Carver®
Creating Value.

Instruction I-190a
For units with 3 piece casings.

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS FOR LHS VERTICAL SUMP PUMPS

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ISO 9001 CERTIFIED

I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

A. GENERAL DESCRIPTION. This manual contains general rules for installation, operation, and maintenance of the LHS Vertical Sump Pump. The information as presented should improve your knowledge and understanding of the LHS Vertical Sump Pump, thus upgrading the quality of pump maintenance and care. Variations exist in pumps, equipment used with these pumps, and in installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual.

The LHS Vertical Sump Pump consists of the following major parts. Refer to figure 2 for location of parts followed by an item number.

Suction Cover. The suction cover (04) provides access to the inner casing (01) and impeller (02). The suction cover (04) is bolted to the casing (01) by capscrews (27). On pumps with an enclosed impeller (02) an available option is a renewable wear ring (05) is pressed into the suction cover (04). A suction strainer (155) is attached to the suction cover (04) to keep large pieces of debris from entering pump.

Casing. The casing (01) houses the impeller (02) and consists of the discharge volute and discharge flange. The casing (01) is bolted to the backcover (11) by capscrews (600).

Backcover. The backcover (11) is connected to the casing (01) with capscrews (600) and to the adaptor flange (417) by studs (186), nuts (187), and washers (110). The o-ring (89A) is mounted in an o-ring groove located on the outer perimeter of the backcover (11).

Impeller. The pumps are equipped with semi-open or enclosed impellers (02). Impeller adjusting capscrews (344) are provided to allow control of impeller-to-casing clearance without disassembling the pump. The impeller (02) is keyed to the shaft by impeller key (28) and locked in place by impeller washer (17) and impeller capscrew (18).

Shaft. The oversize, heavy-duty shaft (07) is manufactured from high-strength steel. If column is over 10 feet long, shaft is a two-piece assembly connected by a shaft coupling (10A) and tapered pins (10B). The pump shaft (07) is connected to the motor shaft by a snap-wrap spider coupling (434).

Slinger. The heavy-duty, renewable slinger (81) provides the shaft (07) rigid support close to the impeller radial loading area for long bearing and shaft life. The slinger (81) also rotates with shaft, preventing pumped fluid from entering the column assembly and lineshaft bearing housing (99).

Lineshaft Bearing. The renewable carbon lineshaft bearings (50) can be grease lubricated or lubricated by external source of compatible liquid. The lineshaft bearings (50) are housed in the bearing housings (99) and are spaced along the shaft (07) at four-foot maximum intervals to eliminate shaft criticals.

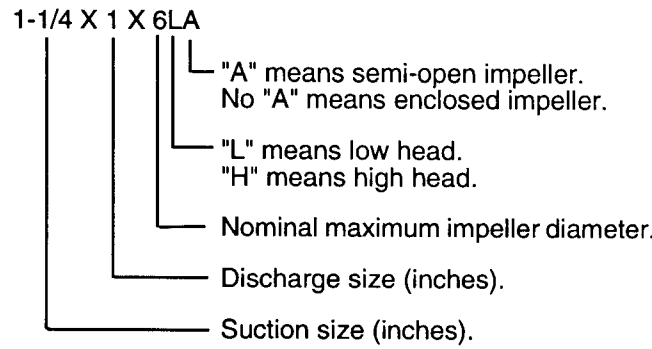
Flanged Column. The flanged columns (337) register and space the casing (01) in respect to the baseplate (36). These columns (337) also support the lineshaft bearing assemblies. The flanged columns (337) are connected to each other by lockwashers (340) and nuts (339) on capscrews (338) and to flange column thrust plate (06) by lockwashers (343) and capscrews (342).

Vapor Seal. The vapor seal (43A) is an available option used to protect ball bearings (51) from noxious fumes emitted from the sump pit. The vapor seal is a mechanical seal consisting of a stationary element, rotating element, and locking collar. The stationary element fits into the seal adaptor (43B). The seal adaptor (43B) fits into the bearing adapter (14). The rotating element is locked in place on the shaft (7A) by the locking collar.

Ball Bearing. An oversize, double row, angular contact ball bearing (51) is housed in the bearing adaptor (14) and are locked in place by a bearing lockwasher (111) and locknut (183). The ball bearing (51) is either grease or oil lubricated.

Motor Bracket. The motor bracket (03) consists of two machined faces which register and space the motor in respect to the baseplate (36). The motor bracket (03) is positioned by a rabbet fit on the baseplate (36) and on the motor. The motor bracket (03) is connected to the baseplate (36) and the flanged column thrust plate (06) with nuts (42) on capscrews (41).

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



C. 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.

D. 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 prop-

erly install, operate, or maintain your pump may result in personal injury, property damage, or unnecessary damage to 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. Sump pumps are shipped assembled, less accessories. 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 vibration, 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 possible false brinelling.

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.

Pump should always be submerged enough to prevent extreme vortexes from forming which might allow air to enter the suction.

B. HANDLING.

WARNING

To lift pumping unit, a hoist or suitable lifting device must be used. Do not pick up the complete unit by the driver or discharge pipe or eye capscrews.

In picking up the vertical sump pump, place the slings so as to distribute the load and not allow a shift or slip as it is being brought to a vertical position.

Vertical mounted units may be lifted by using a sling through the motor high ring base, or by the eye capscrews when provided in the pump casing. The individual driver may be lifted using the proper eye capscrews 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 capscrews 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 sump pumps use three standard sizes with the size markings on the hub. For coupling gap, refer to table 1.

Table 1. Coupling Gap

Coupling No.	AL-090	AL-100	AL-110
Gap in Inches	17/32	3/4	7/8

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

Literature from the manufacturer can be furnished upon request.

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 fan end of motor, is clockwise.

F. COUPLING GUARD. Place coupling guard over motor bracket and capscrew 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 connections.

All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pump casing. The discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. Any flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust.

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

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

H. AUXILIARY PIPING CONNECTIONS AND GAUGES. In addition to the primary piping connections, your pump may require other connections to a discharge gauge or flushing connection. All these lines and gauges should now be installed.

I. OIL LUBRICATION. Your pump may be equipped with an oiler for the ball bearings. If so equipped, the oiler should now be filled.

J. MOTOR. See motor manufacturer instructions.

IV. OPERATION.

A. PRESTART CAUTIONS.

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.
3. Before starting the pump, install closed guards around all exposed rotating parts.
4. Before starting the pump, rotate the unit or assembly by hand to assure all moving parts are free.
5. Never run the pump dry because the close running fits within the pump are water lubricated. 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.

C. STARTING THE PUMP. The pumping unit will operate without operator intervention once system valves have been adjusted to specified pumping conditions. Proceed with operation as follows:

1. Make sure no one is working on the pumping unit.
2. If the pumping unit has been idle for a period of time, make sure unit is firmly attached to its foundation.
3. Check to see if pump is equipped with external flush lines to keep corrosive or abrasive fluids from the shaft. If equipped with external flush lines, turn on flush and/or quench fluid.
4. Open valves to pressure gauges in system.

CAUTION

Check level of liquid in tank to be sure pump is under liquid level.

5. Jog starter switch on motor to check the direction of rotation. Direction of rotation is clockwise from fan end of motor.
6. Partially open discharge valve.
7. Start the pumping unit in accordance with the directions on the electrical power supply.
8. Slowly open discharge valve and adjust it to operating condition required (see pump nameplate for design point condition).
9. Pumping unit is now in full operation.

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 section V.
2. Check and record differential head. Add the suction lift and discharge column losses to the discharge gauge reading, all converted to feet.

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. If pump is being stopped for overhaul, slowly close the discharge valve. Otherwise leave discharge valve set at condition.
2. Stop the pumping unit in accordance with the directions on the electrical power supply.
3. If the pump is being stopped for overhaul, close pressure gauge valves.
4. Close external flushing line to shaft bearings, if so equipped.
5. The pumping unit is now in the off position.

F. INDEFINITE SHUTDOWN.

1. Lubricate bearings.

CAUTION

When pump is handling hazardous fluid, extreme care must be taken to ensure safety of personnel when attempting to drain pump. Suitable protective devices should be used and/or protective clothing should be worn.

2. Drain sump, casing, and all piping if there is a possibility of liquid freezing.
3. Provide pump and motor with a protective cover.

V. TROUBLESHOOTING OPERATING PROBLEMS.

The pump should provide reliable service and long life if the installation and starting procedures outlined in this manual are followed. If operating problems do occur, refer to table 2 to eliminate some of the most common causes of those problems.

Table 2. Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Motor will not start.	1. No input power.	1. Check connections to electrical power source. Check fuses or circuit breakers. Check terminals at source of power input.
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Motor overload.	3. Refer to "Overload on motor".
	4. Mechanical obstruction that prevents rotor from turning.	4. Examine and clean pumping unit thoroughly. Check for bearing failure or bent shaft.
Motor overheats.	1. Motor overload.	1. Refer to "Overload on motor".
	2. Improper voltage.	2. Check voltage at motor terminals.
	3. Obstruction in ventilation.	3. Check ventilation opening of motor. Keep clear of obstructions at all times.
	4. Insufficient cooling medium.	4. Check ambient temperature. Motor temperature should not exceed ambient temperature plus the rated temperature increase of the unit.
	5. Overgreased motor bearings.	5. Remove lubricant from bearing chamber until the proper amount of grease is in chamber.
	6. Improper motor grease.	6. Remove grease and replace with grease recommended by motor manufacturer.

Table 2. Troubleshooting - (Contd)

SYMPTOM	PROBABLE CAUSE	REMEDY
Failure to deliver liquid.	1. Discharge valve closed.	1. Check discharge valve.
	2. Discharge head above shutoff.	2. Consult with nearest Carver Pump Company representative or factory.
	3. Impeller or suction clogged.	3. Inspect and clean impeller and suction pipe.
	4. Wrong rotation.	4. Check power connection to motor.
	5. Liquid level in tank too low.	5. Add liquid to system.
	6. Suction strainer is plugged.	6. Clean suction strainer.
Reduced capacity and/or pressure.	1. Discharge valve closed.	1. Check discharge valve.
	2. Damaged impeller.	2. Replace impeller.
	3. Impeller or suction pipe partially clogged.	3. Inspect and clean impeller and suction pipe.
	4. Suction pipe too close to bottom of tank.	4. Reduce length of pipe.
	5. Liquid level in tank too low.	5. Add liquid to system.
	6. Total head too high.	6. Consult with nearest Carver Pump Company representative or factory.
	7. Wrong rotation.	7. Check power connections to motor.
	8. Speed too low.	8. Consult with nearest Carver Pump Company representative or factory.
	9. Semi-open impeller running clearance too large.	9. Adjust semi-open impeller clearance according to section VII, paragraph B.
	10. Enclosed impeller clearance between suction cover or wear ring, if equipped is too large.	10. Check enclosed impeller clearance according to section VII, paragraph E, step 6.
	11. Suction strainer is plugged.	11. Clean suction strainer.
Pump surges.	1. Liquid level in tank too low.	1. Add liquid to system.
Pump loses prime after starting.	1. Suction lift over six feet.	1. Check with vacuum gauge.
	2. Liquid level in tank too low.	2. Add liquid to system.
Overload on motor.	1. Head lower than that for which pump is designed.	1. Consult with nearest Carver Pump Company representative or factory.
	2. Mechanical defects of pump or motor such as bent shaft, binding or rubbing rotating element.	2. Replace defective parts or replace pump or motor.
	3. Liquid handled of higher specific gravity or lower viscosity than intended application.	3. Consult with nearest Carver Pump Company representative or factory.

Table 1. Troubleshooting - (Contd)

SYMPTOM	PROBABLE CAUSE	REMEDY
Insulation failure.	1. Oil or water soaked windings.	1. Disassemble motor; clean and dry windings.
	2. Excessive vibration.	2. Refer to "Vibrates or is noisy".
	3. Wrong voltage.	3. Check voltage at motor terminals.
Vibrates or is noisy.	1. Insufficient or insecure foundation.	1. Enlarge foundation or relocate pumping unit so it can be firmly bolted to foundation.
	2. Mechanical defects of pump or motor such as bent shaft, binding rotating element, or warped impeller.	2. Replace defective parts or replace pump or motor.
	3. Foreign matter in pump.	3. Disassemble pump; clean and replace damaged parts.
	4. Strain due to piping or improper piping supports.	4. Check piping alignment and remove piping weight from pump with proper supports.
	5. Damaged bearings.	5. Replace bearings.
	6. Insufficient bearing lubrication.	6. Lubricate bearings according to section VI, paragraphs C, D, E, or F.
Rapid wear of coupling spider.	1. Bent shaft.	1. Replace shaft.
Bearing overheating.	1. Excessive oil or grease.	1. Remove excess oil or 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 oil or grease.	5. Refer to section VI, paragraphs C, D, E, or F, for proper maintenance of bearings.
	6. Contaminated oil or grease.	6. Change oil or grease according to section VI, paragraphs C, D, E, or F.
	7. Not enough oil or grease.	7. Add oil or grease according to section VI, paragraphs C, D, E, or F.

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 sheet 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 proceed as follows:

1. Check the suction lift and discharge pressure to establish differential head. Calculate the discharge piping losses and add to the differential head to obtain the total dynamic head (TDH), which should conform to that stamped on the pump nameplate. Note the discharge pressure gauge reading will not be the same as pump nameplate value especially in long sump pumps.
2. Check amperage input and speed of driver.
3. Check pump for quiet running.

B. CHECK BEARING TEMPERATURE. The ball bearing 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 150 degrees F.

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

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

C. GREASE LUBRICATION OF PUMP BALL BEARING. If the ball bearing is grease lubricated, it is 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 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. Therefore, the type of grease added should not vary. However, if it is necessary to change grease type, ball bearing, bearing housing, and bearing cover should be thoroughly cleaned and flushed with suitable solvent to remove all traces of old grease as follows:

NOTE

It is recommended that ball bearing (51) removed from the shaft be replaced. If ball bearing replacement is not possible and bearing is in good condition, bearing should be cleaned as follows:

1. Place bearing, bearing adaptor, and bearing cap 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 bearing, bearing adaptor, and bearing cap 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 bearing half full on both sides with a good quality ball bearing grease.

D. TO RELUBRICATE BALL BEARING WITH GREASE.

1. Lubrication frequency depends on operating conditions. Relubricate every 3000 operating hours for normal duty or once a year.

CAUTION

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

2. Bearing temperature may rise above normal immediately after lubrication, but should stabilize within 4 to 8 hours.
3. Never relubricate the pump while running.
4. To lube ball bearing, remove plug on one side of cap and use grease gun on fitting on other side filling until fresh grease flows on opposite side.

E. OIL LUBRICATION OF PUMP BALL BEARING. The purpose of the oiler is to maintain a constant supply of lubricant to the ball bearing and the vapor seal, if equipped. Use SAE-20 nondetergent oil.

1. Turn and remove the plastic oil reservoir.
2. Fill the bearing chamber.
3. Fill the plastic oil reservoir. Invert the reservoir holding a finger over the outlet and quickly install.

F. GREASE LUBRICATION OF LINESHAFT BEARINGS. Lubricate the lineshaft bearings at fittings on baseplate near the discharge pipe. Use the same grease and lubricate at the same time as the ball bearing.

G. LUBRICATION OF DRIVER. See manufacturer's special instructions to be sure driver bearings are properly lubricated.

H. VAPOR SEAL. In normal service, the shaft is usually not sealed at the baseplate. Sealing is desired to protect the ball bearing against noxious fumes. The vapor seal is lubricated by the oiler described in section VI, paragraph E. An oiler is always provided with the vapor seal so the constant supply of oil will keep the seal intact.

VII. SERVICE AND REPAIR.

A. PREPARATIONS FOR SERVICE OR REPAIR OF PUMP.

1. Read this entire section and study figure 2 before proceeding.
2. Stop pump according to section IV, paragraph E. Disconnect, lock out, and tag electrical power supply to motor. Disconnect wiring from motor.

WARNING

When pump is handling hazardous fluid, extreme care must be taken to ensure safety of personnel when attempting to drain pump. Suitable protective devices should be used and/or protective clothing should be worn.

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 ON PUMPS EQUIPPED WITH SEMI-OPEN IMPELLERS.

1. Prepare pump for repair according to section VII, paragraph A.
2. Remove coupling guard (131) from motor bracket (03) by removing nuts (630), washers (620), and capscrews (610). Disconnect coupling (434) by removing snap-wrap spider to prevent binding or loading on coupling (434).
3. Loosen impeller adjustment capscrews (344) on bearing adapter (14). While rotating shaft by hand, tighten capscrews (100) until impeller (02) just rubs suction cover (04).
4. Loosen capscrews (100) and tighten impeller adjustment capscrews (344) by hand until they just contact bearing adapter (14). Tighten capscrews (344) another 1/3 turn. Tighten capscrews (100) evenly 1/3 turn after contacting bearing adapter (14) with screw head.

NOTE

Shaft setting should be checked again after pump is installed and before restarting pump. Clearance should now be between 0.010 inches and 0.015 inches.

5. Recheck coupling gap and adjust if necessary. Connect coupling (434) by installing snap-wrap spider.
6. Install the coupling guard (131) and secure with capscrews (610), washers (620), and nuts (630).
7. Connect wiring to motor. Remove all tags and connect power supply to motor. Start pumping unit according to section IV, paragraph C.

C. INSTALL NEW BALL BEARING WITHOUT DISASSEMBLY OF PUMP.

1. Prepare pump for repair according to section VII, paragraph A.
2. Remove coupling guard (131) from motor bracket (03) by removing nuts (630), washers (620), and capscrews (610).
3. Disconnect coupling (434) by removing snap-wrap spider.

CAUTION

To lift motor, a hoist or suitable lifting device must be used. The motor alone may be lifted by the motor lifting eyes.

4. Attach hoist or suitable lifting device to motor. Remove capscrews (607) separating motor from motor bracket (03). Remove motor from motor bracket (03).
5. Remove capscrews (25), bearing cap (16), and gasket (13) from bearing adaptor (14). Remove grease seal (34) from bearing cap (16).
6. Straighten the lock tangs on lockwasher (111) with a screwdriver and remove locknut (183) and lockwasher (111).
7. Remove capscrews (100) holding bearing adaptor (14) to thrust plate (06).
8. Loosen bearing adapter assembly (14) from shaft (7A) by using capscrews (344) as forcing capscrews.
9. Remove bearing adapter (14) assembly from shaft (7A) and thrust plate (06). Remove grease seal (33), if equipped, from bearing adapter (14). Bearing spacer (19) should fall out.
10. Using a small press, push the ball bearing (51) out of the bearing adapter (14).
11. If grease lubricated, hand pack new ball bearing (51) half full with grease according to section VI, paragraph C.
12. Install new grease seal (33), if equipped, in bearing adaptor (14). Install bearing adaptor (14) on shaft (7A). Install bearing spacer (19) over shaft (7A) in bearing adapter (14). Install new ball bearing (51) over shaft (7A) in bearing adapter.
13. Secure bearing adapter (14) to thrust plate (06) with capscrews (100).
14. Install bearing lockwasher (111) and locknut (183). Recrimp lock tang on lockwasher (111) in groove of locknut (183).
15. Install new gasket (13) on bearing cap (16). Install new grease seal (34) in bearing cap (16). Install bearing cap (16) and secure to bearing adapter (14) with capscrews (25).

CAUTION

To lift motor, a hoist or suitable lifting device must be used. The motor alone may be lifted by the motor lifting eyes.

16. Attach hoist or suitable lifting device to motor. Install motor on motor bracket (03) and secure with capscrews (607). Remove lifting device.
17. Connect coupling (434) by installing snap-wrap spider. Install the coupling guard (131) and secure with capscrews (610), washers (620), and nuts (630).
18. Connect wiring to motor. Remove all tags and connect power supply to motor. Start pumping unit according to section IV, paragraph C.

D. PUMP DISASSEMBLY. Pump will need to be removed from the sump pit for disassembly.

Removal of Pump. To remove pump from the sump pit, proceed as follows:

1. Prepare pump for repair according to section VII, paragraph A.
2. Remove coupling guard (131) from motor bracket (03) by removing nuts (630), washers (620), and capscrews (610).
3. Disconnect coupling (434) by removing snap-wrap spider.

CAUTION

To lift motor, a hoist or suitable lifting device must be used. The motor alone may be lifted by the motor lifting eyes.

4. Attach hoist or suitable lifting device to motor. Remove capscrews (607) separating motor from motor bracket (03). Remove motor from motor bracket (03).
5. Disconnect discharge piping at baseplate.

CAUTION

To lift pump, a hoist or suitable lifting device must be used.

6. Attach hoist or suitable lifting device to pump. Remove baseplate mounting capscrews. Remove pump from master plate and take to a suitable work area for repair.

Impeller Removal. To remove the suction cover (04) and impeller (02) proceed as follows:

1. Remove capscrews (27) which fasten the suction cover (04) to the casing (01). Carefully break the joint at the casing gasket (15) and move the suction cover (04) straight out so as not to damage the impeller (02) hub.

CAUTION

Exercise care when using a puller on the impeller.

2. Remove the impeller capscrew (18) and impeller washer (17). An allen wrench welded to a socket head is the best tool to remove the impeller capscrew (18). Pull the impeller (02) from the pump shaft (7B). Remove the impeller key (28).

Disassembly of Lineshaft.

1. Remove nuts (187) and washers (110) from the studs (186), which hold the backcover (11) to the adapter flange (417) and lower column (337).
2. Remove nuts (42) and capscrews (41) attaching the motor bracket (03) and thrust plate (06) to the baseplate (36). Remove the motor bracket (03).
3. If the pump is equipped with an oiler, remove oiler (82) and tubing (146).
4. Disconnect tubing(s) (146) at the male connectors (132). Remove tubing clamp(s) (147); gently push the tubing(s) (146) aside and protect them from damage.
5. Pull the entire column, shaft, and thrust plate assembly out through the baseplate (36) and take to a clean work area for disassembly. Remove gasket (44) from thrust plate (06). The flange adapter (417) should remain with the casing (01).
6. Loosen the setscrews (168) in the slinger (81) and remove slinger (81) from shaft lower section (7B).
7. Remove lubrication elbows (32) and pipe nipple (31), vented grease zerk (218), and pipe bushing (217) which protrude from lineshaft bearing housing (99).

WARNING

When pump is handling hazardous fluid, extreme care must be taken to ensure safety of personnel. Suitable protective devices should be used and/or protective clothing should be worn.

8. Wipe any residue or fluid from the shaft (7B). It may be necessary to flush the column cavity to remove any trapped fluid.
9. Use a screwdriver to extract the first lineshaft bearing housing (99).

NOTE

It is recommended that the column sections be numbered and tagged so they are reassembled in the correct order.

10. Remove nuts (339), lockwashers (340), and capscrews (338) from the next flanged column (337) connection and pull this column section off the shaft assembly.
11. Repeat steps 7 through 10 for each individual column section except the top section. It may not be necessary to disassemble the top column section from the thrust plate (06).

Disassembly of Two-Piece Lineshaft. If the column is over 10 feet long, there will be a two-piece lineshaft. The shaft coupling (10A) will be approximately 6-1/2 feet from the upper ball bearing (51). Refer to figure 2.

1. When the shaft coupling (10A) is visible, look for the holes for the tapered pins (10B). Look for the smaller pinhole on the upper pin. Drive a drift punch on the smaller end to remove the upper tapered pin (10B).
2. Unscrew (right-hand threads) the lower shaft (7B) and coupling (10A) from the upper shaft

(7A). Do not remove the coupling (10A) from the lower shaft (7B) unless absolutely necessary.

Disassembly of Lineshaft Bearings.

1. Remove lip seals (35), if equipped, from both ends of the lineshaft bearing housing (99) and remove setscrews (412) in the lineshaft bearing housing. If lineshaft bearings (50) are fluid flushed there should be no lip seals (35).
2. Take the lineshaft bearing housing (99) to a press and push out the lineshaft bearings (50). It takes approximately 400 pounds of force to push out the lineshaft bearings (50).

Removal of Ball Bearings.

1. Remove capscrews (100) holding bearing adapter (14) to thrust plate (06) and remove bearing adapter (14) with assembled parts, including shaft (7A).
2. Remove capscrews (25), bearing cap (16), and gasket (13) from bearing adapter (14). Remove grease seal (34) from bearing cap (16).
3. Uncrimp lock tang of bearing lockwasher (111). Remove locknut (183) and lockwasher (111). Remove bearing adaptor (14) with ball bearing (51), grease seal (33) if equipped, and bearing spacer (19) from shaft (7A).
4. Remove grease seal (33), if equipped, from bearing adapter (14). Bearing spacer (19) should be removed.
5. Using a small press, push the ball bearing (51) out of the bearing adapter (14).
6. If pump is equipped with a vapor seal assembly (43A), remove seal adaptor (43B) and seal assembly (43A).

E. PARTS INSPECTION.

1. All parts should be thoroughly cleaned or replaced with new ones if necessary. All sealing faces should be perfectly clean. It is recommended that all grease seals, lip seals, gaskets, o-rings, and locking devices with a nylock feature be replaced with new if disturbed from position.
2. Inspect ball bearing (51) for damage and replace if necessary. It is recommended that ball bearing (51) removed from the shaft be replaced. If bearing replacement is not possible and bearings are in good condition, bearings should be cleaned as follows:
   a. Place bearing (51), bearing adaptor (14), and bearing cap (16) in a wire or mesh basket and suspend the basket in a light mineral solvent. Allow it to soak, preferably overnight.
   b. After soaking and cleaning, the bearing (51), bearing adaptor (14), and bearing cap (16) should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
   c. Dip bearing (51) in clean, light oil and spin by hand to determine that all foreign matter has been removed.
   d. After cleaning grease lubricated bearing, repack bearing half full on both sides with a good quality ball bearing grease.
   e. Protect until ready for use.
3. Inspect lineshaft bearings (50) for damage and wear. Replace if necessary.
4. Inspect for bent shafts (07A and 07B) and replace shafts if necessary. Shaft threads should be in good condition.
5. If the impeller (02) shows excessive wear due to abrasion or corrosion so performance cannot be restored, it must be replaced.
6. On an enclosed impeller pump, check the clearance as follows:
   a. Measure outside diameter of front impeller (02) hub in three places.
   b. Measure inside diameter of suction cover (04) or wear ring (05), if equipped in three places.
   c. If difference between high reading of inside diameter of suction cover (04) or wear ring (05), if equipped and low reading of outside diameter of impeller (02) hub exceeds double the maximum clearances given in table 3, replace suction cover (04) or wear ring (05), if equipped. To replace wear ring (05) refer to section VII, paragraph F.
7. If the suction cover (04) on the open impeller pump shows excessive wear on the face due to abrasion or corrosion so performance cannot be restored, it should be replaced.
8. Inspect vapor seal (43A) faces and shaft sealing members. They must be in perfect condition. Replace if necessary.
9. Inspect and replace any defective grease zerks.

Table 3. Enclosed Impeller Clearance

MODEL (SUCTION X DISCHARGE X MAXIMUM IMPELLER DIAMETER)	FACTORY STANDARD DIAMETRIC CLEARANCE IN INCHES	
	MINIMUM	MAXIMUM
All models 1-1/4 X 1 X 6 through 3 X 2-1/2 X 7	0.012	0.021
All models 3 X 2-1/2 X 10 through 6 X 5 X 10	0.014	0.023

Usually the wear ring material is matched to the impeller as listed in table 4.

Table 4. Enclosed Impeller and Wear Ring Matched Materials

IMPELLER MATERIAL	WEAR RING MATERIAL
Cast iron	Steel
Bronze	Bronze
Stainless steel	Alloy 20 or 17-4-PH stainless steel

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMPS EQUIPPED WITH ENCLOSED IMPELLERS. If your pump is equipped with an enclosed impeller, it may have an optional, replaceable wear ring (05) in the suction cover (04). If your pump is equipped with the optional wear ring (05), for wear ring replacement proceed as follows:

The clearance between the wear ring and impeller hub will increase with wear. Internal leakage will result and pump performance will decrease. The allowable clearance and method of measurement is described in section VII, paragraph E, step 6.

1. Take suction cover (04) and impeller (02) to a work area with access to machine shop equipment.
2. Remove the wear ring (05) from suction cover (04). This can be accomplished in a lathe.
3. Inspect the impeller hub for damage.
4. Press the new wear ring (05) into suction cover (04). The beveled edge of the wear ring is installed towards the impeller (02).
5. Place impeller (02) 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 be sure the arbor and impeller are running square.
6. Turn the wear ring surface of impeller (02) until a 63 RMS or better finish is obtained.
7. Measure the outside diameter of the front impeller hub and record the value. See the measurement instructions in section VII, paragraph E, step 6.
8. Mount the suction cover (04) with new wear ring (05) installed in a lathe. Indicate male rabbet to within 0.002 T.I.R. maximum.
9. Bore wear ring (05) to within the specified tolerance listed in table 3 over the recorded size of the outside diameter of the front impeller hub.

G. PUMP REASSEMBLY. To reassemble the pump, proceed as follows:

NOTES

All parts should be thoroughly cleaned or replaced with new ones if necessary. All sealing faces should be perfectly clean. It is recommended that all grease seals, lip seals, gaskets, o-rings, and locking devices with a nylock feature be replaced with new if disturbed from position.

It is recommended that ball bearing (51) removed from the shaft be replaced. If ball bearing replacement is not possible and bearing is in good condition, bearing should be cleaned according to section VII, paragraph E, step 2.

During pump reassembly, keep lubrication lines on the same side as discharge pipe for protection.

Positioning the Vapor Seal. Refer to figure 1 to aid in understanding this procedure. If pump is equipped with a vapor seal, position vapor seal on shaft as follows:

1. Measure down from the step on the shaft (7A) a distance of 3-1/4 inches and make a mark with a felt-tip marker. This is the final position of the vapor seal (43A) locking collar.
2. Make sure shaft (7A) is clean. Lubricate upper portion of shaft (7A) where vapor seal (43A) is to be placed with silicon.
3. Slide the locking collar and rotating element of vapor seal (43A) on shaft (7A).
4. Lubricate the stationary element of the vapor seal (43A) with silicon and insert it into the seal adapter (43B). Install seal adapter (43B), with stationary element of the vapor seal (43A) installed, on the shaft (7A).
5. Install bearing adapter (14) on shaft (7A). Install bearing spacer (19) over shaft (7A) in bearing adapter (14).

6. If ball bearing (51) is grease lubricated, hand pack ball bearing (51) half full with grease according to section VI, paragraph C.
7. Install ball bearing (51) over shaft (7A) in bearing adapter (14).
8. Install bearing lockwasher (111) and locknut (183). Crimp lock tang on lockwasher (111) in groove of locknut (183).

NOTE

Do not install bearing adapter capscrews (100) and impeller adjustment capscrews (344) in bearing adapter (14) or bearing cap (16) until pump is completely assembled. They will be tightened during impeller clearance adjustment.

9. Install new gasket (13) on bearing cap (16). Install new grease seal (34) in bearing cap (16). Install bearing cap (16) and secure to bearing adapter (14) with capscrews (25).
10. Slide the vapor seal (43A) and locking collar toward bearing adapter (14) assembly until mark on shaft (7A) is visible. Tighten setscrews in locking collar to fix the position of vapor seal (43A).

Ball Bearing Installation. If pump has a vapor seal, ball bearing assembly was installed in previous procedure. If pump does not have a vapor seal, install the ball bearing as follows:

1. Install new grease seal (33) in bearing adapter (14). Install bearing adapter (14) on shaft (7A). Install bearing spacer (19) over shaft (7A) in bearing adapter (14).
2. If ball bearing (51) is grease lubricated, hand pack ball bearing (51) half full with grease, according to section VI, paragraph C. Install ball bearing (51) over shaft (7A) in bearing adapter (14).

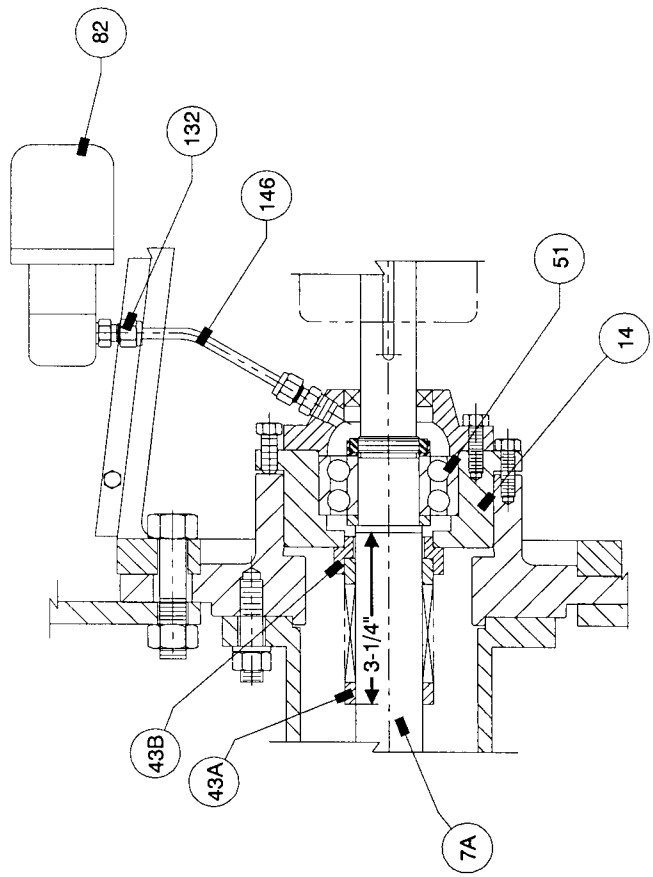


Figure 1. John Crane, Type 1 Vapor Seal Position

3. Install bearing lockwasher (111) and locknut (183). Crimp lock tang on lockwasher (111) in groove of locknut (183).

NOTE

Do not install bearing adapter capscrews (100) and impeller adjustment capscrews (344) in bearing adapter (14) or bearing cap (16) until pump is completely assembled. They will be tightened during impeller clearance adjustment.

4. Install new gasket (13) on bearing cap (16). Install grease seal (34) in bearing cap (16). Install bearing cap (16) and secure to bearing adapter (14) with capscrews (25).

Reassembly of Lineshaft Bearings. During reassembly of new carbon lineshaft bearings, it is essential that the lineshaft bearings be perfectly aligned. If cocked slightly, the new lineshaft bearings will shatter during operation. It is recommended that new bearing housings, with lineshaft bearings already installed, be purchased from Carver Pump Company to prevent the likelihood of lineshaft bearings shattering due to misalignment. If this is not possible, reassemble the lineshaft bearings as follows:

CAUTION

Make sure lineshaft bearings (50) are perfectly aligned in bearing housings (99) during reassembly. If cocked slightly, the new lineshaft bearings (50) will shatter during operation.

1. Press lineshaft bearing(s) (50) in lineshaft bearing housing(s) (99).
2. Secure lineshaft bearings(s) (50) in lineshaft bearing housing(s) (99) with setscrews (412).
3. Install new lip seals (35), if equipped, in both ends of lineshaft bearing housing(s) (99).

Reassembly of Two-Piece Lineshaft. If column is over 10 feet long, the lineshaft is in two pieces. To reassemble a two-piece lineshaft, proceed as follows:

1. Screw (threads are right-hand) upper shaft (7A) to the shaft coupling (10A) and lower shaft (7B).

2. Install upper tapered pin (10B) in shaft coupling (10A).

Reassembly of Lineshaft. During reassembly of lineshaft, be sure the column sections are reassembled in the reverse order of disassembly. To reassemble the lineshaft, proceed as follows:

1. If the top flanged column (337) was removed from the thrust plate (06), install top flanged column (337) on the thrust plate (06) and secure with lockwashers (343) and capscrews (342).
2. Install top lineshaft bearing housing (99) assembly. Install pipe bushing (217), vented grease zerk (218), pipe nipple (31), and lubrication elbows (32) in flange column (337) as applicable.
3. Install next flanged column (337) and secure with lockwashers (340) and nuts (339) on capscrews (338).
4. Repeat steps 2 and 3 for each individual column section.
5. Install slinger (81) on shaft (7B) and secure by tightening setscrews (168).
6. If pump is equipped with a thrust plate gasket (44), install new thrust plate gasket (44) on top of baseplate (36). Install entire column, shaft, and thrust plate assembly through baseplate (36).
7. Reconnect tubing(s) (146) at the male connectors (132). Gently push tubing(s) (146) next to flanged columns (337) and secure in place with tubing clamps(s) (147).
8. If pump is equipped with an oiler (82), install tubing (146) and oiler (82).
9. Install motor bracket (03) and secure motor bracket (03) and thrust plate (06) to the baseplate (36) with nuts (42) on capscrews (41).
10. Install adapter flange (417) and casing (01) and secure to lower flanged column (337) with washers (110) and nuts (187) on studs (186).

Impeller Installation. Use the following procedure to install the impeller (02) and suction cover (04):

1. Install impeller key (28) in keyway of shaft (7B).

CAUTION

Use a new impeller capscrew (18) during reassembly. Impeller capscrew (18) has a nylock feature. Once used, impeller capscrew (18) may not provide adequate security.

2. Install impeller (02) and secure with impeller washer (17) and new impeller capscrew (18).
3. Install new casing gasket (15). Install suction cover (04), being careful not to damage impeller (02) hub.
4. Start capscrews (100) in bearing adapter (14) and impeller adjusting capscrews (344) in bearing adapter (14).
5. Adjust impeller clearance according to section VII, paragraph B.

Installation of Pump. To install the pump on the master plate, proceed as follows:

CAUTION

To lift pump, a hoist or suitable lifting device must be used.

1. Attach hoist or suitable lifting device to pump. Return pump to installation site. Install pump on master plate. Install baseplate mounting capscrews. Remove lifting device.
2. Connect discharge piping at baseplate (36).

CAUTION

To lift motor, a hoist or suitable lifting device must be used. The motor alone may be lifted by the motor lifting eyes.

3. Attach hoist or suitable lifting device to motor. Install motor on motor bracket (03) and secure with capscrews (607). Connect coupling (634) by installing snap-wrap spider. Install coupling guard (131) and secure with capscrews (610), lockwashers (620), and nuts (630). Remove lifting device.
4. Remove all tags from valves and power sources. Open system valves and reconnect power supply to motor.

H. PARTS INVENTORY GUIDE. Spare parts should be on hand for normal service to avoid unnecessary delays for maintenance.

For every one to three pumps keep in stock one spare parts set, as listed in table 5.

I. PARTS ORDERING. There are a variety of options available for these pumps. When ordering parts, prompt accurate service will be provided if you will tell Carver Pump Company:

1. Serial number of pump (on nameplate).
2. Part name (from table 6).
3. Part number (from table 6 and figure 2).
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. PARTS LIST AND DRAWING.

Refer to table 6 for the pump parts list. Refer to figure 2 for the pump sectional drawing.

Table 5. Recommended Spare Parts List

ITEM NO.	QTY.	DESCRIPTION
02	1	Impeller
05	1	Wear ring, if equipped
13	1	Gasket, bearing cap
15	1	Gasket, suction cover
18	1	Impeller capscrew
33	1	Grease seal, if equipped
34	1	Grease seal
35	2	Lip seal, if equipped
43a	1	Vapor seal, if equipped
44	1	Gasket, thrust plate
50, 99, 412	2	Lineshaft bearings, lineshaft bearing housings, setscrews; purchased as a set
51	1	Ball bearing

Table 6. LHS Sump Pump Parts List

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
01	Casing	82	Oiler, optional
02	Impeller	89A	O-ring
03	Motor bracket	99	Lineshaft bearing housing
04	Suction cover	100	Capscrew, bearing adapter
05	Wear ring (with enclosed impeller only)	110	Flatwasher, flanged column
06	Flanged column thrust plate	111	Lockwasher, bearing locknut
07A	Shaft, upper half	131	Coupling guard
07B	Shaft, lower half	132	Male connector
10A	Shaft coupling (for column lengths over 10 feet)	134	Pipe reducer bushing
10B	Tapered pin (for column lengths over 10 feet)	146	Tubing
11	Backcover	147	Tubing clamp
13	Gasket, bearing cap	150	Gasket, shaft
14	Bearing adapter	155	Strainer
15	Gasket, suction cover	156	Pipe nipple
16	Bearing cap	168	Setscrew, slinger
17	Impeller washer	183	Bearing locknut
18	Impeller capscrew	186	Stud, casing
19	Bearing spacer	187	Hex nut
25	Capscrew, bearing cap	217*	Pipe bushing
27	Capscrew, suction cover	218	Vented grease zerk, bearing cap
28	Impeller key	219	Vented grease zerk
29	Coupling key	337	Flanged column
31	Pipe nipple	338*	Capscrew, flanged columns
32	90 degree elbow, female	339*	Hex nut, flanged columns
33	Grease seal, bearing adaptor, optional	340*	Lockwasher, flanged columns
34	Grease seal, bearing cap	342	Capscrew, top flanged column
35	Lip seal, lineshaft bearing, optional	343	Lockwasher, top flanged column
36	Baseplate	344	Capscrew, impeller adjustment
37	Pipe coupling	412	Setscrew, lineshaft bearing
39*	Discharge pipe	417	Adapter flange
40*	Weld plate	418	Plug, bearing cap
41	Capscrew, thrust plate	420	Plug, casing
42	Hex nut, thrust plate	421	Plug, backcover
43A	Vapor seal, optional	434	Coupling
43B	Vapor seal adaptor, optional	600	Capscrew, backcover
44	Thrust plate gasket, optional	607	Capscrew, motor bracket to motor
50	Lineshaft bearing	610	Capscrew, coupling guard to motor bracket
51	Ball bearing	620	Washer, coupling guard to motor bracket
81	Slinger	630	Nut, coupling guard to motor bracket

* = not shown on figure 2.

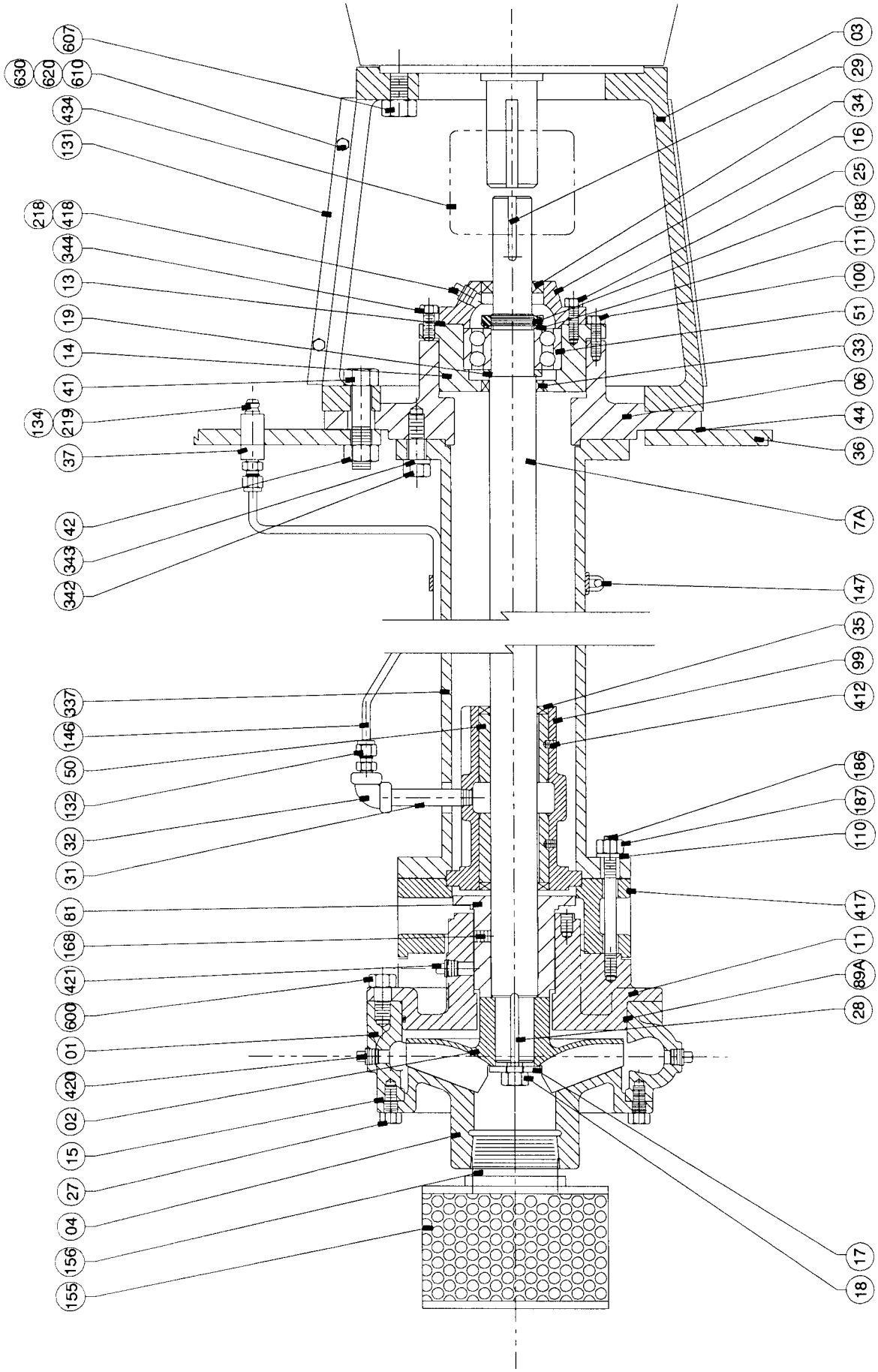
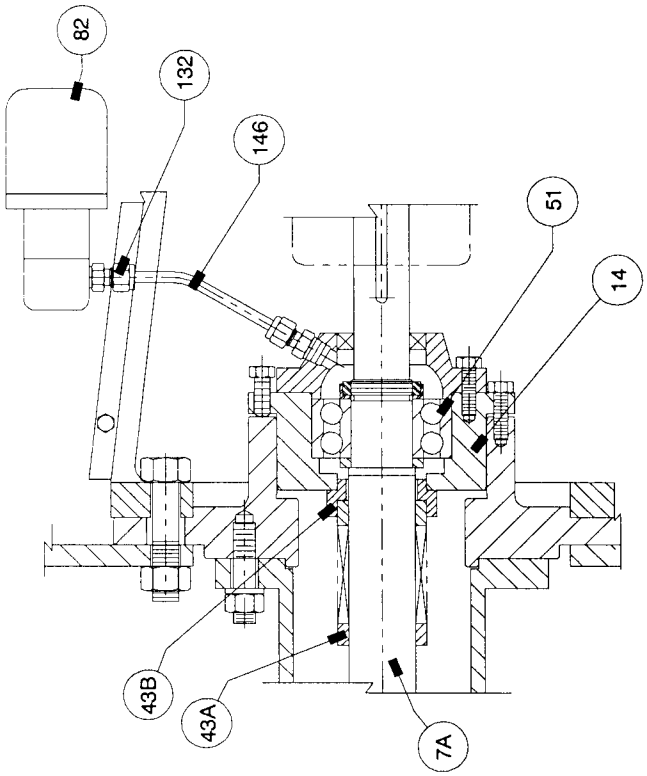
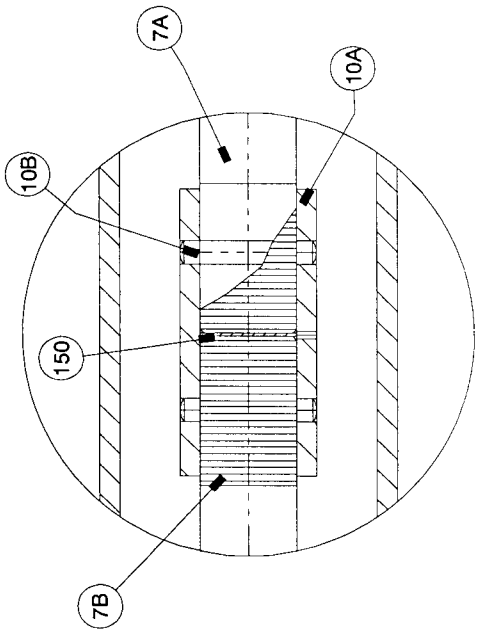


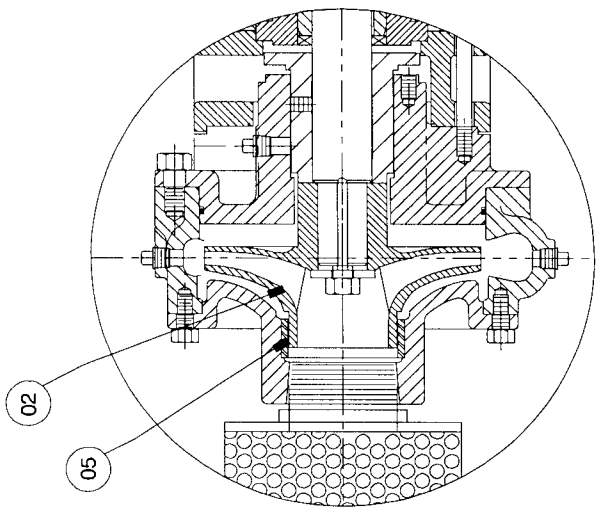
Figure 2. LHS Sectional Drawing (Sheet 1 of 2)



OPTIONAL VAPOR SEAL AND OILER



COUPLING FOR PUMPS WITH COLUMNS OVER 10 FEET LONG



ENCLOSED IMPELLER WITH OPTIONAL WEAR RING

Figure 2. LHS Sectional Drawing (Sheet 2 of 2)

IX. Pump Service Record

Serial No. _____ Size and Type _____ Make _____

Cust.Order No. _____ Date Installed _____

Install. Date	Location	Application

PUMP RATING

Capacity (GPM) _____ Total Head (ft) _____

Suction Pressure _____ Speed (RPM) _____

Liquid _____ Temperature _____

Specific Gravity _____ Viscosity _____

Impeller Diameter (inches) _____

PUMP MATERIALS

Casing _____ Backcover _____ Suction Cover _____

Impeller Capscrew _____ Shafts _____ Impeller _____

Bearing Adapter _____ Bearing Cap _____ Wear Ring _____

MOTOR DATA

Motor _____ Make _____ Serial No. _____

Type _____ Frame _____ AC or DC _____

Volts _____ Phase _____ Cycles _____

HP _____ RPM _____

Notes on Inspection and Repairs

Inspect Date	Repair Time	Repairs	cost	Remarks

Notes: _____

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April 1996