Carver®
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I-160BPO Rev. 01

BACK PULLOUT
INSTALLATION, OPERATION, AND
MAINTENANCE INSTRUCTIONS
FOR L&H HORIZONTAL PUMP ON JP SHAFT
MODELS:

1.25 X 1 X 5L
1.25 X 1 X 5LA
2 X 1.5 X 5L
2 X 1.5 X 5LA
2.5 X 2 X5L
2.5 X 2 X 5LA
4 X 3 X 5L
1.25 X 1 X 7L
1.25 X 1 X 7LA
1.5 X 1.25 X 7BL
1.5 S 1.25 X 7BLA
2 X 1.5 X 7L
2 X 1.5 X 7LA
2.5 X 2 X 7L
2.5 X 2 X 7LA
3 X 2.5 X 7L
3 X 2.5 X 7LA
4 X 3 7L
4 X 3 7LA
5 X 4 X7L
5 X 4 X 7LA
1.5 X 1.25 X 10H
1.5 X 1.25 X 10HA
2 X 1.5 X 10H
2 X 1.5 X 10HA
2.5 X 2 X 10H
2.5 X 2 X 10HA
3 X2.5 X 10H
3 X 2.5 X 10HA
4 X 3 X 10H
4 X 3 X 10HA
5 X 4 X 10H
5 X 4 X 10HA
6 X 5 X10BH
6 X 5 X10BHA

PREFACE: The instructions apply to Carver Pump Company L&H horizontal pumps on JP shafts, close-coupled, or frame-mounted models. The pumps covered in this manual have capacities to 2,000 GPM, heads to 390 feet and temperatures to 250 degrees Fahrenheit (121 degrees Celsius). 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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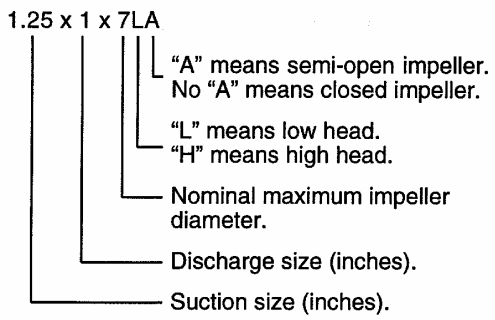
I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

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 the equipment used with the 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.

IMPORTANT SAFETY NOTICE

Various federal, state, and local laws and the regulations concerning OSHA affect installation, use, and operation of pumping equipment. Compliance with such laws relating to the proper installation and safe operation of pumping equipment is the responsibility of the equipment owner. All necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

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 to the factory and to the transportation company any missing or damaged parts incurred during shipment. File a "damage and/or lost in shipment" claim with the carrier.

B. STORAGE OF PUMP. If the pumping unit and/or parts is not immediately installed and operated, store the equipment 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. The pump has been delivered to the job site and is waiting to be installed.
2. The pump has been installed but operation is delayed pending completion of construction.
3. There are long (30 days or more) periods between operating cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

NOTE

Storage requirements vary depending on climatic environment, length of storage, and equipment. For storage periods of three months or longer, contact a representative from Carver Pump Company for specific instructions. Improper storage will damage equipment and will require non-warranty restoration and/or non-warranty 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. Headroom 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. Do NOT use eyebolts 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, 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. Check to make 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 the 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:

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

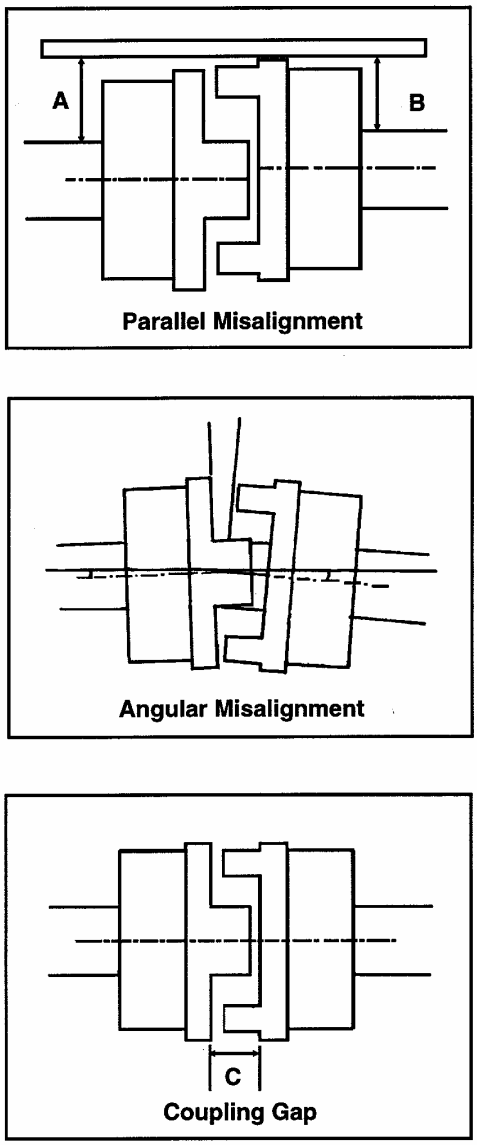


FIGURE 1. COUPLING ALIGNMENT

F. DIRECTION OF ROTATION. Before connecting the coupling halves, bump start driver and verify that rotation is correct. On frame-mounted pumps, an arrow on the bearing frame indicates the correct pump rotation. On closed-coupled pumps, an arrow on the backcover indicates the correct pump rotation. 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.

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

CAUTION

After all the piping is connected, re-check 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. PRE-START 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 liquid 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 liquid, and confirm the seal liquid 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 is 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 the vent.
4. The pump is now primed.

Negative Suction Head:

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

F. INDEFINITE SHUTDOWN. Lubricate 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 checklist 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 is 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. Liquid 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 OR STUFFING BOX LEAKAGE.

1. Excess leakage at seal housing indicates a faulty mechanical seal.
2. Excess leakage at stuffing box indicates improperly adjusted packing gland nut or improperly adjusted packing gland.

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 is 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:
   *Liquid seal line plugged.
   *Flushing liquid 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 performed maintenance 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 use the following procedures:

Reference Table A, Torque Values, to avoid equipment damage and injury to personnel.

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. If mechanical seal option is on pump, check seal housing for leakage. If packing assembly option is on pump, check stuffing box for leakage.

Before disassembly/assembly, review Table A, Torque Values to avoid equipment damage and injury to personnel.

Table A. Recommended Torque Values (ft-lbs)

Bolt Size	Material	
	Steel (or otherwise noted)	316 Stainless Steel
¼"-20	5	7
5/16"-18	11	12
3/8"-16	18	21
½"-13	39	45
5/8"-11	83	97
¾"-10	105	132
7/8"-9	160	203
1"-8	236	300

a. Seal Housing. When first starting the pumping unit, check the area around the seal housing for leakage. Minor leakage through the seal usually stops after a short time. If leakage continues and there is more than 5 drops per minute at the seal housing, replace mechanical seal with new seal. To replace or install new parts, disassemble the pump according to section VII, paragraphs A and B and reassemble according to section VII, paragraph E.

b. Stuffing Box. When first starting the pumping unit, there should be a free leakage at the stuffing box. If there is not a free leakage or if stuffing box begins to smoke, then proceed to step 1.

(1.) Back off nuts (615) until leakage begins.

CAUTION

Do not attempt to shut off all leakage at the stuffing box. There should be a slight leakage at all times. Otherwise, the packing rings (13) will be too tight, causing undue wear of the shaft sleeve (14) and unnecessary consumption of power.

(2.) After several minutes of operation, gradually apply sufficient pressure on packing rings (13) by tightening nuts (615) so that the leakage is reduced to several drops per minute.

(3.) When, after a considerable period of operation, the stuffing box leakage cannot be kept to the desired minimum by tightening nuts (615), replace packing rings (13) according to section VII, paragraph G.

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 good quality ball bearing grease.

To Lubricate Bearings use the following procedure:

1. Lubrication frequency depends on operating conditions. Lubricate 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 lubricate 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 are enough. DO NOT OVERGREASE.

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

VII. SERVICE AND REPAIR.

A. PREPARATIONS FOR DISASSEMBLY OF PUMP.

1. Read this entire section and study the applicable sectional view drawing, figure 2 or 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 from casing bottom. If necessary, flush pump to remove corrosive or toxic pumpage. Install pipe plug in casing when fluid has completely drained. Disconnect piping and gauges as necessary.

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.

NOTE

On pumps equipped with a mechanical seal proceed to step 4. On pumps equipped with a packing assembly proceed to step 5.

4. Remove capscrew (603) along with washer (500) from gland (17). Slide gland (17) towards slinger (40). Proceed to step 6.
5. Remove nuts (615) and washers (500) from studs (630). Remove packing gland (17A) halves from shaft (6).
6. Remove capscrews (600) from backcover (11) 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.
7. 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 (2 or 3) may now be pulled from shaft. Remove impeller key (32).
8. Remove capscrews (602) from backcover (11) and adaptor (71). Remove backcover (11) from adaptor (71) and from shaft (6). Remove o-ring (89A) from backcover (11).

NOTE

On pumps equipped with a mechanical seal, proceed to steps 9 and 10. On pumps equipped with a packing assembly, proceed to steps 11 and 12.

9. On pumps equipped with mechanical seal (90), remove seal spacer (68) and mechanical seal (90) from shaft sleeve (14).

10. Remove shaft sleeve (14), gland (17) and o-ring (89D) from shaft (6). Proceed to step 13.

NOTE

Use a packing hook to remove packing rings.

11. Remove three packing rings (13), lantern ring (29) if present, two additional packing rings (13) and throat bushing (63) from backcover (11).
12. Remove shaft sleeve (14) and o-ring (89D) from shaft (6).
13. Remove slinger (40) from shaft (6).

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

1. Remove nuts (616) from capscrews (601). Disconnect adaptor (71) from bearing frame (99).
2. Remove capscrews (604) from bearing cap (35). 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.
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 and spacer sleeve surfaces 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 in three places.
   b. Measure inside diameter of wear ring in three places.
   c. If difference between high reading of inside diameter of wear ring and low reading of outside diameter of impeller hub exceeds double the maximum clearances given in table 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 and seal spacer or lantern ring, if present and throat bushing. They must be in perfect condition. Replace, if necessary.
8. Inspect o-rings and glands. They must be in perfect condition. Replace, if necessary.
9. Inspect and replace any defective grease fittings.

E. REASSEMBLY OF 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 according to section VI, paragraph B. Install bearing lockwasher (69) and bearing locknut (22) on inboard end of shaft. Crimp tang of bearing lockwasher (69) in one of grooves provided in bearing locknut (22).
2. On frame-mounted pumps, install bearing cap (35) on bearing frame (99) and secure with capscrews (604).

Tighten capscrews evenly.

3. On frame-mounted pumps, reconnect adaptor (71) to bearing frame (99) with capscrews (601) and nuts (616).
4. Install slinger (40) on shaft next to adaptor (71). Install o-ring (89D) on shaft.

Table 1. Wear Ring Clearance

Model (Suction x Discharge x Maximum Impeller Diameter)	FACTORY STANDARD DIAMETRIC CLEARANCE	
	Minimum	Maximum
1.25 x 1 x 5L	0.009	0.014
2 x 1.5 x 5L	0.012	0.016
2.5 x 2 x 5L	0.012	0.016
4 x 3 x 5L	0.016	0.020
1.25 x 1 x 7L	0.012	0.016
1.5 x 1.25 x 7BL	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 10BH	0.021	0.026

NOTE

If a mechanical seal is to be installed, proceed to steps 5 and 6. If a packing assembly is to be installed, proceed to steps 7 and 8.

5. Place gland (17) on shaft (6) next to slinger (40).
6. Lubricate outside of shaft sleeve (14) to facilitate mounting of mechanical seal. Install mechanical seal (90) on shaft sleeve (14) and position rotary face approximately 1/8 inch from end of shaft sleeve (14) with large chamfer. Install shaft sleeve (14) with mechanical seal (90) on shaft (6). Install seal spacer (68) on shaft sleeve (14). Proceed to step 9.

NOTE

New packing rings (13) are die formed and compressed just enough to slide readily without being damaged. Pressure from the fingers should be sufficient for pushing new packing rings (13) into place. If pressure from the fingers is not enough, either the packing rings (13) are too large or some obstruction exists.

When inserting new packing rings (13), make sure the joint in each ring (13) is staggered 90 or 180 degrees.

7. Install shaft sleeve (14) on shaft (6).
8. Using an “S” twist, install three new packing rings (13) on shaft sleeve (14). Install optional lantern ring (29), if present on shaft sleeve (14). Using and “S” twist, install two additional new packing rings (13). Install throat bushing (63) on shaft sleeve (14).
9. Install backcover (11) on adaptor (71) and secure with capscrews (602).

NOTE

If pump is equipped with a closed impeller, omit steps 10 through 12b. Steps 10 through 12b are procedures that describe impeller clearance

adjustment for semi-open impellers only.

CAUTION

During performance of steps 10 through 12b, 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.

10. 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.

11. On frame-mounted pumps, install rotary assembly. On close-coupled pumps, install rotary assembly along with motor. Do not install o-ring (89A) in backcover (11). Secure backcover (11) to casing (1) with capscrews (600).
12. 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 (73), 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 10 through 12a 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.) Install new gasket (73) on suction cover.
(3.) Install suction cover (10), securing with capscrews (605).
(4.) Repeat step 12b until the proper clearance is achieved.

13. Install o-ring (89A) on backcover (11).

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.

14. 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.

15. On frame-mounted pumps, install rotary assembly. On close-coupled pumps, install rotary assembly along with motor. Secure backcover (11) to casing with capscrews (600).

NOTE

On pumps equipped with a mechanical seal, proceed to step 16. On pumps equipped with a packing assembly, proceed to step 17.

16. Position gland (17) next to backcover (11) and secure with washers (500) and capscrews (603). Proceed to step 18.
17. Position gland halves (17A) on shaft (6) secure to backcover (11) with studs (630), washers (500) and nuts (615).
18. Install tubing and tubing fittings, as necessary.

CAUTION

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

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

F. REPLACEMENT OF OPTIONAL WEAR RING ON PUMP EQUIPPED WITH CLOSED IMPELLER. If your pump is equipped with a closed 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 the sectional assembly drawings, 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.

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 from casing bottom. If necessary, flush pump to remove corrosive or toxic pumpage. Install plug when fluid has completely drained.
3. Disconnect piping and gauges as necessary.
4. Remove capscrews (605), which fasten suction cover (9) to casing (1). Carefully break joint at gasket (73) 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 (9). 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.

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

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 that arbor and impeller (2) are running square.
11. Turn wearing surface of impeller (2) until a 63 RMS or better finish is obtained.
12. Measure outside diameter of front impeller hub and record the value.
13. Mount suction cover (9) with new wear ring (7) 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, 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 (73) 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. REPLACEMENT OF PACKING RINGS. To replace packing rings without disassembling the pump use the following procedure:

1. Shut pumping unit down according to section IV, paragraph E.
2. Remove nuts (615) and washers (500) from studs (630). Remove gland halves (17A) from shaft (6).
3. Using a packing hook, remove and discard three packing rings (13).
4. Slide lantern ring (29), if present towards motor end.
5. Using a packing hook, remove and discard two additional packing rings (13).

NOTE

New packing rings (13) are die formed and compressed just enough to slide readily into the stuffing box without being damaged. Pressure with the fingers should be sufficient for pushing new packing rings (13) into place. If pressure from the fingers is not enough, either the packing rings (13) are too large or some obstruction exists.

6. Install two new packing ring (13) using an “S” twist. When inserting new packing rings (13), make sure the joint in each ring (13) is staggered 90 or 180 degrees.
7. Position lantern rings (29) if present, next to packing rings (13).
8. Install three additional new packing rings (13). When inserting new packing rings (13), make sure the joint in each ring (13) is staggered 90 or 180 degrees.
9. Position gland halves (17A) on studs (630). Install washers (500) and nuts (615).
10. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
11. Start pumping unit in accordance with section IV.
12. Adjust leakage rate at stuffing box according to section VI, paragraph A5b.

H. PARTS INVENTORY GUIDE. 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 the sectional view drawings.

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

1. Serial number of pump (located on nameplate).
2. Part description (located on parts list).
3. Part number (located on parts list).
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 LISTINGS AND 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 List

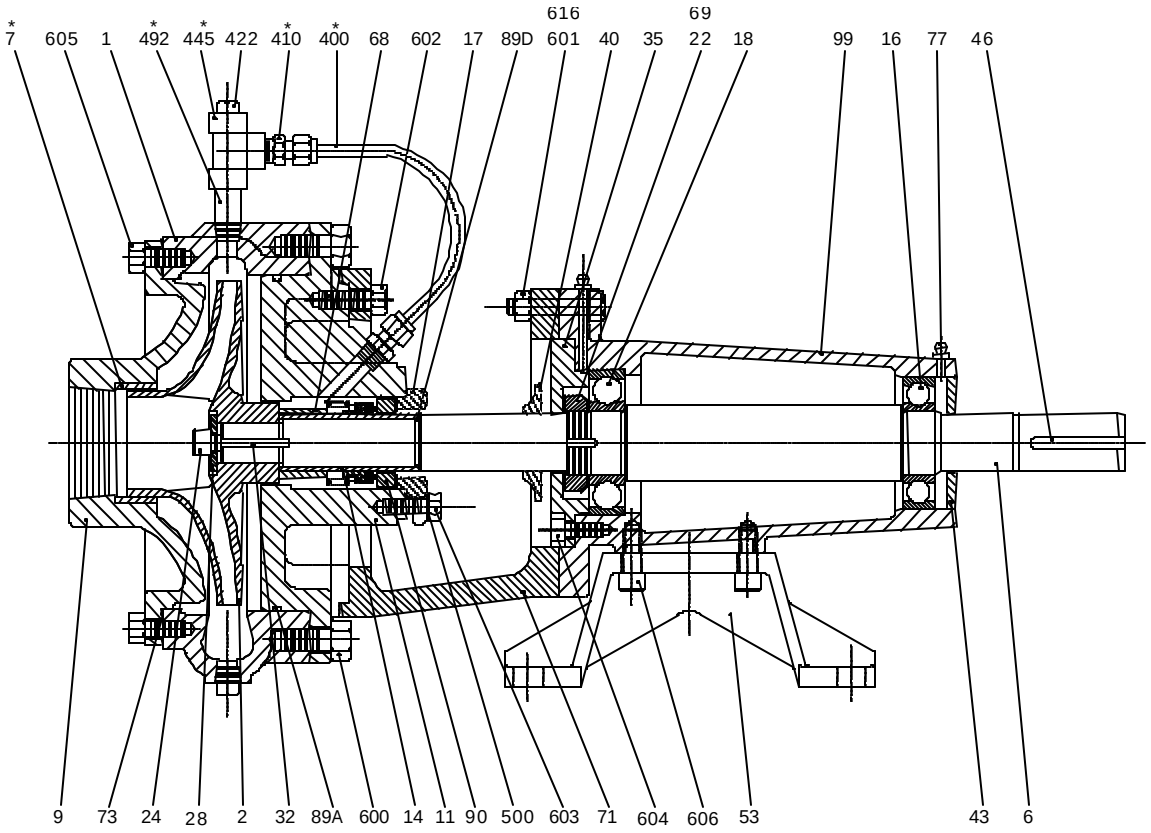
QUANTITY	PART #	DESCRIPTION
1	2 or 3	Impeller
1	6	Shaft
1	7	* Wear Ring for Pump with Closed Impeller
5	13	Packing Rings for Packing Assembly
1	14	Shaft Sleeve
As required	15	Impeller Shims, 0.020 in. for Semi-Open Impeller
1	24	Impeller Capscrew
1	73	Suction Cover Gasket
2	89D	O-ring – Shaft sleeve
1	90	Mechanical Seal for Mechanical Seal Option

Table 4. Parts List for Frame-Mounted L&H Horizontal Pump on JP Shaft

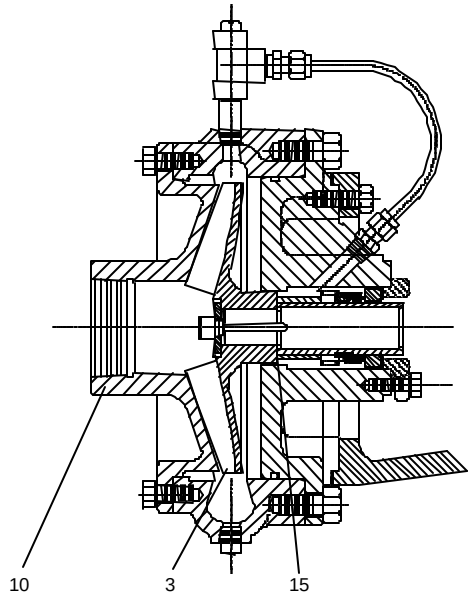
PART #	PART DESCRIPTION	PART #	PART DESCRIPTION
1	Casing	2	Impeller – Closed
3	Impeller – Semi-open	6	Shaft
7	Wear Ring	9	Suction Cover for Closed Imp.
10	Suction Cover for Semi-open Imp.	11	Backcover
13	Packing Ring	14	Shaft Sleeve
15	Impeller Shim for Semi-open Imp.	16	Radial Bearing
17	Gland for Mechanical Seal	17A	Gland Halves for Packing Assembly
18	Thrust Bearing	22	Bearing Locknut
24	Impeller Capscrew	28	Impeller Washer
29	Lantern Ring for Packing Assembly	32	Impeller Key
35	Bearing Cap – I.B.	40	Slinger
43	Bearing Cap – O.B.	46	Coupling Key
53	Frame Foot	63	Throat Bushing for Packing Assembly
68	Seal Spacer for Mechanical Seal	69	Bearing Lockwasher
71	Adaptor	73	Suction Cover Gasket
77	Grease Fitting	89A	O-ring for Backcover
89D	O-ring for Shaft Sleeve	90	Mechanical Seal for Mech. Seal Option
99	Bearing Frame	* 400	Tubing
* 410	Tube Fitting	422	Pipe Plug
* 445	Pipe Tee	* 492	Pipe Nipple
500	Washer	600	Capscrew
601	Capscrew	602	Capscrew
603	Capscrew	604	Capscrew
605	Capscrew	606	Capscrew
615	Hex Nut for Packing Assembly	616	Hex Nut
630	Stud for Packing Assembly		

Table 5. Parts List for Close-Coupled L&H Horizontal Pump on JP Shaft

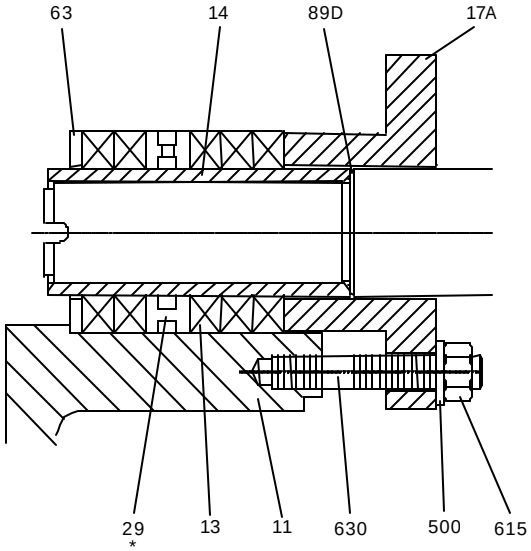
PART #	PART DESCRIPTION	PART #	PART DESCRIPTION
1	Casing	2	Impeller – Closed
3	Impeller – Semi-open	* 7	Wear Ring
9	Suction Cover for Closed Imp.	10	Suction Cover for Semi-open Imp.
11	Backcover	13	Packing Ring for Packing Assembly
14	Shaft Sleeve	14A	Spacer Sleeve for Small Bore Pumps
15	Impeller Shim for Semi-open Imp.	17	Gland for Mechanical Seal
17A	Gland Halves for Packing Assembly	24	Impeller Capscrew
28	Impeller Washer	* 29	Lantern Ring for Packing Assembly
32	Impeller Key	40	Slinger
63	Throat Bushing for Packing Assembly	68	Seal Spacer for Mechanical Seal
71	Adaptor	73	Suction Cover Gasket
89A	O-ring for Backcover	89D	O-ring for Shaft Sleeve
90	Mechanical Seal for Mech. Seal Option	* 400	Tubing
* 410	Tubing Connector	422	Pipe Plug
* 445	Pipe Tee	* 492	Pipe Nipple
500	Washer	600	Capscrew
601	Capscrew	602	Capscrew
603	Capscrew	605	Capscrew
615	Hex Nut	630	Stud



View with Closed Impeller



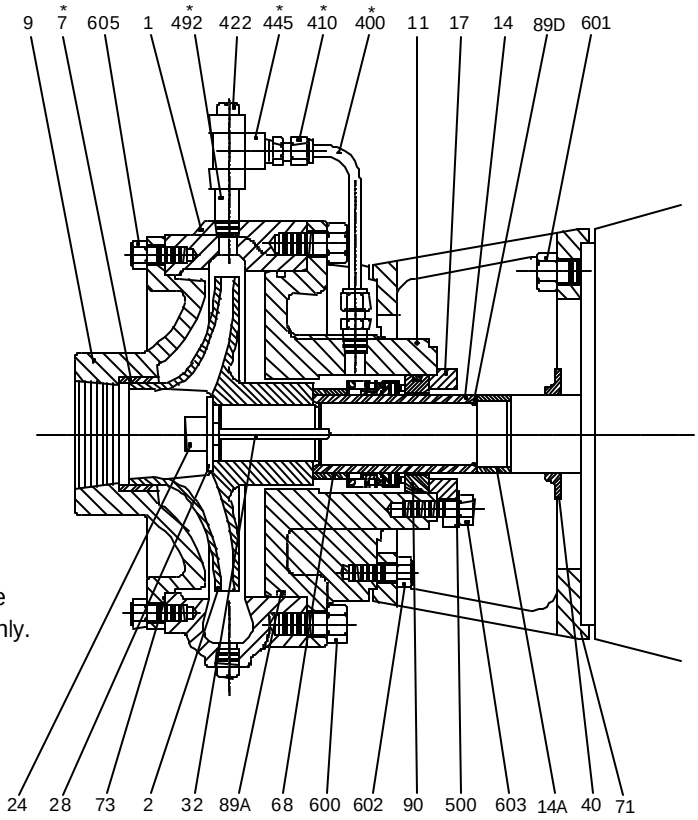
View with Semi-Open Impeller



View with Packing Assembly

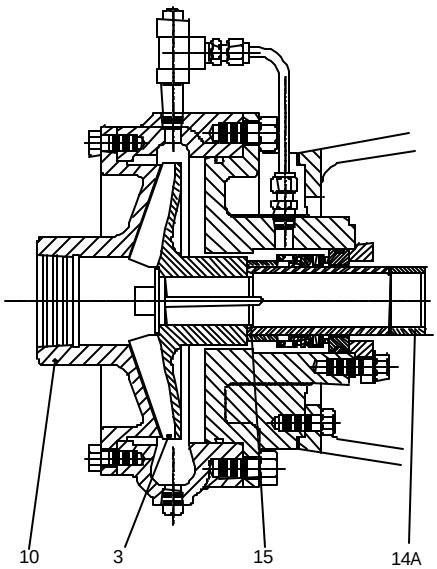
Figure 2. Sectional for Frame -Mounted L&H Horizontal on JP Shaft

*Indicates optional part.

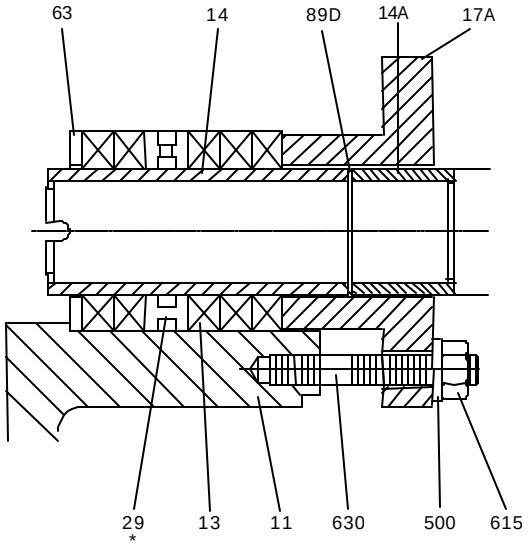


NOTE
Spacer sleeves (14A) are on small bore pumps only.

View with Closed Impeller



View with Semi-Open Impeller



View with Packing Assembly

Figure 3. Sectional for Close-Coupled L&H Horizontal on JP Shaft

*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 _____ Suction Cover _____

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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