


G2S


Line-Shaft Sump Pump

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Part Number: _____

Serial Numbers: _____

 These operating instructions contain fundamental information and precautionary notes. Please read the manual thoroughly prior to installation of unit, electrical connection and commissioning. It is imperative to comply with all other operating instructions referring to components of individual units.

 This manual shall always be kept close to the unit's location of operation or directly on the pump set.

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SERVICE RECORD PAGE

Service No. _____ Model _____ Size and Type _____

Customer Order No. _____ Date Installed _____

Installation Date	Location	Application

PUMP RATING

Capacity _____ Total Head _____

Suction Pressure _____ Speed (RPM) _____

Liquid pumped _____ Temperature _____

Specific Gravity _____ Viscosity _____

Service _____

PUMP MATERIALS

Casing _____ Impeller _____ Shaft _____

Gaskets _____ Bearing Frame _____

Mechanical Seal/Packing _____

MOTOR 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

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

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I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.



A. GENERAL INFORMATION. G2S Pumps are general vertical line-shaft pumps. Carver Pump Company products are carefully engineered and manufactured and, if properly installed, maintained, and operated, should provide maintenance-free operation and a long service life.



These instructions must always be kept close to the product's operating location or directly with the product.

This manual is designed to provide sufficient material to properly maintain the total pumping unit. The information presented should improve your knowledge and understanding of the G2S Pump, thus upgrading the reliability, service life, and quality of pump maintenance.

These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation. Compliance with such laws relating to the proper installation and safe operation of the 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. These instructions are intended to facilitate familiarization with the product and its permitted use to help satisfy safety requirements. Always coordinate repair activity with operations personnel, and follow all plant safety requirements and applicable safety and health laws/regulations.

Refer to Figure 3, the sectional assembly for the location of parts identified by item numbers. Variations do exist between configurations, not all parts described in the text may be on your configuration.

These instructions should be read prior to installing, operating, using and maintaining the equipment in any region worldwide and in conjunction with the main user instructions provided. The equipment must not be put into service until all the conditions relating to safety instructions have been met.

B. DISCLAIMER. Information in these User Instructions is believed to be reliable. In spite of all the efforts of Carver Pump Company to provide sound and all necessary information the content of this manual may appear insufficient and is not guaranteed by Carver Pump Company as to its completeness or accuracy.

C. PERSONNEL QUALIFICATION AND TRAINING. All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may commission the manufacturer/supplier to provide applicable training.

Follow instructions in this manual carefully. Factory warranty applies only when pump operates under conditions as specified on order acknowledgment, and if pump is properly installed and maintained as recommended herein. A copy of this manual should be available to operating personnel. Additional copies of this manual are available upon request from Carver Pump Company and your local distributor. For comments and/or questions about information provided, please contact Carver Pump Company or your local distributor.

D. PUMP IDENTIFICATION. The type of pump, pump size, operating data, and serial number are all stamped on the nameplate attached to the pump. 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. 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.

E. PARTS INVENTORY GUIDE. To avoid unnecessary delays for maintenance, spare parts should be readily available, purchase before and keep in stock, for normal service. Most conditions will be covered if this manual is followed. For every one to three pumps, stock one spare set consisting of items listed in Table 9, Recommended Spare Parts. Part numbers correspond to Figure 3.

F. PARTS ORDERING. When ordering replacement parts, please specify:

- Serial number of pump (located on nameplate)
- Part name (located on parts list)
- Quantity of parts needed

Carver Pump Company may ship an interchangeable part that is not identical in appearance or symbol. This is done only if the part has been improved. Examine parts carefully upon delivery before questioning factory or company representative. Never return parts to the factory without authorization from Carver Pump Company.

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

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

G. SAFETY PRECAUTIONS. The manual is designed to provide adequate instructions for the safe and efficient installation, operation, or maintenance of 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. This manual must be read and understood both by the installing personnel and the responsible trained personnel/operators prior to installation and operation, and it must always be kept close to the location of the pumping unit for easy access.

G.1 Summary of Safety Marking.

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the symbol:



General hazard sign to ISO 7000 - 0434.

Notes highlight an operating or maintenance procedure, condition, or statement which is essential, but is not of

known hazardous nature as indicated by DANGERS, WARNINGS and CAUTIONS.

The word "CAUTION" is used to introduce safety instructions whose non-observance may lead to damage to the machine and its functions.

The word "WARNING" is used to introduce safety instructions whose non-observance may lead to a potential hazard exists, capable of producing injury to personnel, if approved procedures are not followed.

The word "DANGER" indicates a location, equipment, or system where imminent hazards exist, capable of producing immediate injury or death to personnel, if approved procedures are not followed.

Instructions attached directly to the machine, e.g.

- Arrow indicating the direction of rotation
- Markings for fluid connections must always be complied with and be kept in a perfectly legible condition at all times.

Observe all note, caution or danger tags attached to the equipment or included in this manual.

G.2 Non-compliance with Safety Instructions.

Non-compliance with safety instructions may result in personal injury, property damage, or unnecessary damage to the pumping unit. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages. Non-compliance, can for example, result in:

- Failure of important pumping unit functions.
- Failure of prescribed maintenance and servicing practices.
- Hazard to personnel by electrical, mechanical, and chemical effects as well as explosion.
- Hazard to the environment due to leakage of hazardous substances.

G.3 Safety Instructions for Maintenance, Inspection, and installation Work.

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified personnel who are thoroughly familiar with the manual and pumping unit.

The pumping unit must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained before working on any pumping unit.

Work on the pumping unit must be carried out during shutdown. The shutdown procedure described in the manual for taking the unit out of service must be adhered to.

Pumps handling fluids that are hazardous to personnel must be decontaminated prior to being worked on.

Immediately following completion of the work, all safety relevant and protective devices must be reinstalled and/or reactivated.

Please observe all instructions set out in the section on start-up before returning the pumping unit to service.

G.4 Unauthorized Modification and Manufacture of Spare Parts.

Modifications or alterations of the pumping unit supplied are only permitted after consultation with Carver Pump and to the extent permitted by Carver Pump. Original spare parts and accessories authorized by Carver Pump ensure safety. The use of other parts can invalidate any liability of Carver Pump for consequential damage and/or warranty.

G.5 Unauthorized Modes of Operation.

The warranty relating to the operating reliability and safety of the unit supplied is only valid if the pumping unit is used in accordance with its designated use as described in the following sections. The limits stated on the nameplate must not be exceeded under any circumstances.

II. INSPECTION AND STORAGE.

A. INSPECTION. Upon receipt of the shipment, unpack and inspect the pumping unit and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Immediately report any missing parts or damage incurred during shipment to the factory and to the Transportation Company and file your "damage and/or lost in shipment" claim with the carrier.

B. STORAGE OF PUMP. If the equipment is not to be immediately installed and operated, store it in a clean, dry, well-ventilated place, free from vibrations, moisture and rapid or wide variations in temperature.

NOTE

Storage requirements vary depending on climatic environment, length of storage and equipment. For storage periods of three months or longer, contact manufacturer for specific instructions. Improper storage could damage equipment and would result in non-warranty covered restoration of non-warranty covered product failures.

When storing the pump up to three months rotate the shaft for several revolutions at least once per month to coat the bearings with lubricant, retard oxidation and corrosion, and prevent possible false brinelling.

The motor bearings should be prepared for storage according to the motor manufacturer's instructions, in the motor manufacturer's maintenance manual, which should come with the motor.

The standard pump ball bearings are packed with grease which acts as a rust preventative.

Consider a unit to be in storage when:

1. It has been delivered to the job site and is waiting to be installed.
2. It has been installed but operation is delayed pending completion of construction.
3. There are long (30 days or more) periods between operating cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

Measures to be taken for prolonged shutdown of installed pumping unit. If the pumping unit remains installed a periodic check of operation is in order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area. Start up the pumping unit regularly once a month or once every 3 months for a short time (approximately 5 minutes) during prolonged shutdown periods. Prior to operation check/run ensure that there is sufficient liquid available for operating the pump.

III. INSTALLATION.

A. LOCATION. The pump assembly should be located in an area that will permit periodic inspection and maintenance. Head room and access should be provided and all units should be installed in a dry location with adequate drainage. The discharge piping should be direct, with as few elbows and fittings as possible.

B. HANDLING.



CAUTION

Use a hoist with adequate lifting capacity.

Do not pick up the complete unit by the motor, the pump shafts, or motor lifting eyes.

If the pumping unit slips out of the sling arrangement, it may cause injury to personnel and/or damage to the pumping unit.

Moving the unit requires proper preparation and handling. Always make sure that the pump cannot slip out of the transport suspension arrangement. To move the pumping unit with the discharge pipe attach a lifting eye to the discharge flange, wrap a strap through the bearing frame and attach hoisting chain to them (Figure 1). To move the pumping unit without the motor, install two lifting eyes in the bolt holes on the bearing frame. Attach the hoisting chain to the lifting eyes. (Figure 2) The individual motor may be lifted using proper eyebolts provided by the manufacturer, but these should not be used to lift the assembled unit.

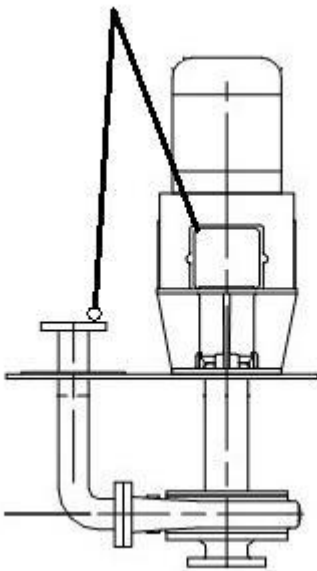


Figure 1. Sling Position for Moving Pumping Unit with Discharge Pipe

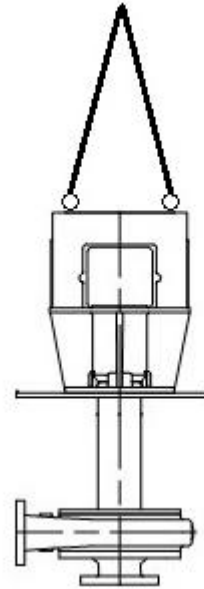


Figure 2. Sling Position for Moving Pumping Unit without Motor

C. COUPLING ALIGNMENT. The pump and motor are connected by a coupling. The base and motor bracket aligns the pump and motor. No further alignment is necessary.

D. PRE-INSTALLATION PROCEDURES.

1. Check the pump foundation and confirm the bolting surface is flat and the bolt pattern is correct.
2. Place gasket on pump foundation and slowly lower pump onto the foundation.
3. With the pump in a vertical position resting on the pump foundation, rotate the pump by hand utilizing the coupling. Check for any mechanical hesitation, binding or any acoustically transmitted signals from the pump. Hand rotation should be smooth and silent if it is not disassemble the pump until the source of the binding is located. Eliminate the binding and reassemble. Install the pump to foundation bolting and tighten to the system torque values. The pump should be rotated frequently during the procedure to tighten down the pumping unit.
4. After the pumping unit has been completely tightened down to the foundation, confirm that there is no binding.
5. Connect the piping.

E. PIPING. All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pumping unit.



All piping connections must be made with the pipe in a freely supported state. Do not apply vertical or side pressure to align the piping with the pump flange.

Before connecting suction, discharge, and auxiliary piping, check to see that the piping is absolutely clean internally. Any debris in the piping will be drawn into the pump passageways and can cause extreme damage. The internal diameters of the suction and discharge lines must be equal to the internal diameters of the pump suction and discharge nozzles.

F. AUXILIARY PIPING CONNECTIONS AND GAUGES. In addition to primary piping connections, the pump may require other connections such as gauges or drains. All these lines and gauges should now be installed.

G. MOTOR. See motor vendor's manual for motor information and information on connecting to the power supply.



Connection to the power supply must be effected by a trained electrician only. Check available main voltage against the data on the motor rating plate and select appropriate start-up method.

H. DIRECTION OF ROTATION. Correct pump rotation is indicated by an arrow on the frame adaptor. The standard direction of rotation, viewed from the motor end, is clockwise. The direction of rotation must agree with the arrow stamped on the pump frame or base.

IV. OPERATION.

A. PRE-START CAUTIONS.



Before activating the pumping unit, check to make sure there are no personnel working on the unit. Serious injury or death to personnel could result if the unit is activated while being worked on.

1. Before starting or operating the pump, read this entire manual, especially the following instructions.
2. Observe all caution or danger tags attached to the equipment.



Never run the pump dry. Close running fits within the pump are liquid lubricated. Dry running will result in pump seizure or damage.

3. Before starting the pump, the pump casing should be completely submerged in liquid.
4. Check final alignment of pump and driver. Both shafts must turn freely by hand.
5. If excessive vibration or noise occurs during operation, shut the pump down and rotate shaft by hand. If excessive vibration or noise continues, consult a Carver representative.
6. Before starting the pump, install closed guards around all exposed rotating parts.
7. Jog starter switch on motor to check that the direction of rotation must agree with the arrow stamped on the pump frame or base.

B. PRIMING. Dry running a centrifugal pump can result in extensive damage and possible seizing. It is, therefore, imperative that the pump be primed prior to initial start-up and that prime must be maintained through subsequent start-stop cycles.

Follow the procedure listed below:

1. Check the level in the tank to see that the pump is submerged in liquid.
2. The pump is now primed.

C. STARTING THE PUMP.



Do NOT operate pumping unit against a closed discharge system. If pump has any chance of operation against a closed system, a bypass system allowing a minimum design flow should be installed. This bypass will be satisfactory for short periods of operation. For extended periods of operation the bypass should be sized for the minimum continuous flow required by the pump.

1. Check pump for proper priming and lubrication.
2. Open discharge valves slightly, about 1 to 1 ½ turns if pump is being started for the first time or from being turned off for overhaul. Start the pump.
3. Slowly open discharge valves and adjust pressure and flow to the appropriate operating conditions. Refer to pump nameplate and system operating procedures for design point condition.

D. OPERATING CHECKS.

1. Check for undue vibration or noise. If any occurs and does not stop within a short period of time, turn off the pump. For determination of the cause and its remedy refer to troubleshooting in Section V or consult Carver Pump Company.
2. Check and record flow and pressure readings. The flow and pressure readings should be within the operating system guidelines and

similar to number stamped on the pump nameplate.

3. Check and record vibration.
4. Check and record power input to the motor.

E. STOPPING THE PUMP.

1. If the pump is being stopped for overhaul, slowly close the discharge valve. Otherwise leave discharge valves set at condition.
2. Stop the pumping unit in accordance with the directions on the electrical power supply.
3. Tagout and lockout power to motor according to OSHA Standard 1910.147.
4. Close any auxiliary fluid lines.
5. The pumping unit is now off.

F. INDEFINITE SHUTDOWN. Relubricate bearings. Provide pump assembly with a protective cover. Remove casing plug to drain casing. Drain all piping if there is a possibility of liquid freezing.

V. TROUBLESHOOTING OPERATING PROBLEMS.

If you have followed the installation and starting procedures outlined in this manual, the pump should provide reliable service and long life. However, if operating problems do occur; significant time and expense can be saved if you refer to Table 1 to eliminate the most common causes of those problems.

For the motor troubleshooting refer to the motor manual.

Table 1. Pumping Unit Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Failure to deliver liquid.	<ol style="list-style-type: none"> 1. Discharge head above shutoff. 2. Check valve stuck or improperly installed. 3. Impeller or suction clogged. 4. Liquid level in tank too low. 5. Wrong rotation. 	<ol style="list-style-type: none"> 1. Check pump rating against actual head condition. 2. Adjust and/or reverse valve. 3. Inspect strainer and impeller. Clean as necessary. 4. Add liquid to system. 5. Check power connection to motor.
Excessive power consumption.	<ol style="list-style-type: none"> 1. Head lower than rating: trying to pump too much liquid or operating at end of performance curve. 2. Specific gravity or viscosity of oil is too high. 	<ol style="list-style-type: none"> 1. Adjust pressure flow. Consult with Carver representative. 2. Check oil temperature and adjust as necessary.

Table 1. Pumping Unit Troubleshooting (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive power consumption. - Continued	<ol style="list-style-type: none"> 3. Mechanical defects such as binding rotating elements. 4. System head lower than design condition. 5. Incorrect impeller diameters. 	<ol style="list-style-type: none"> 3. Check for excessive pipe strain. Check foundation bolting. Replace defective parts. 4. Adjust system head. Trim impellers to actual condition. 5. Replace impellers or trim impellers to correct diameter. Consult with Carver Pump before trimming impellers.
Insufficient discharge or flow.	<ol style="list-style-type: none"> 1. Discharge head above shutoff. 2. Air or gases in oil. 3. Impeller or suction partially clogged. 4. Wrong direction of rotation. 5. Specific gravity or viscosity of oil is too high. 6. Incorrect impeller diameter. 	<ol style="list-style-type: none"> 1. Check pump rating against actual head condition. 2. Adjust and/or redesign suction system. Add oil to system. 3. Inspect strainer and impeller and clean as necessary. 4. Reverse direction of rotation. 5. Check oil temperature and adjust as necessary. 6. Replace impeller or trim impeller to correct diameter. Consult with Carver Pump before trimming impeller.
Vibration excessive.	<ol style="list-style-type: none"> 1. Foundation bolting loose. 2. Coupling halves not properly oriented relative to each other. 3. Impeller partially clogged. 4. Wrong rotation. 5. Insufficient foundation. 6. Pipe strain. 7. Bent shaft. 8. Coupling key to motor or coupling key to pump is not correct length. 9. Rotating equipment imbalance. 10. Motor improperly balanced. 	<ol style="list-style-type: none"> 1. Torque bolting to proper values. 2. Adjust coupling halves system relative to match marks. 3. Inspect impeller and clean as necessary. 4. Adjust direction of rotation. 5. Stiffen foundation as necessary. 6. Modify piping as necessary. 7. Replace shaft. 8. Replace with key of correct length. 9. Replace shaft or balance impeller. 10. Balance motor.
Bearing temperature excessive.	<ol style="list-style-type: none"> 1. Lubrication, insufficient lubrication. 2. Defective bearing. 3. Excessive or no load on bearing. 	<ol style="list-style-type: none"> 1. Lubricate according to Section VI, Paragraphs A and B. 2. Replace bearing. 3. Running to close to shutoff or outside of recommended operating condition.

VI. MAINTENANCE.

Generally the pump does not need continuous supervision. The pump should always run quietly and smoothly, without vibration. To ensure such operation, the following maintenance schedule should be applied at regular intervals during operation of the pump. Occasional visual checks are recommended. Data should be recorded for each pump to keep track of maintenance which has been performed and to note operational problems. A sample maintenance record sheet is provided for this purpose at the front of this manual. For motor maintenance refer to the motor manufacturer's manual for the unit.

Daily Inspection:

- Visually inspect unit.
- Check bearing temperatures.

Weekly Inspection:

- Check power (amps) readings.
- Check pump discharge pressure. Prescribed operating discharge pressure should never drop below 90 percent of design point pressure.
- Check vibration on pump and driver bearings. Vibration should NOT exceed 1.5 overall displacement (unfiltered) peak to peak mils (0.001") at 3600 RPM and 3.0 overall displacement (unfiltered) peak to peak mils (0.001") at 1750 RPM.

Monthly Inspection:

- Check coupling alignment.
- If necessary, grease coupling. Do NOT over grease.
- Check foundation bolts.

Semi-annual Inspection:

- Check coupling alignment due to settling of foundation.
- If stand-by pumps are installed, it is advisable to operate pumps on a rotation system to give each pump a certain duty. This ensures that stand-by pumps will always be in good condition for instant start-up.

25000 Hours - Overhaul

- For pump overhaul, disassemble pump, complete parts inspection, and reassemble pump according to Section VII.
- Inspect suction cover for corrosion, erosion or other damage. 3mm limit of metal loss in casing.

A. LUBRICATION OF PUMP BALL BEARINGS, LINESHAFT BEARINGS AND THROTTLE BUSHING.

Ball Bearings (18). The pump ball bearings are grease lubricated.

Grease, lubrication frequency depends on operating conditions. Normal duty calls for lubrication after 1,000 hours and every 10,000 hours afterwards. Ball bearings are lubricated at Carver Pump Company with Amoco Rykon Premium Grease No. 2EP or equivalent, non-soap, polyurea thickened grease with a drop point of 450 degrees F. This grease was selected because of its suitability for extreme pressures and its high temperature stability. Never mix greases with differing properties.

Polyurea based greases are NOT compatible with lithium or soda soap based greases. Therefore, the type of grease added should not vary. However, if it is necessary to change grease types, the bearing cap should be thoroughly cleaned and flushed with suitable solvent to remove all traces of old grease. Disassemble pump according to Section VII, Paragraph B, remove shaft and ball bearings from bearing frame and follow these procedures:

NOTE

It is recommended that when ball bearings (18) are removed from the shaft (6), the ball bearings be replaced. If ball bearings are in good condition and must be reused, follow the procedures below.

1. Place ball bearings, bearing frame, and bearing cap/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 ball bearings, bearing frame, and bearing cap/cartridge should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
3. Dip ball bearings in clean, light oil and spin by hand to determine that all foreign matter has been removed.
4. After cleaning, repack ball bearings half full on both sides with a good quality bearing grease.
5. Proceed with reassembly of pump according to Section VII, Paragraph D.

To lubricate the ball bearings use the following procedure:



CAUTION

Over greasing creates heat and is the cause of many problems requiring repair. DO NOT OVER GREASE.

1. Never lubricate ball bearings while unit is running. If necessary, shut down pumping unit according to Section IV, Paragraph E.
2. Remove plugs opposite grease fitting on both ends of bearing cap.



CAUTION

Do not lubricate bearing with a power grease gun.

3. Using a hand-operated grease gun on grease fittings, add approximately one ounce of fresh grease. With most hand-operated grease guns, two or three pumps are enough. DO NOT OVER GREASE. When installing new bearing, pack new bearing only half full with grease. Bearing temperature may rise above normal immediately after lubrication, but should stabilize within 4 to 8 hours.

Lineshaft Bearings (63). The grease recommended for the ball bearings above is recommended and used by Carver Pump Company for sealed for life lineshaft bearings. After lineshaft bearings and oil seals (47A) are installed on shaft (6) put enough grease in the lineshaft bearings that it comes out the hole for the plug on the other side. Install plugs (426) in bearing housing (99).

Throttle Bushing (63X). The throttle bushing is self-lubricating.

B. LUBRICATION OF MOTOR. See motor manufacturer's instructions to be sure motor bearings are properly lubricated.

C. TORQUE VALUES. Refer to Table 2, Recommended Torque Values. Clean and properly lubricate threads and bearing face of the fastener to obtain the proper fastener loading from these torque values. Fasteners should be tightened evenly and in stages. Refer to your torque wrench manual for the proper use of your wrench.

Table 2. Recommended Torque Values (ft-lbs)

Bolt Size	Material		
	Composite	Steel (or otherwise noted)	316 Stainless Steel
1/4"-20	5	5	7
5/16"-18	11	11	12
3/8"-16	18	18	21
1/2"-13	33	39	45
5/8"-11	54	83	97
3/4"-10	80	105	132
7/8"-9	109	160	203
1"-8	144	236	300

Table 3. Recommended Equipment

Tools	Materials	Test Equipment
Spanner Wrench Rawhide or Wood Mallet Wooden Wedge Allen Wrench Set Socket, Open, & Box Wrench Set Vice Grips Torque Wrench Bearing Heater	Removable Thread Locker	Coupling Alignment Gauges Volt-Amp Meter

VII. SERVICE AND REPAIR.

Refer to Figure 3 to locate the pump parts by item number and parts list. For motor service and repair refer to the motor manual for the unit.

A. PREPARATIONS FOR DISASSEMBLY OF PUMP.

During disassembly, match mark parts so they can be replaced in their original position. All parts should be thoroughly cleaned or replaced with new, if necessary. Sealing faces should be perfectly clean. Carver Pump Company recommends that all O-rings and shims are only used once.



CAUTION

Factory authorized parts must be used to safely maintain your Carver Pump.

NOTE

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

Parts that may vary from model to model are: semi-open or enclosed impeller, wear ring (enclosed impeller pumps only) and line shaft bearing.

Close discharge valves. The pump casing should be cooled down to ambient temperature. The casing must be empty and not under pressure.

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 Table 3, Recommended Equipment, for proper tooling during disassembly and assembly. Refer to appropriate sectional drawing for location of parts followed by an item number.

Carver Pump Company recommends that the following parts be replaced with new:

- O-rings / gaskets
- Shims
- Bearings
- Grease seals

Prepare the pumping unit for disassembly using the following list:

1. Read this entire section and study the sectional view drawing, Figure 3, before disassembling the pump.



DANGER

Before attempting to disassemble the pump, the electrical power supply to the driver must be locked and tagged in the "OFF" position to prevent injury or death to personnel servicing the pumping unit.

2. Stop the pumping unit; refer to Section IV, Paragraph E.



WARNING

Properly decontaminate pump and piping before disconnecting the pumping unit. Applicable hazardous material procedures must be followed.

3. Slowly close discharge valves.
4. Shut off and close all valves controlling flow of liquid to and from pump. Disconnect piping and gauge lines as necessary.
5. Allow pump to drain. If necessary, flush pump to remove corrosive or toxic pumpage.
6. Remove coupling guard. Match mark coupling halves to assure proper coupling reassembly. Disconnect coupling between pump and motor. If non-spacer coupling is fitted, the driver will have to be removed from the bearing housing.

B. DISASSEMBLY OF PUMP.

(Refer to Figure 3 and Table 8) Disassemble the pumping unit using the following procedure:

1. Complete Section VII, Paragraph A before continuing with disassembly.



CAUTION

Use a hoist with adequate lifting capacity.

NOTE

Mark or number each component while dismantling according to sequence.

2. Attach lifting strap to motor (Refer to motor manual).
3. Remove bolts (607), freeing motor from bearing frame (19). Hoist motor and motor coupling (42) half away from pump and rest on plywood, heavy cardboard or other adequate durable

surface. If servicing motor or replacing coupling, loosen setscrews to remove coupling half and motor coupling key from motor shaft.



CAUTION

Use a hoist with adequate lifting capacity.

NOTE

The pump must be removed from the pit in order to perform the following disassembly procedures.

Do not allow pump to sit and dry out before completing disassembly. Remove as much sediment from outside of pump as possible before moving pumping unit.

4. Remove foundation bolts from base (23). Insert one lifting eye onto each corner of the base bolt holes. Move to a suitable work area.
5. Remove bolts from discharge pipe (not shown) at casing (1).



CAUTION

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

6. Remove bolts (600) and washers (651) from backhead (11). Remove casing (1) with suction cover (9) assembled, if equipped, from backhead.

NOTE

Impeller bolt (26) has right handed threads.

7. Remove impeller bolt (26) and impeller washer (28).
8. Remove impeller (2) and impeller key (32).
9. If equipped, remove shaft sleeve (14), refer to Figure 7, Optional Sleeve detail.

NOTE

DO NOT remove throttle bushing (63X) from backhead (11) unless the throttle bushing needs replaced.

10. Remove bolts (601) from flange adaptor (85). Remove backhead (11) from flange adaptor with throttle bushing (63X) in backhead.
11. Inspect throttle bushing (63X) in accordance with Section VII, Paragraph C, step 4 and Table 4.
12. Remove nuts (618) with bolts (606), lockwashers (656), and washers (658) attaching bearing frame (19) to base (23).



CAUTION

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

13. Remove bearing housing (19) assembly and shaft (6).
14. Remove coupling (42) half on pump side and remove coupling key (46).
15. Remove nuts (613), bolts (603), and washers (653) from column (101) holding flange adaptor (85). Remove flange adaptor.
16. Remove slinger from shaft (6).
17. Remove retaining ring (775) from shaft (6) as applicable.

NOTE

If oil seals are disturbed from position replace with new.

18. Remove plugs (426). Remove lineshaft bearing housing (99). The oil seal (47A) and lineshaft bearing (63) will come off with the lineshaft bearing housing.

Disassembly of Lineshaft Bearings.

19. Check lineshaft bearing (63) in accordance with Section VII, Paragraph C, Parts Inspection. If lineshaft bearing needs replaced, use the following steps.
20. Remove lipseal (47A), if equipped, from both ends of lineshaft bearing housing (99). If lineshaft bearing (63) are fluid flushed, there should be no lip seal.
21. Take lineshaft bearing housing (99) to a press and remove lineshaft bearings (63).

Removal of Bearings.

NOTE

DO NOT remove ball bearings (18) from shaft (6) unless the ball bearing needs replaced, if disturbed from position replace ball bearings with new.

- 22. Loosen coupling setscrew (not shown). Remove coupling half (42) and coupling key (46) from shaft (6).
- 23. Remove bolts (608) from bearing cartridge (37).
- 24. Using bolts (610) as jacking bolts tighten bolts to remove bearing cartridge (37) from bearing housing (19). Shaft (6) will be removed with bearing assembly.
- 25. Remove bolt (609) from bearing cap (35). Remove bearing cap from bearing cartridge (37).

NOTE

Bearing locknut (22) has left handed threads.

- 26. Uncrimp locking tab of lockwasher (69) and remove locknut (22) and lockwasher.
- 27. Remove shaft (6) and ball bearing (18) from bearing cartridge (37) by pulling shaft assembly from bearing cartridge through end housing ball bearing (18). Remove ball bearing and bearing spacer (176) from shaft.

NOTE

If oil seals are disturbed from position replace with new.

- 28. Remove oil seal (47X) from bearing cap (35) and oil seal (47) from bearing cartridge (37).

Disassembly of Lineshaft Coupling. (Refer to Figure 5)

NOTE

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

- 29. Drive a drift punch on the smaller end to remove the upper tapered pin (680).
- 30. Unscrew (right-hand threads) the lower shaft (10) and lineshaft coupling (41) from the upper shaft (12). Make sure that the washer (150) that is between the shafts stays with lower shaft. Do not remove the lineshaft coupling (41) from the lower shaft unless absolutely necessary.

C. PARTS INSPECTION.

- 1. All parts should be thoroughly cleaned or replaced with new ones if necessary. All gasket faces should be perfectly clean. It is recommended that all oil seals, gaskets, O-rings, and locking devices with a nylock feature be replaced with new if disturbed from position.
- 2. Inspect casing for pitting, scoring, and erosion. The inside of the casing should be free of any pits or grooves. Replace the casing if any of these defects are present.
- 3. Check shaft for runout, scratches, grooves, or possible damage. Remove scratches and grooves with polishing cloth and inspect for remaining grooves or deep scratches. Carver recommends replacing a bent or excessively damaged shaft.
- 4. Inspect throttle bushing (63X) for wear. Measure inside diameter of throttle bushing. 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 4 for maximum diameter of throttle bushing.

Table 4. Throttle Bushing Dimensions

Frame Size	Maximum Diameter	Minimum Diameter
1921/1521	1.277 inches	1.275 inches
1932	1.527 inches	1.525 inches

5. Inspect impeller and coupling keys for distortion and push fit into keyways. The keys should be square on all four edges. They should fit without having to be forced. The keys should not rock in keyway. Replace keys or shaft if necessary.
6. Inspect lineshaft bearing (63) for damage and wear. Refer to Table 5 for lineshaft bearing clearances. Replace if necessary.

Table 5. Lineshaft Bearing Clearances

Material	Diametric Clearance
Carbon	.009/.013 inches

7. Inspect and replace any defective grease fittings.
8. **(Semi-Open Impellers, ordering code BA through CG)** If the impeller (2) shows excessive wear due to erosion or pitting, so that performance cannot be restored, it must be replaced.
9. **(Closed Impellers, ordering code DA through EE)** Check the optional wear ring clearance as follows:
 - a. Measure Outside Diameter (OD) of front impeller hub (2) in three places.

- b. Measure Inside Diameter (ID) of wear ring (7) in three places.
 - c. If difference between the high reading of the ID of the wear ring (7) and the low reading of the OD of the impeller (2) hub exceeds double the maximum clearances given in Table 6, replace the wear ring according to Section VII, Paragraph F.
 - d. Measure OD of back impeller hub (2) in three places.
 - e. Measure ID of wear ring (7X) in three places.
 - f. If difference between the high reading of the ID of the wear ring (7X) and the low reading of the OD of the impeller (2) hub exceeds double the maximum clearances given in Table 6, replace the wear ring according to Section VII, Paragraph F.
10. Inspect ball bearings (18) for damage. A damaged bearing must be replaced. If bearings are removed from shaft, it is recommended that the bearings be replaced. If bearing replacement is not possible and bearing is in good condition bearing should be cleaned according to Section VI, Paragraph A. Protect until ready to use.

Table 6. Enclosed Impeller Clearances

Ordering Code	Pump Size	Impeller Size Front (Inches)	Impeller Size Back (Inches)	Wear Ring Size Front (Inches)	Wear Ring Size Back (Inches)	Factory Standard Diametric Clearance	
						Minimum	Maximum
DA	2 x 1 x 11	2.750/2.749	NA	2.762/2.760	NA	.010 in.	.013 in.
DB	4 x 2 x 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742	.016 in.	.020 in.
DC	4 x 3 x 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742	.016 in.	.020 in.
DD	6 x 4 x 11	4.724/4.722	4.724/4.722	4.740/4.742	4.740/4.742	.016 in.	.020 in.
DE	8 x 6 x 11	7.937/7.935	7.937/7.935	7.956/7.958	7.956/7.958	.019 in.	.023 in.
EA	2-1/2 x 1-1/2 x 13	3.337/3.335	NA	3.347/3.349	NA	.010 in.	.014 in.
EB	2-1/2 x 2 x 13	4.124/4.122	4.124/4.122	4.140/4.142	4.136/4.134	.016 in.	.020 in.
EC	3 x 2-1/2 x 13	4.715/4.713	5.894/5.892	4.731/4.733	5.908/5.910	.016 in.	.020 in.
ED	4 x 3 x 13	5.500/5.498	5.894/5.892	5.517/5.518	5.908/5.910	.017 in.	.020 in.
EE	6 x 4 x 13	5.894/5.892	5.894/5.892	5.912/5.914	5.908/5.910	.018 in.	.020 in.

D. REASSEMBLY OF PUMP. During reassembly, install parts as applicable. Assemble the pump in accordance with accepted rules of engineering practice. Coat individual components with a suitable lubricant before assembling. Assembly of unit should be performed on a clean, flat surface.

(Refer to Figure 3, Table 2, and Table 8) Reassemble the pumping unit using the following procedure:

 **CAUTION**

During reassembly, install new O-rings, oil seals, and gaskets if disturbed from position. O-rings, oil seals, and gaskets may have been damaged during disassembly.

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

During reassembly, Carver recommends that ball bearings be replaced.

NOTE

All parts should be thoroughly cleaned or replaced with new ones if necessary. All sealing faces should be perfectly clean.

1. Complete Section VII, Paragraph C before continuing with assembly.
2. If removed, install bearing spacer (176) and ball bearing (18) onto shaft (6). Ball bearings may be pressed onto shaft or heated so they slide onto shaft. Pack ball bearings half full of grease. Refer to Section VI, Paragraph A for proper grease type.

NOTE

Bearing locknut (22) has left handed threads.

3. Install bearing lockwasher (69) and bearing locknut (22) onto shaft (6). Crimp locking tabs on lockwasher into grooves of locknut.
4. Install new oil seals (47 and 47X) in bearing cap (35) and bearing cartridge (37).
5. Install shaft/ball bearing assembly into bearing cartridge (37).
6. Install bearing cap (35) and secure bearing cap to bearing cartridge (37) with bolts (609).

 **WARNING**

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

NOTE

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

7. Install bearing cartridge (37) with shaft assembly into bearing frame (19). Secure assembly with bolts (608) finger tight. Install bolts (610) finger tight into bearing cartridge.
8. Install coupling key (46) and slide coupling half onto pump shaft (6).
9. Install bearing frame assembly and shaft (6) onto base (23) and secure with bolts (606), washers (658), lockwashers (656) and nuts (618).
10. Install column (101) onto shaft (6) and secure to bearing frame (19) with bolts (604).

Assembly of Lineshaft Bearings.

 **CAUTION**

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.

11. Press lineshaft bearing(s) (63) in lineshaft bearing housing(s) (99).
12. Install new oil seals (47A), if equipped, in both ends of the lineshaft bearing housing (99). Install lineshaft bearing housing assembly onto shaft (6).

NOTE

If installing sealed for life lineshaft bearings (63), refer to Section VI, Paragraph A for initial lubrication.

NOTE

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

13. If equipped, install retaining ring (775) on shaft (6). Install slinger (40) on shaft.
14. Install flange adaptor (85) onto column (101) and secure with bolts (603), washers (653) and nuts (613).
15. Install shaft sleeve (14), if equipped. Refer to Figure 7, optional sleeve detail.
16. If throttle bushing (63X) was removed, press new throttle bushing into backhead (11).
17. Install backhead (11) onto flange adaptor (85) with bolts (601).

 **CAUTION**

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

18. Install impeller key (32) and impeller (2) and secure with impeller washer (28) and impeller bolt (26).

 **CAUTION**

If the impeller rubs the casing (1)/suction cover (9), adjust bearing cartridge (37) upward or downward using bolts (608 and 610) until the rotating element turns freely.

19. Secure casing (1) with bolts (600) and washers (651) to backhead (11).
20. If applicable, secure suction cover (9) to casing (1) with bolts (611).
21. Adjust impeller in accordance with Section VII, Paragraph E.

 **CAUTION**

Use a hoist with adequate lifting capacity.

22. (Refer to Section III, Paragraph B) Attach lifting straps. Hoist pump to installation site, placing base (23) on foundation.

23. Remove lifting eyes and replace with foundation bolts as applicable.



CAUTION

Use a hoist with adequate lifting capacity.

24. Hoist motor to installation site. Place motor in position on bearing frame (19) and secure with bolts (603).

NOTE

Rotate shaft by hand to make sure pump rotates freely before start-up.

25. Confirm that the pump rotates freely.
26. Refer to Section IV for alignment information.
27. Connect coupling (42) using match marks made during disassembly and align according to Section III, Paragraph C.
28. Connect piping.
29. Install coupling guard (131).
30. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
31. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

E. ADJUSTING IMPELLER CLEARANCE ON PUMP.

Semi-Open Impeller. To adjust impeller clearance on a pump equipped with a semi-open impeller use the following procedure:

1. Stop pump according to Section IV, Paragraph E. Lock out and tag the power to the driver. Remove coupling guard (131).
2. Disconnect coupling (42).
3. Once pump is in the vertical position, loosen bearing cartridge (37) by loosening bolts (610) then tighten bolts (608) until impeller rubs on suction head.
4. Place a dial indicator on the end of shaft (6).
5. Tighten bearing cartridge (37) until indicator reads between .010 and .015 inch.
6. To hold setting, evenly tighten bolts (610) while watching indicator.
7. Turn shaft (6) by hand to ensure impeller is not rubbing.

Enclosed Impeller. To adjust impeller clearance on a pump equipped with an enclosed impeller use the following procedure:

If the impeller rubs the casing (1), adjust bearing cartridge (37) upward by loosening bolts (608 and 610) or downward by tightening bolts (610) then tighten bolts (608) until the rotating element turns freely. Tighten bolts (610) to hold the impeller setting.

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMP EQUIPPED WITH ENCLOSED IMPELLER.

If your pump is equipped with an enclosed impeller, it may have an optional, replaceable wear ring (7 or 7X) in the suction cover (9) or backhead (11). If your pump is equipped with the optional wear ring (7 or 7X), use the following instructions and Figure 6 for wear ring replacement.

NOTE

Stainless fitted and all iron pumps are not fitted with a separate wear ring when new from the factory. Stainless fitted and all iron pumps when rebuilt can use separate wear rings to restore wearing surface in the backhead or suction cover.

The clearance between the wear ring (7 or 7X) and impeller (2) hub will increase with wear. Internal leakage will result and pump performance will decrease.

Table 7. Impeller/Wear Ring Matching Materials

IMPELLER MATERIAL	WEAR RING MATERIAL
All Iron & Stainless Fitted	Cast Iron
Stainless Steel	17-4PH

To replace the wear ring, follow the disassembly procedures in Paragraphs A and B of this section to the point where the backhead or suction cover has been removed and the wear ring is accessible. 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 6) over recorded size of outside diameter of front impeller (2) hub.



CAUTION

Use removable thread locker when installing impeller bolt.

9. Repeat steps for wear ring (7X) and backhead (11).

10. Reassemble pump per Section VII, Paragraphs D and E as needed.

G. MOTOR. The motor should be maintained in accordance with the manufacturer's instructions.

H. COUPLING. The coupling should be maintained in accordance with the manufacturer's instructions.

I. CHECK VALVE. If applicable, the check valve should be maintained in accordance with the manufacturer's instructions.

VIII. PARTS LISTS AND DRAWINGS.

This section contains listings of parts and corresponding drawings. Table 9 notes the recommended spare parts for this pumping unit. Figure 3 is the sectional assembly drawing.

Table 8. Pump Parts List

Item No.	Part Name	Item No.	Part Name
1	Casing	63X	Throttle bushing
2	Impeller	69	Bearing lockwasher
6	Shaft	85	Flange adaptor
7	Wear ring (if equipped)	99	Bearing housing
7X	Wear ring (if equipped)	101	Column
9	Suction cover	131	Coupling guard
10	Lower shaft (if equipped)	176	Bearing spacer
11	Backhead	425	Plug
12	Upper shaft (if equipped)	426	Plug
14	Shaft sleeve (if equipped)	600	Bolt – Backhead/Casing
18	Ball bearing	601	Bolt – Flange adaptor/Backhead
19	Bearing frame	603	Bolt – Column/Column
22	Bearing Locknut	604	Bolt – Column/Bearing frame
23	Base	606	Bolt – Base/Bearing frame
26	Impeller bolt	607	Bolt – Bearing frame/Motor
28	Impeller washer	608	Bolt – Bearing cartridge/Bearing frame
32	Impeller key	609	Bolt – Bearing cap/Bearing cartridge
35	Bearing cap	610	Bolt – Bearing cartridge - Jacking
37	Bearing cartridge	611	Bolt – Suction cover/Casing
40	Slinger	613	Nut – Column/Column
41	Lineshaft coupling (if equipped)	618	Nut – Bearing frame/Base
42	Coupling	651	Washer – Backhead/Casing
46	Coupling key	653	Washer – Column/Column
47	Oil seal	654	Washer – Column/Bearing frame
47A	Oil seal (if equipped)	656	Lockwasher – Bearing frame/Base
47X	Oil seal	658	Washer – Bearing frame/Base
63	Lineshaft bearing	775	Retaining ring (if equipped)

Table 9. Recommended Spare Pump Parts List

Item No.	Part Name	Item No.	Part Name
7	Wear ring (if equipped)	604	Bolt – Column/Bearing frame
7X	Wear ring (if equipped)	606	Bolt – Base/Bearing frame
14	Shaft sleeve (if equipped)	607	Bolt – Bearing frame/Motor
18	Ball bearing	608	Bolt – Bearing cartridge/Bearing frame
26	Impeller bolt	609	Bolt – Bearing cap/Bearing cartridge
28	Impeller washer	610	Bolt – Bearing cartridge - Jacking
32	Impeller key	611	Bolt – Suction cover/Casing
40	Slinger	613	Nut – Column/Column
46	Coupling key	618	Nut – Bearing frame/Base
47	Oil seal	651	Washer – Backhead/Casing
47A	Oil seal (if equipped)	653	Washer – Column/Column
47X	Oil seal	654	Washer – Column/Bearing frame
63	Lineshaft bushing	656	Lockwasher – Bearing frame/Base
63X	Throttle bushing	658	Washer – Bearing frame/Base
600	Bolt – Backhead/Casing	680	Tapered Pin
601	Bolt – Flange adaptor/Backhead	775	Retaining ring (if equipped)
603	Bolt – Column/Column		

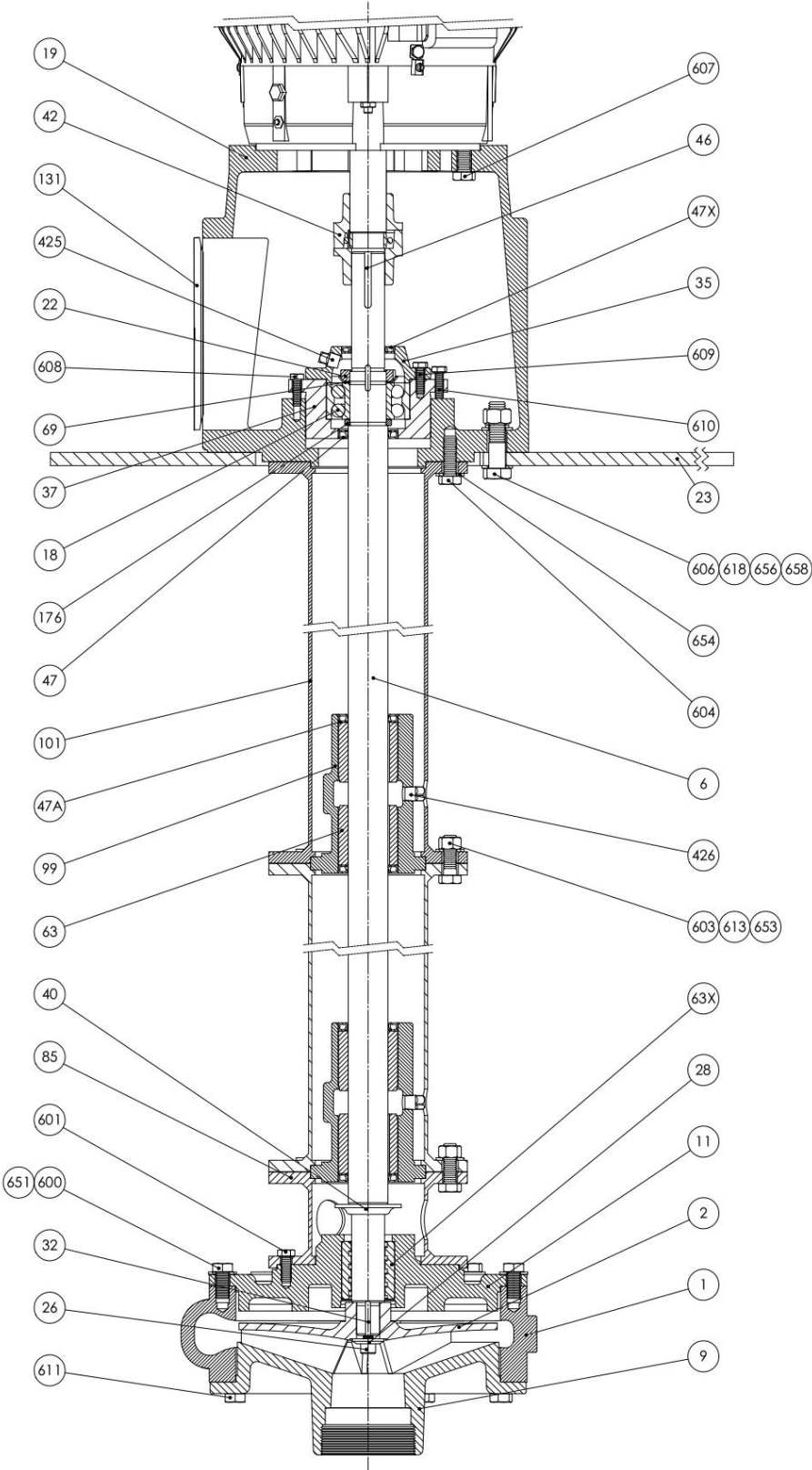
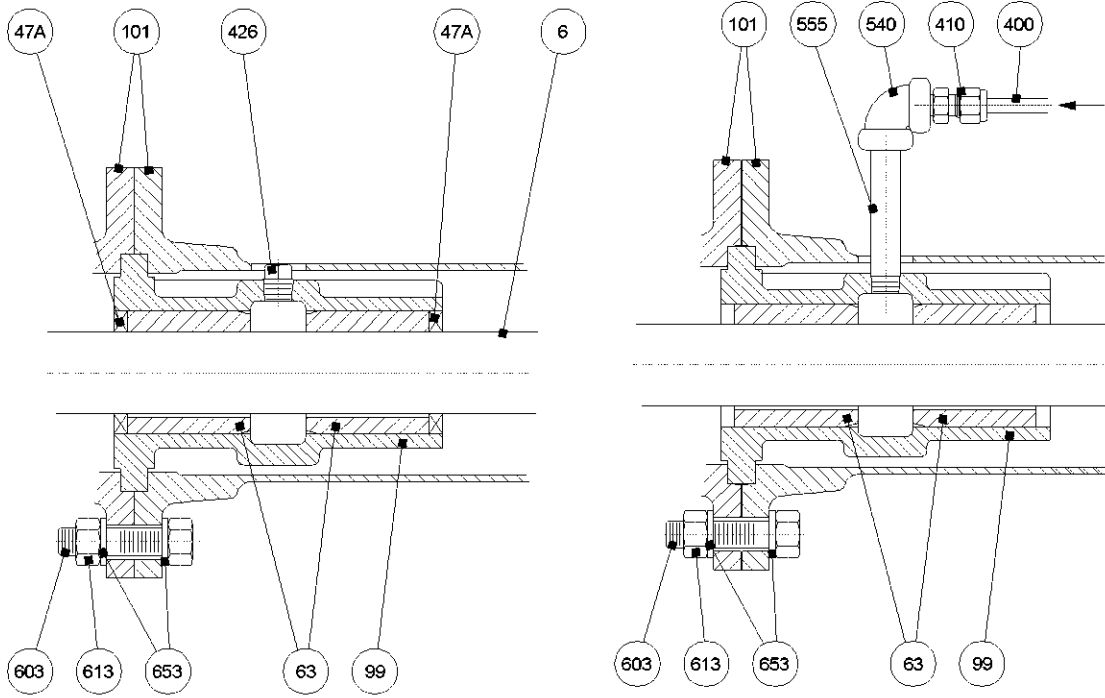
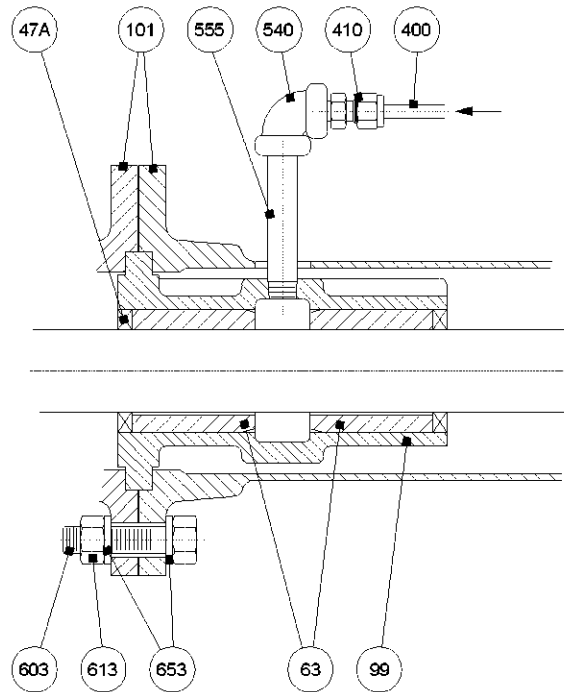


Figure 3. G2S Sectional Drawing



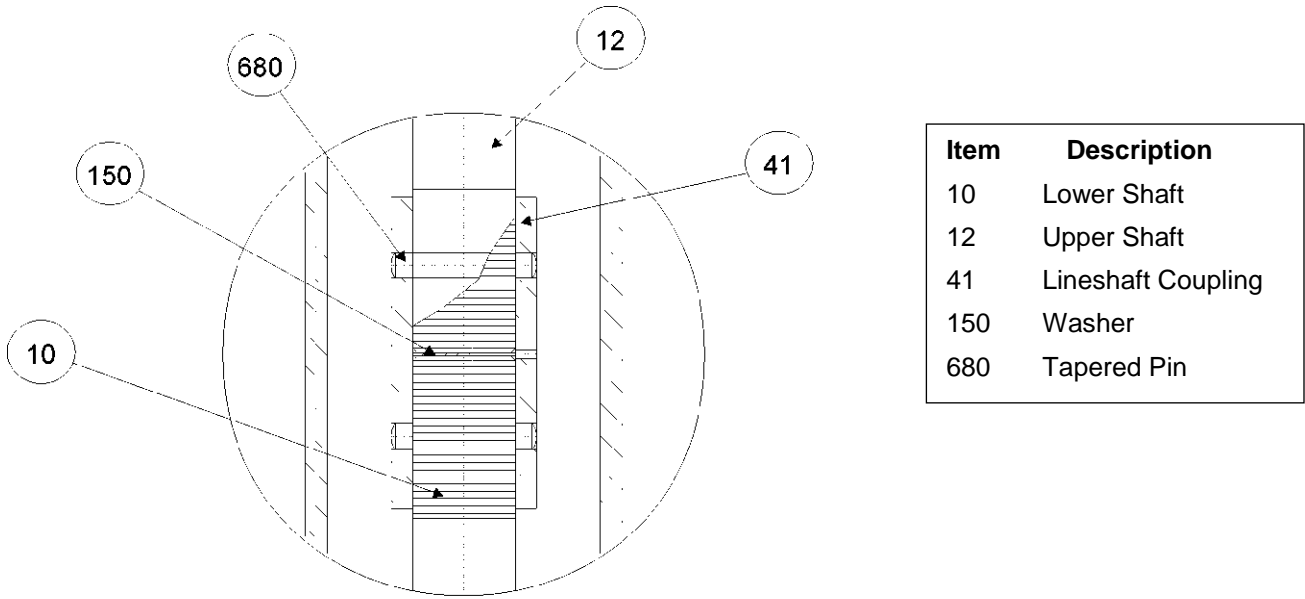
Sealed for Life

External Flush



External Lubrication

Figure 4. Lineshaft Bearing Lube Variations



Detail of Shaft Coupling for Pumps with Columns Over 10 Feet Long

Figure 5. Shaft Coupling Detail

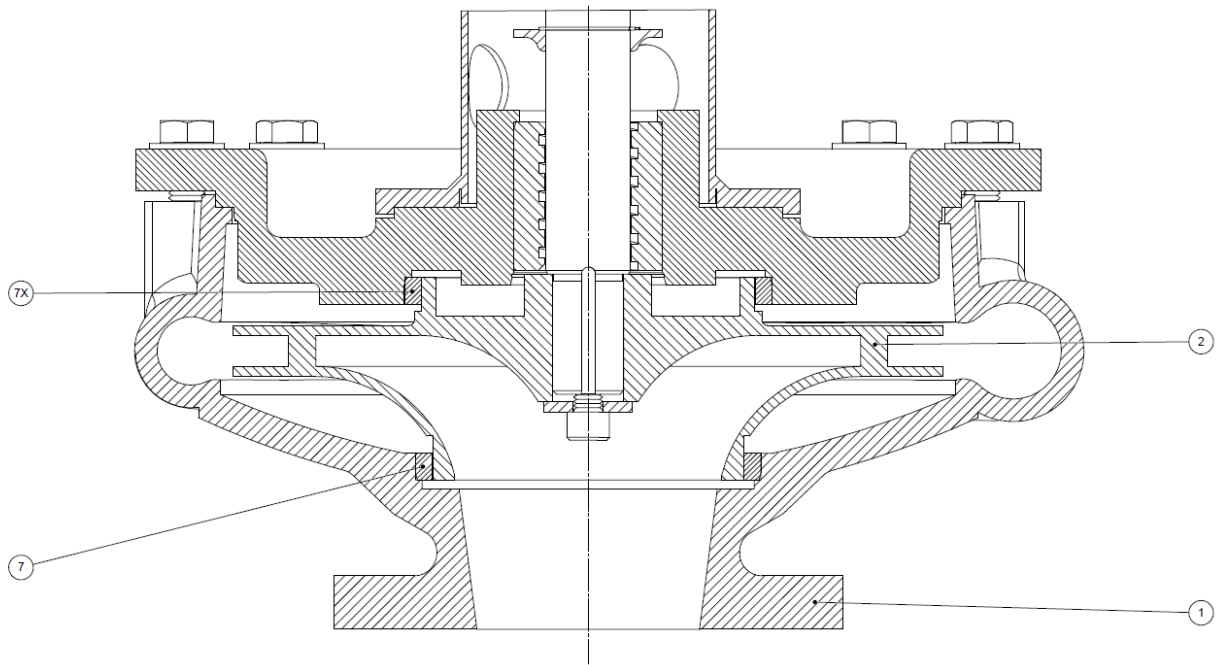


Figure 6. Optional Wear Rings

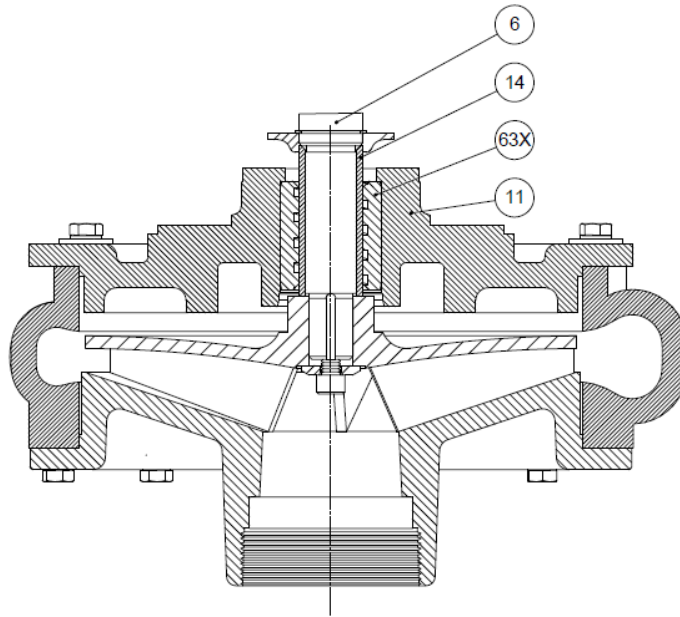


Figure 7. Optional Sleeve

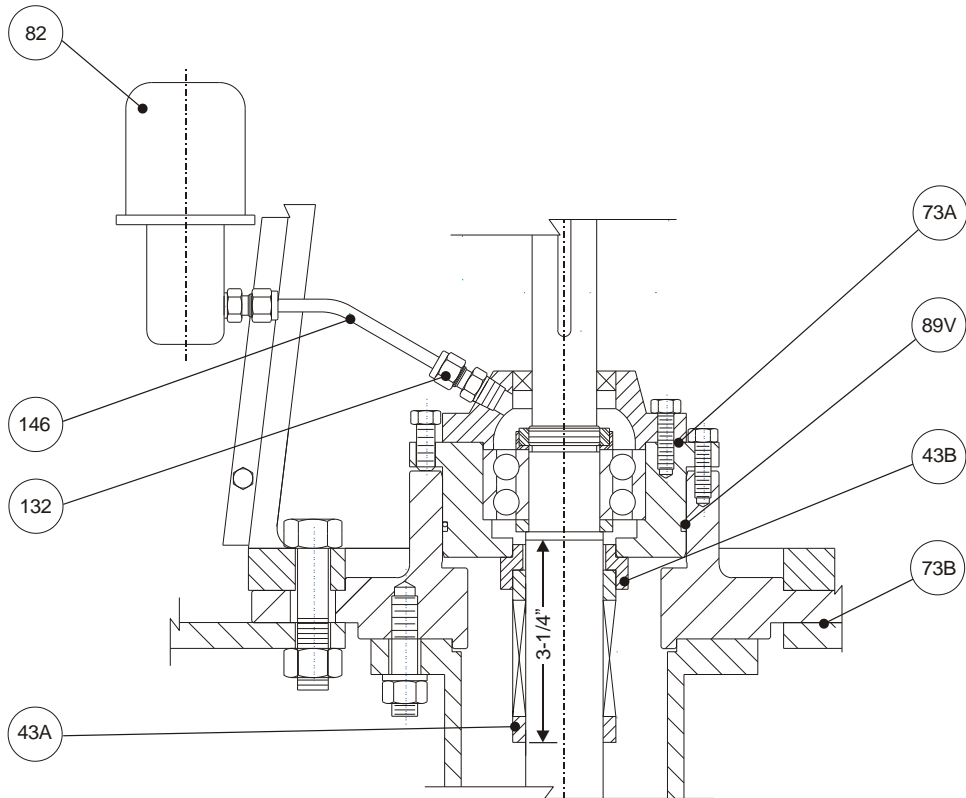


Figure 8. Optional Oil Lubrication

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