Installation, Operation, and Maintenance Instructions for Carver LHT Top Pullout Vertical Pumps

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I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

A. Preface.

The instructions contained in this manual apply to Carver Pump Company LHT top pullout vertical pumps. The pumps are designed for industrial service and are offered in eighteen different models, sizes 1-1/2" to 10" and with capacities from 10 to 6,000 gpm with maximum heads to 210 feet. All wetted surfaces are available in bronze fitted, all iron, stainless fitted, and stainless steel construction. The top pullout design provides fast, easy access to all working parts without disconnecting pipes.

B. General Description.

The LHT pump consists of the following major parts (refer to figure 1 for location of parts followed by an item number):

Casing. The casing (1) houses the impeller (2) and consists of the suction inlet, discharge volute, and discharge nozzle. The casing (1) is secured to the lower casing support (53A) with capscrews (181).

Impeller. The LHT pump can be equipped with a semi-open impeller or with an enclosed impeller. The impeller (2) is keyed to the shaft (6) by the impeller key (32) and is locked in place by the impeller washer (28) and socket head capscrew (26).

Backhead. The backhead (11) has provisions for the o-ring (73) and throat bushing (63). The o-ring (73) prevents pumped fluid from entering the column assembly. The locking ring (17) holds the throat bushing (63) in place and is secured to the backhead (11) with capscrews (189). The throat bushing (63) is secured to the locking ring (17) with setscrews (190). The backhead (11) is secured to the lower column (101A) with capscrews (187).

Columns and Casing Supports. The lower and upper columns (101A and 101) and lower and upper casing supports (53A and 53) register and space the casing (1) in respect to the baseplate (23). The lower column (101A) and upper column (101) are secured with capscrews and hex nuts (188). The lower casing support (53A) and upper casing support (53) are also secured with capscrews and hex

nuts (182). The upper column (101) is secured to the upper casing support (53) with hex nuts on studs (184). The upper casing support (53) is secured to the baseplate (23) with capscrews (183).

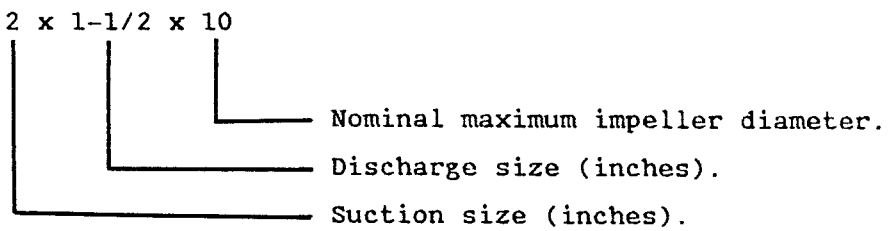
Shaft. A coupling connects the pump shaft (6) to the motor shaft. The coupling is keyed to the pump shaft and the motor shaft.

Bearing Housing. The bearing housing (19) contains the radial bearing (16), bearing cartridge (37), thrust bearing (18), and bearing retainer (176). The bearing housing (19) is secured to the upper column (101) with capscrews (186) and to the intermediate bracket (71) with capscrews and hex nuts (185). The thrust bearing (18) is housed in the bearing cartridge (37), and is held in place by the bearing retainer (176), bearing lockwasher, (69) and bearing locknut (66). The bearing cartridge (37) is secured to the bearing housing (19) with hex nuts on studs (180). Both the thrust bearing (18) and the radial bearing (16) are grease lubricated.

Discharge Pipe. The discharge pipe (105) is secured to the casing (1) with capscrews and hex nuts. For pumps with impeller diameters of 7 or 10 inches and discharge sizes of 2 inches and smaller, a close nipple and companion flange are also used to secure the discharge pipe (105) to the casing (1).

C. Pump Identification.

Use the following example for identifying information about your pump model number.



D. Nameplate.

A nameplate is attached to each pump. The data on this nameplate should be recorded and filed for easy reference. Nameplate data should be furnished to Carver Pump Company or its representative when ordering spare parts or requesting information.

E. Safety Precautions.

This manual contains descriptions and instructions which are the result of carefully conducted engineering and research efforts. The manual is designed to provide adequate instructions for the safe and efficient installation, operation, or maintenance of your pump. Failure or neglect to properly install, operate, or maintain your pump may result in personal injury, property damage, or unnecessary damage to the pump.

Variations exist in both the equipment used with these pumps and in particular installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual. The manual contains general rules for installation, operation, and maintenance of the pump.

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

CAUTION

IMPORTANT SAFETY NOTICE

The installation, use, and operation of this type of equipment is affected by various federal, state, and local laws and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of 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.

II. INSPECTION AND STORAGE.

A. Inspection.

Upon receipt of the shipment, unpack and inspect the pump, driver assemblies, 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 "damaged 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.

Rotate the shaft for several revolutions at least once every two weeks to coat the bearing with lubricant, retard oxidation and corrosion, and prevent flat spots on ball bearings.

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 operation cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

NOTE

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

III. INSTALLATION.

A. Location.

The pump and driver should be located in an area that will permit periodic inspection and maintenance. Head room and access should be provided. The pump should always be submerged enough to prevent vortexes from forming which might allow air to enter the suction.

B. Handling.

WARNING

Do not pick up the complete unit by the driver or discharge pipe or eye bolts.

An adequate hoist with ample capacity to handle the weight of the unit must be used. Always work safely.

In picking up the LHT pump from a horizontal position, place the straps so as to distribute the load while pump is brought to a vertical position.

In lifting a vertical mounted unit out of a tank, screw a lifting eye into the tapped hole at the bearing frame end of the shaft (6) or use a strap through the intermediate bracket (71).The individual driver may be lifted using the proper eye bolts provided by the manufacturer, but these should not be used to lift the assembled unit.

C. Master Plate.

Lower the unit onto the master plate, positioning the baseplate so the anchor bolts are aligned in the middle of the holes in the master plate. In place, the unit should hang freely, supported by the baseplate which should have even contact to prevent movement or distortion.

The baseplate may be supported directly on concrete or steel structure directly under the baseplate.

D. Coupling Gap.

The coupling gap is determined by the size of the coupling. Carver LHT pumps use three standard sizes with the size markings on the hub:

Table 1. Coupling Gap Dimensions

Coupling No.	Gap
AL-90	17/32"
AL-100	3/4"
AL-110	7/8"

Standard couplings are Lovejoy Elastomeric Jaw Couplings, type AL (with snap-wrap spiders).

E. Direction of Rotation.

Before connecting the coupling halves, bump start the driver and verify rotation is in the proper direction. The correct pump rotation is indicated by a directional arrow on the pump casing. The standard direction of rotation, viewed from the motor end, is clockwise.

F. Coupling Guard.

Place coupling guard over intermediate bracket and bolt sections together.

WARNING

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

G. Piping.

CAUTION

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 discharge connection.

All piping should be independently supported near the pump so that a minimum of pipe strain will be transmitted to the pump casing. To reduce head loss, use of oversize piping is recommended whenever possible.

Install a check valve and a control valve in discharge line and a control valve in suction line. The check valve helps protect pump from water hammer and prevents reverse rotation. Reverse rotation should be avoided because it can damage the pump. Causes of reverse rotation include failure to close control valve in discharge line when pump is shut down and the event of power failure. Operators should be alert to prevent reverse rotation. Control valves are used in priming, starting, and pump shut down. **During pump operation, pump**

must never be throttled by the use of a valve or other restriction in the suction line to achieve operating design condition.

H. Motor.

See motor manufacturer's instructions.

IV. OPERATION.

A. Prestart Cautions.

1. Before starting or operating the pump, read this entire manual, especially the following instructions.
2. Before starting the pump, install closed guards around all exposed rotating parts.
3. Before starting the pump, rotate the unit or assembly by hand to assure all moving parts are free.
4. Observe all caution or danger tags attached to the equipment.
5. Never run the pump dry because the close running fits within the pump are lubricated by the fluid being pumped. Dry running may result in pump seizure.
6. If excessive vibration or noise occurs during operation, shut the pump down and consult a Carver representative.

B. Priming.

Since the liquid being pumped is used to lubricate various internal parts, 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.

To prime pump, casing (1) must be completely submerged in liquid.

C. Starting the Pump.

1. Check level in tank to see that the pump is submerged in fluid.
2. Partially open discharge valve.
3. Start the pump.

4. Slowly open discharge valve and adjust it to the operating conditions required (see pump nameplate for design point condition).

D. Operating Checks.

1. Check for undue vibration or noise. If any occurs and does not stop within a short time, turn off the pump. For determination of the cause and its remedy refer to the Troubleshooting section or consult Carver Pump Company.
2. Check and record discharge pressure gauge reading.
3. Check and record ball bearing temperature. It should not exceed 180 degrees F.
4. Check and record amperage input to driver.
5. Observe, measure, and record the above data frequently during the first few days, weeks, and months of operation.

E. Stopping the Pump.

1. Stop motor.
2. Close discharge valve.

F. Indefinite Shutdown.

Relubricate bearings. Provide pump and motor with protective cover. Drain tank, casing, and all piping if there is a possibility of liquid freezing.

V. OPERATING PROBLEM TROUBLESHOOTING.

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 use the following check list to eliminate the most common causes of those problems.

Table 2. Pumping Unit Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Motor will not start.	1. No input power.	1. Check connections to motor controller at controller and in terminal box. Check fuses or circuit breakers in controller cabinet or in input circuit. Check terminals at source of power input.
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Motor overloaded.	3. Check current and compare with nameplate rating. If current exceeds that shown on rating, motor is overloaded.
	4. Mechanical obstruction that prevents rotor from turning.	4. Examine and clean pumping unit thoroughly. Check for bearing failure. Check for bent shaft.
Motor overheats.	1. Motor is overloaded.	1. Check current and compare with nameplate rating. If current exceeds that shown on rating, motor is overloaded.
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Obstruction in ventilation.	3. Check ventilation opening of motor. Keep clear of obstructions at all times.
	4. Insufficient cooling medium.	4. Check room temperature. Temperature should not exceed ambient temperature plus the rated temperature rise of the unit.
	5. Overgreased bearings.	5. Remove lubricant from bearing chamber until the proper amount of grease is in chamber.
	6. Improper grease.	6. Remove grease and replace with grease recommended by motor manufacturer.
Failure to deliver liquid.	1. Discharge head above shutoff.	1. Check pump rating against actual head condition.
	2. Impeller or suction inlet partially clogged.	2. Inspect impeller and suction inlet and clean.
	3. Pump not up to speed.	3. Check voltage and power consumption for motor overload. Refer to "Overload on Motor".
	4. Fluid level too low to prime pump.	4. Add fluid to system.

Table 2. Pumping Unit Troubleshooting (continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive power consumption.	1. Speed too high.	1. Check voltage and power consumption and compare with nameplate data.
	2. Head lower than rating; pumps too much liquid.	2. Consult with nearest Carver Pump representative or factory.
	3. Specific gravity or viscosity of liquid pumped is too high.	3. Consult with nearest Carver Pump representative or factory.
	4. Mechanical defects such as bent shaft or rotating element that binds.	4. Replace defective parts or replace pump or motor.
	5. System head lower than design condition.	5. Consult with nearest Carver Pump representative or factory.
	6. Incorrect impeller diameter.	6. Replace impeller.
Insufficient discharge or flow.	1. Fluid level too low to prime pump.	1. Add fluid to system.
	2. Speed too low.	2. Check driver.
	3. Discharge head too high.	3. Consult with nearest Carver Pump representative or factory.
	4. Suction inlet partially clogged.	4. Inspect, clean, and repair as necessary.
	5. Wrong direction of rotation.	5. Check power connection to motor.
	6. Impeller passage partially clogged.	6. Inspect, clean, and repair as necessary.
	7. Impeller damaged.	7. Replace impeller.
	8. Impeller running clearance too large.	8. Check impeller clearance according to section VII, paragraph B.
	9. Impeller diameter too small.	9. Replace impeller.
	10. Suction inlet too close to bottom of tank.	10. Raise pump so that suction inlet is 2 times the suction size from bottom of tank. For instance, if suction size is 2 inches, suction inlet should be at least 4 inches from bottom of tank.
Pump surges.	1. Not enough liquid in system.	1. Add liquid to system.
Loss of suction during operation.	1. Wrong direction of rotation.	1. Check power connection to motor.
	2. Fluid level too low.	2. Add fluid to system.

Table 2. Pumping Unit Troubleshooting (continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Motor insulation failure.	1. Oil soaked windings.	1. Disassemble the motor according to manufacturer's instructions, clean and dry motor windings.
	2. Water soaked windings.	2. Disassemble the motor according to manufacturer's instructions, clean and dry motor windings.
	3. Excessive vibration.	3. Refer to "Vibration or noise."
	4. Wrong voltage.	4. Check terminal voltage with nameplate data.
Vibration or noise.	1. Foundation bolts loose.	1. Tighten foundation bolts.
	2. Insufficient or insecure foundation.	2. Enlarge the foundation or relocate pumping unit so it can be firmly bolted to its foundation.
	3. Ball bearings have insufficient lubrication.	3. Lubricate bearings according to section VI, paragraph C.
	4. Mechanical defects, such as worn ball bearings, bent shaft, or rotating element that binds.	4. Replace defective parts or replace pump or motor.
	5. Head lower than rating; pumps too much liquid.	5. Consult with nearest Carver Pump representative or factory.
	6. Pipe strain - improperly aligned or supported piping.	6. Check piping alignment and remove piping weight from pump with proper supports.
	7. Pump running at shut-off condition.	7. Consult with nearest Carver Pump representative or factory.
	8. Suction inlet too close to bottom of tank.	8. Raise pump so that suction inlet is 2 times the suction size from bottom of tank. For instance, if suction size is 2 inches, suction inlet should be at least 4 inches from bottom of tank.
Overheating - bearings.	1. Excessive grease.	1. Remove excess grease.
	2. Bent shaft.	2. Replace shaft.
	3. Rotating element binds.	3. Replace defective parts.
	4. Pipe strain.	4. Check piping alignment and remove piping weight from pump with proper supports.
	5. Incorrect type grease.	5. Refer to section VI for proper maintenance of bearings.

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 maintenance which has been performed and to note operational problems. A maintenance record is provided for this purpose at the back of this manual.

A. Field Inspection.

Shutdown is not required. Perform field inspection at regular intervals and cover the following procedures:

1. Check the discharge pressure gauge reading.
3. Check pump for quiet running.

B. Check Bearing Temperature.

Bearings may appear to run hot when pump is first started.

This is often caused by grease seals, not the bearing. When seals are seated, temperature should drop to normal. Do not "test" temperature by hand. Temperature that "feels" hot varies from 120 to 160 degrees F.

Bearing temperatures up to 160 degrees F are normal depending an ambient temperature but should not run hotter than 180 degrees F.

Check temperatures by placing contact-type thermometer against bearing housing. A sudden temperature rise indicates damage that requires checking.

C. Grease Lubrication of Pump Ball Bearings.

The ball bearings are lubricated at Carver Pump Company with Amoco Rykon Premium Grease No. 2EP, a nonsoap, polyurea thickened grease with a drop point of 450 degrees F. This grease was selected because of its suitability to extreme pressures and its high temperature stability. Never mix greases with differing properties.

Polyurea base greases are **NOT** compatible with lithium or soda soap base greases so the type of grease added should not vary. If greases of differing

properties are mixed, the grease will dissolve, causing the bearings to overheat. Extensive damage to the pump could result. However, if it is necessary to change grease type, thrust bearing, radial bearing, bearing cartridge, and bearing housing should be thoroughly cleaned and flushed with suitable solvent to remove all traces of old grease as follows:

1. Place bearings, bearing cartridge, and bearing housing 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 cartridge, and bearing housing should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
3. Dip bearings in clean, light oil and spin by hand to determine that all foreign matter has been removed.
4. After cleaning, repack bearings half full on both sides with a good quality ball bearing grease.

D. To Relubricate Ball Bearing.

1. Lubrication frequency depends on operating conditions. Normal duty calls for relubrication every 3000 hours of operation.

CAUTION

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

2. Refer to paragraph C in this section for type of grease. To lube ball bearings, fit grease gun on grease fitting and add one to two ounces of grease. Repeat for each bearing.

NOTE

A hand-operated grease gun is preferable to a power grease gun. Use of a power grease gun could result in over greasing and damage to the grease seals.

3. Bearing temperature may rise above normal immediately after lubrication, but should stabilize within 4 to 8 hours.

4. Never relubricate bearings while pump is running.

E. Lubrication - Driver.

See manufacturer's special instructions to be sure driver bearings are properly lubricated.

VII. SERVICE AND REPAIR.

A. Preparations for Service or Repair of Pump.

1. Read this entire section and study figure 1 before proceeding.
2. Lock out and tag the power to the driver.
3. Shut off and tag all valves controlling the flow of liquid to the tank and from the pump. If necessary, flush pump to remove corrosive or toxic pumpage.

B. Adjusting Impeller Clearance (for pumps equipped with open impellers).

To adjust impeller clearance on a pump equipped with an open impeller, follow this procedure:

1. Lock out and tag the power to the driver. Remove coupling guard.
2. Disconnect coupling by removing snap-wrap spider to prevent binding or loading on coupling.
3. Loosen hex nuts on studs (180). Loosen jacking capscrews (12A).
4. Rotate shaft (6) by hand until impeller (2) just rubs casing (1).
5. Measure the gap between the bearing cartridge (37) and bearing housing (19). Tighten jacking capscrews (12A) evenly until gap measures between .010 inches and .015 inches over original reading.
6. Evenly tighten hex nuts on studs (180).

NOTE

Shaft setting should be checked again after pump is reinstalled and before restarting pump. Clearance should be between .010 inches and .015 inches over original measurement of gap.

5. Recheck coupling gap and adjust if necessary. Reconnect coupling.
6. Replace the coupling guard.

C. Pump Disassembly.

The top pullout design of this pump allows the shaft and impeller to be removed without disconnecting the piping or casing. Jacking screws for ease of separation and a center of gravity lifting device for easy lifting are provided.

During disassembly, mark parts so that they can be fit exactly as before during reassembly. When removing capscrews, use a socket assembly instead of open-ended wrenches. After extended operation, it may be difficult to separate some components. Rust solvent may be used and suitable extricating tools where possible. Do not use metal-headed hammers; use only those with plastic or rubber heads.

After disassembly, all parts should be thoroughly cleaned or replaced by new ones if necessary. Sealing faces should be perfectly clean. It is recommended that all grease seals, o-rings, bearings, and locking devices with a nylock feature be used only once. When a pump is disassembled after extended service, the gaskets between the flange faces should be replaced.

During disassembly, refer to figure 1 for location of parts followed by an item number.

1. Disconnect, lock out, and tag electrical power supply to motor. Disconnect wiring from motor.
2. Shut off and tag all valves controlling the flow of liquid to the tank and from the pump. If necessary, flush pump to remove corrosive or toxic pumpage.
3. Remove coupling guard. Disconnect coupling.

CAUTION

The use of a hoist with adequate capacity is recommended.

4. Hoist motor and motor coupling half away from pump and rest on plywood or heavy cardboard.
5. Screw lifting eye into the tapped hole located at coupling end of pump shaft or place a strap through intermediate bracket (71). Attach hoisting equipment to lifting eye or strap.
6. Remove nuts from studs (184) securing upper column (101) to upper casing support (53). If upper column (101) will not detach easily from upper casing support (53), use jacking screws (12) provided in column to separate upper column (101) from upper casing support (53). Back off jacking screws.
7. Hoist rotating element and remove to a work area. Lower rotating element so it stands in a vertical position resting on the intermediate bracket (71). Detach hoisting equipment.
8. Remove socket head capscrew (26) from end of shaft (6). Remove impeller washer (28). Pull or pry impeller (2) from shaft (6). Remove impeller key (32) from either impeller (2) or shaft (6).
9. Remove o-ring (73) from backhead (11).
10. Remove capscrews (187) securing backhead (11) to lower column (101A). Remove backhead (11)/locking ring (17)/throat bushing (63) assembly.
11. If throat bushing (63) needs to be replaced, remove capscrews (189) securing locking ring (17) to backhead (11). Remove socket head setscrews (190) securing throat bushing (63) to locking ring (17). Remove locking ring (17). Position backhead so screwdriver or similar tool may be used to push throat bushing (63) out through locking ring end of backhead (11).
12. Place a strap through upper column (101) and hoist rotating element. Lower rotating element so it stands in a vertical position resting on the lower column (101A).
13. Remove capscrews (185) securing intermediate bracket (71) to bearing housing (19). Remove intermediate bracket (71) from bearing housing (19).
14. Remove pump coupling half. Remove coupling key (46) from either coupling or shaft (6).
15. Remove nuts and studs (180) securing bearing cartridge (37) to bearing housing (19). Use jacking screws (12A) to loosen rabbet fit of bearing cartridge (37) and bearing housing (19).
16. Force shaft (6) out through coupling end of the bearing housing (19). The bearings (16 and 18) and bearing cartridge (37) will remain on shaft (6).

17. Remove bearing retainer (176) from bearing cartridge (37). Let retainer (176) rest on shaft. Pull bearing cartridge (37) from shaft (6).
18. Uncrimp bearing lockwasher (69) and remove bearing locknut (66) and lockwasher (69).
19. Using a puller, remove thrust bearing (18) from coupling end of shaft (6). Remove radial bearing (16) from shaft (6). Remove bearing retainer (176) from shaft (6).
20. Loosen capscrews (186) securing bearing housing (19) to upper column (101). Remove bearing housing (19).
21. Remove grease seal (47) from bearing housing (19) and discard. Remove grease seal (47) from upper column (101) and discard.

D. Parts Inspection.

1. Inspect bearings for damage and replace if necessary. If dirty, flush with clean kerosene or carbon tetrachloride, dry, and coat with machine oil. Protect until ready for use.
2. Inspect for bent shaft and replace shaft (6) if necessary.
3. If the impeller (2) shows excessive wear due to abrasion or corrosion so performance cannot be restored, it must be replaced.
4. Inspect throat bushing (63), grease seals (47), and o-ring (73). They must be in perfect condition. Replace if necessary.
5. Inspect and replace any defective grease fittings (76).

E. Pump Reassembly.

During reassembly, replace all parts known to be damaged or worn with new. Replace all seals and gaskets with new. If bearings are not to be replaced, they should be cleaned according to section VI, paragraph C. Thoroughly wash and clean all reusable parts. To reassemble the pump, use the following procedures:

1. If casing was removed, reinstall casing and reconnect piping.
2. Install new grease seal (47) in bearing housing (19). Install bearing retainer (176) on shaft (6) between two bearing seats.
3. Install new radial bearing (16) and new thrust bearing (18) on shaft (6). Bearings (16 and 18) may be pressed onto shaft (6) or heated so they will slide onto shaft (6). Pack bearings half full with grease. Refer to

section VI, paragraph C for proper grease type. Reinstall bearing lockwasher (69) and bearing locknut (66). Recrimp lockwasher (69).

4. Reinstall bearing cartridge (37) over thrust bearing (18). Reinstall bearing retainer (176) on bearing cartridge (37).
5. Set wet end of shaft (6) in through bearing frame end of bearing housing (19). Install shaft (6), bearings (16 and 18), and bearing cartridge (37) through bearing housing (19) by applying force to bearing frame end of shaft (6).
6. Secure bearing cartridge (37) to bearing housing (19) with hex nuts and studs (180). Tighten capscrews (180) by hand only, leaving a slight gap between bearing cartridge (37) and bearing housing (19) so impeller vanes won't be damaged when rotating element is reinstalled in casing (1).
7. Reinstall coupling key (46) in keyway of shaft (6). Install pump coupling half.
8. Reinstall intermediate bracket (71). Secure to bearing housing (19) with nuts on capscrews (185).
9. Install new grease seal (47) in upper column (101). Reinstall upper and lower columns (101 and 101A). Secure upper column (101) to bearing housing (19) with capscrews (186).
10. If throat bushing (63) was removed, press new throat bushing (63) into backhead (11). Reinstall locking ring (17), securing it to backhead (11) with capscrews (189). Drill and tap new holes for setscrews (190) in locking ring (17). Install setscrews (190).
11. Reinstall backhead (11) and secure to lower column (101A) with capscrews (187).
12. Install new o-ring (73) on backhead (11).

CAUTION

Use a new impeller capscrew (26) during reassembly. Impeller capscrew (26) has a nylock feature. Once used, impeller capscrew (26) may not provide adequate security.

12. Reinstall impeller key (32) in shaft (6). Reinstall impeller (2) and impeller washer (28). Secure to end of shaft (6) with new capscrew (26). Do not use old capscrew as impeller damage could result.

13. Install lifting eye into end tap. Attach hoisting equipment to lifting eye and return rotating element to pump.
14. Slowly lower rotating element into casing (1). Do not force rotating element. If installed correctly, it will slide in easily. Secure upper column (101) to upper casing support (53) with nuts on studs (184).
15. Detach hoisting equipment and remove lifting eye from end tap.
16. Hoist motor, motor coupling half, and intermediate bracket (71) onto pump. Secure intermediate bracket (71) to bearing housing (19) with hex nuts on capscrews (185).
17. If pump is equipped with an open impeller, adjust impeller clearance according to paragraph B in this section.

    If pump is equipped with an enclosed impeller, no impeller clearance is needed if impeller (2) does not contact casing (1) when rotating element is lowered into casing (1). Evenly tighten hex nuts on studs (180).

    If pump is equipped with an enclosed impeller and impeller (2) bumps casing (1) when rotating element is reinstalled, follow this procedure to adjust impeller clearance:
    a. Measure the gap between the bearing cartridge (37) and bearing (19).
    b. Tighten jacking capscrews (12A) evenly until gap measures 0.125 inches over original reading.
    c. Evenly tighten hex nuts on studs.
18. Connect coupling. Attach coupling guard.
19. Relubricate bearings according to section VI, paragraphs C and D.
20. Reconnect wiring to motor. Remove tags from electrical power supply. Unlock and connect electrical power supply to motor.
21. Remove tags from system valves. Open all system valves.
22. Start pump in accordance with section IV.

F. Parts Inventory Guide.

Spare parts should be kept on hand to avoid maintenance delays.

For every one to three pumps keep in stock one spare parts set, as listed in Table 3.

Table 3. Recommended Spare Parts for LHT Pump

QTY	ITEM NO.	DESCRIPTION
1	2	Impeller
1	16	Radial bearing
1	18	Thrust bearing
1	26	Impeller capscrew
1	28	Impeller washer
1	32	Impeller key
1	46	Coupling key
2	47	Grease seal
1	63	Throat bushing
1	66	Bearing locknut
1	69	Bearing lockwasher
1	73	O-ring

G. Parts Ordering.

When ordering parts from Carver Pump Company, prompt accurate service will be provided if you include the following information:

1. Serial number of pump (on nameplate).
2. Part name (from parts list Section VIII).
3. Part number (on the exploded view drawing).
4. Quantity of parts needed.

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

If an impeller is ordered, specify diameter across blade tips to be sure there was not further trim on diameter than shown on Carver Pump Company's records. If a motor or motor parts are ordered, specify the name of the driver manufacturer and all data on the driver nameplate.

VIII. DRAWING AND PARTS LIST.

Refer to table 4 for the parts list of the LHT pump. Refer to figure 1 for an sectional view drawing of the LHT pump. Part numbers in parts list match part numbers in figure 1.

Table 4. LHT Pump Parts List

ITEM NO.	QUANTITY	DESCRIPTION
1	1	Casing
2	1	Impeller
6	1	Shaft
11	1	Backhead
12	4	Jacking capscrew, upper column
12A	4	Jacking capscrew, bearing cartridge
16	1	Radial bearing
17	1	Locking ring
18	1	Thrust bearing
19	1	Bearing housing
23	1	Baseplate
26	1	Impeller capscrew
28	1	Impeller washer
32	1	Impeller key
37	1	Bearing cartridge
46	1	Coupling key
47	2	Grease seal
53	1	Upper casing support
53A	1	Lower casing support
63	1	Throat bushing
66	1	Bearing locknut
69	1	Bearing lockwasher
73	1	O-ring
76	2	Grease fittings
101	1	Upper column
101A	1	Lower column
105	2 or 3*	Flange (1-1/2" x 150# slip-on), discharge pipe
	1, if required**	Flange (1-1/2" NPT x 150#), discharge pipe
	1, if required#	Close nipple, discharge pipe
	1	90 degree elbow, discharge pipe
	1	Pipe, discharge pipe
	1	Pipe, discharge pipe
	1 or 2##	Gasket, discharge pipe
	4	Capscrew, discharge pipe to casing
	4	Hex nut, discharge pipe to casing
	4	Stud, discharge pipe to baseplate
	4	Hex nut, discharge pipe to baseplate
176	1	Retaining ring
180	4	Stud and hex nut, bearing cartridge to bearing housing
181	8	Capscrew, upper casing support to casing
182	8	Capscrew and nut, lower casing support to upper casing support
183	8	Capscrew, baseplate to upper casing support
184	8	Hex nut and stud, upper column to upper casing support
186	4	Capscrew, bearing housing to upper column

Table 4. LHT Pump Parts List (continued)

ITEM NO.	QUANTITY	DESCRIPTION
187	4	Capscrew, backhead to lower column
188	4	Hex nut and capscrew, upper column to lower column
189	2	Capscrew, locking ring to backhead
190	2	Socket head capscrew, locking ring to throat bushing

*All iron models, all sizes, have 2 slip-on flanges. Stainless steel models, all sizes, have 3 slip-on flanges.
**Models with 13" impellers aren't equipped with a threaded flange.
#Models with 13" impellers aren't equipped with a close nipple.
##All iron models, all sizes, have 2 gaskets. Stainless steel models, all sizes, have 2 gaskets.

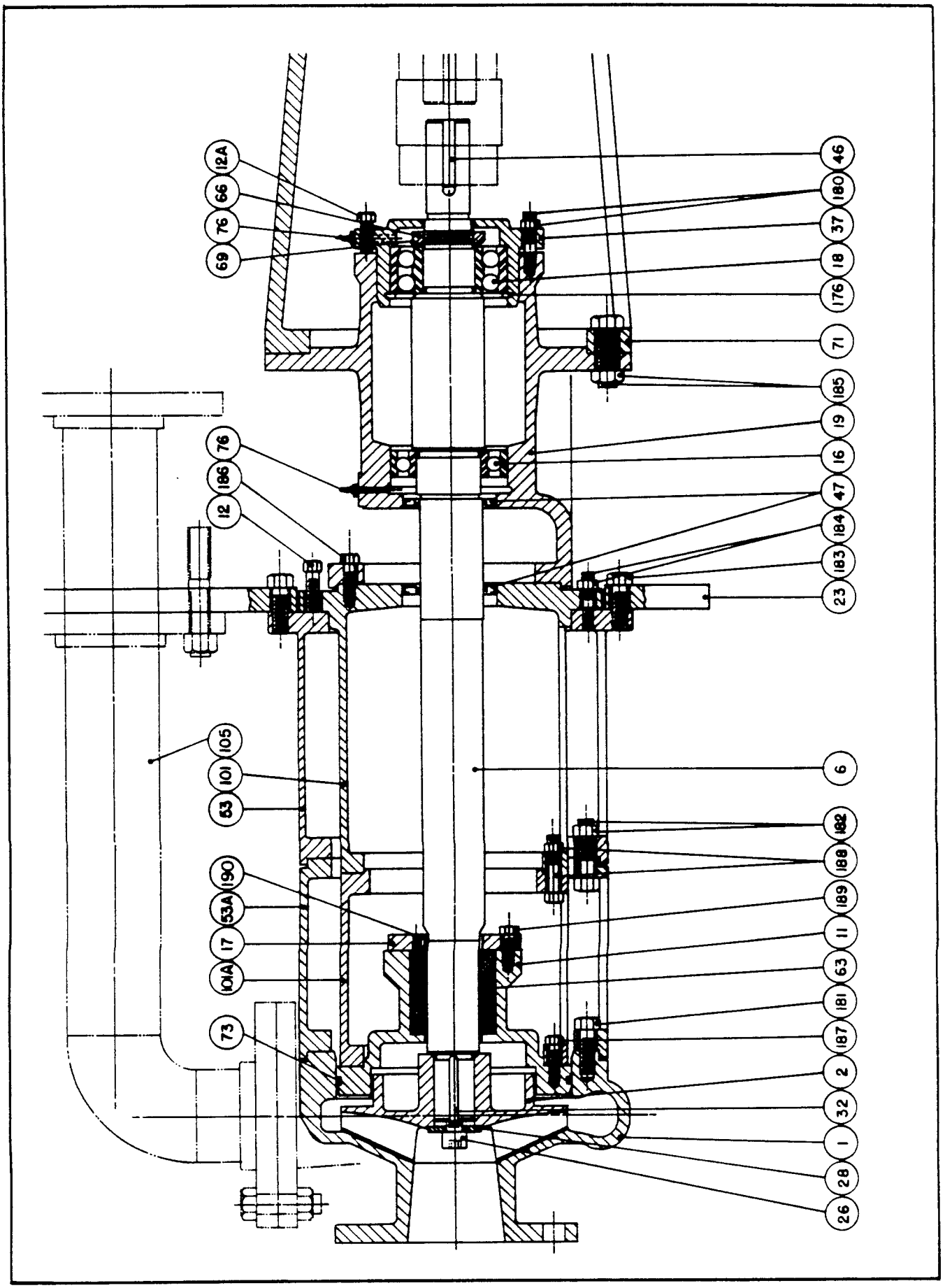


FIGURE 1. SECTIONAL ASSEMBLY DIAGRAM (OPEN IMPELLER)

APPENDIX 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