PACO®
PUMPS, INC.

A6d.1
8/88

PACO TYPE VM
VERTICAL MULTISTAGE PUMPS

- Installation
  - Operating
    - Maintenance Instructions

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1. Shipment Inspection

The PACO Type VM Pump should remain in its shipping carton until it is ready to be installed. This carton is specially designed to protect it from damage. During unpacking and prior to installation, **care should be taken to ensure the pump is not dropped or mishandled.** Immediately report in writing any damage to the transportation company and ask to have it inspected. Do not destroy packing materials until shipment is inspected and the claim is settled.

Examine the components carefully to make sure no damage has occurred to the pumps or accessory components during shipment.

2. Applications and Operating Ranges

Before beginning installation procedures, the following checks should be made to be certain the correct pump has been selected:

A. Applications

Pump Type	Service
VM	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
VMS	316 stainless steel-fitted construction. (Consult manufacturer for specific materials of construction.)

B. Maximum Operating Conditions

Temperature

Pump Type	Fluid Temperature
VM	32° to 230°F (0° to 110°C)

All motors are designed for continuous duty in 104°F (40°C) ambient. For excessive ambient temperatures consult manufacturer.

Working Pressures

Pump Type	Pump Stages	PSI/(Bars)
VM10 & VM10S	2 to 3	230/(17)
	4 to 18	300/(20)
VM20 & VM20S	1 to 2	230/(16)
	3 to 12	300/(20)
VM40 & VM40S	1 to 8	200/(14)
	10 to 12	300/(20)
VM80 & VM80S	2 to 4	175/(12)
	5 to 10	335/(23)
VM120	1 to 5	180/(12.5)
	6 to 8	340/(23)
VM300	2 to 6	175/(12)

3. Installation

Pump Location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and should not be totally enclosed.

For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1.

Secure pump to foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported.

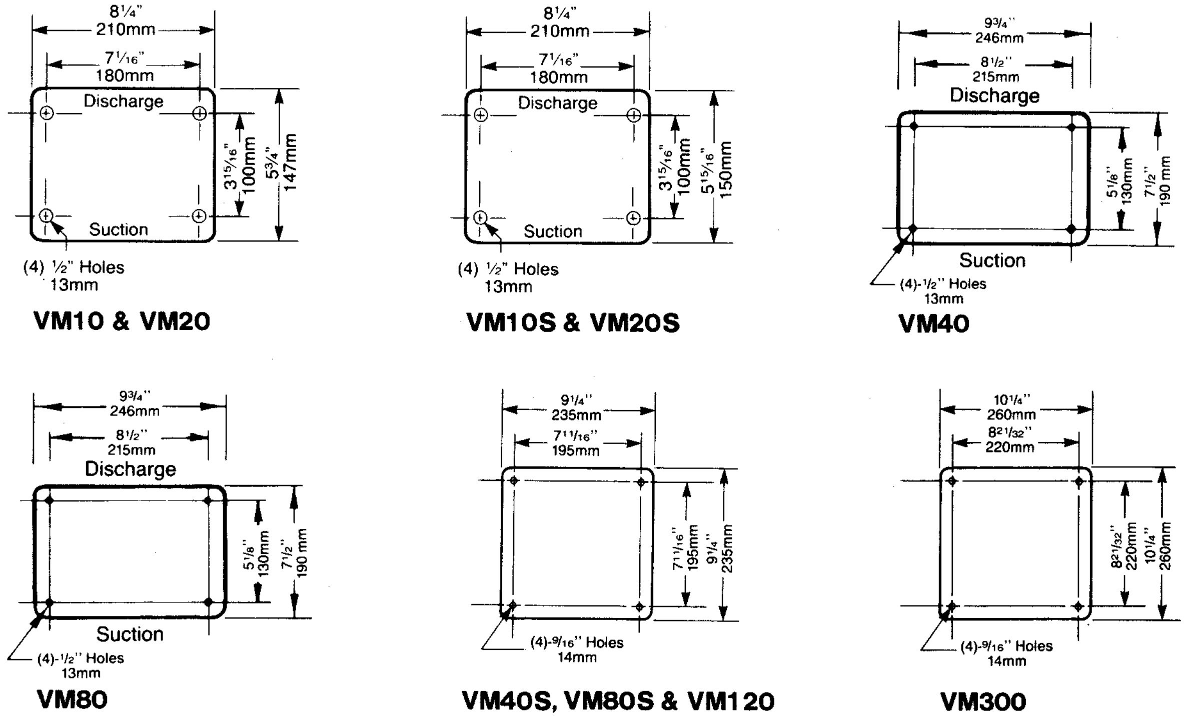


Fig. 1. Bold Hole Centers

Piping

Suction Pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum. Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Fig. 2.

Mimimum Suction Pipe Sizes

The following recommended suction pipe sizes are the **smallest** sizes which should be used with any specific Type VM pump type. The suction pipe size should be verified with each installation to ensure good piping practices are being observed and excess friction losses are not encountered.

VM10	1"	Nominal diameter sch 40 pipe
VM20	1¼"	Nominal diameter sch 40 pipe
VM40 & VM80	2"	Nominal diameter sch 40 pipe
VM120	3"/2½"	Diameter sch 40 pipe is preferable but 2½" pipe may be used if the pumping rate is less than 88 GPM (20 M^3/hr.)
VM300	4"	Nominal diameter sch 40 pipe

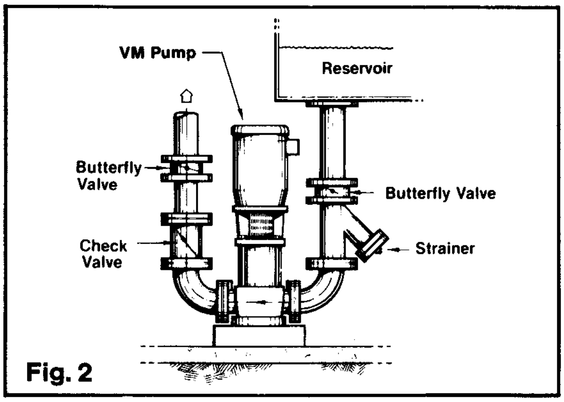


Fig. 2

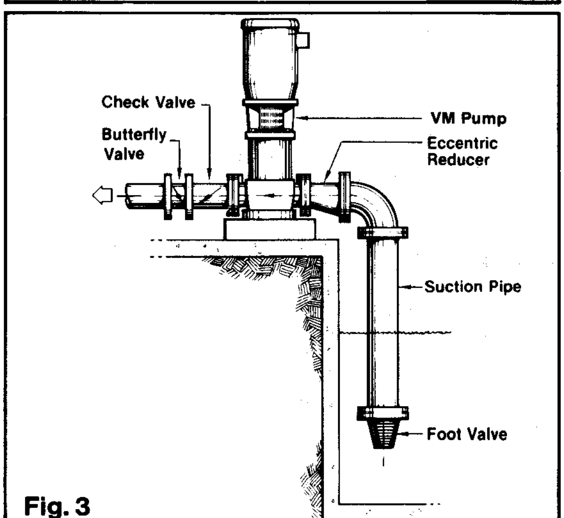


Fig. 3

Suction Lift

Where suction lift is necessary, an isolation valve should **not** be installed in the suction line. It is important for all pipe connections to be airtight or decreased pump performance may result.

A foot valve should be installed below the lowest water level to ensure the pump remains primed.

Slope the suction line downward away from the pump to avoid any air pockets. Eccentric reducer should be used if reduction in pipe size is required. The flat side of the reducer should be on the top side of the pipe to eliminate air pockets. See Figure 3 on page two.

Maximum Suction Lift

The maximum suction lift for each pump can be calculated for any requirement from the Net Positive Suction Head (NPSH) Curves shown below.

The maximum suction lift can be calculated from the following formula:

$$H_{max.} = A - NPSH - H_f - Hv - Hs$$

$H_{max.}$ = Maximum suction lift.
A = Barometric pressure at fluid surface from Table A.
NPSH = Net Positive Suction Head from HPSH curve for specific pump type.
H_f = Suction line friction loss in ft. water column for pipe, valves, and fittings. Calculated by system designer or installer.
Hv = Vapor pressure of the fluid being pumped at a given temperature in ft. of water column from Table B.
Hs = Safety factor usually 5% to 10% of A.

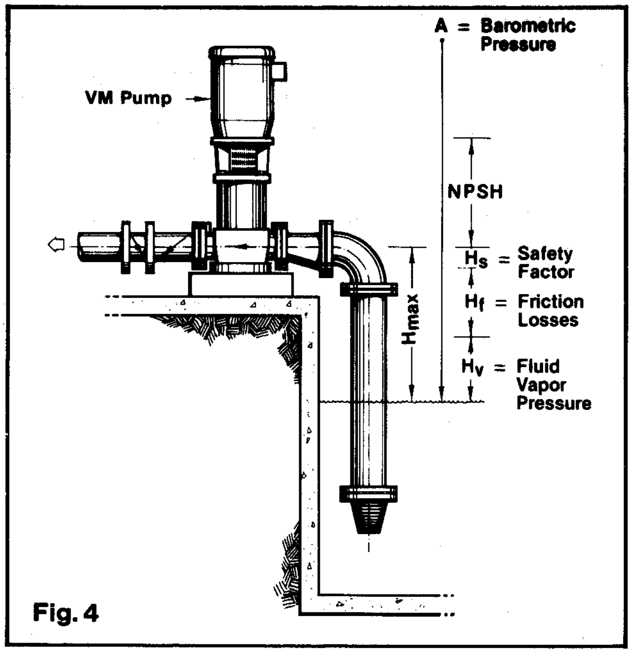


Fig. 4

Example:

Find the maximum suction lift for a VM40-6-3 Hp, 3450 RPM, 60 Hz pump delivering 40 GPM of cold airless water at 70°F (21.1°C) at sea level. The suction line friction loss is 5.7 ft.

Solution:

$$H_{max.} = A - NPSH - H_f - Hv - Hs$$
$$= 33.95 - 4.0 - 5.7 - 0.84 - 3.4$$
$$= 20.01 \text{ ft.}$$

Table A. Altitudes vs Barometric Pressure

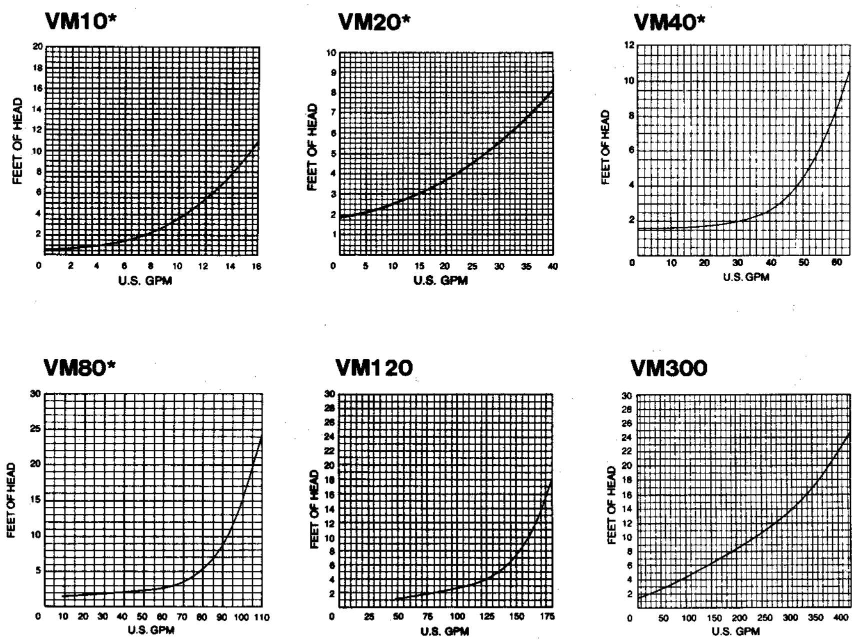
Altitude above sea level in feet	Atmospheric pressure in PSI*	Equivalent in feet of water column (W.C.)
0	14.7	33.95
1000	14.2	32.7
2000	13.6	31.5
3000	13.1	30.4
4000	12.6	29.3
5000	12.1	28.2
6000	11.7	27.2
7000	11.2	26.2
8000	10.8	25.2
9000	10.4	24.2
10000	10.0	23.3

*These are absolute pressures.

Table B. Vapor Pressure

Temp. of water °F/°C	Vapor pressure FT. W.C. / PSI
230/110.0	50.42/20.78
220/104.4	41.50/17.88
212/100.0	35.37/14.68
210/98.9	33.97/14.10
200/93.3	27.62/11.51
190/87.8	22.29/9.33
180/82.2	17.85/7.51
170/76.7	14.19/6.00
160/71.1	11.19/4.74
150/65.6	8.75/3.72
140/60.0	6.78/2.89
130/54.4	5.19/2.22
120/48.9	3.94/1.70
110/43.3	2.98/1.27
100/37.8	2.21/0.95
90/32.2	1.62/0.70
80/26.7	1.18/0.51
70/21.1	0.83/0.36
60/15.6	0.60/0.26
50/10.0	0.42/0.18
40/4.4	/0.12

NPSH Curves 3450 RPM 60Hz



***Note: For "S" Models, NPSH values differ. Please refer to Performance Curve.**

Discharge Piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves, and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch ties directly on either side of the pump. The piping on each side of the pump should be adequately supported to reduce thermal and mechanical stresses on the pump.

Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used.

Bypass

A bypass or pressure relief valve should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Circulation through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table C for minimum flow rates.

PLEASE NOTE:

THE VM PUMPS ARE SHIPPED WITH FULL FLANGE BLANKS AND THE BLANKS MUST BE REMOVED BEFORE THE FINAL PIPE FLANGE TO PUMP CONNECTIONS ARE MADE.

Table C. Minimum Pumping Rates

Pump Type	Min. Flow Rates
VM10	1.2 GPM (0.25 M^3/HR)
VM20	3.0 GPM (0.68 M^3/HR)
VM40	5.25 GPM (1.19 M^3/HR)
VM80	8.5 GPM (1.93 M^3/HR)
VM120	13.5 GPM (3.07 M^3/HR)
VM300	27.0 GPM (6.14 M^3/HR)

4. Electrical

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

WARNING:

The safe operation of this pump requires that it be grounded in accordance with the National Electrical Code and local governing codes or regulations. The ground wire should be a copper conductor of at least the size of the circuit conductors supplying power to the motor. Connect the ground wire to the grounding screw in the terminal box and then to the **acceptable** grounding point. Do not ground to a gas supply line.

Motor

PACO Type VM Pumps are supplied with heavy-duty 3450 RPM, O.D.P., NEMA C frame motors designed and built to our rigid specifications. T.E.F.C. motors are also available. Motors for other voltages and frequencies are available on a special-order basis.

Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 6.

Motor Terminal Box Positions (Top View)

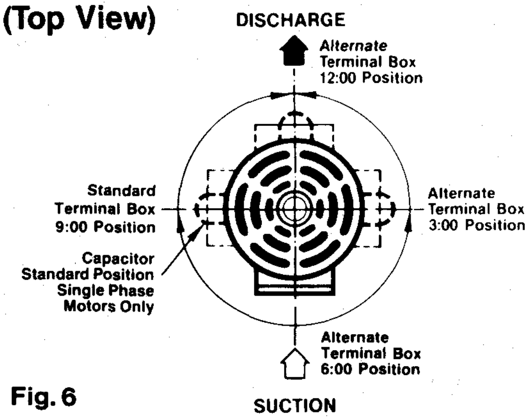


Fig. 6

Supply Power

Verification of the electrical supply should be made to be certain the voltage, phase, and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. Wiring connection diagrams can be found on the plates attached to the motor.

If voltage variations are larger than ±10%, do not operate the pump.

Wire sizes should be based on the ampacity (current carrying properties of a conductor) as required by the latest edition of the National Electrical Code or local regulations.

Rapid cycling of the motor should be prevented to avoid excessive heat built-up in the motor windings due to high starting currents. Generally, direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor.

If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer or resistant starter should be used.

Motor Protection

1. Single-Phase Motors:

With the exception of 7½ and 10 HP motors which require external protection, single-phase Type VM Pumps are equipped with multi-voltage, open-drip proof (O.D.P.) squirrel-cage induction motors with built-in thermal protection.

2. Three-Phase Motors:

Type VM Pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used to give the best possible protection. The overload should be sized and adjusted to trip at 10% over the full-load current rating of the motor. If the motor is lightly loaded, the overload should be resized or adjusted to a lower value. **Under no circumstances should the overloads be set to a higher value than 10% over the full load current shown on the motor nameplate. This will void the warranty.**

Overloads for auto transformer and resistant starter should be sized in accordance with the recommendations of the manufacturer.

It is suggested a fused disconnect be used for each pump where service and standby pumps are installed. Further, an alternating switch should be used so each pump can be equally operated to even the wear.

DO NOT START THE PUMP (EVEN TO CHECK THE DIRECTION OF ROTATION) UNTIL IT HAS BEEN FILLED WITH WATER. Severe damage may be caused to the pump if it is run dry.

5. Start-up

After the pump has been installed, wired and the system filled, the following procedures should be performed.

Do not start the pump before priming or venting the pump. Never operate the pump dry.

Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and remove the priming plug from the pump head. See Figure 7. Gradually open the isolation valve in the suction line until a steady stream of water runs out the priming port. Replace the plug and securely tighten. Completely open the isolation valves.

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

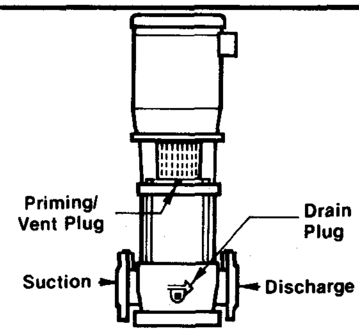


Fig. 7 VM10, 20, 40, 80, 120, 300

Check the Direction of Rotation

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft to be certain it turns freely. Replace the coupling guard.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. **WHEN VIEWED FROM THE TOP, THE PUMP SHOULD ROTATE COUNTER-CLOCKWISE.**
6. To reverse the direction of rotation, switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on plate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation.

Starting and Adjusting

Before starting the pump, please check:

1. Pump is primed.
2. Direction of rotation is **counter-clockwise** when viewed from the top.
3. All piping connections are tight and the pipes are adequately supported.
4. Suction line isolation valve is completely opened, if a valve has been installed.
5. For initial starting, the isolation valve in the discharge pipe should be closed and gradually opened after the pump is turned on. Opening this valve too fast may result in some water hammering in the discharge pipe. Make sure this valve is completely open.
6. Check and record the voltage and amperage of the motor. Adjust the motor overloads if required.
7. Check and record operating pressures if pressure gauges have been installed.
8. Check all controls for proper operation. If pump is controlled by a pressure switch, check and adjust the cut-in and cut-out pressures. If low-water-level controls are used, be sure the low-level switch is properly adjusted so the pump can not run if the pump should break suction.

6. Operation and Maintenance

PACO Type VM multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors will require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time against a closed isolation valve.

This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

Pump cycling should be checked to ensure the pump is not starting more than 20 times per hour on ½ to 5 HP models, 15 times per hour on 7½ to 15 HP models and 10 times on 20 to 30 HP models. Rapid cycling is a major cause of pre-mature motor failure due to increased heat built-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication. See Bypass Piping Section 3.

Freeze Protection:
If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again.

Maintenance:

Motor Lubrication
Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors containing sealed bearings do not require additional lubrication during the first 15,000 hours of operation. Motors with grease fittings should **only** be lubricated with a lithium based grease.

Type of Service	Frequency of Greasing	Approved Types of Grease
Seasonal (motor is idle for more than 6 months)	yearly	Shell Dolium R FSSO Beacon 3 BP-XRB2 Shell Alvania 3 Mobil Grease 2 Texaco Regal Starfos Premium
Intermittently	semi-annually	
Continuous	quarterly	

Do not over grease the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure.

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor heaters.
6. Check the operation of all controls. Check unit control cycling twice and adjust if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.

If the pump fails to operate or there is a loss of performance, refer to the Trouble Shooting Section 7.

Motor Replacement
If the motor is damaged due to bearing failure, burning or shorting out, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on Type VM pumps are specifically designed to our rigid specifications. REPLACEMENT MOTORS MUST BE OF THE SAME NEMA C FRAME SIZE, BE EQUIPPED WITH HEAVY DUTY BEARINGS AND RATED TO HAVE THE SAME SERVICE FACTOR. Failure to follow these recommendations may result in premature motor failure.

Disassembly

1. Remove the coupling guard screens.
2. Using the proper size metric allen wrench, loosen the four cap screws in the coupling.
3. With the correct size wrench, loosen and remove the four bolts which hold the motor to the discharge section of the pump end.
4. Lift the motor straight up until the shaft is free from the coupling.

Assembly

1. Thoroughly clean the surfaces of the motor and pump end mounting flanges. Set the motor on the pump end.
2. Place the terminal box in the desired position by rotating the motor.
3. Insert the mounting bolts, then diagonally and evenly tighten.
4. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point. Note: The shaft can only be raised approximately 0.20 inches (5mm).
5. Now lower the shaft 0.02 to 0.06 inches or the thickness of a dime (0.5 to 1.5mm), and retighten the metric allen-head screws in the coupling. Be sure to tighten the top and bottom allen bolts on one side of the coupling and then the other. Torque coupling screws to 10 - 15 lbf-ft (1.5 - 2.0 kgfm) for motors up to 1.5 HP, 32 - 60 lbf-ft (4.4 - 8.3 kgfm) for motors from 5 - 10 HP and 75 lbf-ft (10.5 kgfm) for 15 through 30 HP motors.
6. Check to see that the distance between the coupling halves is about the same before making final torque. Adjust if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Replace the two coupling guard screens.

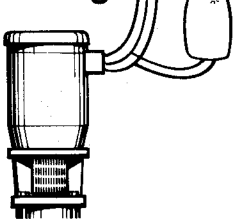
7. Trouble-Shooting

When working with electrical circuits, use caution to avoid electrical shock. It's recommended that rubber gloves and boots be worn, and that care be taken to have metal terminal boxes and motors grounded to power supply ground or steel water pipes.

WARNING: FAILURE TO GROUND THE PUMP MAY RESULT IN SERIOUS ELECTRICAL SHOCK.

Preliminary Tests

Supply Voltage



How to Measure

By means of a volt meter, which has been set to the proper scale, measure the voltage at the pump terminal box or starter.

On three-phase units, measure between the legs (phases).

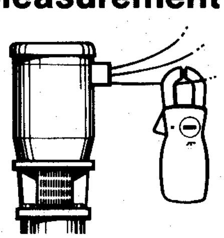
What it Means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current Measurement



How to Measure

By use of an ampmeter, set on the proper scale, measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

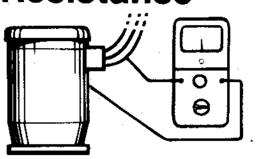
Current should be measured when the pump is operating at constant discharge pressure when the motor is fully loaded.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect. Check winding and insulation resistances.
3. Too high or low supply voltage.
4. Motor windings are shorted.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

Trouble Shooting Chart

Fault	Possible Causes	How to Check	How to Correct
A. Pump Does Not Run.	1. No electricity at motor.	Check for voltage at motor terminal box.	If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter.	Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.

Fault	Possible Causes	How to Check	How to Correct
A. Pump Does Not Run. (Cont.)	4. *Starter does not energize.*	*Energize control circuit* and check for voltage at the holding coil.	*If no voltage,* check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contact in control devices.	Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off voltage, disconnect field wiring from control box to the motor. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values.	If open winding or ground is found, remove motor and repair or replace.
	7. Defective Capacitor. (Single-Phase motors)	Turn off voltage, discharge capacitor. Check with ohmmeter (RX-100K).	When the motor is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). *Replace if defective.*
B. Pump Runs But at Reduced Capacity or Does Not Deliver Water.	1. Wrong rotation.	Check wiring for proper connections.	Correct wiring.
	2. Pump is not primed or airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level.	Refill the pump, replace plug and start the pump. Long suction lines must be filled *before starting the pump.*
	3. Strainers, check, or foot valves are clogged.	Remove strainer, screen or valve and inspect.	Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data.	Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge *piping leaks.*	Pump runs backwards when *turned off. Air in suction pipe.*	Suction pipe, valves and fittings *must be airtight.* Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff.	Covert PSI to feet (PSI x 2.31 ft/PSI = ________ ft.) Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.

Fault	Possible Causes	How to Check	How to Correct
C. Pump Cycles Too Much.	1. Pressure Switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts.	Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation.	Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber.	Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume.
	4. Tank is too small.	Check tank size and air volume in tank.	Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is ⅔ of the total tank volume at the pump cut-in pressure.
D. Fuses Blow or Circuit Breakers or Heaters Trip	1. Low Voltage.	Check voltage at starter panel and motor.	If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Starter overloads are set too low.	Cycle pump and measure amperage.	Increase heater size or adjust trip setting.
	3. Three-phase current is unbalanced.	Check current draw on each lead to the motor.	Must be within ±5%. If not, check motor and wiring.
	4. Motor is shorted or grounded.	Turn off voltage, disconnect field wiring from the terminal box at the motor. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values.	If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals.	Tighten loose terminals. Replace damaged wire.
	6. Pump is stuck.	Turn off power and manually rotate pump shaft.	If shaft does not rotate, remove pump and inspect. Disassemble and repair.
	7. Motor hums and cuts off. (Single-phase Motors).	Check for stuck pump or defective capacitor.	See A7 and D6.

"WARRANTIES"

Please refer to the Limitation of Warranties applicable to and at the time of the sale/purchase of these products.

PACO® PUMPS

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