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Series LM/LP

Single Stage In-Line Centrifugal Pumps

Installation and Operating Instructions



Table of Contents:

	Page #'s
Checking the Condition of the Pump	1
Pre-Installation	1
Installation Procedures	1-2
Electrical	3-4
Starting the Pump	4-5
Operating Parameters	5-8
Trouble Shooting	8-12
Notes	13-14

Please leave these instructions with the pump for future reference.

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Pipework

Arrows on the flanges of the pump volute indicate the flow direction of water through the pump. Grundfos LM/LP model pumps can be mounted in either the vertical or horizontal position. The pump can be installed with the motor in all positions between vertical and horizontal but the motor/pump shaft must never fall below the horizontal plane. See Figure 1. In open systems, install suction piping to minimize friction losses and avoid air pockets. See Figure 2. Size discharge piping to reduce fluid velocities and minimize friction losses.

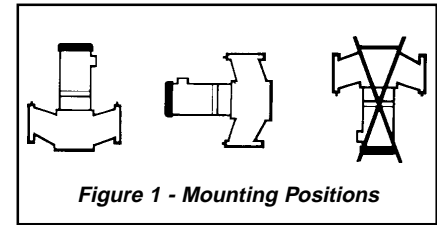


Figure 1 - Mounting Positions

TABLE A: MINIMUM PUMPING RATES

Pump Type	Min.Flow Rates
2.5 LM or LP Models	15 GPM
3.0 LM or LP Models	25 GPM
4.0 LM or LP Models	50 GPM

It is suggested that isolation valves be installed on each side of the pump to avoid draining the system if the pump needs to be cleaned or repaired. It is also suggested that a check valve be installed in the discharge pipe. A plugged tee or capped pipe should be mounted in the suction line to fill the pump and pipe before start-up especially if the system is not pressurized.

The pump and/or piping should be adequately supported on both sides to reduce thermal and mechanical stresses on the pump. If pumps are installed close to noise sensitive areas, it is advisable to use pump and piping vibration isolators to prevent vibration from being transmitted to the structure.

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. See Table A for minimum flow rates. The bypass should be routed back to a heat dissipating source or to a drain depending on the liquid being pumped and local codes. Control of the bypass can be made by using a pressure relief valve or thermostatic control valve.

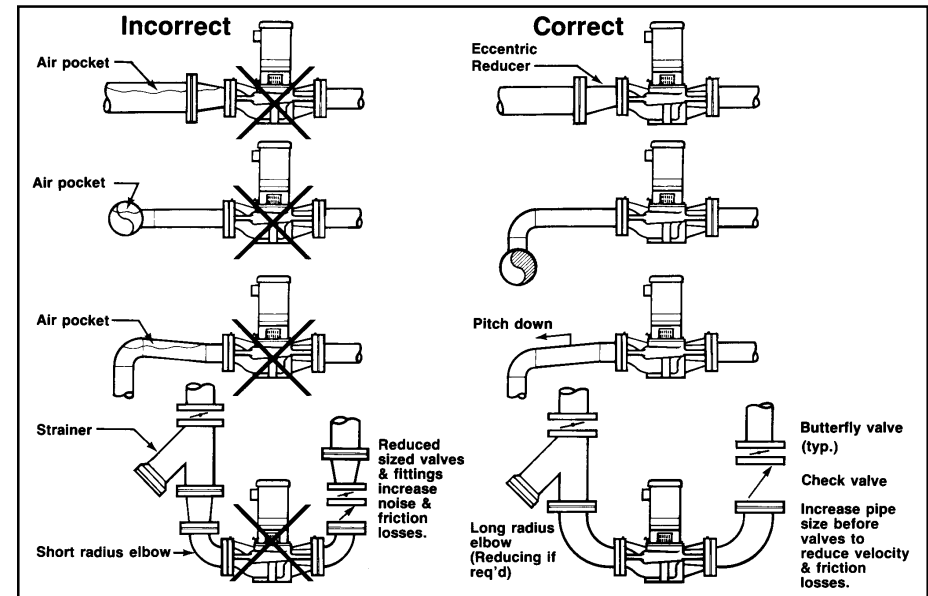


Figure 2 - Suction Piping

All electrical work should be performed by a qualified technician 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. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE **ACCEPTABLE** GROUNDING POINT.

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.

Motor

Grundfos LM/LP Pumps are supplied with heavy-duty 1750 RPM (LM Models) or 3450 RPM (LP Models), O.D.P, NEMA C frame motors selected 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 (do not remove the shaft coupling), turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 3.

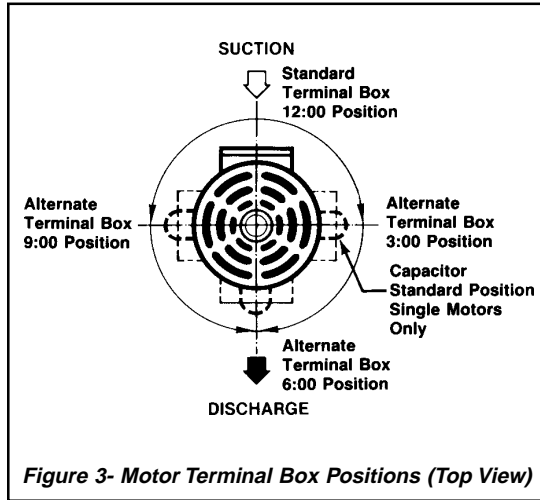


Figure 3- Motor Terminal Box Positions (Top View)

Verify Electrical Requirements

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 $\pm 10\%$ of the nameplate-rated voltage. For multi-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 plates attached to the motor.

If voltage variations are larger than $\pm 10\%$, do not operate the pump.

Field Wiring

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

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 the inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer or resistance starter should be used.

It is suggested that a fused disconnect be used for each pump where service and stand by pumps are installed.

Problem	Possible Cause	Remedy
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than $\pm 10\%$, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within $\pm 5\%$. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. 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 bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above 104°F (40°C), ambient-compensated heaters should replace standard heaters.

<i>Problem</i>	<i>Possible Cause</i>	<i>Remedy</i>
The pump runs but at reduced capacity or does not deliver water	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passage-ways. Remove any foreign materials found.
	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
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. Repair as necessary.
	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 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.

Motor Protection

A. Single-Phase Motors:

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

B. Three-Phase Motors:

LM/LP Pumps with three-phase motors must use 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. The overload should be sized and adjusted to trip at 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 the full load current shown on the motor nameplate. This will void the warranty.

Starting the Pump the First Time

After the pump has been installed, wired and the system filled, the following procedures must be performed. Do not start the pump before priming or venting. 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 valves and open the air vent screw. See Figure 4. Gradually open the suction side isolation valve until a steady stream of airless water runs out of the air vent hole. Tighten the air vent screw and 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 open the air vent screw and suction valve (if one is installed). Fill suction line through the plugged tee or capped pipe if one has been provided as suggested in the Installation Procedures section, Page 2. If no other means to fill the suction line has been provided, remove one of the gauge tapping plugs in the pump flanges and pour water into the hole using a funnel or hose with adapter. All air in pump and suction line must be purged prior to start-up.

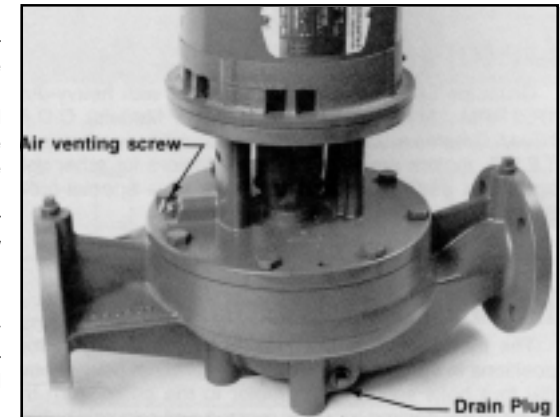


Figure 4

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;

Starting the Pump the First Time

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 MOTOR END, THE PUMP SHOULD ROTATE COUNTERCLOCKWISE;**
6. To reverse the direction of rotation, first 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 nameplate. Change wiring as required;
8. Switch on the power again and check for proper motor rotation.

Starting and Adjusting

Before starting the pump, please check that the:

1. Pump is primed;
2. Direction of rotation is counterclockwise when viewed from the motor end;
3. All piping connections are tight and adequately supported;
4. Suction line isolation valve is completely opened, in a valve has been installed.

For initial starting:

1. The isolation valve in the discharge pipe should be closed and gradually opened after the pump is turned on. Opening this valve to fast may result in some water hammering in the discharge pipe. During operation, be sure this valve is completely open;
2. Check and record the voltage and amperage of the motor. Adjust the motor overloads if required;
3. Check and record operating pressures if pressure gauges have been installed;
4. Check all controls for proper operation. If pump is controlled by a pressure switch, check and adjust the cut-in and cut-out pressure. If low-water level controls are used, be sure the low-level switch is properly adjusted so the pump cannot run if the pump should break suction.

Operating Parameters

Grundfos LM/LP in-line centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are production 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 without flow through the pump. 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 bearing and seals.

Pump Cycling

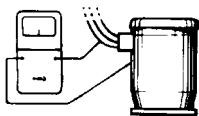
Pump cycling should be checked to ensure the pump is not starting more than 20 times per hour on ½ to 5 HP models; 15 times per hour on 7½ to 15 HP models; and 10 times per hour on 20 to 40 HP models. Rapid cycling is a major cause of premature motor failure due to increased heat buildup in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Trouble Shooting

<i>Problem</i>	<i>Possible Cause</i>	<i>Remedy</i>
The pump does not run	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The 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 is 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. Convert measured pressure (in PSI) to head (in feet): (Measured 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.

Trouble Shooting

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 Rx 100K 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 ohm. If they do not, motor should be repaired or replaced.

Diagnosing Specific Problems

Problem	Possible Cause	Remedy
The pump does not run	1. No power 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.
	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 contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.

Operating Parameters

Maintenance

Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings do not require additional lubrication during the first 15,000 hours of operation. Motors with grease fittings should only be lubricated with approved types of grease. Do not over grease the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. DO not mix petroleum grease and silicon grease in motor bearings.

Type of Service	Frequency of Greasing	Approved Types of Grease
Seasonal (motor is idle for more than 6 months)	Yearly	Shell Dolium R Chevron SRI#2 Or compatible equivalent type of grease
Intermittently	Semiannually	Texaco SRI#2. Mobilith SHC100 is required for 30 & 40 HP motors
Continuous	Quarterly	Texaco "Premium PB"
<i>For severe duty or extreme conditions, special motor frames or configuration, or any questions regarding greasing procedures, contact the motor manufacturer.</i>		

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215 frame or smaller. Use 2 to 3 strokes on NEMA 254 through NEMA 365 frame. For motors with drain plugs on the opposite side of Alemite grease fitting at the pulley end: remove grease drain plug and operate motor for 20 minutes before replacing drain plug.

Motor Replacement

If the motor is damaged due to bearing failure or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on LM/LP pumps are specifically selected to our rigid specifications. **REPLACEMENT MOTORS MUST BE OF THE SAME NEMA C FRAME SIZE, AND MUST BE EQUIPPED WITH THE SAME FRAME 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 guards;
2. Using the proper size metric allen wrench, loosen the four cap screws in the coupling and spread coupling apart;
3. With the correct size wrench, loosen and remove the four bolts which hold the motor to 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. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end, guiding the motor shaft into the coupling.
2. Place the terminal box in the desired position by rotating the motor.
3. Insert the motor mounting bolts, then diagonally and evenly tighten.
4. Remove the coupling adjusting fork bolted to the pump motor stool. The required adjusting fork is determined by shaft diameter for both the LM and LP pump types. See Table B for the correct adjusting fork.

Shaft Diameter	Part No.
0.630" (16 mm)	48 01 76
0.866" (22 mm)	48 01 77
1.300" (33 mm)	48 01 78

Operating Parameters

- 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). See Figure 5.
- Insert the Grundfos adjusting fork underneath the coupling and lower the coupling until it touches the adjusting fork. See Figure 6.
- IT IS EXTREMELY IMPORTANT TO TIGHTEN THE COUPLING SCREWS CORRECTLY. The four allen head fasteners should be tightened as follows. Tighten, but not completely, the bottom fasteners on one side of the coupling. Then tighten, but not completely, the top and bottom fasteners on the other side of the of the coupling so that the gaps between the coupling halves are equal. Repeat this procedure, tightening each side of the coupling successively until the fasteners are torqued to the values listed in Table C. Check to ensure the gaps between the coupling halves are equal. Loosen and adjust if necessary. See Figure 7.

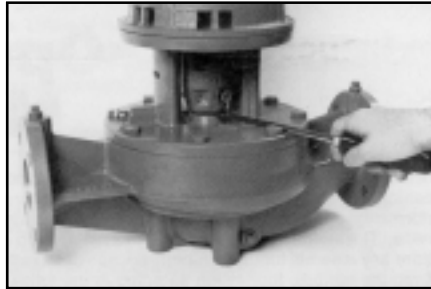


Figure 5

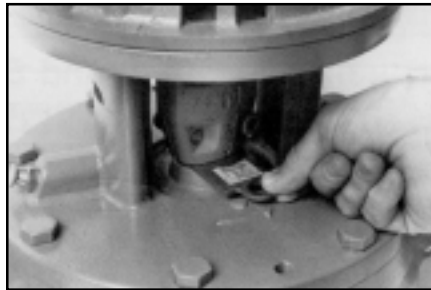


Figure 6

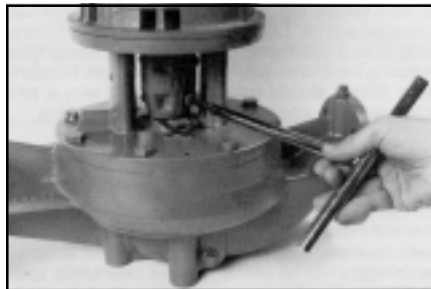


Figure 7

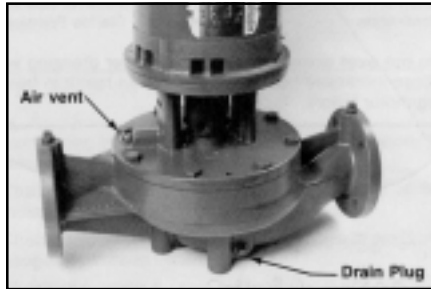


Figure 8

TABLE C: COUPLING BOLT TORQUE VALUES		
Screw Size	HP Ranges	Torques
M6 x 20	Up to 5	10 ft.-lbs.
M8 x 20	5 to 10	23 ft.-lbs.
M10 x 25	15 to 30	46 ft.-lbs.

- Remove adjusting fork and be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
- Replace adjusting fork and secure to pump housing.
- Replace the two coupling guards.

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, loosen the air vent screw and remove the drain plug at the base of the pump. See Figure 8. Do not replace the drain plug or tighten the air vent screw until the pump is to be used again.

Operating Parameters

Regular Check-Ups

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

- Pump meets required performance and is operating smoothly and quietly;
- There are no leaks, particularly at the shaft seal;
- The motor is not overheating;
- Remove and clean all strainers or filters in the system;
- Verify the tripping of the motor overload protection;
- Check the operation of all controls. Check until control cycling twice and adjust if necessary;
- 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 should be manually rotated or run for short periods of time at monthly intervals.

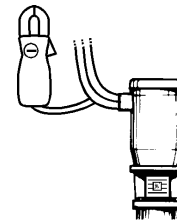
If the pump fails to operate or there is a loss of performance, refer to the Trouble Shooting Section.

Trouble-Shooting

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER SOURCE BEFORE HANDLING.

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).

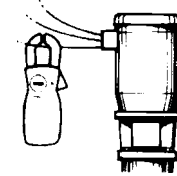
What it Means

When the motor is under load, the voltage should be within $\pm 10\%$ 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 correct the power supply.

Current Measure



How to Measure

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

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