I-120 Revision 01

GH Series

Installation, Operation
and Maintenance Manual

Carver®

Creating Value.

SERVICE RECORD PAGE

Service No. _____ Size and Type _____ Make _____

Customer 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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

I. GENERAL INFORMATION.

A. PREFACE. Our general horizontal (GH) end suction pumps are designed to handle water acids and alkaline solutions for general service and process industry applications. Hydraulic performance extends to 2,500 gallons per minute (GPM) and is covered by twenty-eight sizes. The sizes are available in cast iron, bronze fitted, 316 stainless steel (SS) fitted, and all 316 SS construction. All models feature a back pullout design, removable suction covers, and casings, which rotate in ninety-degree increments for different field piping orientations. Additional standard features include 316 SS shaft sleeves, keyed impellers, dynamic balancing to ISO G2.5 guidelines, and bearings, which are secured with locking rings.

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

Factory warranty applies to pumps operating under conditions specified on the order acknowledgement, and are properly installed and maintained, as recommended herein.

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 on our website, 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 stamped on the nameplate attached to the pump. Upon receipt of the pumping unit, record pump specifications and all other necessary information on the service record and inspection and repair record located in the front of this manual. When ordering spare parts (refer to Table 4) or requesting information, furnish nameplate data to Carver Pump Company or its representative. When ordering a pump, refer to Figure A, Ordering Code, for assistance. Include the information from Figure A in all correspondence regarding the unit. By furnishing this information, it ensures 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. For every one to three pumps, stock one spare parts set consisting of items listed in Table 4, Recommended Spare Parts. Part numbers correspond to drawings (figure 2 and figure 3) located in 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:

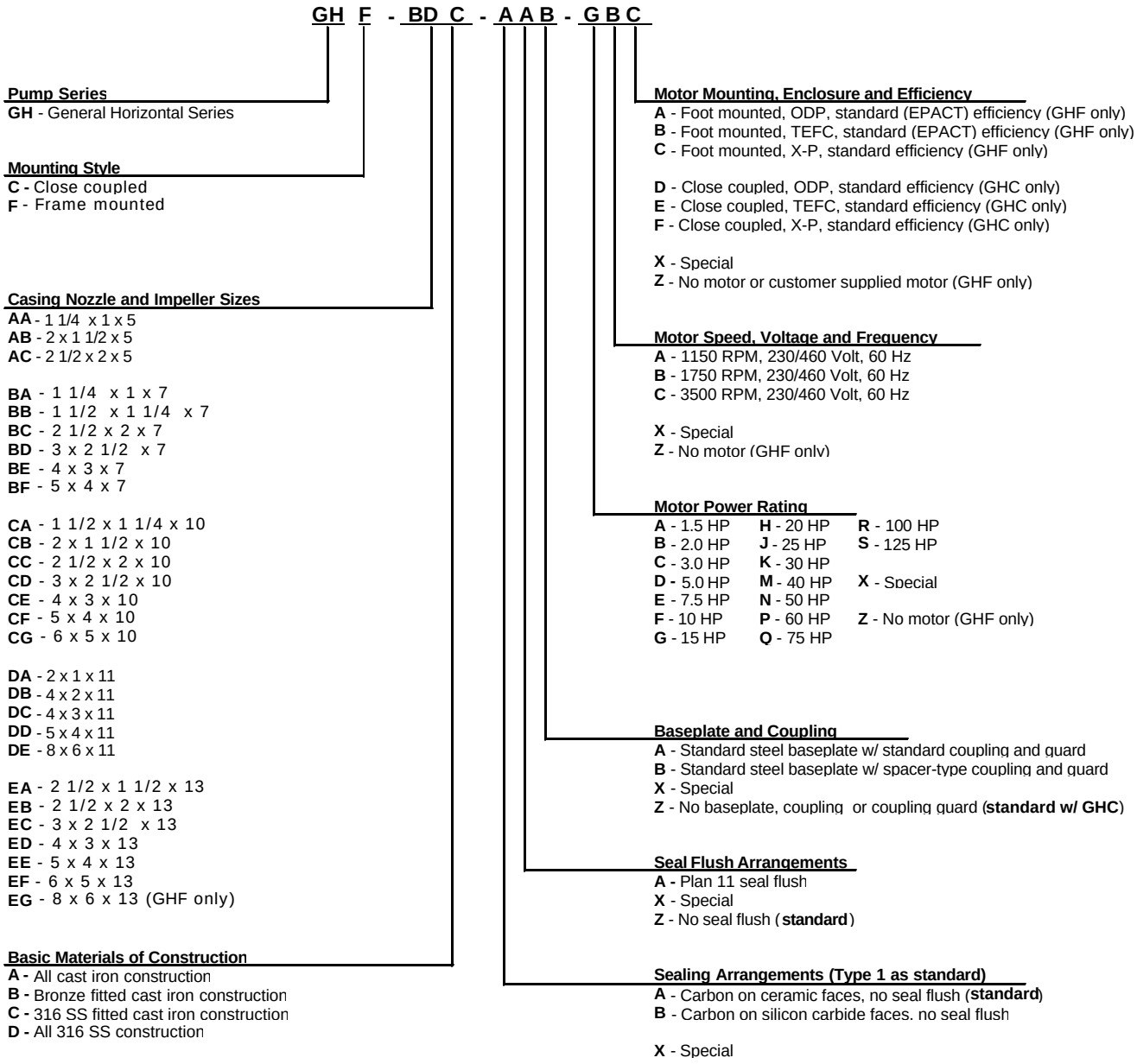
- Serial number of pump (located on nameplate)
- Part name (refer to Table 5)
- Item number (refer to Table 5 and figures 2 and 3)
- Quantity of parts needed

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 GH Series pump and pump/motor and top plate arrangements. When quoting or ordering a GH 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.



NOTE: Casing Nozzle and Impeller Sizes containing codes AA through AChave semi-open impellers. Casing Nozzle and Impeller Sizes containing codes BA through EG have closed impellers.

Figure A. Ordering Code

E. SAFETY PRECAUTIONS. This manual is written with the intent to provide safe instructions for 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 to properly handle of the unit. Note warnings, which are strategically placed to ensure safety for personnel. Warnings are indicated by the following symbol:

Carefully read ALL warnings to ensure safety of 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 or disclosed in the information contained herein.

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. 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 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 to the factory and to the transportation company any missing parts or damage incurred during shipment. File a “damage 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. Keep flange covers intact until suction and discharge piping are connected to pump flanges.

B. STORAGE. If the equipment is NOT immediately installed and operated, Carver Pump Company recommends rotating each shaft several revolutions at least once every two weeks. This is done to prevent flat spots on ball bearings and indentations in the race of the ball bearing, which is termed "false brinelling." False brinelling oftentimes causes early bearing replacement. For information regarding bearing lubrication, refer to section VI, Maintenance, item B, Bearing Lubrication.

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

- The pump has been delivered to the job site and is awaiting installation.
- 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 of 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, 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. For pump disassembly and assembly procedures, refer to section VII, Service and Repair. When disassembling the pump, replace and repair rusted and/or worn parts, as necessary.

NOTE

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

1. Shut down the pumping unit in accordance with the operating procedures outlined throughout this manual.
2. Turn system suction and discharge valves to the "off" position.
3. Drain the unit. If freezing temperatures are applicable, drain all piping.
4. Fill unit with mineral oil or suitable non-corrosive protectant compatible with the system.
5. Lubricate bearings.
6. Provide pump and motor with a protective cover.

III. INSTALLATION.

Skilled personnel should install the pump in accordance with engineering standards. Faulty installation causes operating troubles and premature wear of parts.

Lift pumping unit with a hoist or suitable lifting device. Do NOT lift complete unit using the driver, pump shaft, discharge piping, or driver eyebolts. Handle composite parts with extreme care.

Make sure there is enough headroom to perform

periodic inspection and maintenance on the pump and driver. Install units in a dry location with adequate drainage.

NOTE

Always submerge the pump in enough fluid to prevent vortices from forming. If large vortices form, air enters the suction and causes an imbalance of the impeller and the pump to run dry. If these vortices form, damage may occur to the pump and/or its parts. For information on how to order replacement parts, refer to section I, General Information, item D, Parts Ordering.

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

A. INSTALLATION CHECKS. Use the following installation checks to ensure proper operation of pump:

1. **LOCATION.** Install the pump close to the fluid. Use a short, direct suction pipe to keep suction losses at a minimum. If possible, locate the pump so fluid will flow by gravity to the suction opening. Direct the discharge piping with as few elbows and fittings as possible. The total net positive suction head available (NPSHA), which includes the suction lift and pipe friction losses, must be greater than the net positive suction head required (NPSHR) by the pump.
2. **FOUNDATION.** Consider the following criteria for a foundation: three to six inches wider and longer than the baseplate, a level surface, sufficient mass to prevent vibration, and form a permanent rigid support for the unit. The best foundations are concrete with appropriately sized anchor bolts. The anchor bolts are embedded in the foundation in pipe sleeves having an inside diameter 2-1/2 times larger than the bolt diameter. This will ensure accurate position of the unit. Ensure the concrete surface is clean, yet rough.
3. **LEVELING OF UNIT.** Install unit onto foundation. Position base so anchor bolts are aligned in middle of holes in base. On all frame-mounted units, always disconnect the coupling halves. Do NOT reconnect coupling halves until all alignment operations are complete.

   To support the base, place metal shims or metal wedges directly beneath the area of the base, which supports the most weight. Space the shims or wedges close enough to give even support and stability.

   Adjust metal supports or wedges until suction and discharge flanges are level. Accomplish alignment and leveling corrections by adjusting supports under the base. When proper alignment is obtained, tighten foundation bolts by hand. Recheck alignment before grouting. Tighten bolts snugly.

   CAUTION

   Do NOT straighten base with anchor bolts.

4. **COUPLING ALIGNMENT.** On frame-mounted pumps, check alignment of pump and driver shafts. Check to make sure pump and driver shafts turn freely by hand. If driver is mounted and aligned at the factory, realign at the site since misalignment may occur during transport and installation. This must be done before grouting the baseplate and connecting the piping.

   Standard couplings are Lovejoy Elastomeric Jaw couplings, type AL, with snap-wrap spiders or sox spiders.

   Flexible couplings can only absorb limited misalignment of the shafts.

   To check the coupling alignment use the following directions (refer to figure 1):

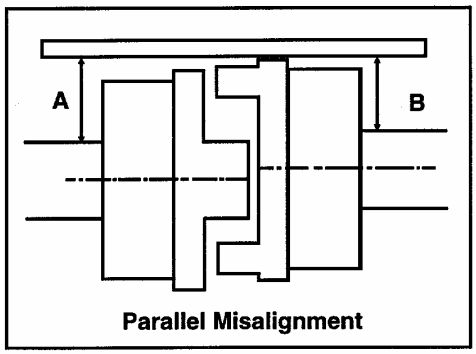
   a. **Parallel alignment** is checked with a straight edge across the outside of both coupling halves.

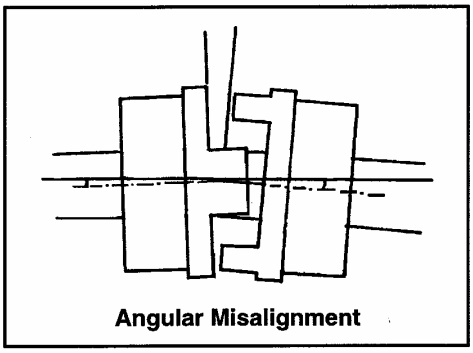
Measure distance A or B between the straight edge and both shafts. Repeat measuring at two locations 120 degrees apart on periphery of coupling. **DO NOT ROTATE COUPLING.** The difference between the three measurements for A and B must not exceed 0.005 inches at any of the positions.

b. **Angular alignment** is checked with a dial indicator. The coupling must be connected before checking angular alignment. Mount the dial indicator on one coupling half and take a reading from back of other coupling half. Rotate coupling hub. Record total indicator readings at ninety degree intervals. Total indicator readout (T.I.R.) must not exceed 0.015 inches between the four readings.

c. **Coupling gap dimensions** (dimension "C" on figure 1) are as follows:

- Coupling number AL-090 is 17/32 inch.
- Coupling number AL-100 is 3/4 inch.
- Coupling number AL-110 is 7/8 inch.





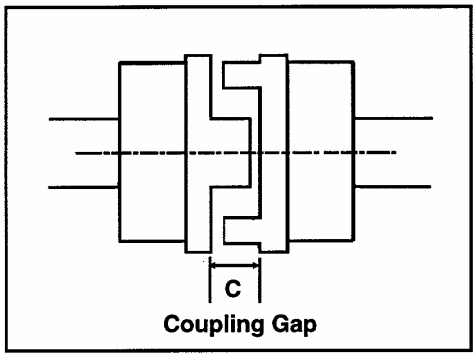


FIGURE 1. COUPLING ALIGNMENT

5. **DIRECTION OF ROTATION.** Before connecting the coupling halves, bump start driver and verify rotation is correct. On frame-mounted pumps, an arrow on the bearing frame indicates correct rotation. On closed-coupled pumps, an arrow on the backcover indicates correct rotation. The standard direction of rotation, viewed from the motor end is clockwise.
6. **COUPLING GUARD.** On frame-mounted pumps, place coupling guard over the coupling and bolt to base.

Check safety codes and always install protective guards or shields as required by various federal, state, or local laws and the regulations concerning OSHA.

7. **GROUTING.** When coupling alignment is correct and suction and discharge flanges are level, grout the unit using a high-grade, non-shrinking grout. Fill the entire base with grout. Check to make sure all gaps are filled.

NOTE

Allow the grout to fully cure before firmly tightening the foundation bolts.

8. **PIPING.**

CAUTION

Connect piping and gauge lines with pump in a freely supported state. Support all piping to avoid undue pipe strain or weight on the pump. Do NOT force piping. Do NOT use pump as an anchorage point for the piping. Pipe strain causes wear and/or damage to parts.

Take extreme care when connecting new piping lines to ensure no foreign matter such as dirt, chips, tools, etc., is in the piping, tank, or return piping. Debris drawn into the pump may cause excessive damage and imbalance.

Ensure discharge piping is one or two sizes larger than pump flange sizes, especially where piping is considerably long. Equip any flexible joints installed in the piping with tension rods to absorb piping axial thrust.

Check to make sure the suction pipe is air tight and sloped upward to pump flange to avoid air pockets, which will impair pump operation. Direct discharge pipe as close as possible using a minimum number of valves to reduce pipe friction losses.

Never use a straight taper (concentric) reducer in a horizontal suction line because air pockets may form in the top of the reducer and the pipe. Carver recommends using an offset (eccentric) reducer.

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

CAUTION

Never throttle pump with a valve in the suction line.

CAUTION

After all piping is connected, re-check coupling alignment.

9. **MOTOR.** Connect wiring to motor. Due to high voltage required to operate the pumping unit, familiarize personnel handling the equipment with electrical safety practices and modern methods of resuscitation. Refer to the motor manufacturer's specific instructions regarding installation, operation, and maintenance of the driver.
10. 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, for specific storage

requirements.
11. Connect electrical power supply to motor.
12. Open system valves.

IV. OPERATION.

A. PRE-START CAUTIONS.

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. Before starting the pump, fill casing and suction line with liquid. Prime the pump with an ejector or vacuum pump.
6. Before starting a mechanical seal pump equipped with external flush lines, turn on seal liquid, and confirm the seal liquid is at sufficient pressure.
7. If excessive vibration or noise occurs during operation, shut the pump down and consult a Carver representative.
8. Use a check valve in discharge piping if there is a high volume of reverse flow.
9. Check level in tank to ensure the pump is submerged in fluid.
10. Check to make sure fluid in pump is clean, clear, and free of debris.
11. 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, check the bearings and lubricant before operating the unit.
12. Reference Table A, Torque Values, to avoid equipment damage and injury to personnel.

Troubleshoot the aforementioned checks using Table 1, Troubleshooting, or contact your nearest Carver Pump Company representative.

B. PRIMING. Since the liquid pumped functions to lubricate various internal parts, dry running a centrifugal pump can result in extensive damage and possible seizing. Therefore, it is imperative the pump is primed prior to initial start-up. Maintain prime through subsequent start-stop cycles.

The priming procedure is different for positive and negative suction head systems. Follow the procedures below for the different systems:

Positive Suction Head:

1. Open vent on the highest point on the pump casing.
2. Open all suction valves.
3. Allow liquid to flow from vent hole until all air bubbles are vented. Then, close the vent.
4. The pump is now primed.

Negative Suction Head:

1. Install an ejector or vacuum pump on the vent at the highest point on the casing.
2. Close the discharge valve.
3. Open the suction valve.
4. Start the ejector or vacuum pump.
5. Allow liquid to flow until a continuous flow is exhausted from ejector. Close valve to the vent.
6. The pump is now primed.

C. 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, General Information, item E, Safety Precautions. Proceed with operation as follows:

1. Check to make sure personnel are not working on 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. If unit is equipped with seal cooling lines, turn on seal cooling liquid.
4. Open valves to pressure gauges in system.
5. Check pump for proper priming and lubrication.
6. 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.
7. Partially open discharge valve.
8. Start the pumping unit in accordance with the directions on the electrical power supply.
9. Slowly adjust discharge valve to operating conditions required. Refer to the pump nameplate for design point condition.
10. Pumping unit is now in full operation.

D. STOPPING THE PUMP. Stop the pump using the following procedure:

1. If pump is stopped for overhaul, slowly close 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. If unit is equipped with seal cooling lines, turn off external cooling liquid line to seal.
5. 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

V. TROUBLESHOOTING.

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

Table 1. Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Motor will not start.	• No input power.	• Check connections to electrical power source. Check fuses or circuit breakers. Check terminals at source of power input.
	• Improper voltage.	• Check voltage at motor terminals.
	• Motor overload.	• Refer to “Overload on motor”.
	• Mechanical obstruction that prevents rotor from turning.	• Examine and clean pumping unit thoroughly. Check for bearing failure or bent shaft.
Motor overheats.	• Motor overload.	• Refer to “Overload on motor”.
	• Improper voltage.	• Check voltage at motor terminals.
	• Obstruction in ventilation.	• Check ventilation opening of motor. Keep clear of obstructions at all times.
	• Insufficient cooling medium.	• Check ambient temperature. Motor temperature should not exceed ambient temperature plus the rated temperature increase of the unit.
	• Overgreased motor bearings.	• Remove lubricant from bearing chamber until the proper amount of grease is in chamber.
	• Improper use of motor grease.	• Remove grease and replace with grease and grease amount recommended by motor manufacturer.
Failure to deliver fluid.	• Pump not primed.	• Prime pump in accordance with section IV, Operation, item B, Priming.
	• Discharge valve closed.	• Check discharge valve.
	• Discharge head above shutoff.	• Consult with nearest Carver Pump Company representative or factory.
	• Suction lift higher than pump rating.	• Consult with nearest Carver Pump Company representative or factory.
	• Impeller or suction pipe clogged.	• Inspect and clean impeller and suction pipe.
	• Wrong direction of rotation.	• Check power connection to motor.
	• Liquid level in tank too low.	• Add liquid to system.
	• Suction strainer is plugged.	• Clean suction strainer.

Table 1. Troubleshooting (cont.)

SYMPTOM	PROBABLE CAUSE	REMEDY
Reduced capacity and/or pressure (cont).	• Damaged impeller. • Impeller or suction pipe partially clogged. • Suction pipe too close to bottom of tank. • Liquid level in tank too low. • Total head too high. • Wrong rotation. • Air leak in suction piping, seal housing, or gaskets. • Speed too low. • Semi-open impeller running clearance too large. • Enclosed impeller clearance between suction cover or wear ring is too large. • Suction strainer is plugged. • Incorrect impeller diameter.	• Replace impeller. • Inspect and clean impeller and suction pipe. • Reduce length of pipe. • Add liquid to system. • Consult with nearest Carver Pump Company representative or factory. • Check power connections to motor. • Search for, locate, and isolate air leak and repair. • Consult with nearest Carver Pump Company representative or factory. • Check semi-open impeller clearance in accordance with section VII, item E, Assembly of Pump, step 15. • Check enclosed impeller clearance in accordance with section VII, item D, Parts Inspection. • Clean suction strainer. • Trim impeller diameter in accordance with conditions set on pump nameplate.
Pump surges.	• Liquid level in tank too low.	• Add liquid to system.
Pump loses prime after starting.	• Suction lift is over six feet. • Liquid level in tank too low.	• Check with vacuum gauge. • Add liquid to system.
Overload on motor.	• Head lower than that for which pump is designed. • Mechanical defects of pump or motor such as bent shaft, binding or rubbing rotating element.	• Consult with nearest Carver Pump Company representative or factory. • Replace defective parts or replace pump or motor.

Table 1. Troubleshooting (cont.)

SYMPTOM	PROBABLE CAUSE	REMEDY
Overload on motor (cont).	• Liquid handled of higher specific gravity or lower viscosity than intended application. • Incorrect impeller diameter.	• Consult with nearest Carver Pump Company representative or factory. • Trim impeller diameter in accordance with conditions set on performance curve.
Insulation failure.	• Oil or water soaked windings. • Improper voltage.	• Return motor to the motor manufacturer. • Check voltage at motor terminals.
Excessive leakage around seal housing or stuffing box.	• Faulty mechanical seal. • Improper adjustments.	• Replace mechanical seal in accordance with the procedures set forth in section VII, Service and Repair, item E, Assembly of Pump. • Check and adjust. Repair and replace, as necessary.
Operation at incorrect speed.	• Improper line voltage or frequency. • Overload. • Motor electrical problem.	• Check line voltage. Ensure voltage meets requirements set forth on motor nameplate data. • Check nameplate rating. • Check motor for loose or open connections.

VI. MAINTENANCE.

Generally, the pumps do not need continuous supervision. Occasional visual checks are recommended. Data should be recorded for each pump to keep track of performed maintenance and to note operational problems. The record, "Notes on Inspection and Repairs," is provided for this purpose at the front of this manual.

A. FIELD INSPECTION. Shutdown is not required. Perform field inspection at regular intervals and use 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 power input and speed of driver.
3. Check and record pumping temperatures.
4. Check pump for quiet running.
5. If mechanical seal option is on pump, check seal housing for leakage. When first starting the pumping unit, check the area around the seal housing for leakage. Minor leakage through the seal usually stops after a short time. If leakage continues and there is more than 5 drops per minute at the seal housing, replace mechanical seal with new seal. To replace or install new parts, disassemble the pump in accordance with section VII, Service and Repair, items A and B, and assemble pump in accordance with section VII, item E, Assembly of Pump.

B. BEARING LUBRICATION. Lubrication frequency depends on operating conditions. Normal duty calls for lubrication every 1000 hours of operation. Bearings are lubricated at Carver Pump Company with Amoco Rykon Premium Grease No. 2EP, a non-soap, polyurea thickened grease with a drop point of 450 degrees Fahrenheit. This grease was selected due to its suitability to extreme pressures and its high temperature stability.

CAUTION

Do NOT 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, Service and Repair. 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, rinse in a clean, light mineral solvent and agitate 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 good quality ball bearing grease.

Bearing Lubrication

To lubricate bearings, use the following procedure:

CAUTION

Overgreasing creates heat and is the cause of many problems requiring repair. Do NOT overgrease. To prevent overgreasing, use a hand-operated grease gun.

1. Never lubricate pump bearings while operating unit. If necessary, shut down pump in accordance with section IV, Operation, item D, Stopping the Pump.

CAUTION

Do NOT lubricate bearings with a power grease gun.

2. Bearing temperature may rise above normal immediately after lubrication, but should stabilize within four and eight hours.
3. Using a hand-operated grease gun on fitting located on top of bearing frame, add approximately one ounce of fresh grease for each bearing. With most hand-operated grease guns, two or three pumps are enough. When installing new bearings, pack new bearings only half full with grease.

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 lubrication procedures outlined in this section.

VII. SERVICE AND REPAIR.

A. PREPARATIONS FOR DISASSEMBLY AND ASSEMBLY OF PUMP.

1. Read this entire section and study the applicable sectional drawing, figures 2 or 3, before disassembling the pump.
2. Stop pump in accordance with section IV, Operation. Disconnect, lock out, and tag electrical power supply to motor. Disconnect wiring from motor.
3. Shut off and tag all valves controlling flow of liquid to and from pump. Drain casing (1) by removing pipe plug from casing bottom. If necessary, flush pump to remove corrosive or toxic pumpage. Install pipe plug in casing once fluid has completely drained. Disconnect piping and gauges, as necessary.

If pumping unit is pumping hazardous fluid, take extreme care to ensure safety of personnel when draining pump. Use suitable protective devices and/or wear protective clothing.

NOTE

Prior to assembly, refer to the following paragraphs in this section: Parts Inspection (item D), and Wear Ring Replacement (item F).

During disassembly, mark parts to determine their proper location before beginning assembly. When removing capscrews, use socket or box-ended wrenches instead of open-ended wrenches. After prolonged operation, components may adhere to shaft. In such instances, use rust solvent and apply suitable extracting tools, wherever possible. Do NOT use force under any circumstances.

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

B. DISASSEMBLY OF PUMP. Disassemble the pumping unit using figures 2 or 3, and the following procedure:

1. Remove coupling guard and disconnect coupling from frame-mounted pump.

CAUTION

To lift pump and/or motor, use a two-man lift or suitable lifting device.

2. Disconnect tubing and tubing fittings, as necessary.
3. Unbolt bearing frame (19) or motor from base and move pumping unit to open working area.
4. Remove washer (645) and nut (615) from stud (630). Slide gland (17) towards slinger (40).
5. Remove capscrews (600) from backcover (11) and casing (1). On frame-mounted pumps, remove rotary assembly from casing and take to a suitable work area. On close-coupled pumps, remove rotary assembly along with motor and take the items to a suitable work area.
6. Remove impeller capscrew (26), impeller o-ring (89C), impeller washer (28), and impeller gasket (73X). The

best tool to remove impeller capscrew (26) is a hex wrench welded to a socket head.

CAUTION

Use extreme care handling impeller.

7. Remove impeller (2) from shaft. Remove 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 capscrews (601) from backcover (11) and adaptor (71). Remove backcover (11) from adaptor (71) and from shaft (6). Remove o-ring (89) from backcover (11).

NOTE

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

9. On pumps equipped with mechanical seal (90), remove seal spacer (68) and mechanical seal (90) from shaft sleeve (14) or (14A).
10. Remove shaft sleeve (14) or (14A), sleeve gasket (73), gland (17), and o-ring (89X) from shaft (6).
11. Remove slinger (40) from shaft (6).

C. DISASSEMBLY OF POWER FRAME ON FRAME-MOUNTED PUMPS.

1. Remove capscrews (605). Disconnect adaptor (71) from bearing frame (19).
2. Remove socket head bolt (608) from bearing cap (35). Remove bearing cap (35) from shaft (6). Remove shaft assembly from bearing frame (19).
3. Crimp tang on bearing lockwasher (69) and remove bearing locknut (22).
4. Remove bearings (16 and 18) from shaft.

D. PARTS INSPECTION.

NOTE

Mark or number each component while disassembling to ensure correct sequence. Remove or unscrew individual components, as necessary.

1. Clean all parts thoroughly or replace with new parts, as necessary. All sealing faces should be perfectly clean. Carver recommends replacing all grease seals, lip seals, oil seals, gaskets, glands, and o-rings. Additionally, replace any locking devices with a nylock feature 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.
4. Inspect bearings (16 and 18) for damage. Damaged bearings must be replaced. If bearings are removed from shaft, Carver recommends replacement of bearings. As bearings are removed from shaft, mark parts to determine correct location before beginning assembly. If bearing replacement is not possible and bearings are in good condition, clean and lubricate the bearings in accordance with section VI, item B, Bearing Lubrication. Provide appropriate protection for bearings until time of usage.
5. Check all shaft sleeve and spacer sleeve surfaces 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 or spacer sleeves if any marks, pits, or grooves are still visible. The shaft sleeve is slip-fitted to the shaft for easy removal.
6. Inspect for bent shaft (6) and replace shaft, if necessary. Shaft threads should be in good condition. Bearing seats must be in perfect condition.
7. If impeller (2) shows excessive wear due to abrasion or corrosion, and

performance cannot be restored, impeller must be replaced. If new impellers are installed, make sure all impellers are balanced.

8. If the suction cover on an open impeller pump shows excessive wear on the face due to abrasion or corrosion, and performance cannot be restored, replace suction cover.
9. Inspect and replace any defective grease fittings.
10. If a closed impeller pump is equipped with optional suction cover wear ring, check the clearance as follows:
    a. Measure outside diameter of front impeller hub in three places. Refer to Table 2, Enclosed Impeller Clearance.
    b. Measure inside diameter of wear ring in three places.
    c. If difference between high reading of inside diameter of wear ring and low reading of outside diameter of impeller hub exceeds double the maximum clearances given in Table 2, replace wear ring in accordance with section VII, Service and Repair, item F, Replacement of Optional Wear Ring on Pumps Equipped with Closed Impellers. Refer to Table 2 for factory wear ring clearance.
11. Inspect mechanical seal faces and seal spacer. They must be in perfect condition. Replace, as necessary.

Table 2. Enclosed Impeller Clearance

Ordering Code (refer to Figure A)	Pump Size	Front Wear Ring Clearance (inches)	Back Wear Ring Clearance (inches)
BA	1-1/4 X 1 X 7	.012/.016	N/A
BB	1-1/2 X 1-1/4 X 7	.014/.018	N/A
BC	2-1/2 X 2 X 7	.012/.016	N/A
BD	3 X 2-1/2 X 7	.014/.018	N/A
BE	4 X 3 X 7	.014/.018	.012/.016
BF	5 X 4 X 7	.015/.020	.012/.016
CA	1-1/2 X 1-1/4 X 10	.011/.014	N/A
CB	2 X 1-1/2 X 10	.012/.016	N/A
CC	2-1/2 X 2 X 10	.012/.016	N/A
CD	3 X 2-1/2 X 10	.012/.016	.012/.016
CE	4 X 3 X 10	.012/.016	.012/.016
CF	5 X 4 X 10	.012/.016	.012/.016
CG	6 X 5 X 10	.021/.026	.021/.026
DA	2 X 1 X 11	.012/.015	.012/.015
DB	4 X 2 X 11	.016/.020	.016/.020
DC	4 X 3 X 11	.016/.020	.016/.020
DD	5 X 4 X 11	.016/.020	.016/.020
DE	8 X 6 X 11	.019/.023	.019/.023
EA	2-1/2 X 1-1/2 X 13	.020/.023	N/A
EB	2-1/2 X 2 X 13	.020/.024	.020/.024
EC	3 X 2-1/2 X 13	.016/.020	.014/.018
ED	4 X 3 X 13	.017/.020	.014/.018
EE	5 X 4 X 13	.018/.022	.014/.018
EF	6 X 5 X 13	.017/.021	.014/.018
EG	8 X 6 X 13 (frame-mounted only)	.019/.022	.014/.018

E. ASSEMBLY OF PUMP. Use figures 2 and 3, and the following procedure to assemble the pumping unit.

NOTE

Replace bearing (16 or 18), once removed from shaft (6). If ball bearing replacement is not possible and bearing is in good condition, clean bearing in accordance with section VI, Maintenance, item B, Bearing Lubrication.

1. On frame-mounted pumps, press bearings (16 and 18) on each end of shaft (6) with open sides of bearings facing bearing caps (35 and 37). Hand pack bearings half full with proper grease in accordance with section VI, Maintenance, item B, Bearing Lubrication. Install bearing lockwasher (69) and bearing locknut (22) on inboard end of shaft. Crimp tang of bearing lockwasher (69) in one of grooves provided in bearing locknut (22).
2. Install shaft (6) into bearing frame (19).
3. On frame-mounted pumps, install bearing cap (35) on bearing frame (19) and secure with capscrews (608). Tighten capscrews evenly.
4. Lubricate pump by inserting grease into grease zerks (76).
5. On frame-mounted pumps, reconnect adaptor (71) to bearing frame (19) with capscrews (605).

NOTE

Do NOT tighten bearing adaptor capscrews (605) in bearing adaptor (71) until pump is completely assembled.

6. Install slinger (40) on shaft next to adaptor (71). Install o-ring (89X) on shaft (6).
7. Place gland (17) on shaft (6) next to slinger (40).
8. Lubricate outside of shaft sleeve (14) or (14A) to facilitate mounting of mechanical seal (90). Install mechanical seal (90) on shaft sleeve (14) or (14A). Install shaft sleeve (14) or (14A) with mechanical seal (90) on shaft (6). Install seal spacer (68) on shaft sleeve (14) or (14A).
9. Install sleeve gasket (73).
10. Install backcover (11) on adaptor (71) and secure with capscrews (601).

NOTE

On pumps equipped with a closed impeller, omit steps 14 through 15b. Steps 14 through 15b are procedures that describe impeller clearance adjustment for semi-open impellers only.

CAUTION

During performance of steps 14 through 15b, use old impeller capscrew (26) to secure impeller (2). Once proper impeller clearance is achieved, use a new impeller capscrew (26) to secure impeller (2).

CAUTION

During assembly, install new impeller capscrew (26) with locktite.

11. Install impeller (2), impeller washer (28), and impeller gasket (73X) on shaft and secure with impeller capscrew (26) and impeller o-ring (89C).

CAUTION

Use a two-man lift or suitable lifting device to lift pumping unit, motor, or assemblies.

12. Install o-ring (89) on backcover (11). Install casing (1) to backcover (11) with capscrews (600).
13. Using appropriate leveling tools, level casing. Tighten capscrews (601), (605), and (600).
14. Install suction cover (9) to casing (1). Do NOT install o-ring (89A) or shims (15).
15. There must be a clearance of 0.010 inches minimum and 0.020 inches maximum between open impeller (2) and suction cover (9). To check clearance, rotate shaft by hand and listen for any rubbing noise.

    If rubbing noises are present, the clearance between impeller and suction cover is less than 0.010 inches. To remedy this:

    a. Remove capscrews (611). Remove suction cover (9).

b. Install new shim (15) on suction cover.
c. Install suction cover (9), securing with capscrews (611).
d. Repeat step 15 until the proper clearance is achieved.

16. After proper clearance is achieved or impeller is enclosed, install o-ring (89A) on suction cover (9). Tighten capscrews (611).
17. Position gland (17) next to backcover (11) and secure with washers (645) and bolts (630) and nuts (615).
18. Install tubing and tubing fittings, as necessary.

CAUTION

Use a two-man lift or suitable lifting device to lift pumping unit, motor, or assemblies.

19. Return pumping unit to installation site. Install pumping unit on its base and secure to base with foundation bolts.
20. On frame-mounted pumps, align coupling in accordance with section III, Installation, item 4, Coupling Alignment. Reconnect coupling. Install coupling guard.
21. Reconnect piping and gauges, as necessary. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
22. Start pumping unit in accordance with section IV, Operation.

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMPS EQUIPPED WITH CLOSED IMPELLERS. If your pump is equipped with a closed impeller, it may have an optional, replaceable wear ring (7 and 7X) in suction cover (9) or casing (1). If your pump is equipped with the optional wear ring (7 and 7X), use Tables 3 and 4, figures 2 and 3, and the following instructions for wear ring replacement.

Table 3. Impeller and Wear Ring Matching Materials

IMPELLER MATERIAL	WEAR RING MATERIAL
Cast iron	Cast iron (suction head)
Bronze	Cast iron (suction head)
Stainless steel	17-4PH Stainless steel

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

Usually, the wear ring material is matched to the impeller, as listed in Table 3.

To replace wear ring, follow the disassembly procedures in section VII, Service and Repair, item B, Disassembly of Pump, to the step where the casing or suction cover has been removed and the wear ring is accessible. Refer to section VII, Service and Repair, item D, Parts Inspection, for allowable clearances. Once wear ring is accessible, reference figures 2 and 3, and use the following procedure:

1. Lock out and tag power to driver.
2. Shut off all valves controlling flow of liquid to and from pump. Drain pump casing (1) by removing pipe plug from casing bottom. If necessary, flush pump to remove corrosive or toxic pumpage. Install plug when fluid has completely drained.
3. Disconnect piping and gauges, as necessary.
4. Remove capscrews (611), which fasten suction cover (9) to casing (1). Carefully remove shim (15) and move suction cover straight out, so as not to damage impeller (2) hub.
5. Remove impeller capscrew (26), o-ring (89C), impeller washer (28), and impeller gasket (73X). The best tool to remove impeller capscrew (26) is a hex wrench welded to a socket head. Remove impeller from shaft. Remove impeller key (32).
6. Take suction cover and impeller to a work area with access to machine shop equipment.
7. Remove wear ring (7 and 7X) from suction cover (9). This can be best

accomplished on a lathe.

8. Inspect impeller hub for damage.
9. Press new wear ring (7 and 7X) into suction cover (9). Beveled edge of wear ring is installed toward impeller.
10. Place impeller (2) on an arbor and mount between centers in a lathe or a grinder. Indicate back of impeller hub to within 0.002 T.I.R. maximum to ensure that arbor and impeller (2) are running square.
11. Turn wearing surface of impeller (2) until a 63 RMS or better finish is obtained.
12. Measure outside diameter of front impeller hub and record the value.
13. Mount suction cover (9) with new wear ring (7 and 7X) installed in a lathe. Indicate male rabbet to within 0.002 T.I.R. maximum.
14. Bore wear ring to within specified tolerance listed in Table 2, over recorded size of outside diameter of front impeller hub.

CAUTION

During assembly, install new impeller capscrew (26) with locktite.

15. Install impeller (2), impeller washer (28), and impeller gasket (73X) on shaft and secure with new impeller capscrew (26) and new impeller o-ring (89C).
16. Install shim (15) on suction cover. Install suction cover (9) and secure to casing with capscrews (611).
17. Reconnect piping and gauges, as necessary.
18. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
19. Start pumping unit in accordance with Section IV, Operation.

VIII. PARTS LISTS AND SECTIONAL DRAWINGS.

Refer to Table 4 for a list of recommended spare parts for GH pumps. Refer to Table 5 for the complete parts listing for frame-mounted and close-coupled pumps. For the location of all parts referenced in Tables 4 and 5, refer to the appropriate sectional drawing, figures 2 and 3.

Table 4. Recommended Spare Parts List

QUANTITY	PART #	DESCRIPTION
1	2	Impeller
1	6	Shaft
1	7	Wear Ring for Casing (optional)
1	7X	Wear Ring for Backcover
1	14, 14A	Shaft Sleeve
As required *	15	Suction Cover Shims for Semi-Open Impeller
1	16	Radial Bearing
1	18	Thrust Bearing
1	22	Bearing Locknut
1	26	Impeller Capscrew
1	28	Impeller Washer
1	32	Impeller Key
1	46	Coupling Key
1	69	Bearing Lockwasher
1	73	Sleeve Gasket
1	73X	Impeller Gasket
1	89	O-ring – Backcover
1	89A	O-ring – Suction Cover
1	89C	O-ring - Impeller
2	89X	O-ring – Shaft sleeve
1	90	Mechanical Seal

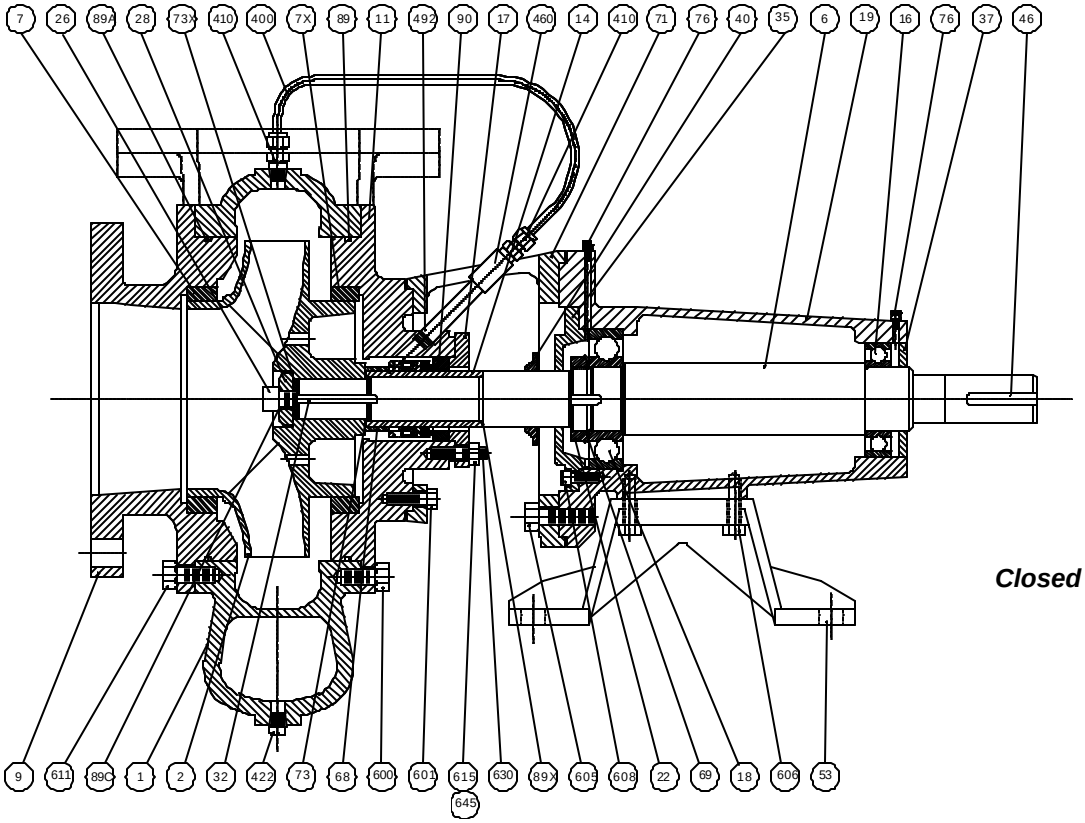
* present only on semi-open impellers

Table 5. Parts List for General Horizontal (GH) Pumps (Frame-Mounted and Close-Coupled)

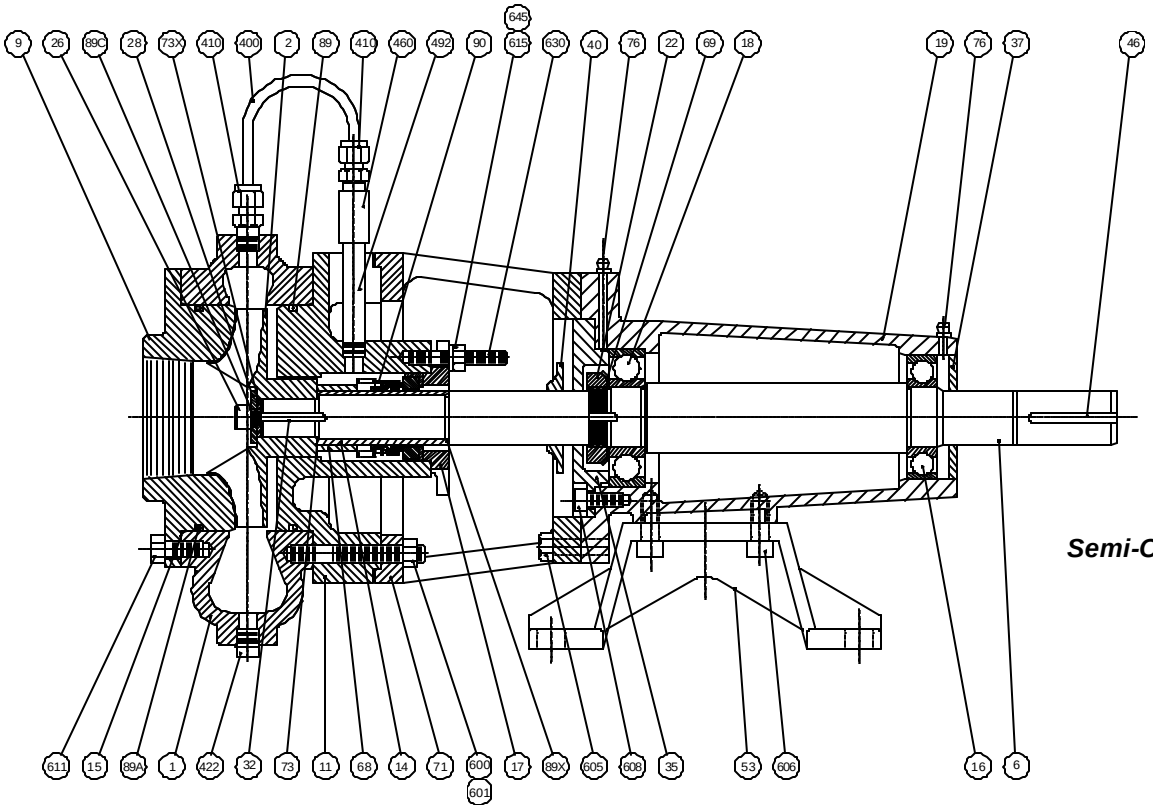
PART #	PART DESCRIPTION	PART #	PART DESCRIPTION
1	Casing	71	Motor Adaptor
2	Impeller	73	Sleeve Gasket
6	Shaft	73X	Impeller Gasket
7	Wear Ring	76	Grease Zerk *
7X	Backcover Wear Ring	89	O-ring – Backcover
9	Suction Cover	89A	O-ring – Suction Cover
11	Backcover	89C	O-ring – Impeller
14, 14A	Shaft Sleeve	89X	O-ring – Shaft Sleeve
15	Suction Cover Shim	90	Mechanical Seal
17	Gland, Mechanical Seal	400	Piping (optional)
16	Radial Bearing	410	Male Connectors (optional)
18	Thrust Bearing	422	Pipe Plug – Casing
19	Bearing Frame	423	Pipe Plug – Stuffing Box (optional)
22	Bearing Locknut	460	Pipe Coupling (optional)
26	Impeller Capscrew	492	Pipe Nipple (optional)
28	Impeller Washer	600	Capscrew – Casing / Box
32	Impeller Key	601	Capscrew – Bracket / Box
35	Bearing Cap – Inboard	605	Capscrew – Bracket / Frame
37	Bearing Cap – Outboard *	606	Capscrew – Foot / Frame
40	Slinger	608	Socket Head Bolt – Bearing Cap
46	Coupling Key	611	Capscrew – Cover / Casing
53	Frame Foot	615	Nut – Gland
68	Seal Spacer – Mechanical Seal	630	Stud – Gland
69	Bearing Lockwasher	645	Washer – Gland

* Non-Replaceable

item 15 – only present on semi-open impellers
item 423 – only present if recirculation line does NOT exist

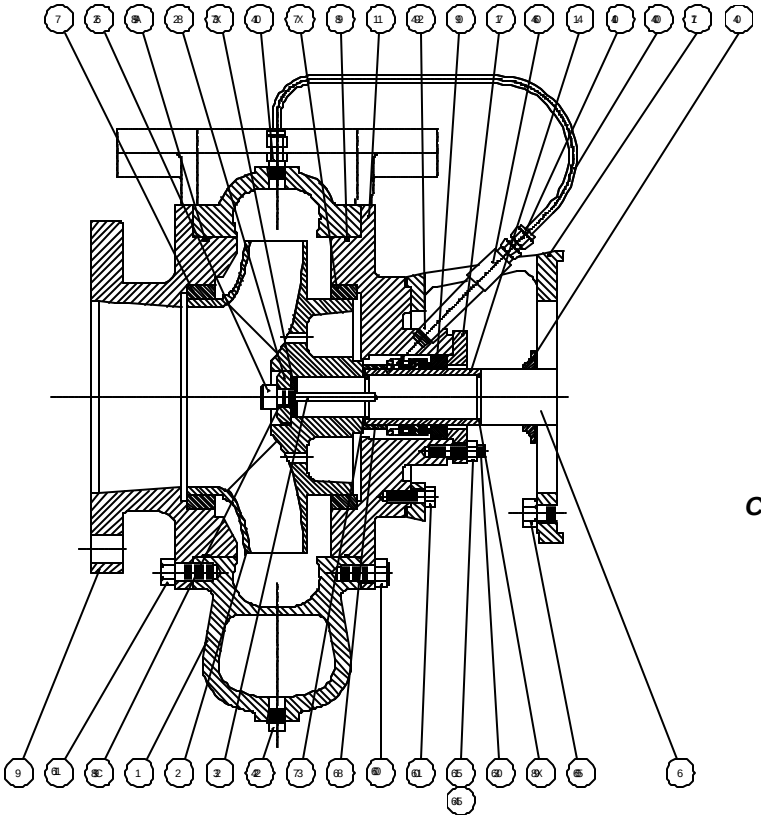


Closed Impeller

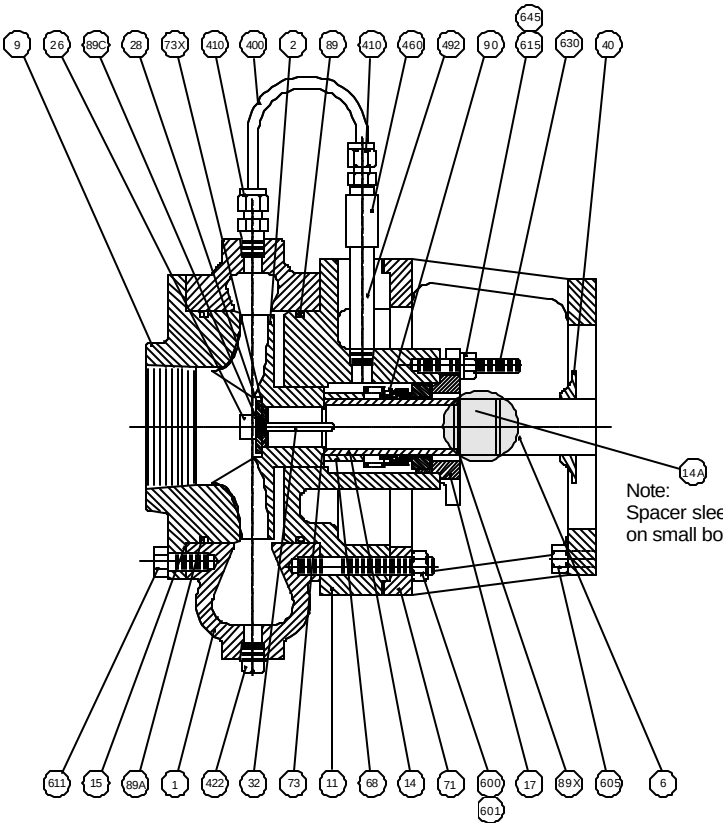


Semi-Open Impeller

Figure 2. Sectional Drawings for Frame-Mounted GH Pump



Closed Impeller



Semi-Open Impeller

Note:
Spacer sleeves (14A) are
on small bore pumps only.

Figure 3. Sectional Drawings for Close-Coupled GH Pump

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