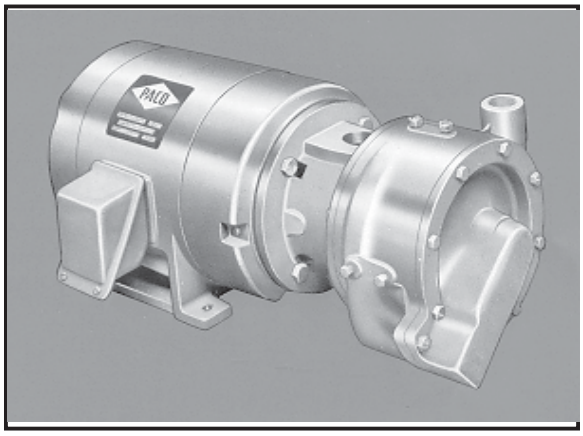
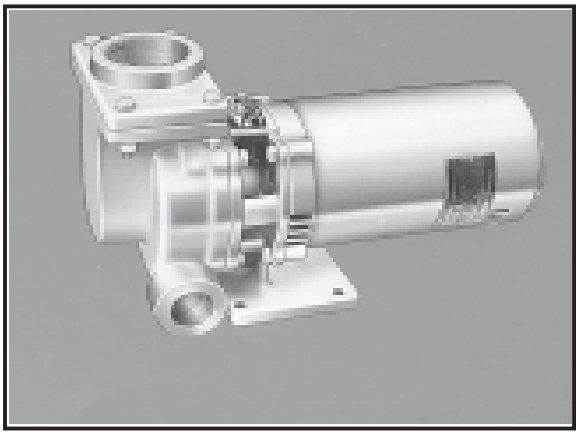
PACO PUMPS

OLN, LN & OL

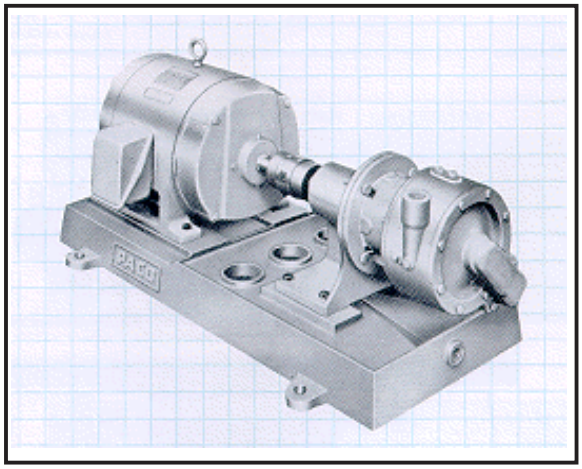
Installation, Operating,
Maintenance Instructions
and
Parts List



TYPE OLN
TWO STAGE



TYPE LN
SINGLE STAGE



TYPE OL
TWO STAGE

PACO PUMPS

TABLE OF CONTENTS

I. INSTALLATION-MECHANICAL

Read these instructions thoroughly before installing and operating your PACO IN-Line Type VL Centrifugal Pump. Successful operation depends on careful attention to the procedures described in Sections 1, 2 of this manual. Keep this instruction manual handy for future use. The enclosed parts lists will prove helpful if replacement parts are required.

A. PUMP IDENTIFICATION

- All PACO Pumps are identified by Catalog and Serial Numbers. These numbers are stamped on the pump nameplate (Fig.1 a) affixed to each pump volute casing, and should be referred to in all correspondence with the Company.

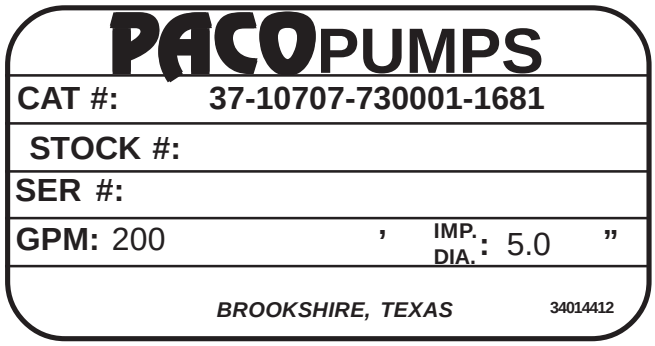


FIGURE 1a

B. RECEIVING

- Check pumping unit for shortage and damage immediately upon arrival. Pump accessories when required are packaged in a separate container and shipped with the unit.

- **If equipment is damaged in transit, promptly report this to the carrier's agent.** Make complete notations on the freight bill to speed satisfactory adjustment by the carrier.

- Unload and handle the unit with a sling. Do not lift unit by lifting lugs on the pump case or eye.

C. TEMPORARY STORAGE

- If pump is not to be installed and operated soon after arrival, store it in a clean, dry area of moderate ambient temperature.

- Rotate the shaft by hand periodically to coat bearing with lubricant and retard oxidation and corrosion.

- Follow motor manufacturer's storage recommendations where applicable.

D. LOCATION

- Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to paragraph F. SUCTION (INLET) PIPING.

- Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive suction head.

- Make sure sufficient NPSH (Net Positive Suction Head) is provided at the suction end by considering the pump's location in relation to the entire system. Available NPSH must always equal or exceed required NPSH specified on the pump performance curve.

- Always allow sufficient accessibility for maintenance and inspection. Provide a clear space with ample head room for use of a hoist strong enough to lift the unit.

- Make sure a suitable power source is available for the pump motor. Electrical characteristics should match those specified on the motor data plate, within the limits covered in Section 3D.

- Avoid pump exposure to sub-zero temperatures to prevent pump liquid from freezing. If freezing conditions exist during shutdown periods, see Section 3E for specific recommendations.

E. PIPING-GENERAL

- **Do not use pump as a support for piping!** Use pipe hangers or other supports at proper intervals to provide complete piping support near the pump. Both suction and discharge piping should be independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened.

- Make sure piping is as straight as possible, avoiding unnecessary bends and fittings. Where necessary use 45° or long-sweep 90° pipe fittings to decrease friction loss.

- Where flanged joints are used make sure that inside diameters properly match.

- Do not spring or force piping when making any connections.

F. SUCTION (INLET) PIPING

The sizing and installation of suction piping is particularly important. It must be selected and installed in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation. Many NPSH problems can be traced directly to improper design of suction piping systems. Observe the following precautions when installing suction piping:

- Suction piping should be as direct as possible, but never shorter than ten times the pipe diameter. Short suction piping can be the same diameter as the suction opening. Longer piping should be one or two sizes larger (depending on length), reducing to diameter of suction opening near the pump.
- At no point should suction piping be smaller in diameter than the pump suction opening.
- Horizontal suction line should follow an even gradient if possible. A gradual upward slope to the pump is recommended for suction lift conditions, and a gradual downward slope for positive suction head.
- Use an eccentric reducer, with the eccentric side down when reducing pipe diameter to diameter of suction opening.
- Avoid any high points, such as pipe loops which may create air pockets and throttle the system or produce erratic pumping.
- Install a gate valve in the suction line to isolate the pump during shutdown and maintenance, and facilitate pump removal. Where two or more pumps are connected to the same suction line, install duplicate gate valves to isolate each pump from the line.
- Gate valves should always be installed in positions that avoid air pockets. Globe valves should not be used, particularly when NPSH is critical.
- Properly sized pressure gauges can be installed in gauge taps on pump suction and discharge nozzles. Gauges enable the operator to monitor pump performance and determine that pump conforms to parameters of performance curve. If cavitation, vapor binding, or other unstable operation occurs, pressure gauges will indicate wide fluctuation in suction and discharge pressures.
- Gauge cocks are recommended for use with pressure gauges from constant wear and vibration when not in use.

G. DISCHARGE (OUTLET) PIPING

- Short discharge piping can be the same diameter as pump discharge opening. Longer piping should be one or two sizes larger depending on length.
- An even gradient is best for long horizontal runs of discharge piping.
- Install a gate valve near the discharge opening to prime and start pump. The discharge gate valve is also used to isolate pump during shutdown and maintenance, and facilitate pump removal.
- Any high points in discharge piping may entrap air or gas and thus retard pump operation.
- If check valves are used, or if other possibilities or liquid hammer exist, close the discharge gate valve before pump shutdown.

H. MECHANICAL SEALS

All PACO Type OLN, LN, OL pumps come equipped with mechanical seals and are matched to conditions for which the pump was sold. Observe the following precautions to avoid seal damage and obtain maximum seal life:

- Do not exceed temperature or pressure limitations for the mechanical seal used.
- **DO NOT RUN THE PUMP DRY OR AGAINST A CLOSED VALVE!** Dry operation will cause seal failure within minutes.
- Clean and purge suction piping in new installations before installing and operating pump. Pipe scale, welding slag and other abrasives can cause rapid seal failure.

I. MOTOR

- Make sure the motor is properly mounted for easy access to conduit connections, grease fittings and drains. Motor may be rotated upon the bracket or volute casing to achieve a satisfactory position.
- Starting and overload control devices (if used) should match electrical characteristics of motor. For safety and convenience these devices may require installation some distance from the pump. Always follow control manufacturer's instructions for proper installation and connection.

J. EXTERNAL WIRING

- Install electrical wiring in accordance with National Electrical Code standards, and local reulations as apply. Line voltage and wire capacity should match motor rating specified on motor data plate, witnin the limits covered in Section IID.

- Connect electrical wiring to motor leads, following motor manufacturer's instructions (if any.)

- Check final connections by breifly supplying power to motor and observing shaft rotation. Motor shaft must rotate in a clockwise direction as viewed from the motor end opposite the pump. (The 1570 rotates in a counter-clockwise direction.) If rotation is coounter-clockwise check motor connections and make necessary wiring changes. (Similarly on the 1570 if rotation is clockwise make necessary changes.)

K. ALIGNMENT

PACO UNITYPE (close-coupled) pumps have a machined bracket fit between pump and motor and re-alignment of pump and motor normally will not be required.

PACO Frame-Mounted pumps (flexible-coupled) do require some re-alignment after shipping. Use a straight edge across coupling and shims under group and motor will bring coupling into alignment. Alignment should be checked again after piping has been filled with liquid.

L. FOUNDATION

A concrete foundation is desirable in permanent installation. Roughen surface of foundation with a chishel and clean off all loose pieces. Set the unit in place and put wedges under each corner and at the sides, midway between the two ends. Check the flexible coupling (if any) for angular misalginment and for horizontal vertical misalignment, and correct by adjusting wedges. Adjustment to correct misalignment in one direction may cause misalignment in another direction, so after making an adjustment, recheck other alignment. After alignment, tighten foundation botls snuggly and recheck alignment before grouting. Pour grout under base. After grout has set, recheck alignmnet, and if necessary to correct it, add to or remove shims under driver feet.

M. RELIEF VALVE

All 9-1/2 inch two-stage pumps are fitted with a safety relief valve to prevent case failure from mis-application. If the pump is operated with the suction and discharge valves closed, there is an internal pressure build-up caused by excessive "no flow" heat generation.

This relief valve should never discharge during normal operation.

If relief valve has discharged, stop pump immediately and determine cause of internal pressure. Replace relief valve before restart.

WARNING: This relief valve is a safety device and must be in place and operational at all times.

Do not remove, tamper with, or attempt to repair; replace only with original part. Failure to comply may result in injury to personnel or damage to equipment.

II. OPERATION

A. PRIMING

- The PACO OLN pump is not self-priming, and must be completely primed (filled with liquid) before starting.

- If pump will operate with a positive suction head, prime by opening suction valve and allowing liquid to enter pump casing. Open air vent at this time, and make sure all air is forced from pump by liquid before closing.

- Rotate the shaft by hand to free entrapped air from impeller passageways.

- If pump has a suction lift, priming must be accomplished by other methods. The use of foot valves or ejectors, or manual filling of the pump casing and suction line with liquid are possible methods suggested for this purpose.

CAUTION

- **NEVER RUN THE PUMP DRY IN THE HOPE THAT IT WILL PRIME ITSELF!** Serious damage to the mechanical seal will result.

B. PRE-START CHECKLIST

Make the following inspections before starting your PACO Type OLN, LN & OL pump:

1. Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce clockwise rotation as viewed from back of motor.

2. If motor has been in storage for an extended length of time, either before or after installation, refer to motor instructions before starting.

3. Check voltage, phase, and line circuit frequency with the motor data plate.

4. Turn rotating element by hand to make sure it rotates freely.

5. Tighten plugs in gauge and drain taps. If pump is fitted with pressure gauges, keep gauge cocks closed when not in use.

6. Check suction and discharge piping for leaks, and make sure all flange bolts are securely tightened .

C. STARTING

- Fully open gate valve (if any) in suction line, and close gate valve in discharge line.

- Fill suction line with liquid and completely prime pump.

- Start the motor (pump).

- Immediately make a visual check of pump and suction piping for pressure leaks.

- Immediately after pump reaches full operating speed, slowly open the discharge gate valve until complete system flow is achieved.

- Check discharge piping for pressure leaks.

- If Pump is fitted with pressure gauges, open gauge cocks and record pressure reading for future reference. Verify that pump is performing in accordance with parameters specified on performance curve.

- Check and record voltage, amperage per phase, and kilowatts if a wattmeter is available.

D. VOLTAGE REGULATION

The motor will operate satisfactorily under the following conditions for voltage and frequency variation, but not necessarily in accordance with the standards established for operation under rated conditions:

- The voltage variation may not exceed 10% above or below rating specified on the motor data plate.

- The frequency variation may not exceed 5% above or below motor rating.

E. SHUTDOWN

The following shutdown procedures will apply in most normal shutdowns for the PACO Type OLN, LN & OL pump: If pump will be inoperative for an extended length of time, follow storage procedures in Section 1 B.

- Always close the discharge gate valve before stopping pump. Close valve slowly to prevent hydraulic shock.

- Cut power to motor.

OVERNIGHT

- For overnight or temporary shutdown periods under nonfreezing conditions, pump may remain filled with liquid. Make sure pump is fully primed before restarting.

- For short or frequent shutdown periods under freezing conditions, keep fluid moving within pump casing and insulate or heat pump exterior to prevent freezing.

LONG PERIODS

- For long shutdown periods, or to isolate pump for maintenance, close suction gate valve. If no suction valve is used and pump has positive suction head, drain all liquid from suction line to terminate liquid flow into pump suction nozzle. Remove plugs in pump drain and vent taps, as required, and drain all liquid from pump volute casing.
- If freezing conditions will exist during long shutdown periods, completely drain pump and blow out all liquid passages and pockets with compressed air. Freezing of pump liquid can also be prevented by filling pump with antifreeze solution.

III. MAINTENANCE

A. MOTOR LUBRICATION

- To lubricate motor while running or at rest, remove grease drain plug (if any) and filler plug on grease fitting. Grease with clean lubricant until grease appears at drain hole or along motor shaft. One-half to one cubic inch of grease is sufficient for motors 5 HP and under, with proportionately more grease for greater HP motors.
- Most fractional and some integral frame motors have "sealed-for-life" bearings, and do not require further lubrication throughout motor life.
- Always follow motor manufacturer's lubrication instructions, and periodically check grease fittings and drain plugs for leaks.
- If lubricating instructions do not accompany motor refer to Table 3a for recommended lubrication periods.

MOTOR RPM	MOTOR HP	OPERATING CONDITIONS		
		STANDARD	SEVERE	EXTREME
1750 & BELOW	1/3 7-1/2	3 YRS.	1 YR.	6 MOS.
	10-40	1-3 YRS.	6 MOS.-1 YR.	3 MOS.
	50-150	1 YR.	6 MOS.	3 MOS.
	200 & UP	1 YR.	6 MOS.	3 MOS.
ABOVE 1750	(ALL HP)	6 MOS.	3 MOS.	3 MOS.

TABLE 3b

STANDARD CONDITIONS 8 hours per day operation, normal or light loading, clean air, 100° F maximum ambient temperature. **SEVERE CONDITIONS** Continuous 24 hour operation, shock loading or vibration, poor ventilation, 100–150° F ambient temperature.

EXTREME CONDITIONS Continuous operation, heavy shock or vibration, dirt or dust in air, extreme ambient temperatures.

Table 3b lists recommended types of grease for both pump and motor lubrication. These types have all been thoroughly tested and should be used whenever possible.

B. PUMP LUBRICATION

- Close coupled (unitype) pumps, both type OL, LN and OLN, require no lubrication.
- If pedestal (frame-mounted) pump is provided with grease fittings or plugs, its ball bearings will require lubrication. Pumps are shipped from the factory with sufficient grease for one or two months operation. If bearings have not been in operation for four months or more, fresh grease should be used and the old grease flushed out before operation. When in storage, motor or pump should be turned by hand if accessible every month or so to keep bearings covered with grease, preventing rust from moisture. If bearing has bottom plug as well as top plug or fitting, remove bottom plug, this allowing old grease to escape.
- Table 7a lists recommended types of grease for both pump and motor lubrication. These types have all been throughly tested and should be used whenever possible.

MANUFACTURER	LUBRICANT
SHELL	**DOLIUM R**
EXXON	**POLYREX**
CHEVRON	**SRI GREASE NLGI 2**
	BLACK PEARL - NLGI 2
PHILLIPS	**POLYTAC**
TEXACO	**POLYSTAR RB**

Table 7a

C. MECHANICAL SEALS

Mechanical seals are precision made parts. When properly installed, they prevent pump liquid from leaking out around the shaft. Seal faces can be easilyscratched or damaged by handling, and extreme care must be taken to prevent their contact with hard surfaces or abrasives.

- Figure 3a (below) indentifies major seal components, and illustrates how an end face mechanical seal functions when properly installed inside pump casing.
- If seal failure develops, follow the procedures described in Section 4c or 4d (as applicable and replace worn seals with new mechanical seals.

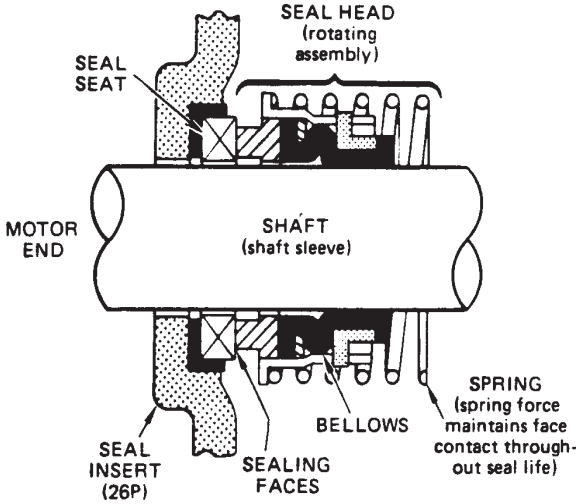


FIGURE 3a: End Face Mechanical Seal

D. WEAR RINGS

- Case wear rings are designed to serve as a buffer between pump casing and rotating impeller. As the name implies, these rings will wear with pump use and must be periodically replaced. Water ring life varies significantly with composition of liquid being pumped, and will be greatly extended by absence of abrasive particles in liquid.

- Wear rings also serve an important hydraulic func tion, minimizing pressure leakage from high to low pressure zones inside the pump volute casing. Rings should be replaced when the diametrical clearance between impeller and wear ring exceeds the following values for rated discharge sizes.

PUMP DISCHARGE SIZE (IN INCHES)	1-1/4 - 2
MAXIMUM CLEARANCE (IN THOUSANDTHS)	.030

- To replace used wear rings, follow procedures out lined in Section IV. Always make sure wear ring cavity in pump volute casing is thoroughly cleaned before replacement, to insure a properly aligned fit.

IV. DISASSEMBLY & ASSEMBLY

A. Disassembly and Assembly of PACOType LN UNITYPE with Fractional or Integral Frame Motor.

1. Refer to correct drawing in Section VI for model to be disassembled.

2. Remove volute cap screws and lift motor and pump assembly from Volute 1A.

3. Remove Volute Gasket 11A from bottom face of bracket and sicard. New sealin gasket should always be used whenever pump is reasssembled.

4. If pump is equipped with fractional frame, unscrew Inpeller 3A from motor shaft. Loctite is applied to impeller threads during factory assembly and must be loosened by applying torch heat to eye of impeller and uscrewing while hot. To block shaft rotation while removing impeller, hold a large screwdriver securely in slot at back end of motor shaft and unscrew impeller.

- If pump is equipped with integral frame motor, remove Impeller Cap Screw 8A and Washer 10A, then remove Impeller 3A from shaft using two pry bars to prevent breaking or damaging impeller. Position pry bars in close proximity to impeller vanes for maximun structural leverage. Remove Impeller Key 12A.

5. See Section V for seal disassembly and assembly.

6. Remove the Shaft Sleeve 5A, if present. Models equipped with a 7-inch impeller and a 5/8 inch shaft, do no use a shaft sleeve.

7. Remove Motor Bracket 21A from shaft, and pry worn seal seat from inset on bottom of bracket, if not already done in Step 5.

   Gryropoise motors feature a bracket which is part of the motor motor intself. This step may be eliminated if the model being disassembled is equipped with a gyropoise motor.

8. Water Slinger, if present, is installed on motor shaft with press fit and may be pried loose manu-ally be twisting screwdriver head or sharp edge of metal object between slinger and motor.

9. After making sure all machined surfaces are thoroughly cleaned, reassemble in reverse order. Apply loctite to threads of impeller and motor shaft prior to reinstalling impeller.

B. Disassembly and Assembly of PACOType OL, LN or OLN Two-Stage Pump or Frame Mounted.

1. Refer to correct drawing in Section VI for model to be disassembled.

2. Remove Cover 2A. Remove and discard Cover Gasket 11A or O-Rings 17A and 17C.

3. Refmove Impeller Capscrew 8A and IMpeller Washer 10A. Remove nuts. With two large screwdrivers on opposite sides of volute, pry evenly to remove Volute 1A and second-stage Impeller 3F. Prying unevenly with bend shaft. Remove and discard Volute Gasket 11F or O-Ring 17A.

4. Remove First-Stage Impeller 3A, using two large screwdrivers as above. Remove First-Stage Impeller Key 12E, if present.

5. If they are to be replaced, remove first stage impeller wear ring 4A and second stage impeller wear ring 4B. The rings have to be drilled and broken out with a chisel.

6. Remove Seal Retaining Ring 61B from Shaft Sleeve 5A. TO REPLACE SEAL, SEE SECTION MECHANICAL SEAL REPLACEMENT, Section IV.

7. Remove bolts connecting bracket 21A to motor or bearing frame.

8. Remove Water Sling 13G.

9. Remove shaft sleeve (5A), apply heat to loosen Loctite. When Loctite is soft, sleeve can be twisted by holding it with channel locks, and slide off the shaft.

To Disassemble Bearing Frame:

10. Remove Moisture Seal 14M, if present.

11. Remove Bearing Housing Retaining Ring 61F and press or tap bearing-shaft assembly unit one bearing is out. Remove second Retaining Ring 61K, if present, and pull complete assembly from bearing housing.

12. Remove Shaft Retaining Ring 61C, if present, and press off bearings.

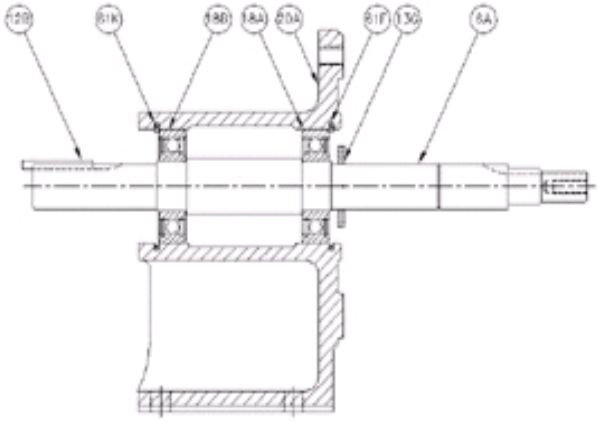
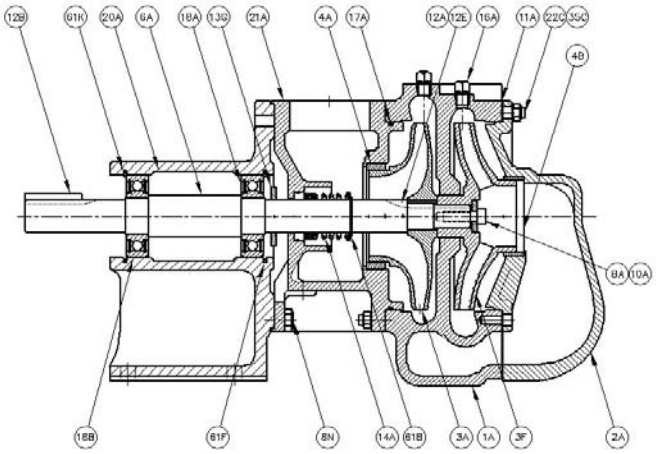


Figure 4A Bearing Frame Assembly

CLOSED COUPLED PUMP

Part No.	Description
1A	Volute
2A	Outboard Cover
3A	Impeller, 1st Stage
3F	Impeller, 2nd Stage
4A	Case Wear Ring, 1st Stage
4B	Case Wear Ring, 2nd Stage
5A	Shaft Sleeve
8A	Impeller Capscrew
8N	Capscrew
10A	Impeller Washer
11A	Gasket
12A	Impeller Key, 1st Stage
12E	Impeller Key, 2nd Stage
13G	Slinger
14A	Mechanical Seal
16A	Pipe Plug
17A	O-Ring
21A	Suction Bracket
22C	Stud
35C	Nut
61B	Snap Ring
65A	Motor



Assembly

Figure 6F Bearing Frame

FRAME MOUNTED PUMP

Part No.	Description	Part No.	Description
1A	Volute	14A	Mechanical Seal
2A	Outboard Cover	16A	Pipe Plug
3A	Impeller, 1st Stage	17A	O-Ring
3F	Impeller, 2nd Stage	18A	Ball Bearing
4A	Case Wear Ring, 1st Stage	18B	Ball Bearing
4B	Case Wear Ring, 2nd Stage	20A	Bearing Frame
*5A	Shaft Sleeve	21A	Suction Bracket
6A	Shaft	22C	Stud
8A	Impeller Capscrew	*23A	Coupling
8N	Capscrew	*23B	Coupling
10A	Impeller Washer	*23C	Coupling
11A	Gasket	35C	Nut
12A	Impeller Key, 1st Stage	61B	Snap Ring
12E	Coupling Key	61F	Snap Ring
12E	Impeller Key, 2nd Stage	61K	Snap Ring
13G	Slinger	*65A	Motor

To Reassemble Bearing Frame

13. Reassemble pump in reverse order, using new gaskets and seals.

14. See paragraph C, page 8 for instructions on use of Locite to reinstall impeller and/or shaft sleeve.

C. Special Instructions for Assembling Impellers for PACO OLN Type Models 39-1595 and 39-20953.

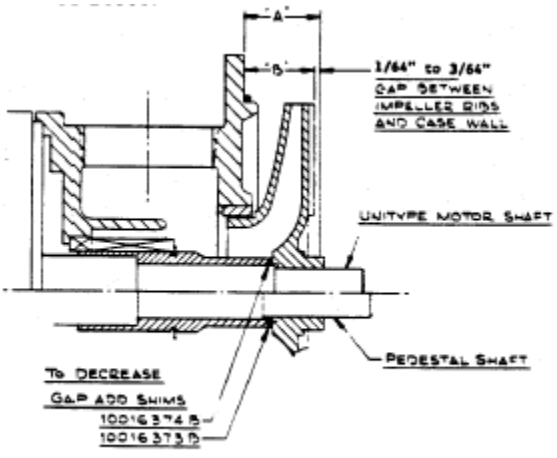


Figure 4b

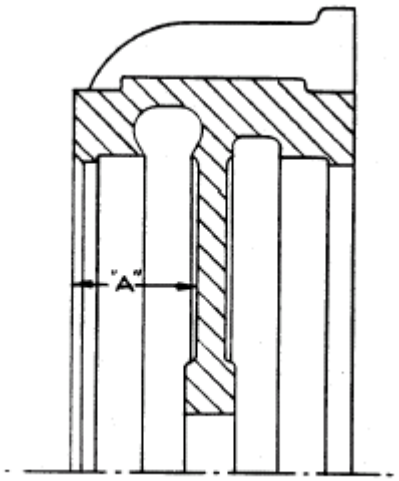


Figure 4c

Assembly Procedures:

1. Place straight edge across case and measure “A”.

2. Place straight edge across impeller ribs and measure “B”.

   The gap, “A” minus “B”, MUST BE BETWEEN 1/64” to 3/64”. To increase the gap, add insert gaskets; to shorten gap, add shims in front or impeller.

E. LOCTITE

- Loctitie adhesive compound is a liquid resin that produces a tough bond when applied to threaded and close-fitting connections during assembly. It is used by Sulzer on all threaded impellers, to prevent inadvertent counter-rotation during pump operation, and on shaft sleeves to secure to motor shaft.

- If adhesive shear strength is too great for disassembly with ordinary had tools, parts must be heated by torch and disassembled while hot. Apply torch heat to impeller eye when unscrewing threaded impellers, axially along shaft sleeve exterior to loosen for removal. Holding power of Loctite decreases as temperature rises, and compund completely decomposes at temperatures above 650° F.

- If adhesive shear strength is too great for disasssembly with ordinary hand tools, parts must be heated by torch and disassembled while hot. Apply torch heat to impeller eye when unscrewing threaded impellers, axially along shaft sleeve exterior to loosen for removal. Holding power of Loctite decreases as tempeature rises, and compund completely decomposes at tempeatures above 650°F.

- Wipe or brush clean all adhesive surfaces fefore reapplying Loctite. Locquic Primer is a degreasing agent recommeded for use in preparing mating surfaces for Loctitie application. Do not use gasoline or other petroleum products for cleaning, because an oily surface will remain. Assemble shaft sleeves with twisting motion to insure an even hold, and always make sure sleeve is firmly in place against shaft shoulder.

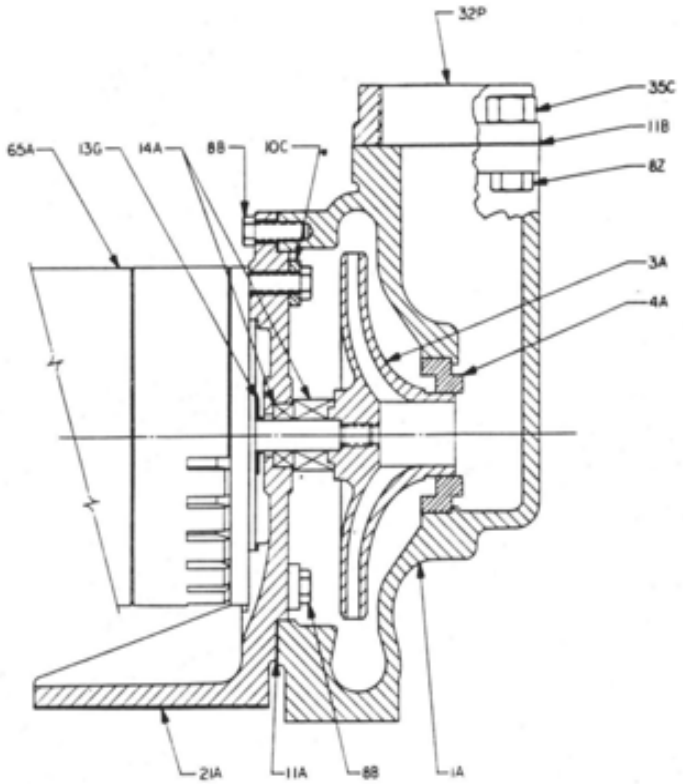
F. WEAR RINGS

- To remove worn Case Wear Ring 4A, drill two holes (slightly smaller than width of ring) into exposed edge of ring. Once holes are drilled, a chisel may be used to completely sever ring at holes, and break

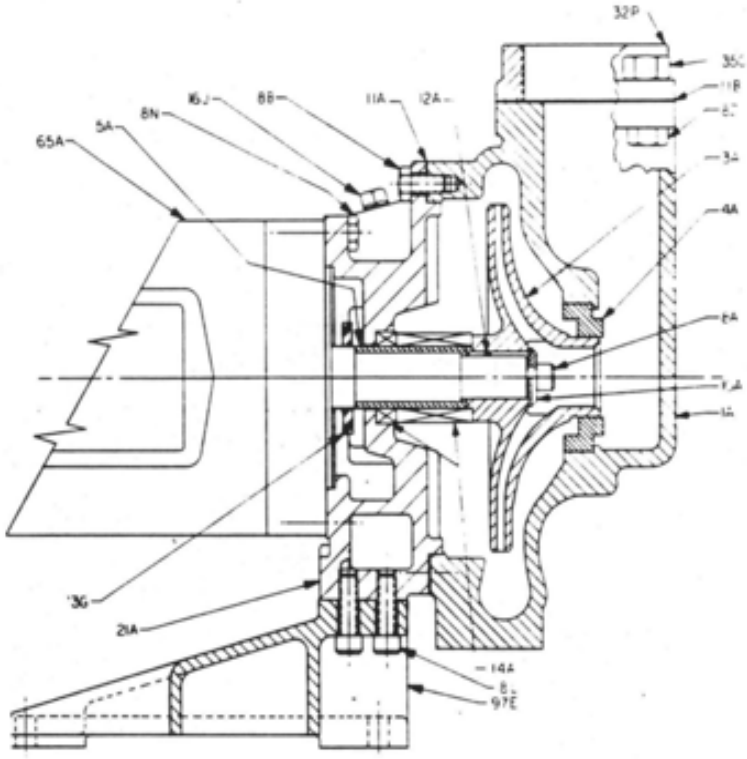
PACO PUMPS

TYPE LN
CROSS SECTION AND PARTS LIST

A4a.1



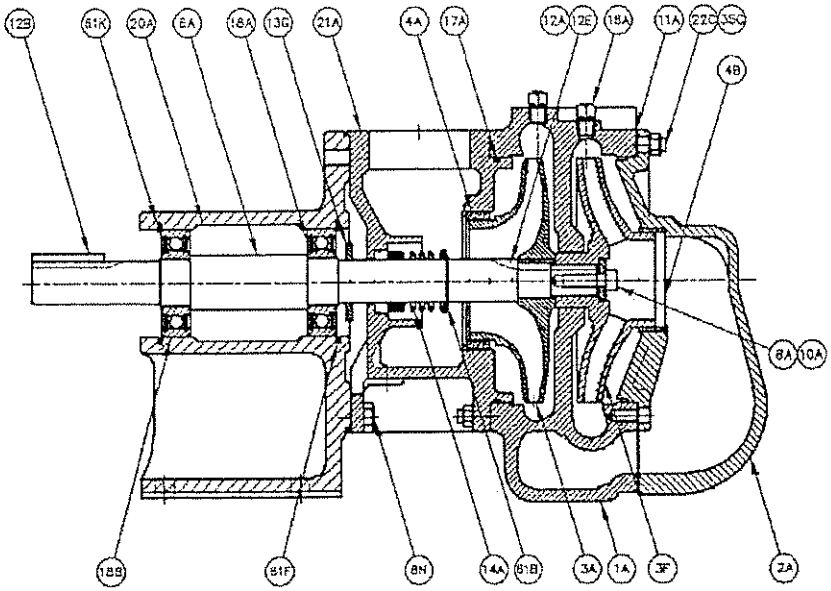
UNITYPE PUMP	
Part No.	**Description**
1A	Casing
3A	Impeller
4A	Case Wear Ring
8B 8D	Capscrew—Volute Capscrew—Motor
8Z 10C	Capscrew Washer
11A 11B	Gasket Gasket
13G 14A	Slinger Mechanical Seal
21A	Bracket
32P 35C	Suction Flange Nut
65A	Motor



FRAME MOUNTED PUMP	
Part No.	**Description**
1A	Casing
3A	Impeller
4A	Case Wear Ring
5A 8A	Shaft Sleeve Impeller Screw
8B 8L 8N 8Z 10A	Capscrew Capscrew Capscrew Capscrew Impeller Washer
11A 11B	Gasket Gasket
12A	Key
13G 14A	Slinger Mechanical Seal
16J	Pipe Plug
21A	Bracket
32P 35C	Suction Flange Nuts
65A	Motor
97E	Foot Support

PACO PUMPS

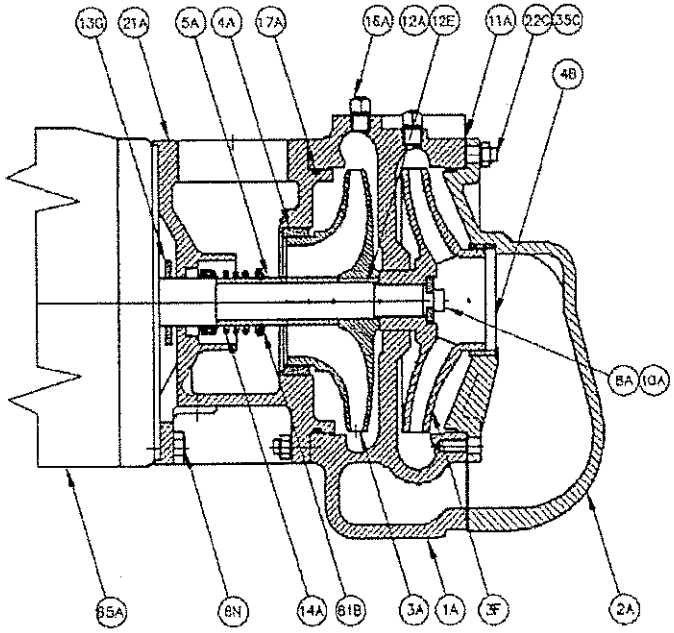
TYPE OLN – FM
CROSS-SECTION AND PARTS LIST



FRAME MOUNTED PUMP

Part No.	Description	Part No.	Description
1A	Volute	14A	Mechanical Seal
2A	Outboard Cover	16A	Pipe Plug
3A	Impeller, 1st Stage	17A	O-Ring
3F	Impeller, 2nd Stage	18A	Ball Bearing
4A	Case Wear Ring, 1st Stage	18B	Ball Bearing
4B	Case Wear Ring, 2nd Stage	20A	Bearing Frame
*5A	Shaft Sleeve	21A	Suction Bracket
6A	Shaft	22C	Stud
8A	Impeller Capscrew	*23A	Coupling
8N	Capscrew	*23B	Coupling
10A	Impeller Washer	*23C	Coupling
11A	Gasket	35C	Nut
12A	Impeller Key, 1st Stage	61B	Snap Ring
12E	Coupling Key	61F	Snap Ring
12E	Impeller Key, 2nd Stage	61K	Snap Ring
13G	Slinger	*65A	Motor

TYPE OLN – CC
CROSS-SECTION AND PARTS LIST

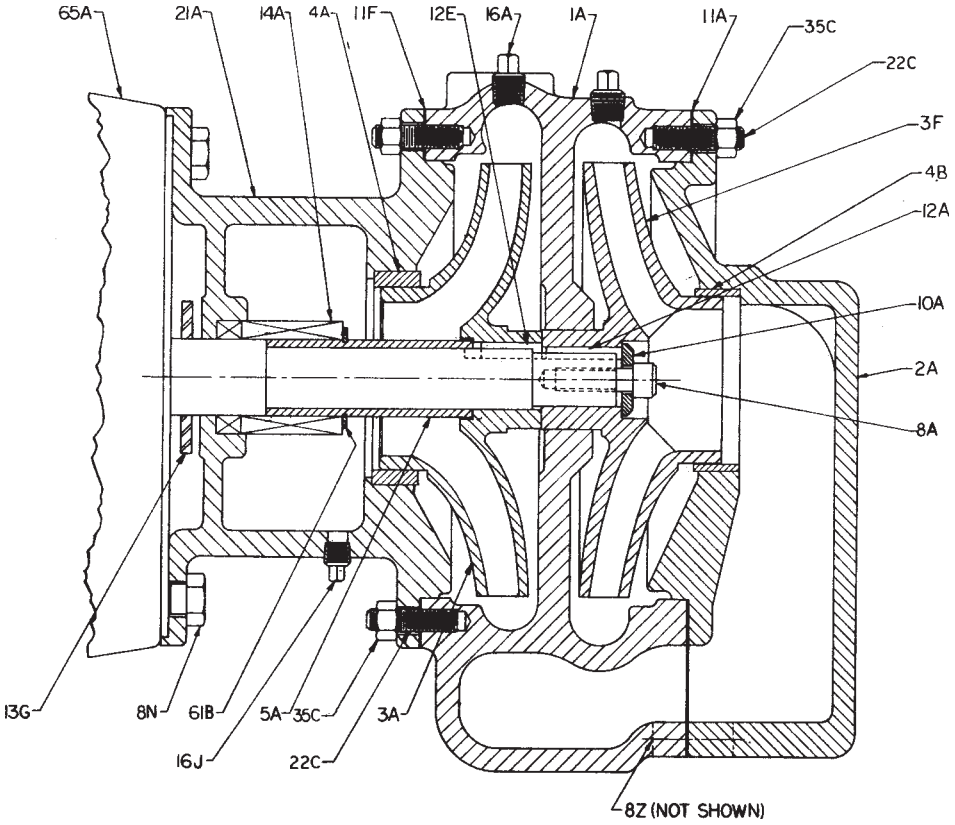


CLOSED COUPLED PUMP

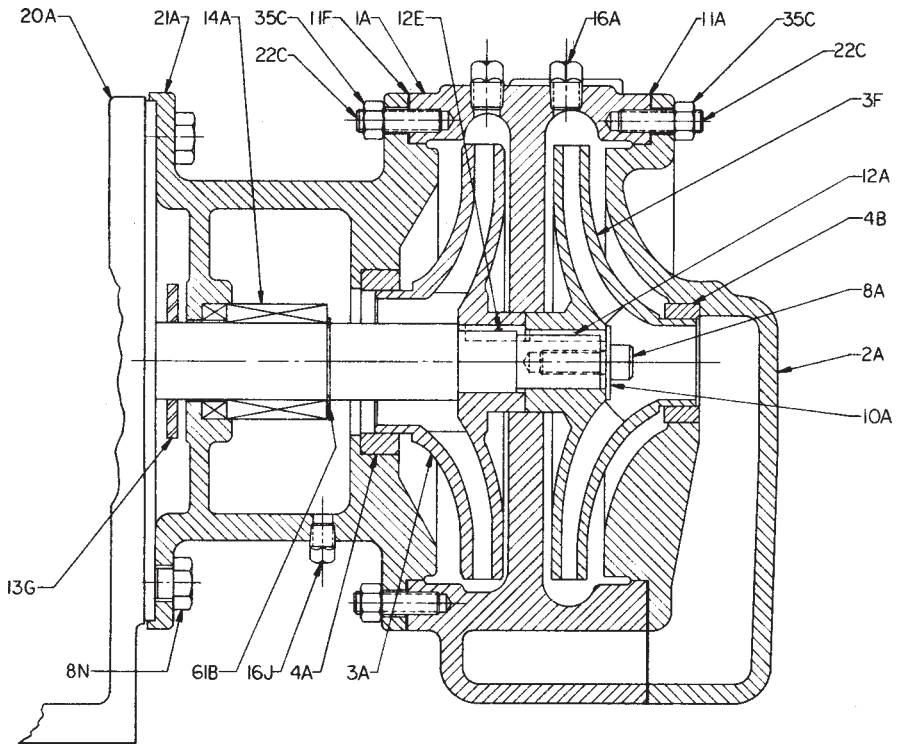
Part No.	Description	Part No.	Description
1A	Volute	12A	Impeller Key, 1st Stage
2A	Outboard Cover	12E	Impeller Key, 2nd Stage
3A	Impeller, 1st Stage	13G	Slinger
3F	Impeller, 2nd Stage	14A	Mechanical Seal
4A	Case Wear Ring, 1st Stage	16A	Pipe Plug
4B	Case Wear Ring, 2nd Stage	17A	O-Ring
5A	Shaft Sleeve	21A	Suction Bracket
8A	Impeller Capscrew	22C	Stud
8N	Capscrew	35C	Nut
10A	Impeller Washer	61B	Snap Ring
11A	Gasket	65A	Motor

PACO PUMPS

TYPE OL
CROSS SECTION AND PARTS LIST



UNITYPE PUMP	
PART NO.	**DESCRIPTION**
1A	Casing
2A	Cover
3A	First Stage Impeller
3F	Second Stage Impeller
4A	Case Wear Ring
4B	Case Wear Ring
5A	Shaft Sleeve
8A	Impeller Screw
8N	Capscrew
8Z	Capscrew
10A	Impeller Washer
11A	Gasket
11F	Gasket
12A	Key
12E	Key
13G	Slinger
14A	Mechanical Seal
16A	Pipe Plug
16J	Pipe Plug
21A	Bracket
22C	Studs
35C	Nuts
61B	Retaining Ring
65A	Motor



FRAME MOUNTED PUMP	
PART NO.	**DESCRIPTION**
1A	Casing
2A	Cover
3A	First Stage Impeller
3F	Second Stage Impeller
4A	Case Wear Ring
4B	Case Wear Ring
8A	Impeller Screw
8N	Capscrew
10A	Impeller Washer
11A	Gasket
11F	Gasket
12A	Key
12E	Key
13G	Slinger
14A	Mechanical Seal
16A	Pipe Plug
16J	Pipe Plug
20A	Bearing Frame
21A	Bracket
22C	Studs
35C	Nuts
61B	Retaining Ring

VII. TROUBLE-SHOOTING CHECKLIST

FACTORY AUTHORIZED PARTS

PACO maintains a stock of Replacement Parts Kits at its manufacturing facilities. Shipment of these kits is normally made within three days after receipt of an order. In emergency situations, shipments can usually be made within 24 hours.

Be sure to include unit serial number and catalog number when ordering any parts.

PUMP DOES NOT DELIVER ANY LIQUID

LACK OF PRIMER	Repeat priming procedure outlined in Section 3A and make sure pump is completely primed with liquid. Make sure all air is bled from pump and suction piping, and piping is completely filled with liquid.
SPEED TOO LOW	Make sure power is directly across-the-line, and motor is receiving full voltage. If frequency is too low, or if motor has an open phase, refer to Section: 2 and make necessary correction. If power is supplied from separate generator source, make sure generator is running at proper speed for voltage required.
WRONG ROTATION	Make sure that pump (motor) is rotating in a clockwise direction, as viewed from back of motor. Check rotation arrow on top of pump volute casing.
DISCHARGE HEAD TOO HIGH	Check piping for friction losses, and make sure discharge head matches conditions for which pump was selected (pump rating). Larger diameter piping may correct conditions of excessively high discharge head. Make sure that no obstructions exist in discharge piping.
SUCTION LIFT TOO HIGH	Check for obstructions at suction inlet, and check for possible friction losses in suction piping (use a friction table). To determine if static lift is too great, measure suction pressure with a mercury column or gauge while pump is operating. Static lift can be reduced either by raising the surface level of liquid being pumped, or by lowering the pump.
IMPELLER CLOGGED	Disassemble pump volute casing and completely clean impeller passageways.

PUMP DOES NOT DELIVER ENOUGH LIQUID

SUCTION PIPING LEAKS AIR	Make sure all flange and valve connections in suction line are airtight. If liquid being pumped is non-explosive, and explosive gas or dust is not present, air leakage can be checked by holding a match near pipe joints and checking flame for flutter. If flammable liquid is being pumped, suction line can be tested by closing off suction inlet and submitting line to pressure. Make sure all leaks are completely sealed
SPEED TOO LOW	(See above.)

TROUBLE-SHOOTING CHECKLIST (Cont'd)

DISCHARGE HEAD TOO HIGH	(See above.)
SUCTION LIFT TOO HIGH	(See above.)
IMPELLER PARTIALLY CLOGGED	(See above.)
INSUFFICIENT NPSH FOR HOT WATER	Condition can be determined by connecting pressure gauge to suction piping, or to gauge tap on pump suction nozzle. Gauge indicator will oscillate if water is flashing to steam in suction line.
WEAR RING EXCESSIVELY WORN	Inspect case wear ring for excessive wear. If wear ring is defective, replace with new wear ring.
IMPELLER DAMAGED	Inspect pump impeller. Check impeller wear ring surface. If impeller is excessively damaged or impeller vanes badly worn (eroded), replace with new impeller.
FOOT VALVE TOO SMALL	Inspect foot valve and make sure area through ports of valve is at least as large as area of pump suction piping (preferably 1 1/2 times as large). If strainer is used with foot valve, the net clear area should be three to four times that of suction piping.
	If inlet cannot be lowered, or if swirling eddies are created which permit air to enter suction line, chain a board to suction piping (near inlet). Board will be drawn into whirlpool, smothering the vortex and preventing air funnels from entering line.

PUMP DOES NOT PRODUCE ENOUGH PRESSURE

SPEED TOO LOW	(See above.)
AIR OR GASES IN LIQUID	To determine whether gases are present in liquid being pumped, e.g., marsh gas in swamp water, test liquid in laboratory by simulating suction line pressure and checking for bubble formation. It may be possible to overrate pump to a point where it will provide adequate pressure, despite existing conditions. A better solution is to install a gas-separation chamber in the suction line near the pump, and periodically exhaust accumulated gas.
IMPELLER DAMAGED	(See above.)
WEAR RING EXCESSIVELY WORN	(See above.)
IMPELLER DIAMETER TOO SMALL	Check with Company representative to determine if larger impeller can be used. Otherwise, reduce pipe friction losses or increase speed of impeller rotation. (Make sure motor is not seriously overloaded.)

PUMP OPERATES BRIEFLY, THEN STOPS

IMPROPER PRIMING	Repeat priming procedure outlined in Section 3a.
SUCTION LIFT TOO HIGH	(See above.)
SUCTION PIPING LEAKS AIR	(See above.)
AIR OR GASES IN LIQUID	(See above.)

PUMP USES TOO MUCH POWER

DISCHARGE HEAD LESS THAN PUMP RATING	Reduce outside diameter of pump impeller. Impeller diameter may be turned down on a lathe and rebalanced, or replaced with smaller diameter impeller.
LIQUID TO HEAVY (VISCOSITY, OR SPECIF. GR.)	Use motor with greater horsepower rating or reduce RPM.
WRONG ROTATION	(See above.)
VOLUTE CASING DISTORTED BY PIPING STRESS	Check pump alignment. Examine pump interior for excessive or unusual friction between impeller and casing. Check wear ring and rotating elements, and replace worn or damaged parts.
MISALIGNMENT	Realign pump and motor and clean all mating surfaces.
VOLTAGE INCORRECT	(See page 5, section “D”)

D. DISASSEMBLY

Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work needed.

1. Turn off power
2. Drain system. Flush if necessary.
3. Closed-Coupled Units: Remove couping, spacer
   Frame-mounted Units: Remove coupling, spacer, coupling guard and frame hold-down bolts.
4. Disassembly of Liquid End:
   - Remove casing bolts (370)
   - Remove back pull-out assembly from casing (100).
   - Unscrew impeller nut (304) with a socket wrench.

CAUTION
Do not insert screwdiver between impeller vanes to prevent rotaion.

It may be necessary to use a strap wrench around the impeller if impacting the socket wrench will not loosen the impeller bolt. Hold shaft on frame mounted units.

- Use two pry bars, 180 degrees apart, to remove impeller (101) from shaft.
- Remove impeller key (178) and seal spring.
- With two pry bars 180 degrees apart inserted through the windows of the motor adapter (108), pry on the end of the shaft sleeve (126). The mechanical seal rotary unit (383)will come off with the sleeve.
- Remove the seal housing adapter bolts (370H). Remove seal housing (184) togehter with station ary seal parts.
- Place seal housing on flat surface and press out stationary seal parts.

Terms And Conditions Of Sale

SECTION 1: THE CONTRACT

The Contract shall be comprised of the following terms, together with such terms and conditions as are set forth in Seller's written proposal or quotation (the "Quotation"), including any documents, drawings or specifications incorporated therein by reference, and any additional or different terms proposed in Buyer's purchase order (the "Purchase Order") that are accepted by Seller in writing, which together shall constitute the entire agreement between the parties, provided, however, that preprinted terms on Buyer's purchase order or invoice shall not apply and Seller gives notice of objection to such terms. An offer by Seller in its Quotation that does not stipulate an acceptance date is not binding. This Contract shall be deemed to have been entered into upon written acknowledgment of the Purchase Order by an officer or authorized representative of Seller, which may not be modified, supplemented, or waived except in a writing executed by an authorized representative of the party to be bound.

SECTION 2: PRICE

The price quoted in the Quotation shall be the Purchase Price unless otherwise agreed in the Purchase Order. The Purchase Price for equipment shall include packing for shipment. Field Services shall be provided at Seller's standard rates. All other costs, including packing for storage, freight, insurance, taxes, customs duties and import/export fees, or any other item not specified in the Contract, shall be paid by Buyer unless separately stated in the Quotation and included in the price quoted. Any sales, use, or other taxes and duties imposed on the transaction or the equipment supplied shall be paid or reimbursed by Buyer.

SECTION 3: PAYMENT TERMS

Payment shall be due within 30 days of the date of Seller's invoice in U.S. funds unless otherwise agreed. If Buyer does not observe the agreed dates of payment, Buyer shall pay interest to Seller on overdue amounts at a rate that is the higher of: 9% per annum or a rate 5% in excess of the rate borne from time to time by new issues of six-month United States Treasury bills. Seller shall be entitled to issue its invoice for the Purchase Price for equipment upon the earlier of shipment, or notice to Buyer that Seller is ready to ship, and for services, upon completion. If the Purchase Price exceeds $250,000 USD, Buyer shall pay the Purchase Price in Progress payments as follows: Fifteen percent (15%) upon submittal of general arrangement drawings, thirty five percent (35%) after receipt of first Bowl Casting, twenty percent (20%) after first case/bowl hydro test or bowl machining and thirty percent (30%) after notification of ready to ship.

SECTION 4: ACCEPTANCE AND INSPECTION

All equipment shall be finally inspected and accepted by Buyer within 14 days after delivery or such other period of time as is agreed in the Purchase Order. Buyer shall make all claims (including claims for shortages), excepting only those provided for under the warranty clause contained herein, in writing within such 14 day period or they are waived. Services shall be accepted upon completion. Buyer shall not revoke its acceptance. Buyer may reject the equipment only for defects that substantially impair its value, and Buyer's remedy for lesser defects shall be in accordance with Section 10, Warranty. If tests are made by Buyer to demonstrate the ability of the equipment to operate under the contract conditions and to fulfill the warranties in Section 10, Buyer is to make all preparations and incur all expenses incidental to such tests. Seller will have the right of representation at such tests at its expense, and the right to technically direct the operation of the equipment during such tests, including requiring a preliminary run for adjustments.

SECTION 5: TITLE AND RISK OF LOSS

Full risk of loss (including transportation delays and losses) shall pass to Buyer upon delivery, regardless of whether title has passed to Buyer, transport is arranged or supervised by Seller, or start-up is carried out under the direction or supervision of Seller. Delivery shall be ex works, INCOTERMS 2000. Loss or destruction of the equipment or injury or damage to the equipment that occurs while the risk of such loss or damage is borne by Buyer does not relieve Buyer of its obligation to pay Seller for the equipment.

SECTION 6: PATENT OR TRADEMARK INFORMATION

If the equipment sold hereunder is to be prepared or manufactured according to Buyer's specifications, Buyer shall indemnify Seller and hold it harmless from any claims or liability for patent or trademark infringement on account of the sale of such goods.

SECTION 7: CHANGES

Buyer may request, in writing, changes in the design, drawings, specifications, shipping instructions, and shipment schedules of the equipment. As promptly as practicable after receipt of such request, Seller will advise Buyer what amendments to the Contract, if any, may be necessitated by such requested changes, including but not limited to amendment of the Purchase Price, specifications, shipment schedule, or date of delivery. Any changes agreed upon by the parties shall be evidenced by a Change Order signed by both parties.

SECTION 8: CANCELLATION OR TERMINATION

Buyer shall have the right to cancel the Contract upon 15 days' prior written notice to Seller, and Seller shall stop its performance upon the receipt of such notice except as otherwise agreed with Buyer. If Buyer cancels the Contract, it shall pay: (a) the agreed unit price for equipment or components completed and delivered, (b) additional material and labor costs incurred, and for engineering services supplied by Seller with respect to the canceled items, which shall be charged to Buyer at Seller's rates in effect at the time of cancellation, but which shall not exceed the contract price for such items, and (c) such other costs and expenses, including cancellation charges under subcontracts, as Seller may incur in connection with such cancellation or termination.

SECTION 9: DELIVERY AND DELAYS

Seller shall use its best efforts to meet quoted delivery dates, which are estimated based on conditions known at the time

of quotation. Seller shall not be liable for any nonperformance, loss, damage, or delay due to war, riots, fire, flood, strikes or other labor difficulty, governmental actions, acts of God, acts of the Buyer or its customer, delays in transportation, inability to obtain necessary labor or materials from usual sources, or other causes beyond the reasonable control of Seller. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended to reflect the length of time lost by reason of such delay. Seller shall not be liable for any loss or damage to Buyer resulting from any delay in delivery.

SECTION 10: WARRANTY

Seller warrants that the equipment or services supplied will be free from defects in material, and workmanship for a period of 12 months from the date of initial operation of the equipment, or 18 months from the date of shipment, whichever shall first occur. In the case of spare or replacement parts manufactured by Seller, the warranty period shall be for a period of six months from shipment. Repairs shall be warranted for 12 months or, if the repair is performed under this warranty, for the remainder of the original warranty period, whichever is less. Buyer shall report any claimed defect in writing to Seller immediately upon discovery and in any event, within the warranty period. Seller shall, at its sole option, repair the equipment or furnish replacement equipment or parts thereof, at the original delivery point. Seller shall not be liable for costs of removal, reinstallation, or gaining access. If Buyer or others repair, replace, or adjust equipment or parts without Seller's prior written approval, Seller is relieved of any further obligation to Buyer under this section with respect to such equipment or parts. The repair or replacement of the equipment or spare or replacement parts by Seller under this section shall constitute Seller's sole obligation and Buyer's sole and exclusive remedy for all claims of defects. SELLER MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WITH RESPECT TO THE EQUIPMENT OR SERVICES OTHER THAN AS SPECIFIED IN THIS SECTION 10. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED.

For purposes of this Section, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by Seller. With respect to such equipment, parts, or work, Seller's only obligation shall be to assign to Buyer any warranty provided to Seller by the manufacturer or supplier providing such equipment, parts or work.

No equipment furnished by Seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, Buyer's failure to properly store, install, operate or maintain the equipment in accordance with good industry practices or specific recommendations of Seller, or Buyer's failure to provide complete and accurate information to Seller concerning the operational application of the equipment.

SECTION 11: TECHNICAL DOCUMENTS

Technical documents furnished by Seller to Buyer, such as drawings, descriptions, designs and the like, shall be deemed provided to Buyer on a confidential basis, shall remain Seller's exclusive property, shall not be provided in any way to third parties, and shall only be used by Buyer for purposes of installation, operation and maintenance. Technical documents submitted in connection with a Quotation that does not result in a Purchase Order shall be returned to Seller upon request.

SECTION 12: LIMITATION OF LIABILITY

Seller shall in no event be liable for any consequential, incidental, indirect, special or punitive damages arising out of the Contract, or out of any breach of any of its obligations hereunder, or out of any defect in, or failure of, or malfunction of the equipment, including but not limited to, claims based upon loss of use, lost profits or revenue, interest, lost goodwill, work stoppage, impairment of other equipment, environmental damage, nuclear incident, loss by reason of shutdown or nonoperation, increased expenses of operation, cost of purchase of replacement power or claims of Buyer or customers of Buyer for service interruption whether or not such loss or damage is based on contract, tort (including negligence and strict liability) or otherwise.

Seller's maximum liability under this Contract shall not exceed the Purchase Order amount of the equipment or portion thereof upon which such liability is based. All such liability shall terminate upon the expiration of the warranty period, if not sooner terminated.

SECTION 13: THIS COMPANY IS AN EQUAL OPPORTUNITY EMPLOYER

This agreement incorporates by reference applicable provisions and requirements of Executive Order 11246 and FAR Section 52.222-26 (covering race, color, religion, sex and national origin); the Vietnam Era Veterans Readjustment Assistance Act of 1974 and FAR Section 52.222-35 (covering special disabled and Vietnam era veterans); and the Rehabilitation Act of 1973 and FAR Section 52.222-36 (covering handicapped individuals). By acceptance of this agreement Buyer certifies that it does not and will not maintain any facilities in a segregated manner, or permit its employees to perform their services at any location under its control where segregated facilities are maintained, and further that appropriate physical facilities are maintained for both sexes. Buyer agrees that it will obtain a similar certificate prior to award of any nonexempt lower-tier subcontracts.

SECTION 14: LAW AND ARBITRATION

The Contract shall be governed by the law of the State of Texas. Any disputes arising out of this Contract shall be resolved by informal mediation in any manner that the parties may agree within 45 days of written request for mediation by one party to the other. Any dispute that cannot be resolved through mediation shall be resolved by binding arbitration conducted in English in Portland, Oregon under the Commercial Rules of the American Arbitration Association except as otherwise provided in this Section. The arbitration shall be conducted by three arbitrators chosen in accordance with said Rules. The arbitrators are not entitled to award damages in excess of compensatory damages. Judgment upon the award may be entered in any court having jurisdiction.

Check our worldwide offices at
www.paco-pumps.com