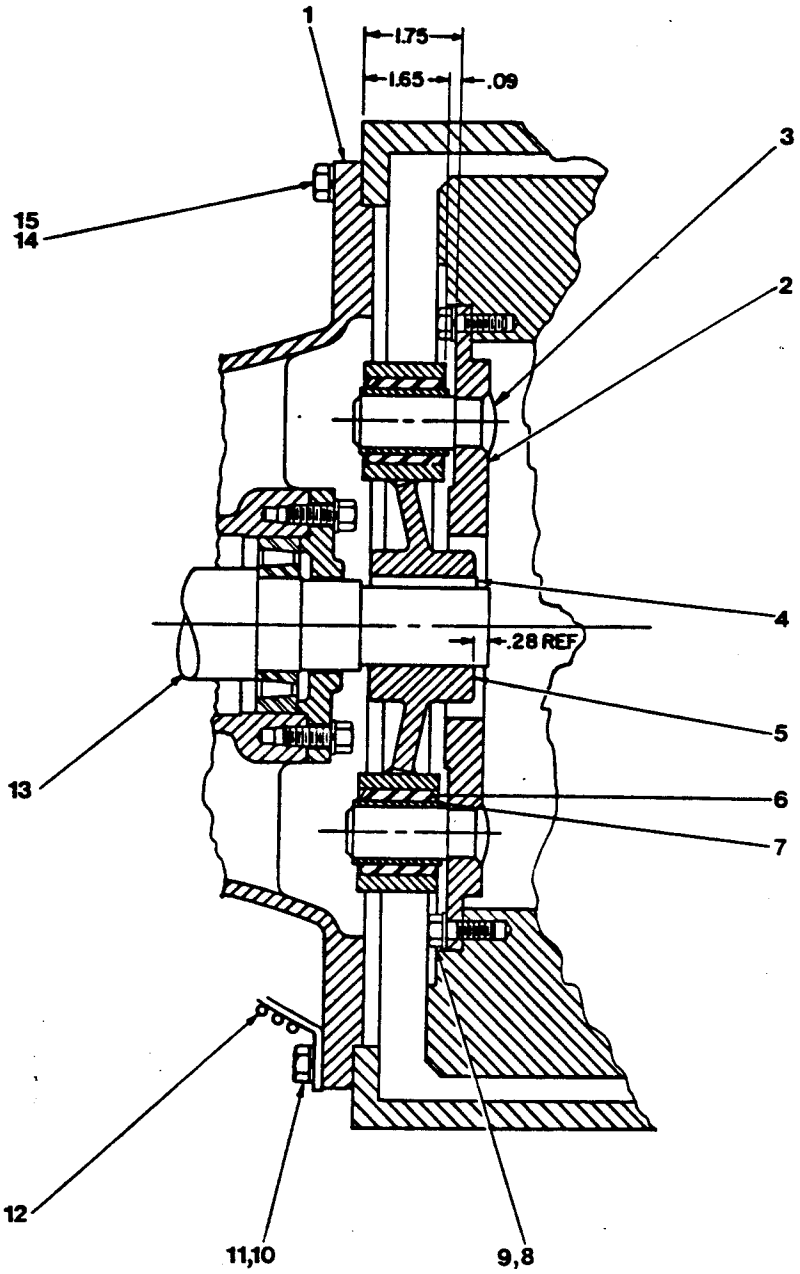


Figure 3. Drive Assembly For Pump Model 16A2-HL3

PARTS LIST
Drive Assembly For Pump Model 16A2-HL3

ITEM NO.		PART NAME	PART NUMBER	MATL CODE	QTY
1		INTERMEDIATE	36-C	10010	REF
2		DRIVE PLATE ASSY	12320	15990	1
3	*	-DRIVE PIN	13819	15030	2
4	*	KEY	N00607	15990	1
5		DRIVE ARM ASSY	13817-C	-----	2
6		-DYNA FLEX JOINT	S02110	-----	2
7	*	-SLEEVE	NOT AVAILABLE	-----	2
8		HEX HD CAPSCREW	B00604-S	15991	8
9		LOCKWASHER	J00006	15991	8
10		HEX HD CAPSCREW	B00605-S	15991	4
11		LOCKWASHER	J00006	15991	4
12		INTERMEDIATE GUARD	42381-507	24150	2
13	*	IMPELLER SHAFT	45	15010	1
14		HEX HD CAPSCREW	B00604-S	15991	8
15		LOCKWASHER	J00006	15991	8

*INDICATES PARTS RECOMMENDED FOR STOCK

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

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 and 3) and the accompanying parts lists.

Most service functions may be performed by draining the pump and removing the back cover assembly. If major repair is required, the piping and/or engine must be disconnected.

Before attempting to service the pump, take precautions to ensure that the engine will remain inoperative and close all valves in the suction and discharge lines.

WARNING

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.
3. Allow the pump to cool if overheated.
4. Vent the pump slowly and cautiously.
5. Close the suction and discharge valves.
6. Check the temperature before opening any covers, plates, or plugs.
7. Drain the pump.

WARNING

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment.

Back Cover Removal

(Figure 2)

The impeller, wear plate, seal assembly and check valve can be serviced after the back cover assembly (37) has been removed.

Before removing the assembly, remove the pump casing drain plug (31) and the cover drain plug (41) and drain the pump. Clean and reinstall the drain plugs.

Loosen the cover clamp screw (35) and clamp bar (36) securing the back cover. Pull the back cover and assembled wear plate (30) from the pump casing (1). Inspect the wear plate for excessive wear or scoring and, if replacement is required, remove the hardware (32 and 33) securing it to the back cover.

Suction Check Valve Removal

(Figure 2)

For access to the check valve, remove the suction piping. Remove the hardware (42 and 43) securing the suction flange and gasket (4 and 5) to the pump casing (1).

Inspect the suction flange gasket for wear or damage, and replace as required.

Disengage the machine screw (44) and pull the check valve seat (6), gasket (7), and check valve assembly (45) from the suction port.

Inspect the check valve components for wear or damage. If replacement is required, remove the hardware (46 and 47) securing the check valve (49) and weights (48 and 50).

Impeller Removal

(Figure 2)

Before attempting to remove the impeller (2), turn the cross arm on the automatic lubricating seal grease cup (59) clockwise until it rests against the cover (see Figure 5). This will prevent the grease in the cup from escaping when the impeller is removed.

To loosen the impeller, immobilize the shaft (16) and tap the vanes in a counterclockwise direction (when facing impeller) with a block of wood or a soft-faced mallet. Unscrew the impeller and replace it if cracked or badly worn. Use caution when removing the impeller; tension on the seal spring will be released as the impeller is unscrewed.

Slide the impeller adjusting shims (61) off the impeller shaft. For ease of reassembly, tag and tie the shims, or measure and record their thickness.

Seal Disassembly

(Figure 2)

Remove the outer rotating element, stationary seat, packing rings, stationary washer and the seal spring. Remove the shaft sleeve. Remove the inner stationary washer, packing ring, stationary seat and rotating element using a stiff wire with a hooked end if necessary.

Inspect the seal liner (25) for wear or grooves that could cause leakage or damage to the seal packing rings. The seal liner is a press fit in the seal plate (28), and does not normally require replacement. If replacement is necessary, the seal plate must be removed (see **Pump Disassembly**).

If no further disassembly is required, see **Seal Reassembly And Installation**.

Pump Disassembly

(Figure 2)

To service the seal plate, intermediate, bearings, or drive assembly, the pump end must be removed from the base. See Figure 1, and remove the hardware (41, 42, and 43) securing the pump casing to the base.

Remove the nuts (27) securing the pump casing (1) and the seal plate (28) to the intermediate (13), and remove the pump casing. If shims have been used under the mounting feet to level the pump casing, tag and tie these shims. Before attempting to remove the seal plate, remove the grease cup and piping (57, 58, and 59). Slide the seal plate from the shaft.

Separating Intermediate And Drive Assembly From Engine

(Figure 3)

If necessary to separate the intermediate and drive assemblies from the engine, support the intermediate using a hoist and sling, and remove the hardware (10, 11 14 and 15) securing the intermediate (1) to the engine bellhousing. Separate the assemblies by pulling the intermediate straight away from the engine.

As the assemblies are separated, the drive pins (3) will disengage from the drive arm assembly (5). The drive arm assembly is a tight press fit on the shaft (13) and will remain on the shaft.

Use a bearing puller to remove the drive arm assembly from the impeller shaft. Remove the shaft key (4).

It is not necessary to remove the drive plate assembly (2) from the engine flywheel unless the drive pins are bent or worn and must be replaced. To remove the drive plate assembly, remove the hardware (8 and 9) securing the assembly to the engine flywheel.

The drive pins are secured into the drive plate by a tight press fit and peening. To remove the pins, drill through from the peened end and drive the pins out using a drift pin.

Inspect the dyna flex joints (7), and replace them if worn. The dyna flex joints are a press fit in the drive arm.

Impeller Shaft And Bearing Disassembly

(Figure 2)

When the pump is properly operated and maintained, the intermediate housing should not require disassembly. Disassemble the shaft and bearings **only** when there is evidence of wear or damage.

CAUTION

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

Remove the hardware (20 and 21) securing the bearing cap (15) to the intermediate (13), and remove the bearing cap and bearing shim set (14). Tag and tie the bearing shims, or measure and record their thickness.

Place a block of wood against the impeller end of the shaft (16), and tap the shaft and assembled bearings out of the intermediate. Remove the outboard bearing cup (18) from the bearing cone (19).

NOTE

> There is no provision for draining the grease from the intermediate cavity. Place a drip pan under the intermediate before removing the bearing.

Place the intermediate on a level surface with the drive side down, and press the bearing closure (24) and inboard bearing cup (22) from the intermediate bore.

Use a bearing puller to remove the inboard bearing cone (23) and outboard bearing cone (19) from the impeller shaft.

Impeller Shaft and Bearing Reassembly And Installation

(Figure 2)

Clean the intermediate, impeller 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.

WARNING

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

Inspect the shaft for distortion, nicks or scratches or damaged threads on the impeller end. Dress small nicks and burrs with a fine file or emery cloth. Replace the impeller shaft if defective.

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

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

CAUTION

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 rollers or roller cage and cause premature bearing failure.

The bearing tolerances provide a tight press fit onto the impeller shaft and a snug slip fit into the intermediate. Replace the shaft or intermediate if the proper bearing fit is not achieved.

Pre-pack the bearings by hand with No. 0 grease until the bearings are thoroughly lubricated.

Install the inboard and outboard bearing cones on the impeller shaft with the high side of the taper toward the lubrication cavity.

CAUTION

When installing the bearings onto the shaft, NEVER press or hit against the roller or roll cage. Press ONLY on the inner race.

Press the cones onto the shaft until they seat squarely against the shaft shoulders.

Press the bearing closure (24) into the intermediate until it seats squarely against the intermediate shoulder. Press the inboard bearing cup (22) into the intermediate until it seats squarely against the bearing closure.

CAUTION

When installing the bearing cups into the bearing bore, push against the outer race. NEVER hit the rollers or roll cage.

Slide the shaft and assembled bearing cones into the intermediate bore until the inboard bearing cone (23) fully engages the inboard bearing cup.

Install the outboard bearing cup (18) over the outboard bearing cone (19), and install the bearing shims (14).

NOTE

Shaft endplay should be between .003 and .005 inch. Add or remove bearing shims to establish the correct endplay.

Secure the bearing cap to the intermediate with the hardware (20 and 21).

Lubricate the bearings as indicated in **LUBRICATION**.

Securing Intermediate And Drive Assembly To Engine

(Figure 3)

If the drive pins were removed from the drive plate assembly, install new pins by pressing them into the drive plate and peening the ends. Secure the drive plate assembly to the engine flywheel with the attaching hardware (8 and 9).

Install the shaft key and press the drive arm assembly onto the impeller shaft.

CAUTION

Make certain that the drive plate and drive arm assemblies are mounted in accordance with the dimensions shown in Figure 3. If the drive assembly is not properly positioned on the impeller shaft, a preload condition can occur and cause premature thrust bearing failure.

Align the drive arm assembly so that the drive pins will engage the dyna flex joints, and secure the intermediate and intermediate guards to the engine bellhousing.

Pump Reassembly

(Figure 2)

Before installing the seal plate, inspect the bore of the seal liner (25) for wear or grooves that might cause leakage or damage to the seal packing rings. If the seal liner must be replaced, position the seal plate on the bed of an arbor (or hydraulic) press and use a new sleeve to force the old one out. After the new liner is properly installed, a 1/4 inch diameter hole must be drilled through it to permit the flow of lubricant to the seal assembly. **Be careful** to center the drill in the threaded grease pipe hole and not damage the threads. Deburr the hole from the inside of the seal liner after drilling.

Position the seal plate over the impeller shaft and temporarily secure it to the intermediate using two capscrews and nuts (1/2 UNC x 1 1/2 inch long, not supplied).

NOTE

It is recommended that the seal and impeller be installed at this time. It is best to adjust the back impeller clearance before installing the pump casing. See **Impeller Reassembly And Adjustment.**

Reinstall the automatic grease cup and piping (57, 58, and 59).

After the seal and impeller have been installed, remove the two capscrews temporarily holding the seal plate and install the same thickness of pump casing gaskets (29) as previously removed. Secure the pump casing and seal plate to the intermediate with the hardware (27). Be sure to reinstall any leveling shims used under the pump casing mounting feet before installing the base mounting hardware.

NOTE

The front impeller clearance must be adjusted after pump casing and back cover are fully reassembled by adding or subtracting pump casing gaskets (29). Do not secure the pump casing to the base until this operation is completed.

Seal Reassembly

(Figure 2 and 4)

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent.

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.

The seal is not normally 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 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 concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Clean and polish the seal spacer sleeve, or replace it if there are nicks or cuts on either end. If any components are worn, replace the complete seal; **never mix old and new seal parts.**

If a replacement seal is being used, remove it from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the packing rings and seal liner with water or a very **small** amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 4).

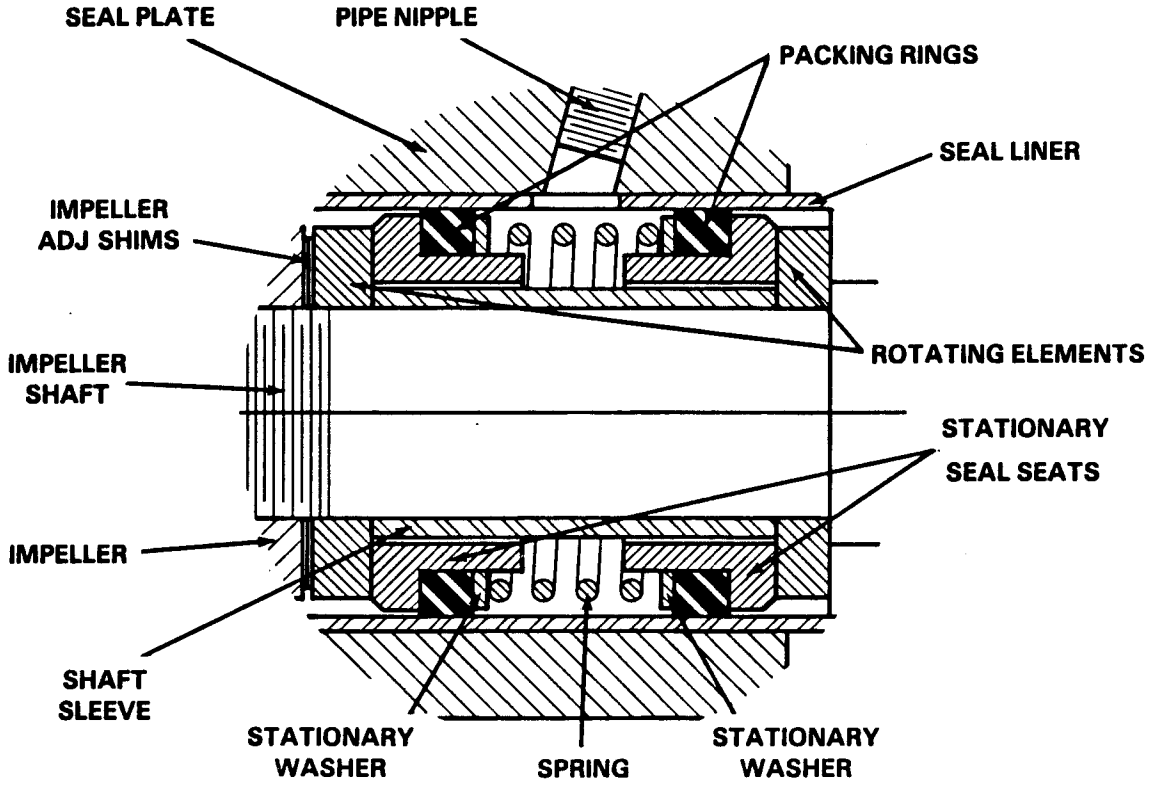


Figure 4. GS01500 Seal Assembly

CAUTION

This seal is not designed for operation at temperatures above 110°F. Do not use at higher operating temperatures.

Inspect the seal plate, the seal liner, and the impeller shaft for burrs or sharp corners, and remove any that exist. Replace the seal liner (25) if wear or grooves exist which could cause leakage or damage to the seal packing rings.

NOTE

The seal plate must be removed to install a new seal liner. See **Pump Reassembly** for specific instructions on seal liner installation.

Position the inboard rotating element onto the shaft with the chamfered side facing the shaft shoulder and slide it on until fully seated.

Subassemble the inboard stationary seat, packing ring, and spring washer and press the unit into the lubricated seal liner.

Install the spacer sleeve and spring.

Subassemble the outboard stationary seat, packing ring, and spring washer. Press this unit into the lubricated seal liner.

Install the outboard rotating element with chamfered side facing the impeller.

Lubricate the seal as indicated in **LUBRICATION**, after the impeller has been installed.

Impeller Installation

(Figure 2)

Inspect the impeller, and replace it if cracked or badly worn.

Slide the same number of impeller adjusting shims (61) as previously removed onto the shaft and screw the impeller on until tight.

A clearance of .020 to .040 inch between the impeller and the seal plate is necessary for maximum pump efficiency. Measure this clearance, and add or remove impeller shims until it is reached.

NOTE

If the pump has been completely disassembled, install a new pump casing gasket set and secure the pump casing to the intermediate at this time.

A clearance of .010 to .020 inch between the impeller and the wear plate is also recommended for maximum pump efficiency. This clearance must be set after installing the back cover, by adding or removing gaskets in the pump casing gasket set until the impeller binds against the wear plate when the shaft is turned. After the impeller binds, add .015 inch of gaskets.

NOTE

An alternate method of adjusting this clearance is to reach through the discharge port with a feeler gauge and measure the gap. Add or subtract pump casing gaskets accordingly.

Suction Check Valve Installation

(Figure 2)

Inspect the check valve components, and replace as required. Subassemble the check valve weights and check valve using the attaching hardware (46 and 47).

Install the check valve in the valve seat. Replace the seat gasket and secure the valve seat to the suction port using the round head machine screws. Replace the suction flange gasket and secure the suction flange. Check operation of the check valve to ensure proper seating and free movement.

NOTE

If the suction or discharge flange was removed, replace the respective gaskets and apply "Permatex Aviation No. 3 Form-A-Gasket" or equivalent to the mating surfaces.

Back Cover Installation

(Figure 2)

If removed for replacement, secure the wear plate (30) to the back cover with the hardware (32 and 33).

Clean any scale or debris that might prevent a good seal from the back cover shoulder and pump casing. Replace the back cover gasket (34) and slide the back cover assembly into the pump casing. Be sure the wear plate does not bind against the pump casing.

NOTE

To ease future disassembly, apply a film of grease or 'Never-Seez' on the back cover shoulder, or any surface that contacts the pump casing. This will reduce rust and scale build-up.

Secure the back cover assembly by installing the clamp bar and tightening the cover clamp screw. **Do not** over tighten the clamp screw; it should be just tight enough to ensure a good seal at the back cover shoulder.

Final Pump Reassembly

(Figure 1)

Be sure the pump is secured to the base and engine.

Install the suction and discharge lines, and open all valves. Make certain that all piping connections are secure.

Be sure the pump end and engine have been properly lubricated, see **LUBRICATION**.

Fill the pump casing with clean liquid. Reinstall the fill cover plate and tighten it.

Refer to **OPERATION**, Section C, and start the pump.

LUBRICATION

Seal Assembly

Fill the grease cup through the grease fitting with a good grade of No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal (see Figure 5).

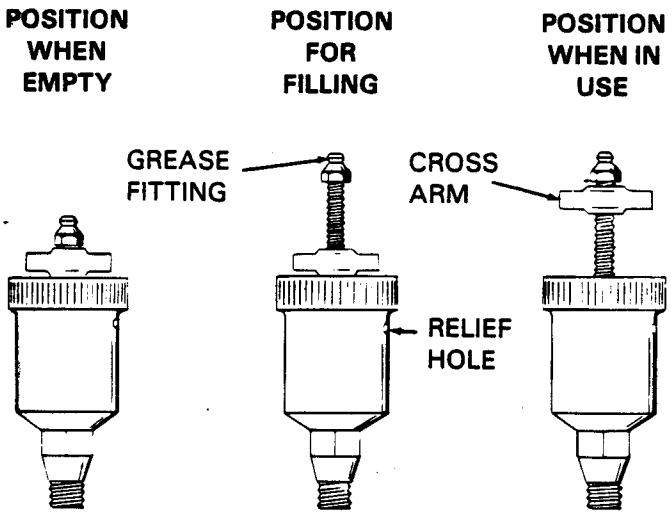


Figure 5. Automatic Lubricating Grease Cup

Bearings

The intermediate was fully lubricated when shipped from the factory. Under normal conditions, turn the cap on the grease cup three complete turns to add grease to the intermediate after each 250 hours of operation (or once each month, whichever comes first). **Do not** over-lubricate. Over-lubrication can cause the bearings to over-heat, resulting in premature bearing failure. When the grease cup is empty, refill it with No. 0 lithium base grease.

CAUTION

> If grease is forced out around the shaft as new grease is added, the bearing cavity is full and should be disassembled and cleaned immediately.

There are no provisions in the bearing cavity to drain or flush the lubricant. The pump and intermediate must be disassembled to completely clean and maintain this cavity.

Under normal conditions, change the grease after each 5000 hours of operation, or at 12 month intervals, whichever comes first. Change the grease more frequently if the pump is operated continuously or installed in an environment where variable hot and cold temperatures are common.

When lubricating a dry (overhauled) intermediate, fill the cavity through the grease cup with approximately one-sixth of a pound of grease (approximately one-third full).

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

Engine

Refer to the engine manufacturer's recommendations.

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

For Canadian Warranty Information,
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