

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST



0 SERIES PUMP

MODEL
04E1-GHH

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

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TABLE OF CONTENTS

INTRODUCTION	PAGE I – 1
WARNINGS – SECTION A	PAGE A – 1
INSTALLATION – SECTION B	PAGE B – 1
PREINSTALLATION INSPECTION	PAGE B – 1
PUMP INSTALLATION	PAGE B – 1
Pump Specifications	PAGE B – 1
Pump and Mounting Dimensions	PAGE B – 2
DIMENSIONAL DRAWING	PAGE B – 3
VEHICLE REQUIREMENTS	PAGE B – 4
Tank Preparation	PAGE B – 4
Vehicle Configuration	PAGE B – 4
Brake Installation	PAGE B – 4
Air Cylinder Pressure	PAGE B – 4
POSITIONING PUMP	PAGE B – 4
Lifting	PAGE B – 4
Mounting Location	PAGE B – 5
Mounting Brackets	PAGE B – 5
Drive Flanges	PAGE B – 6
DRIVE SHAFT AND LINKAGE CONNECTIONS	PAGE B – 6
Drive Shaft Alignment	PAGE B – 6
Gear Shift Connections	PAGE B – 7
SUCTION AND DISCHARGE PIPING	PAGE B – 8
Typical System Installation	PAGE B – 8
Piping	PAGE B – 9
Valves	PAGE B – 10
Eductors	PAGE B – 11
OPERATION – SECTION C	PAGE C – 1
PRIMING	PAGE C – 1
GROUNDING	PAGE C – 1
STARTING	PAGE C – 2
OPERATION	PAGE C – 2
Operating Controls	PAGE C – 2
Shifting Sequence	PAGE C – 2
OPERATING CHECKS	PAGE C – 3
Leakage	PAGE C – 3
Strainer Check	PAGE C – 3
Liquid Temperature And Overheating	PAGE C – 3
Pump Vacuum Check	PAGE C – 3
STOPPING	PAGE C – 4
Cold Weather Preservation	PAGE C – 4
TROUBLESHOOTING – SECTION D	PAGE D – 1
PUMP MAINTENANCE AND REPAIR – SECTION E	PAGE E – 1
STANDARD PERFORMANCE CURVE	PAGE E – 1
PARTS LISTS:	
Pump Model	PAGE E – 3

TABLE OF CONTENTS (continued)

Gearbox Assembly	PAGE E - 5 & 7
24571-801 Air Shift Installation Kit	PAGE E - 9
48123-401 Cross Member Kit	PAGE E - 11
PUMP AND SEAL DISASSEMBLY	PAGE E - 12
Removing Pump and Gearbox	PAGE E - 12
Suction Head and Wear Ring Removal	PAGE E - 13
Impeller Removal	PAGE E - 13
Seal Removal	PAGE E - 13
Pump Casing Removal	PAGE E - 13
PUMP AND SEAL REASSEMBLY	PAGE E - 13
Pump Casing Installation	PAGE E - 13
Seal Reassembly and Installation	PAGE E - 14
Impeller Installation	PAGE E - 16
Suction Head and Wear Ring Installation	PAGE E - 17
Installing Pump and Gearbox	PAGE E - 17
Final Pump Assembly	PAGE E - 17
GEARBOX DISASSEMBLY	PAGE E - 17
Air Shift Cover Disassembly	PAGE E - 17
Drive Flange Removal	PAGE E - 18
Output Shaft Disassembly	PAGE E - 18
Input Shaft Disassembly	PAGE E - 18
Idler Shaft Disassembly	PAGE E - 19
Impeller Shaft Disassembly	PAGE E - 19
Cleaning and Inspecting Bearings	PAGE E - 19
GEARBOX REASSEMBLY	PAGE E - 20
Impeller Shaft Reassembly	PAGE E - 20
Idler Shaft Reassembly	PAGE E - 20
Input Shaft Reassembly	PAGE E - 21
Output Shaft Reassembly	PAGE E - 21
Air Shift Cover Reassembly	PAGE E - 22
Pressure Testing	PAGE E - 22
Drive Flange Installation	PAGE E - 22
LUBRICATION	PAGE E - 23
Seal Assembly	PAGE E - 23
Trunnion Bracket	PAGE E - 23
Gearbox Assembly	PAGE E - 23
Intermittent (Normal Refueler) Duty Cycle	PAGE E - 23
Continuous Pumping Duty Cycle	PAGE E - 23

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 an 0 Series, enclosed impeller, self-priming centrifugal model, with straight-in suction without a suction check valve. It is designed for ve-

hicular mounting in petroleum service. The basic material of construction for wetted parts is aluminum, with cast iron wear rings.

The pump is close-coupled to an integral, 1950 RPM split-shaft gearbox speed increaser with a 2.56:1 ratio. Power is transmitted to the gearbox through a customer-installed universal shaft assembly.

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

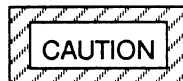
Gorman-Rupp of Canada Limited
70 Burwell Road
St. Thomas, Ontario N5P 3R7

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

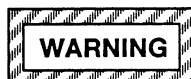
The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:

NOTE

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



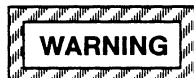
INSTRUCTIONS WHICH MUST BE FOLLOWED TO AVOID CAUSING DAMAGE TO THE PRODUCT OR OTHER EQUIPMENT INCIDENTAL TO THE INSTALLATION. THESE INSTRUCTIONS DESCRIBE THE REQUIREMENTS AND THE POSSIBLE DAMAGE WHICH COULD RESULT FROM FAILURE TO FOLLOW THE PROCEDURES.



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.

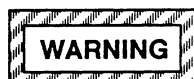
WARNINGS – SECTION A

THESE WARNINGS APPLY TO 0 SERIES SPLIT-SHAFT REFUELER PUMPS. GORMAN-RUPP HAS NO CONTROL OVER OR PARTICULAR KNOWLEDGE OF THE TRUCK CHASSIS WHICH WILL BE USED. REFER TO THE MANUAL ACCOMPANYING THE TRUCK BEFORE ATTEMPTING TO BEGIN OPERATION.



BEFORE ATTEMPTING TO OPEN OR SERVICE THE PUMP:

1. FAMILIARIZE YOURSELF WITH THIS MANUAL.
2. SWITCH OFF THE VEHICLE IGNITION AND REMOVE THE KEY, OR TAKE OTHER ACTION TO ENSURE THAT THE PUMP WILL REMAIN INOPERATIVE.
3. ALLOW THE PUMP TO COOL IF OVERHEATED.
4. CHECK THE TEMPERATURE BEFORE OPENING ANY COVERS, PLATES, OR PLUGS.
5. CLOSE THE SUCTION AND DISCHARGE VALVES.
6. VENT THE PUMP SLOWLY AND CAUTIOUSLY.
7. DRAIN THE PUMP.



THIS PUMP IS DESIGNED FOR VEHICULAR MOUNTING IN PETROLEUM SERVICE. DO NOT ATTEMPT TO PUMP CORROSIVE MATERIALS, OR ANY LIQUIDS WHICH MAY DAMAGE THE PUMP OR ENDANGER PERSONNEL AS A RESULT OF PUMP FAILURE.

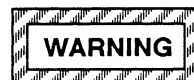


IF THIS PUMP IS USED WITH VOLATILE AND/OR FLAMMABLE LIQUIDS, BE CERTAIN PROPER SAFETY PRACTICES ARE FOLLOWED BEFORE OPERATING OR SERVICING THE PUMP. PROVIDE ADEQUATE VENTILATION, PROHIBIT

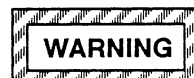
SMOKING, WEAR STATIC-RESISTANT CLOTHING AND SHOES. CLEAN UP ALL FUEL SPILLS IMMEDIATELY AFTER OCCURRENCE.



DO NOT OPERATE THE PUMP AGAINST A CLOSED DISCHARGE VALVE FOR LONG PERIODS OF TIME. IF OPERATED AGAINST A CLOSED DISCHARGE VALVE, PUMP COMPONENTS WILL DETERIORATE, AND THE LIQUID COULD COME TO A BOIL, BUILD PRESSURE, AND CAUSE THE PUMP CASING TO RUPTURE OR EXPLODE.



IF THIS PUMP IS USED WITH VOLATILE AND/OR FLAMMABLE LIQUIDS, OVERHEATING MAY PRODUCE DANGEROUS FUMES. TAKE PRECAUTIONS TO ENSURE THE AREA SURROUNDING THE PUMP IS ADEQUATELY VENTILATED. ALLOW THE PUMP TO COOL AND USE EXTREME CAUTION WHEN VENTING THE PUMP, OR WHEN REMOVING COVERS, PLATES, PLUGS, OR FITTINGS.



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.



AFTER THE VEHICLE IS POSITIONED FOR PUMP MAINTENANCE, BLOCK THE WHEELS AND SET THE EMERGENCY BRAKE BEFORE ATTEMPTING TO DISCONNECT THE DRIVE SHAFT OR REMOVE THE PUMP. BE SURE THE PUMP IS PROPERLY REINSTALLED AND SECURE BEFORE OPERATION.



NEVER TAMPER WITH THE GOVERNOR TO GAIN MORE POWER. THE GOVERNOR ESTABLISHES SAFE OPERATING LIMITS THAT SHOULD NOT BE EXCEEDED. LIMIT THE MAXIMUM INPUT SPEED (1950 RPM) AND PERFORMANCE AS INDICATED ON THE PERFORMANCE CURVE ON PAGE E-1.

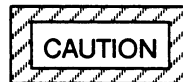


THE GEARBOX PROVIDED ON THIS PUMP IS DESIGNED FOR OPERATION AT A MAXIMUM INPUT SPEED OF 1950 RPM. IF OPERATED AT A HIGHER RPM, PUMP OR GEARBOX COMPONENTS MAY BE DESTROYED.

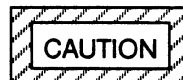


DECALS AND TAGS VITAL TO PUMP OPERA-

TION WERE SHIPPED LOOSE WITH THE PUMP. AFFIX THESE DECALS IN A PROMINENT PLACE VISIBLE TO THE PUMP OPERATOR.



NEVER RUN THE PUMP DRY OF PUMPING MEDIUM. THERE MUST BE A SUPPLY OF LIQUID TO THE PUMP AT ALL TIMES TO PREVENT DESTRUCTION OF THE SHAFT SEAL FACES.



THIS PUMP HAS BEEN SHIPPED DRY OF GEARBOX LUBRICATION, EXCEPT FOR 6 OUNCES (18 ML) OF DOW CORNING 'MOLYKOTE® M GEAR GUARD' (AN ANTI-WEAR ADDITIVE, CONSISTING OF MOLYBDENUM DISULPHIDE SOLID LUBRICANTS SUSPENDED IN PETROLEUM OIL). THE GEARBOX MUST BE LUBRICATED BEFORE THE PUMP IS OPERATED (SEE LUBRICATION IN SECTION E).

INSTALLATION – SECTION B

Review all WARNINGS in Section A.

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



DO NOT TEST OR OPERATE THIS PUMP AND INTEGRAL GEARBOX BEFORE READING THE INSTALLATION AND OPERATION INSTRUCTIONS ON THIS MANUAL.

This pump is an 0 Series, semi-enclosed impeller, self-priming centrifugal model with straight-in suction, and an integral split-shaft gearbox assembly. The pump is designed for vehicular mounting in petroleum service, where the liquid is supplied to the pump under pressure. The gearbox replaces a part of the main drive shaft connecting the transmission to the rear axle.

This design permits full utilization of engine power to selectively operate either the pump or the rear driving wheels on the vehicle. **Both cannot be operated at the same time.**

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

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 gearbox for cracks, dents, damaged threads, and other obvious damage.

- b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.
- c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated. Note the direction of rotation indicated on the pump. Check that the pump shaft rotates in the required direction.



ONLY OPERATE THIS PUMP IN THE DIRECTION INDICATED ON THE GEARBOX AND/OR THE ACCOMPANYING DECAL. REVERSE ROTATION OF THE SHAFT WILL ADVERSELY EFFECT PUMP PERFORMANCE, AND THE PUMP AND/OR GEARBOX COULD BE SERIOUSLY DAMAGED.

- d. Check 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 gearbox 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.

PUMP INSTALLATION

Pump Specifications

See Table 1 for the typical pump specifications and gearbox data.

Table 1. Pump Specifications

Pump Type	Self-priming, centrifugal with enclosed impeller
Suction	4-inch "Victaulic" fitting
Discharge	4-inch "Victaulic" fitting
Nominal Capacity	See the Performance Curve, Page E-1
Impeller Shaft Seal	Mechanical self-lubricated
Gearbox (Air Shift)	
Air Pressure Required at Shift Cylinder	70-140 psi (5,1-10,2 kg/cm ²) through 1/4" line
Gear Ratio	2.56:1 Speed Increase
Input shaft Rotation	Clockwise (when viewed from the trunnion end)
Maximum Input Speed	1950 RPM (See the Performance Curve, Page E-1)
Input & Output Shaft	Heavy-duty 2-3/4 inch - 10 spline
Input & Output Flanges	"Dana" Heavy-Duty 1800 Series
Lubrication	68 U.S. ounces (2011 ml) - See LUBRICATION , Section E for SAE grade 6 fl. oz. (18 ml) 'Molykote® M Gear Guard' (Dow Corning)
Approx. Net Weight (pump and gearbox)	285 pounds (129,3 kg)

Table 2. Through Torque Capacity Based On Shaft and Spline Size

Type of Engine	Transmission	Max Through Torque (ft.-lbs.)
Diesel	Automatic	11,000
	Manual	10,000
Gasoline	Automatic	13,300
	Manual	12,300

Pump and Mounting Dimensions

A 40 inch (1016 mm) cross member is provided for mounting the output end of the gearbox, and a trunnion mount is provided for the input end. This design

provides a flexible three-point suspension. The trunnion mount prevents the chassis frame twist from being transmitted through the gearbox.

See Figures 1 on page B-3 and Figure 2 on page E-4 for the physical dimensions of the pump.

VEHICLE REQUIREMENTS

The following instructions apply equally to new installations, rebuilds or retrofits.



AFTER INSTALLATION, DO NOT ATTEMPT TO TEST RUN OR OPERATE THE PUMP AND INTEGRAL GEARBOX BEFORE READING **OPERATION**, SECTION B. THE GEARBOX WAS SHIPPED DRY OF LUBRICATION, EXCEPT FOR 6 OUNCES (18 ML) OF DOW CORNING 'MOLYKOTE® M GEAR GUARD' (AN ANTI-WEAR ADDITIVE, CONSISTING OF MOLYBDENUM DISULPHIDE SOLID LUBRICANTS SUSPENDED IN PETROLEUM OIL). LUBRICATE THE GEARBOX AS INSTRUCTED IN **LUBRICATION**, SECTION E BEFORE ATTEMPTING TO OPERATE THE PUMP.

Tank Preparation

It is **essential** that any tank scale, dirt, or other foreign material be removed from the tank and piping prior to pump installation. Failure to do so could result in clogging or damage to the pump.



DAMAGE TO THE PUMP RESULTING FROM DEBRIS IN THE SUCTION LINE WILL NOT BE COVERED BY THE PUMP WARRANTY.

BEFORE CONNECTING THE SUCTION AND DISCHARGE PIPING, CAREFULLY CHECK THE STORAGE TANK AND PIPING FOR CONSTRUCTION DEBRIS SUCH AS NUTS, BOLTS, WIRE, WELD SLAG, AND OTHER FOREIGN MATERIAL. INSTALL A COMMERCIALLY AVAILABLE 80 MESH SCREEN IN THE SUCTION LINE TO PREVENT DEBRIS FROM ENTERING THE PUMP.

Brake Installation

When shifting from vehicle drive to pump mode, or vice versa, **drive shaft rotation must be limited to 15 RPM or less** to prevent raking of gears. Vehicles with automatic transmissions should be equipped

with a brake on the transmission shaft to stop shaft rotation during shifting.

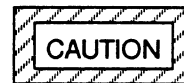
Air Cylinder Pressure

For proper operation of the gearbox, the air shift device requires air pressure of 70 to 140 psi (5,1 to 10,2 kg/cm²). See **Gear Shift Connections** for further information.

POSITIONING PUMP

Lifting

Use lifting equipment with a capacity of at least **1,425 pounds (260 kg.)**. This pump weighs approximately **285 pounds (129,3 kg.)**, not including the weight of accessories and cross-members.



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.

DUE TO THE CONFINED MOUNTING LOCATION, SPECIALIZED EQUIPMENT SUCH AS A TRANSMISSION JACK WITH CUSTOM BRACKETS SHOULD BE USED TO LIFT AND POSITION THE PUMP AND GEARBOX.

Mounting Location

The following factors must be considered when selecting a mounting location for the pump.

- a. Mounting brackets
- b. Universal joint angles
- c. Shift linkage
- d. Piping
- e. Ground clearance
- f. Accessibility of pump and gearbox for service.

Any damage to the pump or gearbox resulting from improper mounting and installation is **not** covered by the Gorman-Rupp Warranty.

Mounting Brackets

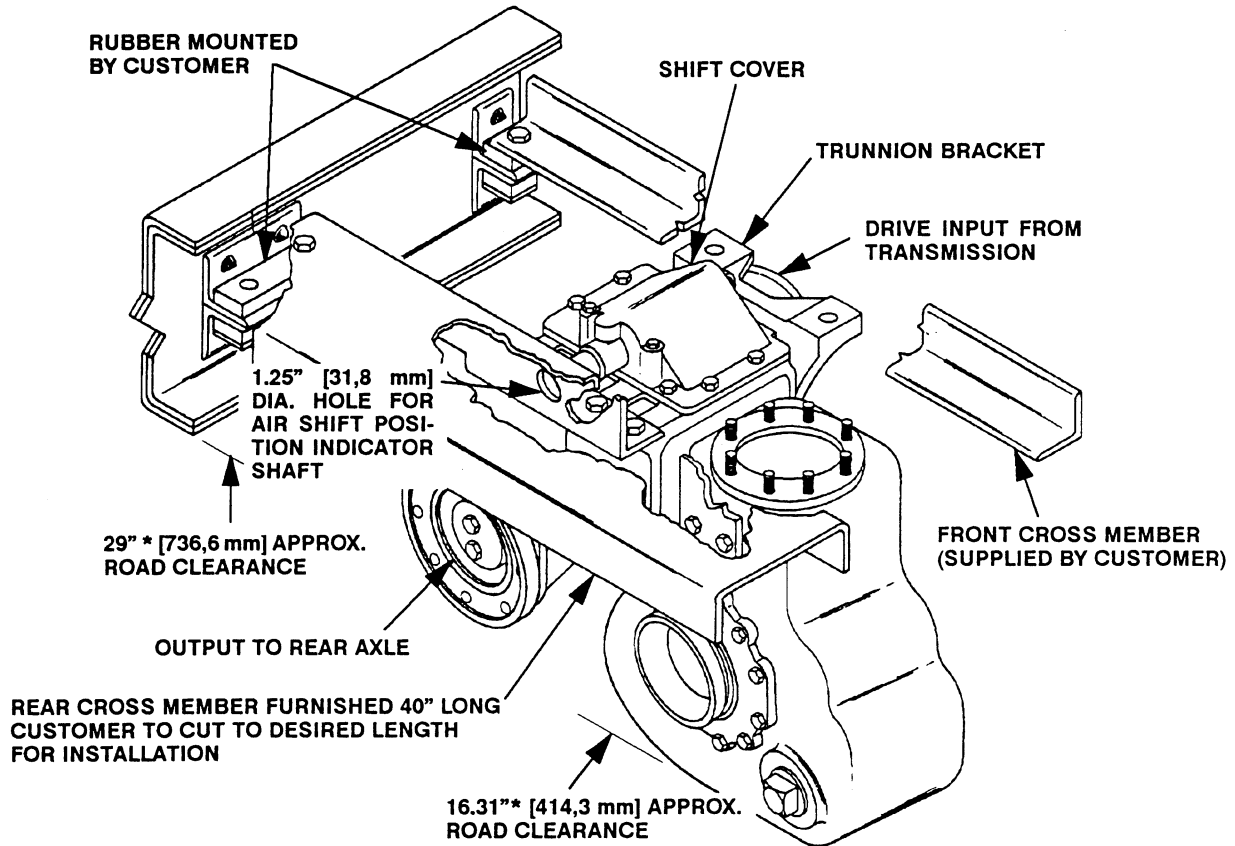
The customer must furnish two cross members which fit between the vehicle chassis side rails (see Figure 2). They must be heavy enough to support the weight of the pump assembly and provide easy access for pump maintenance.

Secure the rear cross member rigidly to the pump and gearbox using a fabricated mounting bracket (customer-furnished). The mounting bracket must fasten to the threaded holes located in the pump casing above the pump suction, and in the top of the gearbox housing. The bracket and cross member

must not obstruct pump operation or impede removal of the pump casing during maintenance.



THE REAR CROSS MEMBER OR MOUNTING BRACKET MUST NOT INTERFERE WITH MOVEMENT OF THE AIR SHIFT INDICATOR SHAFT (LOCATED ON TOP OF THE GEARBOX). IF NECESSARY, DRILL A 1.25-INCH DIAMETER HOLE THROUGH THE CROSS MEMBER OR BRACKET TO PROVIDE CLEARANCE.



NOTE: DIMENSIONS MARKED WITH AN ASTERISK (*) MAY BE ALTERED TO FACILITATE INSTALLATION OF UNIT

Figure 2. Typical Pump Mounting on Vehicle Chassis

The drive input end of the gearbox is fitted with a trunnion which prevents chassis frame twist from being transmitted through the gearbox. Mount the trunnion to the front cross member (not supplied) to support the drive input end of the pump. When mounting the trunnion, make certain that it will not interfere with the input drive flange. The trunnion mounting foot **must** be directed toward the input flange.

Position the cross members and mounted pump on the side rails of the chassis. The cross members **must** be mounted with rubber or other vibration-dampening material when secured to the side rails.

Do not secure the cross members to the side rails before establishing the exact location and position of the air shift rod and shift indicator connections. Be careful not to put the pump in a bind from front to rear during mounting. Improper alignment could result in bearing or gear failure, or gearbox breakage (see **Drive Shaft Alignment**).

Drive Flanges

The input and output shafts on the gearbox (2-3/4 inch, 10-spline) are equipped with heavy-duty Dana 1800 Series flanges. The shaft splines are designed to produce a tight interference fit with the drive flange. This fit is intentional to eliminate fretting corrosion.

For instructions on removing and installing the flanges, see the specific areas in **MAINTENANCE AND REPAIR**, Section E.

DRIVE SHAFT AND LINKAGE CONNECTIONS

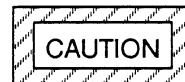
Drive Shaft Alignment

To promote maximum universal joint and bearing life, the universal joint angles must be kept to a minimum. A joint angle of 1 degree is **required** for proper needle bearing circulation, but excessive angles cause accelerated wear and require a lower maximum operating speed (see Table 3).

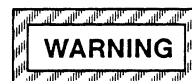
Table 3. Joint Angle/Maximum RPM

JOINT ANGLE	MAXIMUM SPEED
5 degrees	5000 RPM
6 degrees, 30 minutes	4000 RPM
8 degrees	3000 RPM

Align the gearbox with the transmission and the rear axle to obtain the optimum universal joint angles. See Figure 3 for drive shaft alignment.



BE CERTAIN THE REAR AXLE POSITION WHEN THE VEHICLE IS EMPTY OR FULLY LOADED WILL NOT CAUSE EXCESSIVE UNIVERSAL JOINT ANGLES, OR CAUSE THE DRIVE SHAFT SLIP JOINTS TO BOTTOM OUT.



WHEN INSTALLING AND/OR ALIGNING UNIVERSAL SHAFT ASSEMBLIES, SHUT OFF THE VEHICLE IGNITION AND REMOVE THE KEY TO ENSURE THAT THE PUMP WILL REMAIN INOPERATIVE.

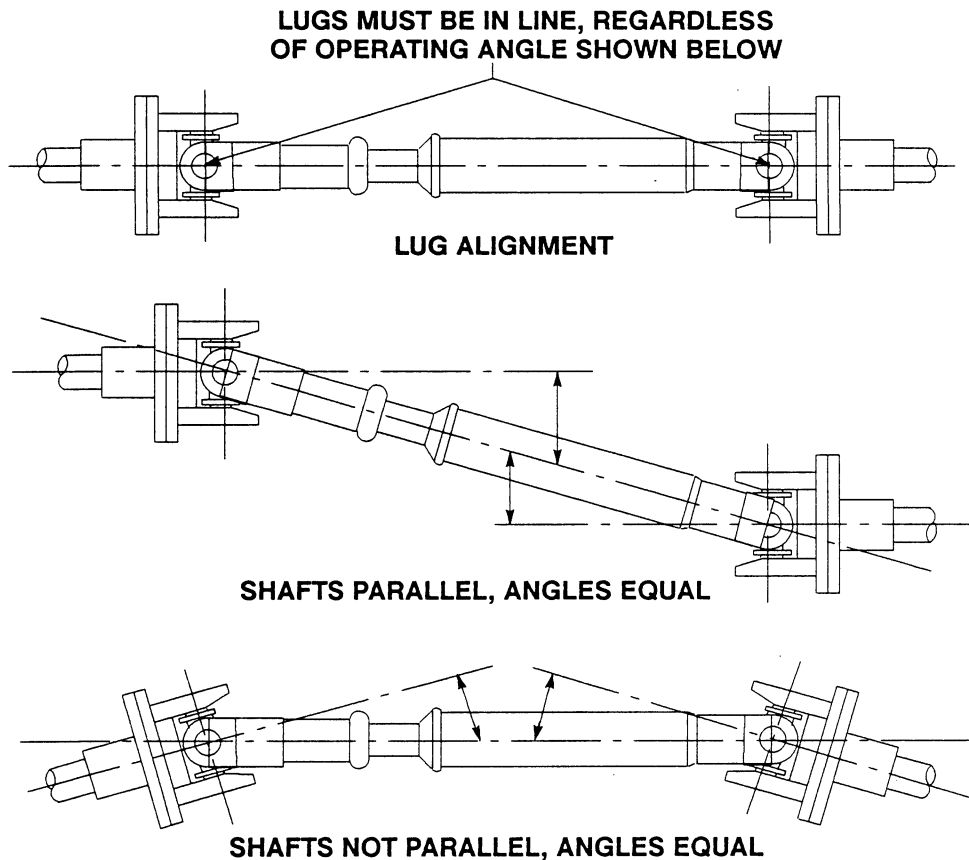


Figure 3. Drive Shaft Alignment

The alignment of the pump and its power source is critical for trouble-free mechanical operation. Before checking alignment, make sure that the gearbox mounting bolts are tight.

When connecting the universal joint drive shaft assembly to a PTO unit, install, support, and align the drive shaft in accordance with the manufacturer's instructions. The pump and the drive power source are generally positioned so that shaft centerlines are parallel and horizontal.

Make sure the horizontal and vertical joints are equal. Limit the angles to 1 to 3 degrees using a short coupled joint, and less than 8 degrees with a double joint assembly. The maximum operating angle should not exceed 15 degrees (see Figure 3).

NOTE

Install a short coupled slip joint on the input side and a double joint with slip on the output side of the gearbox to attain the prescribed angles and eliminate

tensile stress on the shaft.

The input and output shafts should be completely subassembled and checked for straightness and balance before installation. Also check the universal joint yokes for proper alignment.

Check the direction of rotation of the PTO unit before starting the pump. The drive shaft must rotate in the direction shown on the body of the pump, gearbox, and/or decals, tags, and labels.

Gear Shift Connections

After the pump is mounted to the chassis, hook up the air shift rod to the proper control stations.



DECALS AND TAGS VITAL TO PUMP OPERATION WERE SHIPPED LOOSE WITH THE PUMP.

THESE DECALS MUST BE AFFIXED IN A PROMINENT PLACE VISIBLE TO THE PUMP OPERATOR.

Proper operation of the gearbox air shift requires 1/4-inch air lines and air pressure of 70 to 140 psi (5,1 to 10,2 kg/cm²) **at the gearbox**. The air line connection at the end cap of the air cylinder is for vehicle operation, and the air line connection at the top of the air shifter cover is for pump operation. Seal all hose fittings with "Permatex" or equivalent compound.

When activated, the shifter rod travels through a hole in the rear cross member. A customer-supplied shift indicator (mechanical, electrical, or air operated device) should be installed in this area to indicate shifter mode to the pump operator. A tapped hole is provided in the shaft for convenience.

See Figure 4 and 5 for approximate shaft travel and hole size. See Figure 4, Section E for Air Shift Kit parts.

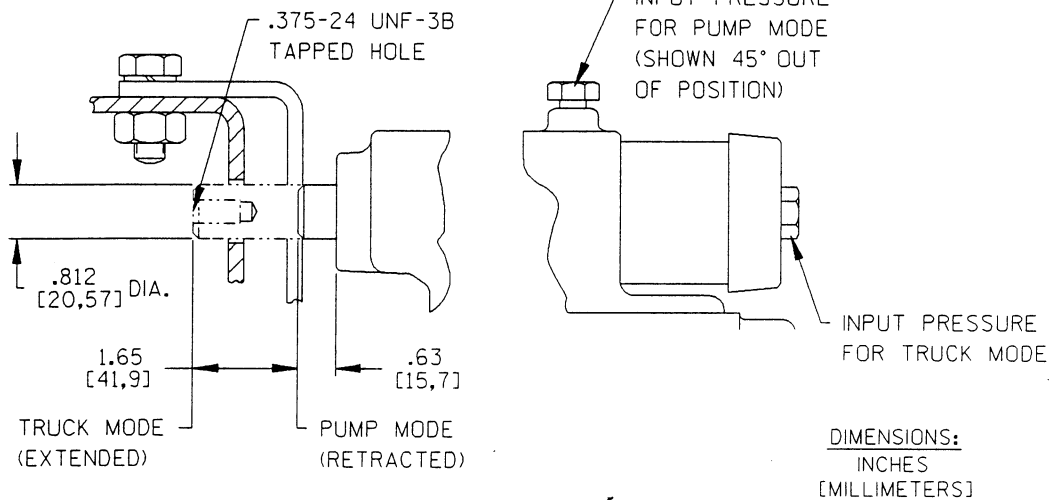


Figure 4. Air Shifter Shaft Detail

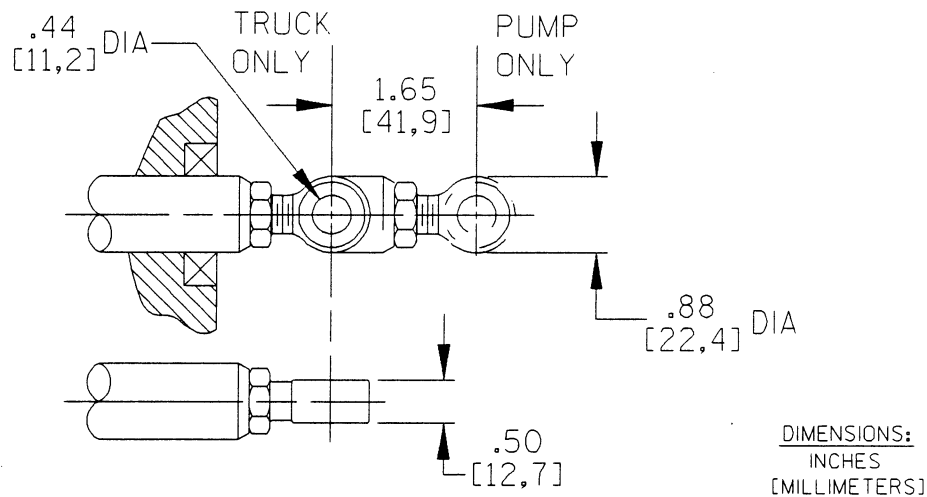


Figure 5. Optional Manual Shifter

SUCTION AND DISCHARGE PIPING

Typical System Installation

Most petroleum handling vehicles perform both fueling and defueling operations. This requires a system

utilizing flow-directing (FDF) valves, eductors, related piping and safety accessories. Some of the accessories are available from Gorman-Rupp as optional equipment.

Refer to Figures 6 and 7 for illustrations of typical piping systems used on refueling vehicles.

SCHEMATIC SYSTEM USING EDUCTOR FOR DISPENSING AND FILLING

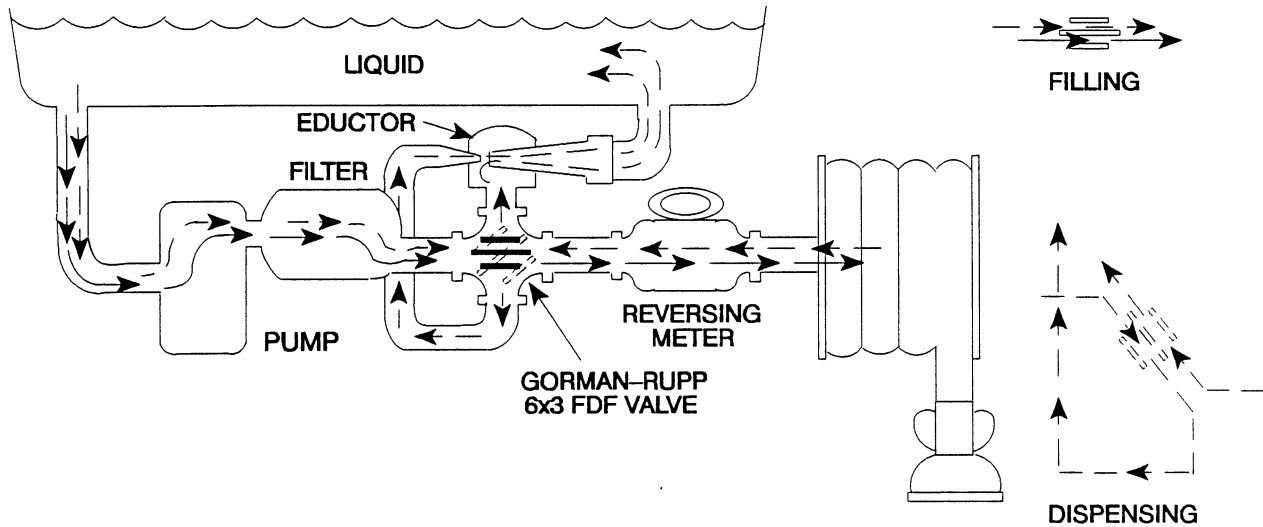
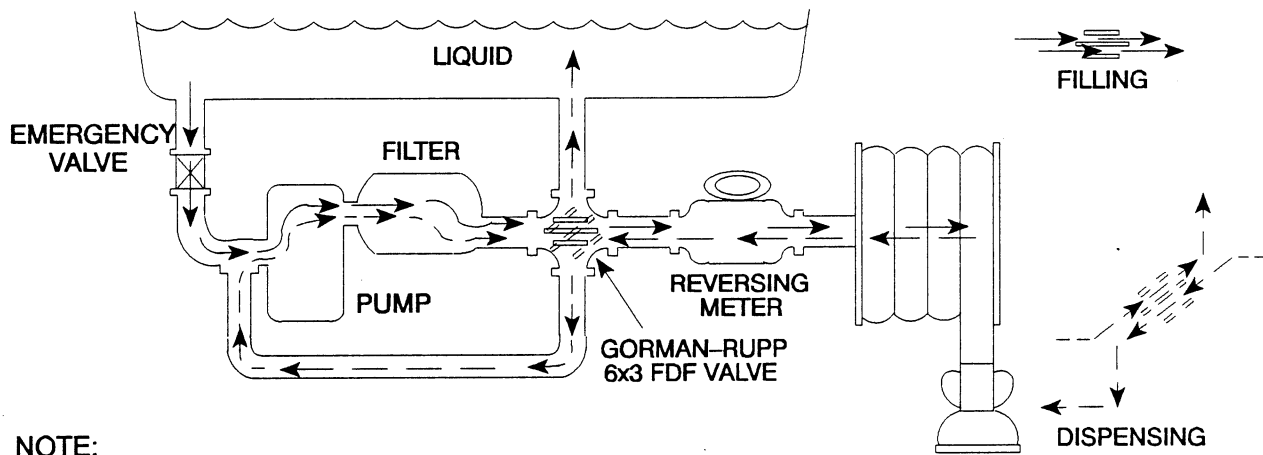


Figure 6. Typical Installation Using Eductor For Filling And Dispensing

SCHEMATIC SYSTEM USING PUMP FOR DISPENSING AND FILLING



NOTE:
 EMERGENCY VALVE OPEN FOR FILLING
 EMERGENCY VALVE CLOSED FOR DISPENSING

Figure 7. Typical Installation Using Pump For Filling And Dispensing

Piping

Run the 4-inch suction piping from the tank sump to the pump inlet. The suction lines should be as short and straight as possible to minimize friction loss.

All piping material 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.

A suction strainer was not furnished with this pump since it is **not** designed to handle liquids containing solids. However, to protect the pump from accidental damage a commercially available 80 mesh

screen should be installed in the suction line. Make certain that the total open area of the screen is at least three or four times the cross section of the suction line to ensure an adequate supply of liquid to the pump.



DAMAGE TO THE PUMP RESULTING FROM DEBRIS IN THE SUCTION LINE WILL NOT BE COVERED BY THE PUMP WARRANTY.

BEFORE CONNECTING THE SUCTION AND DISCHARGE PIPING, CAREFULLY CHECK THE STORAGE TANK AND PIPING FOR CONSTRUCTION DEBRIS SUCH AS NUTS, BOLTS, WIRE, WELD SLAG, AND OTHER FOREIGN MATERIAL. INSTALL A COMMERCIALY AVAILABLE 80 MESH SCREEN IN THE SUCTION LINE TO PREVENT DEBRIS FROM ENTERING THE PUMP.

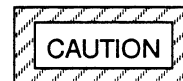
The pump discharge is a 4-inch "Victaulic" type fitting. The discharge should be mounted just below the top of the chassis frame. It can easily be piped to the filter inlet, discharge manifold, valves, etc..

To avoid wracking, flexible connections or bellows **must** be installed in the pump suction and discharge.

Do not tighten connecting flanges unless they are properly aligned. Never pull a pipe into place by tightening the flange bolts.

Valves

Gorman-Rupp manufactures several sizes of flow-diverting (FDF) valves for use in truck-mounted pumping applications. The valves are designed to reverse the flow of liquid with only the turn of a handle. This allows the same pump to fill or dispense from the tank.



THE FDF VALVE IS DESIGNED FOR DIRECTING FLOW ONLY. IT WILL NOT SERVE AS A POSITIVE SHUTOFF OR THROTTLING VALVE.

See Figures 8 and 9 illustrating the installation dimensions and theory of operation for a typical FDF valve. Consult the factory for further assistance or other sizes.

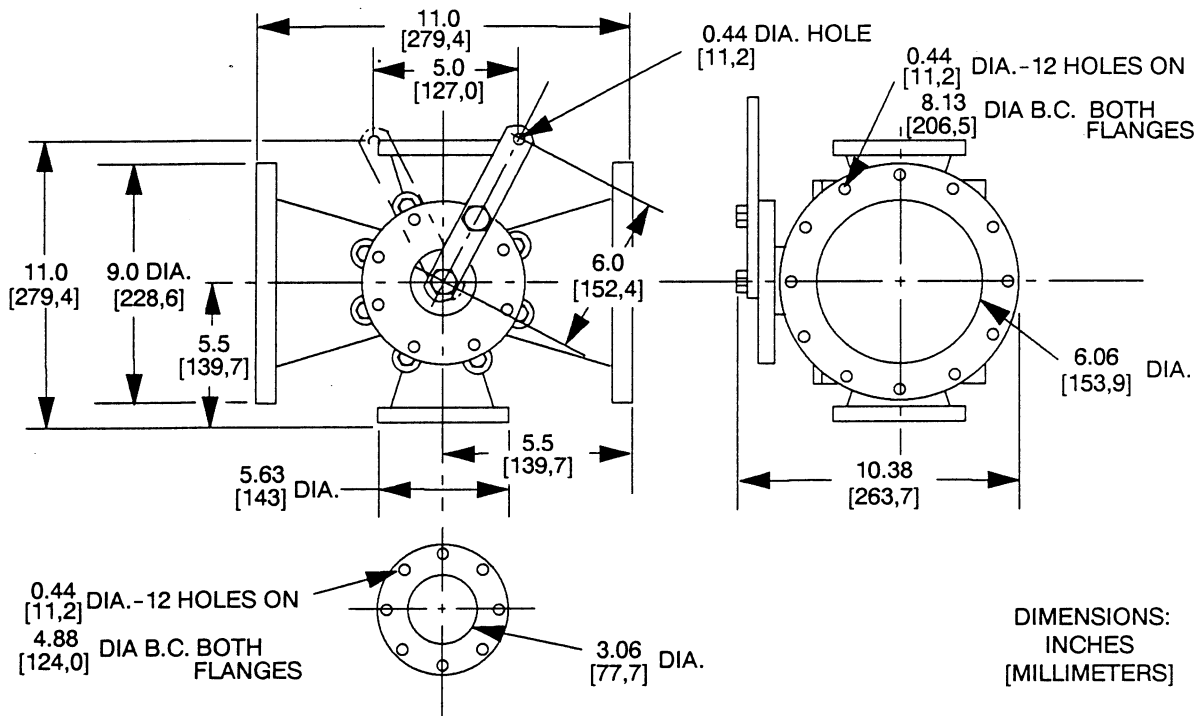


Figure 8. Typical FDF Valve Installation Dimensions

When the center web of the valve is aligned with the 6-inch ports (fueling position), the flow passes straight through. When the handle is turned to the de-

fueling position, the web blocks the straight flow and opens two paths of flow through the 6-inch and 3-inch ports.

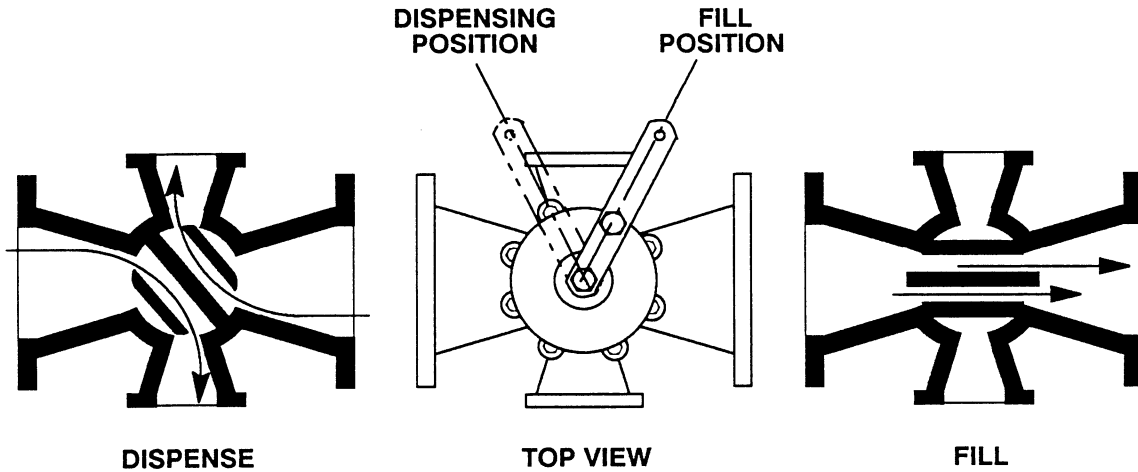


Figure 9. FDF Valve Theory of Operation

Eductors

An eductor may be used in conjunction with an FDF valve to increase dispensing rates and improve efficiency. An eductor may also be used to collapse the

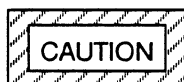
tank service hose after the tank has been filled or emptied.

Contact the Gorman-Rupp Company or an authorized distributor for specifications and performance data on eductors or FDF valves.

OPERATION – SECTION C

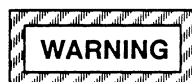
Review all warnings in Section A.

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

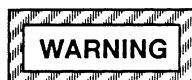


WHETHER NEW INSTALLATION OR REBUILD OF REFUELER, THE FOLLOWING REQUIREMENTS APPLY:

1. IT IS ESSENTIAL THAT TANK SCALE, DIRT, AND ANY OTHER FOREIGN ELEMENTS BE REMOVED FROM THE TANK AND PIPING PRIOR TO PUMP INSTALLATION.
2. THE GEARBOX WAS SHIPPED DRY OF LUBRICANT. LUBRICATION **MUST** BE ADDED BEFORE ANY OPERATION.
3. THE PUMP **MUST NOT** BE RUN DRY OF PRODUCT AT ANY TIME.



THIS PUMP IS DESIGNED FOR VEHICULAR MOUNTING IN PETROLEUM SERVICE. DO NOT ATTEMPT TO PUMP CORROSIVE LIQUIDS WHICH MAY DAMAGE THE PUMP OR ENDANGER PERSONNEL AS A RESULT OF PUMP FAILURE.

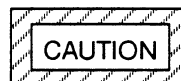


NEVER TAMPER WITH THE GOVERNOR TO GAIN MORE POWER. THE GOVERNOR ESTABLISHES SAFE OPERATING LIMITS THAT SHOULD NOT BE EXCEEDED. THE GEARBOX PROVIDED ON THIS PUMP IS DESIGNED FOR OPERATION AT A MAXIMUM INPUT SPEED OF 1950 RPM. IF OPERATED AT A HIGHER RPM, PUMP OR GEARBOX COMPONENTS MAY BE DESTROYED.

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 and gearbox are properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

This pump is not self-priming, but should never be operated unless there is liquid in the pump casing.



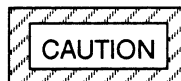
NEVER OPERATE THIS PUMP UNLESS THERE IS LIQUID IN THE PUMP CASING. THE PUMP WILL NOT PRIME WHEN DRY. EXTENDED OPERATION OF A DRY PUMP WILL DESTROY THE SEAL ASSEMBLY.

When installed in a flooded suction application, simply open the system valves and permit the incoming liquid to evacuate the air. After the pump and piping system have completely filled, evacuate any remaining air pockets in the pump or suction line by loosening a pipe plug or opening bleeder valves.

Once the pump casing has been filled, the pump will prime as long as positive suction head is available.

GROUNDING

To eliminate electrostatic build-up by the liquid being pumped, the pump must be grounded by attaching a ground wire to a ground rod (grounding is not required if pumping water). Install the ground rod in accordance with the National Electrical Code and all local codes. Be sure the clamp or fastener has made a tight electrical connection with the rod.



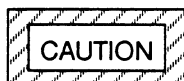
INSPECT AND TEST THE GROUND WIRE ASSEMBLY FOR CONDUCTIVITY. REPLACE BROKEN OR FRAYED WIRE BEFORE RESUMING OPERATION.

STARTING

Consult the operations manual furnished with the vehicle.

Rotation

The correct direction of pump rotation is clockwise when facing the gearbox input shaft. The pump could be damaged and performance adversely affected by incorrect rotation. If pump performance is not within the specified limits (see the curve on page E-1), check the direction of rotation before further troubleshooting.

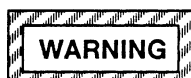


ONLY OPERATE THE INPUT SHAFT IN A CLOCKWISE DIRECTION WHEN FACING THE INPUT SHAFT. OTHERWISE, PUMP PERFORMANCE WILL BE ADVERSELY AFFECTED, AND THE PUMP AND/OR GEARBOX COULD BE SERIOUSLY DAMAGED.

Drive

The pump and gearbox assembly are designed to be mounted midship between the chassis frame members. The gearbox split shaft replaces a part of the vehicle drive shaft connecting the transmission to the rear axle.

The gearbox assembly has a ratio of 2.56:1, and is designed for operation at a maximum input speed of 1950 RPM. **Do not** operate at a higher input speed.



THE GEARBOX PROVIDED ON THIS PUMP IS DESIGNED FOR OPERATION AT A MAXIMUM INPUT SPEED OF 1950 RPM. IF OPERATED AT A HIGHER RPM, PUMP OR GEARBOX COMPONENTS MAY BE DESTROYED.

OPERATION

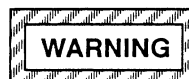


DO NOT OPERATE THE PUMP AGAINST A CLOSED DISCHARGE VALVE FOR LONG PERIODS OF TIME. IF OPERATED AGAINST A CLOSED DISCHARGE VALVE, PUMP COMPONENTS WILL DETERIORATE, AND THE LIQUID COULD COME TO A BOIL, BUILD PRESSURE, AND CAUSE THE PUMP CASING TO RUPTURE OR EXPLODE.

The split drive shaft of the pump gearbox provides for selective operation of either the pump or the vehicle; **both cannot be operated at the same time.**

Operating Controls

Since Gorman-Rupp has no control over the actual installation, it is the obligation of the tank builder or the installer to devise controls to **safely** operate the pump from inside the cab, or from a remote control panel. All instructions and operational procedures for the pump and system **must** be provided to the pump operator.



DECALS AND TAGS VITAL TO PUMP OPERATION WERE SHIPPED LOOSE WITH THE PUMP. THESE DECALS MUST BE AFFIXED IN A PROMINENT PLACE VISIBLE TO THE PUMP OPERATOR.

The shift mode indicator **must** be visible to the operator.

Shifting Sequence

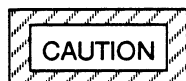
In shifting to vehicle operation using the standard air shift kit, the air shift rod linkage is activated to engage the output shaft and provide direct drive (1:1 ratio) through the gearbox to the rear axle of the vehicle.

In shifting to pump operation, activate the air shifter to disengage the gearbox drive output shaft, and to engage the drive input shaft to the gear train which

operates the pump. **Never** shift from “drive” to “pump” unless the vehicle is completely stopped.

The air cylinder must maintain air pressure of 70 to 140 psi (5,1 to 10,2 kg/cm²) **at the gearbox** for air shift operation.

Whether using air or manual shift, when shifting from pump to vehicle operation or vice versa, the power input shaft should **not** be rotating more than 15 RPM. If the vehicle is equipped with a brake on the transmission output shaft, engage the brake before shifting.



WHEN THIS PUMP IS OPERATED BY A DIESEL ENGINE, LOW IDLE SPEED SHOULD BE INCREASED APPROXIMATELY 200 RPM, OR TO A SPEED ENSURING EVEN, VIBRATION-FREE OPERATION OF THE DRIVE SHAFT TO PREVENT EXCESSIVE WEAR OF COMPONENTS.

OPERATING CHECKS

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.

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).

Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 160° F (71 °C). 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.



ALLOW AN OVER-HEATED PUMP TO COOL BEFORE SERVICING. 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. AFTER THE PUMP COOLS, DRAIN THE LIQUID FROM THE PUMP BY REMOVING THE CASING DRAIN PLUG. USE CAUTION WHEN REMOVING THE PLUG TO PREVENT INJURY FROM HOT LIQUID.

Pump Vacuum Check

Since the pump does not have a suction check valve, the discharge line must be fitted with a check valve if a pump vacuum reading is taken.

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 15 to 17 inches (381 to 432 mm) or more of mercury when pumping petroleum. 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 operation 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.

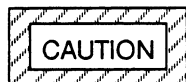
NOTE

Petroleum products are very sensitive to changes in temperature. Warmer temperatures elevate the product vapor pressure resulting in low vacuum readings. Do not mistake temperature problems for faulty pump installation or performance.

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.



IF THE APPLICATION INVOLVES A HIGH DISCHARGE HEAD, GRADUALLY CLOSE THE DISCHARGE THROTTLING VALVE BEFORE STOPPING THE PUMP.

After stopping the pump, take precautions to ensure that the pump will remain inoperative.

Cold Weather Preservation

Normal freezing conditions will not damage the pump. However, during extremely severe conditions care should be exercised during start-up, especially if the pump has been idle for more than a few hours.

GEARBOX TEMPERATURE CHECK

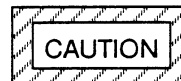
The gearbox runs at higher than ambient temperatures because of heat generated by friction and

churning of the lubricating oil. Temperatures of approximately 250°F (121°C) are considered normal. During continuous operation, the oil temperature can exceed 300°F (149°C).

NOTE

*For continuous duty operation (when the pumping period exceeds 30 minutes without a 20 minute minimum cool-down period between pumping cycles), see **CONTINUOUS DUTY PUMPING** in **MAINTENANCE AND REPAIR**, Section E for lubrication instructions.*

Checking gearbox temperatures by hand is inaccurate. Place a contact-type thermometer against the housing and record this temperature for future reference. The temperature of the lubricating oil will be approximately 10°F (6°C) higher than the housing surface temperature.



GEARBOX COMPONENTS MAY BE DAMAGED BY EXCESSIVE HEAT. LIMIT CONTINUOUS OPERATION TO 30 MINUTES OR LESS TO PREVENT HEAT BUILD-UP. SEE **CONTINUOUS DUTY PUMPING** IN **MAINTENANCE AND REPAIR**, SECTION E FOR SPECIFIC LUBRICATION INSTRUCTIONS IF THE PUMP IS OPERATED ON A LONGER DUTY CYCLE.

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 WARNINGS in Section A.



BEFORE ATTEMPTING TO OPEN OR SERVICE THE PUMP:

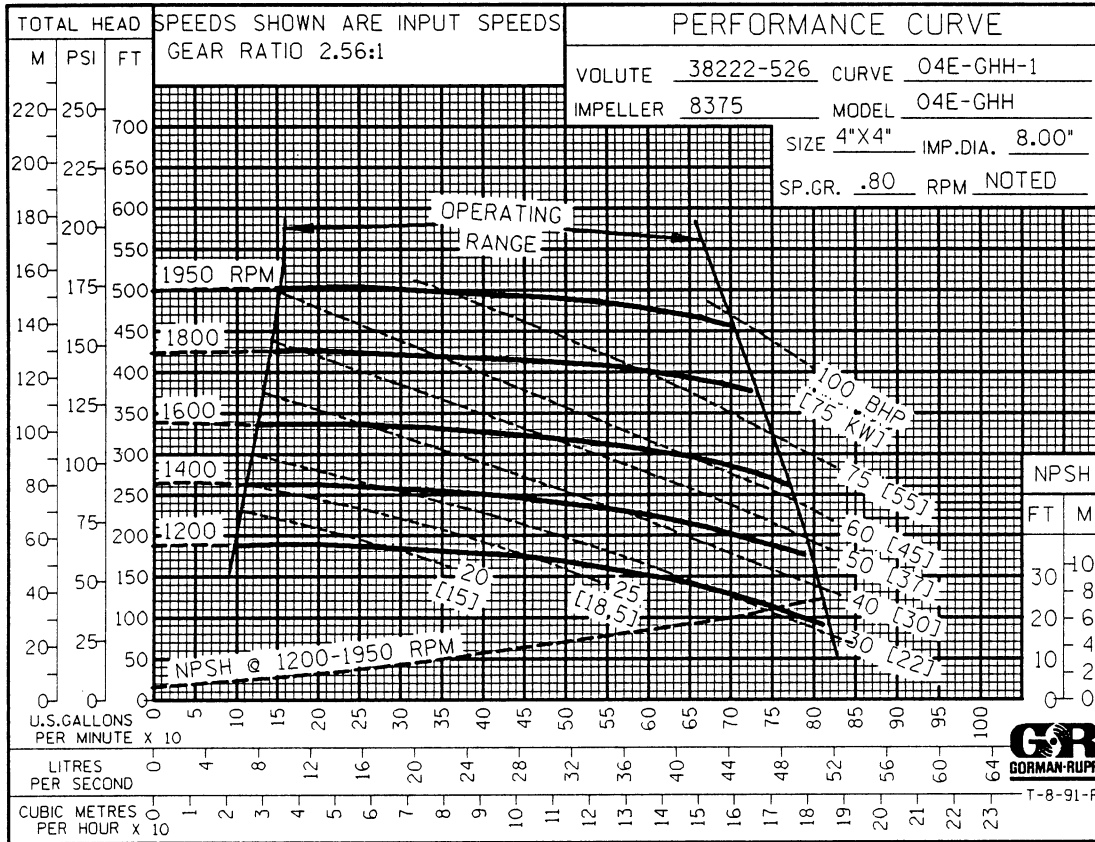
1. FAMILIARIZE YOURSELF WITH THIS MANUAL.
2. SWITCH OFF THE VEHICLE IGNITION AND REMOVE THE KEY, OR TAKE OTHER ACTION TO ENSURE THAT THE PUMP WILL REMAIN INOPERATIVE.
3. ALLOW THE PUMP TO COOL IF OVERHEATED.
4. CHECK THE TEMPERATURE BEFORE OPENING ANY COVERS, PLATES, OR PLUGS.
5. CLOSE THE SUCTION AND DISCHARGE VALVES.
6. VENT THE PUMP SLOWLY AND CAUTIOUSLY.
7. DRAIN THE PUMP.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	<p>Air leak in suction line.</p> <p>Lining of suction hose collapsed.</p> <p>Leaking or worn seal or pump gasket.</p> <p>Strainer clogged.</p>	<p>Correct leak.</p> <p>Replace suction hose.</p> <p>Check pump vacuum. Replace leaking or worn seal or gasket.</p> <p>Check strainer and clean if necessary</p>
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	<p>Air leak in suction line.</p> <p>Strainer clogged.</p> <p>Pump speed too slow.</p> <p>Lining of suction hose collapsed.</p> <p>Discharge line clogged or restricted; hose kinked.</p> <p>Discharge throttling valve partially closed; check valve is installed improperly.</p> <p>Impeller or other wearing parts worn or damaged.</p>	<p>Correct leak.</p> <p>Check strainer and clean if necessary</p> <p>Check driver output.</p> <p>Replace suction hose.</p> <p>Check discharge lines; straighten hose.</p> <p>Open discharge valve fully; check piping installation.</p> <p>Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.</p>

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP REQUIRES TOO MUCH POWER	Universal joint drive misaligned. Pump speed too high. Discharge head too low.	Align drive. Check driver output. Adjust discharge valve.
EXCESSIVE NOISE	Cavitation in pump. Pumping entrained air. Pump or drive not securely mounted. Universal joint drive misaligned. Low or incorrect lubricant.	Reduce discharge pressure and/or pump speed. Locate and eliminate source of air bubble. Secure mounting hardware. Align drive. Check for proper type and level of lubricant.
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits. Low or incorrect lubricant. Suction and discharge lines not properly supported. Drive misaligned. Bearings in power source or gearbox worn or binding.	Check bearing temperature regularly to monitor any increase. Check for proper type and level of lubricant. Check piping installation for proper support. Align drive properly. Check bearings.

PUMP MAINTENANCE AND REPAIR – SECTION E

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

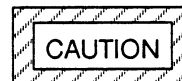


* STANDARD PERFORMANCE FOR PUMP MODEL 04E1-GHH

* Based on 70° F (21 ° C) clear water at sea level, corrected to 0.80 specific gravity, with minimum suction lift. 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.



PUMP SPEED AND OPERATING CONDITION POINTS MUST BE WITHIN THE CONTINUOUS PERFORMANCE RANGE SHOWN ON THE CURVE.

SECTION DRAWING

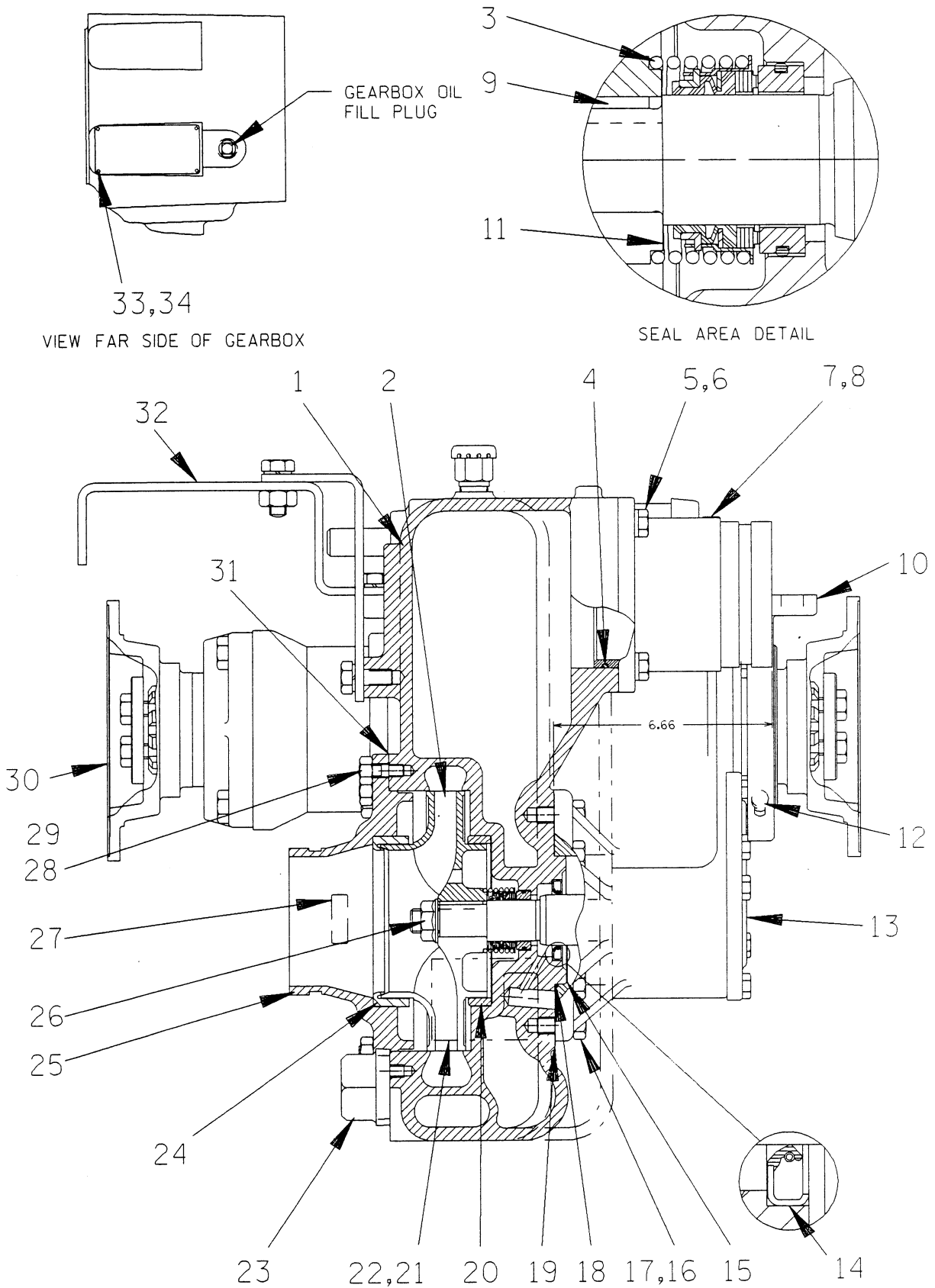


Figure 1. Pump Model 04E1-GHH

PARTS LIST
Pump Model 04E1-GHH
 (From S/N 979434 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	PUMP CASING	38222-526	13000	1	23	CASING DRAIN PLUG	P32	11991	1
2 *	IMPELLER	8375	1304R	1	24 *	SUCT HEAD WEAR RING	64H5	10018	1
3 *	SEAL ASSEMBLY	25271-192	-----	1	25	SUCTION HEAD	38247-206	13000	1
4 *	DISCH FLANGE O-RING	25155-244	-----	1	26 *	IMPELLER FLANGED NUT	22565-307	-----	1
5	HEX HD CAPSCREW	B0805	15991	4	27	SUCTION STICKER	6588AG	-----	1
6	LOCKWASHER	J08	15991	4	28	STUD	C0605 1/2	15991	12
7	DISCHARGE FLANGE	38641-314	13000	1	29	HEX NUT	D06	15991	12
8	DISCHARGE STICKER	6588BJ	-----	1	30	COMPANION FLANGE	24571-912	-----	2
9 *	IMPELLER KEY	N0405 1/4	15990	1	31 *	SUCTION HEAD GASKET	8376G	20000	1
10	TRUNNION	38151-023	11010	1	32	CROSS MEMBER KIT	48123-401	-----	1
11 *	IMPELLER SHIM SET	2X	17090	1	33	OIL LEVEL PLATE	38818-051	17020	1
12	LUBE FITTING	S186	-----	1	34	DRIVE SCREW	BM#04-03	15990	4
13	GEARBOX ASSY (SEE FIG. 2 AND 2A)	24571-027	-----	1	NOT SHOWN:				
14 *	OIL SEAL	S2007	-----	1		LUBE INSTRUCTION TAG	38817-041	-----	1
15 *	BEARING SHIM SET	8545	15990	1		GEAR LUBE DECAL	38816-086	-----	1
16	STUD	C0807	15991	6	OPTIONAL:				
17	HEX NUT	D08	15991	6		BRONZE IMPELLER	8375	14000	1
18 *	PUMP CASING O-RING	25152-155	-----	1		BRONZE WEAR RING	8464	14000	1
19 *	PUMP CASING GASKET	38683-464	18000	1		BRONZE WEAR RING	64H5	14000	1
20 *	CASING WEAR RING	8464	10018	1		SPEEDOMETER GEAR			
21	NAME PLATE	38818-020	13990	1		DRIVE KIT	48123-010	-----	1
22	DRIVE SCREW	BM#04-03	15990	4					

* INDICATES PARTS RECOMMENDED FOR STOCK

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

CANADIAN SERIAL NO. AND UP

PARTS LIST
24571-027 Gearbox Assembly

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	AIR SHIFT COVER ASSY	24571-521	-----	1	31	DRIVE SCREW	24571-581	-----	2
2 *	-OIL SEAL	24571-168	-----	1	32	LOCK RING	24571-513	-----	1
3	-SHIFTER COVER	24571-526	-----	1	33	IDLER SHAFT	24571-561	-----	1
4	-BREATHER	S1703	-----	1	34	ROLLER BEARING	24571-081	-----	1
5	-SHIFTER FORK	24571-525	-----	1	34A	ROLLER BEARING	24571-081	-----	1
6	-SOC HD CAPSCREW	24571-533	-----	2	35	WOODRUFF KEY	AV1009	15990	1
7	-SHIFTER SHAFT ASSY	24571-529	-----	1	36	IDLER GEAR	24571-560	-----	1
8 *	-O-RING	24571-214	-----	1	37	HEX HD CAPSCREW	24571-041	-----	7
9 ●	-SHIPPING PLUG	24571-174	-----	2	38	BEARING CAP	24571-563	-----	1
10 *	-CYLINDER GASKET	24571-203	-----	2	39 *	BEARING CAP GASKET	24571-565	-----	1
11 *	-AIR CYLINDER O-RING	24571-215	-----	1	40	BALL BEARING	S1088	-----	1
12	-CYLINDER	24571-528	-----	1	40A	BALL BEARING	S1088	-----	1
13	-CYLINDER CAP	24571-222	-----	1	41	IMPELLER SHAFT	24571-582	-----	1
14	-HEX HD CAPSCREW	24571-223	-----	2	42 ●	SHIPPING COVER	24571-586	-----	1
15	-O-RING BOSS PLUG	24571-535	-----	1	43 ●	PROTECTIVE SHIP NET	24571-588	-----	1
	(SEE PAGE E-6 FOR LOCATION)				44 ●	PROTECTIVE SLEEVE	24571-587	-----	1
16 *	SHIFTER COVER GASKET	24571-036	-----	1	45	SLIDING CLUTCH	24571-567	-----	1
17	DRIVE GEAR	24571-557	-----	1	46	ROLLER BEARING	23528-002	-----	1
18	LOCK RING	24571-514	-----	1	47	GEARBOX HOUSING	24571-556	-----	1
19	BALL BEARING	24571-579	-----	1	48 *	BRG CAP GASKET	24571-564	-----	1
19A	BALL BEARING	24571-579	-----	1	48A *	BRG CAP GASKET	24571-564	-----	1
20	SPACER/SLINGER	24571-572	-----	1	49	TAIL SHAFT ASSY	24571-601	-----	1
21	HEX HD CAPSCREW	24571-111	-----	4	50	-LOCK RING	24571-513	-----	1
21A	HEX HD CAPSCREW	24571-111	-----	4	51	-GEAR	24571-517	-----	1
22	INPUT SHAFT	24571-558	-----	1	52	-SPACER	24571-503	-----	1
23 ●	PROTECTIVE SHIP NET	24571-589	-----	2	53	-BALL BEARING	24571-519	-----	1
24	HEX HD CAPSCREW	24571-575	-----	4	54	-OUTPUT SHAFT	24571-502	-----	1
25	LOCKPLATE WASHER	24571-577	-----	2	55	-OIL SEAL	24571-506	-----	1
26 *	OIL SEAL	24571-506	-----	2	56	-BEARING CAP	24571-504	-----	1
27	BEARING CAP	24571-562	-----	1	57	-BEARING CAP GASKET	24571-505	-----	1
28	BALL BEARING	24571-519	-----	1	58	-BEARING RETAINER	24571-508	-----	1
29	SPACER	24571-559	-----	1	59	-ROLLER BEARING	24571-520	-----	1
30	NAME PLATE	24571-580	-----	1	60	-LOCK RING	24571-514	-----	1

● NOTE: ITEMS 9, 23, 42, 43 AND 44 ARE PROVIDED FOR SHIPPING PURPOSES ONLY. THESE PARTS MUST BE REMOVED BEFORE INSTALLATION.

* INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

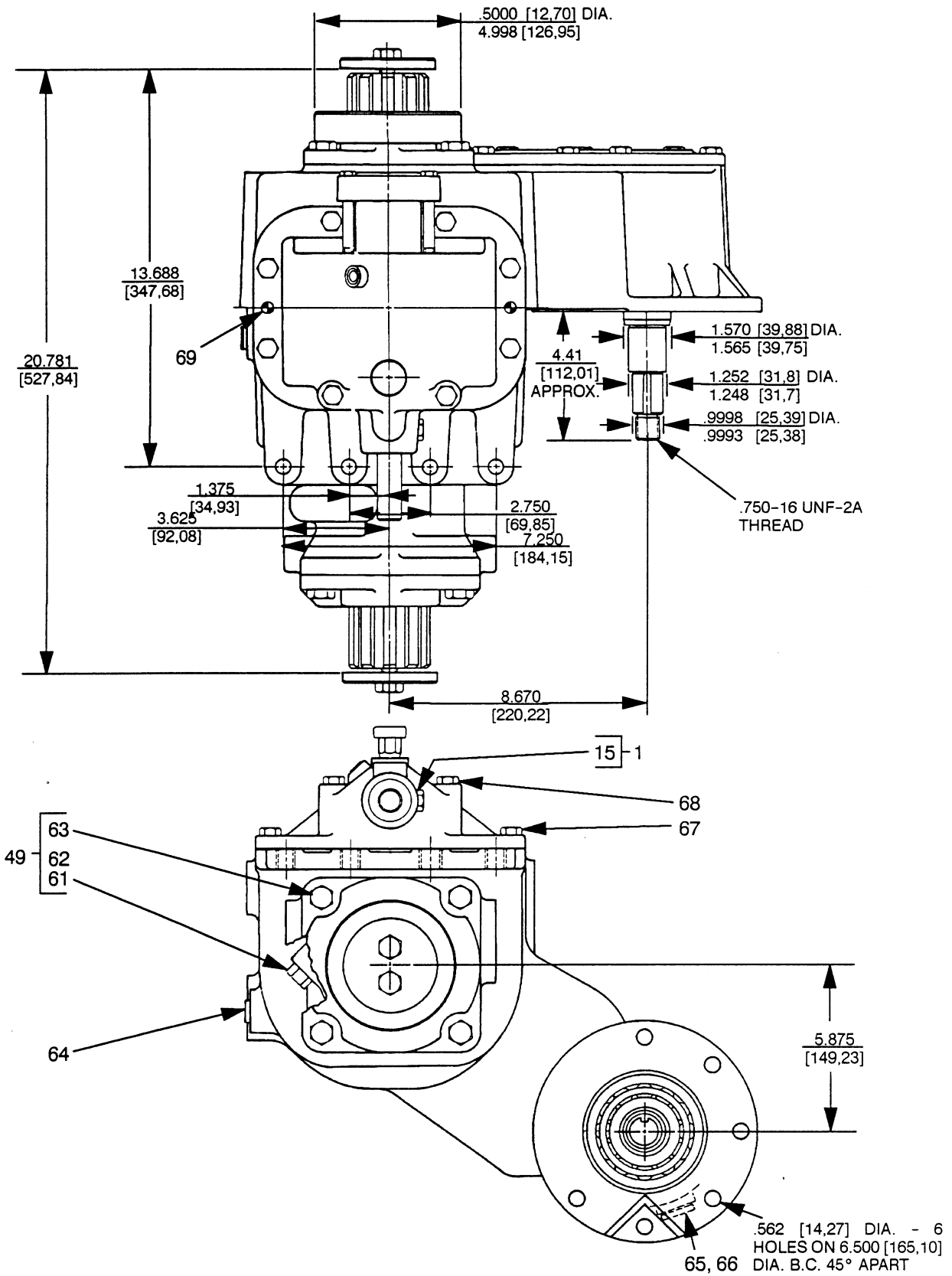


Figure 2A. 24571-027 Gearbox Assembly (Cont'd)

PARTS LIST
24571-027 Gearbox Assembly (Cont'd)

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
49	TAIL SHAFT ASSEMBLY (CONT'D)	24571-601	-----	1
61	-PLUG W/PATCH	24571-516	-----	1
62	-BUSHING	24571-109	-----	1
63	-HEX HD CAPSCREW	24571-111	-----	4
64	-OIL LEVEL PLUG	24571-576	-----	1
65	-GEARBOX DRAIN PLUG	24571-573	-----	1
66	* -DRAIN PLUG GASKET	24571-574	-----	1
67	HEX HD CAPSCREW	24571-049	-----	6
68	HEX HD CAPSCREW	24571-204	-----	2
69	DOWEL PIN	AA0704	15990	2
OPTIONAL:				
	GEARBOX MANUAL SHIFT COVER ASSY	24571-540	-----	1
*	IDLER SHAFT REMOVAL ASSEMBLY	48781-007	-----	1
*	INPUT SHAFT REMOVAL SPACER	33144-010	15080	1
*	GEARBOX REASSEMBLY TOOL KIT	29511-901	-----	1
	-SEAL DRIVER AND STOP	29511-902	-----	1
	-BEARING DRIVER	29511-903	-----	1
	-BEARING STOP	29511-904	-----	1
	-BEARING DRIVER	29511-905	-----	1
	-BEARING DRIVER	29511-907	-----	1
	-BEARING DRIVER	29511-908	-----	1
	-BEARING DRIVER	29511-909	-----	1
	-BEARING DRIVER	29511-910	-----	1
	-BEARING DRIVER	29511-912	-----	1
	-BEARING DRIVER AND SPACER	29511-913	-----	1
	-PRESSURE TEST SLEEVE	29511-914	-----	1
	-IDLER SHAFT ASSEMBLY FORK	29511-915	-----	1
	-INPUT SHAFT BEARING SUPPORT STOP	29511-920	-----	1
	AUXILIARY STUB SHAFT P.T.O. ASSY			
	-P.T.O. SHAFT ASSY	48123-008	-----	1
	-BEARING COVER	38325-010	10000	1
	-BEARING SHIM SET	8543	15990	1
	-SHAFT EXTENSION	38511-509	16000	1
	-KEY	N0404	15990	1
	-OIL SEAL	S2276	-----	1
	-DOWEL PIN	AA0403	15990	1
	-GEAR HOUSING	38313-022	10000	1
	-GASKET	38688-016	20000	1

* INDICATES PARTS RECOMMENDED FOR STOCK

SECTION DRAWING

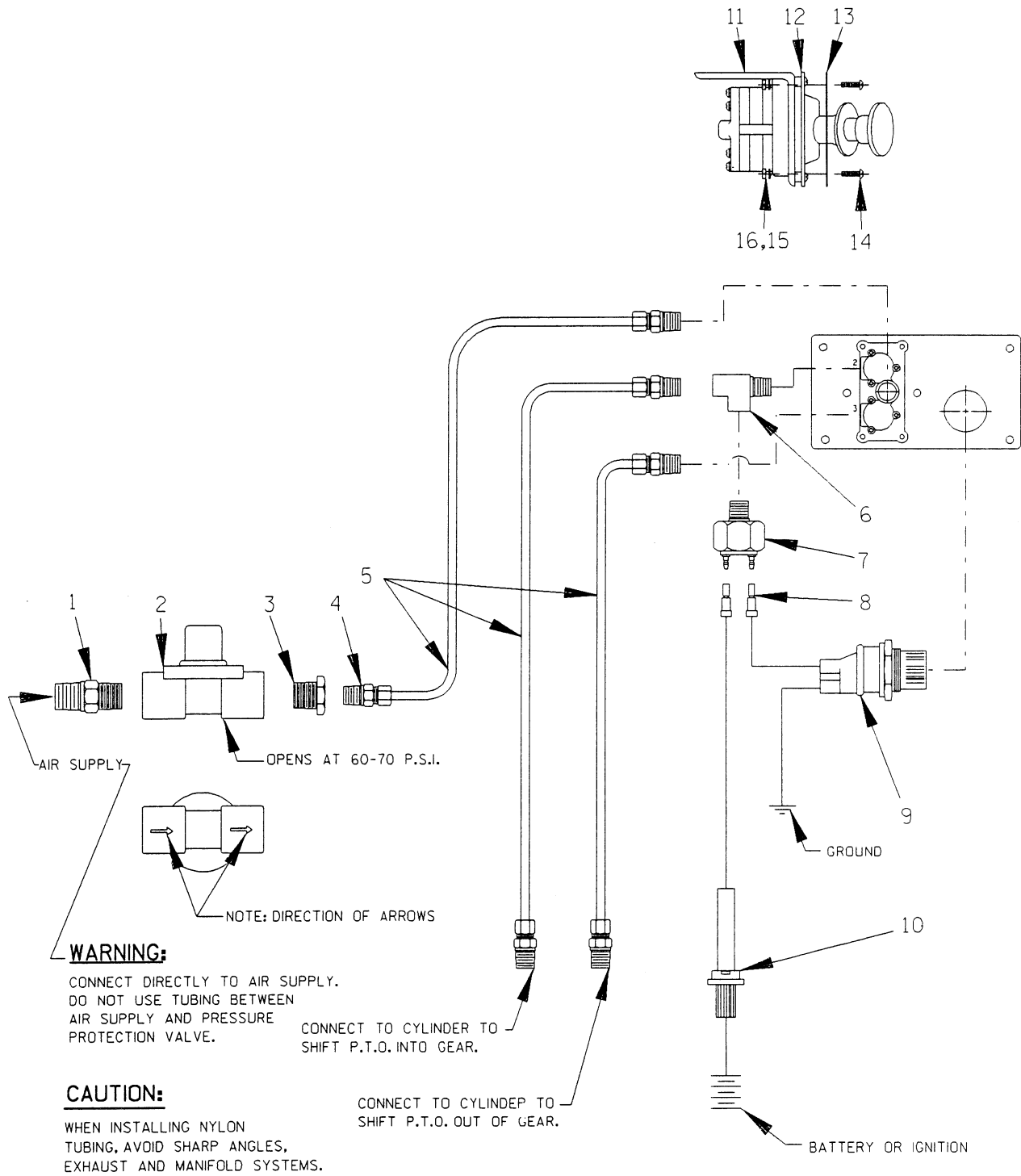


Figure 3. 24571-801 Air Shift Installation Kit

PARTS LIST
24571-801 Air Shift Installation Kit*

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	HEX NIPPLE	378416	-----	1
2	PRESSURE PROTECTION VALVE	378414	-----	1
3	REDUCER BUSHING	379131-1	-----	1
4	MALE CONNECTOR	379042	-----	6
5	35 FT. NYLON TUBING	379044-7	-----	1
6	STREET TEE	500750-1	-----	1
7	PRESSURE SWITCH	378301	-----	1
8	WIRE TERMINAL	378307	-----	2
9	INDICATOR LIGHT	378978	-----	1
10	FUSE HOLDER	378884	-----	1
11	SUPPORT BRACKET	379130	-----	2
12	VALVE ASSEMBLY	328864X	-----	1
13	CONTROL PLATE	68-P-28	-----	1
14	SLOTTED SCREW	500448-9	-----	4
15	LOCKWASHER	500357-7	-----	4
16	HEX NUT	500376-6	-----	4

* INDIVIDUAL SHIFT KIT PARTS ARE THE MANUFACTURER'S PART NUMBERS. FOR REPAIR PARTS CONTACT:
 THE DANA CORPORATION
 P.T.O. ASSEMBLY AND WAREHOUSE CENTER
 8225 HACKS CROSSROAD
 OLIVE BRANCH, MISSISSIPPI 38654

SECTION DRAWING

NOTE:

CUSTOMER TO CUT CROSS MEMBER TO DESIRED LENGTH
AND SUPPLY END MOUNTING AS REQUIRED.

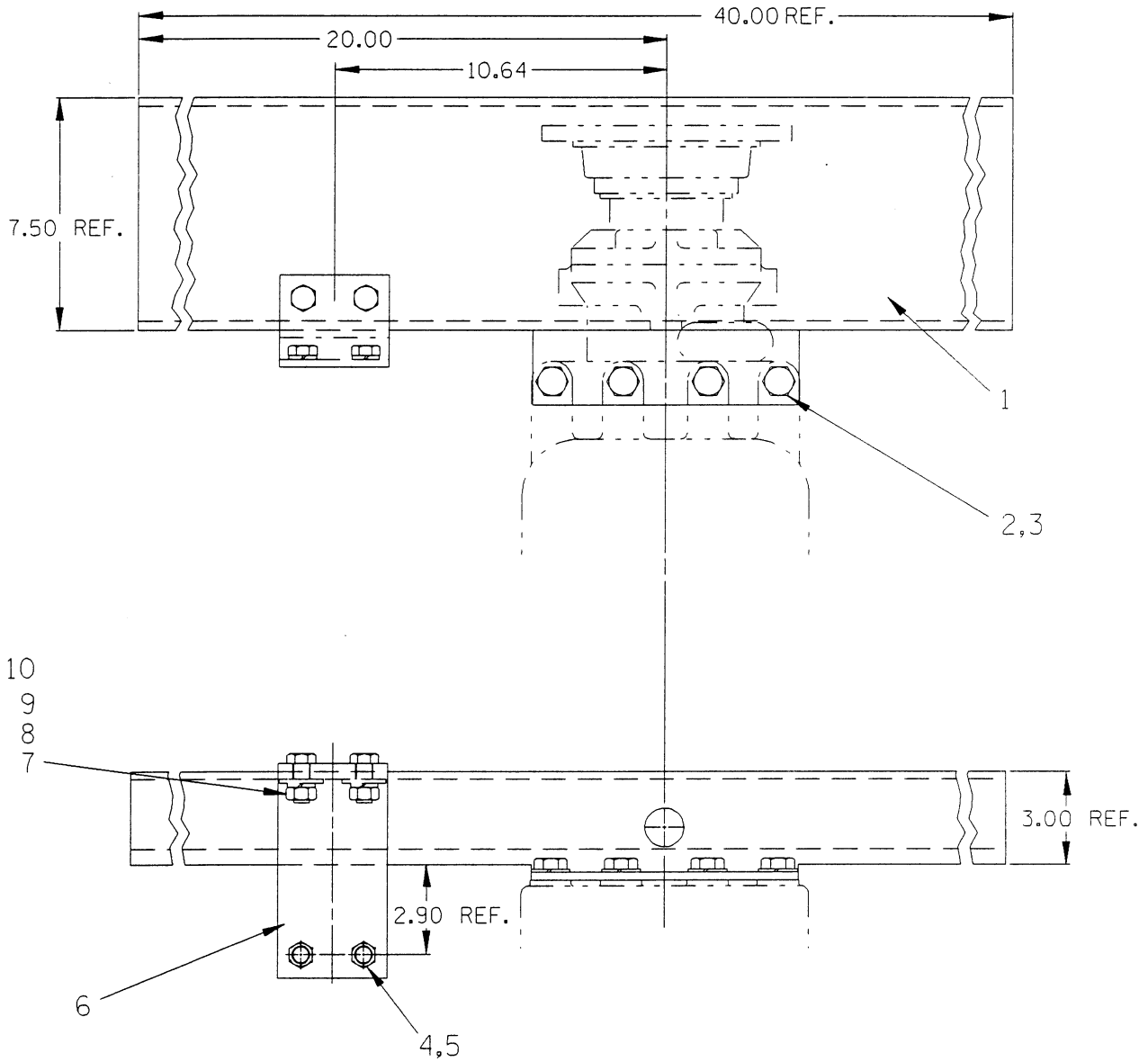


Figure 4. 48123-401 Cross Member Kit

PARTS LIST
48123-401 Cross Member Kit

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	CROSS MEMBER	34778-004	15020	1
2	HEX HD CAPSCREW	B1004	15991	4
3	LOCKWASHER	J10	15991	4
4	HEX HD CAPSCREW	B0804	15991	2
5	LOCKWASHER	J08	15991	2
6	BRACKET	34125-075	15020	1
7	HEX HD CAPSCREW	B0805	15991	2
8	FLAT WASHER	K08	15991	2
9	LOCKWASHER	J08	15991	2
10	HEX NUT	D08	15991	2

PUMP AND SEAL DISASSEMBLY

Review all warnings in Section A.

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



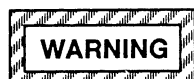
IF THIS PUMP IS USED WITH VOLATILE AND/OR FLAMMABLE LIQUIDS, BE CERTAIN PROPER SAFETY PRACTICES ARE FOLLOWED BEFORE OPERATING OR SERVICING THE PUMP. PROVIDE ADEQUATE VENTILATION, PROHIBIT SMOKING, WEAR STATIC-RESISTANT CLOTHING AND SHOES. CLEAN UP ALL FUEL SPILLS IMMEDIATELY AFTER OCCURRENCE.

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 (Figures 1, 2 and 2A) and the accompanying parts list.

Most service functions, such as wear ring, impeller, and seal replacement, may be performed by draining the pump and removing the suction head. However, due to the confined mounting location of the pump, it is recommended that the pump be removed from the vehicle for service. The following instructions assume complete disassembly is required.

If the gearbox requires repair, proceed with **PUMP AND SEAL DISASSEMBLY**, followed by **GEARBOX DISASSEMBLY**.

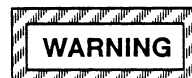
Before attempting to service the pump, switch off the engine ignition and remove the key ensure that it will remain inoperative. Close all valves in the suction and discharge lines.



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. **CHECK THE TEMPERATURE BEFORE OPENING ANY COVERS, PLATES, OR PLUGS.**
5. **CLOSE THE SUCTION AND DISCHARGE VALVES.**
6. **VENT THE PUMP SLOWLY AND CAUTIOUSLY.**
7. **DRAIN THE PUMP.**

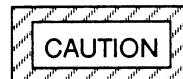


AFTER THE VEHICLE IS POSITIONED FOR PUMP MAINTENANCE, BLOCK THE WHEELS AND SET THE EMERGENCY BRAKE BEFORE ATTEMPTING TO DISCONNECT THE DRIVE SHAFT OR REMOVE THE PUMP. BE SURE THE PUMP IS PROPERLY REINSTALLED AND SECURE BEFORE OPERATION.

The instructions in this section are keyed to Figure 1 and the accompanying parts lists.

Removing Pump and Gearbox

Due to the confined mounting location of the pump, it is recommended that the pump be removed from the vehicle for service.



DUE TO THE CONFINED MOUNTING LOCATION, SPECIALIZED EQUIPMENT SUCH AS A TRANSMISSION JACK WITH CUSTOM BRACKETS SHOULD BE USED TO LIFT AND POSITION THE PUMP AND GEARBOX.

Close all valves in the suction and discharge lines. Remove the casing drain plug (23), and drain the pump. Clean and reinstall the drain plug.

Remove the suction piping. Remove the nuts securing the pump casing to the petroleum flange on the vehicle tank.

Remove the hardware securing the input and output drive flanges (30) to the drive shafts. Disconnect the air lines from the air shift cylinder assembly on the gearbox.

Remove the hardware securing the gearbox to the rear cross member. Remove the hardware securing the trunnion to the front cross member.

Move the pump and gearbox to a clean, well-equipped shop for maintenance and repair.

Suction Head and Wear Ring Removal

The wear ring (24) and impeller (2) are easily accessible and may be serviced by removing the suction head (25).

Remove the nuts (29), and pull the suction head and wear ring out of the pump casing. Remove the suction head gasket (31).



USE CAUTION NOT TO DAMAGE THE SUCTION HEAD WHEN REMOVING THE WEAR RING (24).

Inspect the wear ring for excessive wear or scoring. If replacement is required, use a chisel or other suitable tool to cut it from the suction head. **Be careful** not to damage the suction head bore.

Impeller Removal

To remove the impeller, block impeller rotation by inserting a brass rod through the pump discharge and between the impeller vanes. **Use caution** not to damage the impeller. Remove the impeller nut (26).

Install 1/4-20 UNC by 4-inch long capscrews in the tapped holes in the impeller, and use a suitable puller to remove the impeller from the shaft. Use caution when removing the impeller; tension on the seal spring will be released. Retain the impeller key (9).

Remove the impeller adjusting shims (11). For ease of reassembly, tie and tag the shims, or measure and record their thickness.

Seal Removal

Remove the seal spring. Lubricate the shaft adjacent to the seal, and work oil up under the rubber bellows. Slide the rotating portion of the seal off the shaft.

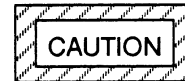
Use a pair of stiff wires with hooked ends to remove the stationary element and O-ring from the casing bore.

Pump Casing Removal

The presence of gearbox lubricant in the seal cavity behind the stationary element indicates failure of the gearbox oil seal (14). Before attempting to remove the seal, remove the gearbox drain plug and gasket (65 and 66, Figure 2A) and drain the gearbox lubricant. Reinstall the drain plug and gasket.

If the oil seal, wear ring (20), O-ring (18) or gasket (19) require replacement, or if the gearbox is to be disassembled, remove the nuts (17) and slide the pump casing off the shaft.

Remove the O-ring and gasket (18 and 19). Use a set of screwdrivers or other suitable tools to pry the oil seal (14) from the back of the pump casing.



USE CAUTION NOT TO DAMAGE THE PUMP CASING WHEN REMOVING THE WEAR RING (20).

Inspect the wear ring (20) for excessive wear or scoring. If replacement is required, use a chisel or other suitable tool to cut it from the pump casing. **Be careful** not to damage the pump casing bore.

If no further disassembly is required, proceed with **PUMP AND SEAL REASSEMBLY**. If the gearbox requires disassembly, do not reassemble the pump components at this time. Refer to **GEARBOX DISASSEMBLY** and **GEARBOX REASSEMBLY**, followed by **PUMP AND SEAL REASSEMBLY**.

PUMP AND SEAL REASSEMBLY

If the gearbox requires disassembly, refer to **GEARBOX DISASSEMBLY** and **GEARBOX REASSEMBLY**, followed by **PUMP AND SEAL REASSEMBLY**.

Pump Casing Installation

If the wear ring (20) was removed, position the replacement ring in the pump casing with the chamfered end toward the bore shoulder. Press the wear ring into the pump casing until fully seated.

NOTE

*The wear ring **must** seat squarely in the pump casing; otherwise, binding and/or excessive wear will occur as the shaft turns.*

Apply a thin coat of "Permatex Aviation No. 3 Form-A-Gasket" to the contact surfaces of the oil seal (14) and the casing bore. Position the oil seal in the pump casing bore with the lip positioned as shown in Figure 1. Press the oil seal into the bore until fully seated against the bore shoulder.

Install the stationary seal element and O-ring in the seal bore as described in **Seal Reassembly and Installation** before securing the pump casing to the adaptor.

With the stationary seal seat installed in the seal bore of the pump casing, lubricate the O-ring (18), and slide it onto the pump casing shoulder.

Position the pump casing gasket (19) over the casing studs (16).

Before further reassembly, calculate the thickness of bearing adjusting shims (15) required to obtain a shaft end play of .005 to .010 inch (0,127 to 0,254 mm). Use a depth micrometer to measure the height of the pump casing shoulder (with the gasket installed), and the depth of the bearing in the gearbox housing from the gasket mating surface. Select a combination of shims to make up the difference between the two measurements, and install the bearing shims in the bearing bore.

Lubricate the lip of the oil seal (14) to ease installation. Apply "Never-Seez" or equivalent compound to the casing studs (16). Carefully slide the pump casing over the shaft until fully seated against the gearbox housing. **Be careful** not to damage the lip of the oil seal or the stationary seal element.

Use "Loctite 242" or equivalent compound on the nuts (17) and secure the pump casing to the gearbox housing with the nuts.

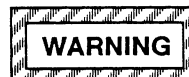
If the discharge flange (7) was removed, lightly oil the new O-ring (4), and install it in the groove in the flange. Slide the flange into the pump casing, using

caution not to cut the O-ring. Secure the flange with the hardware (5 and 6).

Seal Reassembly and Installation

(Figures 1 and 5)

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

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. 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 bellows and stationary element O-ring with water or a very **small** amount of light lubricating oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 5).

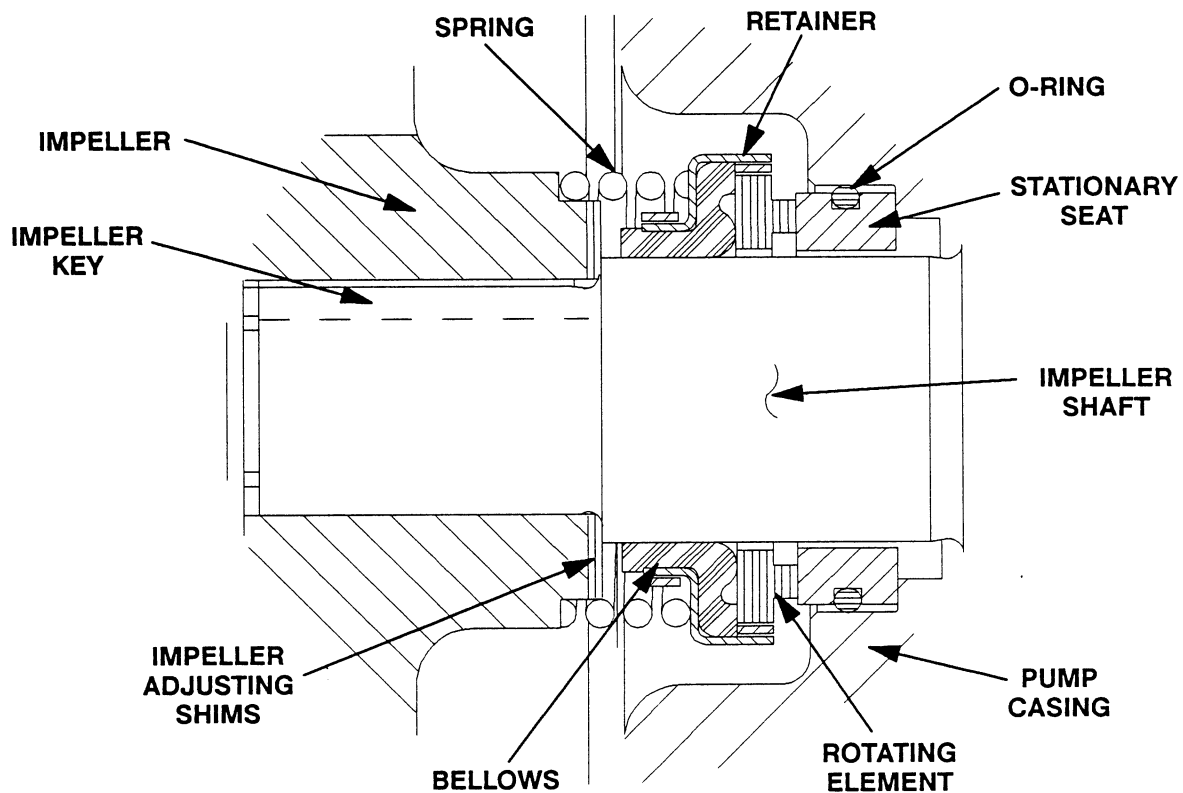
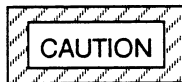


Figure 5. 25271-192 Seal Assembly



THIS SEAL IS NOT DESIGNED FOR OPERATION AT TEMPERATURES ABOVE 160°F (71°C). DO NOT USE AT HIGHER OPERATING TEMPERATURES.

Inspect the impeller shaft for distortion, nicks, scratches, or damage to the shaft keyway. Dress small nicks and burrs with a fine file or emery cloth. If the shaft is defective, refer to **GEARBOX DISASSEMBLY** and replace the shaft.

Lubricate the stationary element O-ring with a light coat of oil. Place a clean, lint-free tissue over the seal face, and use thumb pressure to press the element and O-ring into the pump casing until fully

seated. Be careful not to damage the seal face. After installation wipe the seal face in a concentric pattern with a clean, lint-free cloth to remove any fingerprints.

NOTE

If the pump casing was removed, install the casing O-ring and gasket (18 and 19) on the pump casing studs. Carefully slide the casing over the shaft, and secure it to the gearbox with the nuts (17).

Install a tapered sleeve (see Figure 6) over the shaft keyway to ease installation of the rotating portion of the seal. This tool can be made from steel tubing or pipe.

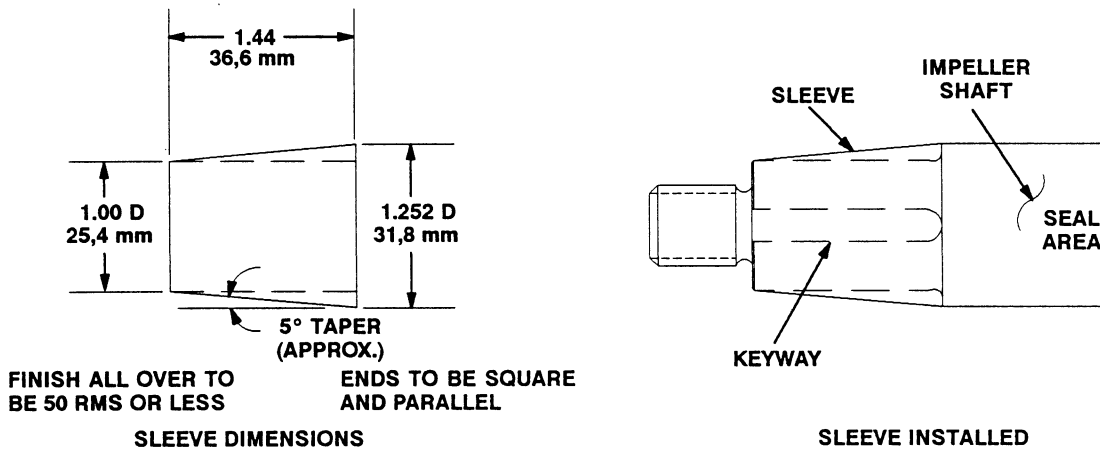


Figure 6. Seal Installation Sleeve

Lubricate the tapered sleeve and position it on the shaft. Position the rotating portion of the seal (consisting of the retainer, bellows and rotating element) on the sleeve, and apply even pressure against the shoulder of the seal retainer until the rotating subassembly slides onto the shaft and the seal faces contact. A push tube cut from a piece of plastic tubing would aid this installation. The I.D. of the tube should be approximately the same diameter as the I.D. of the seal spring.

Remove the tapered sleeve and install the seal spring.

Impeller Installation

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

For maximum pump efficiency, the impeller must be centered within the volute scroll. Center the impeller by adding or removing adjusting shims (11).

To verify impeller positioning, measure the pump casing and impeller as shown in Figure 7. Use these measurements to calculate the required impeller location (dimension E). Add or remove impeller adjusting shims until dimension E is obtained.

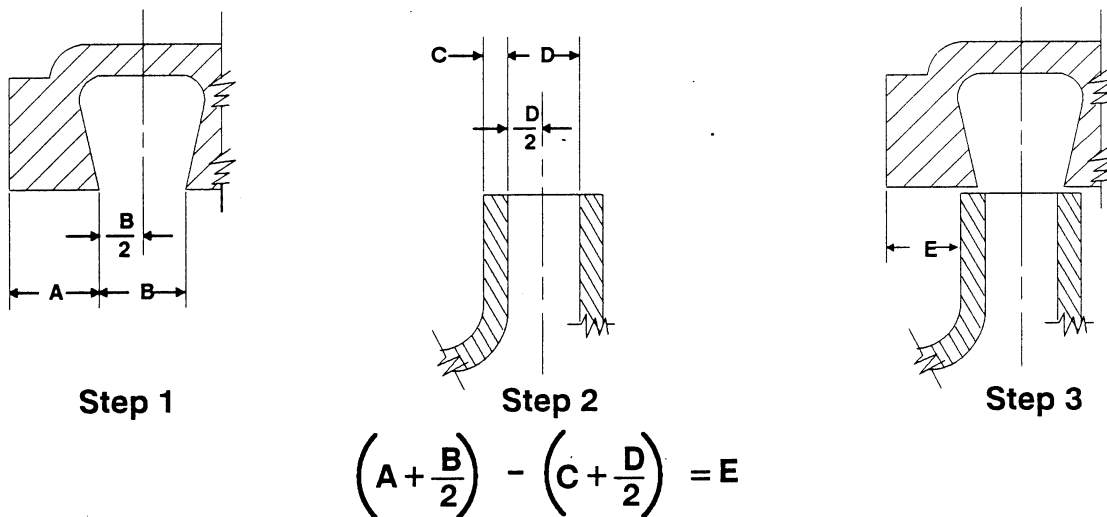


Figure 7. Centering Impeller Within Volute Scroll

NOTE

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

way, key (9) and shaft threads. Apply "Loctite No. 242" to the key and keyway and install the key. Align the impeller and press it onto the shaft until fully seated.

NOTE

It is not recommended that substitute locking mate-

With the correct thickness of impeller adjusting shims installed, apply "Locquic Primer T" to the key-

rials be used in this application. Use **only** the recommended "Loctite" products.

After the impeller is installed, secure the impeller by torquing the impeller nut (26) to 120 ft. lbs. (1440 in. lbs. or 16,6 m. kg.).

Suction Head and Wear Ring Installation

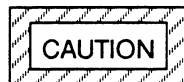
If the wear ring (24) was removed, position the replacement ring in the suction head (25) with the chamfered end toward the bore shoulder. Press the wear ring into the suction head until fully seated.

NOTE

The wear ring **must** seat squarely in the suction head; otherwise, binding and/or excessive wear will occur as the shaft turns.

Apply "Never-Seez" or equivalent compound to the studs (28). Slide the suction head gasket (31) and suction head over the studs, and secure with the nuts (29).

Installing Pump and Gearbox



DUE TO THE CONFINED MOUNTING LOCATION, SPECIALIZED EQUIPMENT SUCH AS A TRANSMISSION JACK WITH CUSTOM BRACKETS SHOULD BE USED TO LIFT AND POSITION THE PUMP AND GEARBOX.

Install the nuts securing the pump discharge to the vehicle tank.

Install the hardware securing the input and output drive flanges (30) to the drive shafts. Install the air lines from the air shift cylinder assembly on the gearbox.

Install the hardware securing the gearbox (13) to the rear cross member. Install the hardware securing the trunnion to the front cross member.

Final Pump Assembly

Install the suction line and open all valves. Make certain that all piping connections are tight, properly supported and secure.

Be sure the gearbox has been properly lubricated, see **LUBRICATION** at the end of this section.

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

GEARBOX DISASSEMBLY

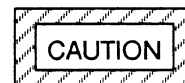
Unless otherwise specified, the instructions in this section are keyed to Figures 2 and 2A, and the accompanying parts lists.

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



GEARBOX DISASSEMBLY IN THE FIELD IS NOT RECOMMENDED. THESE OPERATIONS SHOULD BE PERFORMED ONLY IN A PROPERLY-EQUIPPED SHOP BY QUALIFIED PERSONNEL.

Due to the confined mounting location of the pump, it is recommended that the pump be removed from the vehicle for service.



DUE TO THE CONFINED MOUNTING LOCATION, SPECIALIZED EQUIPMENT SUCH AS A TRANSMISSION JACK WITH CUSTOM BRACKETS SHOULD BE USED TO LIFT AND POSITION THE PUMP AND GEARBOX.

Refer to **Removing Pump and Gearbox** under **PUMP AND SEAL DISASSEMBLY** and remove the pump and gearbox from the vehicle. Move the pump and gearbox to a clean, well-equipped shop for maintenance and repair.

Disassemble the pump components as indicated in **PUMP AND SEAL DISASSEMBLY**.

Air Shift Cover Disassembly

To remove the air shift cover assembly (1), disengage the capscrews (67 and 68) securing the assembly to the gearbox housing (47).

The cylinder cap (13) and shifter fork (5) must be removed before the shifter shaft assembly (7) can be

removed. To remove the cylinder cap, disengage the capscrews (14).

To remove the shifter fork, disengage the socket head capscrews (6) securing the fork to the shifter shaft. Remove the shifter fork.

Remove and inspect the shifter shaft assembly and piston O-ring (11) and replace any parts as required. Remove the oil seal (2) and shaft O-ring (8).

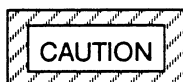
Drive Flange Removal

Disengage the capscrews (24) and remove the lock-plate washers (26). Use a suitable puller to remove the input and output drive flanges.

Output Shaft Disassembly

To remove the tail shaft assembly, which includes the output drive shaft (54) and related components, remove the capscrews (21A) and pull the assembly from the gearbox housing. Remove the bearing retainer gasket (48).

Disengage the hardware (63) and separate the bearing cap (56) and gasket (57) from the bearing retainer (58). Inspect the oil seal (55) and, if replacement is required, press it from the bearing cap.



THE OUTPUT SHAFT CANNOT BE REMOVED FROM THE BEARING RETAINER WITHOUT FIRST REMOVING THE BALL BEARING (53) AND ROLLER BEARING (59) FROM THE SHAFT. THE BEARINGS MAY BE DAMAGED DURING REMOVAL.

To remove the output shaft (54), tap against the splined end of the shaft with a soft-faced mallet or brass bar until the shaft is driven approximately 3/4 inch (19 mm) into the bearing retainer. From the opposite end of the shaft, use the mallet to tap the shaft back into the bearing retainer. This will unseat the ball bearing (53) from the retainer.

Use a suitable bearing puller to remove the bearing from the shaft.

Push the shaft through the roller bearing (59) until the snap ring (50) seats squarely against the bearing.

Remove the lock ring (60), and gently tap the splined end of the shaft until the roller bearing is out of the bearing retainer. Carefully slide the bearing retainer off the shaft. Slide the spacer sleeve (52) off the shaft. Remove the snap ring (50) and pull the roller bearing off the shaft.

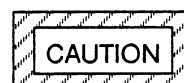
Use a suitable puller to remove the bearing (46) from the output shaft.

Input Shaft Disassembly

To remove the input drive shaft (22), disengage the capscrews (21) and separate the bearing cap (27) and gasket (48A) from the gearbox housing. Inspect the oil seal (26) and, if replacement is required, press it from the bearing cap.

Reach through the tailshaft end of the gearbox housing and remove the sliding clutch (45). Remove the lock ring (32) from the shaft.

Position the gearbox housing on an arbor (or hydraulic) press with the drive flange (splined) end of the input shaft facing up. Insert a spacer tool (G-R P/N 33144-011) between the drive gear (17) and the internal wall of the gearbox housing so that the drive gear is held in place as the shaft is pressed through. Press the shaft from the housing while reaching through the top of the gearbox housing to remove the drive gear, bearings (19 and 19A), and spacer/slinger (20).



TO PREVENT DAMAGE DURING REMOVAL, IT IS RECOMMENDED THAT BEARINGS BE CLEANED AND INSPECTED **IN PLACE**. IT IS **STRONGLY** RECOMMENDED THAT THE BEARINGS BE REPLACED **ANY** TIME THE GEARBOX IS DISASSEMBLED.

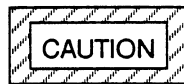
Clean and inspect the bearings (19 and 20) as outlined in **Cleaning and Inspecting Bearings**. If the ball bearing (19) requires replacement, use a suitable puller to remove them from the drive gear. Remove the lock ring (18), and spacer (29) from the drive gear.

If replacement is required, use a suitable puller to remove the bearing (28) from the gearbox housing.

Idler Shaft Disassembly

Position the gearbox housing on a solid surface with the bearing cap (38) facing up. Support the housing on wooden blocks while in this position.

Disengage the capscrews (37) and remove the bearing cap and gasket (38 and 39). There is a tapped hole (3/4-10 UNC by 5/8 inch deep) in the end of the idler shaft (33) to accommodate a specially-designed puller (G-R P/N 48781-007). Use this tool to pull the shaft and key (35) through the idler gear (36), and remove the idler gear through the top of the gearbox.



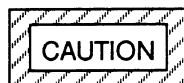
TO PREVENT DAMAGE DURING REMOVAL, IT IS RECOMMENDED THAT BEARINGS BE CLEANED AND INSPECTED **IN PLACE**. IT IS **STRONGLY** RECOMMENDED THAT THE BEARINGS BE REPLACED **ANY TIME** THE GEARBOX IS DISASSEMBLED.

Separate the outer race of the front roller bearing (34) from the inner race. Slide the inner race of the roller bearing (34A) out of the outer race.

Clean and inspect the inner and outer bearing races as outlined in **Cleaning and Inspecting Bearings**. If bearing replacement is required, pull the inner race of the front bearing (34) off the shaft. Pull the outer race of the roller bearing (34A) from the gearbox cavity using a suitable puller.

Impeller Shaft Disassembly

With the pump end disassembled (see **PUMP AND SEAL DISASSEMBLY**) and idler shaft removed, the impeller shaft (41) and bearings (40 and 40A) can be pressed out from either side of the gearbox.

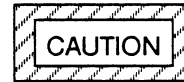


TO PREVENT DAMAGE DURING REMOVAL, IT IS RECOMMENDED THAT BEARINGS BE CLEANED AND INSPECTED **IN PLACE**. IT IS **STRONGLY** RECOMMENDED THAT THE BEARINGS BE REPLACED **ANY TIME** THE GEARBOX IS DISASSEMBLED.

Clean and inspect the bearings as outlined in **Cleaning and Inspecting Bearings**. If the bearings require replacement, use a suitable puller to remove them from the shaft.

Cleaning and Inspecting Bearings

It is recommended that bearings be cleaned and inspect **in place** as follows.



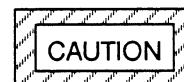
TO PREVENT DAMAGE DURING REMOVAL FROM THE SHAFT, IT IS RECOMMENDED THAT BEARINGS BE CLEANED AND INSPECTED **IN PLACE**. IT IS **STRONGLY** RECOMMENDED THAT THE BEARINGS BE REPLACED **ANY TIME** THE GEARBOX IS DISASSEMBLED.

Clean the gearbox housing, shafts 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.

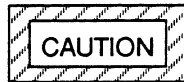
The bearing tolerances provide a tight press fit onto the shafts or a snug slip fit into the gearbox housing. Replace the bearings, shafts, or gearbox housing if the proper bearing fit is not achieved.

Although bearings should be cleaned and inspected in place to prevent damage during removal, it is **strongly** recommended that bearings be replaced any time the gearbox is disassembled.

GEARBOX REASSEMBLY

Unless otherwise specified, the instructions in this section are keyed to Figures 2 and 2A, and the accompanying parts lists.

Clean and inspect the bearings as indicated in **Cleaning and Inspecting Bearings**.



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 GEARBOX IS DISASSEMBLED.

Inspect the shafts for distortion, damaged keyways, nicks or scratches, or for damage on the impeller or drive ends. Dress small nicks and burrs with a fine file or emery cloth. Replace the shafts if defective.

Check all oil seal and gasket seating surfaces for nicks and scratches. Dress small nicks and burrs with a fine file or emery cloth. Be careful not to distort the shape of the surfaces.

When reassembling the gearbox, replace all gaskets and O-rings. Apply a light coating of oil on mating surfaces shafts, gears and oil seals to ease reassembly.

Impeller Shaft Reassembly

Use two 3/8-16 UNC by 1-1/2 inch long capscrews (not supplied) to secure the bearing stop (G-R P/N 29511-904) to the housing diagonally across the opening for the bearing cap (38).

Position the gearbox housing on the bed of an arbor (or hydraulic) press with the opening for the bearing

cap (38) facing down. Support the gearbox housing on wooden blocks while in this position.

Use the bearing driver (G-R P/N 29511-903) to press the front bearing (40) into the gearbox housing until seated against the bearing stop.



TO PREVENT DAMAGE TO THE BEARINGS DURING REASSEMBLY, **DO NOT** TAP OR DRIVE BEARINGS INTO PLACE WITH A HAMMER. INSTALL BEARINGS ON SHAFTS AND INTO BORES USING THE DESIGNATED DRIVING TOOLS AND AN ARBOR OR HYDRAULIC PRESS.

Use the bearing driver (G-R P/N 29511-905) to press the rear bearing (40A) onto the impeller shaft (41) until fully seated against the shaft shoulder.

Use the bearing driver (G-R P/N 29511-905) to press the assembled impeller shaft and bearing into the gearbox housing until the shaft shoulder seats squarely against the front bearing (40).

Idler Shaft Reassembly

Reposition the gearbox housing with the opening for the bearing cap (38) facing up. Support the gearbox housing on wooden blocks while in this position. Remove the bearing stop from the gearbox housing.

Position the outer race of the rear roller bearing (34A) in the gearbox housing. Note that one side of the outer race is solid; this solid outer ring **must** be positioned toward the **outside** of the gearbox housing. When installed, the inner race must have the shouldered side positioned toward the gear.

Use the bearing driver (G-R P/N 29511-907) to press the outer race into the gearbox housing bore until fully seated. Slide the inner race into the outer race until fully seated.

Position the inner race of the front roller bearing (34) on the shaft so that the shoulder on the race is toward the shaft shoulder.

Use the bearing driver (G-R P/N 29511-908) to press the race onto the shaft until seated squarely against the shaft shoulder.

Reach through the top of the gearbox and lay the idler gear (36) in position next to the rear bearing. Position the spacer fork (G-R P/N 29511-915) between the idler gear and the rear bearing.

Install the key (35) in the idler shaft. Coat the idler shaft and idler gear bore lightly with "Never-Seez Black Moly".

Use one end of the spacer fork tool to align the gear and rear bearing concentrically. **Be sure** that the fork is positioned so the larger diameter (3-9/16 inch or 90 mm) recess faces the bearing. Insert the idler shaft, making sure the key is properly aligned with the slot in the gear. Press the shaft through the idler gear until the shaft shoulder is snug against the gear.

Remove the spacer fork and press the shaft and gear into the rear bearing (34A) until the gear shoulder contacts the bearing.

Position the outer race of the front bearing (34) in the gearbox housing bore. Note that one side of the outer race is solid; this solid outer ring **must** be positioned toward the **inside** of the gearbox housing.

Screw the pin in the bearing driver (G-R P/N 29511-909) into the tapped hole in the idler shaft. Use the driver to press the outer race of the bearing into the housing until fully seated against the inner race.

Replace the bearing cap gasket (39), and secure the bearing cap (38) to the gearbox housing by torquing the capscrews (37) to 35 ft. lbs. (420 in. lbs. or 4,8 m. kg.).

Input Shaft Reassembly

Use the bearing driver (G-R P/N 29511-910) to press the bearing (28) into the gearbox housing until fully seated.

Reposition the gearbox housing with the opening for the output shaft facing up. Support the gearbox housing on wooden blocks while in this position.

Install the lock ring (18) in the gear. Use the bearing driver (G-R P/N 29511-911) to press the inner bearing (19A) into the drive gear until squarely seated against the lock ring.

Position the spacer (29) against the inner bearing, and use the bearing driver (G-R P/N 29511-912) to press the outer bearing (19) into the gear until squarely seated against the lock ring and spacer.

Before installing the input shaft, position the spacer/slinger (20) in the gearbox with the flat side away

from the input shaft opening (facing up). Position the drive gear assembly in the gearbox housing with the exposed bearing next to the spacer/slinger.

Install the lock ring (32) in the groove on the input shaft. Use the bearing driver (G-R P/N 29511-913) in combination with the bearing support stop (G-R P/N 29511-920) to press the shaft through the tail shaft opening until the lock ring seats against the inner bearing.

Reposition the gearbox housing with the input splines on the shaft facing up. Support the gearbox housing on wooden blocks while in this position.

Use the seal driver and stop (G-R P/N 29511-902) to press the oil seal (26) into the bearing cap (27) until fully seated. Install the gasket (48A) and secure the cap to the gearbox housing by torquing the cap-screws (21) to 90 ft. lbs. (1080 in. lbs. or 12,4 m. kg.). **Use caution** not to damage the oil seal lip on the shaft splines.

Reposition the gearbox housing with the opening for the tail shaft facing up. Support the gearbox housing on wooden blocks while in this position.

Push the sliding clutch (45) over the long splined end of the input shaft. The narrow row of teeth must face toward the lock ring (32). Check for free movement by sliding the clutch back and forth over the full length of the splines.

Output Shaft Reassembly

Press the roller bearing (59) into the bearing retainer (58) until fully seated and install the lock ring (60).

Position the roller bearing (46) in the geared end of the output shaft (54) and press it into the shaft bore until fully seated.

Slide the splined end of the output shaft through the bearing until the bearing seats squarely against the shaft shoulder.

Install the lock ring (50), and slide the gear (51) and spacer (52) onto the shaft.

Position the spacer (G-R P/N 29511-913) over the geared end of the output shaft, and rest the retainer, shaft and spacer on the bed of the press with the splined end of the shaft facing up. Use the bearing driver (G-R P/N 29511-913) to press the bearing (53) over the shaft until fully seated in the bearing retainer bore.

Install the bearing retainer gasket (48). Slide the tail shaft assembly into the gearbox housing until the bearing retainer seats squarely against the housing shoulder, and the bearing (46) is positioned over the end of the input shaft. Secure the bearing retainer to the gearbox housing by torquing the capscrews (21A) to 90 ft. lbs. (1080 in. lbs. or 12,4 m. kg.).

Use the seal driver and stop (G-R P/N 29511-902) to press the oil seal (55) into the bearing cap (56) until fully seated. Install the gasket (57) and secure the cap to the bearing retainer by torquing the capscrews (5, Figure 4) to 50 ft. lbs. (600 in. lbs. or 7 m. kg.).

Air Shift Cover Reassembly

Reinstall the shifter shaft O-ring (8) and oil seal (2). Be sure the lip of the oil seal is directed toward the shifter fork.

Replace the plunger O-ring (11). Lubricate the O-rings, piston and cylinder I.D. with "Dexron II or Delvac I" automatic transmission fluid, and reinstall the shifter shaft assembly (7). Secure the cylinder cap (14) by tightening the capscrews (14) equally to prevent cocking the cylinder body; torque the capscrews to 35 ft. lbs. (420 in. lbs. or 4,8 m. kg.). Check for free movement of the shaft and piston.

Inspect the shifter fork (5) and replace as necessary. Position the shifter fork on the shifter shaft. Apply "Loctite Primer Grade T" followed by "Loctite Threadlocker No. 271" to the allen head screws (6), and secure the fork to the shaft by torquing the capscrews to 45 ft. lbs. (540 in. lbs. or 6,2 m. kg.).

Engage the shifter fork with the sliding clutch, and secure the air shift cover to the gearbox housing by torquing the capscrews (72 and 73) to 35 ft. lbs. (420 in. lbs. or 4,8 m. kg.).

Apply "Permatex" or equivalent compound on the hose fittings before installing the air supply lines to the air cylinder. Air check all possible leak points with 120 to 150 psi (8,4 to 10,5 kg/cm²) before further reassembly.

Check the shifter fork and sliding clutch alignment by working the shifter fork back and forth. The shaft should travel approximately 1-5/8 inches (41,3 mm) between the two positions.

Pressure Testing

The gearbox should be pressure tested any time a sealed surface is disturbed. This includes flange, gasket or oil seal removal, as well as a complete overhaul.

To pressure test the gearbox, install the pressure test sleeves (G-R P/N 29511-914) over the input and output shafts, and secure them with the capscrews and lockplate washers (24 and 25); torque the capscrews to 90 ft. lbs. (1080 in. lbs. or 12,4 m. kg.).

Remove the breather vent (4) and install a valve stem and air pressure gauge in the hole. Apply "Loctite Pipe Sealant with Teflon" or equivalent compound to the threads before installation.

Use filtered compressed air to pressurize the gearbox until it stabilizes at 6 psi (0,4 kg/cm²), then shut off the air flow and observe the pressure gauge. If the pressure drops more than 1 psi (0,07 kg/cm²) in 15 seconds, an unacceptable air leak exists at one of the sealing surfaces.

To find the leak, repressurize the gearbox, and apply a liberal amount of commercially available window cleaner or liquid detergent to each sealing surface. Watch for air bubbles to appear indicating a leak. Correct any leaks that are found, and retest the gearbox.

Drive Flange Installation

The shaft splines are designed to produce a slight interference fit with the drive flanges. This fit is required to prevent fretting corrosion.

Coat the input and output shaft splines with light oil. Apply oil to the leading area of the drive flanges where the oil seal lips seat. Position the input and output flanges on their respective shafts.

It is recommended that a sleeve be used to drive the flanges onto the shaft until fully seated. The sleeve must be sized to fit over the shaft and into the flange counterbore.

After the flanges have been installed, secure them to the shafts with the capscrews and lockplate washers (24 and 25); torque the capscrews to 90 ft. lbs. (1080 in. lbs. or 12,4 m. kg.).

Lubricate the gearbox as indicated in **LUBRICATION** at the end of this section. Install the pump and

gearbox assembly onto the vehicle as described in **Installing Pump and Gearbox** at the end of **PUMP AND SEAL REASSEMBLY**.

LUBRICATION

Seal Assembly

The seal assembly is lubricated by the liquid being pumped. No additional lubrication is required.

Trunnion Bracket

(Figure 1)

To lubricate the trunnion (10) and bearing retainer, add SAE No. 2 lithium-based pressure gun grease through the lubrication fitting (12) until grease escapes from the trunnion area.

Gearbox Assembly

(Figure 2A)

The gearbox was shipped from the factory dry of lubrication, **except** for 6 ounces (18 ml) of Dow Corning "Molykote® M Gear Guard" (an anti-wear additive consisting of molybdenum disulphide solid lubricants suspended in petroleum oil). For initial lubrication of the gearbox, remove the oil level plug (64), and add approximately 68 U.S. ounces (2011 ml) of premium quality, multi-purpose, extreme pressure gear lubricant with an SAE rating per the following ambient temperatures.

Table 1. Lubrication Specifications

Temperature Range	Lubricant
-40°F (-53°C) to 0°F (-18°C)	Delvac I
-10°F (-23°C) to +40°F (+4°C)	80 W 90
+32°F (0°C) and above	80 W 140

The recommended oil level is 1/2-inch (12,7 mm) below the oil level plug. If the gearbox is over-filled, foaming may occur with oil loss through the breather vent during continuous duty operation. Under-filling can result in loss of lubrication to the tailshaft bearing, resulting in premature bearing failure. Check the lubricant level regularly, and maintain it at the recommended level.

Reinstall the oil level plug.

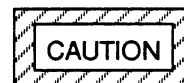
Intermittent (Normal Refueler) Duty Cycle

Change the lubricant in a new gearbox after an initial break-in period of 24 hours, and before 100 hours of operation. The lubricant should be changed while the pump is at operating temperature.

To change the lubricant, remove the magnetic drain plug and gasket (65 and 66), and drain the gearbox. If operating conditions require changing grades of oil to Delvac I, it is recommended that the gearbox be thoroughly flushed with flushing oil prior to refilling. Always clean the magnetic plug thoroughly before reinstalling it. Add 6 ounces (18 ml) of Dow Corning "Molykote® M Gear Guard", and "top off" with approximately 68 U.S. ounces (2011 ml) of oil as previously described.

After the initial change, the lubricant should be changed after every 500 hours of operation or every 6 months, whichever comes first. The lubricant should be changed more frequently when the pump is operated under severe conditions, such as extremely dusty conditions or in areas where extreme temperature changes are regularly experienced.

Check the oil in the gearbox monthly, and maintain it at the proper level. Check the gearbox monthly for leaks.



CONTAMINATED GEARBOX LUBRICANT OR METAL SHAVINGS ON THE MAGNETIC DRAIN PLUG MAY INDICATE IMPENDING PUMP OR GEARBOX FAILURE. MONITOR OPERATION CLOSELY AND SCHEDULE MAINTENANCE ACCORDINGLY.

Continuous Pumping Duty Cycle

For duty cycles which do not provide at least a 20 minute cool-down (non-pumping) period after each 30 minutes of continuous pumping, the following lubrication schedule shall apply.

1. Change the lubricant in a new gearbox after an initial break-in period of 10 hours and before 20 hours of operation. The lubricant should be changed while the pump is at operating temperature. Remove the magnetic plug and gasket (65 and 66) and drain the gearbox. Always clean the magnetic plug thoroughly before reinstalling.
2. After the initial change, the lubricant should be changed after every 40 hours of operation or 3 months, whichever comes first.

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

**For Canadian Warranty Information,
Please Visit www.grcanada.com/warranty
or call:
519-631-2870**