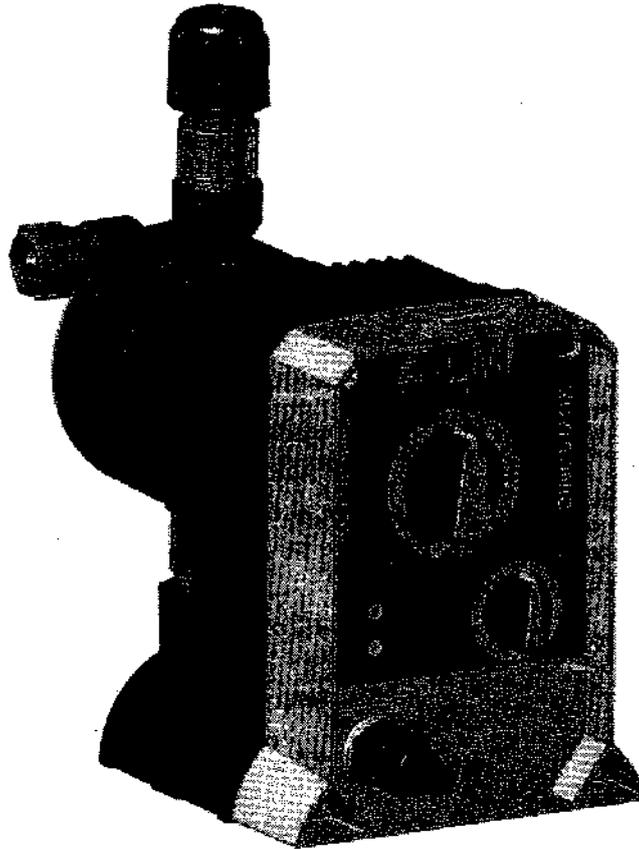


Instruction Manual

ROYTRONIC Series P+

Electronic Metering Pumps



For file reference, please record the following data:

Model No: _____

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.



Carefully read and understand all precautions before installing or servicing any metering pump.



 **LMI**
MILTON ROY

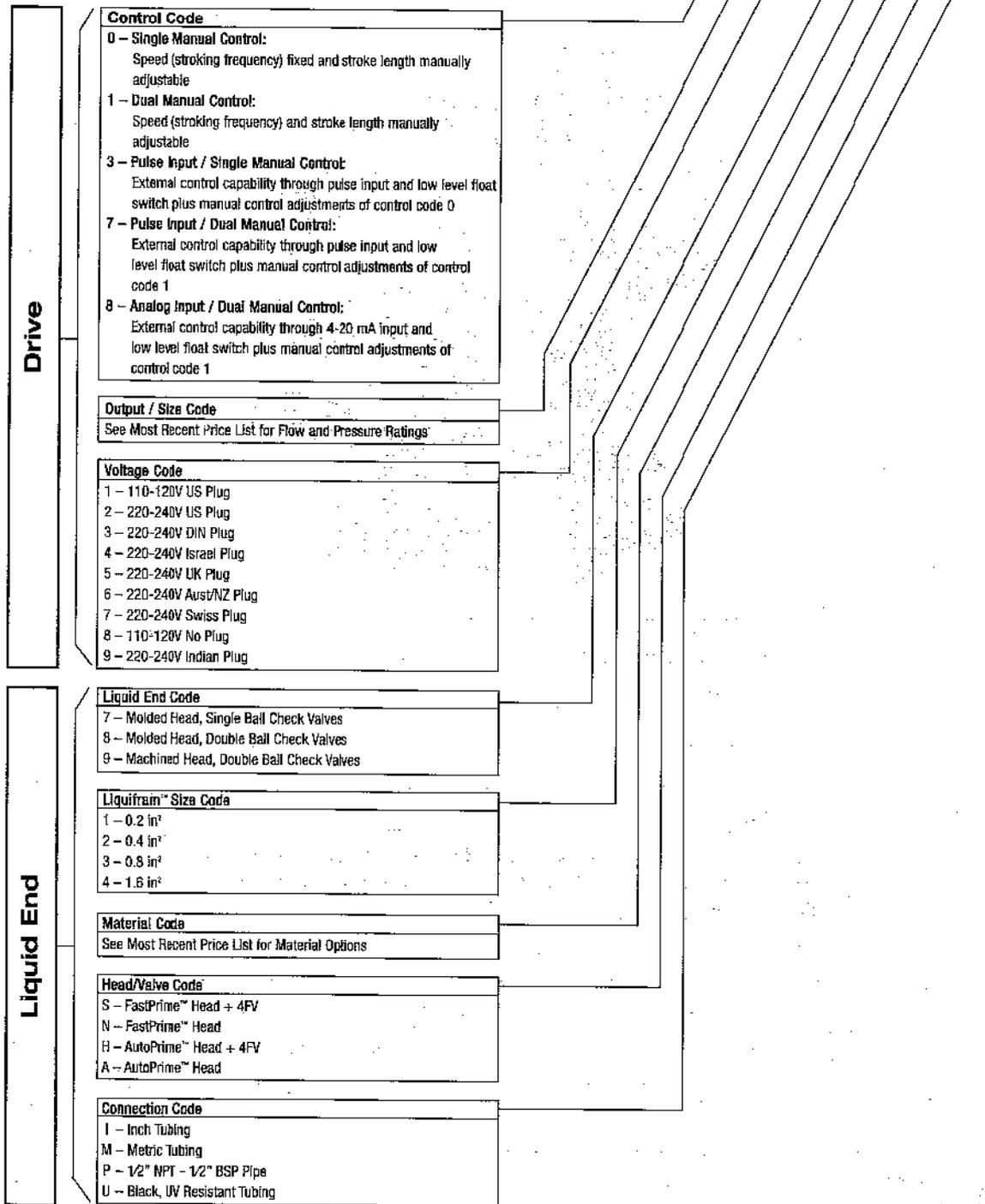
201 Ivyland Rd.
Ivyland, PA 18974
TEL: (215) 293-0401
FAX: (215) 293-0445
www.lmipumps.com

Lit# 1890.8 7/2007

SERIES P⁺

Model P⁺ **7 5 1 - 8 2 8 S 1**

Model Code Configuration



*Note: Not all configurations are available. Please see your local distributor or price list for available options.

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PRECAUTIONS

1.0 PRECAUTIONS

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Protective Clothing



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to MSDS precautions from your solution supplier.

Water Pre-Prime



All LMI pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, seal rings, balls and Liquifram™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)

Solution Compatibility



Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. LMI pumps are tested by NSF for use on muriatic acid and sodium hypochlorite. Always refer to the solution supplier and the **LMI Chemical Resistance Chart** for compatibility of your specific LMI metering pump. Contact your local LMI distributor for further information.

Tubing Connections



Inlet and outlet tubing or pipe sizes must not be reduced. Outlet tubing size must not be increased. Make certain that all tubing is **SECURELY ATTACHED** to fittings prior to start-up (see Section 3.3, Tubing Connections). **ALWAYS** use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded and secure to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

Vinyl Tubing



Your carton may contain a roll of clear vinyl tubing; this is only for connection to the return line of the FastPrime™ Head and must not be used as discharge tubing.

Fittings and Machine Threads



All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting is snug may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

All LMI pumps have straight screw machine threads on the head and fittings and are sealed by the O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve, the stainless steel liquid end connections, or if piping is directly connected to the pipe threads of the suction or discharge fittings.**

Plumbing



Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI is not responsible for improper installations.

Back Pressure/Anti-Syphon Valve



If you are pumping downhill or into low or no system pressure, a back pressure/anti-syphon device such as LMI's Four-Function Valve should be installed to prevent over-pumping or syphoning. Contact your LMI distributor for further information.

Electrical Connections



WARNING: To reduce the risk of electrical shock, the metering pump must be plugged into a properly grounded grounding-type receptacle with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. **Do not use adapters!** All wiring must conform to local electrical codes. If the supply cord is damaged, it must be replaced by the manufacturer, stocking distributor, or authorized repair center in order to avoid a hazard.

Ground Fault Circuit Interrupter



WARNING: To reduce the risk of electric shock, install only on a circuit protected by a Ground Fault Circuit Interrupter (GFCI).

Line Depressurization



To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI's Four-Function Valve (4-FV) is one way to include this feature.

Over Pressure Protection



To ensure safe operation of the pump it is recommended that some type of safety/pressure-relief valve be installed to protect the piping and other system components from failing due to excessive pressure.

2.0 Introduction

LMI is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

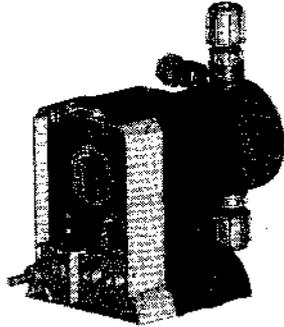
This manual is for Roytronic™ Series P⁺ pumps.

2.1 Specifications

	P ⁺ XX1	P ⁺ XX2 – P ⁺ XX9
Operating Temperature	14 to 113°F -10 to 45°C	14 to 113°F -10 to 45°C
Voltage	110 to 120 V	220 to 240 V
Frequency	50 to 60 Hz	50 to 60 Hz
Max. Current	0.66 A	0.34 A
Wattage	39 W	42 W
Fuse Specification	1.25 AHT (5 x 20 mm)	1.25 AHT (5 x 20 mm)

2.2 Unpacking Check List

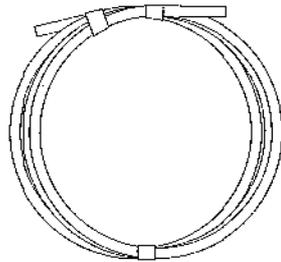
Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.



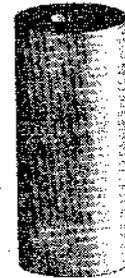
Metering Pump



Foot Valve



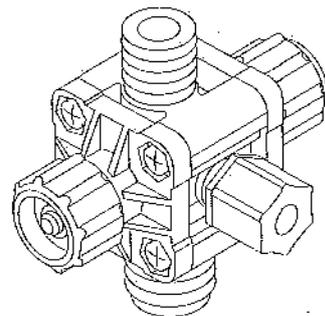
Tubing (0 to 3 Rolls)



Ceramic Foot Valve Weight



Injection Check Valve



Four-Function Valve (Optional)



3.0 Installation

3.1 Pump Location and Installation

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be operated in ambient temperatures above 113°F (45°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

3.2 Pump Mounting

The pump can be mounted in one of two ways:

A. **FLOODED SUCTION** (ideal installation); or

B. **SUCTION LIFT** - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water or viscosity of less than 100 cSt (centistokes). For denser or more viscous solutions, consult distributor.

Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

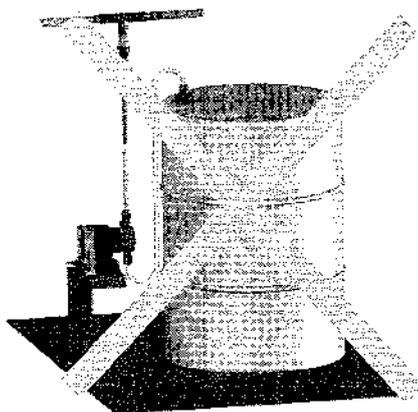
3.2.1 Flooded Suction

For flooded suction the pump is mounted at the base of the storage tank. This installation is the most trouble-free, and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced. A foot valve is not necessary in a flooded suction installation.



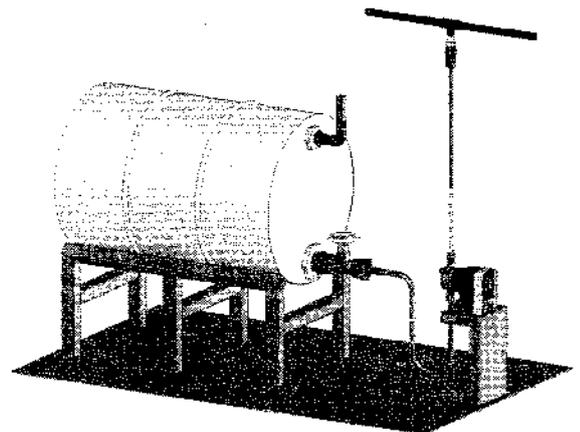
When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning.

Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT

Avoid this type of false flooded suction.



CORRECT

3.2.2 Suction Lift - Wall Bracket Mount

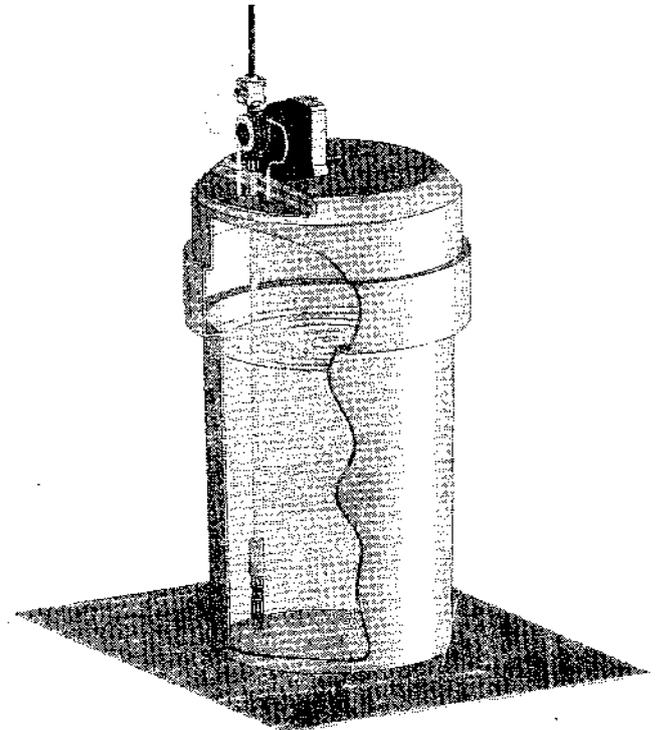
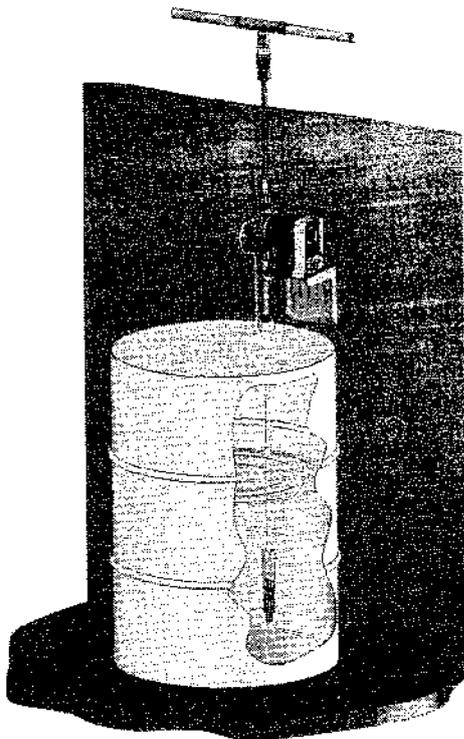
The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

3.2.3 Suction Lift - Tank Mount

The pump may be mounted on a molded tank provided there is a recess to keep the pump stationary. LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350) have molded recesses for pump mounting.

3.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m). An LMI mounting kit (part number 10461) is available for securing the pump to a shelf.



INSTALLATION

3.3 Tubing Connections



A. Use only LMI tubing.

B. **DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.** The pressure created by the pump can rupture vinyl tubing, which is only for connection to the return line of the FastPrime™ fitting.



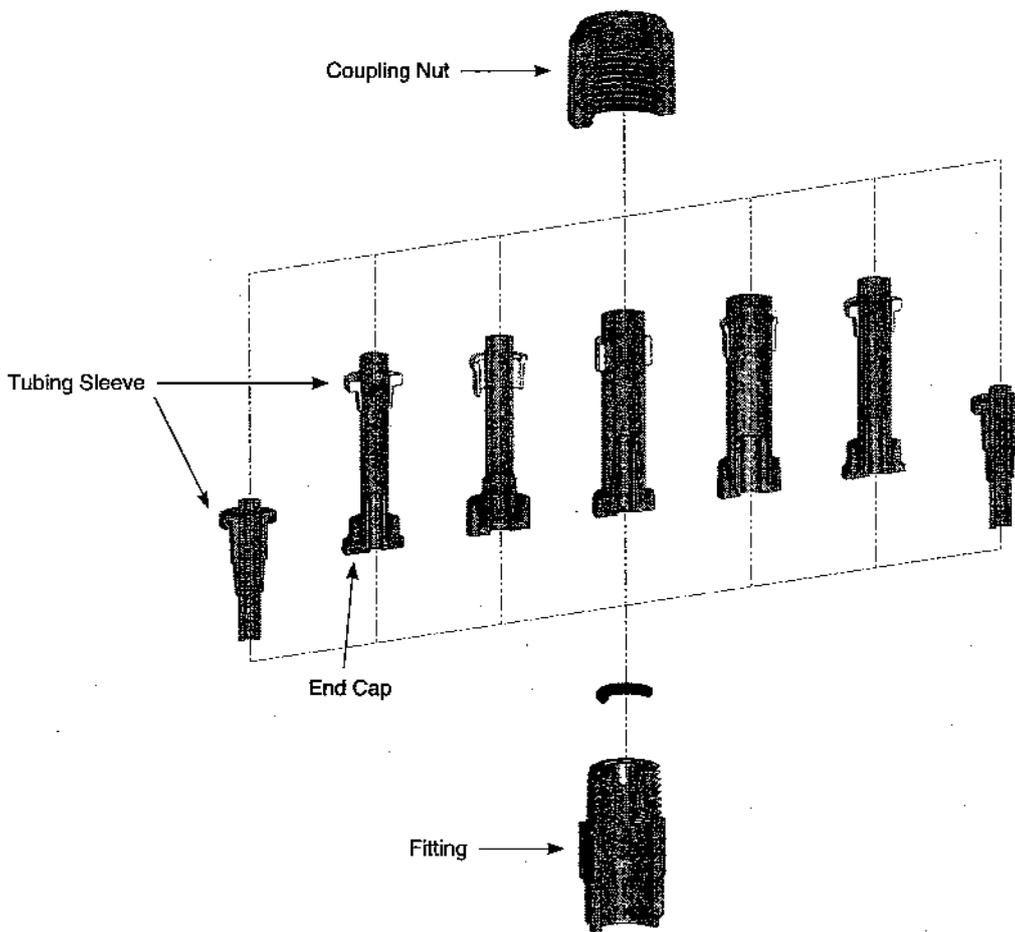
C. Before installation, all tubing must be cut with a clean square end.

D. Valve and head connections from the factory are capped or plugged to retain pre-primed water. Remove and discard these caps or plugs before connecting tubing.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

To assemble tubing into the fittings:

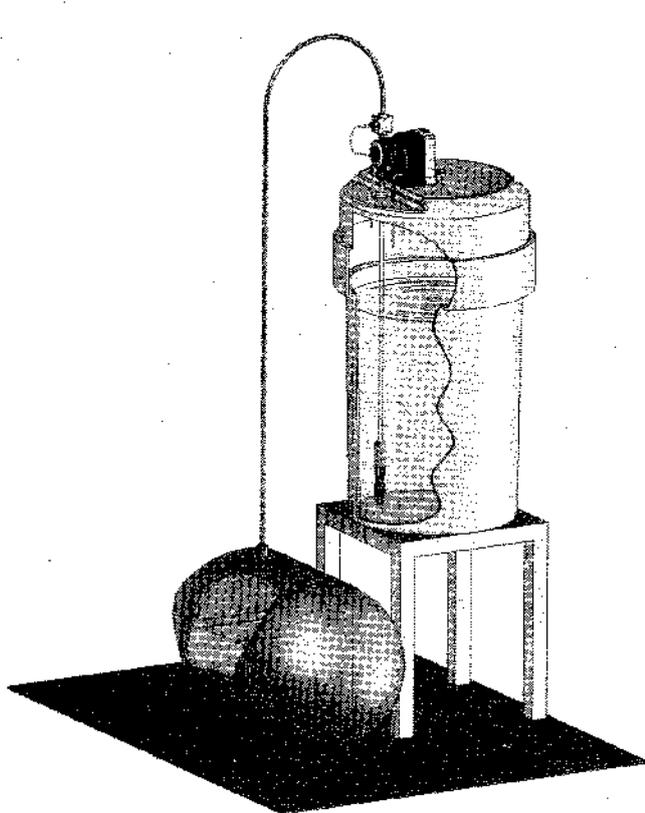
1. Put coupling nut over tubing.
2. Press on tubing sleeve about one inch (25mm).
3. For 1/4" or 6mm OD tubing cut tubing so that 1/4" to 3/8" protrudes from the sleeve. For all other tubing push tube to the bottom of groove in end cap.
4. Tighten the coupling nut onto the fitting.



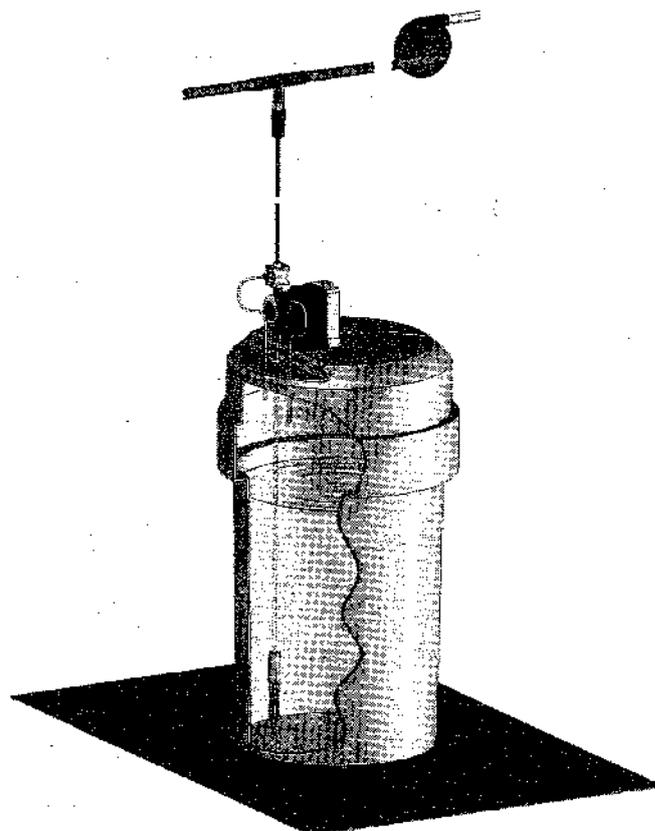
3.4 Four-Function Valves (4-FV)

Your pump may be equipped with a 4-FV, or standard discharge valve. If your pump is not equipped with a multi-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor. The features of a 4-FV are listed below.

1. **Pressure Relief:** If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.
2. **Line Depressurization:** Opening the relief knob provides line drain back to the supply tank.
3. **Anti-Syphon:** Prevents syphoning when pumping solution downhill or into a vacuum.
4. **Back Pressure:** Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.



4-FV prevents syphoning when pumping downhill into low or no pressure.

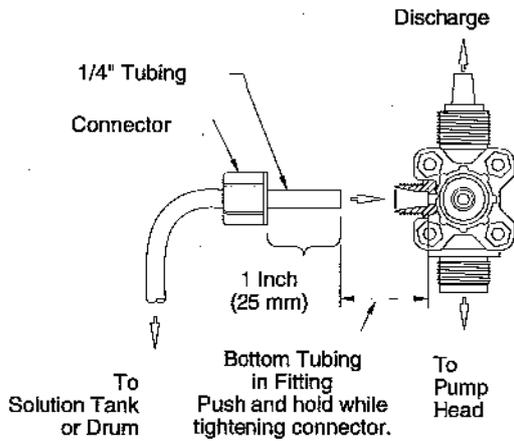


4-FV prevents syphoning when pumping into a vacuum such as the suction side of a recirculating pump.

Typical Installations Requiring the Anti-Syphon Feature of a Four-Function Valve

INSTALLATION

3.5 Four-Function Valve Installation



To install the 4-FV screw in the valve and hand tighten. An additional 1/8 - 1/4 turn may be necessary to prevent leakage.

1/4" O.D. tubing connects to the side of the valve and acts as a return line to the solution tank. To ensure priming, this tubing must **NOT** be submerged in the solution.

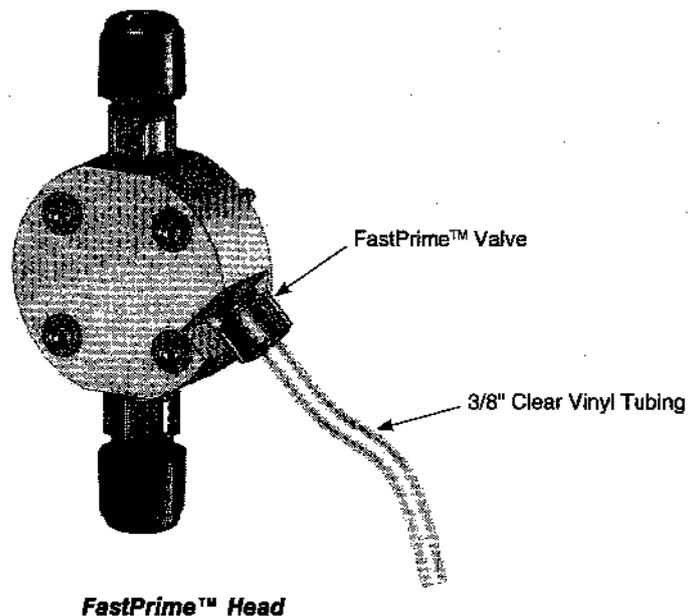
Four-Function Valve Tubing Connection



This return line tubing must be secured to ensure pumped solution will safely return to supply tank.

3.6 FastPrime™

The FastPrime™ Head is equipped with a valve that allows for opening the head to atmospheric pressure. When installing a pump equipped with a FastPrime™ Head connect the 3/8" outer diameter clear vinyl tubing provided with the pump to the barbed nozzle. Route the vinyl return line back to the solution tank. This tubing must not be submerged in the solution.



3.7 Foot Valve/Suction Tubing Installation

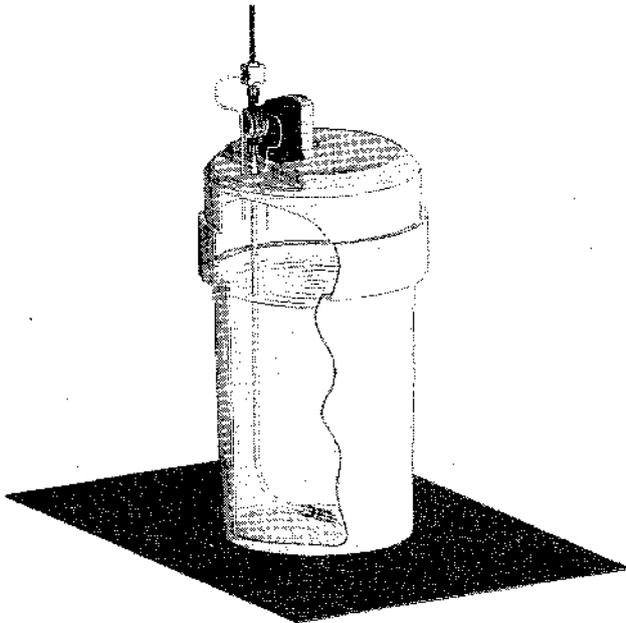
The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

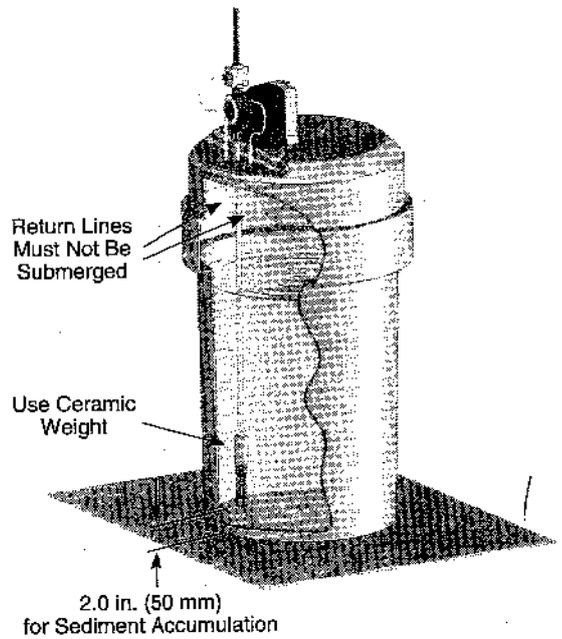
The ceramic weight, when installed, helps position the foot valve in a vertical position.

Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 3.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 3.3).



Foot Valve Tilted Sideways WILL NOT PRIME
INCORRECT



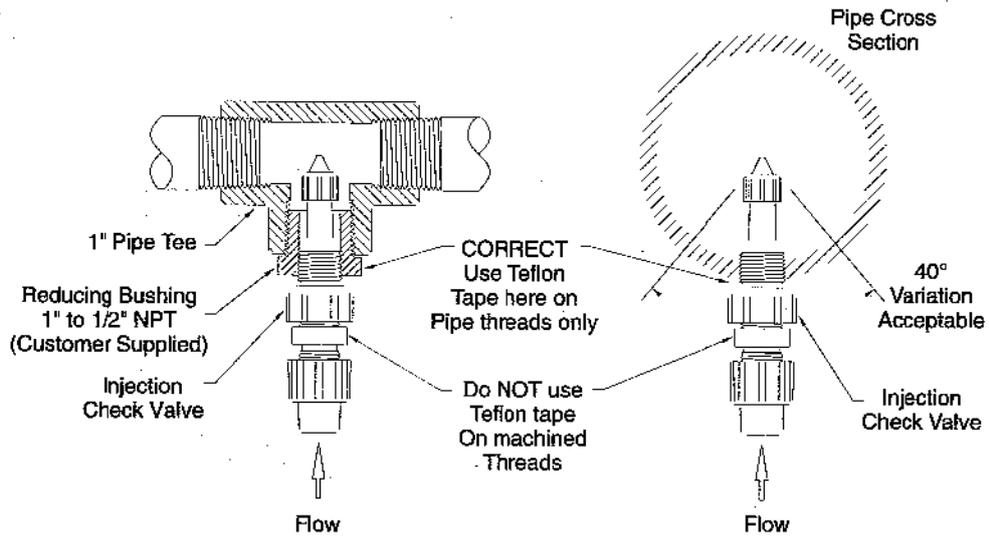
Foot Valve Must Remain Vertical
CORRECT

3.8 Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Install the injection check valve at the location where chemical is being injected into the system. Any size NPTF fitting or pipe tee with a reducing bushing to 1/2" NPTF will accept the injection check valve. Use Teflon® tape or pipe dope to seal the pipe threads *only*.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 80° are acceptable (see illustration).

After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head. Make sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 3.3).

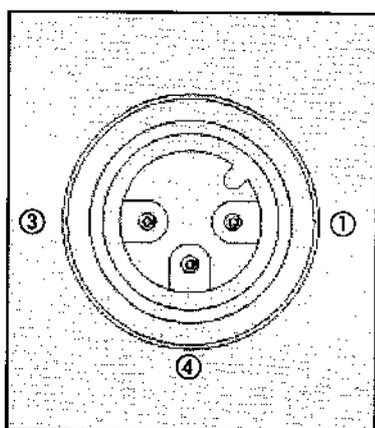
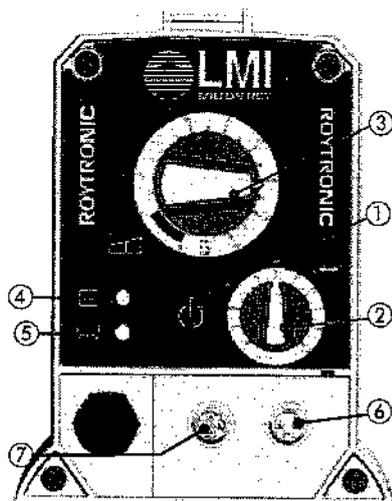


Typical Injection Check Valve Installations



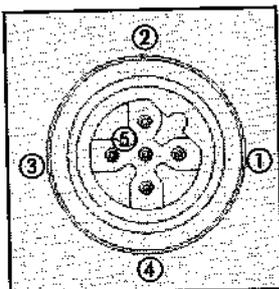
4.0 Operation

4.1 Output Adjustment Controls



1. **Power/Mode Selection Button:** This button allows convenient starting and stopping of the pump. For pumps with external control capability (P+3, P+7, P+8) this button switches pump operation between internal and external modes. When operating in internal mode the Pulse Indicator Light will flash green. When operating in external mode the Pulse Indicator Light will flash yellow.
2. **Speed Adjustment Knob:** This knob provides adjustment of the stroking speed. For pumps with this knob (P+1, P+7, P+8) turning this knob clockwise \cup increases stroke frequency (speed) from a minimum of 1 stroke per minute.
3. **Stroke Adjustment Knob:** This knob provides adjustment of the stroke length. Turning this knob clockwise \cup increases the stroke length, which results in a higher amount of chemical displaced per stroke. It is recommended that the stroke range stay between 20% and 100%.
4. **Pulse Indicator Light:** This light will flash green when pumping in internal mode, and will flash yellow when pumping in external mode. The light is on between strokes and off during the actual stroke.
5. **Low-Level Indicator Light:** This light will turn red when a Low-Level Sensor registers a low chemical level. This will turn off the pump. You must have a Low-Level Sensor connected to the pump through the Low-Level Connector for this function to operate.
6. **Low-Level Connector (3-Pin)** This connector is for the connection of a Low-Level Sensor (48413). The low-level switch input connections are always active for all models in all functional modes. If the fluid level drops below the level specified by the Low-Level Sensor, the pump will stop and the Low-Level Indicator Light will turn on. The pump is designed to recognize an open circuit as full, and a closed circuit as empty. The pin functions are as follows:
 1. Low Level Signal
 3. No Connection
 4. Ground/Return Connection

OPERATION



7. **External Control Connector (5-Pin):** This connector is for the connection of various options and accessories that can be used to externally control the pump. The pin functions (and the wire color for the standard LMI external control cable) are as follows:

1. Remote On Signal (Brown)
2. Ground/Return Connection (White)
3. External Pulse Signal (Blue) (used only with P+3, and P+7 Series pumps)
4. 18Volt Supply Voltage (Black)
5. 4-20mA Input Signal (Green/Yellow) (used only with P+8 Series pumps).

Some of the accessories available for use with P+3, and P+7 Series metering pumps are listed below. Note that an Adapter Cable (48488) is needed when connecting any of the MICROPACE(TM) units or flowmeters.

- A. MICROPACE™ A/D Converter (MP-100) - for translating a 4-20 milliamp signal into an analog signal.
- B. MICROPACE™ Divider (MP-400D) - for reducing the frequency of high frequency pulses.
- C. MICROPACE™ Multiplier (MP-500M) - for increasing the frequency of low frequency pulses.
- D. Pulse Transmitter (48489) - for pulsing in time with another LMI Electronic Metering Pump.
- E. RFP Flowmeter and Programmable Divider - for pacing the stroke frequency of the system flow.
- F. FC Flowmeter/Contactor - for pacing the stroke frequency off of the system flow.

4.2 Start-up and Adjustment

- The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.
- Pumps are shipped from the factory with water in the pump head to aid in priming.

4.2.1 Start-Up/Priming for FastPrime™ Heads

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Turn The FastPrime™ knob 1 to 2 turns counter-clockwise ☹.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the FastPrime valve. Once this happens, turn the knob clockwise ☺ until hand tight and **SHUT THE PUMP OFF.**
6. The pump is now primed.
7. Proceed to output adjustment, Section 4.3.

4.2.2 Start-Up/Priming for Pump Supplied with 4-FV



Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

If the pump does not self-prime, remove the 4-FV on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. 1/4 turn open the relief side (black knob) of the 4-FV.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the 4-FV. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**.
6. The pump is now primed.
7. Proceed to output adjustment, Section 4.3.

4.2.3 Start-Up/Priming Without 4-FV

If the pump does not self-prime, remove the discharge check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob and the stroke knob at 100%.
3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**.
5. The pump is now primed.
6. Proceed to output adjustment, Section 4.3.

4.3 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

OPERATION

4.3.1 Total Pump Output

Calculate the **approximate** output of the pump as follows:

When converting between different units, remember these conversion factors:

1 Gallon =
3,785 Liters

1 Day =
1,440 Minutes

240 SPM =
14,400 SPH

$$\text{PUMP OUTPUT} = \text{MAX PUMP OUTPUT} \times \% \text{ SPEED} \times \% \text{ STROKE}$$

Example: P+151-998SI

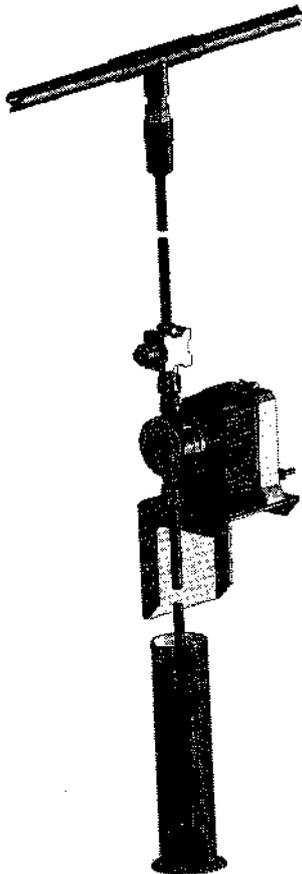
Use Max Output (from dataplate on side of pump) = 1 GPH (1 gallon per hour).

If the pump is set at 60% speed and 70% stroke length, the approximate pump output is:

$$1.0 \times 0.60 \times 0.70 = 0.42 \text{ GPH.}$$

Multiply by 24 (hours in one day) to calculate in gallons per day. If pump is not equipped with speed adjustment, calculate by **Max Pump Output x % Stroke** only.

4.3.2 Calibration in Internal Mode



Once installation is complete and the approximate output has been determined, the pump should be calibrated to adjust speed and stroke for your actual desired output. (Calibration cylinders may be purchased from your local LMI distributor, ref. publication 1798.)

1. Be sure the pump is primed, and discharge tubing and Injection Check Valve are installed as they would be in normal service (i.e., including factors such as injection pressure, fluid viscosity, and suction lift).
2. Place the Foot Valve in a graduated container with a volume of 1000 ml or more.
3. Plug in and switch pump to Internal Mode. Pump until all the air is exhausted from the suction line and head.
4. Turn the pump off. Refill graduated container to a level starting point.
5. Using a stopwatch or timer, turn the pump on for a measured amount of time (120 pump strokes minimum). The longer the time period, the more confident you can be of the results. Be sure to count the number of strokes during the calibration period when making comparisons.
6. Turn the pump off. Note the time elapsed in relation to volume displaced in the graduate. Now, calculate the output in the time unit you choose (minutes, hours, days, etc.).
7. If the output is too low or too great, use the Stroke Adjustment Knob and/or the Speed Adjustment Knob to fine-tune the amount of flow, estimating required correction and repeat steps 1-7.

4.3.3 Calibration in External Mode

It may be helpful to decrease the speed of the pump in order to count the number of strokes. For accuracy count at least 120 strokes.

1. Since pump output is governed by an external device such as Flowmeter-Pulser, Liquitron™ Controller, or 4-20 mA DC signal from an instrument with an LMI Analog-to-Digital Converter, **only the output per stroke may be calibrated.**
2. With pump primed and discharge tubing connected to the injection point as it would be in normal service, place Foot Valve Assembly in a graduated container with a volume of 1000 ml or more.
3. Switch pump to **Internal** mode with Speed Knob set at 100% until air is exhausted from suction line and pump head.
4. Switch pump **OFF** and refill graduate to a starting point.
5. Switch pump **ON** and **count the number of strokes** for exactly one minute, then switch pump **OFF**.
6. Note volume pumped during the calibration period of one minute. Divide into this the number of strokes to determine the volume of solution pumped per stroke.

Example: 720 ml in 240 strokes = 3.0 ml per stroke.

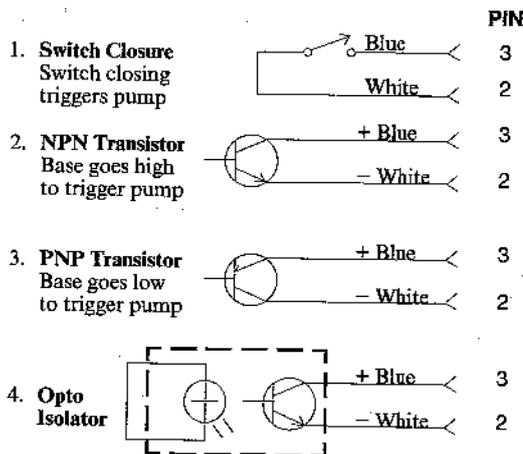
Multiply this by your expected stroke rate per minute, per hour or per day and compare with desired output requirements.

7. Turn Stroke Adjustment Knob to your best estimate of required correction and repeat calibration procedure.

OPERATION

4.4 Methods of Externally Triggering or Pacing P*3, P*7, and P*8 Pumps

Method of Triggering P*3, and P*7 Pumps Through External Control Connector

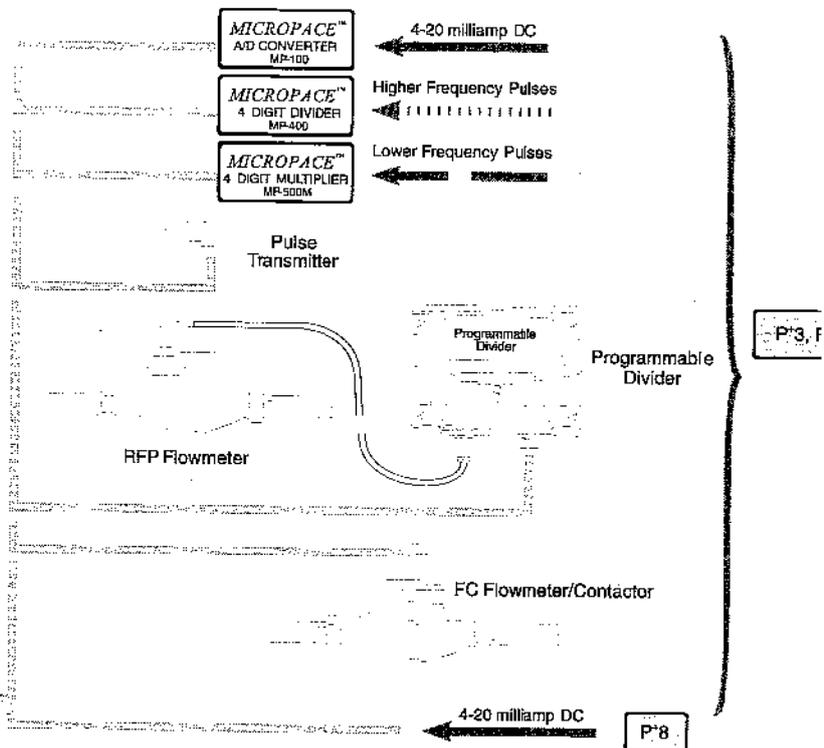
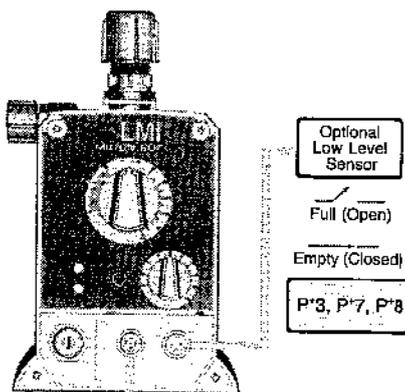


Switch or transistors must be capable of switching 24V DC 15 milliamperes. Minimum time in low impedance state (ON) is 25 milliseconds. Minimum time in high impedance state (OFF) is 50 milliseconds.

The default configuration for the Remote On/Off input is: open contacts = pump stopped; closed contacts = pump enabled. Therefore pins 1 and 2 of the External Control Connector must be shorted together in external mode for the pump to respond to external signals.

These pumps have two operating modes: Local (Pulse Indicator Light flashes green) and Remote (Pulse Indicator Light flashes yellow). Pressing the Power Mode Selection Button switches between Local and Remote modes. The default configuration for operating mode is Local mode.

When the pump is in Local mode the Remote On/Off input is ignored. When pump is in Remote mode the Remote On/Off input is always monitored. pump will return to the last power mode if power is interrupted.



4.4.1 Control Modes

4.4.1.1 Local Mode

- When in Local mode the P+3 pump runs continuously at maximum speed.
- When in Local mode P+7 and P+8 pumps run at the speed indicated by the speed knob.

4.4.1.2 Remote Mode (for P+3, and P+7)

The default definition of a pulse is: close = pulse starts, open = pulse ends.

- In Remote mode pulses occurring faster than a rate of 1200 pulses per minute (less than 50ms apart) and pulses with a duration of less than 25ms are ignored.
- Pulses occurring between 240 strokes per minute (SPM) and 1200 pulses per minute results in the pump running at 240 SPM.
- Pulses occurring at less than 240 SPM results in the pump stroking at that rate.

4.4.1.3 Remote Mode (for P+8)

In Remote mode the pump speed is controlled by a milliamp (mA) Analog Input signal. The factory default settings for the Analog Input are: 20mA input = maximum speed, 4 mA = 1 stroke per minute. The mA input setting can be calibrated to any level between 0 – 22 mA. When recalibrating the input settings, the span between high and low input must be greater than 6 mA. If the span is not large enough, the Pulse Indicator Light will flash green and yellow alternately at about 10 times per second.

In the default settings, the fast level mA input is greater than the slow level mA input. This is known as direct action. In direct action when the mA input is at or above the setting for the fast level, the pump will run at maximum speed. When the mA input is below the setting for the slow level, the pump will stop.

Reverse action is when the slow level mA input is greater than the fast level mA input. In reverse action when the mA input is at or below the setting for the fast level, the pump will run at maximum speed. When the mA input is above the setting for the slow level, the pump will stop.

OPERATION

4.4.1.4 Calibrating the Analog Input Settings (for P*8)

1. Press and hold the Power/Mode Selection Button for more than 5 seconds. This enters the calibration mode. Pumping will stop while in calibration mode.
2. Turn the Speed Adjustment Knob completely clockwise \odot to enter the fast level analog input state. The Pulse Indicator Light will flash 1 second green $\frac{1}{4}$ second yellow.
3. Apply the desired fast level analog signal and press the Power/Mode Selection Button for less than 3 seconds. The Pulse Indicator Light will be green for 1 second before resuming flashing to confirm storage of the setting.
4. Turn the Speed Adjustment Knob completely counter-clockwise \ominus to enter the slow level analog input state. The Pulse Indicator Light will flash 1 second yellow $\frac{1}{4}$ second green.
5. Apply the desired slow level analog signal and press the Power/Mode Selection Button for less than 3 seconds. The Pulse Indicator Light will be yellow for 1 second before resuming flashing to confirm storage of the setting.
6. To return the pump to the factory default settings turn the Speed Adjustment Knob to 50%. The Pulse Indicator Light should flash 1 second green, 1 second yellow. Then press the Power/Mode Selection Button.
7. To exit calibration mode press and hold the Power/Mode Selection Button for more than 3 seconds.

5.0 Spare Parts Replacement and Routine Maintenance

LMI recommends replacing the elastomeric components of the pump on an annual basis. Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

5.1 Depressurizing the Discharge Line (for Pumps Equipped with a 4-FV Only)



ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI's Four-Function Valve (4-FV) is one way to include this feature.

Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your 4-FV and runs back to your solution drum or tank.

2. Turn the black knob on the 4-FV ¼ turn. Pull out and hold the yellow knob for a few seconds. The discharge line is now depressurized. Keep both valve knobs open until solution drains back down the discharge tubing into solution drum or tank. Then release the yellow knob, and ¼ turn the black knob to normal position.

5.2 Depressurizing the Discharge Line (for Single-Ball FastPrime™ Heads Only)

ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your FastPrime™ valve and runs back to your solution drum or tank.

2. Turn the FastPrime™ knob one-and-a-half turns counter-clockwise ☹. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then turn the knob clockwise ☺ to tighten knob to closed position.

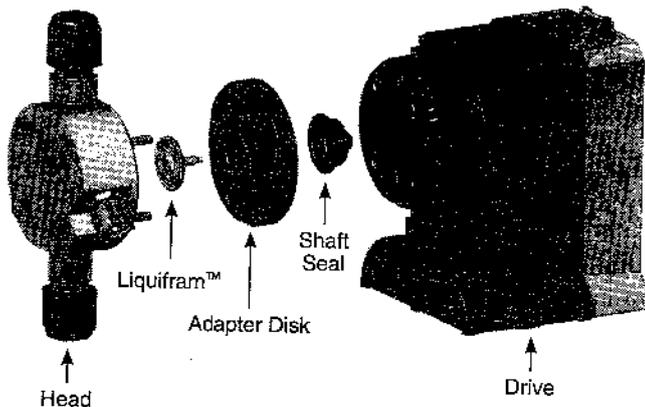
5.3 Liquifram™ (Diaphragm) Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working or performing any maintenance or replacement on your pump. See MSDS information, solution supplier for additional precautions.

LMI metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing Liquifram™, cartridge valves, O-rings, 4-FV cap assemblies and the injection check valve spring. LMI recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the Liquifram™, the cartridge valves, or O-rings, the injection check valve spring should also be replaced (see next Section 5.4). A Spare Parts Kit or RPM Pro Kit containing these parts may be obtained from your local distributor.



Replacing the Liquifram™:

1. Carefully depressurize, drain, and disconnect discharge line (see previous sections in manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Remove the four screws and washers from the head and immerse the head in water or other neutralizing solution.

3. Start the pump. While running, set the Stroke Adjustment Knob to 0% and turn pump off.
4. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise ⚙. Discard old Liquifram™. Remove the Adapter Disk (located behind the Liquifram™) and ensure that the diameter of the raised section of the disk is the same as the diameter of the replacement Liquifram™.
5. Remove Adapter Disk and check condition of the Shaft Seal. Replace Shaft Seal if necessary.
6. Replace the Adapter Disk so that the drain hole of the disk is oriented downward and the mounting holes line up with the mounting holes of the pump.

Be careful not to scratch the Teflon® face of the new Liquifram™.

7. Screw on the new Liquifram™ clockwise ⚙ until turned all the way in. Start the pump and turn the stroke knob to 100%. Stop the pump.
8. Remount the pump head using the four (4) screws and washers. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.



5.4 Cartridge Valve and O-ring Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

1. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Remove the four screws and washers from the head and immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve and O-rings. If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.

Before disassembling the check valves, note the orientation of the valve.

4. Install new check valves in each location. Ensure that the cartridges are oriented correctly.

5.5 Injection Check Valve Parts Replacement

Depressurize and drain pipeline (or isolate Injection Check Valve point using valves) so Injection Check Valve can safely be disassembled.



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working or performing any maintenance or replacement on your pump. See MSDS information for solution supplier for additional precautions.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pac™ kit number or contact your local LMI stocking distributor.

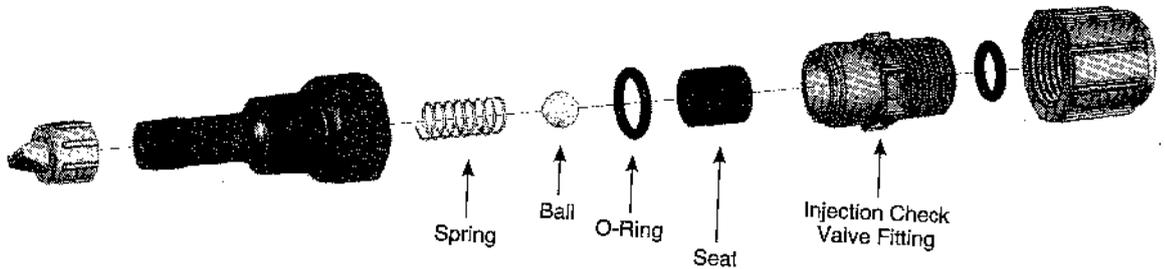
1. Isolate Injection Check Valve and depressurize pipe or drain pipeline.
2. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in manual).

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect the tubing leading to the Injection Check Valve, then remove the Injection Check Valve Fitting. Remove and replace the worn spring, seat, ball, and O-ring.

Before disassembling the check valve, note the orientation of the parts.

4. Install a new spring, seat, ball, and O-ring. Ensure that the parts are oriented correctly.



5.6 FastPrime™ Valve O-Ring Replacement



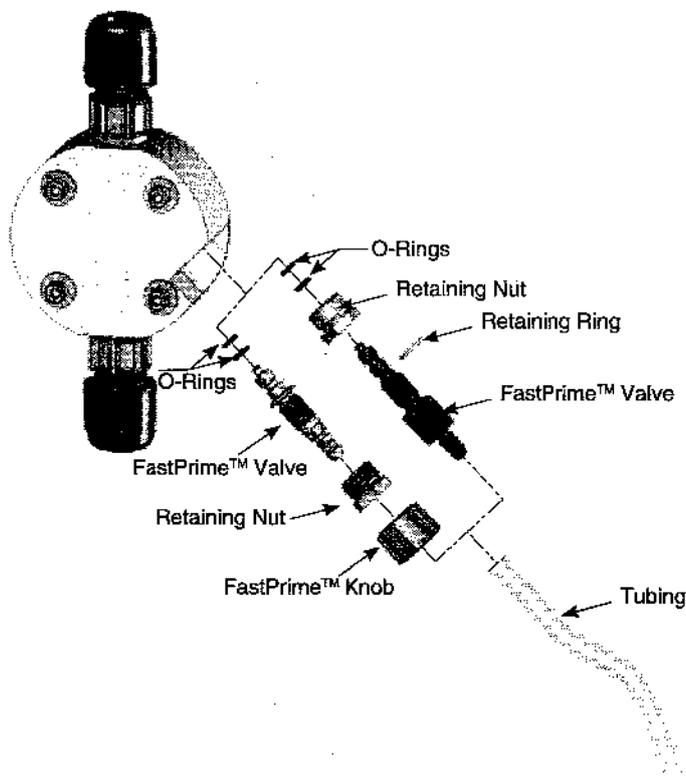
ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your FastPrime™ valve and runs back to your solution drum or tank.

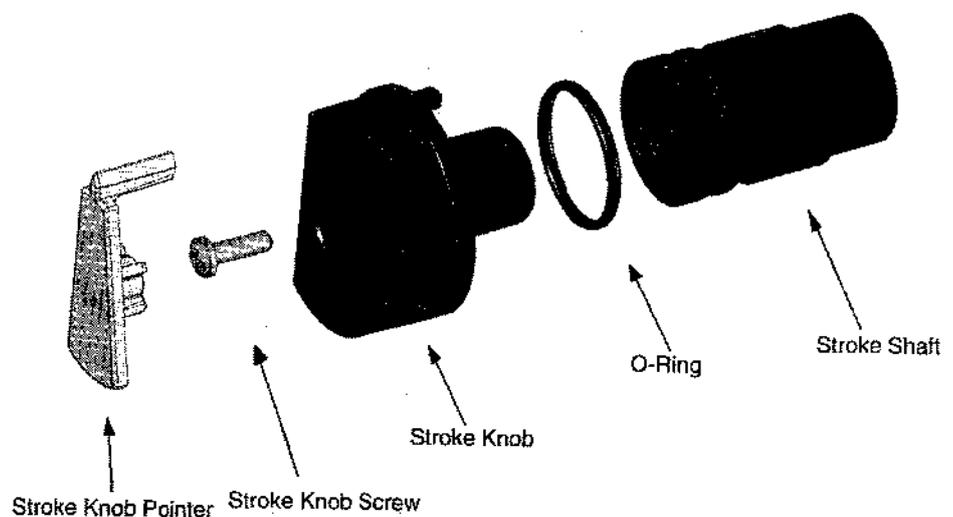
2. Turn the FastPrime™ Knob one-and-a-half turns counter-clockwise ☹. This will depressurize the head. Keep valve open. Carefully remove the return line by gently pulling tubing and moving it from side to side to gradually back tubing off of the barbed fitting.
3. Hold return line tubing upright until solution drains back into solution drum or tank.
4. Using a 11/16" (or 17mm) socket or wrench remove the Retaining Nut, and pull out the entire FastPrime™ Valve assembly. Remove and replace the two small O-rings.
5. Reinsert the FastPrime™ Valve assembly and retighten the Retaining Nut. Then turn the FastPrime™ Knob clockwise ☺ to tighten knob to closed position.
6. Recut 1 to 2 inches off the tip of the return line and ensure the end is squared. Press the return line tubing on completely past the barbs.



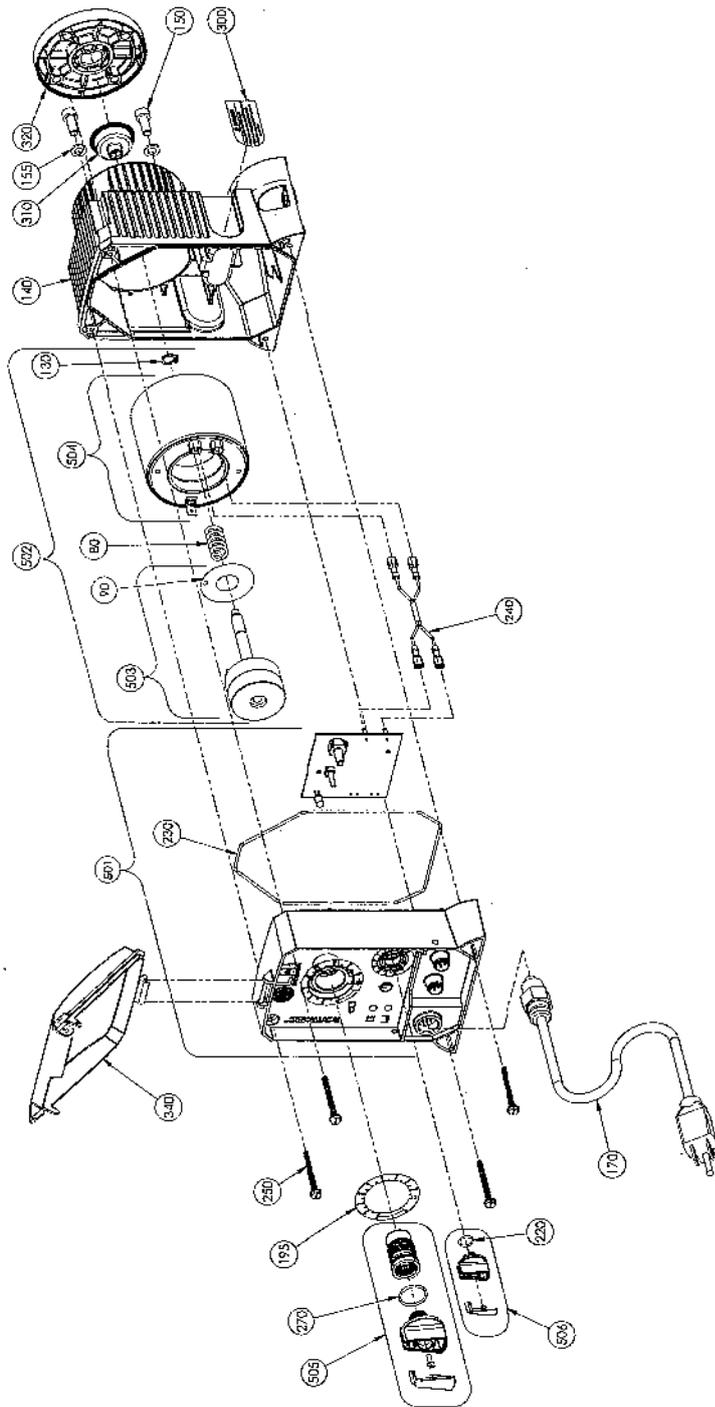
5.7 Stroke Length Setting

The Stroke Adjustment Knob is calibrated for each pump, and does not need to be removed during Liquifram™ replacement or during most other maintenance. If the Stroke Knob is removed for any reason it becomes necessary to reset the stroke length. Follow the procedure below to approximate the proper factory setting. If a more accurate setting is required contact your distributor or manufacturer.

1. Install a new Stroke Shaft. Note that there will be some resistance as the O-ring slides into the control panel. The Stroke Knob can be used to turn the Stroke Shaft. Continue to turn the Stroke Shaft until there is no longer any diaphragm movement. It may be necessary to turn on the pump in order to get the Stroke Knob completely forward however, care should be taken to ensure that the Stroke Shaft is contacting the Plunger before turning on the unit. Otherwise the pump could be damaged.
2. Once the Stroke Shaft is completely forward, you can reset the stroke length.
 - a. On P+X5, P+X6, and P+X9 pumps press in the Stroke Knob so that the Stroke Knob Pointer indicates 0 (zero).
 - b. For P+X1, P+X4, and P+X8 pumps press the Stroke Knob in at 50 and turn the knob to point at 100. Then remove the Stroke Knob and reinsert so that the Stroke Knob Pointer is indicating 50 again.
3. Use a Phillips head screwdriver to install the Stroke Knob Screw.
4. Insert the Stroke Knob Pointer into the Stroke Knob.



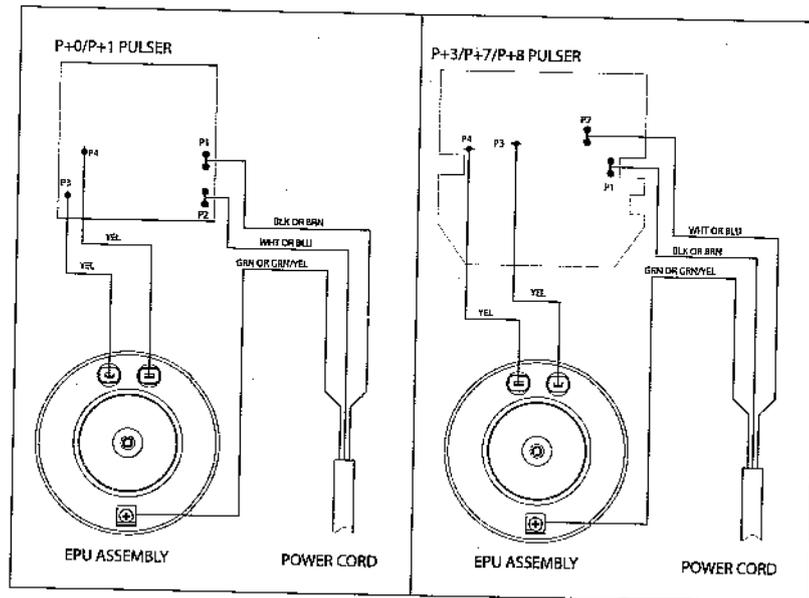
5.8 P+ Drive Parts List



Bubble Number	Description
270	Stroke Shaft O-Ring
300	Warning Label
310	Shaft Seal
320	Adapter Disk
340	Clear Cover
501	Control Panel Assembly
502	EPU Assembly
503	Plunger Assembly
504	Pole Piece Assembly
505	Stroke Knob Assembly
506	Speed Knob Assembly

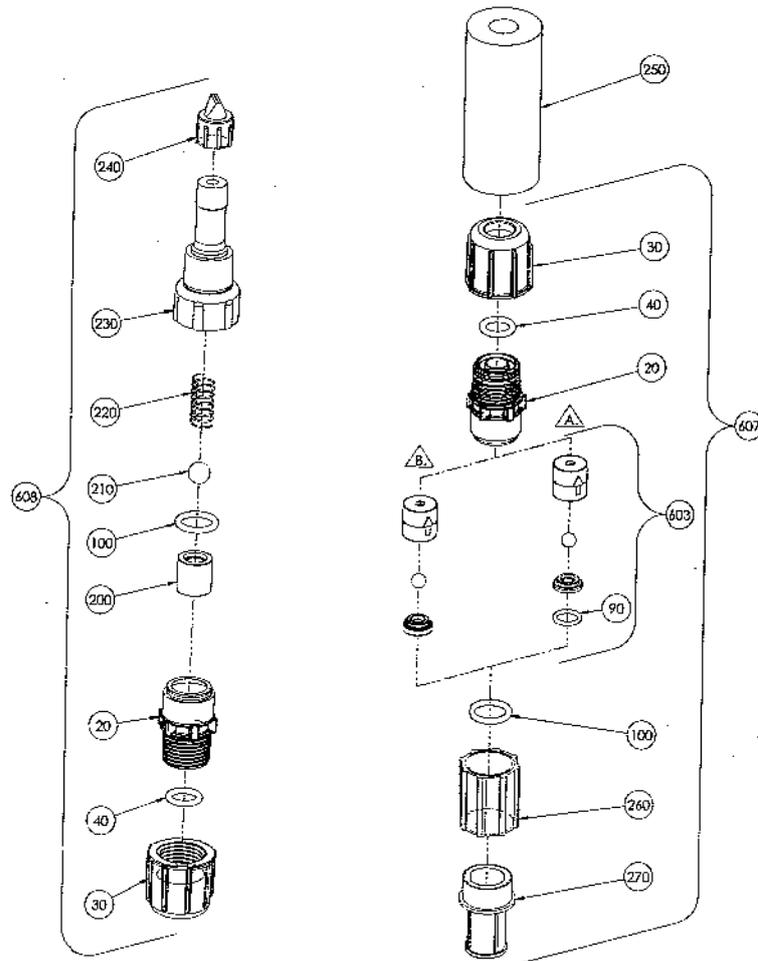
Bubble Number	Description
80	EPU Return Spring
90	EPU Shim
130	Retaining Ring
140	Drive Housing
150	EPU Attachment Bolt
155	EPU Attachment Washer
170	Power Cord
195	Stroke Dial Label
220	Speed Knob O-Ring
230	Control Panel O-Ring
240	Wire Harness
250	Drive Assembly Screws

5.9 EPU Wiring Diagram



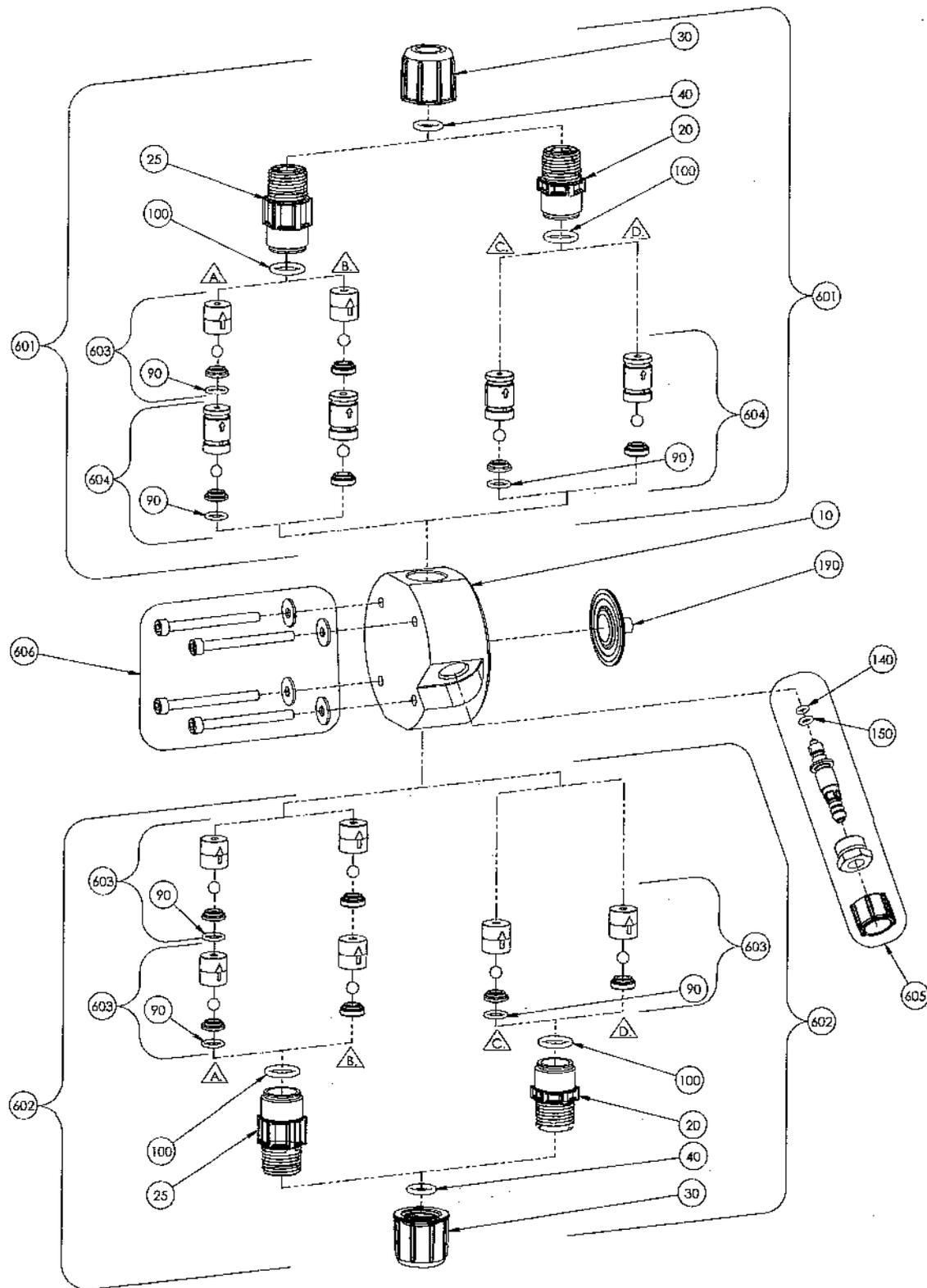
5.10 Liquid End Parts List

Bubble Number	Description
10	Pump Head
20	Single Ball Check Valve Fitting
25	Double Ball Check Valve Fitting
30	Coupling Nut
40	Tube Connect O-Ring
90	Seat O-Ring
100	Cartridge Valve O-Ring
140	FastPrime™ Valve Gasket
150	FastPrime™ Valve O-Ring
180	Liquid End Cover
190	Liquifram™
200	Injection Valve Seat
210	Injection Ball
220	Injection Spring
230	Injection Check Valve Body
240	Injection Flapper Valve
250	Ceramic Weight
270	Foot Valve Strainer
601	FastPrime™ Discharge Check Valve
602	Suction Check Valve
603	Cartridge Valve
604	FastPrime™ Cartridge Valve
605	FastPrime™ Valve
606	Liquid End Hardware
607	Foot Valve
608	Injection Valve
609	AutoPrime™ Discharge Check Valve
610	AutoPrime™ Discharge Cartridge Valve
611	AutoPrime™ Shuttle Valve
612	AutoPrime™ Shuttle Cartridge Valve

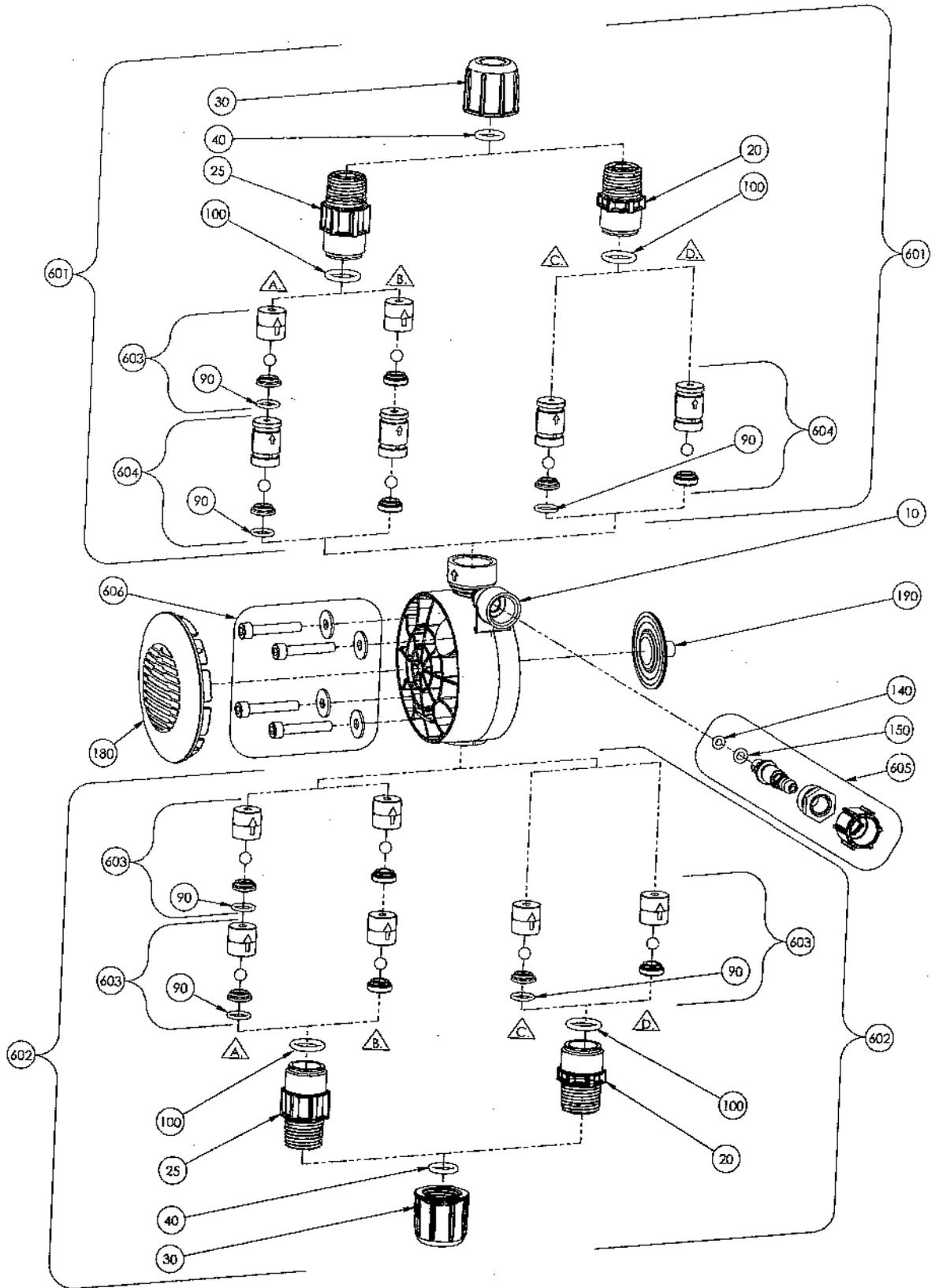


Injection Valve

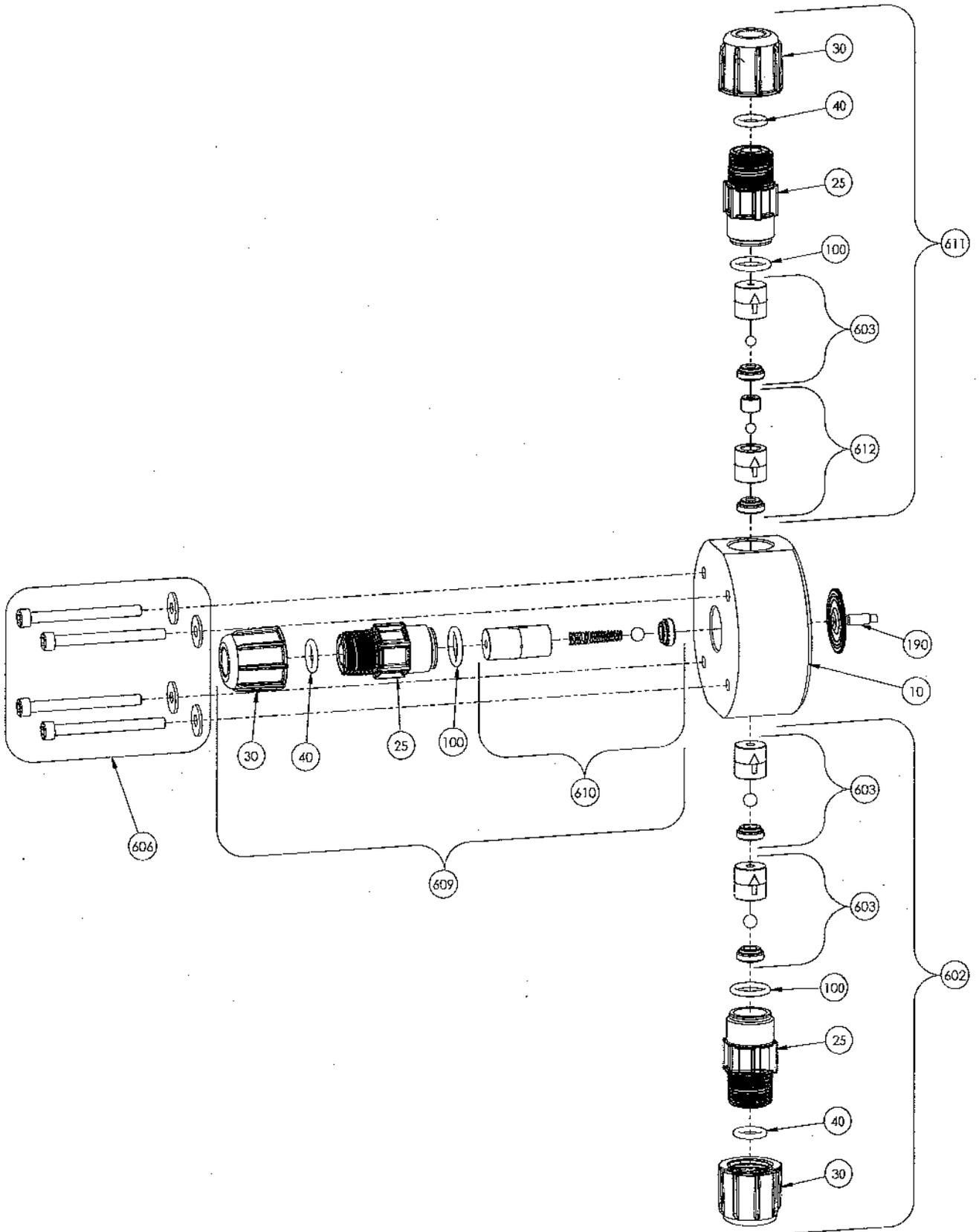
Foot Valve



Machined FastPrime™ Liquid End



Molded FastPrime™ Liquid End



AutoPrime™ Liquid End



6.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump Will Not Prime	1. Pump not turned on or plugged in.	1. Turn on pump/plug in pump.
	2. Output dials not set properly.	2. Always prime pump with speed and stroke at 100%.
	3. Foot Valve not in vertical position on bottom of tank.	3. Foot Valve must be vertical (see Foot Valve Installation, Section 3.6).
	4. Pump suction lift too high.	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing is curved or coiled in tank.	5. Suction tubing must be vertical. Use LMI ceramic weight supplied with pump (see Section 3.6).
	6. Fittings are over tightened.	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Air trap in suction valve tubing.	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 3.2.1).
	8. Too much pressure at discharge. (Pumps without multi-function valve.)	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 4.2). When pump is primed, reconnect discharge tubing.
Pump Loses Prime	1. Solution container ran dry.	1. Refill container with solution and reprime (see Section 4.2).
	2. Foot Valve is not in a vertical position on the bottom of the tank.	2. Foot Valve must be vertical (see Foot Valve Installation, Section 3.6).
	3. Pump suction lift is too high.	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing is curved or coiled in tank.	4. Suction tubing must be vertical. Use LMI ceramic weight supplied with pump (see Section 3.6).
	5. Fittings are over tightened.	5. DONOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Air trap in suction valve tubing.	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 3.2.1).
	7. Air leak on suction side.	7. Check for pinholes, cracks. Replace if necessary.

6.0 Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Leakage at tubing	1. Worn tubing ends.	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Loose or cracked fitting.	2. Replace fitting if cracked. Carefully hand tighten fittings. DO NOT USE PIPE WRENCH. An additional 1/8 or 1/4 turn may be necessary
	3. Worn seal rings.	3. Replace balls and seal rings (see Section 5.3)
	4. Solution attacking Liquid Handling Assembly	4. Consult your local distributor for alternate materials.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn Seal Rings.	2. Worn seal rings or cartridge valves may need replacement (see Section 5.3).
	3. Ruptured Liquifram™.	3. Replace Liquifram™ (see Section 5.3).
	4. Incorrect stroke length.	4. Recalibrate Output (see Section 4.3.2)
	5. Tubing run on discharge may be too long.	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Clogged Foot Valve strainer.	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
Failure to Run	1. Pump not turned on or plugged in.	1. Turn on or plug in pump.
	2. EPU failure.	2. Disassemble pump and measure the resistance of the EPU across the EPU wires. Consult supplier or factory.
	3. Pulser failure.	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 3.4).
	2. Little or no pressure at injection point.	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 3.4).
	3. Excessive strokes per minute.	3. Replace pulser or resistor. Consult factory.