CarVer®

Instruction I-100

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS FOR L&H HORIZONTAL BACK PULLOUT PUMP

PREFACE: The instructions apply to Carver Pump Company L&H horizontal back pullout pumps, close coupled or frame mounted models with a JM shaft extension. The pumps covered in this manual have capacities to 2,000 GPM, heads to 390 feet and temperatures to 250 ^{o} F. (121^{o} C.). They are designed for use with standard NEMA motors in industrial, commercial, chemical, and pollution control applications. All wetted surfaces are available in bronze fitted, all iron, or 316 stainless steel fitted.

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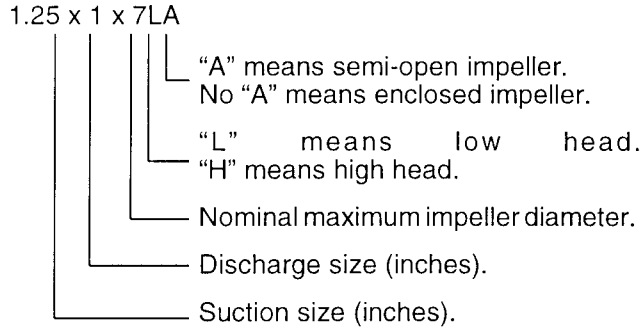
I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

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



B. NAMEPLATE. A nameplate is attached to each pump. The data on the 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.

C. 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 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.

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. This 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

Installation, use, and operating of pumping 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 pumping equipment is the responsibility of the equipment owner and all necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

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 "damage and/or lost in shipment" claim with the carrier.

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

Grease Lubricated Pump. Rotate the shaft for several revolutions at least once per month to coat the bearings with lubricant, retard oxidation and corrosion, and prevent possible false brinelling.

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

III. INSTALLATION.

A. LOCATION. The pump should be installed as close to the fluid as possible. A short, direct suction pipe can be used to keep suction losses at a minimum. If possible, locate the pump so fluid will flow by gravity to the suction opening. The discharge piping should be direct 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.

The pump and driver should be located in an area that will permit periodic inspection and maintenance. Head room and access should be provided and all units should be installed in a dry location with adequate drainage.

B. HANDLING.

CAUTION

Do not pick up the complete unit by the driver or pump shafts or eyebolts.

To lift a horizontal mounted unit, a hoist or suitable lifting device should be attached to each corner of base structure. Use a sling for pumps without baseplates. The individual driver may be lifted using proper eyebolts provided by the manufacturer, but these should not be used to lift the assembled unit.

C. FOUNDATION. The foundation should be 3 to 6 inches wider and longer than the baseplate, have a level surface, and be of sufficient mass to prevent vibration and form a permanent rigid support for the unit. The best foundations are concrete with anchor bolts of adequate size embedded in the foundation in pipe sleeves having an inside diameter 2-1/2 times larger than the bolt diameter. This will allow for accurate positioning of the unit. Keep the concrete surface clean, yet rough.

D. LEVELING OF UNIT. Lower unit onto foundation, positioning base structure so anchor bolts are aligned in middle of holes in base. On all frame mounted units, always disconnect the coupling halves and never reconnect them until all alignment operations are complete.

The base should be supported on metal shims or metal wedges placed directly beneath the part of the base supporting the most weight. The shims or wedges should be spaced close enough to give even support and stability.

Adjust metal supports or wedges until suction and discharge flanges are level. On frame mounted pumps, driver and pump shafts need to be in alignment. Alignment and leveling corrections can be accomplished by adjusting supports under the base. When proper alignment is obtained, tighten foundation bolts snugly, but not too firmly. Recheck alignment before grouting.

CAUTION

Do not attempt to straighten the base by using the anchor bolts.

E. COUPLING ALIGNMENT. On frame mounted pumps, check alignment of pump and driver shafts. Be sure pump and driver shafts can be turned freely by hand. Even if driver is mounted and aligned at the factory, it must be realigned at the site because misalignment can 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. Literature from the manufacturer can be furnished upon request.

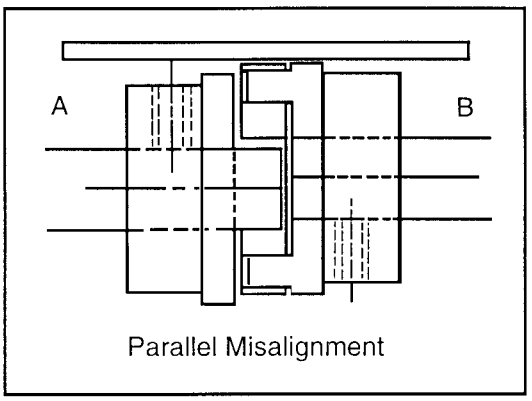
Flexible couplings can only absorb limited misalignment of the shafts. This part must not be used to compensate misalignment of the pump and driver shafts.

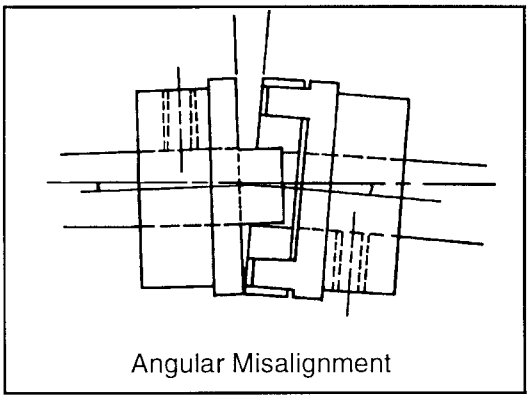
To check the coupling alignment use the following directions (refer to figure 1):

1. **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.

2. **Angular alignment** is checked with a dial indicator. The coupling must be connected before checking angular alignment. Mount dial indicator on one coupling half and take a reading from back of other coupling half. Rotate coupling hub being read. Record total indicator readings at 90 degree intervals. Total indicator readout (T.I.R.) must not exceed 0.015 inches between the four readings.

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





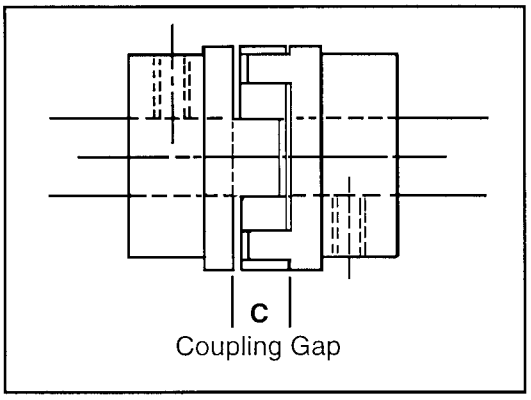


Figure 1. Coupling Alignment

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

F. DIRECTION OF ROTATION. Before connecting coupling halves, bump start driver and verify that rotation is correct. On frame mounted pumps, correct pump rotation is indicated by an arrow on the power frame. On closed coupled pumps, correct pump rotation is indicated by an arrow on the adaptor/backcover. The standard direction of rotation, viewed from the motor end, is clockwise.

G. COUPLING GUARD. On frame mounted pumps, place a coupling guard over the coupling and bolt to base.

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.

H. GROUTING. When coupling alignment is correct and suction and discharge flanges are level, the unit should be grouted using a high grade non-shrinking grout. The entire base should be filled with grout. Be sure to fill all gaps. **ALLOW THE GROUT TO FULLY CURE BEFORE FIRMLY TIGHTENING THE FOUNDATION BOLTS.**

I. PIPING. All piping should be independently supported near the pump so that pipe strain will not be transmitted to pump casing.

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 flange.

The suction pipe must be air tight and sloped upward to pump flange to avoid air pockets which will impair pump operation. The discharge pipe should be as direct 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. Use an offset (eccentric) reducer instead.

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 water hammer and prevents reverse rotation in event of power failure. Closing valves are used in priming, starting, and pump shut down. Pump must never be throttled by use of a valve in the suction line.

CAUTION

After all the piping is connected, recheck the coupling alignment.

J. AUXILIARY PIPING CONNECTIONS AND GAUGES. In addition to primary piping connections, the pump may require other connections to the discharge and suction flange gauges, or baseplate drain connections. All these lines and gauges should now be installed.

K. 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. Before starting the pump, rotate shaft by hand to assure all moving parts are free.
3. Before starting the pump, install closed guards around all exposed rotating parts.
4. Observe all caution or danger tags attached to the equipment.
5. Never run pump dry because the close running fits within the pump are water lubricated. Dry running may result in pump seizure.
6. Before starting the pump, fill the casing and suction line with liquid. The pump may be primed by using an ejector or vacuum pump.
7. Before starting a mechanical seal pump equipped with external flush lines, turn on seal water, and confirm the seal water is at sufficient pressure.
8. 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.

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

Positive Suction Head:

1. Open the 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 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. Then close valve to the vent.
6. The pump is now primed.

C. STARTING THE PUMP.

1. If unit is equipped with seal cooling lines, turn on seal cooling water.
2. Fully open the suction valve.
3. Check pump for proper priming and lubrication.
4. Start the pump.
5. 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 period of time, turn off the pump. For determination of the cause and its remedy refer to troubleshooting in section V or consult Carver Pump Company.
2. Check and record differential head by deducting suction gauge reading from discharge gauge reading. In applications where suction lift is involved, add suction and discharge gauge readings. The head should be similar to the total dynamic head (TDH) that is stamped on the pump nameplate.
3. Check and record bearing temperature. It should not exceed 180 degrees F.
4. Check and record power input to the driver.

E. STOPPING THE PUMP.

1. Begin to partially close discharge valve.
2. Tag out and lock power to driver according to OSHA Standard 1910.147.
3. Completely close discharge and suction valves.
4. If unit is equipped with seal cooling lines, turn off external cooling water line to seal.

F. INDEFINITE SHUTDOWN. Relubricate bearings. Provide pump and motor with a protective cover.

Remove casing plug to drain casing. Drain all piping if there is a possibility of liquid freezing.

V. TROUBLESHOOTING OPERATING PROBLEMS.

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

A. NO DISCHARGE.

1. Pump not primed.
2. Speed too low.
3. Required discharge head too high.
4. Suction lift higher than pump rating.
5. Clogged or plugged impeller.
6. Wrong direction of rotation.

B. EXCESSIVE POWER CONSUMPTION.

1. Speed too high.
2. Head lower than rating; pumps too much liquid.
3. Specific gravity or viscosity of liquid pumped is too high.
4. Mechanical defects:
   *Bent shaft.
   *Rotating element binds.
5. Misalignment.
6. System head lower than design condition.
7. Incorrect impeller diameter.

C. INSUFFICIENT DISCHARGE PRESSURE OR FLOW.

1. Pump not primed.
2. Speed too low. Check driver.
3. Discharge head too high.
4. Suction lift too high.
5. Wrong direction of rotation.
6. Air leaks into suction piping, seal housing, or gaskets.
7. Impeller passage partially plugged.
8. Impeller damaged.
9. Impeller running clearance too large.
10. Optional impeller wear ring clearance is excessive.
11. Insufficient suction line submergence.
12. Air in liquid.
13. Impeller diameter too small.
14. Insufficient net positive suction head.

D. LOSS OF SUCTION DURING OPERATION.

1. Suction line leaks.
2. Water seal line plugged.
3. Suction lift too high.
4. Air or gases in liquid.
5. Air leaks into suction piping, seal housing, or gaskets.
6. Wrong direction of rotation.
7. Insufficient suction line submergence.

E. TOO MUCH SEAL HOUSING LEAKAGE.

1. Damaged shaft sleeve needs replacing.

F. VIBRATION OR NOISE.

1. Misalignment between driver and pump shafts.
2. Loose foundation bolts.
3. Defect in grouting.
4. Mechanical defects:
   *Shaft bent.
   *Rotating element binds.
5. Head lower than rating; pumps too much liquid.
6. Pipe strain - improperly aligned or supported piping.
7. Pump running at shut-off condition.

G. OVERHEATING.

1. Bearings:
   *Excessive grease.
   *Shaft bent.
   *Rotating element binds.
   *Pipe strain.
   *Insufficient bearing lubrication.
   *Incorrect type grease.
2. Seal housing:
   *Water seal line plugged.
   *Flushing water not circulating for mechanical seal.

H. SPEED TOO LOW.

1. Check motor.
2. Check electrical voltage.

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 cover the following procedures:

1. Check the suction and discharge pressures to establish differential head. It should conform to that stamped on the pump nameplate.
2. Check power input and speed of driver.
3. Check pumping temperatures.
4. Check pump for quiet running.
5. Check seal housing for increased leakage.

B. GREASE LUBRICATION OF PUMP BEARINGS. 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 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, the bearings should be thoroughly cleaned and flushed with suitable solvent to remove all traces of old grease as follows:

1. Place bearings 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 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.

To Relubricate Bearings use the following procedure:

1. Lubrication frequency depends on operating conditions. Relubricate every 1000 hours for normal duty.

CAUTION

Overgreasing creates heat and is the cause of many problems requiring repairs. **DO NOT OVERGREASE.**

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.

CAUTION

Use a hand operated grease gun to prevent overgreasing.

4. 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 is enough. **DO NOT OVERGREASE.**

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

D. MECHANICAL SEAL. The mechanical seals used can vary according to power frame and shaft size. Consult mechanical seal manufacturer for any special instructions.

Keep a spare seal on hand if standby equipment is not available.

Causes of Failure or Leakage Between Seal Faces.

1. Scored or worn seal faces.
2. Stationary insert face not perpendicular to shaft axis.
3. Binding seal ring.
4. Wobbling rotating seal ring.
5. Cracked or broken stationary insert.
6. Shaft run out through seal housing.
7. Foreign matter between seal faces.
8. Loose or released setscrews.
9. Spring compression lost.
10. Mechanical seal improperly applied or installed.

VII. SERVICE AND REPAIR.

A. PREPARATIONS FOR DISASSEMBLY OF PUMP.

1. Read this entire section and study the sectional view drawings, figures 2 and 3, before disassembling the pump.
2. Lock out and tag the power to the driver.
3. Shut off all valves controlling flow of liquid to and from pump. Drain casing (1) by removing pipe plug (422). If necessary, flush pump to remove corrosive or toxic pumpage. Reinstall pipe plug in casing when fluid has completely drained. Disconnect piping and gauges as necessary.

CAUTION

Use of a hoist with adequate capacity is recommended.

B. DISASSEMBLY OF PUMP.

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

CAUTION

Use a two man lift or a hoist with adequate lifting capacity.

2. Disconnect tubing and tubing fittings as necessary.
3. Unbolt bearing frame (99) or motor from base and move pumping unit to open working area.
4. Remove capscrews (600) from adaptor/backcover (71) and casing (1). On frame mounted pumps remove rotary assembly from casing and take it to a suitable work area. On close coupled pumps remove rotary assembly along with motor and take the items to a suitable work area.
5. Remove o-ring (89A) from adaptor/backcover (71).
6. Remove impeller capscrew (24) and impeller washer (28). The best tool to remove impeller capscrew (24) is a hex wrench welded to a socket head. Impeller may now be pulled from shaft. Remove impeller key (32).
7. Remove mechanical seal (90), shaft sleeve (14), o-ring (89D), and slinger (40) from shaft (6).

C. DISASSEMBLY OF POWER FRAME ON FRAME MOUNTED PUMP.

1. Remove capscrews (601). Disconnect adaptor/backcover (71) from the bearing frame (99).
2. Remove bearing cap (35) from shaft (6). Remove shaft assembly from bearing frame (99).
3. Pry down tang on bearing lockwasher (69) and remove bearing locknut (22).
4. Bearings (16 and 18) may now be pressed off shaft.

D. PARTS INSPECTION.

1. On frame mounted pumps, inspect bearings for damage and replace if necessary. If the bearings do not need replacing, clean the bearings using the following procedures.
   a. Place bearings in a wire or mesh basket and suspend basket in a light mineral solvent and allow to soak, preferably overnight.
   b. After soaking and cleaning, bearings should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
   c. Dip bearings in clean, light oil and spin by hand to determine that all foreign matter has been removed. Protect the bearings until ready for use.

Table 1. Wear Ring Clearance

MODEL (Suction x Discharge x Maximum Impeller Diameter)	FACTORY STANDARD WEAR RING CLEARANCE	
	Minimum	Maximum
1.25 x 1 X 5L	0.009	0.014
2 X 1.5 X 5L through 1.25 x 1 x 7L	0.012	0.016
1.5 X 1.25 X 7L	0.014	0.018
2 X 1.5 X 7L	0.012	0.016
2.5 X 2 X 7L	0.012	0.016
3 X 2.5 X 7L	0.014	0.018
4 X 3 X 7L	0.014	0.018
5 X 4 X 7L	0.015	0.020
1.5 X 1.25 X 10H	0.011	0.014
2 X 1.5 X 10H	0.012	0.016
2.5 X 2 X 10H	0.012	0.016
3 X 2.5 X 10H	0.012	0.017
4 X 3 X 10H	0.012	0.016
5 X 4 X 10H	0.016	0.021
6 X 5 X 10H	0.021	0.026

2. On frame mounted pumps, inspect for bent shaft and replace shaft if necessary. Shaft threads should be in good condition. Bearing seats must be in perfect condition.
3. Shaft sleeve surface must be smooth and free of pits and grooves. Replace if damaged. The shaft sleeve is slip fitted to the shaft for easy removal.
4. If the impeller shows excessive wear due to abrasion or corrosion, so that performance cannot be restored, it must be replaced.
5. 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 (2) in three places.
   b. Measure inside diameter of wear ring (7) in three places.
   c. If difference between high reading of inside diameter of wear ring (7) and low reading of outside diameter of impeller (2) hub exceeds double the maximum clearances given in table 1, replace wear ring according to section VII, paragraph F. Refer to table 1 for factory wear ring clearance.
6. If suction cover on open impeller pumps shows excessive wear on the face due to abrasion or corrosion, so that performance cannot be restored, it should be replaced.
7. Inspect mechanical seal faces, gaskets, o-rings and shaft sealing members. They must be in perfect condition. Replace if necessary.
8. Inspect and replace any defective grease fittings.

E. ASSEMBLY PUMP.

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 43). Hand pack bearings half full with proper grease (refer to section VI, paragraph B). Install bearing lockwasher (69) and bearing locknut (22) on inboard end of shaft. Crimp tang of bearing lockwasher (23) in one of grooves provided in bearing locknut (22).
2. On frame mounted pumps, reinstall bearing cap (35) on bearing frame (7) and secure with capscrews (603). Tighten capscrews evenly.
3. On frame mounted pumps, reconnect adaptor/backcover (71) to bearing frame (99) with capscrews (601).
4. Reinstall slinger (40) on shaft next to adaptor/backcover (71). Install o-ring (89D) on shaft next to step on shaft.

NOTE

If pump is equipped with an enclosed impeller, omit steps 5 through 7b. Steps 5 through 7b are procedures which describe impeller clearance adjustment for semi-open impellers only.

CAUTION

During performance of steps 5 through 7a, use old impeller capscrew (24) to secure impeller (3). Once proper impeller clearance is achieved, use a new impeller capscrew (24) to secure impeller (3). Impeller capscrew (24) has a nylock feature and once used may not provide adequate security.

5. Install impeller (3) and impeller washer (28) on shaft and secure with impeller capscrew (24).

CAUTION

Use a two man lift or a hoist of adequate lifting capacity.

6. On frame mounted pumps, reinstall rotary assembly. On close coupled pumps reinstall rotary assembly along with motor. Do not reinstall o-ring (89A) in adaptor/backcover (71). Secure adaptor/backcover (71) to casing (1) with capscrews (600).
7. There must be a clearance of 0.010 inches minimum and 0.020 inches maximum between an open impeller (3) and suction cover (10). To check clearance, rotate shaft by hand and listen for any rubbing noise.
   a. If no rubbing noise is present, the clearance between impeller and suction cover will be greater than 0.020 inches, once gasket (12), which is 0.025 inch thick, is placed between suction cover and casing. To remedy this, a 0.020 inch shim (15) is placed behind impeller to bring impeller out toward suction cover. Before shim is installed:

CAUTION

Use a two man lift or a hoist of adequate lifting capacity.

(1.) Remove capscrews (600) securing adaptor/backcover (71) to casing. On frame mounted pumps, remove rotary

assembly. On close coupled pumps, remove rotary assembly along with motor.

(2.) Remove impeller capscrew (24), impeller washer (28), and impeller (3).

(3.) Install impeller shim (15) on shaft. Repeat steps 5 through 7a until proper clearance is achieved.

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

(1.) Remove capscrews (605). Remove suction cover (10).

(2.) Add gasket (12) on suction cover.

(3.) Reinstall suction cover (10), securing with capscrews (605).

(4.) Repeat step 7b until the proper clearance is achieved.

8. Lubricate stationary element of mechanical seal (90) with petroleum jelly. Install stationary element of mechanical seal (90) in adaptor/backcover (71).
9. Lubricate outside of shaft sleeve (14) with petroleum jelly.
10. Reinstall mechanical seal (90) rotating element on shaft sleeve (4) and position rotary face approximately 1/8 inch from end of shaft sleeve (14) with large chamfer.
11. Install shaft sleeve (14) with rotating element of mechanical seal intact on shaft.

CAUTION

Use a new impeller capscrew (24) to secure impeller (2 or 3). Impeller capscrew (24) has a nylock feature and once used may not provide adequate security.

12. Install impeller (2 or 3) and impeller washer (28) on shaft and secure with impeller capscrew (24).

CAUTION

Use a two man lift or a hoist of adequate lifting capacity.

13. On frame mounted pumps, reinstall rotary assembly. On close coupled pumps reinstall rotary assembly along with motor. Reinstall o-ring (89A) in adaptor/backcover (71). Secure adaptor/backcover (71) to casing with capscrews (600).
14. Reinstall tubing and tubing fittings as necessary.

CAUTION

Use a two man lift or a hoist of adequate lifting capacity.

15. Return pumping unit to installation site. Reinstall pumping unit on its base and secure to base with foundation bolts.
16. On frame mounted pumps, align coupling according to section III, paragraph E. Reconnect coupling. Reinstall coupling guard.
17. Reconnect piping and gauges as necessary. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
18. Start pumping unit in accordance with section IV.

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMP EQUIPPED WITH ENCLOSED IMPELLER. If your pump is equipped with an enclosed impeller, it may have an optional, replaceable wear ring in the suction cover. If your pump is equipped with the optional wear ring, follow these instructions for wear ring replacement. The wear ring is illustrated as item number 7 in figures 2 and 3.

The clearance between the wear ring and impeller hub will increase with wear. Internal leakage will result and pump performance will decrease. Refer to section VII, paragraph D5 and table 1.

Usually wear ring material is matched to impeller as listed in table 2.

Table 2. Impeller and Wear Ring Matching Materials

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

To replace wear ring, use the following procedure (refer to figures 2 or 3 for location of parts followed by an item number):

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 (422). If necessary, flush pump to

remove corrosive or toxic pumpage. Reinstall pipe plug in casing when fluid has completely drained.

3. Disconnect piping and gauges as necessary.
4. Remove capscrews (605) which fasten suction cover (9) to casing (1). Carefully break joint at gasket (12) and move suction cover straight out so as not to damage impeller (2) hub.
5. Remove impeller capscrew (24) and impeller washer (28). The best tool to remove impeller capscrew (24) is a hex wrench welded to a socket head. Impeller may now be pulled 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) from suction cover. This can be best accomplished on a lathe.
8. Inspect impeller hub for damage.
9. Press new wear ring (7) 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 be sure 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) 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 1 in section VII, paragraph D5, over recorded size of outside diameter of front impeller hub.

CAUTION

Use a new impeller capscrew (24) to secure impeller (2). Impeller capscrew (24) has a nylock feature and once used may not provide adequate security.

15. Install impeller (2) and impeller washer (28) on shaft and secure with a new impeller capscrew (24).
16. Install gasket (12) on suction cover. Install suction cover (9) and secure to casing with capscrews (605).
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.

G. PARTS INVENTORY GUIDE. To avoid unnecessary delays for maintenance, spare parts should be on hand for normal service. Most conditions may be covered if this guide is followed. For every one to three pumps, stock one spare parts set consisting of items listed in table 3. Part numbers listed in table 3 correspond to part numbers on the sectional view drawings.

H. 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 the following information.

1. Serial number of pump (located on nameplate).
2. Part name (located on parts list).
3. Part number (located on exploded view).
4. Quantity of parts needed.

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

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

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

VIII. PARTS LIST AND SECTIONAL VIEW DRAWINGS.

This section contains listings of parts and corresponding sectional view drawings. Table 4 contains the parts listing for frame mounted pumps. Figure 2 shows location of parts listed in table 4. Table 5 contains the parts listing for close coupled pumps. Figure 3 shows location of parts listed in table 5.

Table 3. Recommended Spare Parts

QUANTITY	PART NUMBER	DESCRIPTION
1	2 or 3	Impeller
1	6	Shaft
1	* 7	Wear Ring, for Pump with Enclosed Impeller
1	14	Shaft Sleeve
As req'd.	15	Impeller Shims, 0.020 inch for Semi-open Impeller
1	24	Impeller Capscrew
As req'd.	73	Gasket
2	89D	O-ring - Shaft Sleeve

Table 4. Parts List for Frame Mounted L&H Horizontal Back Pullout Pump

PART NUMBER	PART DESCRIPTION	PART NUMBER	PART DESCRIPTION
1	Casing	2	Impeller - Enclosed
3	Impeller - Semi-open	6	Shaft
* 7	Wear Ring	9	Suction Cover for Enclosed Imp.
10	Suction Cover for Semi-open Imp.	14	Shaft Sleeve
15	Impeller Shim for Semi-open Imp.	16	Radial Bearing
18	Thrust Bearing	22	Bearing Locknut
24	Impeller Capscrew	28	Impeller Washer
32	Impeller Key	35	Bearing Cap - I.B.
40	Slinger	43	Bearing Cap - O.B.
46	Coupling Key	53	Frame Foot
69	Bearing Lockwasher	71	Adaptor/backcover
73	Gasket	77	Grease Fitting
89A	O-ring - Backcover	89D	O-ring - Shaft Sleeve
90	Mechanical Seal	99	Bearing Frame
*400	Tubing	*410	Tube Fitting
422	Pipe Plug	*455	Pipe Tee
*487	Pipe Nipple	600	Capscrew
601	Capscrew	602	Capscrew
603	Capscrew	605	Capscrew

Table 5. Parts List for Close Coupled L&H Horizontal Back Pullout Pump

PART NUMBER	PART DESCRIPTION	PART NUMBER	PART DESCRIPTION
1	Casing	2	Impeller - Enclosed
3	Impeller - Semi-open	* 7	Wear Ring
9	Suction Cover for Enclosed. Imp.	10	Suction Cover for Semi-open Imp.
14	Shaft Sleeve	15	Impeller Shim for Semi-open Imp.
24	Impeller Capscrew	28	Impeller Washer
32	Impeller Key	40	Slinger
71	Adaptor/backcover	73	Gasket
89A	O-ring - Backcover	89D	O-ring - Shaft Sleeve
90	Mechanical Seal	*400	Tubing
*410	Tubing Connector	422	Pipe Plug
*445	Pipe Tee	*492	Pipe Nipple
600	Capscrew	601	Capscrew
605	Capscrew		

* Indicates optional part.

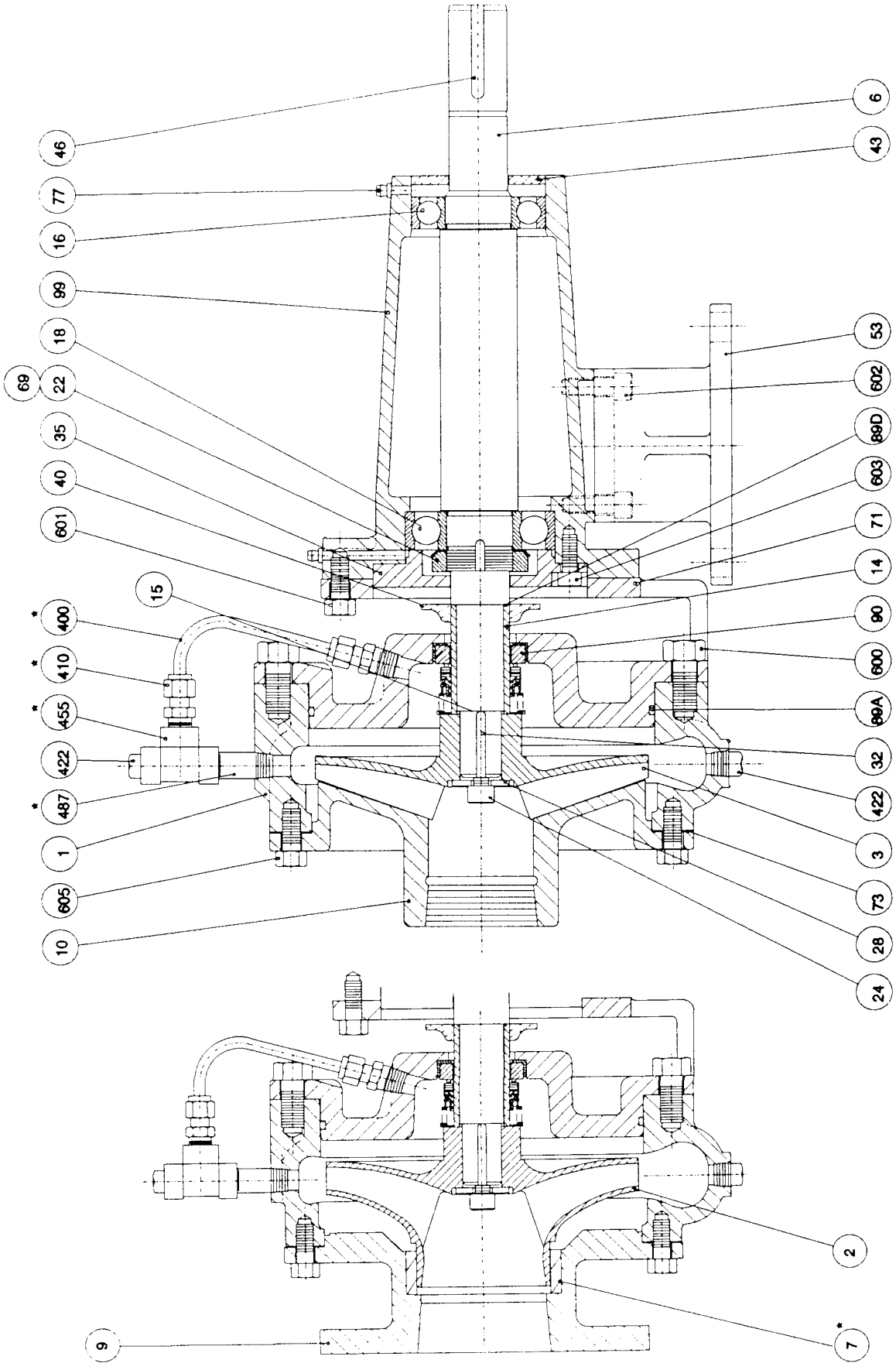


Figure. 2 Sectional for Frame Mounted L&H Horizontal Back Pullout Pump

* Indicates optional part.

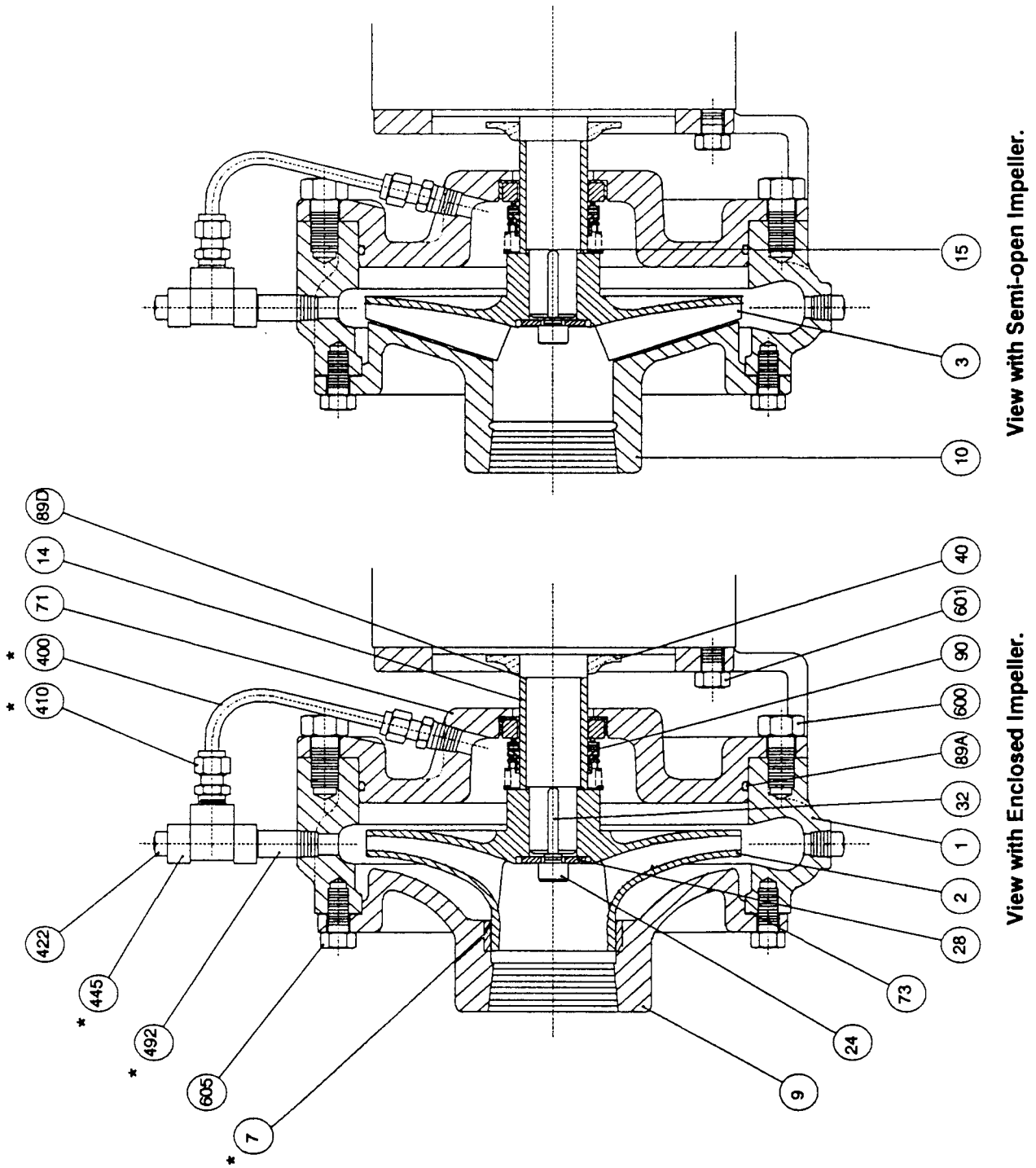


Figure. 3 Sectional for Close Coupled L&H Horizontal Back Pullout Pump

*** Indicates optional part.**

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 _____ Adaptor/backcover _____

Bearing Frame _____ Shaft _____

Impeller _____ Impeller Nut _____

Wear Ring _____ Mechanical Seal _____

MOTOR DATA

Motor_____ Make _____ Serial No. _____

Type_____ Frame_____ AC or DC _____

HP _____ RPM _____ Volts _____

Phase_____ Cycles_____

Notes on Inspection and Repairs

Inspect Date	Repair Time	Repairs	cost	Remarks

Notes: _____

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