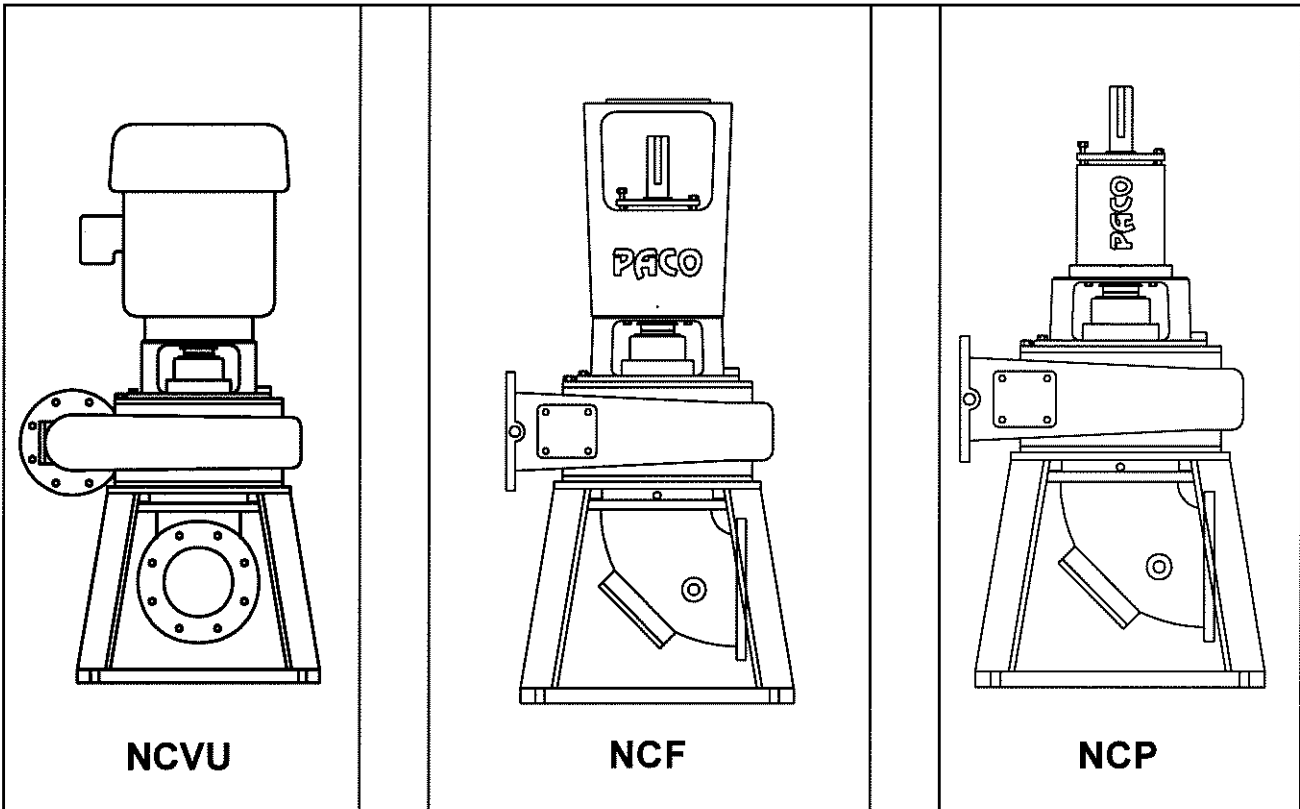


**INSTALLATION, OPERATION AND  
MAINTENANCE INSTRUCTIONS**

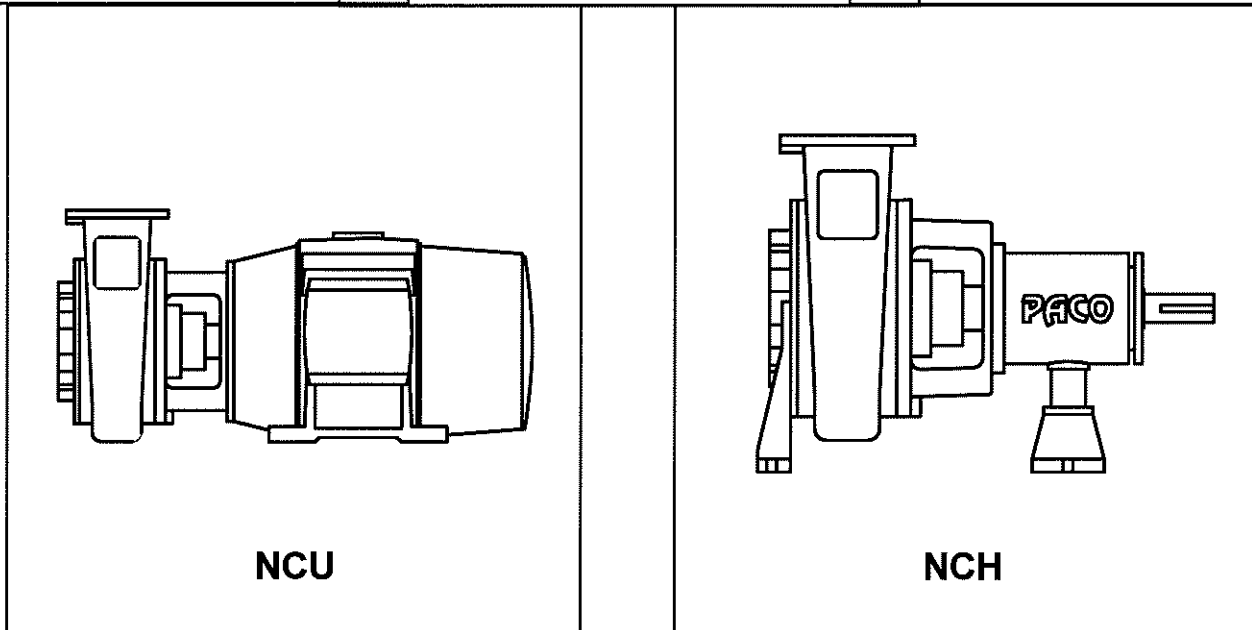
**PACO  
DRY PIT  
NON CLOG PUMPS**



**NCVU**

**NCF**

**NCP**



**NCU**

**NCH**

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**CAUTIONS and WARNINGS are inserted at key points of this manual to provide check points for personnel and machinery safety. CAUTIONS: Apply to personnel. WARNINGS: Apply to personnel and machinery.**

## I. INSTALLATION - MECHANICAL

All installations should be performed by personnel experienced with the placement, connection, and alignment of pumping equipment. The following instructions are general in nature, and may not deal with the specifics of your installation. **Read these instructions thoroughly before installing and operating your PACO Dry Pit Non-Clog Pump.** Successful operation depends on careful attention to the procedures described in Sections I, II, III and IV of this manual. Keep this instruction manual handy for future use.

### A. PUMP IDENTIFICATION

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

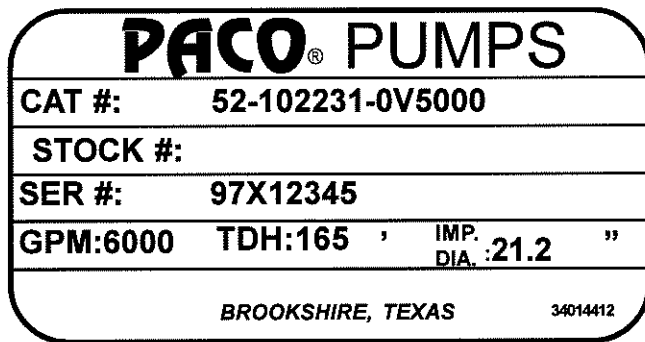


FIGURE 1a

### B. RECEIVING

- Check pumping unit for shortages and damages immediately upon arrival. Pump accessories, when required, are packaged in a separate container and shipped with the unit.
- If equipment is damaged in transit, **immediately report the damage to the truck line's agent.** Make a complete report on the freight bill to speed satisfactory adjustment by the carrier.
- Unload and handle the equipment with a sling or tow motor. **Do not lift unit by lifting lugs on the pump case or eyebolts on the motor!** These are not intended to support the complete pump assembly but to aid in disassembly.

### C. TEMPORARY STORAGE

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

- Rotate the shaft by hand monthly to coat the bearings with lubricant and retard oxidation and corrosion.
- Where applicable, follow motor manufacturer's storage recommendations.

### D. LOCATION

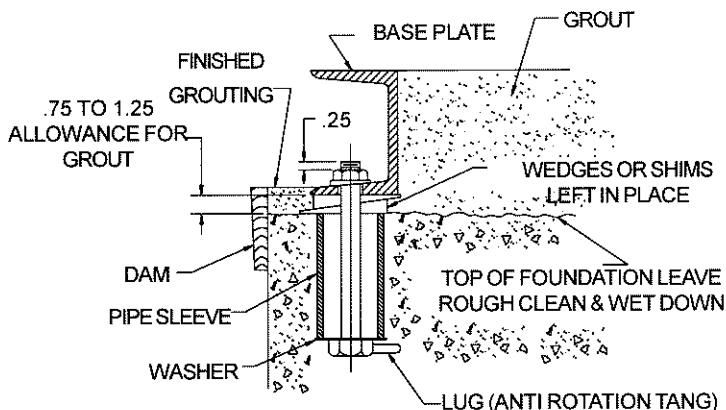
- Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to paragraph I. SUC-TION (INLET) PIPING.
- Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive 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 Sections II and III.

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

### E. HORIZONTAL PUMP INSTALLATION

- Your Dry Pit Non-Clog should be permanently installed on a firm, concrete foundation mounting pad of sufficient size to dampen any vibration and prevent any deflection or misalignment. The pad may float on springs or be a raised part of the equipment room floor. The foundation should be poured without interruption to 3/4 to 1-1/2 inches below the final pump elevation. The top surface should be well scored or grooved before the concrete sets to provide a suitable bonding surface for grout. Anchor bolts should be set in pipe sleeves for positioning allowance, as shown in Fig. 2a. Allow enough bolt length for grout, lower base plate flange, nuts and washers. Allow

the foundation to cure several days before proceeding with pump installation.



**FIGURE 2a: Anchor Bolt Installation.**

- After the concrete pad has been poured and set, lower the pump base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt, and at intervals not to exceed 24" along each side.
- Shims or wedges must be placed to raise the bottom of the base 3/4" to 1-1/4" above the pad, allowing clearance for grout. Level the pump shaft, flanges, and base plate using a spirit level, adjusting the wedges or shims, as required.
- Check to make sure the piping can be aligned to the pump flanges without placing any strain on either flange.
- After pump alignment has been established, put nuts on foundation bolts and tighten them just enough to keep the unit base plate from moving. Construct a form or dam around the concrete pad and pour grout in and around the pump base. (See Fig. 2a). Grout compensates for uneven foundation, distributes the weight of the unit, and prevents shifting. Use an approved, non-shrinking grout (such as Embecco 636 by Master Builders, Cleveland, Ohio or equivalent). Allow at least 24 hours for this grout to set before proceeding with piping connections.
- After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary. Recheck the pump alignment after the foundation bolts are secured.

## F. VERTICAL PUMP INSTALLATION

The PACO NCF, NCP, or NCVU Vertical Non-Clog pumps need not be grouted to their foundations, but should be anchored with 4 anchor bolts set in concrete similar to the horizontal anchoring arrangement

(Fig.2a.)

- The NCP-type pumps are fitted with a vertical bearing frame for driving from above with a flexible shaft.
- See Flexible Shafting Operation & Maintenance Manual supplied by Shaft Manufacturer.
- Motors for NCF type pumps are shipped separate, to be mounted by customer.
- Motors mount on a machined cast iron bracket bolted to the pump bearing frame. Shaft concentricity will be assured by machined fit between motor and bracket. Coupling must be installed in conjunction with motor, and no further alignment is required.
- Install coupling guard if unit is so equipped.
- NCVU units have the motor as an integral part of the pump. Units are ready to wire and run as shipped with the addition of seal lubrication.

## G. 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 to insure no strain is transmitted to the pump when the bolts are tightened. Use of expansion joints or vibration pads does not preclude the need to properly support the piping.
- **Do not spring or force piping when making connections!**
- Make sure all piping is as direct as possible.
- Avoid unnecessary bends and fittings.

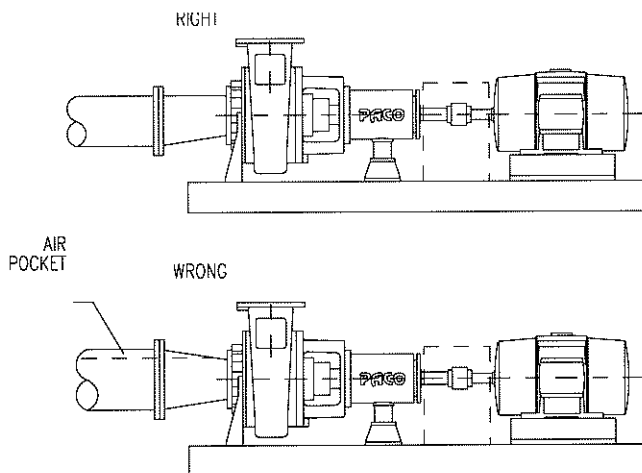
## H. SUCTION (INLET) PIPING

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 piping:

- Suction piping should be as direct as possible, and ideally the length should be at least 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 the diameter of the suction opening near the pump.

- Use an eccentric reducer with the eccentric side down, (as shown in Fig. 3a ) when reducing pipe diameter to the diameter of the pump suction opening.
- **At no time should suction piping be smaller in diameter than the pump suction opening.**
- Horizontal suction lines 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.
- Avoid any high points, such as pipe loops, (as shown in Fig. 3a ), that may create air pockets and throttle the system or produce erratic pumping.



**FIGURE 3a: Suction Piping.**

- Install a valve in the suction line to isolate the pump during shutdown and maintenance.
- Valves should always be installed in positions that avoid air pockets. Globe valves should not be used, particularly when NPSH is critical.
- During pumping operation, valves on the suction line must always be at **FULL OPEN**.
- Pressure gauges properly sized for the range of operation, should be installed in gauge taps on the pump suction and discharge nozzles.

## I. DISCHARGE (OUTLET) PIPING

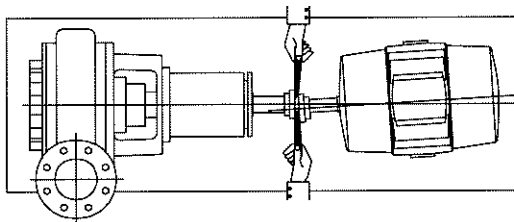
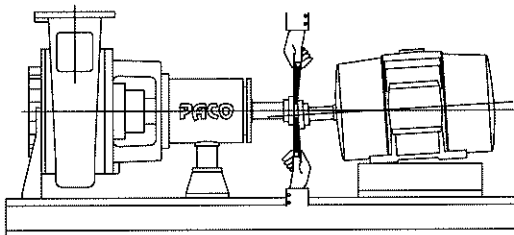
- Short discharge piping can be the same diameter as the pump discharge opening. Longer piping should be one or two sizes larger depending on length.
- Any high points in discharge piping may entrap air or gas and thus retard pump operation. Air vents or bleed valves as a means to release entrapped air are recommended.
- An even gradient is best for long horizontal runs of discharge piping.
- Install a valve near the pump discharge opening to prime and start the pump. The discharge valve is also used to isolate the pump during shutdown and maintenance.

## J. COUPLING ALIGNMENT-HORIZONTALS

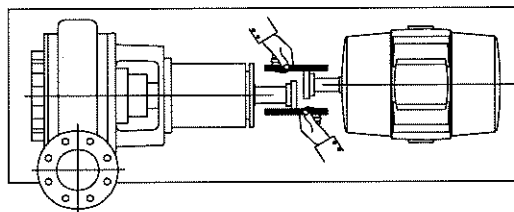
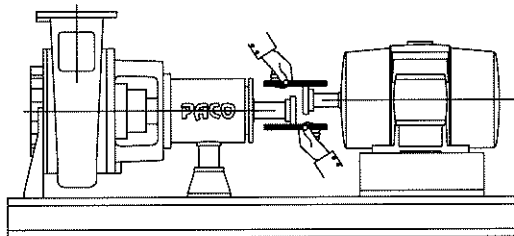
- The following anchoring and alignment procedure is typical and, if performed with care, should result in a smooth running, trouble-free installation.
- If the pump and motor were shipped mounted on the pump base as an assembly, remove the coupling guard.
- The pump and motor were accurately aligned at the factory, but handling during shipment usually alters this pre-alignment. Using a small straight edge and feeler gauges or a dial indicator, check for horizontal, vertical, and angular misalignment of the coupling hubs (Fig. 4a).
- Coupling alignment is proper when the dial indicator reads no more than .005" run out in any direction (or when the straight edge contacts both hubs evenly in both horizontal and vertical positions). If misalignment is detected, loosen the motor and shift or shim as necessary to re-align, then re-tighten bolts. **Always align the motor to the pump as piping strain will occur if the pump is shifted.**  
**Never reposition pump on base!**
- After final piping connections to the pump have been made, motor wiring compared, correct rotation has been established, and piping filled with liquid, check shaft alignment once again.
- Leave the coupling guards off until the pump priming procedure is completed for a final shaft alignment check.

- **Purge all air** from the seal chambers and recirculation lines prior to operating the pump.
- 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.
- The mechanical seal does not leak at all during normal operation, therefore if any appreciable leakage occurs, the seal should be removed, inspected and if necessary replaced. **Mechanical seals should be stocked as spare parts to reduce equipment down time.**

#### Checking Angular Alignment



#### Checking Parallel Alignment



**FIGURE 4a: Alignment.**

- To protect personnel from rotating machinery, **Always install coupling guards after installation is complete; before starting pump!**

#### K. SHAFT SEALING-GENERAL COMMENTS

- PACO offers both mechanical seals and packed stuffing boxes as a means to seal the shaft. Pumps with stuffing boxes are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing material will be in good condition for operation with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing boxes (see *Packing Assembly, Page 12*, to repack the boxes).

- The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. When pumps are equipped with mechanical seals, no maintenance or adjustment is required.

#### L. GLAND ADJUSTMENT

- Make sure the flushing fluid lines are connected and their valves are open. After pump start-up, with the pump running, the packing gland should be adjusted to permit 40 or 60 drops per minute leakage, this is required for shaft sleeve lubrication.

- The packing gland should be tightened evenly to provide uniform compression on the packing material. **Do not operate packing dry, and do not over tighten packing gland to eliminate leaking** as the shaft sleeve will become damaged. After initial start up, additional packing and adjustment may be required until the packing is properly seated.

#### M. MECHANICAL SEALS

- All PACO Dry Pit Non-Clog pumps that are equipped with mechanical seals are matched to the conditions for which the pump was sold. Observe the following precautions to avoid seal damage and obtain maximum seal life.

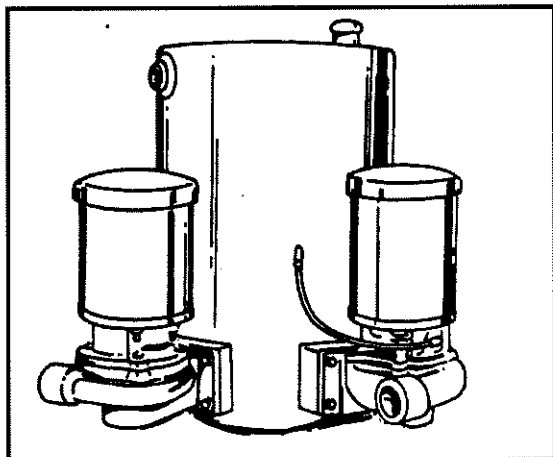
- Do not exceed temperature or pressure limitations for the mechanical seal used.

- **Do not run the pump dry or against a closed valve!** Dry operation will cause seal failure within minutes.

- If a double seal is used, the seal housing must be pressurized with seal lubricant such as fresh water, machine oil used with a pressurizer or filtered pump media.

**N. WATER SEAL UNIT**

For maximum seal or packing protection when pumping abrasive sewage, PACO offers a water seal unit for pressurizing the non-clog packing (Fig. 8a) These units are provided to meet state sanitary codes prohibiting any direct connection between the potable water supply and possible sources of contamination.



**FIGURE 8a: Water Seal Unit**

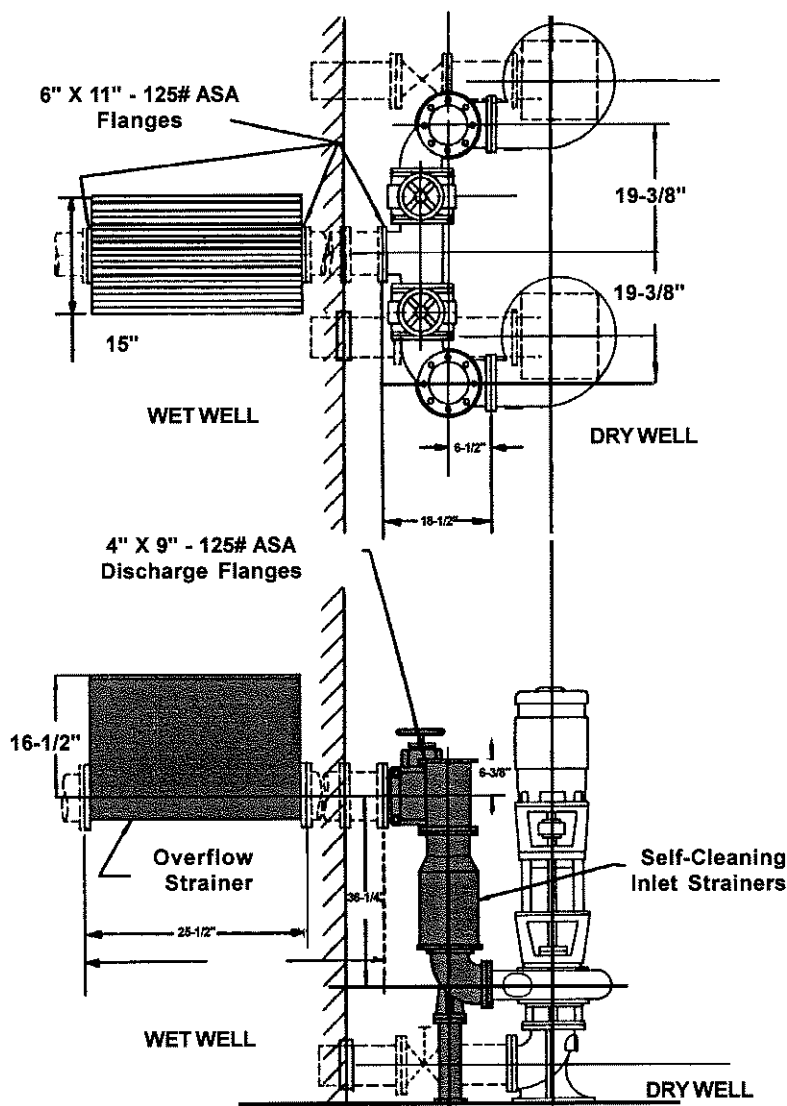
- Water seal units have galvanized 32-gallon and 64 gallon tanks with open tops, mechanical make up valves and cast iron bases for anchoring.
- Where one water seal unit serves several Non-Clog pumps, parallel connections should be made with a solenoid valve on each line to close flow to any pump that shuts down.
- Water seal units have a built-in purge feature and can run for extended periods at no flow without overheating.

**O. DRY PIT SCREEN-FLO INFLUENT STRAINER SYSTEM**

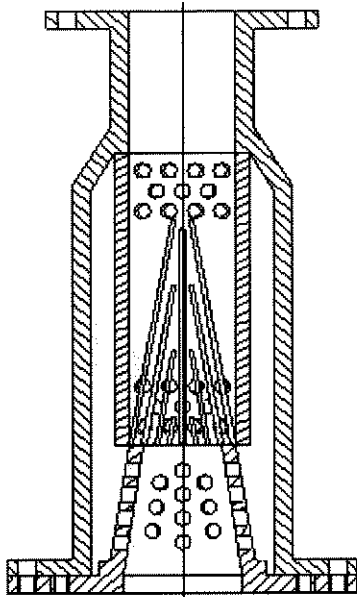
The dry pit screen-flo influent strainer system is used in conjunction with two vertical non-clog pumps for handling raw sewage without the troublesome clogging from trash. Refer to Fig. 9a for installation layout.

- The overflow strainer box is to be installed on the incoming raw sewage pipe inside the wet well. The box is positioned with the grating upward. The flange connections are 6".
- From the overflow strainer box, the 6" influent pipe must go through the sump wall, coming out at least 36-1/4" above the pump discharge, centerline to centerline.

- The suction opening in the wet well should be at the lowest point in the well and should be equal in size, or larger than the pump suction elbow.
- The pump suction pipe and the discharge pipes must have isolation valves.
- The self-cleaning strainers are installed with rods pointing upward as shown in Fig. 10a. If influent piping coming through sump wall is more than 36-1/4" above the pump discharge, spool pieces or spacer flanges may be used between the strainers and the discharge tees.



**FIGURE 9a: Screen Flo Unit**



**FIGURE 10a: Self Cleaning Strainer**

## **P. COUPLING ASSEMBLY**

After final piping connections to the pump have been made, motor wiring completed, and correct rotation has been established, check shaft alignment once again and, if no further correction is needed, proceed to assemble the couplings. Couplings with cover and grid assembly may be greased with any of the approved lubricants shown in Table 13a, Section IV-B. Leave coupling guards off until pump priming procedure is complete.

## **II. INSTALLATION, ELECTRICAL**

### **A. MOTORS, GENERAL**

The motor control circuit must have the following components in order to comply with the National Electrical Code.

- **Motor Disconnecting Device:** A motor disconnecting device must be installed that is capable of disconnecting both the controller (motor starter) and the motor from their source of power.

The disconnecting device must be located so that the controller (motor starter) can be seen from the disconnecting means. In all cases the distance from the disconnecting device to the controller must be less than 50'.

In most installations the disconnecting device will be a circuit breaker or fusible disconnect switch.

- **Motor short circuit and ground fault protection:** Short circuit and ground fault protection are usually provided by means of a circuit breaker or fusible disconnect switch.

The selection of the size of the circuit breaker or fuse must be in accordance with Section 430-52 and Table 430-152 of the National Electrical Code.

- **Motor controller with running over current protection (magnetic starter):**

These components must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

### **B. INSTALLATION WIRING**

- Mount the control panel or motor starter(s) in close proximity to the pump to provide convenient control and ease of installation.
- Wire panel or starter(s) to motor(s) and pilot device(s): Wires to each motor must be sized for at least 125% of the motor nameplate full load amps. AWG #16 Type THW stranded wire is recommended for wiring of pilot devices (float switches).
- Check incoming power source to insure it is the same as the voltage and phase of the motors.
- Verify that the starters are suitable to operate pump motors on voltage and phase that is available.

### **C. WATER SEAL PUMP AND SOLENOID VALVE (Optional)**

The optional water seal pump must be wired so it operates whenever the non-clog pump is operating. A recommended interconnecting diagram, ID18736, is included in Appendix 1 (page 19). When used with a duplex pump installation, a solenoid valve may be used to control the flow of water seal flushing water. These normally closed solenoid valves must be wired so that they are energized whenever the non-clog pump is operating. ID18737, in Appendix 1, (page 19) shows the recommended interconnection of the solenoid valve using auxiliary contacts on the magnetic starter for the pump.

Auxiliary contacts are provided on most makes of magnetic starters and additional sets of auxiliary contacts are available. For complete operation of a system with two non-clog pumps and a common water seal unit, two sets of auxiliary contacts are required on the magnetic starter of each non-clog pump motor.



Use a pressure gauge between the solenoid valve (if used) and the seal housing to verify that the pressure entering the seal housing exceeds the discharge pressure of the non-clog pump. If the installation is a duplex installation, using a common water seal unit verify that the pressure entering the seal housing exceeds the discharge pressure of each of the non-clog pumps with both pumps operating.

### III. OPERATION

#### A. PRIMING

- The PACO Dry Pit Non-Clog pump is not self-priming, and must be completely primed (filled with liquid) before starting.
- If the pump will operate with a positive suction head, prime by opening the suction valve and allowing liquid to enter the pump casing. Open the air vent at the top of the pump casing, and make sure all air is forced from the pump by liquid before closing.
- **IMPORTANT:** Rotate the shaft by hand while priming and venting to free entrapped air from the impeller passageways.
- If the pump has suction lift, priming must be accomplished by other methods. The use of foot valves, ejectors or vacuum pumps, or by 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 shaft seals, pump wear rings and shaft sleeves will result.

#### B. PRE-START CHECKLIST

**WARNING: In the interest of operator safety, the unit must not be operated above the nameplate conditions. Such operation could result in unit failure causing injury to operating personnel. Consult instruction book for proper operation and maintenance of the pump and its supporting components.**

Make the following inspections before starting your PACO Dry Pit Non-Clog pump:

- Make sure the suction and discharge piping has been cleaned and flushed to remove dirt and debris before operating pump.
- Check the voltage, phase, and line circuit frequency with the motor nameplate.
- If the motor has been in storage for an extended

length of time, either before or after installation, refer to motor instructions before starting.

- Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce proper rotation.
- Turn rotating element by hand to make sure it rotates freely.
- Tighten plugs in gauge and drain taps. If the pump is fitted with pressure gauges, keep gauge cocks closed when not in use.
- Recheck the motor to pump alignment per *Coupling Alignment, K, section*.
- Check suction and discharge piping for leaks, and make sure all flange bolts are securely tightened.

#### C. MOTOR ROTATION

**CAUTION: Never check driver rotation unless pump and driver couplings are disconnected and physically separated. Failure to follow this instruction can result in serious damage to pump and driver if rotation is wrong.**

After the unit has been wired and checked to insure that all components in the system (disconnect device, magnetic starters, pilot devices and motors) are properly connected, check motor rotation as follows:

For 3 phase units only—momentarily energize the motors to insure that rotation is correct as indicated by the arrow cast into the pump volute. If rotation is incorrect, interchange two wires at the motor starter terminals T1 and T2.

**IMPORTANT:** The pumps must not be operated while dry. Use extreme caution that motors are energized only momentarily to determine proper rotation.

#### D. STARTING THE PUMP

**WARNING: The pump must not be operated without an approved coupling guard in place. Failure to observe this warning could result in injury to operating personnel.**

- Install coupling guard on flexible coupled units.
- Fully open valve (if any) in suction line, and close valve in discharge line.
- If applicable, turn on any external source of cooling or lubricating fluid to the shaft seals.

- Start the motor (pump).
- Immediately after the pump reaches full operating speed, slowly crack open the discharge valve, and open bleed valves at system high points. Do not open discharge valve completely until system is full of liquid, purged of air and checked for leaks.
- After entirely filling the system, fully open discharge valve and close system bleed valves.
- If the pump is fitted with pressure gauges, open gauge cocks and record pressure reading for future reference. Verify that the pump is performing in accordance with the parameters specified on the performance curve.
- Check and record voltage, amperage per phase, and kilowatts if a watt meter is available.

#### **E. PUMP SHUTDOWN**

- The following shutdown procedures will apply in most normal shutdowns for the PACO Dry Pit Non-Clog pump. If the pump will be inoperative for an extended length of time, follow storage procedures in Extended Period Shutdown.
- Always close the discharge valve before stopping the pump. Close the valve slowly to prevent hydraulic shock.
- Cut and lock off power to the motor.

#### **F. SHORT DURATION SHUTDOWN**

- For overnight or temporary shutdown periods under non-freezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting.
- For short or frequent shutdown periods under freezing conditions, keep fluid moving within the pump casing and insulate or heat the pump exterior to prevent freezing.

#### **G. EXTENDED PERIOD SHUTDOWN**

- For long shutdowns or to isolate the pump for maintenance, close the suction and discharge valves. If no suction valve is used and the pump has positive suction head, drain all liquid from the suction line to terminate liquid flow into the pump suction nozzle. If applicable, turn off any external source of cooling or lubricating fluid to the shaft seals. Remove plugs in pump drain and vent taps, as required, and drain all

liquid from the pump casing. Remove packing, if applicable.

- If freezing conditions will exist during long shut down periods, after draining the pump, blow out all liquid in passages and pockets with compressed air.

Freezing of pump liquid can also be prevented by filling the pump with antifreeze solution.

- Rotate the shaft by hand monthly to coat bearings with lubricant and retard oxidation and corrosion.
- Where applicable follow motor manufacturer's storage recommendations.

#### **H. SCREEN-FLO OPERATION**

With pumps not running, incoming raw sewage flows through the overflow strainer, through the gate and check valves and into the self-cleaning strainers. Here, all solids that will not pass through the rod strainers (2 inch diameter and larger) are caught and held, while the liquid passes on through the pump, entering the pump discharge and exiting through the pump suction, and into the wet well.

When the liquid level reaches the set level, the level control circuit starts one pump. The pump discharge carries the solids up out of the strainer rods, at the same time closing the check valve to prevent back flow through the influent pipe. While one pump is running, any incoming sewage will enter the sump through the other strainer and pump.

In the event that both strainers become totally clogged, incoming sewage will fill the overflow strainer box inside the wet well. The liquid will run into the sump while the solids remain trapped in the box until the next pump cycle clears the self-cleaning strainers.

#### **IV. MAINTENANCE**

##### **A. MOTOR LUBRICATION**

***WARNING: Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.***

***Before attempting any inspection or repair on the pump, the driver controls must be in the "OFF" position, locked and tagged to prevent injury to personnel performing service on the pump.***

MOTOR RPM	MOTOR HP	OPERATING CONDITIONS		
		STANDARD	SEVERE	EXTREME
1780 & BELOW	10-40	1-3 YRS.	6 MOS.-1 YR.	6 MOS.-1YR
	50-150	1 YR.	3 MOS.	6 MOS.
	200 & UP	1 YR.	3 MOS.	6 MOS.
ABOVE 1750	(ALL HP)	6 MOS.	3 MOS.	3 MOS.

**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 the air, extreme ambient temperatures.

**TABLE 11a: Recommended Lubrication Periods.**

- Always follow motor manufacturer's lubrication instructions if available, and periodically check grease fittings and drain plugs for leaks.
- If lubricating instructions do not accompany motor, refer to (Table 11a) for recommended lubrication periods.
- 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.

MANUFACTURER	BEARING LUBRICANT
CHEVRON	SRI Grease NLGI No.2
TEXACO	Polystar RB2 NLGI No.2

**TABLE 12a: Recommended Bearing Grease For Motors**

- Table 12a lists the recommended types of grease for motor lubrication. These types have all been thoroughly tested and should be used whenever possible.

**B. PUMP BEARING LUBRICATION-  
GENERAL COMMENTS**

**WARNING:** Operation of the unit without proper lubrication can result in overheating of the bearings. Bearing failures, pump seizures and actual breakup of the equipment exposing operating personnel to personal injury.

- PACO Dry Pit Non-Clog pumps have bearings that may be "sealed-for-life" (requiring no lubrication), or may be regreaseable.
- Regreaseable bearings are packed with grease at our factory prior to shipping. This initial filling of grease is good for one year or 2000 hours of normal operation, whichever occurs first. After this time, a regular grease maintenance schedule must be implemented. (See Table 13a for recommended pump bearing greases.)

MANUFACTURER	LUBRICANT
SHELL	DOLIUM®R™
EXXON	POLYREX®
CHEVRON	SRI GREASE NLGI 2
	BLACK PEARL - NLGI 2
PHILIPS	POLYTAC
TEXACO	POLYSTAR RB

**TABLE 13a: Recommended Bearing Grease For Pumps.**

- **Do not over-grease!** Too much grease can cause over-heating and premature bearing failure. The bearing manufacturers recommend that the bottom 1/3 of the bearing be filled with grease. That is all!

**C. STUFFING BOX PACKING SHAFT SEAL-  
WATER LUBRICATION**

- The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. Only a sufficient volume of sealing liquid to create a definite direction of flow from the stuffing box inward to the pump casing is required. Piping from the pump discharge dome to the packing box is supplied on PACO Dry Pit Non-Clog pumps when requested.

**D. PACKING MAINTENANCE**

- The stuffing box should be packed with fresh packing before initial start-up, after repairs to the pump, and in case of excessive leakage. Any time the packing is replaced, the shaft sleeves should be inspected for wear, roughness or scouring and replaced with new ones, if necessary. For instructions on filling the stuffing box see *Packing Assembly*, for seal gland adjustment see *Gland Adjustment*.

**E. DISASSEMBLY FOR MAINTENANCE-  
GENERAL COMMENTS**

**WARNING:** Depending on the product being pumped, the pump should be washed down before any work is done on it.

**WARNING:** Observe extreme caution when venting and/or draining hazardous liquids. Wear protective clothing in the presence of caustic, corrosive, volatile, flammable, or hot liquids. DO NOT breathe toxic vapors. DO NOT allow sparking. Flames, or hot surfaces in vicinity of the equipment.

**F. PUMP DISASSEMBLY**

- See figure 14a, page 14, for cross sectional drawing.
  - Open motor disconnect and tag with service notice. Close suction and discharge isolation valves and remove drain plugs from pump volute.
  - Separate volute (1A)\* from rest of pump either by removing motor and bearing frame, leaving volute in piping (this will always be the case with vertical units) or by disconnecting piping from volute and removing volute itself from bearing frame, leaving bearing frame and motor intact.
- NOTE:** When spacer couplings are used on horizontal units, bearing frame can be pulled out without disturbing motor or volute attachments.
- Fold back tab washer and remove impeller cap screw (8A) and impeller washer.
  - Remove impeller and case wear plates, if pump is so equipped (4S and 4Q).
  - Remove impeller (3A) using large puller or prying evenly with 2 levers.
  - Remove seal cap (2N) and mechanical seal if applicable. **MAKE SURE EXTREME CARE IS TAKEN NOT TO DAMAGE MECHANICAL SEAL FACES.**
  - Remove back plate (2K) and/or bracket (21F) levers (loosen packing gland bolts to facilitate packing housing removal.)
  - Remove sleeve (5A).

**G. PUMP ASSEMBLY**

1. Shaft Sleeve

- Thoroughly clean shaft (6A) and sleeve (5A) surfaces.

- Install O-ring over shaft and then slide the sleeve over the O-ring and shaft. Tighten sleeve set screws.
- Place water slinger over pump shaft.
- Bracket/Back Plate: Attach bracket to bearing frame and back plate (if applicable) to the bracket. **MAKE SURE PACKING DRAINS ARE POINTING DOWN IF IN HORIZONTAL POSITION.**

**H. PACKING ASSEMBLY**

- Attach seal cap to backplate/bracket.
- Push 2 rings of the appropriate size packing (Table 2) with ends staggered 180 degrees apart, into the bracket and over the sleeve.

Sleeve O.D.	Packing Size
1.75"	3/8"
2.38"	1/2"
3.5"	5/8"
4.5"	3/4"

**TABLE 2**

- Place the Lantern ring (5L) in next.
- Put 3 more packing rings (ends 180 degrees apart) on top of the lantern ring and position the split gland over the rings and studs. Hand tighten the packing gland nuts on the studs.

**I. DOUBLE SEAL**

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

Figure 14a identifies major seal components and illustrates how an end face mechanical seal functions when properly installed inside pump casing.

The following assembly procedures should be followed with care and cleanliness to insure long, trouble-free seal life.

- Place O-ring on seal cap.
- Install seal seats into seal cap (2N) and bracket (21F.) Apply light oil to rubber parts and push with fingers using very clean cloth or tissue paper.

- Clean and lightly oil shaft sleeve.
- Lightly oil sealing faces.
- Place first seal head over sleeve facing the seal seat in the bracket.
- Place spring over first seal head.
- Place second seal head over sleeve facing out towards impeller.
- Place seal cap (2N) over seal heads and attach to back plate (2K).
- Tighten screws through seal cap into bracket. This step compresses seal spring and fixes final position of seal bellows.
- Rotate the pump by hand and make sure the seal is not binding.

- If impeller-to-case clearance is not within above limits, correction is made in the following manner:

Pumps mounted on bearing frames have axially adjustable shafts. Movement is controlled by tightening and loosening appropriate adjusting screws (8C) at rear of bearing frame (See Fig. 16a).

- On NCVU/NCU, adjust end gap by loosening wear rings and adjusting gap. Re-fasten wear rings after suitable gap is obtained.

Remainder of Pump Assembly:

- Install gasket (11F) on backplate.
- Install impeller key, locking tab washer (12A), impeller (3A), impeller washer (10A) and impeller screw (8A). Tighten impeller screw and fold tab washer, against the impeller washer and impeller screw.
- Install impeller and case wear plates (4S and 4Q).
- Reconnect volute and suction cover to rest of pump assembly using new gasket (11A). Tighten all cap screws securely.

**J. IMPELLER END GAP ADJUSTMENT**

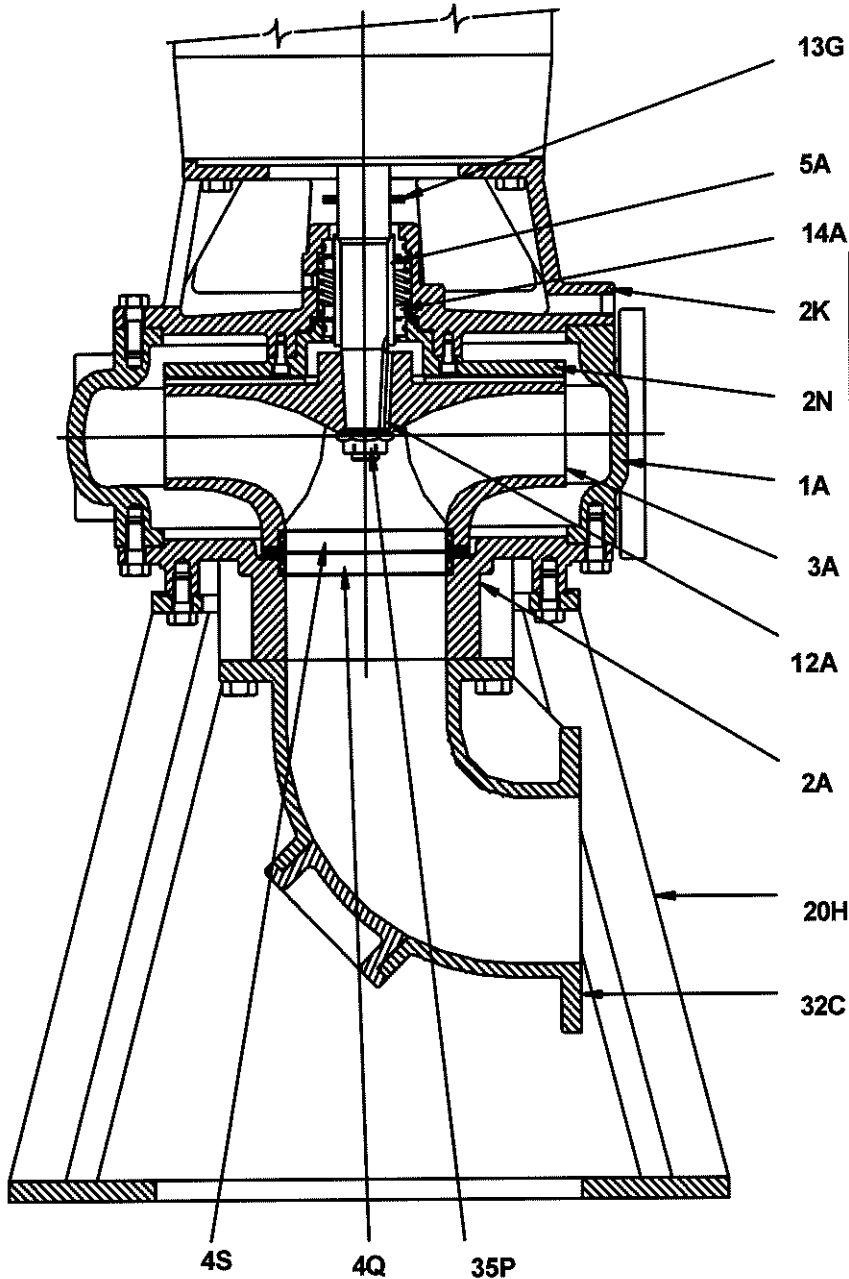
At this point it is necessary to measure the clearance between the end of the impeller suction eye and the facing surface within the volute (Fig. 14a). This distance is critical in Non-Clog pumps. If too small, the impeller will impact against the volute, and if too large, excessive water will recirculate around the suction eye, lowering pump efficiency.

- Using feeler gauges, measure the impeller/case clearance and compare against figures in Table 15a.

IMPELLER TO CASE	CLEARANCE
9-1/2" and smaller impeller	.020"/.051"
12" and larger impellers	.040"/.071"

**TABLE 15a**

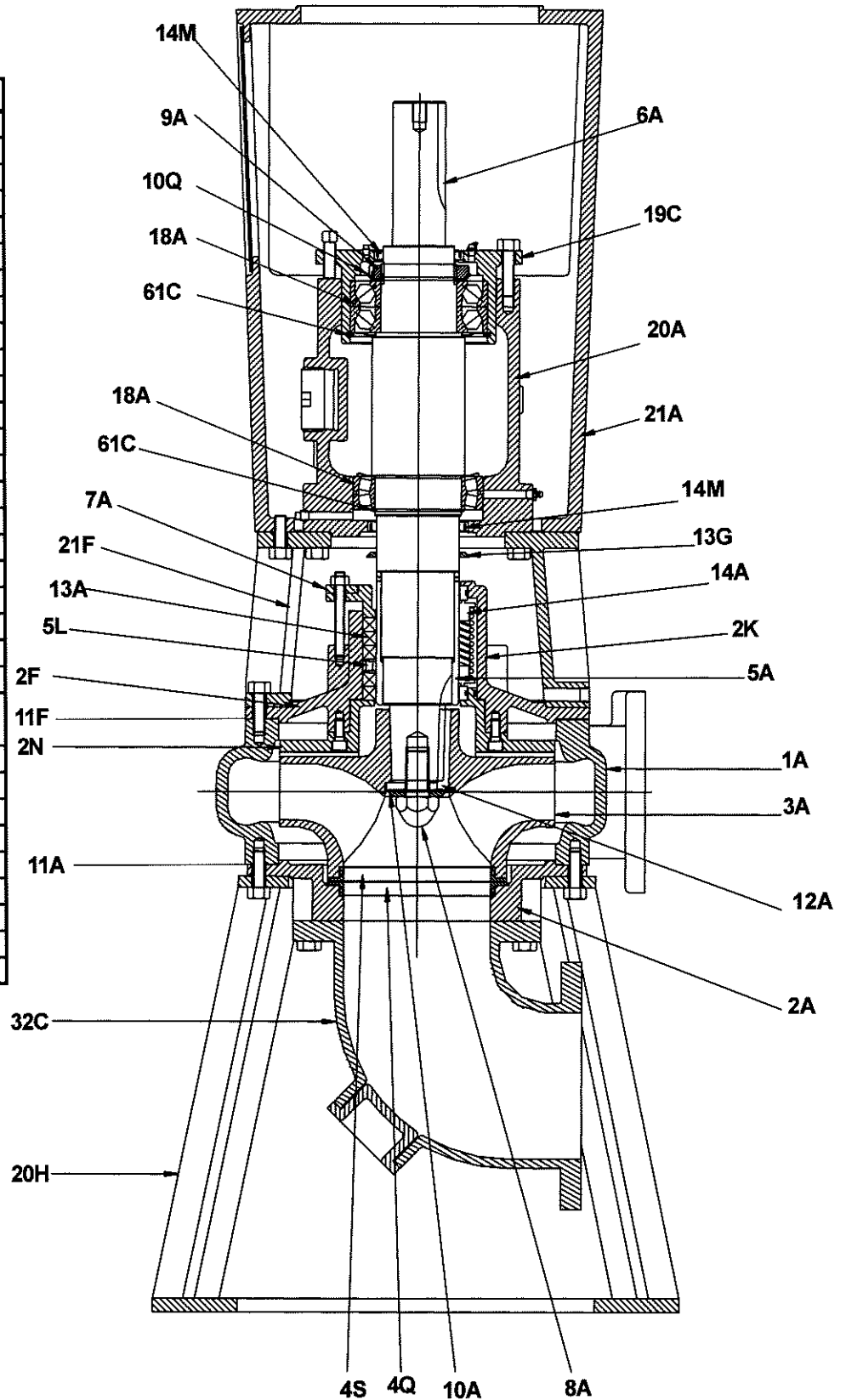
**NCVU**



ITEM	PART DESCRIPTION
1A	VOLUTE
2A	SUCTION COVER
2H	HAND HOLE COVER (NOT SHOWN)
2K	BACKPLATE (DOUBLE MECH. SEAL)
2N	SEAL CAP
3A	IMPELLER
4Q	SUCTION COVER WEAR RING
4S	IMPELLER WEAR RING
5A	SLEEVE
12A	KEY
13G	SLINGER
14A	DOUBLE MECHANICAL SEAL ASSEMBLY (OPTIONAL)
20H	STAND
32C	ELBOW W/ CLEAN OUT PORT
35P	IMPELLER NUT

**NCF**

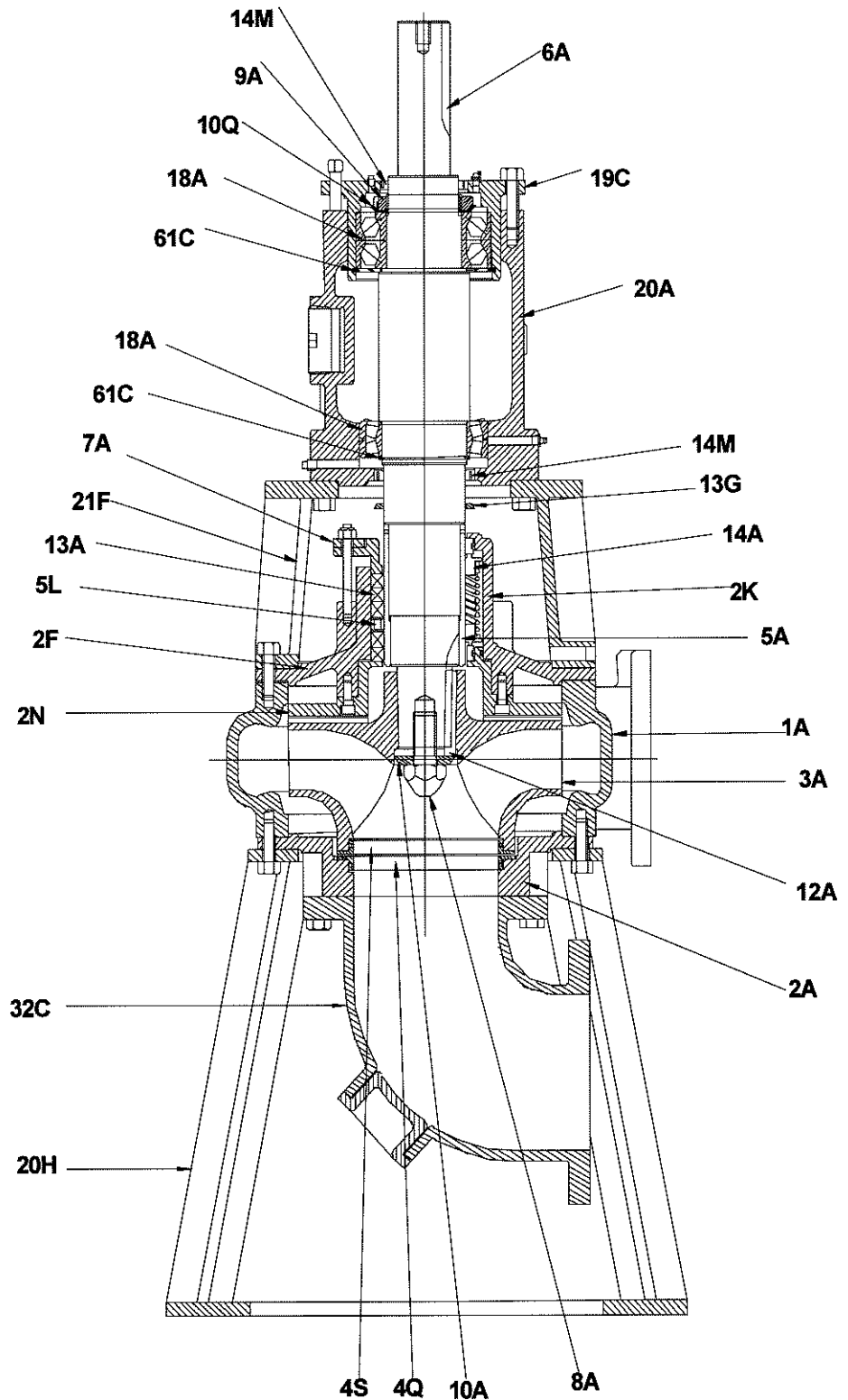
ITEM	PART DESCRIPTION
1A	VOLUTE
2A	SUCTION COVER
2F	BACKPLATE (PACKING)
2H	HAND HOLE COVER (NOT SHOWN)
2K	BACK PLATE (DOUBLE MECH. SEAL)
2N	SEAL CAP
3A	IMPELLER
4Q	SUCTION COVER WEAR RING
4S	IMPELLER WEAR RING
5A	SLEEVE
5L	LANTERN RING (PACKING)
6A	SHAFT
7A	PACKING GLAND
8A	IMPELLER SCREW
9A	BEARING LOCKNUT
10A	IMPELLER WASHER
10Q	BEARING LOCKWASHER
11A	GASKET
11F	GASKET
12A	KEY
13A	PACKING
13G	SLINGER
14A	DOUBLE MECHANICAL SEAL ASSEMBLY (OPTIONAL)
14M	BEARING GREASE SEAL
18A	BEARING
19C	BEARING ADJUSTER
20A	BEARING FRAME
20H	STAND
21A	MOTOR BRACKET
21F	PEDESTAL BRACKET
32C	ELBOW WITH CLEAN OUT PORT
61C	SNAP RING



**FIGURE 14a: Dry Pit Pump**

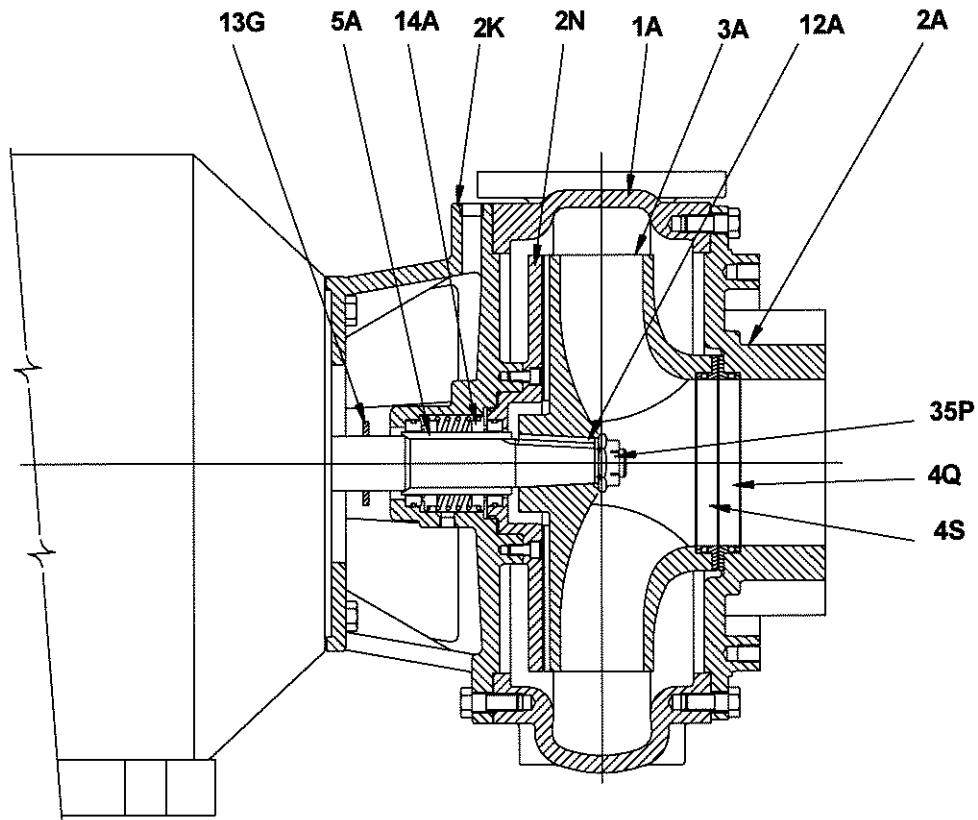
**NCP**

ITEM	PART DESCRIPTION
1A	VOLUTE
2A	SUCTION COVER
2F	BACKPLATE (PACKING)
2H	HAND HOLE COVER (NOT SHOWN)
2K	BACK PLATE (DOUBLE MECH. SEAL)
2N	SEAL CAP
3A	IMPELLER
4Q	SUCTION COVER WEAR RING
4S	IMPELLER WEAR RING
5A	SLEEVE
5L	LANTERN RING (PACKING)
6A	SHAFT
7A	PACKING GLAND
8A	IMPELLER SCREW
9A	BEARING LOCKNUT
10A	IMPELLER WASHER
10Q	BEARING LOCKWASHER
12A	KEY
13A	PACKING
13G	SLINGER
14A	DOUBLE MECHANICAL SEAL ASSEMBLY (OPTIONAL)
14M	BEARING GREASE SEAL
18A	BEARING
19C	BEARING ADJUSTER
20A	BEARING FRAME
20H	STAND
21F	PEDESTAL BRACKET
32C	ELBOW WITH CLEAN OUT PORT
61C	SNAP RING



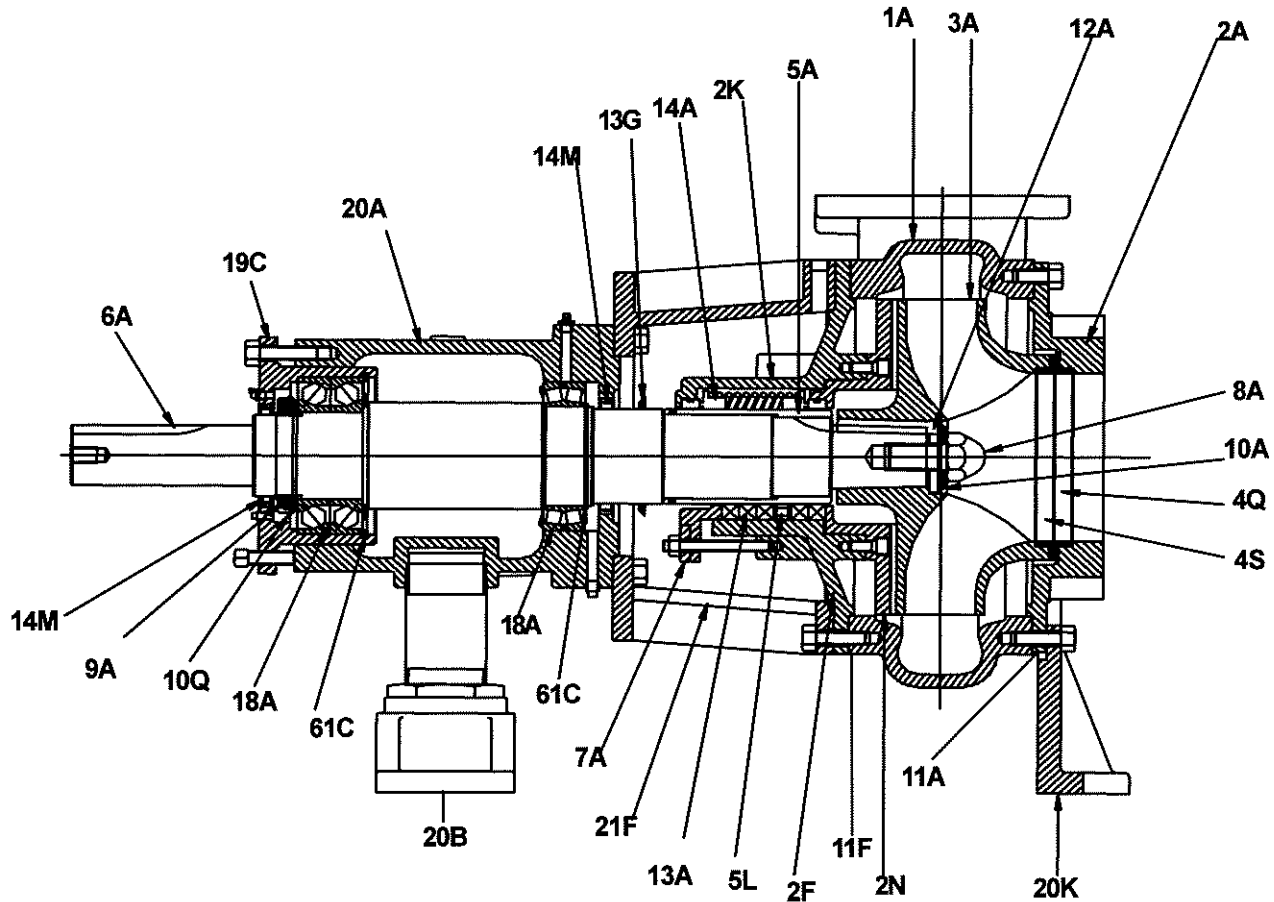


**NCU**



ITEM	PART DESCRIPTION
1A	VOLUTE
2A	SUCTION COVER
2H	HAND HOLE COVER (NOT SHOWN)
2K	BACKPLATE (DOUBLE MECH. SEAL)
2N	SEAL CAP
3A	IMPELLER
4Q	SUCTION COVER WEAR RING
4S	IMPELLER WEAR RING
5A	SLEEVE
12A	KEY
13G	SLINGER
14A	DOUBLE MECHANICAL SEAL ASSEMBLY (OPTIONAL)
20H	STAND
32C	ELBOW W/ CLEAN OUT PORT
35P	IMPELLER NUT

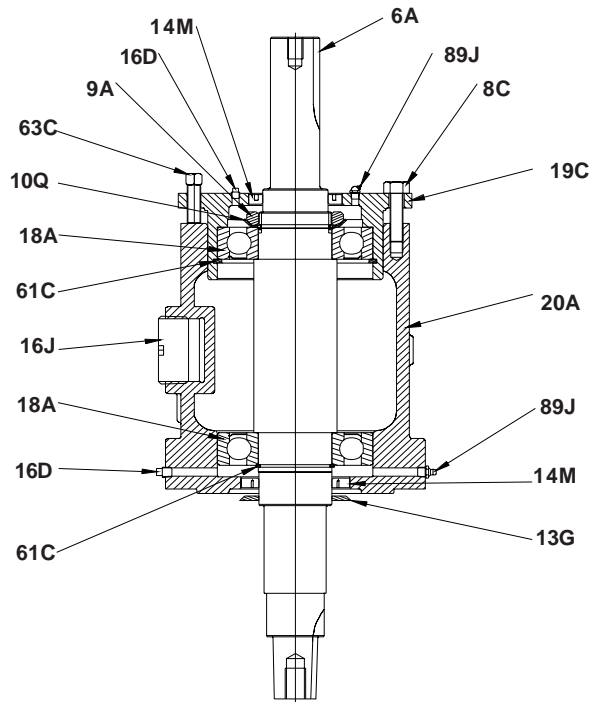
**NCH**



ITEM	PART DESCRIPTION
1A	VOLUTE
2A	SUCTION COVER
2F	BACKPLATE (PACKING)
2H	HAND HOLE COVER (NOT SHOWN)
2K	BACK PLATE (DOUBLE MECH. SEAL)
2N	SEAL CAP
3A	IMPELLER
4Q	SUCTION COVER WEAR RING
4S	IMPELLER WEAR RING
5A	SLEEVE
5L	LANTERN RING (PACKING)
6A	SHAFT
7A	PACKING GLAND
8A	IMPELLER SCREW
9A	BEARING LOCKNUT
10A	IMPELLER WASHER

ITEM	PART DESCRIPTION
10Q	BEARING LOCKWASHER
11A	GASKET
11F	GASKET
12A	KEY
13A	PACKING
13G	SLINGER
14A	DOUBLE MECHANICAL SEAL ASSEMBLY (OPTIONAL)
14M	BEARING GREASE SEAL
18A	BEARING
19C	BEARING ADJUSTER
20A	BEARING FRAME
20B	BEARING FRAME SUPPORT FOOT
20K	VOLUTE SUPPORT FOOT
21F	PEDESTAL BRACKET
61C	SNAP RING

**K. BEARING FRAME DISASSEMBLY AND ASSEMBLY**



**FIGURE 16a: Bearing Frame**

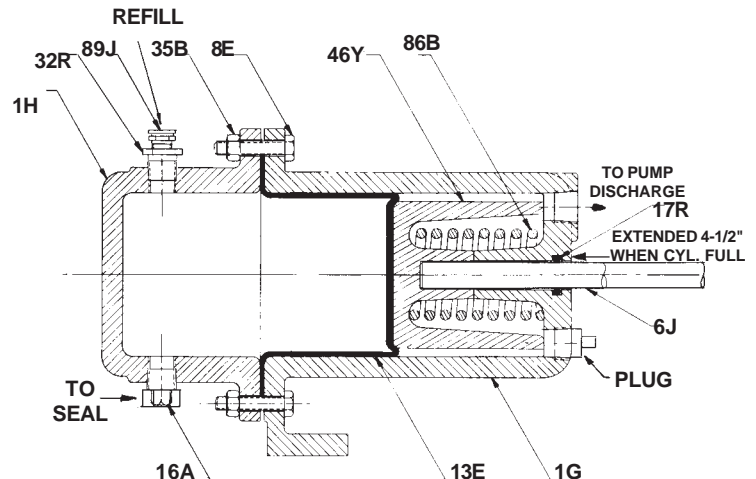
1. Remove slinger (13G) or (17).
2. Remove adjusting cap screws (8C) and set screws (63C).
3. Slide shaft assembly out of bearing frame by pulling on adjuster (19C).
4. Remove adjuster retaining ring (61C) from adjuster (19C).
5. Slide adjuster off of rear bearing (18A).
6. Remove bearing snap rings (61C), bearing lockwasher and locknut (if applicable).
7. Press bearings (18A) off of shaft.
8. Remove grease seals (14M).
9. Reassemble bearing frame in reverse order of above sequence.

**When re-assembling, make sure the angular contact thrust bearings are facing opposite directions. (#4 AND #5 FRAMES ONLY)**

**L. SEAL PRESSURIZER**

- The function of the pressurizer is to maintain a pressure differential between the seal cavity and the inside of the pump. This eliminates the passage of abrasives from the pumpage into the seal or packing.
- The pressurizer is normally shipped full of light machine oil. As the pump runs, the seal oil can very gradually leak into the volute. This piston rod in the pressurizer will move into the cylinder as the oil leaks. When there is about 1/2" of rod extending from the end of the cylinder, the oil is almost gone and the pressurizer should be refilled.
- For pumping sewage or wastes, fill pressurizer with SAE 10 oil. For food products or other pumpage, fill with clear water or other clean liquid compatible with pump service.
- The following procedure may be followed for refilling pressurizer.

1. Fill lever-type grease gun with clean seal pressurizing liquid.
2. Pump fresh liquid through fitting opposite rod end of pressurizer until rod is fully extended from body, about 4-1/2" (see Fig. 17a).
3. If pressurizing system has been run completely dry or has been drained for changing fluid, open vent of double seal housing to bleed air out while filling.

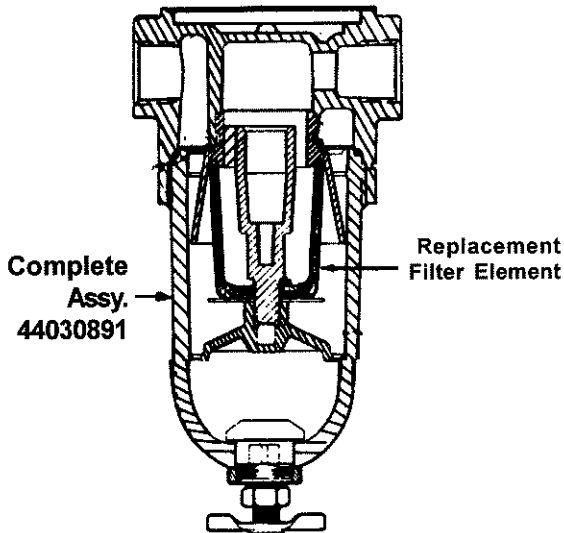


**FIGURE 17a: Pressurizer**

**M. MICRON FILTER**

- The function of the Micro-Filter, Fig. 18a, is to permit the pumpage itself to be used as the seal pressurizing fluid. The 50-micron filter will prevent damaging

abrasives from entering the seal or packing housing. Filter should be cleaned periodically as sediment bowl becomes full. The following service procedure is recommended.



**FIGURE 18a: Micro Filter**

1. Drain and unscrew filter bowl and clean in warm soapy water.
2. Unscrew barrel and remove filter element. Clean element in kerosene or solvent and blow dry with compressed air. Blow from upper side of filter element, opposite to direction of normal flow.
3. Inspect body O-ring for damage, replace if necessary.
4. Re-install filter element and thread barrel in place.
5. Lightly grease thread on filter bowl and re-install. Tighten hand tight only.

**N. WATER SEAL UNIT**

- PACO Water Seal units require little maintenance beyond periodic lubrication of regreasable motors.

**O. SCREEN-FLO**

- The screen-flo unit itself requires no regular maintenance. The only moving parts are in the gate valve and the check valve, neither of which requires any periodic attention.
- Occasionally the overflow strainer will have to be cleaned of objects such as pieces of wood or plastic bags that may block the box exit. Such objects may also become trapped in the gate valve or check valve and have to be removed. In these cases partial disassembly is required to gain

access to the valves.

None of these stoppages will prevent the sump from being pumped down. If one check valve will close, that pump can be run to clear the sump.

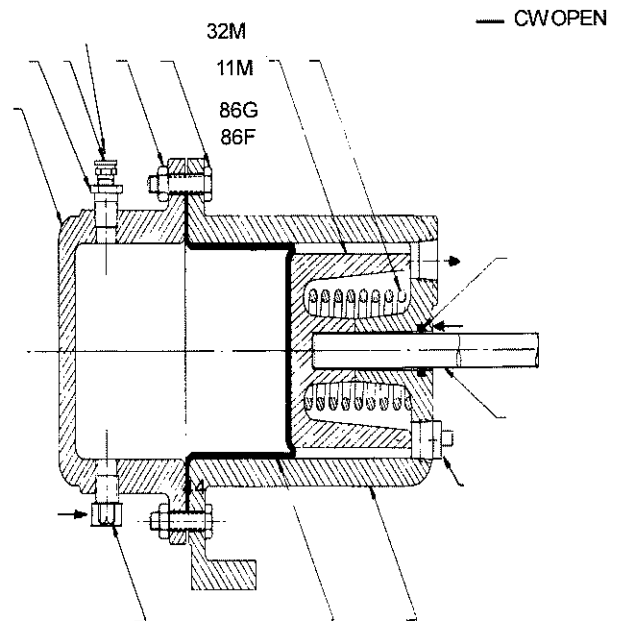
**P. DISASSEMBLY—ASSEMBLY (Fig. 19a)**

1. Close isolation valves on pump suction and discharge pipes and screen-flo inlet tee.
2. Remove drain plug in volute or suction elbow.
3. Unbolt upper section of discharge piping and raise slightly to take weight off of discharge tee.
4. Unbolt and remove screen-flo discharge tee (32M).
5. Remove self-cleaning strainer housing (44) by unbolting bottom flange. Strainer sleeve, rods, and flapper check valve are now accessible for cleaning.

Reassemble in reverse order of disassembly, being sure all flanged faces and threaded holes are clean. Use new flange gaskets at all connections. Inspect flapper gasket (11M) carefully and replace if any sign of wear appears at hinge area.

75W

7A  
7H  
52E  
6G  
30A  
59C



**FIGURE 19a: Screen Flow**

**V. TROUBLE SHOOTING**

**A.**

SYMPTOMS	CAUSE CODE
Pump does not deliver any liquid at start-up. Pump stops delivering liquid after start-up. Pump overheats and/or ceases to deliver liquid. Insufficient flow rate. Excessive flow rate. Discharge pressure is too high. Shaft seal leaks appreciably, or the packing leaks excessively. Shaft seal or packing fails prematurely. Pump uses too much power. Pump runs rough and noisily.  Bearings overheat and/or fail prematurely.	1*2*3*4*5*6*7*8*9*10*11*14*16*17*22*23*24*34 2*3*4*5*6*7*8*9*10*11*12*13*22*23*24*34 1*3*9*10*11*21*22*27*29*30*31*33*34*40*41 2*3*4*5*6*7*8*9*10*11*14*16*17*20*21*22*23*24*25*26*34 15*18*20*34 4*14*16*18*20*22*23*24*25*26*34 27*28*29*30*33*34*35*36*39*41 12*13*27*28*29*30*33*34*35*36*37*38*39*41 15*16*18*19*20*23*25*27*28*31*33*34*35*37*38*44 2*3*4*5*6*7*8*9*10*11*15*17*18*21*23*24*27*28*29*30* 31*32*33*34*40*41*42*45*46* 27*28*29*30*31*32*33*34*40*41*42*43*44*45*46

**B. POSSIBLE CAUSES**

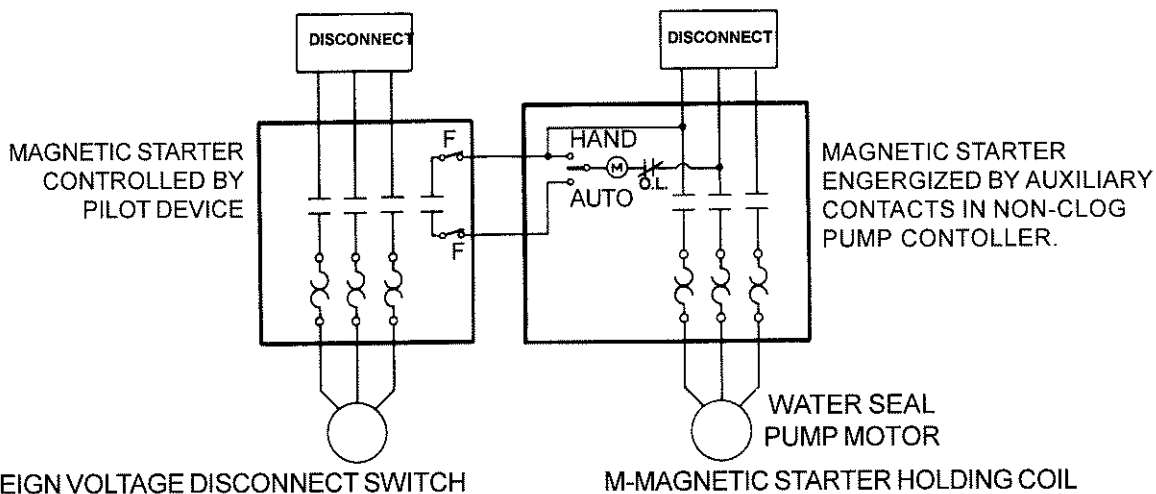
- |   |  |
|---|--|
| 1. The pump has not been properly bled of air.  | flushing inlet thereby restricting fluid flow.   |
| 2. The pump suction line have not been completely primed.   | 14. Pump drive rotational speed too low.   |
| 3. The suction head (NPSHR) required by the pump is too high, or the net positive suction head available (NPSHA) at your facility is too low. | 15. Pump drive rotational speed too high.  |
| 4. The fluid pumped contains too much entrained air or gas.   | 16. Pump rotation wrong or impeller installed backwards.   |
| 5. There are airpockets in the suction line.  | 17. Total head of installation (back Pressure) higher than rated total head of the pump.                     |
| 6. An entry of air has suddenly occurred in the suction line.   | 18. Total head of installation (back Pressure) lower than rated total head of the pump.                      |
| 7. An entry of air past the shaft seal into the pump has occurred.  | 19. Density of fluid pumped differs from that specified when the pump was purchased.                         |
| 8. The inlet of the suction line is insufficiently submerged.   | 20. Viscosity of fluid pumped differs from that specified when the pump was purchased.                       |
| 9. The suction valve is closed or only partially open.  | 21. The pump is operating at too low a rate of flow (The discharge valve may be throttled too much).         |
| 10. The suction strainer is clogged with dirt or debris.  | 22. If pumps are operating in parallel, the pump characteristics may not be suitable for parallel operation. |
| 11. The foot valve is clogged or undersized.  | 23. The impeller may be clogged with debris.   |
| 12. Little or no cooling fluid supplied to the shaft seals.   | 24. The impeller may be damaged.   |
| 13. The lantern ring is not positioned opposite the   |  |

**TROUBLE SHOOTING-POSSIBLE CAUSES (Cont'd)**

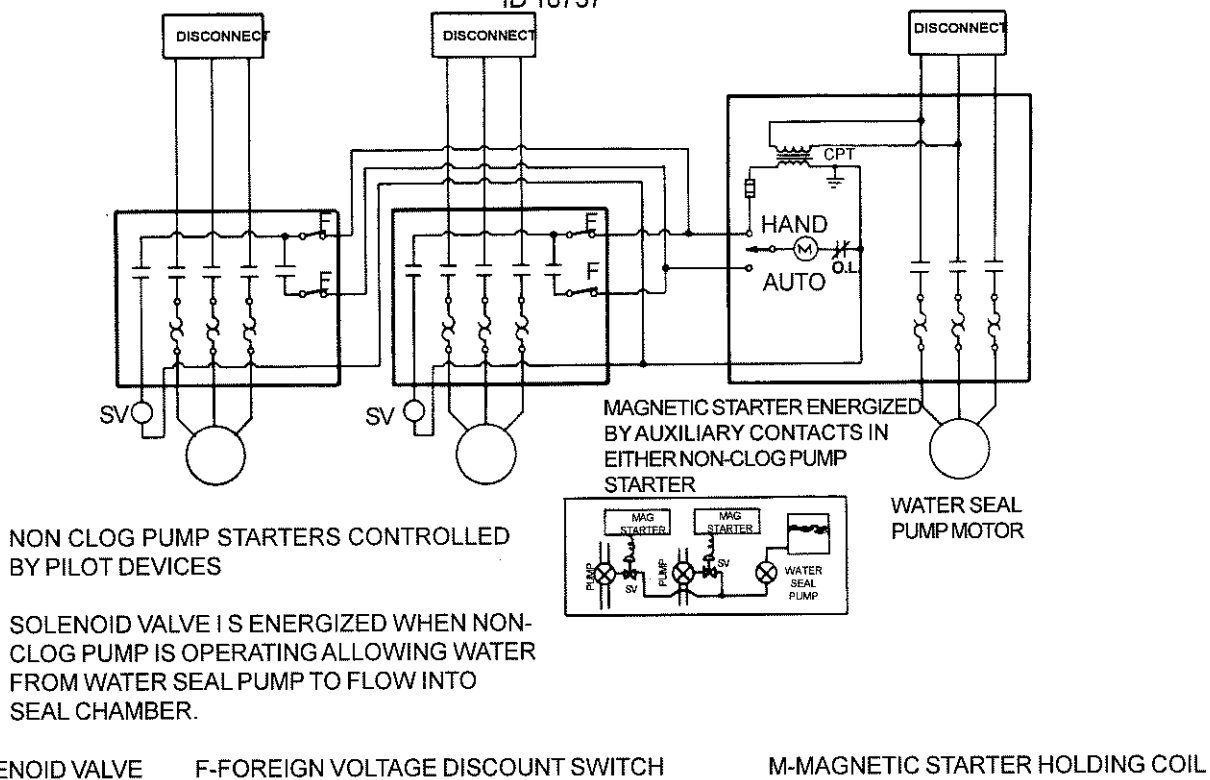
- |  |  |
|--|--|
| <p>25. The casing and impeller wear rings may be excessively worn.</p> <p>26. There may be internal leakage from the discharge to the suction compartments as the result of internal gasket failure.</p> <p>27. There may be a misalignment of the pump shaft.</p> <p>28. The shaft may chatter because it is bent.</p> <p>29. The pump may run rough due to improper balancing of the impeller.</p> <p>30. The shaft may not be running due to worn bearings.</p> <p>31. The impeller may be rubbing against the inside of the case.</p> <p>32. The concrete pad might not be of sufficient size to provide pump stability.</p> <p>33. The pump may have become misaligned during installation.</p> <p>34. The operating conditions of the installation do not agree with the data specified when the pump was purchased.</p> <p>35. The shaft seal may be incorrectly installed, or the stuffing box has not been packed correctly.</p> <p>36. The shaft sleeve may be scored or pitted in the region of the packing due to dirt or abrasive matter in the flushing fluid.</p> <p>37. Excessive tightening of the packing gland may block the flushing port thereby diminishing the sealing fluid flow.</p> <p>38. Packing material may have become wedged or extruded between the shaft and the bottom of the stuffing housing due to excessive clearance on the Packing backup washer.</p> <p>39. The mechanical seal may have been damaged by running dry.</p> <p>40. There may be excessive axial thrust (side loading) due to improper impeller central alignment.</p> <p>41. The bearings may be worn.</p> <p>42. The bearings may have been damaged during installation and/or dirt or other foreign matter may</p> | <p>have entered the bearings during greasing or oiling.</p> <p>43. Excessive greasing may cause the bearings to overheat.</p> <p>44. Inadequate lubrication may be causing bearing failure.</p> <p>45. Dirt may have entered the bearings past the O-Rings.</p> <p>46. Moisture may have entered the bearing housing causing the bearings to rust.</p> |
|--|--|

**VI. APPENDIX I**

**Interconnecting Diagram For Water Seal Pump  
 ID 18736**



**INTERCONNECTING DIAGRAM FOR WATER SEAL PUMP & SOLENOID VALVES  
 ID 18737**



## 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](http://www.paco-pumps.com)