

(GVS) I-480 Rev. 02
For Units Sold After 8-29-2003

GVS Series

*Installation, Operation
and Maintenance Manual*



 **Carver[®]**

Creating Value.

SERVICE RECORD PAGE

Service No. _____ Size and Type _____ Make _____

Cust. Order No. _____ Date Installed _____

Installation Date	Location	Application

PUMP RATING

Capacity (GPM) _____ Total Head (ft) _____

Suction Pressure _____ Speed (RPM) _____

Liquid _____ Temperature _____

Specific Gravity _____ Viscosity _____

Impeller Diameter (inches) _____

PUMP MATERIALS

Casings _____ Impeller _____ Diffuser _____

Shaft _____ Wear Ring _____

O-rings _____ Bearing Frame _____

Mechanical Seal, Suction End (Low Pressure) _____

Mechanical Seal, discharge End (High Pressure) _____

DRIVER DATA

Motor _____ Make _____ Serial No. _____

Type _____ Frame _____ AC or DC _____

HP _____ RPM _____ Volts _____

Phase _____ Cycles _____

NOTES ON INSPECTION AND REPAIRS

INSPECTION DATE	REPAIR TIME	REPAIRS	COST	REMARKS

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I. GENERAL INFORMATION.

A. PREFACE. Our general service vertical sump (GVS) pumps are designed for industrial service, moderate to high flow rates. GVS pumps are provided with the wet end, support column, bearing frame, motor mounting bracket, small top plate, and standard discharge piping. All wetted surfaces are available in all iron, 316 stainless steel (SS) fitted cast iron, and 316 SS construction.

Standard options include 316 SS underliners (0.048" thickness) for contamination and corrosion protection, inlet tail pipes and suction strainers.

Carver Pump Company products are carefully engineered and manufactured and, if properly installed, maintained, and operated, will provide long service life.

If the pump operates under conditions, as specified on the order acknowledgment, and is properly installed and maintained, as recommended herein, factory warranty applies.

This manual, which is the result of carefully conducted engineering and research efforts, provides technical information necessary to properly disassemble, assemble, maintain and operate your pump. To ensure smooth operation of the pump with minimal maintenance, carefully read the information provided and follow the recommended procedures. Additional copies of this manual are available from the following locations: www.carverpump.com, and upon request from your local Carver Pump Company distributor.

For comments and/or questions regarding the information contained herein, please contact Carver Pump Company or your local distributor.

B. PUMP IDENTIFICATION. The type of pump, pump size, operating data, and serial number are all stamped on the nameplate attached to the baseplate. Pump specifications should be recorded upon receipt of the pumping unit. Record all necessary information on the pump service record page and inspection and repair record provided at the front of this manual. When ordering spare parts (refer to Table 6) or requesting information, nameplate data should be furnished to Carver Pump Company or its representative. When ordering a pump, refer to Figure A, Ordering Codes. This information must be included in all correspondence regarding the unit. This will ensure that the correct pump and/or parts are ordered in a timely manner.

C. PARTS INVENTORY GUIDE. To avoid unnecessary delays during maintenance of pump, spare parts should be readily available for normal service. Most matters can be handled with proper usage of this manual. For every one to three pumps, stock one spare parts set consisting of items listed in Table 6, Recommended Spare Parts. Part numbers correspond to drawings found at the back of this manual.

D. PARTS ORDERING. Carver Pump Company strives to provide prompt, accurate service. To ensure quality service support, please provide the following information when ordering parts:

- Serial number of pump (located on nameplate)
- Part name (refer to Tables 6 or 7)
- Item number (refer to Tables 6 or 7 and figures 1 and 2)
- Quantity of parts needed

Carver may ship an interchangeable part that is not identical in appearance or symbol. Examine the parts carefully on receipt before calling the factory or a company representative. Never return parts to the factory without authorization from Carver Pump Company.

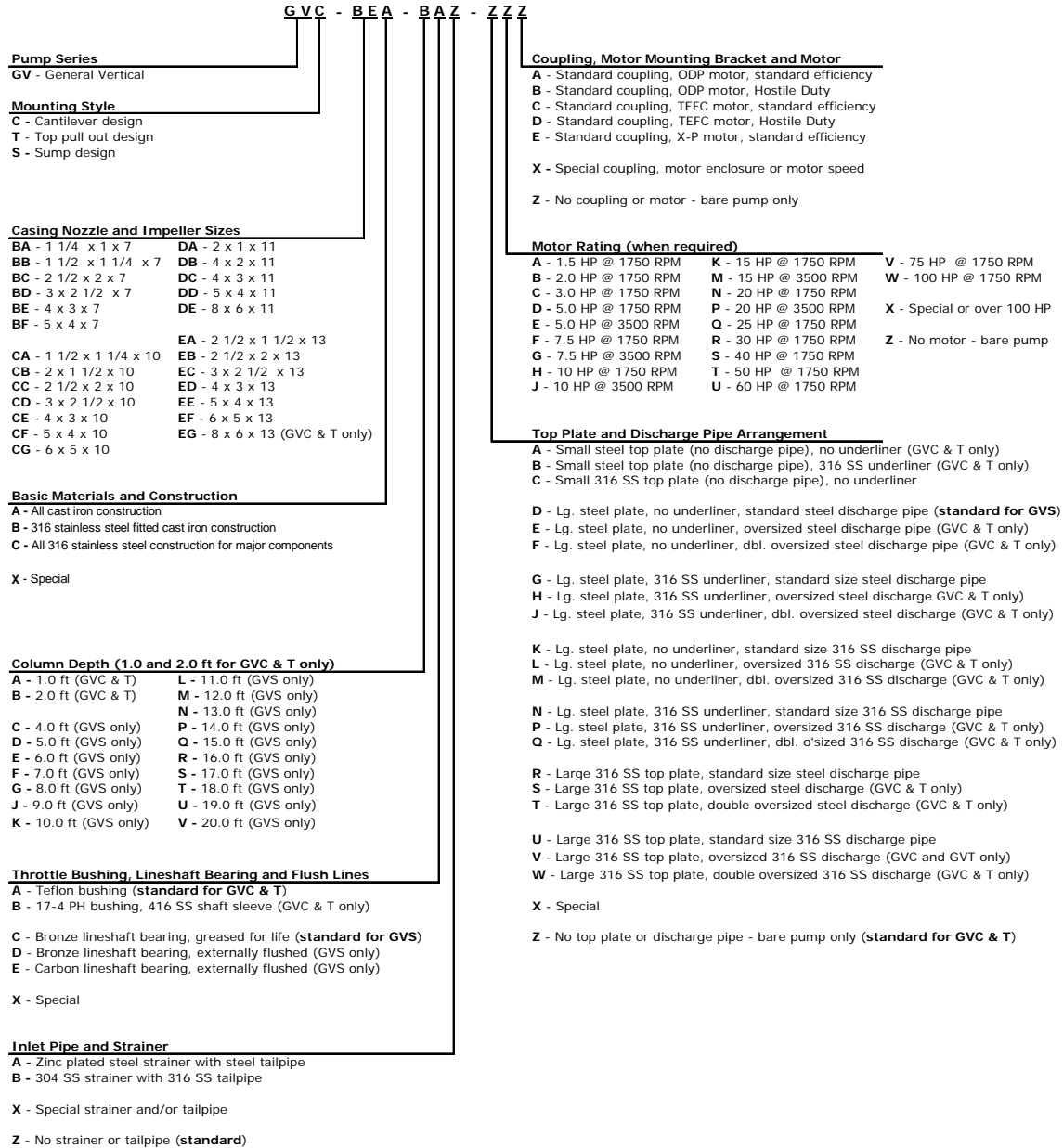
If an impeller is ordered, specify diameter across blade tips. Check to make sure diameter was NOT trimmed further than diameter shown on Carver Pump Company records.

If a driver or driver parts are ordered, specify the name of the manufacturer and all other data located on the driver nameplate.

The following Ordering Code defines the new GVS Series pump and pump/motor and top plate arrangements. When quoting or ordering a GVS pump, **this Ordering Code must be used.**

This Ordering Code enables Carver Pump Company to accept orders quickly, assuring timely and correct manufacture of the desired pump.

EXAMPLE



* Casing Nozzle and Impeller Sizes containing codes BA through BF and CA through CG have semi-open impellers. Casing Nozzle and Impeller Sizes containing codes DA through DE and EA through EG have closed impellers.

Figure A. Ordering Codes

E. SAFETY PRECAUTIONS. This manual is written with the intent to provide instructions for the safety of personnel when efficiently installing, operating, and maintaining the pump. Failure or neglect to properly install, operate, or maintain the pump may result in personal injury, property damage, or unnecessary damage to the pump and/or parts.

Throughout the manual, note various cautions, which are intended to remind personnel of proper handling of the unit, and note warnings, which are strategically placed to ensure safety for personnel.

Variations exist in the equipment used with these pumps and in particular, installation of the pump and driver. This manual contains general rules for installation, operation, and maintenance of the driver. Contact the driver manufacturer for specific operating instructions.

Observe and understand all caution or danger tags attached to the equipment.

The following general safety precautions do not relate to any specific procedure within this manual but are pertinent to providing a safe working environment for personnel.

CAUTION

Various federal, state and local laws and the regulations concerning OSHA affect installation, use, and operation of pumping equipment. Compliance with such laws relating to the proper installation and safe operation of pumping equipment is the responsibility of the equipment owner and all necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

1. Prior to working on pump or driver, ensure all switches and circuit breakers have been locked in the open (off) position and tagged, "Out of Service."
2. All circuits NOT known to be dead must be considered live at all times.
3. Do NOT wear loose or torn clothing around rotating machines. Do NOT wear jewelry or watches around rotating machines.
4. While working near electricity, do NOT use metal rules, flashlights, metallic pencils, or any other objects having exposed conducting material.
5. Ensure you are NOT grounded while adjusting electrical equipment or using measuring equipment.
6. In general, use only one hand when servicing live electrical equipment.

7. De-energize all electrical equipment before connecting or disconnecting meters or test leads.
8. When connecting a meter to terminals for measurement, use a range higher than the expected voltage.
9. Check to make sure the frame of the driver and starter panel are securely grounded before operating pumping unit or performing any tests or measurements.
10. If a test meter is held or adjusted while voltage is applied, ground case of meter before starting measurement. Do NOT touch live equipment while holding meter. Some moving vane-type meters should not be grounded nor held during measurements.
11. Do NOT use test equipment known to be damaged or in poor condition.

II. INSPECTION AND STORAGE.

A. INSPECTION UPON ARRIVAL. Upon receipt of the shipment, check for missing or damaged items. Unpack and inspect the pump, driver assemblies, and individual parts. Carefully inspect all boxes and packing material for loose parts before discarding. Immediately report any missing parts or damage incurred during shipment to the factory and to the transportation company. File your "damaged and/or lost in shipment" claim with the carrier.

NOTE

The pump and equipment, as shipped from Carver Pump Company, have appropriate protection for short-term storage. If the equipment is NOT immediately installed and operated, store the equipment in a covered, clean, dry, well-ventilated location, free from vibrations, moisture, and rapid or wide variations in temperature.

The pump is shipped with flange covers to protect flange faces and prevent foreign matter from entering pump. Flange covers should remain intact until suction and discharge piping are connected to pump flanges.

B. STORAGE OF PUMP. If the equipment is NOT immediately installed and operated, Carver Pump Company recommends rotating each shaft several revolutions at least once every two weeks to prevent flat spots on ball bearings.

Consider a unit to be in storage when any of the following situations occur:

- The pump has been delivered to the job site and is waiting to be installed.

- The pump has been installed but operation is delayed pending completion of construction.
- There are long (30 days or more) periods between operating cycles.
- The plant (or department) is shut down for periods of longer than 30 days.

CAUTION

A pump, which is made of cast or ductile iron that sits in extreme heat, high humidity, or full or partially full water over 30 days will rust and will most likely seize. If the pump rusts and/or seizes, a complete overhaul and repair may be necessary to refurbish the pump.

Storage requirements vary depending on the length of storage, the climatic environment, and the equipment. For storage periods of three months or longer, contact a representative from Carver Pump Company for specific instructions. Improper storage will damage the equipment and will require non-warranty restoration and/or non-warranty product failures. Refer to Section VIII, Service and Repair, for pump disassembly and assembly procedures. When disassembling the pump, replace and repair rusted parts, as necessary.

NOTE

If the customer anticipates the pump/equipment will be subject to an extended period of storage after installation, (for example, a unit used for seasonal operation), contact a representative from Carver Pump Company. If this is the case, Carver will provide specific instructions for the equipment during the extended period of storage. In general, if a pump is to be shut down for an extended period, the following steps are recommended:

1. Shut down the pumping unit in accordance with the operating procedures outlined throughout this manual.
2. Shut off system suction and discharge valves.
3. Drain the unit.
4. Fill unit with mineral oil or suitable non-corrosive protectant that is compatible with the system.
5. Provide pump and motor with a protective cover.

III. INSTALLATION.

Skilled personnel should install the pump in accordance with engineering standards. Faulty

installation will result in operating troubles and premature wear of parts.

WARNING

Lift pumping unit using a hoist or suitable lifting device. Do NOT lift complete unit using the driver, pump shaft, discharge piping or driver eyebolts. Take extreme care when handling composite materials.

The pump and driver should be easily accessed with enough headroom to perform periodic inspection and maintenance.

NOTE

The pump should always be submerged in enough fluid to prevent vortices from forming. If large vortices form, air enters the suction and causes the impeller to become imbalanced or causes the pump to run dry. If one allows large vortices to form, damage may occur to the pump and/or its parts.

The pump is generally supplied with coupling, motor, and baseplate, and the complete set is assembled at Carver Pump Company. After ascertaining that the unit has suffered no damage in transit, one may install the pumping unit. Proceed as follows:

1. Make sure the mounting surface is level. Attach the base to the mounting surface. Check that pump rotates freely.

CAUTION

Support all piping as to avoid undue pipe strain or weight upon the pump. Do NOT force piping. Do NOT use pump as an anchorage point for the piping. Pipe strain will cause wear and/or damage to parts.

2. Connect discharge piping. Extreme care should be taken when connecting new piping lines to be sure that no foreign matter such as dirt, chips, tools, etc., is in the piping, tank, or return piping as the debris will be drawn into the pump and cause excessive damage. Any debris caught in the pump passageways will cause an imbalance in the pumping unit.

The discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. Any flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust.

The discharge piping should be as direct as possible using a minimum number of valves to reduce pipe friction losses.

Install a check valve and closing valve in the discharge line. The check valve between the pump and closing valve protects the pump from water hammer and prevents reverse rotation in the event of a power failure. The closing valve is used in priming, starting and shutdown.

3. Connect any necessary auxiliary piping and gauge lines.
4. Since the pumping unit is shipped with bearings packed, initial greasing is not necessary unless pumping unit has been in storage for an extended period of time (refer to section II, Inspection and Storage).
5. Turn pump and motor shafts by hand to ensure free rotation.
6. Connect wiring to motor. Due to high voltage required to operate the pumping unit, personnel working with the equipment should be familiar with electrical safety practices and modern methods of resuscitation.
7. Connect electrical power supply to motor.
8. Open system valves.

IV. ALIGNMENT.

A flexible coupling connects the pump and motor.

The motor bracket aligns the pump and motor. No further alignment is necessary.

V. OPERATION.

A. PRESTART CAUTIONS.

WARNING

Before activating the pumping unit, check to make sure there are no personnel performing maintenance on the unit. Serious injury or death to personnel could occur if unit is unexpectedly activated.

Before starting or operating the pumping unit, read this entire manual and conduct the following checks:

1. Before starting the pump, rotate shaft by hand to assure all moving parts are free.
2. Before starting the pump, install closed guards around all exposed rotating parts.
3. Observe all caution or danger tags attached to the equipment.
4. Do NOT run pump dry. Dry running may result in pump seizure.

5. If excessive vibration or noise occurs during operation, shut the pump down and consult a Carver representative.
6. Use of a check valve in discharge piping is recommended if there is a high volume of reverse flow.
7. Check level in tank to see that the pump is submerged in fluid.
8. Check to make sure fluid in the pump is clean, clear and free of debris.
9. Standard grease lubricated pumps are shipped with factory lubrication packed bearings. Lubrication is adequate for a minimum of 1,000 operating hours or six months of continuous operation under normal conditions. After extended storage or exposure to unusually humid or hot environmental conditions, the bearings and their lubricant should be checked before operating the unit. For bearing lubrication options, refer to figure 3.

B. STARTING THE PUMP. The pumping unit operates without operator intervention once system valves have been adjusted to the specified pumping conditions. When the casing of the pump is submerged into the fluid pumped, the pump is rendered self-priming. Before starting the unit, refer to section I, paragraph E, Safety Precautions. Proceed with operation as follows:

1. Make sure no one is working on the pumping unit.
2. If the pumping unit has been idle for a period of time, make sure unit is firmly attached to its foundation.
3. Open valves to pressure gauges in system.

CAUTION

Check level of liquid in tank so casing is under liquid level.

4. Jog starter switch on motor to check direction of rotation. Correct direction of rotation is shown using a directional arrow on the pump motor bracket. Standard direction of rotation is clockwise when viewed from fan end of motor.
5. Partially open discharge valve.
6. Start the pumping unit in accordance with the directions on the electrical power supply.
7. Slowly adjust discharge valve to operating condition required.
8. Pumping unit is now in full operation.

C. STOPPING THE PUMP. To stop the pump, use the following process:

1. If pump is stopped for overhaul, slowly close the discharge valve. Otherwise, leave discharge valve set at condition.
2. Stop the pumping unit in accordance with the directions on the electrical power supply.
3. If the pump is stopped for overhaul, close pressure gauge valves.
4. The pumping unit is now in the off position.

VI. TROUBLESHOOTING.

The pump should provide reliable service and long life if the installation and starting procedures outlines in this manual are followed. If operating problems do occur, refer to Table 1 to eliminate some of the most common causes of those problems.

Table 1. Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Motor will not start.	<ol style="list-style-type: none"> 1. No input power. 2. Improper voltage. 3. Motor overload. 4. Mechanical obstruction that prevents rotor from turning. 	<ol style="list-style-type: none"> 1. Check connections to electrical power source. Check fuses or circuit breakers. Check terminals at source of power input. 2. Check voltage at motor terminals. 3. Refer to "Overload on motor". 4. Examine and clean pumping unit thoroughly. Check for bearing failure or bent shaft.
Motor overheats.	<ol style="list-style-type: none"> 1. Motor overload. 2. Improper voltage. 3. Obstruction in ventilation. 4. Insufficient cooling medium. 5. Overgreased motor bearings. 6. Improper motor grease. 	<ol style="list-style-type: none"> 1. Refer to "Overload on motor". 2. Check voltage at motor terminals. 3. Check ventilation opening of motor. Keep clear of obstructions at all times. 4. Check ambient temperature. Motor temperature should not exceed ambient temperature plus the rated temperature increase of the unit. 5. Remove lubricant from bearing chamber until the proper amount of grease is in chamber. 6. Remove grease and replace with grease recommended by motor manufacturer.
Failure to deliver fluid.	<ol style="list-style-type: none"> 1. Discharge valve closed. 2. Discharge head above shutoff. 3. Impeller or suction pipe clogged. 4. Wrong rotation. 5. Liquid level in tank too low. 6. Suction strainer is plugged. 	<ol style="list-style-type: none"> 1. Check discharge valve. 2. Consult with nearest Carver Pump Company representative or factory. 3. Inspect and clean impeller and suction pipe. 4. Check power connection to motor. 5. Add liquid to system. 6. Clean suction strainer.
Reduced capacity and/or pressure.	<ol style="list-style-type: none"> 1. Discharge valve closed. 2. Damaged impeller. 3. Impeller or suction pipe partially clogged. 4. Suction pipe too close to bottom of tank. 5. Liquid level in tank too low. 6. Total head too high. 7. Wrong rotation. 	<ol style="list-style-type: none"> 1. Check discharge valve. 2. Replace impeller. 3. Inspect and clean impeller and suction pipe. 4. Reduce length of pipe. 5. Add liquid to system. 6. Consult with nearest Carver Pump Company representative or factory. 7. Check power connections to motor.

Table 1. Troubleshooting (cont.)

SYMPTOM	PROBABLE CAUSE	REMEDY
Reduced capacity and/or pressure (cont).	<ul style="list-style-type: none"> 8. Speed too low. 9. Semi-open impeller running clearance too large. 10. Enclosed impeller clearance between suction cover or wear ring is too large. 11. Suction strainer is plugged. 	<ul style="list-style-type: none"> 8. Consult with nearest Carver Pump Company representative or factory. 9. Check semi-open impeller clearance according to section VIII, paragraph E. 10. Check enclosed impeller clearance according to section VIII paragraph C, procedure ten. 11. Clean suction strainer.
Pump surges	<ul style="list-style-type: none"> 1. Liquid level in tank too low. 	<ul style="list-style-type: none"> 1. Add liquid to system.
Pump loses prime after starting.	<ul style="list-style-type: none"> 1. Suction lift is over six feet. 2. Liquid level in tank too low. 	<ul style="list-style-type: none"> 1. Check with vacuum gauge. 2. Add liquid to system.
Overload on motor.	<ul style="list-style-type: none"> 1. Head lower than that for which pump is designed. 2. Mechanical defects of pump or motor such as bent shaft, binding or rubbing rotating element. 3. Liquid handled of higher specific gravity or lower viscosity than intended application. 	<ul style="list-style-type: none"> 1. Consult with nearest Carver Pump Company representative or factory. 2. Replace defective parts or replace pump or motor. 3. Consult with nearest Carver Pump Company representative or factory.
Insulation failure.	<ul style="list-style-type: none"> 1. Oil or water soaked windings. 2. Improper voltage. 	<ul style="list-style-type: none"> 1. Return motor to the motor manufacturer. 2. Check voltage at motor terminals.
Vibrates or is noisy	<ul style="list-style-type: none"> 1. Insufficient or insecure foundation. 2. Mechanical defects of pump or motor such as bent shaft, binding rotating element, or warped impeller. 3. Foreign matter in pump. 4. Strain due to piping or improper piping supports. 5. Damaged bearings. 6. Insufficient bearing lubrication. 	<ul style="list-style-type: none"> 1. Enlarge foundation or relocate pumping unit so it can be firmly bolted to foundation. 2. Replace defective parts or replace pump or motor. 3. Disassemble pump. Identify and remove foreign matter. Clean parts and replace damaged parts. 4. Check piping alignment and remove piping weight from pump with proper supports. 5. Replace bearings. 6. Lubricate bearings according to section VII, paragraph C, Bearing Lubrication.

VII. MAINTENANCE.

Generally, the pump does not require continuous supervision. Occasional visual checks are recommended. Data should be recorded for each pump to keep track of maintenance, which has been performed and note operational problems. A pump service record page is provided for this purpose in the front of this manual.

A. FIELD INSPECTION. Shutdown is not required. Perform field inspection at regular intervals and perform the following checks:

1. Check and record the suction and discharge pressures to establish differential head. It should conform to the pump nameplate.
2. Check and record the power input and speed of the driver.
3. Check and record pumping temperatures.
4. Check pump for quiet running.

B. BEARING TEMPERATURE. Bearing temperature should be monitored periodically. Normal operating temperatures are 120 degrees F to 160 degrees F, depending on the ambient temperature, but should not run hotter than 180 degrees F. Bearings may appear to run hot when pump is first started. This is caused by the shaft seal, not the bearing. When the seal is seated, temperature should drop to normal.

Check bearing temperature by placing a pyrometer against the bearing frame while pump is running. A temperature rise above 180 degrees F indicates possible damage that requires checking. The most common cause of high bearing temperatures is overgreased bearings.

C. BEARING LUBRICATION. Lubrication frequency depends on operating conditions. Normal duty calls for relubrication every 1000 hours of operation. Bearings are lubricated at Carver Pump Company with Amoco Rykon Premium Grease No. 2EP, non-soap, polyurea thickened grease with a drop point of 450 degrees F. This grease was selected due to its suitability to extreme pressures and its high temperature stability. Never mix greases with differing properties.

Polyurea base greases are NOT compatible with lithium or soda soap base greases. Therefore, the type of grease added should not vary. However, if it is necessary to change grease types, the bearings, bearing frame, and bearing cap and/or cartridge should be thoroughly cleaned and flushed with suitable solvent to remove all traces of old grease. If equipped, fill the bearing's autogreaser. Remove bearings in accordance with section VIII, paragraph A. For proper lubrication of bearings, use the following procedures:

To properly lubricate driver bearings, refer to the manufacturer's specific instructions.

Grease Lubrication

1. Place bearings, bearing frame, and bearing cap and/or cartridge in a wire or mesh basket and suspend the basket in a light mineral solvent. Allow it to soak, preferably overnight.
2. After soaking and cleaning, the bearings, bearing frame, and bearing cap and/or cartridge should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
3. Dip bearings in clean, light oil and spin by hand to determine that all foreign matter has been removed.
4. After cleaning, repack bearings on both sides full with a good quality ball bearing grease.

Bearing Relubrication

To relubricate bearings use the following procedure:

CAUTION

Overgreasing creates heat and is the cause of many problems requiring repair. DO NOT OVERGREASE.

1. Never relubricate pump bearings while unit is running. If necessary, shut down pump according to section V, paragraph C, Stopping the Pump.
2. Remove plug opposite grease fitting.

CAUTION

Do not lubricate bearings with a power grease gun.

3. Using a hand-operated grease gun on grease fittings, add approximately one ounce of fresh grease for each bearing. DO NOT OVERGREASE. When installing new bearings, hand pack new bearings full with grease.

Bearing temperature may rise above normal immediately after lubrication, but should stabilize within four to eight hours.

NOTE

Carver recommends replacing bearings if removed from the shaft. If it is necessary to reuse bearings that are in good condition, use proper bearing replacement procedures outlined in this section.

If applicable, lineshaft bearings should be lubricated at fittings on baseplate near the discharge pipe. Use the same grease and lubricate at the same time as the ball bearing.

VIII. SERVICE AND REPAIR.

A. INSTALLATION OF NEW BALL BEARINGS WITHOUT DISASSEMBLY OF PUMP.

Ball bearings may be installed without complete disassembling of pump. Use the following procedure to install new ball bearings:

1. Prepare pump for repair in accordance with paragraph B of this section.
2. Remove coupling guard (131) from motor bracket (71) by removing nuts (612), washers (652), and bolts (602). Disconnect coupling (42) and remove coupling element (not shown) to prevent binding or loading on coupling (42).

CAUTION

To lift motor, use a hoist or suitable lifting device.

3. Attach hoist or suitable lifting device to motor. Remove bolts (607) separating motor from motor bracket (71). Hoist motor and motor coupling half away from pump and rest on plywood, heavy cardboard or other adequate durable surface.
4. Loosen coupling setscrew (not shown). Remove coupling half (42) and key (46) from shaft (6).
5. Remove bolts (609) and bearing cap (35) from bearing cartridge (37). Remove lip seal (47X) from bearing cap (35).

CAUTION

Bearing locknut (22) is left handed thread.

6. Straighten the locking tabs on bearing lockwasher (69) with a screwdriver and remove bearing locknut (22) and bearing lockwasher (69).
7. Remove bolts (608) holding bearing cartridge (37) to bearing housing (19).
8. Loosen bearing cartridge (37) assembly from shaft (6) by using bolts (610) as forcing bolts.
9. Remove bearing cartridge (37) assembly from shaft (6) and bearing housing (19). Remove lip seal (47), if equipped, from bearing cartridge (37).
10. Using a small press, push the ball bearing (18) out of the bearing cartridge (37). Bearing spacer (176) should fall out.
11. If grease lubricated, hand pack new ball bearing (18) with grease according to section VII, paragraph C.
12. Install new lip seal (47), if equipped, in bearing cartridge (37). Install bearing cartridge (37) on shaft (6). Install bearing spacer (176) over shaft (6) in bearing

- cartridge (37). Install new ball bearing (18) over shaft (6) in bearing cartridge (37).
13. Secure bearing cartridge (37) to bearing housing (19) with bolts (608).

CAUTION

Bearing locknut (22) is left handed thread.

14. Install bearing lockwasher (69) and locknut (22). Crimp locking tabs on lockwasher (69) in groove of locknut (22).

NOTE

Do NOT tighten bearing cartridge bolts (608) and jacking bolts (610) in bearing cartridge (37) until pump is completely assembled.

15. Install new lip seal (47X) in bearing cap (35). Install bearing cap (35) and secure to bearing cartridge (37) with bolts (609).
16. Adjust impeller in accordance with section VIII, paragraph E.
17. Install key (46) and coupling half (42) on shaft (6). Tighten coupling setscrew (not shown).

CAUTION

To lift motor, use a hoist or suitable lifting device.

18. Attach hoist or suitable lifting device to motor. Install motor on motor bracket (71) and secure with bolts (607). Remove lifting device.
19. Connect coupling (42). Install the coupling guard (131) and secure with bolts (602), washers (652), and nuts (612).
20. Connect wiring to motor. Remove all tags and connect power supply to motor. Start pumping unit in accordance with section V, paragraph A and B.

B. DISASSEMBLY. Read this entire section and study the drawings in the back of this manual before proceeding.

1. Stop pump in accordance with section V, paragraph C. Disconnect, lock out, and tag electrical power supply to motor. Disconnect wiring from motor.
2. Shut off and tag all valves controlling the flow of liquid to the tank and from the pump. If necessary, flush pump to remove corrosive or toxic pumpage.

WARNING

When pump is handling hazardous fluid, take extreme care to ensure safety of personnel attempting to drain pump. Use suitable protective devices and/or wear protective clothing.

The GVS pumps are of the same basic design, but some parts do vary between models. Parts that may vary from model to model are: semi-open or enclosed impeller, wear ring (enclosed impeller pumps only), and line shaft bearing.

During disassembly, mark parts to determine the proper location when assembly begins. When removing bolts, use socket or box-ended wrenches instead of open-ended wrenches. After extended operation, it may be difficult to separate some components. Rust solvent may be used and suitable extricating tools where possible. Do not use metal-headed hammers; use only those with plastic or rubber heads.

NOTE

To avoid damaged o-rings, check to make sure all parts are free of sharp edges or burrs.

After prolonged operation, components may not be easily removed from shaft. In such instances, rust solvent may be used and suitable extracting tools applied wherever possible.

Refer to appropriate sectional drawing, for location of parts followed by an item number

Table 2. Recommended Torque Values (ft-lbs)

Bolt Size	Material	
	Steel (or otherwise noted)	316 Stainless Steel
1/4"-20	5	7
5/16"-18	11	12
3/8"-16	18	21
1/2"-13	39	45
5/8"-11	83	97
3/4"-10	105	132
7/8"-9	160	203
1"-8	236	300

Before disassembly, review Table 2, Torque Values to avoid equipment damage and injury to personnel.

DISASSEMBLY

Refer to appropriate sectional drawing. Disassemble the pumping unit using the following procedure:

1. Remove coupling guard (131) from motor bracket (71) by removing nuts (612), washers (652) and bolts (602). Disconnect

coupling (42) to prevent binding or loading on coupling (42).

CAUTION

To lift motor, use a hoist or suitable lifting device.

2. Attach hoist or suitable lifting device to motor. Remove bolts (607), separating motor from motor bracket (71). Hoist motor and motor coupling half way from pump and rest on plywood, heavy cardboard or other adequate durable surface.
3. Disconnect discharge piping at baseplate (23).

Remove the pump from the sump pit in order to perform the following disassembly procedures.

CAUTION

To lift pump, use a hoist or suitable lifting device.

4. Attach lifting straps and eyebolts to baseplate (23). Remove baseplate mounting bolts. Remove pump from master plate and take to a suitable work area.

CAUTION

To prevent damage to shaft, use a hoist or suitable lifting device to support column and shaft during disassembly.

To remove suction cover (9) and impeller (2), use the following steps:

5. Remove bolts (611). Remove suction cover (9) with o-ring (89A).

CAUTION

Use extreme care when handling impeller.

NOTE

Replace used o-rings, seals and ball bearings with new o-rings, seals and ball bearings.

6. Remove impeller bolt (26) and impeller washer (28).
7. Remove impeller (2) and impeller key (32).
8. Remove bolts from discharge pipe (not shown) at casing (1).
9. Remove nuts (613), washers (653) and bolts (603) from column (101).
10. Remove casing (1), backcover (11) and flange adaptor (85).
11. Loosen setscrew (864). Remove slinger (40).

WARNING

When pump is handling hazardous fluid, take extreme care to ensure safety of personnel attempting to drain pump. Use suitable protective devices and/or wear protective clothing.

- 12. Remove plugs (426). Remove lineshaft bearing housing (99).

Disassembly of lineshaft bearings

- 13. Check lineshaft bearing (63) in accordance with paragraph C (of this section), Parts Inspection. If lineshaft bearing (63) need replaced, use the following steps and refer to paragraph D (of this section), "lineshaft bearing assembly":
- 14. Remove lip seal (47A), if equipped, from both ends of the lineshaft bearing housing (99). If lineshaft bearing (63) are fluid flushed, there should be no lip seal (47A).
- 15. Take lineshaft bearing housing (99) to a press and remove lineshaft bearings (63).
- 16. Loosen coupling setscrew (not shown). Remove coupling half (42) and key (46) from shaft (6).
- 17. Remove bolts (608) from bearing cartridge (37).
- 18. Using bolts (610) as jacking bolts, tighten bolts (610) to remove bearing cartridge (37) from bearing housing (19).

CAUTION

Bearing locknut (22) is left handed thread.

- 19. Remove shaft (6) with bearing assembly. Remove bolt (609). Uncrimp locking tab of lockwasher (69) and remove locknut (22) and lockwasher (69).
- 20. Remove shaft (6) and ball bearing (18) from bearing cartridge (37). Remove ball bearing (18) and bearing spacer (176) from shaft (6).
- 21. Remove lip seal (47X) from bearing cap (35) and lip seal (47) from bearing cartridge (37).

Disassembly of two-piece lineshaft

NOTE

If the column is over ten feet long, there will be a two-piece lineshaft. The shaft coupling (41) will be approximately 6-1/2 feet from the upper ball bearing (18). Refer to figure 2.

- a. Drive a drift punch on the smaller end to remove the upper tapered pin (680).

- b. Unscrew (right-hand threads) the lower shaft (10) and coupling (41) from the upper shaft (12). Do not remove the coupling (41) from the lower shaft (10) unless absolutely necessary.

C. PARTS INSPECTION.

NOTE

Mark or number each component while disassembling to ensure correct sequence. The individual components should be unscrewed or removed, as necessary.

- 1. All parts should be thoroughly cleaned or replaced with new parts, if necessary. All sealing faces should be perfectly clean. Carver recommends that all lip seals, gaskets, o-rings, and locking devices with a nylock feature be replaced with new, if disturbed from position.
- 2. Discard used lip seals, shims and o-rings. Thoroughly wash and clean all parts with a suitable solvent.
- 3. Check shaft for runout, scratches, grooves, or possible damage. Remove scratches and grooves with a polishing cloth and inspect for remaining grooves or deep scratches. Carver recommends replacing a bent or excessively damaged shaft.
- 4. Inspect ball bearings (18) for damage. Damaged ball bearings must be replaced. If ball bearings are removed from shaft, Carver recommends replacement of ball bearings. If ball bearing replacement is not possible and ball bearings are in good condition, ball bearings should be cleaned and lubricated according to section VII, paragraph C. Provide appropriate protection for bearings until time of usage.
- 5. Inspect lineshaft bearing (63) for damage and wear. Refer to Table 3 for lineshaft bearing clearances. Replace if necessary.

Table 3. Lineshaft Bearing Clearances

Material	Diametric Clearance
Carbon & Bronze	.009/.011

- 6. Inspect for bent shaft (6) and replace shaft (6), if necessary. Shaft threads should be in good condition. Ball bearing seat must be in perfect condition.
- 7. If impeller (2) shows excessive wear due to abrasion or corrosion and performance cannot be restored, impeller must be replaced. If new impellers are installed, make sure all impellers are balanced.

8. If the suction cover (9) on an open impeller pump shows excessive wear on the face due to abrasion or corrosion, whereas performance cannot be restored, replace the suction cover (9).
9. Inspect and replace any defective grease fittings.
10. On an enclosed impeller pump, check the clearance as follows:
 - a. Measure outside diameter of front impeller (2) wear ring in three places. Refer to Table 4, Enclosed Impeller Clearance.
 - b. Measure inside diameter of suction cover (9) or wear ring (7), if equipped, in three places.
 - c. If difference between high reading of inside diameter of the suction cover (9) or wear ring (7), if equipped, and low reading of outside diameter of impeller (2) wear ring exceeds double the maximum clearances given in Table 4, replace suction cover (9) and impeller (2) or wear ring (7), if equipped. To replace wear ring (7), refer to paragraph F (of this section).

Table 4. Enclosed Impeller Clearance

Ordering Code (refer to Figure A)	Pump Size	Impeller Size (inches)		(7) Wear Ring Size (inches)	(7X) Wear Ring Size (inches)
		Front	Back		
DA	2 X 1 X 11	2.750/2.749	NA	2.762/2.760	NA
DB	4 X 2 X 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742
DC	4 X 3 X 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742
DD	5 X 4 X 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742
DE	8 X 6 X 11	7.937/7.935	7.937/7.935	7.956/7.958	7.956/7.958
EA	2-1/2 X 1-1/2 X 13	3.337/3.335	NA	3.347/3.349	NA
EB	2-1/2 X 2 X 13	4.124/4.122	4.124/4.122	4.140/4.142	4.136/4.134
EC	3 X 2-1/2 X 13	4.715/4.713	5.894/5.892	4.731/4.733	5.908/5.910
ED	4 X 3 X 13	5.500/5.498	5.894/5.892	5.517/5.518	5.908/5.910
EE	5 X 4 X 13	5.894/5.892	5.894/5.892	5.912/5.914	5.908/5.910
EF	6 X 5 X 13	6.681/6.679	5.894/5.892	6.698/6.700	5.908/5.910

D. ASSEMBLY. Read this entire section and study the drawings in the back of the manual before proceeding.

Before assembly, review Table 2, Torque Values to avoid equipment damage and injury to personnel.

NOTE

Prior to assembly, refer to the following paragraphs in this section: Parts Inspection, paragraph C, Adjusting Impeller Clearance, paragraph E, Optional Wear Ring Replacement, paragraph F, and Optional Oil Lubrication, paragraph G.

Refer to appropriate sectional drawing, for location of parts followed by an item number. Assemble the pumping unit using the following procedures:

CAUTION

To prevent damage to shaft, use a hoist or suitable lifting device to support column and shaft during assembly.

NOTE

Replace ball bearing (18), once removed from shaft (6). If ball bearing (18) replacement is not possible and ball bearing (18) is in good condition, clean ball bearing (18) according to section VII, paragraph C.

1. Install bearing spacer (176) and ball bearing (18) onto shaft (6).

CAUTION

Bearing locknut (22) is left handed thread.

2. Install bearing lockwasher (69) and bearing locknut (22) onto shaft (6). Crimp locking tabs on lockwasher (69) in groove of locknut (22).
3. Install new lip seal (47X) into bearing cap (35).
4. Install new lip seal (47) into bearing cartridge (37).
5. Install ball bearing (18) and shaft (6) into bearing cartridge (37). Secure bearing cap (35) to bearing cartridge (37) with bolts (609).

NOTE

Do NOT tighten bearing cartridge bolts (608) and jacking bolts (610) in bearing cartridge (37) until pump is completely assembled.

6. Install shaft assembly into column (101). Secure assembly with bolts (608) finger tight.
7. Install jacking bolts (610) into bearing cartridge (37) finger tight.

Assembly of lineshaft bearings

NOTE

During assembly of new carbon lineshaft bearing(s) (63), it is essential that the lineshaft bearing(s) be perfectly aligned. If slightly cocked, the new lineshaft bearing(s) will shatter during assembly. Carver recommends new lineshaft bearing housing(s) (99), with lineshaft bearing(s) already installed, be purchased from Carver Pump Company. This will prevent the likelihood of lineshaft bearing(s) shattering due to misalignment. If this is not possible, assemble the lineshaft bearing(s) according to the following procedure:

- a. Press lineshaft bearing(s) (63) in lineshaft bearing housing(s) (99).
 - b. Install new lip seals (47A), if equipped, in both ends of lineshaft bearing housing(s) (99).
8. Install lineshaft bearing housing(s) (99) onto shaft (6) into column (101).

NOTE

Using two pipe nipples (1/4"), temporarily align lineshaft bearing housing (99) with column (101).

9. Slide slinger (40) onto shaft (6). Tighten setscrew (864).
10. Install flange adaptor (11), backcover (11), and casing (1) onto shaft (6) and secure with bolts (603), washers (653) and nuts (613).
11. Install discharge pipe with bolts (not shown) onto casing (1).
12. Install a grease zerk into lineshaft bearing housing(s) (99). Fill with appropriate grease until grease exits opposite side. Remove grease zerk and install two pipe plugs (426).

CAUTION

During assembly, install new impeller bolt (26) with locktite. Impeller bolt (26) has a nylock feature. Once used, impeller bolt (26) may not provide adequate security.

13. Install impeller key (32) and impeller (2) onto shaft (6) and secure with washer (28) and impeller bolt (26).
14. Install o-ring (89A) onto suction cover (9).
15. Secure suction cover (9) to casing (1) with bolts (611).
16. Adjust impeller (2) in accordance with paragraph E (of this section).
17. Reconnect discharge pipe to discharge flange (not shown) at baseplate (23)

Assembly of two-piece lineshaft

NOTE

If column is over 10 feet long, the shaft is two pieces. To assemble a two-piece shaft, use the following procedure and refer to figure 2:

- a. Check to make sure coupling spacer (150) is installed in shaft coupling (41).
- b. Screw (threads are right-hand) upper shaft (12) to the shaft coupling (41) and lower shaft (10).
- c. Install upper tapered pin (680) in shaft coupling (41).

CAUTION

Use a hoist or suitable lifting device to lift pump.

18. Attach hoist or suitable lifting device to pump. Return pump to installation site. Install pump on master plate. Install baseplate mounting capscrews. Remove lifting device.
19. Connect discharge piping at baseplate (23).

CAUTION

Use a hoist or suitable lifting device to lift motor. The lifting eyes may be used to lift just the motor.

20. Attach hoist or suitable lifting device to motor. Install motor on motor bracket (71) and secure with bolts (607). Connect coupling (42). Install coupling guard (131) and secure with bolts (602), lockwashers (652), and nuts (612). Remove lifting device.
21. Remove all tags from valves and power sources. Open system valves and reconnect power supply to motor.

E. ADJUSTING IMPELLER CLEARANCE. To adjust impeller clearance use the following procedure:

1. Stop pump according to section V, paragraph C. Disconnect, lock out, and tag electrical power supply to motor. Disconnect wiring from motor.
2. Remove coupling guard (131) from motor bracket (71) by removing nuts (612), washers (652) and bolts (602). Disconnect coupling (42) to prevent binding or loading on coupling (42).
3. Loosen impeller adjustment bolts (608) on bearing cartridge (37). While rotating shaft (6) by hand, loosen bolts (610) until impeller (2) just rubs suction cover (9).
4. Tighten impeller adjustment bolts (610) by hand until they just contact bearing housing

(19). Tighten bolts (610) another 1/3 turn. Tighten bolts (608) evenly 1/3 turn after contacting bearing housing (19) with screw head.

NOTE

Shaft setting should be checked again after pump is installed and before restarting pump. Rotate shaft (6) by hand to make sure impeller is not rubbing suction cover (9). Clearance should now be between 0.010 inches and 0.015 inches for **semi-open impellers**. Clearance should now be between 0.020 inches and 0.030 inches for **enclosed impellers**.

5. Recheck coupling gap and adjust, if necessary. Connect coupling (42).
6. Install the coupling guard (131) and secure with bolts (602), washers (652), and nuts (612).
7. Connect wiring to motor. Remove all tags and connect power supply to motor. Start pumping unit according to section V, paragraph A and B.

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMPS EQUIPPED WITH ENCLOSED IMPELLERS.

If your pump is equipped with an enclosed impeller, it may have an optional, replaceable wear ring (7) in the suction cover (9) or wear ring (7X) in the backcover (11). If your pump is equipped with the optional wear ring (7) or (7X), use Tables 4 and 5, figure 4, and the following instructions for wear ring replacement.

The following procedure references only the front wear ring (7). Use the same procedure to replace the back wear ring (7X).

NOTE

Stainless fitted and all iron pumps do not use a wear ring. Stainless steel pumps use a wear ring.

Table 5. Impeller/Wear Ring Matching Materials

IMPELLER MATERIAL	WEAR RING MATERIAL
Stainless Steel	17-4-PH stainless steel

The clearance between the wear ring (7) and impeller (2) hub will increase with wear. As wear continues, apparent internal leakage and decreased pump performance will warrant replacing the wear ring.

To replace the wear ring, follow the disassembly procedures in paragraph B of this section to the point where the casing or suction cover has been removed and the wear ring is accessible. Refer to paragraph C, Parts Inspection, of this section, for allowable clearances. Once the wear ring is accessible, use the following procedures:

1. Remove wear ring (7) from suction cover (9). This can best be accomplished on a lathe.
2. Inspect impeller (2) hub for damage.
3. Press new wear ring (7) into suction cover (9). Beveled edge of wear ring (7) is installed toward impeller (2).
4. Place impeller (2) on an arbor and mount between centers in a lathe or a grinder. Indicate back of impeller (2) hub to within 0.002 T.I.R. maximum to be sure arbor and impeller (2) are running square.
5. Turn wearing surface of impeller (2) until a 63 RMS or better finish is obtained.
6. Measure outside diameter of front impeller (2) hub and record the value.
7. Mount suction cover (9) with new wear ring (7) installed in a lathe. Indicate male rabbit to within 0.002 T.I.R. maximum.
8. Bore wear ring (7) to within specified tolerance (listed in Table 4) over recorded size of outside diameter of front impeller (2) hub.

G. OPTIONAL OIL LUBRICATION. Refer to figure 5 to aid in understanding this procedure. If pump is equipped with oil lubrication, position mechanical seal on shaft as follows:

1. Measure down from the step on the shaft (6) a distance of 3-1/4 inches and make a mark with a felt-tip marker. This is the final position of the mechanical seal (43A) locking collar.
2. Make sure shaft (6) is clean. Lubricate upper portion of shaft (6) where mechanical seal (43A) is to be placed with silicon.

3. Slide the locking collar and rotating element of the mechanical seal (43A) on shaft (6).
4. Lubricate the stationary element of the mechanical seal (43A) with silicon and insert it into the seal adaptor (43B). Install seal adaptor (43B), with stationary element of the mechanical seal (43A) installed, on the shaft (6).
5. Install bearing cartridge (37) on shaft (6). Install bearing spacer (176) over shaft (6) in bearing cartridge (37).
6. Install ball bearing (18) over shaft (6) in bearing cartridge (37).

CAUTION

Bearing locknut (22) is left handed thread.

7. Install bearing lockwasher (69) and locknut (22). Crimp Locking tabs on lockwasher (69) in groove of locknut (22).

NOTE

Do NOT tighten bearing cartridge bolts (608) and jacking bolts (610) in bearing cartridge (37) until pump is completely assembled. They will be tightened during impeller clearance adjustment.

8. Install new gasket (73A) on bearing cap (35). Install new lip seal (47) in bearing cap (35). Install bearing cap (35) and secure to bearing cartridge (37) with bolts (609).
9. Slide the mechanical seal (43A) and locking collar toward bearing cartridge (37) assembly until mark on shaft (6) is visible. Tighten setscrews in locking collar to fix the position of the mechanical seal (43A).

IX. PARTS LIST AND FIGURES.

Refer to Table 6 for a list of recommended spare parts. Refer to Table 7 for the complete parts list of the GVS pump. For location of all parts referenced on the list, refer to the sectional drawings.

Table 6. Recommended Spare Parts

Item No.	Qty.	Description
2	1	Impeller
7	1	Undersized Wear ring (if equipped)
7X	1	Undersized Wear ring (if equipped)
14	1	Shaft sleeve (if equipped)
18	1	Ball bearing
22	1	Bearing locknut
26	1	Impeller bolt
28	1	Impeller washer
32	1	Impeller key
35	1	Bearing cap
37	1	Bearing cartridge
46	1	Coupling key
47	1	Lip seal, bearing adaptor
47A	2 per housing	Lip seal, lineshaft bearing housing
47X	1	Lip seal, bearing cap
63	1	Line shaft bearing
69	1	Bearing lockwasher
89A	1	O-ring, suction cover
89X	1	O-ring, backcover

Table 7. Pump Parts List for GVS Series pump

Item No.	Part Name	Item No.	Part Name
1	Casing	131	Coupling guard
2	Impeller	150	Coupling spacer, shaft coupling
6	Shaft	176	Bearing spacer
7	Wear ring (if equipped)	400	Tube (optional)
7X	Back wear ring	410	Male tube connector (opt.)
9	Suction cover	422	Plug
10	Lower shaft	423	Plug, backcover
11	Backcover	425	Grease zerk
12	Upper shaft	426	Pipe plug
18	Ball Bearing	540	Pipe elbow (optional)
19	Bearing housing	555	Pipe (optional)
22	Bearing locknut	600	Bolt, backcover
23	Baseplate	601	Bolt, flange adaptor
26	Impeller bolt	602	Bolt
28	Impeller washer	603	Bolt
32	Impeller key	604	Bolt
35	Bearing cap	606	Bolt, bearing housing
37	Bearing cartridge	607	Bolt, motor bracket
40	Slinger	608	Bolt, bearing cartridge
41	Shaft coupling	609	Bolt, bearing cap
42	Coupling	610	Bolt (jacking bolt)
46	Coupling key	611	Bolt, suction cover
47	Lip seal	612	Nut
47A	Lip seal (if equipped)	613	Nut
47X	Lip seal, bearing cap	618	Nut
63	Lineshaft bearing	651	Washer
69	Bearing lockwasher	652	Washer
71	Motor bracket	653	Washer
85	Flange adaptor	654	Washer
89A	O-ring, suction cover	680	Taper pin, shaft coupling
89X	O-ring, backcover		(if equipped)
99	Lineshaft bearing housing	864	Setscrew, slinger
101	Column		

Table 8. Optional Oil Lubrication Parts List

Item No.	Part Name	Item No.	Part Name
43A	Mechanical seal	82	Oiler
43B	Seal adaptor	89V	O-ring, bearing cartridge
73A	Gasket, bearing cap	132	Male connector
73B	Gasket, bearing housing, baseplate	146	Tubing

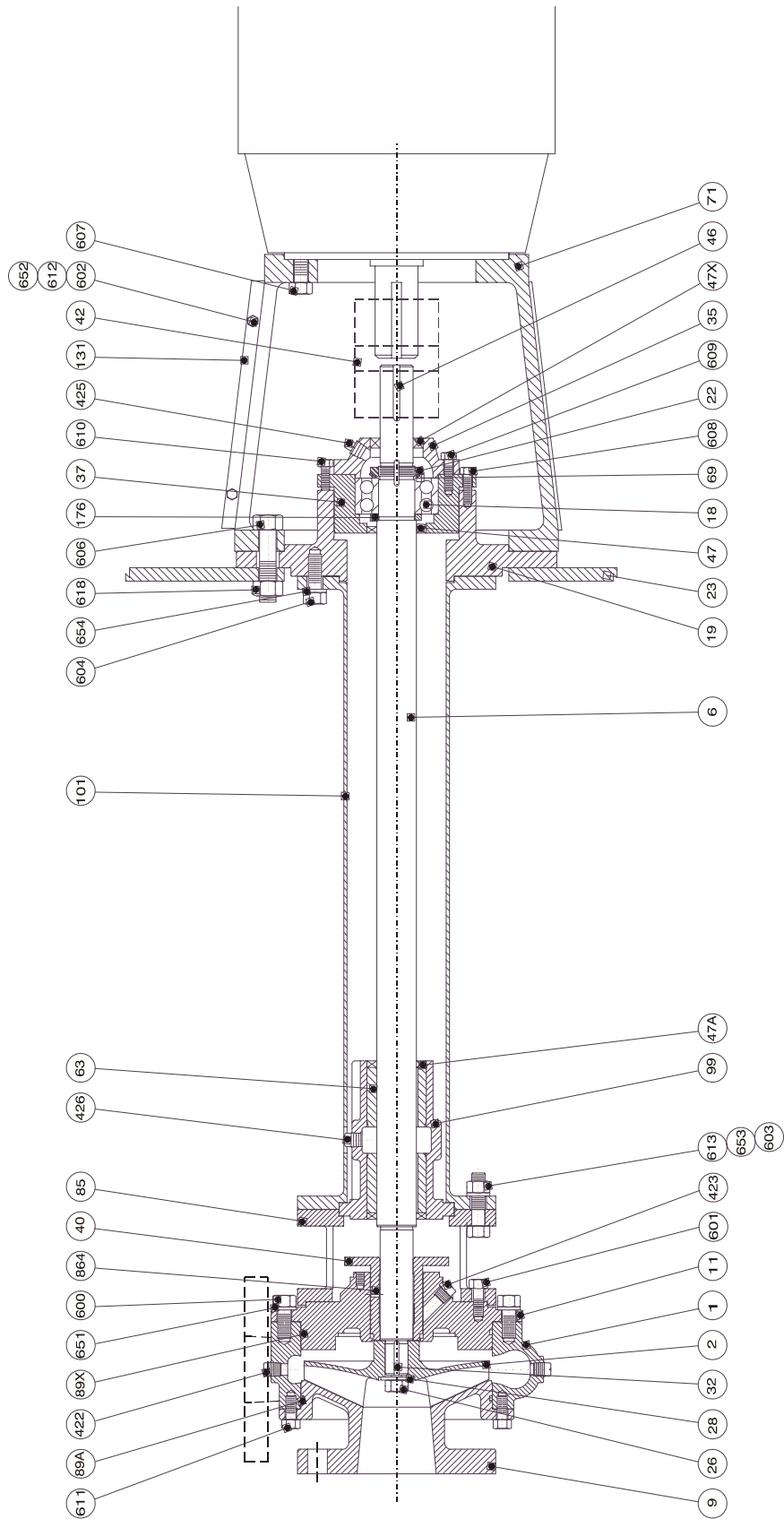
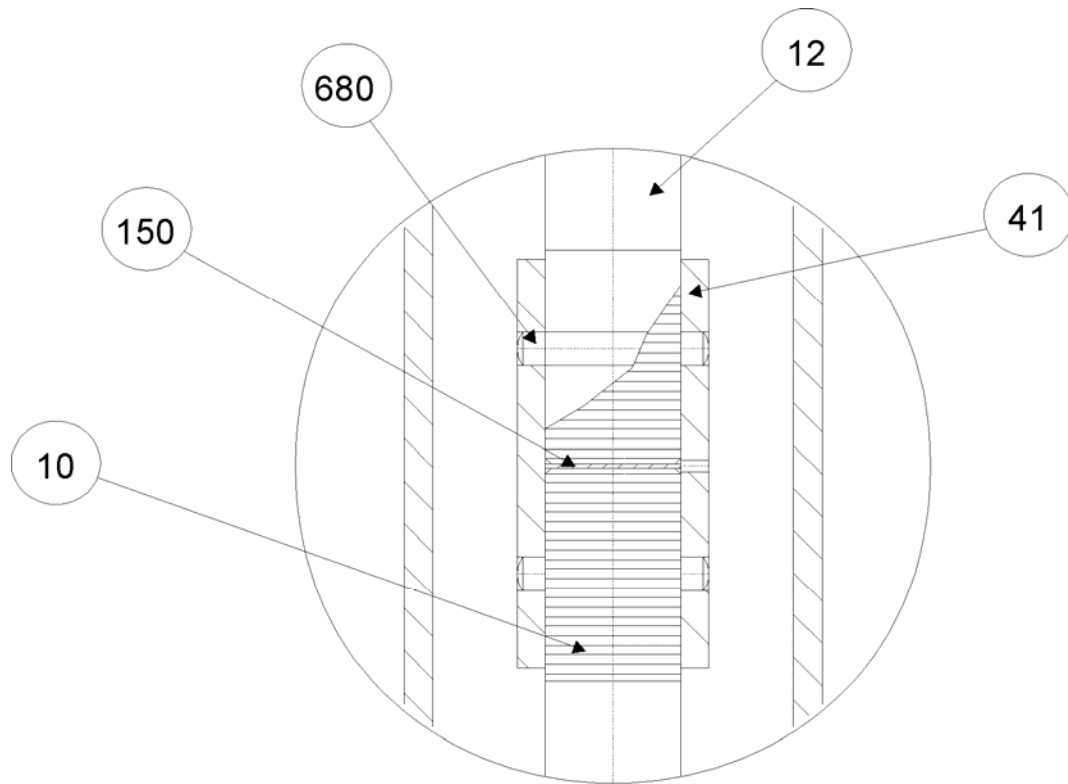
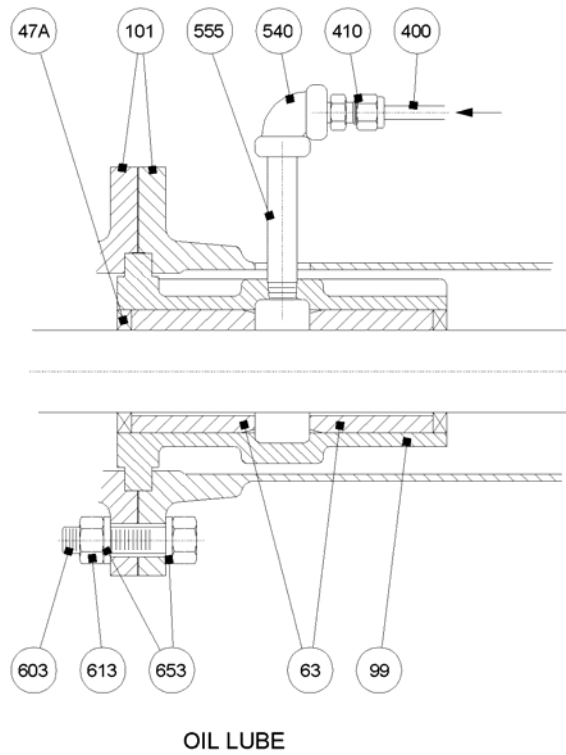
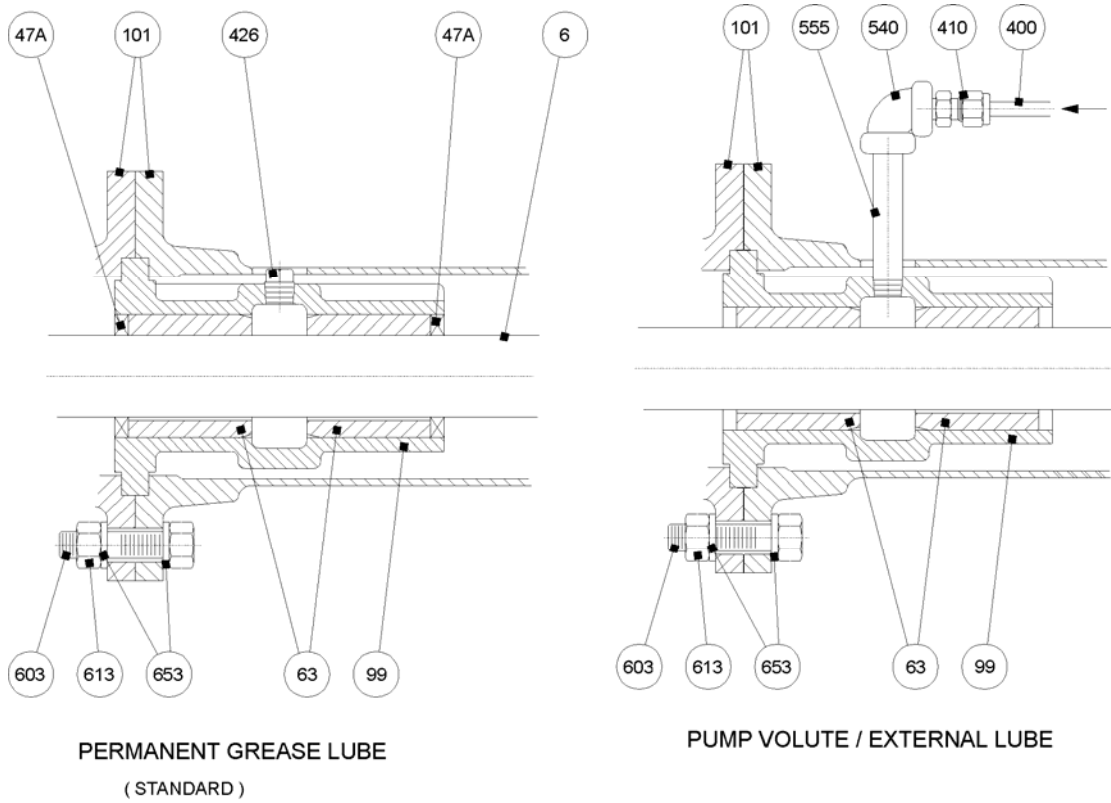


Figure 1. GVS Sectional Drawing



DETAIL OF SHAFT COUPLING FOR PUMPS WITH COLUMNS OVER 10 FEET LONG

Figure 2. Shaft Coupling Detail



BEARING LUBRICATION OPTIONS

Figure 3. Bearing Lube Options

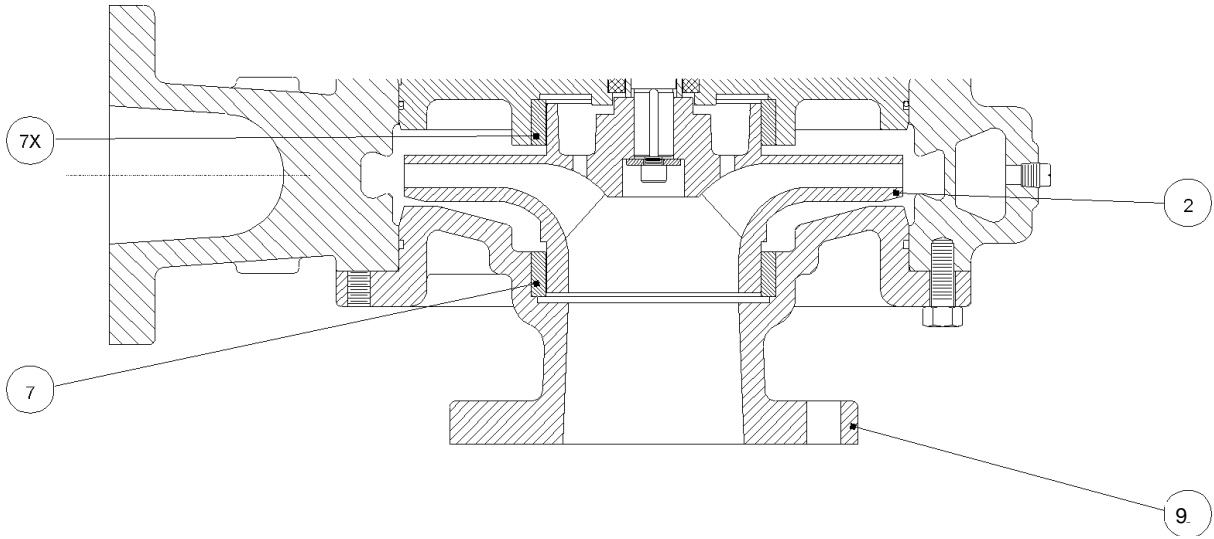


Figure 4. Optional Wear Ring

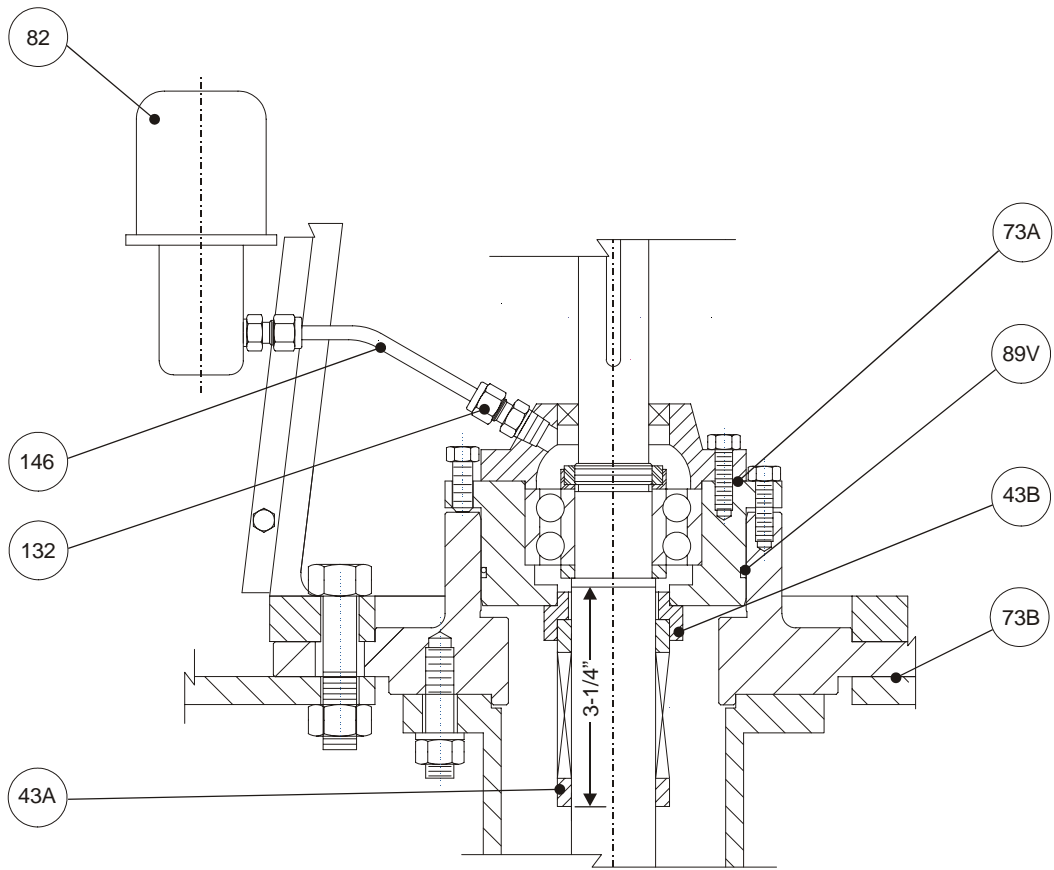


Figure 5. Optional Oil Lubrication



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