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 5) 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 5, Recommended Spare Parts. Part numbers correspond to drawings (figure 1 and figure 2) 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 Table 6)
- Item number (refer to Table 6 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

G V C - B E A - B A Z - Z Z Z

Pump Series
GV - General Vertical

Mounting Style
C - Cantilever design
T - Top pull out design
S - Sump design

Casing Nozzle and Impeller Sizes

BA - 1 1/4 x 1 x 7	**DA** - 2 x 1 x 11
BB - 1 1/2 x 1 1/4 x 7	**DB** - 4 x 2 x 11
BC - 2 1/2 x 2 x 7	**DC** - 4 x 3 x 11
BD - 3 x 2 1/2 x 7	**DD** - 5 x 4 x 11
BE - 4 x 3 x 7	**DE** - 8 x 6 x 11
BF - 5 x 4 x 7	
	EA - 2 1/2 x 1 1/2 x 13
CA - 1 1/2 x 1 1/4 x 10	**EB** - 2 1/2 x 2 x 13
CB - 2 x 1 1/2 x 10	**EC** - 3 x 2 1/2 x 13
CC - 2 1/2 x 2 x 10	**ED** - 4 x 3 x 13
CD - 3 x 2 1/2 x 10	**EE** - 5 x 4 x 13
CE - 4 x 3 x 10	**EF** - 6 x 5 x 13
CF - 5 x 4 x 10	**EG** - 8 x 6 x 13 (GVC & T only)
CG - 6 x 5 x 10	

Basic Materials and Construction
A - All cast iron construction
B - 316 stainless steel fitted cast iron construction
C - All 316 stainless steel construction for major components

X - Specia

Column Depth (1.0 and 2.0 ft for GVC & T only)

A - 1.0 ft (GVC & T)	**L -** 11.0 ft (GVS only)
B - 2.0 ft (GVC & T)	**M -** 12.0 ft (GVS only)
	N - 13.0 ft (GVS only)
C - 4.0 ft (GVS only)	**P -** 14.0 ft (GVS only)
D - 5.0 ft (GVS only)	**Q -** 15.0 ft (GVS only)
E - 6.0 ft (GVS only)	**R -** 16.0 ft (GVS only)
F - 7.0 ft (GVS only)	**S -** 17.0 ft (GVS only)
G - 8.0 ft (GVS only)	**T -** 18.0 ft (GVS only)
J - 9.0 ft (GVS only)	**U -** 19.0 ft (GVS only)
K - 10.0 ft (GVS only)	**V -** 20.0 ft (GVS only)

Throttle Bushing, Lineshaft Bearing and Flush Lines
A - Teflon bushing (**standard for GVC & T**)
B - 17-4 PH bushing, 416 SS shaft sleeve (GVC & T only)

C - Bronze lineshaft bearing, greased for life (**standard for GVS**)
D - Bronze lineshaft bearing, externally flushed (GVS only)
E - Carbon lineshaft bearing, externally flushed (GVS only)

X - Special

Inlet Pipe and Strainer
A - Zinc plated steel strainer with steel tailpipe
B - 304 SS strainer with 316 SS tailpipe

X - Special strainer and/or tailpipe

Z - No strainer or tailpipe (**standard**)

Coupling, Motor Mounting Bracket and Motor
A - Standard coupling, ODP motor, standard efficiency
B - Standard coupling, ODP motor, Hostile Duty
C - Standard coupling, TEFC motor, standard efficiency
D - Standard coupling, TEFC motor, Hostile Duty
E - Standard coupling, X-P motor, standard efficiency

X - Special coupling, motor enclosure or motor speed

Z - No coupling or motor - bare pump only

Motor Rating (when required)

A - 1.5 HP @ 1750 RPM	**K** - 15 HP @ 1750 RPM	**V** - 75 HP @ 1750 RPM
B - 2.0 HP @ 1750 RPM	**M** - 15 HP @ 3500 RPM	**W** - 100 HP @ 1750 RPM
C - 3.0 HP @ 1750 RPM	**N** - 20 HP @ 1750 RPM	
D - 5.0 HP @ 1750 RPM	**P** - 20 HP @ 3500 RPM	**X** - Special or over 100 HP
E - 5.0 HP @ 3500 RPM	**Q** - 25 HP @ 1750 RPM	
F - 7.5 HP @ 1750 RPM	**R** - 30 HP @ 1750 RPM	**Z** - No motor - bare pump
G - 7.5 HP @ 3500 RPM	**S** - 40 HP @ 1750 RPM	
H - 10 HP @ 1750 RPM	**T** - 50 HP @ 1750 RPM	
J - 10 HP @ 3500 RPM	**U** - 60 HP @ 1750 RPM	

Top Plate and Discharge Pipe Arrangement
A - Small steel top plate (no discharge pipe), no underliner (GVC & T only)
B - Small steel top plate (no discharge pipe), 316 SS underliner (GVC & T only)
C - Small 316 SS top plate (no discharge pipe), no underliner

D - Lg. steel plate, no underliner, standard steel discharge pipe (**standard for GVS**)
E - Lg. steel plate, no underliner, oversized steel discharge pipe (GVC & T only)
F - Lg. steel plate, no underliner, dbl. oversized steel discharge pipe (GVC & T only)

G - Lg. steel plate, 316 SS underliner, standard size steel discharge pipe
H - Lg. steel plate, 316 SS underliner, oversized steel discharge GVC & T only)
J - Lg. steel plate, 316 SS underliner, dbl. oversized steel discharge (GVC & T only)

K - Lg. steel plate, no underliner, standard size 316 SS discharge pipe
L - Lg. steel plate, no underliner, oversized 316 SS discharge (GVC & T only)
M - Lg. steel plate, no underliner, dbl. oversized 316 SS discharge (GVC & T only)

N - Lg. steel plate, 316 SS underliner, standard size 316 SS discharge pipe
P - Lg. steel plate, 316 SS underliner, oversized 316 SS discharge (GVC & T only)
Q - Lg. steel plate, 316 SS underliner, dbl. o'sized 316 SS discharge (GVC & T only)

R - Large 316 SS top plate, standard size steel discharge pipe
S - Large 316 SS top plate, oversized steel discharge (GVC & T only)
T - Large 316 SS top plate, double oversized steel discharge (GVC & T only)

U - Large 316 SS top plate, standard size 316 SS discharge pipe
V - Large 316 SS top plate, oversized 316 SS discharge (GVC and GVT only)
W - Large 316 SS top plate, double oversized 316 SS discharge (GVC & T only)

X - Special

Z - No top plate or discharge pipe - bare pump only (**standard for GVC & T**)

* 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. As a result, serious injury or death to personnel could occur if unit is 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.
10. Reference Table A, Torque Values, to avoid equipment damage and injury to personnel.

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.

Before disassembly/assembly, review Table A, Torque Values to avoid equipment damage and injury to personnel.

Table A. Recommended Torque Values (ft-lbs)

Bolt Size	Material	
	Steel (or otherwise noted)	316 Stainless Steel
¼"-20	5	7
5/16"-18	11	12
3/8"-16	18	21
½"-13	39	45
5/8"-11	83	97
¾"-10	105	132
7/8"-9	160	203
1"-8	236	300

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.	1. No input power.	1. Check connections to electrical power source. Check fuses or circuit breakers. Check terminals at source of power input.
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Motor overload.	3. Refer to “Overload on motor”.
	4. Mechanical obstruction that prevents rotor from turning.	4. Examine and clean pumping unit thoroughly. Check for bearing failure or bent shaft.
Motor overheats.	1. Motor overload.	1. Refer to “Overload on motor”.
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Obstruction in ventilation.	3. Check ventilation opening of motor. Keep clear of obstructions at all times.
	4. Insufficient cooling medium.	4. Check ambient temperature. Motor temperature should not exceed ambient temperature plus the rated temperature increase of the unit.
	5. Overgreased motor bearings.	5. Remove lubricant from bearing chamber until the proper amount of grease is in chamber.
	6. Improper motor grease.	6. Remove grease and replace with grease recommended by motor manufacturer.
Failure to deliver fluid.	1. Discharge valve closed.	1. Check discharge valve.
	2. Discharge head above shutoff.	2. Consult with nearest Carver Pump Company representative or factory.
	3. Impeller or suction pipe clogged.	3. Inspect and clean impeller and suction pipe.
	4. Wrong rotation.	4. Check power connection to motor.
	5. Liquid level in tank too low.	5. Add liquid to system.
	6. Suction strainer is plugged.	6. Clean suction strainer.
Reduced capacity and/or pressure.	1. Discharge valve closed.	1. Check discharge valve.
	2. Damaged impeller.	2. Replace impeller.
	3. Impeller or suction pipe partially clogged.	3. Inspect and clean impeller and suction pipe.
	4. Suction pipe too close to bottom of tank.	4. Reduce length of pipe.
	5. Liquid level in tank too low.	5. Add liquid to system.
	6. Total head too high.	6. Consult with nearest Carver Pump Company representative or factory.
	7. Wrong rotation.	7. Check power connections to motor.

Table 1. Troubleshooting (cont.)

SYMPTOM	PROBABLE CAUSE	REMEDY
Reduced capacity and/or pressure (cont).	8. Speed too low.	8. Consult wit nearest Carver Pump Company representative or factory.
	9. Semi-open impeller running clearance too large.	9. Check semi-open impeller clearance according to section VIII, paragraph D.
	10. Enclosed impeller clearance between suction cover or wear ring is too large.	10. Check enclosed impeller clearance according to section VIII paragraph B, procedure seven.
	11. Suction strainer is plugged.	11. Clean suction strainer.
Pump surges	1. Liquid level in tank too low.	1. Add liquid to system.
Pump loses prime after starting.	1. Suction lift is over six feet. 2. Liquid level in tank too low.	1. Check with vacuum gauge. 2. Add liquid to system.
Overload on motor.	1. Head lower than that for which pump is designed.	1. Consult with nearest Carver Pump Company representative or factory.
	2. Mechanical defects of pump or motor such as bent shaft, binding or rubbing rotating element.	2. Replace defective parts or replace pump or motor.
	3. Liquid handled of higher specific gravity or lower viscosity than intended application.	3. Consult with nearest Carver Pump Company representative or factory.
Insulation failure.	1. Oil or water soaked windings.	1. Return motor to the motor manufacturer.
	2. Improper voltage.	2. Check voltage at motor terminals.
Vibrates or is noisy	1. Insufficient or insecure foundation.	1. Enlarge foundation or relocate pumping unit so it can be firmly bolted to foundation.
	2. Mechanical defects of pump or motor such as bent shaft, binding rotating element, or warped impeller.	2. Replace defective parts or replace pump or motor.
	3. Foreign matter in pump.	3. Disassemble pump. Identify and remove foreign matter. Clean parts and replace damaged parts.
	4. Strain due to piping or improper piping supports.	4. Check piping alignment and remove piping weight from pump with proper supports.
	5. Damaged bearings.	5. Replace bearings.
	6. Insufficient bearing lubrication.	6. Lubricate bearings according to section VI, paragraph D, 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. STUFFING BOX. The stuffing box is equipped with a throttle bushing which requires no regular maintenance. The inside diameter of the throttle bushing will increase with wear. The throttle bushing should be inspected after pump disassembly. The throttle bushing requires replacement if the inside diameter is more than 0.020 inch out of round. Refer to Table 2, Throttle Bushing Dimensions.

C. 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.

D. 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 VII, 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 half full on both sides 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 plugs opposite grease fittings on both ends of bearing frame.

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. With most hand-operated grease guns, two or three pumps are enough. DO NOT OVERGREASE. When installing new bearings, pack new bearings only half 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) by removing snap-wrap spider 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 capscrews (607) separating motor from motor bracket (71). Remove motor from motor bracket (71).
4. Remove capscrews (609) and bearing cap (35) from bearing adaptor (37). Remove grease seal (47X) from bearing cap (35).
5. Straighten the lock tangs on lockwasher (69) with a screwdriver and remove locknut (22) and lockwasher (69).
6. Remove capscrews (608) holding bearing adaptor (37) to thrust plate (19).
7. Loosen bearing adaptor assembly (37) from shaft (6) by using capscrews (610) as forcing capscrews.
8. Remove bearing adaptor (37) assembly from shaft (6) and thrust plate (19). Remove grease seal (47), if equipped, from bearing adaptor (37).
9. Using a small press, push the ball bearing (18) out of the bearing adaptor (37). Bearing spacer (176) should fall out.
10. If grease lubricated, hand pack new ball bearing (18) half full with grease according to section VI, paragraph C.
11. Install new grease seal (47), if equipped, in bearing adaptor (37). Install bearing adaptor (37) on shaft (6). Install bearing spacer (176) over shaft (6) in bearing adaptor (37). Install new ball bearing (18) over shaft (6) in bearing adaptor.
12. Secure bearing adaptor (37) to thrust plate (19) with capscrews (608).
13. Install bearing lockwasher (69) and locknut (22). Crimp lock tang on lockwasher (69) in groove of locknut (22).
14. Install new grease seal (47) in bearing cap (35). Install bearing cap (35) and secure to bearing adaptor (37) with capscrews (609).
15. Adjust impeller in accordance with section VIII, paragraph D.

CAUTION

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

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

B. DISASSEMBLY AND ASSEMBLY. Read this entire section and study Figure 1 and Figure 2 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 shaft sleeve.

NOTE

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

During disassembly, mark parts to determine the proper location when assembly begins. When removing capscrews, 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. Do NOT use force under any circumstances.

Refer to appropriate sectional drawing, for location of parts followed by an item number. Assemble the pump in accordance with accepted rules of engineering practice.

DISASSEMBLY

Disassemble the pumping unit using Figure 1, Figure 3, and the following procedure:

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

CAUTION

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

2. Attach hoist or suitable lifting device to motor. Remove capscrews (607), freeing 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.
3. Disconnect discharge piping at baseplate.

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 base (23). Remove baseplate mounting capscrews. Remove pump from master plate and take to a suitable work area.

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 bearings with new o-rings, seals and bearings.

6. Remove impeller bolt (26) and impeller washer (28).
7. Remove impeller (2) and impeller key (32).

CAUTION

Do NOT pry composite parts. Damage may occur to composite parts if they are struck with force, pounded with a metal object or pried.

8. Remove bolts from discharge pipe at casing (not shown).
9. Remove nuts (613), washers (653) and bolts (603).
10. Remove casing (1) and backcover (11).
11. Check throttle bushing (63X) per section VIII, paragraph C, Table 2, Throttle Bushing Dimensions. Remove only if replacing throttle bushing (63X).
12. 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.

CAUTION

To lift bearing housing, use a hoist or suitable lifting device.

13. Remove plugs (426). Remove bearing housings (99).

Disassembly of lineshaft bearings

14. Check lineshaft bearings in accordance with paragraph C (of this section), Parts Inspection. If lineshaft bearings need replaced, use the following steps and refer to the assembly section, "lineshaft bearing assembly":
15. Remove lip seals (47A), if equipped, from both ends of the lineshaft bearing housing (99). If lineshaft bearings (63) are fluid flushed, there should be no lip seals (47A).
16. Take lineshaft bearing housing (99) to a press and remove lineshaft bearings (63).
17. Loosen setscrew (not shown on sectional drawing). Remove coupling half (42) and key (46) from shaft (6).
18. Remove bolts (608) from bearing adaptor (37).
19. Using bolts (610) as jacking bolts, tighten bolts (610) to remove bearing adaptor from bearing housing (19).
20. Remove shaft (6) with bearing assembly. Remove bolt (609). Uncrimp locking tab of lockwasher (69) and remove locknut (22) and lockwasher (69).
21. Remove shaft (6) and bearing (18) from bearing adaptor (37). Remove bearing (18) and bearing spacer (176) from shaft (6).
22. Remove lip seal (47X) from bearing cap (35) and lip seal (47) from bearing adaptor (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 (10A) 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 (10B).
b. Unscrew (right-hand threads) the lower shaft (7B) and coupling (10A) form the upper shaft (7A). Do not remove the coupling (10A) from the lower shaft (7B) 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 grease seals, lip seals, oil seals, gaskets, o-rings, and locking devices with a nylock feature be replaced with new, if disturbed from position.
2. Discard used oil 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 bearings (18) for damage. Damaged bearings must be replaced. If bearings are removed from shaft, Carver recommends replacement of bearings. If bearing replacement is not possible and bearings are in good condition, bearings should be cleaned and lubricated according to section VII, paragraph D. Provide appropriate protection for bearings until time of usage.
5. Check all shaft sleeves visually for score marks, scratches, pits, grooves or burrs. Remove blemishes with a polishing cloth and inspect for remaining grooves or deep scratches. Remove burrs with a file. Carver recommends replacing shaft sleeves if any marks, pits or grooves are still visible.
6. Inspect lineshaft bearings for damage and wear. Replace if necessary.
7. Inspect for bent shaft (6) and replace shaft (6), if necessary. Shaft threads should be in good condition. Bearing seat must be in perfect condition.
8. 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.
9. If the suction cover 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.
10. Inspect and replace any defective grease fittings.
11. Inspect the inside diameter of throttle bushing (63X). The inside diameter of the throttle bushing (63X) will increase with wear. The throttle bushing requires replacement if the inside diameter is more than 0.020 inch out of round or .005 inch oversized. Refer to Table 2 for maximum diameter of throttle bushing.

Table 2. Throttle Bushing Dimensions

Frame Size	Maximum Diameter	Minimum Diameter
43V-01 (small bore)	1.277 inches	1.275 inches
43V-02 (medium bore)	1.527 inches	1.525 inches

12. 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 3, 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 3, replace suction cover (9) and impeller (2) or wear ring (7), if equipped. To replace wear ring (7), refer to paragraph E of this section.

Table 3. Enclosed Impeller Clearance

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

ASSEMBLY

Assemble the pumping unit using the following procedures:

NOTE

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

1. Install bearing spacer (176) and bearing (18) onto shaft (6).
2. Install bearing lockwasher (69) and bearing locknut (22) onto shaft (6). Crimp lockwasher tab.
3. Install new lip seal (47X) into bearing cap (35).
4. Install new lip seal (47) into bearing adaptor (37).
5. Install bearing (18) and shaft (6) into bearing adaptor (37). Secure bearing cap (35) to bearing adaptor (37) with capscrews (609).

NOTE

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

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

Assembly of lineshaft bearings

NOTE

During assembly of new carbon lineshaft bearings, it is essential that the lineshaft bearings be perfectly aligned. If slightly cocked, the new lineshaft bearings will shatter during assembly. Carver recommends new bearing housings, with lineshaft bearings already installed, be purchased from Carver Pump Company. This will prevent the likelihood of lineshaft bearings shattering due to misalignment. If this is not possible, assemble the lineshaft bearings 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 bearing housing (99) onto shaft (6) into column (101).

NOTE

Using two pipe nipples (1/4"), temporarily align bearing housing (9) with column (101).

9. Slide slinger (40) onto shaft (6). Check throttle bushing (63X) in accordance with section VIII, paragraph C, Table 2, Throttle Bushing Dimensions.
10. Install casing (1) with back cover (111) onto shaft (6) and secure with bolts (603), washers (653) and nuts (613).
11. Install discharge piping onto discharge casing (1).
12. Install a temperature grease zerk into bearing housing (9). Fill with appropriate grease until grease exits opposite side. Remove grease zerk and install two pipe plugs (426).

CAUTION

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

13. Install impeller (2) and key (32) onto shaft (6) and secure with washer (28) and impeller capscrew (26).
14. Install o-ring (89A) onto suction cover (9).
15. Secure suction cover (9) to casing (1) with capscrew (611).
16. Adjust impeller in accordance with this section, paragraph D for open impellers and paragraph E for enclosed impellers.
17. Reconnect discharge pipe to discharge flange (not shown).

Assembly of two-piece lineshaft

NOTE

If column is over 10 feet long, the lineshaft is two pieces. To assemble a two-piece lineshaft, 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 capscrews (607). Connect coupling (42) by installing snap-wrap spider. Install coupling guard (131) and secure with capscrews (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.

D. ADJUSTING IMPELLER CLEARANCE ON PUMPS EQUIPPED WITH SEMI-OPEN IMPELLERS. To adjust impeller clearance on a pump equipped with a ***semi-open impeller***, use the following procedure:

1. Stop pump according to section V, paragraph C. Lock out and tag the power to the driver.
2. Remove coupling guard (131) from motor bracket (71) by removing nuts (612), washers (652) and bolts (602). Disconnect coupling (42) by removing snap-wrap spider to prevent binding or loading on coupling (42).
3. Loosen impeller adjustment capscrews (608) on bearing adaptor (37). While rotating shaft by hand, loosen capscrews (610) until impeller (2) just rubs suction cover (9).
4. Tighten impeller adjustment capscrews (610) by hand until they just contact bearing housing (19). Tighten capscrews (610) another 1/3 turn. Tighten capscrews (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 by hand to make sure semi-open impeller is not rubbing suction cover. Clearance should now be between 0.010 inches and 0.015 inches.

5. Recheck coupling gap and adjust, if necessary. Connect coupling (42) by installing snap-wrap spider.
6. Install the coupling guard (131) and secure with capscrews (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 IV, paragraph C.

E. 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 casing (1). If your pump is equipped with the optional wear ring (7), use Tables 3 and 4, figure 4, and the following instructions for wear ring replacement.

NOTE

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

Table 4. 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 rabbet to within 0.002 T.I.R. maximum.
8. Bore wear ring (7) to within specified tolerance (listed in Table 3) over recorded size of outside diameter of front impeller (2) hub.

CAUTION

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

IX. PARTS LIST AND FIGURES.

Refer to Table 5 for a list of recommended spare parts. Refer to Table 6 for the complete parts list of the GVS pump. For location of all parts referenced on the list, refer to the sectional drawings.

Table 5. Recommended Spare Parts

Item No.	Qty.	Description
2	1	Impeller
7	1	Undersized Wear ring (if equipped)
14	1	Shaft sleeve (if equipped)
18	1	Thrust bearing
22	1	Bearing locknut
26	1	Impeller capscrew
28	1	Impeller washer
32	1	Impeller key
35	1	Bearing cap
37	1	Bearing adaptor
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
63X	1	Throttle bushing
69	1	Bearing lockwasher
89A	1	O-ring, suction cover
89X	1	O-ring, throttle bushing

Table 6. Pump Parts List for GVS Series pump

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

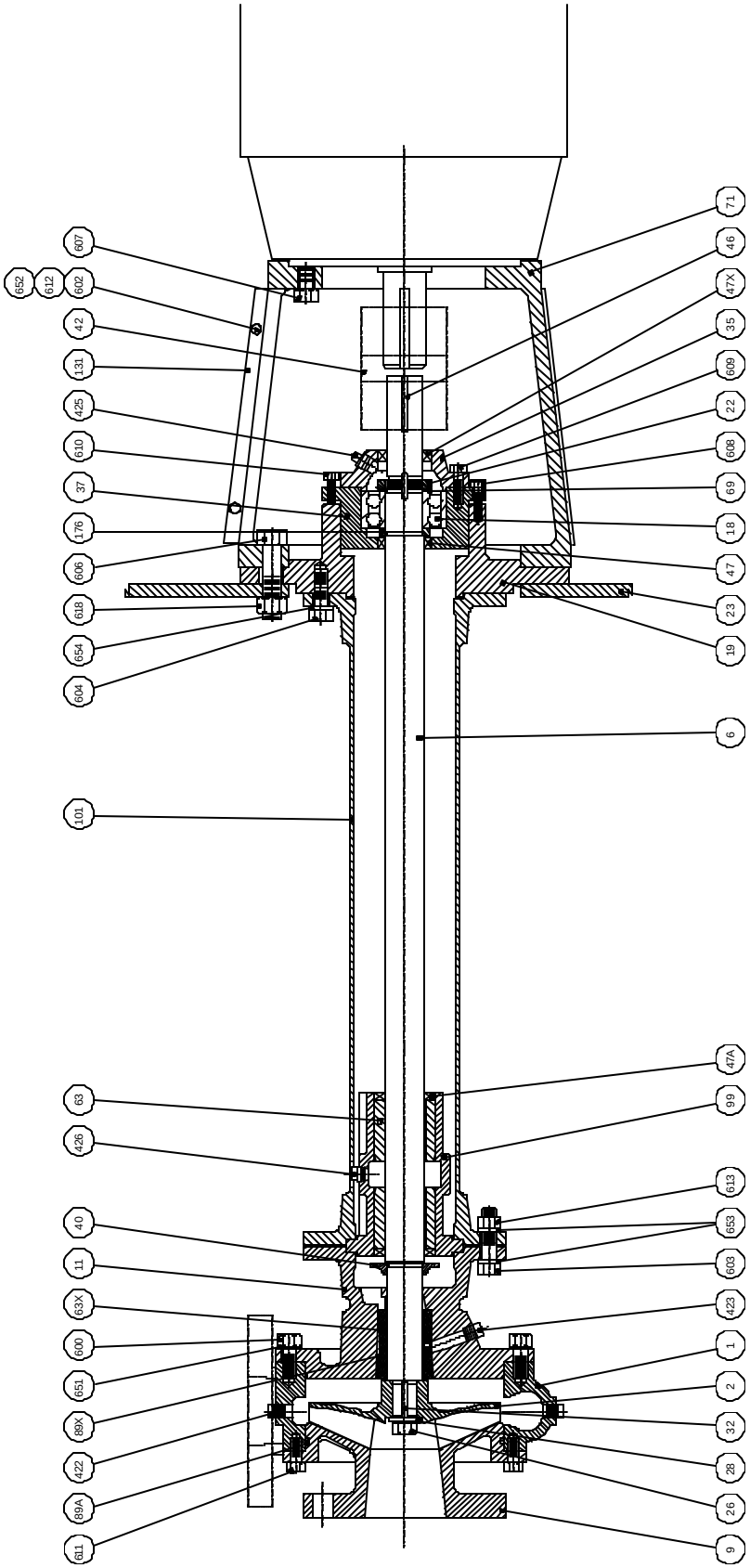


Figure 1. GVS Sectional Drawing

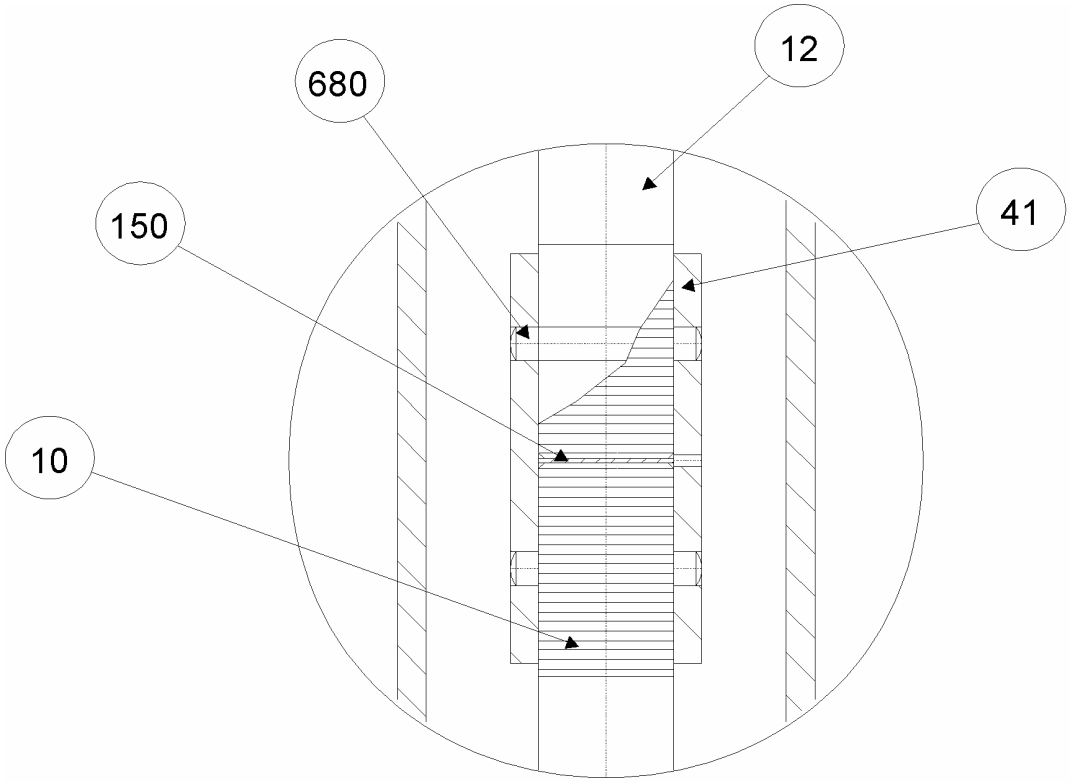
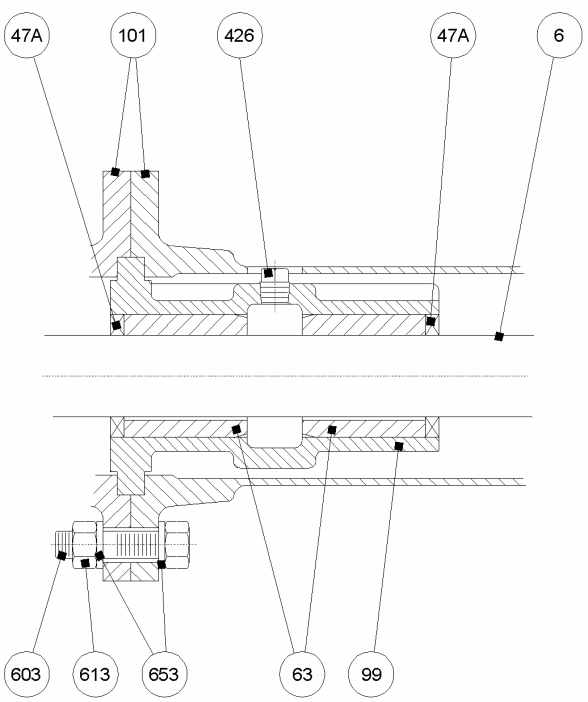
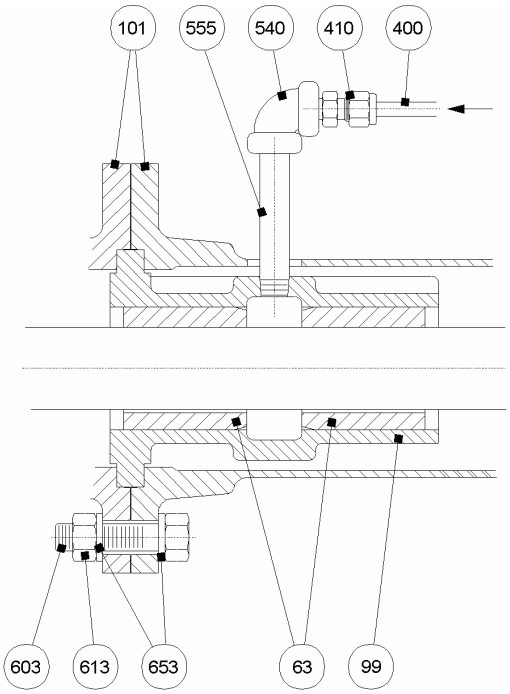


Figure 2. Shaft Coupling Detail

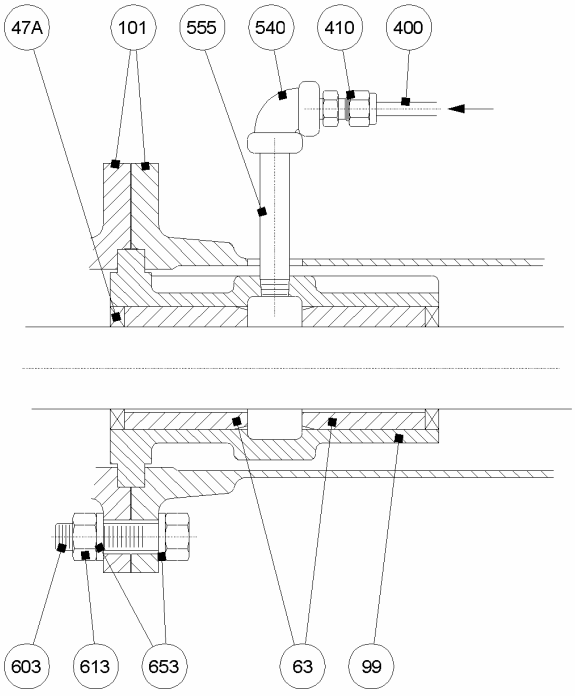


PERMANENT GREASE LUBE

(STANDARD)



PUMP VOLUTE / EXTERNAL LUBE



OIL LUBE

BEARING LUBRICATION OPTIONS

Figure 3. Bearing Lube Options

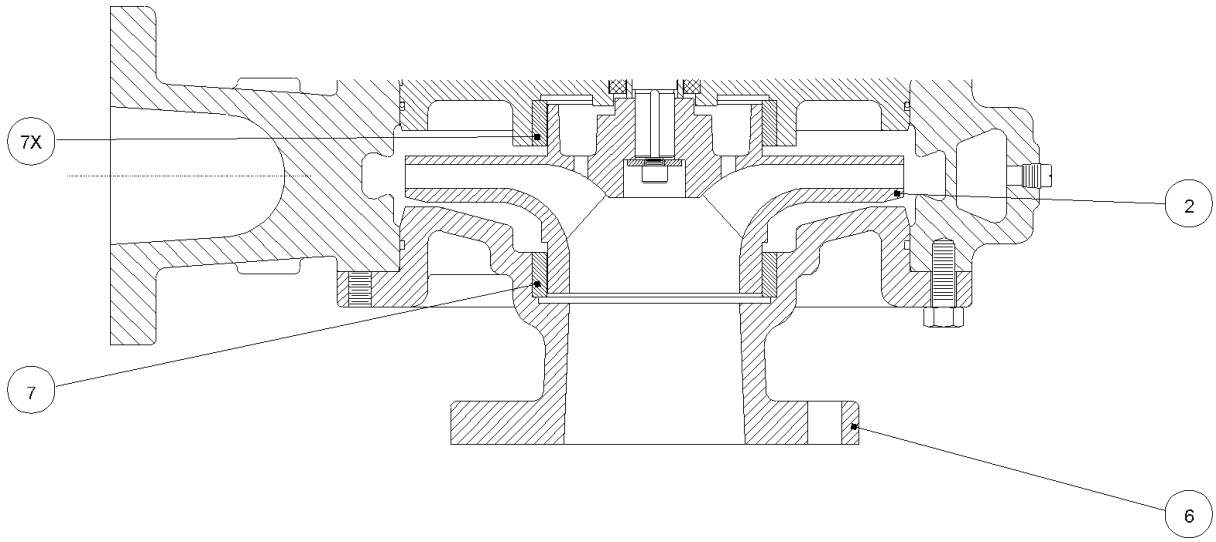


Figure 4. Optional Wear Ring

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October 2003