

Priming Systems

Operation & Maintenance

Form No.	Section	Issue Date	Rev. Date
F-1031	2312	10/07/94	02/27/06

Table of Contents

Principals of Operation	1
Rotary Vane Priming Pump – VPE and VPES	2
Rotary Vane Priming Pump – VPO and VPOS	3
Priming Valve	4
Operating Instructions	6
Models VPE, VPES, VPO, VPOS (Electric Operation) ..	6
Manual Hand Primer	6
Maintenance Instructions	7
Priming Pump	7
Priming Valve	7
Priming Tank	7
Manual Controls	7
Testing	7
Rotor Clearance Adjustment	7
Vanes	7
Service Suggestions	8
Models VPE, VPES, VPO, VPOS	8
Wiring Diagrams	10

Illustrations

1.. Priming System	1
2. Rotary Vane Priming Pump	2
3. VPES Priming Pump	2
4. Rotary Vane Priming Pump	3
5. VPOS Priming Pump	3
6. Priming Valve (Manual–Electric)	4
7. Solenoid–Actuated Priming Valve	4
8. Manual–Electric Priming Valve	5
9. Solenoid	8
10. Wiring Diagram	10

Tables

1. Switch and Solenoid Wires	10
2. Wire from Battery to Motor	10



Principles of Operation

Before any centrifugal pump can be operated, it must be primed. Priming is the process of replacing air in the intake lines and portions of the pump with water. If the pump is to be operated from draft, priming must be done by means of a positive displacement pump, or some other device for creating a partial vacuum. Also, when pumping from a water tank, priming will be accomplished more quickly and positively if a priming device is used. Priming will occur naturally when pumping from hydrants or in relay, because inlet water pressure is high enough to force air out of the pump and intake lines, providing a discharge line is opened to permit the air to escape.

A Waterous priming system consists of a priming pump and a priming valve. The priming pump draws air out of the centrifugal pump through the priming valve. The priming valve must be open when priming the pump and then closed when the pump is fully primed (pumping water with all air removed).

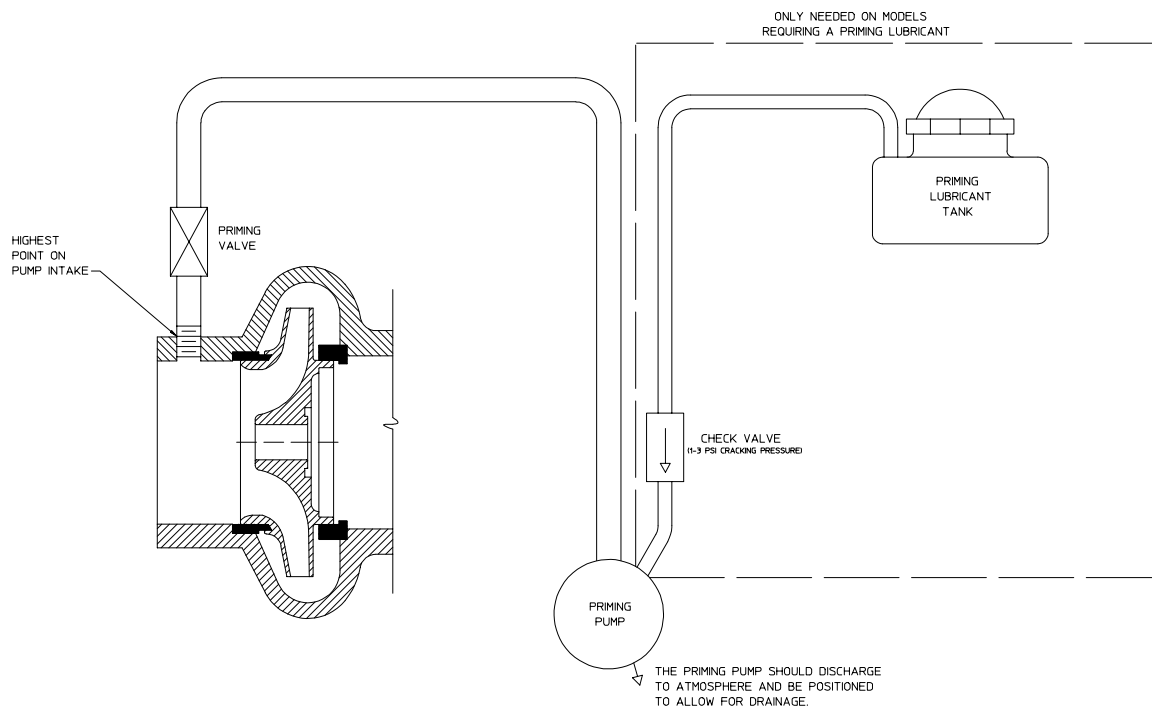
On some models, a lubricant is needed to help seal and lubricate the priming pump.

Pumping from Draft

To obtain a quick prime & maintain pump performance:

- a.) Position pump as near as possible to water supply.
- b.) Avoid humps or sharp bends in intake hose. Make sure no part of hose is higher than pump intake inlet. (Air pockets in intake hose may cause loss of prime or erratic pump action and may reduce pump capacity.)
- c.) Make sure all intake connections are tight and discharge valves are closed.
- d.) Always use an intake strainer or screen.
- e.) Immerse intake strainer at least two feet below water surface to prevent pump from drawing air. (Whirlpools forming above intake strainer indicate that strainer is too close to surface of water.)
- f.) Make sure intake strainer is far enough from bottom to prevent pumping sand, gravel or other foreign matter.

Figure 1. Priming System



IL2130

Note: If pump fails to prime or loses prime, refer to the troubleshooting guide in form F-1031, Section 1000.

Rotary Vane Priming Pump – VPE and VPES

Rotary vane priming pumps are available separately mounted (model VPES) or transmission mounted (model VPE). The VPE and VPES models are driven by an electric motor. The VPE and VPES models each contain one eccentric rotor with three vanes that slide in and out of the rotor.

On the VPE and VPES models, during operation, lubricant from the auxiliary priming tank provides lubrication and an air tight seal between the vanes and pump casing. As the rotor turns, air is drawn from the priming valve inlet due to the vacuum created behind the priming pump. As the priming pump evacuates the air from the lines and the main pump, atmospheric pressure forces water into the pump.

A check valve in the tubing line prevents possible back flow of water into the priming tank. An orifice controls the lubricant flow from the priming tank.

Figure 2. Rotary Vane Priming Pump

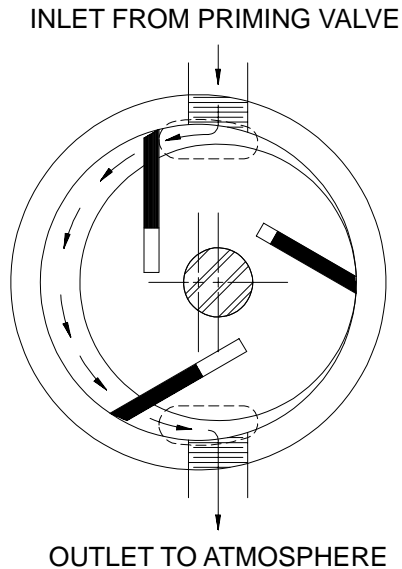
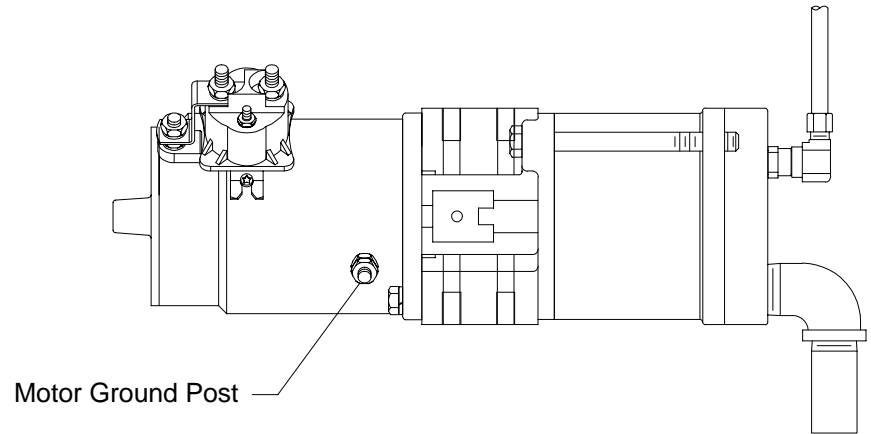


Figure 3. Model VPES Priming Pump



from DPL82082

This electric motor driven rotary vane primer is used for separately mounted applications. With the priming valve and lubricant supply tank, it forms a complete, dependable priming system.

Rotary Vane Priming Pump – VPO, VPOS Models

Rotary vane priming pumps are available separately mounted (model VPOS) or transmission mounted (model VPO). The VPO and VPOS models are driven by an electric motor. The VPO and VPOS models each contain one eccentric rotor with four vanes that slide in and out of the rotor.

As the rotor turns, air is drawn from the priming valve inlet due to the vacuum created behind the priming pump. As the priming pump evacuates the air from the lines and the main pump, atmospheric pressure forces water into the pump.

An optional lubricant tank is available for use with VPO/VPOS models to provide additional lubrication and sealing.

Figure 4. Rotary Vane Priming Pump

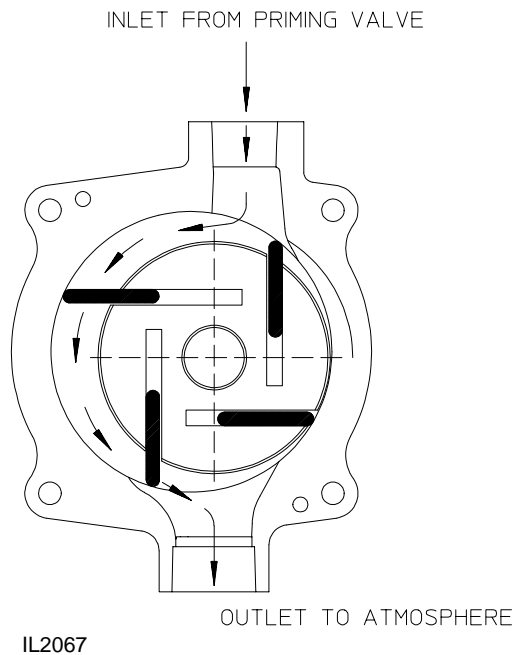
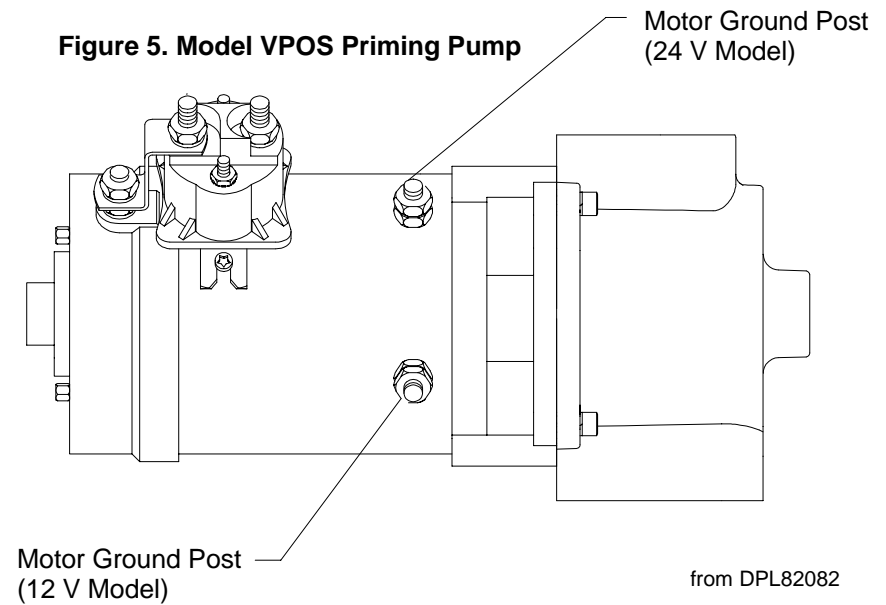


Figure 5. Model VPOS Priming Pump



This electric motor driven rotary vane primer is used for separately mounted applications. With the priming valve, it forms a complete, dependable priming system.

Priming Valve

The valve consists of a stainless steel sliding plunger in a bronze valve body that contains three inlet ports and an outlet. A rubber insert in the plunger is forced against the seat in the body when the valve is closed, assuring a tight seal between the inlets and the outlet.

A relief groove in the valve body connects one inlet port to the area behind the plunger. When the main pump is operating, pressure at the rear of the plunger is at least equal to that on the opposite end of the plunger. This feature prevents the priming valve from opening accidentally.

When the valve is opened during priming operation, it allows a uniform air flow from the various main pump passages to the priming pump. After the main pump is primed, the priming valve is closed to prevent air from leaking into the pump.

Figure 6. Priming Valve (Manual–Electric Shown)

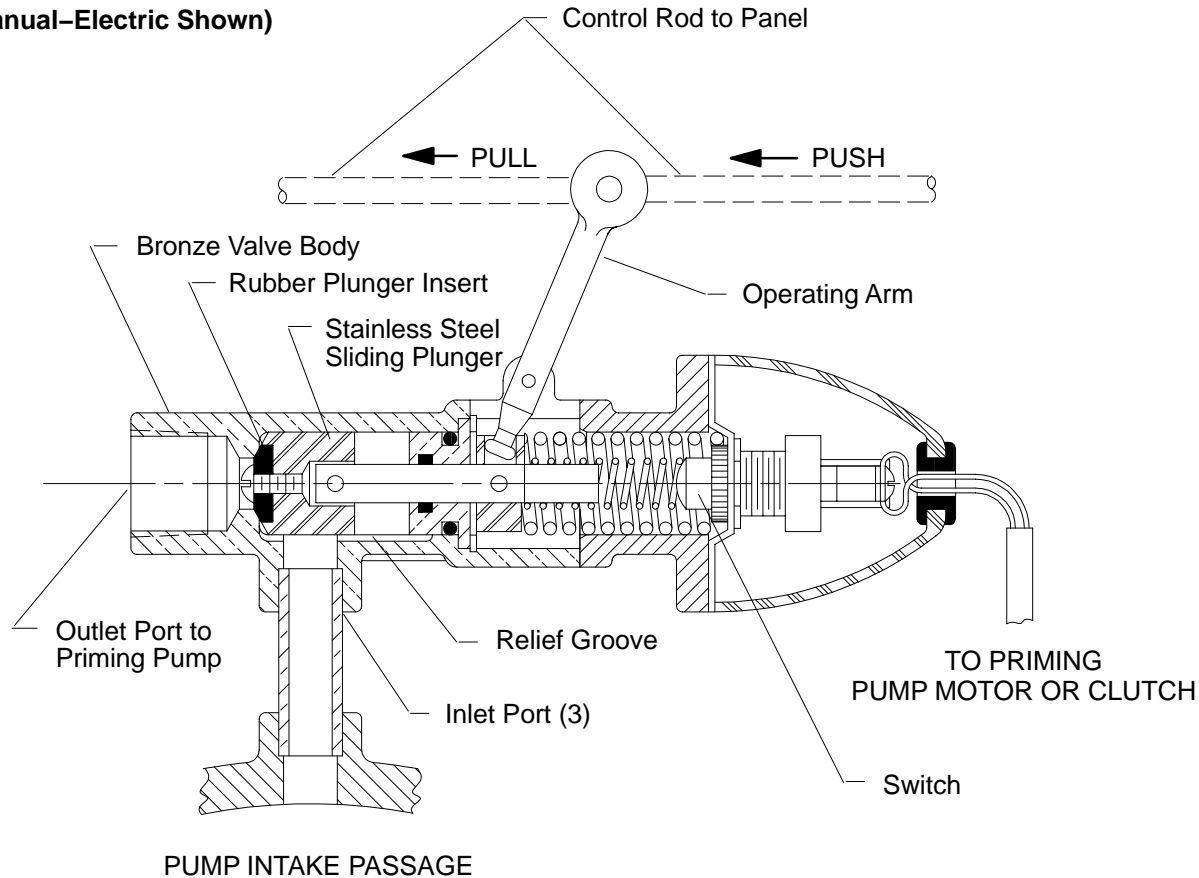
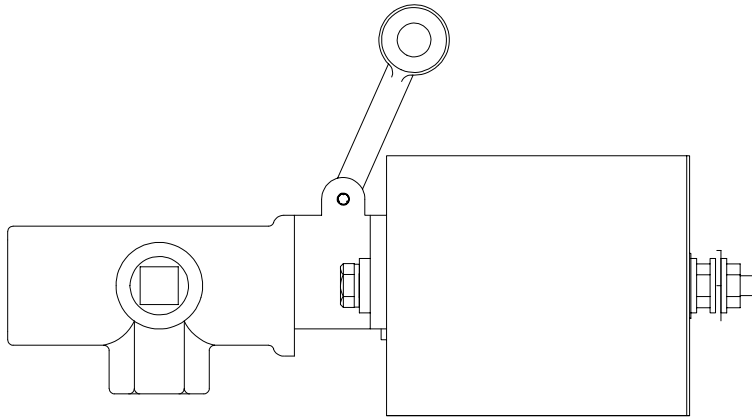


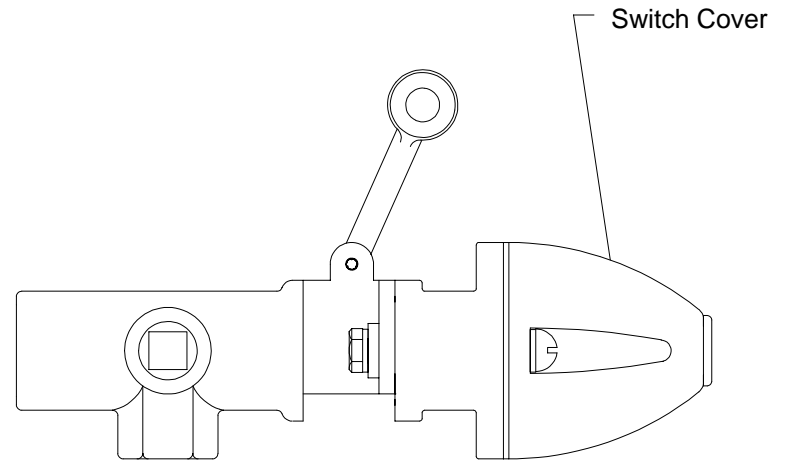
Figure 7. Solenoid-Actuated Priming Valve



from DPL82083

This valve is identical to the manual-electric valve except the switch on the end of the valve is replaced with a solenoid. Priming with this valve is fully automatic. Pressing a push-button switch on the control panel actuates a solenoid on one end of the priming valve to open it, and at the same time starts the priming pump. Releasing the switch closes the priming valve and stops the priming pump.

Figure 8. Manual-Electric Priming Valve



from DPL82083

This valve has a switch on one end enclosed in a housing. As the valve is manually opened, an internal plunger closes the switch to start the priming pump. Releasing the valve control opens the switch to stop the priming pump.

Operating Instructions

Models VPE, VPES, VPO, VPOS (Electric Operation)

1. Close discharge valves, drain valves and all other openings.
2. Make sure all intake connections are tight.
3. Open priming valve as described below. (As valve opens, the priming pump starts automatically.)

Manual Electric Valve

A rod leading out to the control panel operates this valve. As the rod is pulled (or pushed, if so installed), it closes a switch mounted on the valve to start the priming pump.

Solenoid Actuated Valve

Depressing the priming switch button on the control panel simultaneously opens the solenoid operated valve, and starts the priming pump motor. (If the solenoid should fail to open the valve, it can be opened manually.)

If a manual override control is installed for solenoid actuated priming valve, make sure it moves out (or in) when you press the switch button. If it does not move, then operate the manual control while pushing the switch button. As soon as possible after operation, determine why it did not operate, clean and lubricate or repair as necessary.

4. Operate priming pump until it discharges a solid stream of water through its discharge outlet.

NOTE: If priming pump does not prime main pump and discharge a steady stream of water within 30 seconds (1250 gpm or smaller) or 45 seconds (1500 gpm or larger), stop pump and determine cause of problem. (An additional 15 seconds may be required if the truck is equipped with a 4 inch or larger front or rear intake pipe.)

CAUTION

Operating the priming pump for more than one minute continuously may damage the electric motor and/or motor solenoid.

5. After main pump is primed, release valve control.

NOTE: The motor and solenoid are NOT rated for continuous duty. If possible, allow primer to be OFF for a minimum of one minute between uses.

Manual (Hand) Primer

1. Close discharge valve(s), drain valves and all other openings.
2. Make sure all intake connections are tight.
3. Open priming valve.

4. Start main pump and immediately begin pumping the primer handle (to minimize time the pumps runs dry) until water begins exiting the primer outlet.
5. Close priming valve and open main pump discharge valve(s).

Maintenance Instructions

Priming Pump

During operation of VPE model and VPO model with optional lubricant tank, lubricant from the priming tank lubricates the priming pump. **The priming pump should be operated weekly to cycle fresh lubricant through the primer.** This cycling is of particular importance when using biodegradable lubricant, since the biodegradable properties allow it to break down quickly and lose its lubricating qualities. On rotary vane primers only, an orifice is in the lubricant line where it enters the priming pump head, to prevent excessive amounts of lubricant entering the pump and reducing its performance. Make sure clean lubricant is used in the priming tank and make sure the orifice is always open.

Priming Valve

After long service, normal wear of plunger insert, quad ring or O-ring may prevent air sealing of the valve. Replace O-rings and plunger insert if any signs of leakage are discovered. A repair kit is available from the Waterous Company.

Priming Tank

A vent hole is located in the elbow on top of the priming tank to break the siphon and stop the flow of lubricant after priming. The hole should be kept open at all times, but do not enlarge it.

Refill priming tank as needed with lubricant.

If dispensing priming lubricant into the environment, always use a biodegradable or non-toxic lubricant. Biodegradable / non-toxic Prime-Safe™ is available from Waterous.

NOTE: If 30 weight motor oil is used, it is recommended that a catch pan be used under the primer to collect the used oil so it can be disposed of properly.

Manual Controls

If priming valve has manual controls, check them monthly to make sure they operate freely. If rust or dirt cause them to bind, clean and lubricate them.

Testing

Once a month, perform the following vacuum test.

Remove all caps except openings without valves. Close all discharge, intake, drain valves and other similar openings. Operate priming device to create a vacuum of about 22 in. Hg in pump, then stop primer and engine.

Watch pressure gage; if vacuum drops more than 10 in. Hg in 5 minutes, listen for air leaks around packing glands, gaskets, valves, etc.

Replace gaskets, repack or otherwise repair source of trouble.

Rotor Clearance Adjustment

All Waterous priming pumps are factory tested and will draw a minimum of 22 In. Hg vacuum. After prolonged service, the rotor to pump clearance may increase because of wear, resulting in lower vacuum.

On VPE models, if maximum vacuum falls below 22 In. Hg., readjust rotor end clearance to 0.008 to 0.011 inches (VPE) by removing shims from between head and body.

On VPO models, if maximum vacuum falls below 22 In. Hg., inspect primer for wear of the housing, vanes, rotor and seals. Replace as needed.

Vanes

Use of rotary vane primers will cause vane wear. If wear is excessive, vacuum levels will decrease. Periodic replacement of vanes and seals is required to maintain acceptable vacuum levels. Contact Waterous service for replacement kits.

Service Suggestions

Models VPE, VPES, VPO, VPOS

If the priming system fails to operate properly, refer to the troubleshooting guide in F-1031, Section 1000 for the possible cause and suggested remedy.

If the cause of the failure cannot be determined using the troubleshooting guide, the following Service Suggestions should help locate the cause of the malfunction. Go through each step in sequence to check out all the components of the priming system, or until the cause of the malfunction is located.

1. Make sure battery is properly charged. If battery is in low state of charge, it may be difficult to operate the priming pump at proper speed.
2. Check all wiring to the priming pump and valve for loose terminals, damaged insulation, or broken wire strands – especially near terminals.
3. Check that the correct cable size is used (see Table 1 and Table 2).
4. Check for proper grounding of the motor. On newer VPE and VPO models, there is a ground stud on the side of the motor that should be connected with a ground cable to the truck chassis. Older model primers rely on grounding through the primer body; corrosion and/or dirt build-up may cause a loss of ground.
5. If priming pump still does not operate, remove priming motor. Step 6 will help troubleshoot the priming pump, and step 7 will help troubleshoot the motor.
 - a.) VPE models – The priming pump can be removed as a subassembly.
 - b.) VPO models – There are two cast parts that make up the priming pump, the part attached to the motor should not be removed from the motor.
6. For proper function of the priming system, always follow the Maintenance Instructions section of this document. The following are possible priming pump-related causes of low vacuum levels or a non-functioning priming pump:
 - a.) No lubricant in the primer. VPE models **must** have lubricant in order to achieve vacuum levels of 22 in. Hg. or higher. VPO models can achieve vacuum levels of 22 in. Hg. without lubricant, but for higher vacuum levels or as the primer wears, the use of lubricant helps maintain desired vacuum levels.
 - b.) Corrosion inside the priming pump. VPE primers are more susceptible to corrosion if not used regularly; weekly operation is recommended to help keep internal components coated with fresh lubricant. VPO primers are made of corrosion-resistant materials, but abrasives passing through the primer can damage the corrosion resistant surfaces.

Clean the priming pump surfaces to remove corrosion, or replace worn parts.

- c.) Stuck or broken vanes. If primer is not used regularly, corrosion and/or the breakdown of biodegradable lubricants can cause vanes to stick; foreign objects can enter the primer and cause a vane to break; or sand can damage the rotor and inside walls of the primer, not allowing the vanes to slide freely. Clean the inside of the primer and replace vanes or worn parts as needed.
 - d.) Inside walls of primer damaged from sandy water. A tight fit between the vanes and smooth primer walls are required for high vacuum levels. Damage to this smooth surface (and smooth vane edges) causes a loss of the required tight fit. Replacement of damaged parts is usually required.
7. Check for primer motor function in the following manner:
- a.) With the motor disassembled from the priming pump, manually rotate the motor shaft to make sure it turns freely. If it does not, replace the motor.
 - b.) Using the correct battery (12V or 24V) for the application, attach a ground cable (6 AWG or heavier) from the negative, “-”, battery terminal to the ground post on the primer motor (see Figure 3 or 5). Connect the positive, “+”, battery terminal to the solenoid “HOT” terminal, again using a 6 AWG or heavier cable.

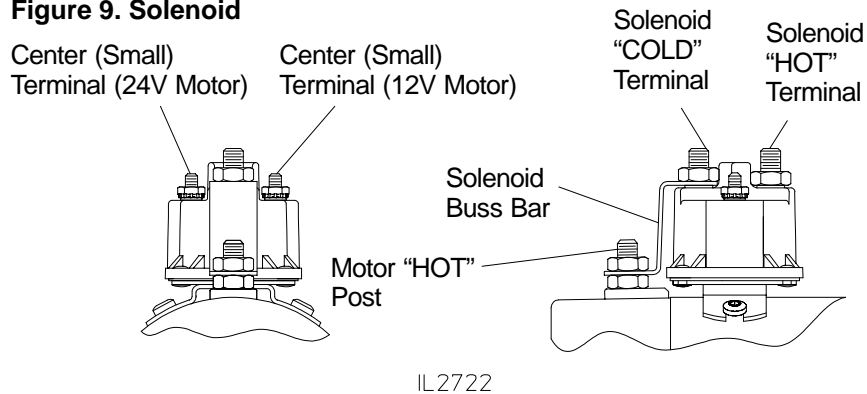
WARNING

Solenoid Motor Testing Hazard. Improper wiring may cause the jumper wire to become very hot, resulting in burns to fingers or hands.

To prevent the jumper wire from overheating on 24V motors, **DO NOT** place the jumper wire on the solenoid ground terminal (small terminal with wire attached).

- c.) Check for motor solenoid function by connecting a jumper between center (small) and hot terminals of solenoid (see Figure 9); the motor should run. Disconnect the jumper. If the motor ran with the jumper installed, go to step 8.

Figure 9. Solenoid



CAUTION

Wherever jumper wire is used, do not leave the wire connected after making the desired test. Failure to disconnect the jumper before proceeding with subsequent tests may cause serious damage to the electrical equipment.

- d.) If motor does not run, temporarily place a heavy jumper (6 AWG or heavier) firmly across hot and cold terminals of solenoid. If the motor then runs, check that the buss bar connections are tight. If connections are good, the solenoid is probably defective and should be replaced.
- e.) If priming motor still does not run, connect a heavy jumper directly between positive "+", battery terminal and "HOT" post of motor.
- f.) If motor does not run, replace or rebuild it. If motor does run with jumper connected, check cable between battery and priming motor solenoid.

- 8. If the priming motor operated with jumper connected between center (small) and hot terminals of solenoid, control switch or switch wiring may be defective. To check switch, connect a jumper to its terminals. If priming motor operates with switch bypassed, switch is defective and should be replaced. If priming motor does not operate with switch bypassed, check wiring from switch to solenoid.

NOTE: To expose control switch on manual electric priming valve (Figure 8), remove two round-head screws attaching cover to valve.

- 9. If pump is equipped with solenoid-actuated priming valve (Figure 7), and other components of priming system operate properly, then check priming valve. To do so, depress push-button switch and watch valve. If priming motor operates but valve does not, run a jumper from hot post of priming motor solenoid to terminal of priming valve solenoid. If valve operates with jumper connected, then power cable is defective and should be replaced. If valve still does not operate, then replace its solenoid.

Table 1. Switch and Solenoid Wires

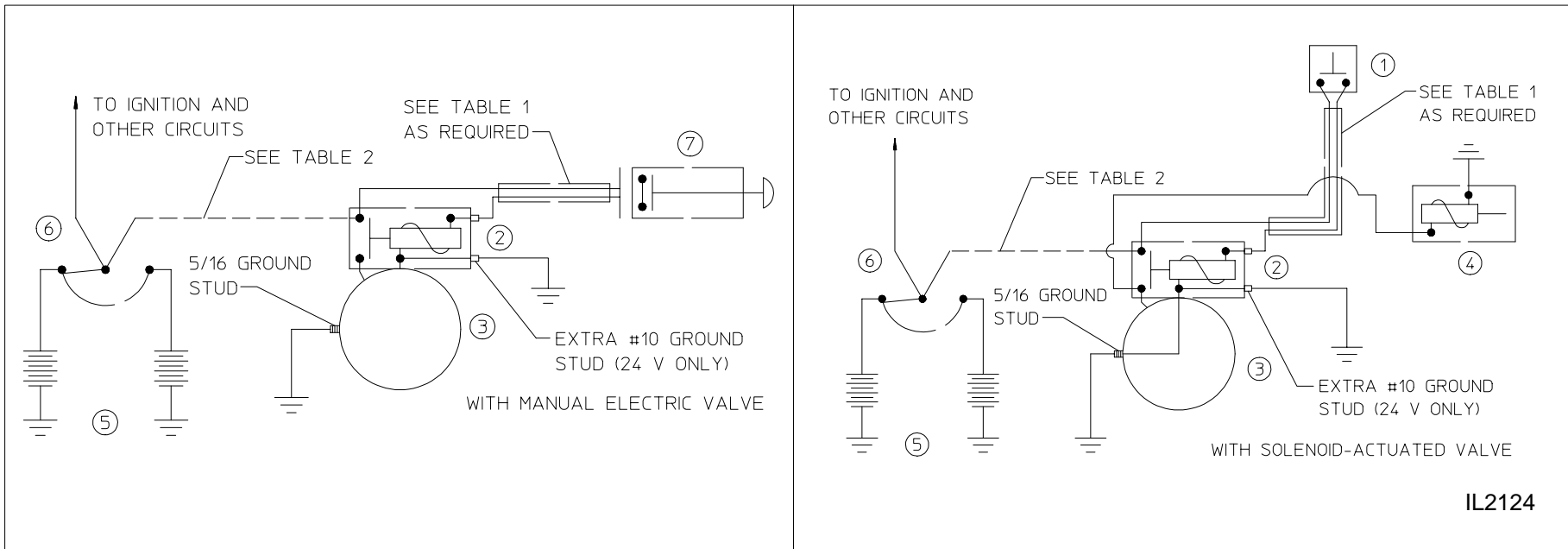
Amps	Length of Wire, Feet				
	20 or less	30	40	50	100
3	20 Ga.	20	20	18	16
4	20	20	18	16	14
5	20	18	16	16	12

Table 2. Wire from Battery to Motor

Amps	Length of Wire, Feet (at .2 Volt Drop)				
	10	20	30	40	50
100	4 Ga.	1/0	3/0	4/0	2@2/0
125	2	2/0	4/0	2@2/0	2@3/0
150	1	3/0	2@2/0	2@3/0	2@4/0
175	1	3/0	2@2/0	2@3/0	2@4/0
200	1/0	4/0	2@3/0	2@4/0	-
225	1/0	4/0	2@3/0	2@4/0	-
250	2/0	2@2/0	2@4/0	-	-
270	2/0	2@2/0	2@4/0	-	-
300	3/0	2@3/0	2@4/0	-	-
350	4/0	2@4/0	-	-	-

- | No. | Description |
|-----|----------------------------------|
| 1 | Normally Open Push Button Switch |
| 2 | Motor Solenoid |
| 3 | Priming Pump Motor |
| 4 | Priming Valve Solenoid |
| 5 | Dual Batteries |
| 6 | Selector Switch |
| 7 | Manual-Electric Priming Valve |

Figure 12. Wiring Diagram – Models VPE, VPES, VPO, VPOS, HHE and HHEB Priming Pumps



On 24V primers, there is an extra #10 stud on the solenoid. Make sure it is wired to the 5/16 ground stud on the motor frame. The 5/16 ground stud, on both 12V and 24V models, should be connected to the truck chassis.

