Installation Maintenance and Operation

SOUTH SANGAMON WTP
SANGAMON COUNTY, ILLINOIS

Chemical Feed System

MP Solenoid Pumps

MPC Controller

Shadow Pumps and Hypo head

Pulsafeeder, Inc.
2883 Brighton Henrietta Townline Road
Rochester, NY 14623
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Series MP

ELECTRONIC METERING PUMPS

Installation
Operation
Maintenance
Instruction

READ ALL WARNINGS CAREFULLY
BEFORE INSTALLING

SAFETY INSTRUCTIONS

⚠ WARNING

When using chemical feed pumps, basic safety precautions should always be followed to reduce risk of fire, electric shock, and personal injury. Failure to follow these instructions could result in death or serious injury.

READ ALL INSTRUCTIONS

*** **⚠ DANGER**: Secure chemicals and metering pumps, making them inaccessible to children and pets.

*** **DO NOT PUMP FLAMMABLE LIQUIDS.**

*** Do not cut the plug or ground lug off the electrical cord. Consult a licensed electrician for proper installation or replacement.

** **⚠ WARNING**: Always wear protective clothing, including gloves and safety glasses, when working on or near chemical metering pumps.

** Inspect tubing regularly for cracking or deterioration and replace as necessary. **(Always wear protective clothing and safety glasses when inspecting tubing.)**

** Use **CAUTION** to keep fingers away from rotating parts.

** If pump is exposed to direct sunlight, use a U.V. resistant tubing.

** Follow directions and warnings provided from the chemical manufacturer. The user is responsible for determining the chemical compatibility with the chemical feed pump.

** Make sure the voltage on the pump name tag matches the installation voltage. If pump fails to start, check line voltage.

** Consult with local health officials and/or qualified water conditioning specialists when treating potable water.

** Always depressurize system prior to installation or disconnecting the metering pump tubing.

** If injection point is lower than the chemical tank and pump, install an anti-siphon valve.

** **DO NOT MODIFY PUMP.** This poses a potentially dangerous situation and will void the warranty.

* **⚠ CAUTION**: All pumps are factory tested with water. Remove tubing and thoroughly dry if the chemical being pumped will react with water (for example sulfuric acid).

* Hand tighten plastic connections **(Do not use wrench)**.

* Consult licensed plumber and electrician before installation to conform to local codes.

* **NOTE:** For accurate volume output, pump must be calibrated under all operating conditions.

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INTRODUCTION

These installation, operation and maintenance instructions cover your electronic metering pump. Refer to the pump nameplate to determine the actual model.

■ PRINCIPLE OF OPERATION

Diaphragm metering pumps are used to dispense chemicals or fluids. This is achieved by an electromagnetic drive mechanism (solenoid) which is connected to a diaphragm. When the solenoid is pulsed by the control circuit, it displaces the diaphragm which, through the use of check valves, moves the fluid out the discharge under pressure. When the solenoid is de-energized it returns the diaphragm and pulls more fluid into the pump head and the cycle repeats.

The stroke rate of the pumps is controlled via the touchpad and present status is indicated by the LCD display. The stroke length is controlled via the stroke length knob.

■ MATERIALS OF CONSTRUCTION

The wetted materials (those parts that contact the solution being pumped) available for construction are Glass filled polypropylene, PVC, SAN, Hypalon, Viton, PTFE, 316 Stainless Steel, PVDF, Ceramic and Alloy C. These materials are very resistant to most chemicals. However, there are some chemicals, such as strong acids or organic solvents, which cause deterioration of some elastomer and plastic parts, such as the diaphragm, valve seats, or head. Consult Chemical Resistance Guide or Supplier for information on chemical compatibility.

Various manufacturers of plastics, elastomers and pumping equipment publish guidelines that aid in the selection of wetted materials for pumping commercially available chemicals and chemical compounds. Two factors must always be considered when using an elastomer or plastic part to pump chemicals. They are:

1. The temperature of service: Higher temperatures increase the effect of chemicals on wetted materials. The increase varies with the material and the chemical being used. A material quite stable at room temperature might be affected at higher temperatures.
2. Material choice: Materials with similar properties may differ greatly from one another in performance when exposed to certain chemicals.

■ MANUFACTURER'S PRODUCT WARRANTY

Pulsafeeder warrants all pumps and controllers of its manufacture to be free of defects in material or workmanship. Liability under this policy extends for 24 months from date of shipment from the factory. The manufacturer's liability is limited to repair or replacement of any failed equipment or part which is proven defective in material or workmanship upon manufacturer's examination. This warranty does not include removal or installation costs and in no event shall the manufacturer's liability exceed the selling price of such equipment or part.

The manufacturer disclaims all liability for damage to its products through improper installation, maintenance, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or any other unauthorized repair. The manufacturer is not responsible for consequential or other damages, injuries or expense incurred through the use of its products.

Above warranty is in lieu of any other warranty, whether expressed or implied. The manufacturer makes no warranty of fitness or merchantability. No agent of ours is authorized to provide any warranty other than the above.

The European Union Warranty address is listed below, however, please note that the seller should be contacted first.

Steigar 24
NL 1351 AB Almere
Netherlands

■ EUROPEAN TECHNICAL FILE LOCATION

PO Box 91
Washington
NE37 1YH
United Kingdom

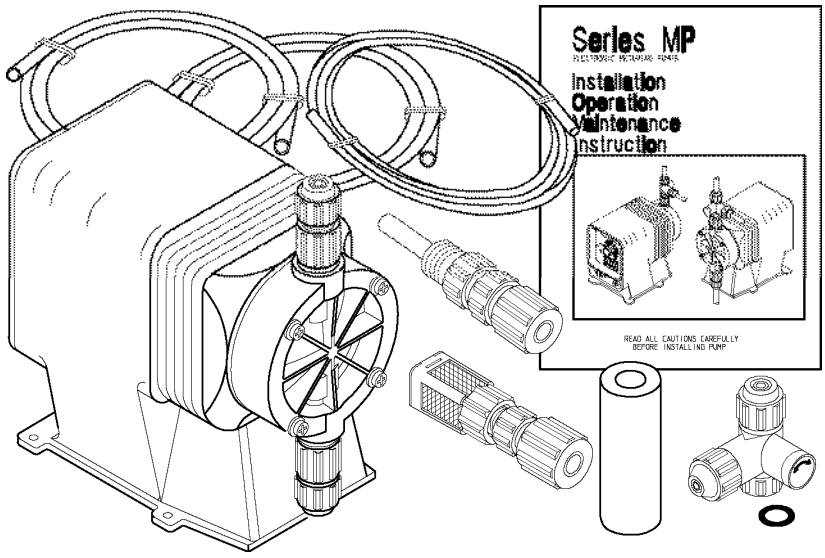
■ UNPACKING THE PUMP

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damages should be reported immediately to the carrier and to the seller of the equipment.

The carton should contain:

- Metering Pump
- Clear Flexible Suction Tubing*
- Stiff White Discharge Tubing*
- Foot valve/Strainer Assy.*
- Backpressure Injection Valve Assy.
- One Instruction Book that you are now reading
- Bleed Valve Assembly* (most models)

*These items are included with the standard pump. Items may or may not be included depending on model.



Make sure that all items have been removed from the shipping carton before it is discarded.

PRECAUTIONS FOR OPERATION

Each Electronic Metering Pump has been tested to meet prescribed specifications and safety standards. Proper care in handling, installation and operation will help in ensuring a trouble free installation.

Please read all these cautionary notes prior to installation and start-up of your metering pump.

1. **Important: Pump must be installed and used with supplied back pressure/injection valve. Failure to do so could result in excessive pump output flow.**
2. Handle the pump with care. Dropping or heavy impact causes not only external damage to the pump, but also to electrical parts inside.
3. Install the pump in a place where the ambient temperature does not exceed 40°C (104°F). The pump is water resistant and dust proof by construction and can be used outdoors, however **do not operate the pump submerged.** To avoid high internal pump temperatures, do not operate in direct sunlight.
4. Install the pump in a place convenient for its future maintenance and inspection, then fix it to prevent vibration.
5. Protective caps must be removed prior to installing tubing onto valve assemblies. Use tubing of specified size. Connect the tubing to the suction side securely to prevent the entrance of outside air. Make sure that there is no liquid leakage on the discharge side.
6. Be careful to check that the voltage of the installation matches the voltage indicated on the pump nameplate. Each pump is equipped with a three prong plug. Always be sure the pump is grounded. To disconnect, do not pull wire but grip the plug with fingers and pull out. Do not use the receptacle in common with heavy electrical equipment which generates surge voltage. It can cause the failure of the electronic circuit inside the pump.
7. Tampering with electrical devices can be potentially hazardous. Always place chemicals and pump installation well out of the reach of children.
8. Never repair or move the metering pump while operating. Always disconnect electrical power. **For safety, always wear protective clothing (protective gloves and safety glasses) when working on or near chemical metering pumps.**
9. An air bleed valve is available for most models with tubing connections. Air purges should be performed when the pump chamber contains no fluid at the time of start-up. As a safety measure, connect the return tubing to the air bleed valve and bypass fluid back to storage tank or a suitable drain.
10. Chemicals used may be dangerous and should be used carefully and according to warnings on the label. Follow the directions given with each type of chemical. Do not assume chemicals are the same because they look alike. Always store chemicals in a safe location away from children and others. We cannot be responsible for the misuse of chemicals being fed by the pump. Always have the material safety data sheet (MSDS) available for any fluid being pumped.
11. All pumps are pretested with water before shipment. Remove head and dry thoroughly if you are pumping a material that will react with water, (i.e. sulfuric acid, polymers). Valve seats, ball checks, gaskets, and diaphragm should also be dried. Before placing pump into service, extreme care should be taken to follow this procedure.
12. Valve cartridges are stamped to indicate fluid flow direction. Always install so that markings read from top to bottom, with the arrow pointing in the direction of flow.
13. When metering hazardous material **DO NOT** use plastic tubing, strictly use proper rigid pipe. Consult supplier for special adapters or valve assemblies.
14. **Pump is NOT to be used to handle or meter flammable liquids or materials.**
15. Standard white discharge tubing is not recommended for installations exposed to direct sunlight. Consult supplier for special black tubing.
16. Factory will not be held responsible for improper installation of pump, or plumbing. All cautions are to be read thoroughly prior to hook-up and plumbing. For all installations a professional plumber should be consulted. Always adhere to local plumbing codes and requirements.

17. When using pump with pressurized systems, make sure the pressure of the system does not exceed the maximum pressure rating on the pump nameplate. Be sure to de-pressurize system prior to hook up or disconnecting the metering pump.
18. Electronic power modules are equipped with automatic reset thermal overload devices and may reset unexpectedly.
19. The pump is designed to operate using a backpressure/injection valve. If the discharge point is below the liquid level of the source or if the discharge pressure is less than the suction pressure, siphoning may occur. To correct this condition, install an anti-siphon valve or other anti-siphon device. Check local regulations which may apply. (Ref. Figure G1).
20. If the power cord is unplugged or in the event of electrical power interruption while the pump is operating, the pump will remember its last operating state for years and will resume operation as before, whenever power is restored.

INSTALLATION, PIPING AND WIRING

The metering pump should be located in an area that allows convenient connections to both the chemical storage tank and the point of injection. The pump is water resistant and dust proof by construction and can be used outdoors, however **do not operate submerged.** Avoid continuous temperatures in excess of 40°C (104°F). To do otherwise could result in damage to the pump.

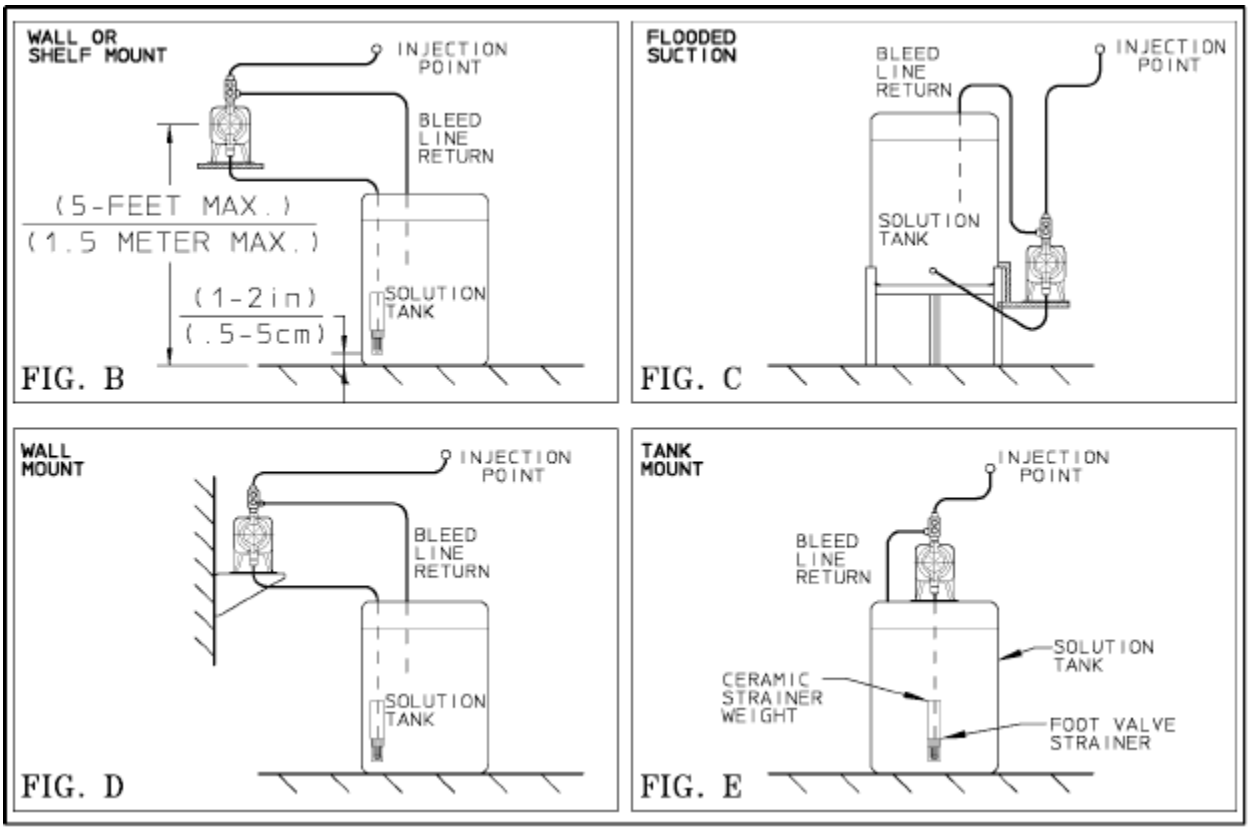
MOUNTING

Typical mounting arrangements are shown in Figures B to E.

Important: Injection point must be higher than the top of the solution supply tank to prohibit gravity feeding, unless a suitable backpressure is always present at the injection point. Installation of an anti-siphon valve will prohibit gravity feeding.

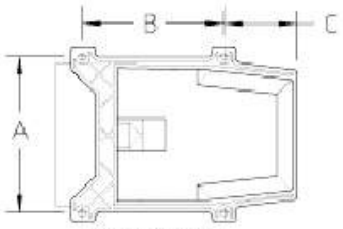
1. For wall or shelf mounting, refer to Figure E. Connect suction tubing to suction valve of chemical pump. Suction valve is the lower valve. Tubing should be long enough so that the foot valve/strainer assembly hangs about 1-2 inches (2.5 - 5 cm) above the bottom of chemical tank. To keep chemical from being contaminated, the tank should have a cover.
2. Flooded suction mounting (installing the pump at the base of the chemical storage tank, Figure C) is the most trouble free type of installation and is recommended for very low output requirements. Since the suction tubing is filled with chemical, priming is accomplished quickly and the chance of losing prime is reduced.

   To mount pump, drill 4 holes of .25in. (6.3 mm) diameter in the shelf as shown in the dimension drawing (Figure F). Attach pump securely using four #10 bolts and nuts.



3. The pump can be mounted to a wall as shown in Figure D. A wall mount bracket kit is available which includes all necessary hardware to mount the pump to the wall. Mounting the pump other than as shown in Figure D defeats the purpose of the housing drain. Mounting dimensions for the pump are provided in Figure F for reference.

4. The pump can be mounted on top of a solution tank as shown in Figure E. Install chemical pump on the cover. Insert suction tubing through the center hole and cut tubing so foot valve/strainer hangs about 1 or 2 inches (2.5 - 5 cm) above the bottom of the tank. Mount the chemical pump rigidly by drilling four .25in. (6.3 mm) holes and using four #10 screws and nuts.



SERIES "MP"

HOUSING SIZE	DIMENSIONS (in/cm) A	B	C
HSG. #2	4.81/12.2	4.38/11.1	2.19/5.6
HSG. #3	5.56/14.1	4.38/11.1	2.19/5.6

FIGURE F

5. USE AN ANTI-SIPHON VALVE IN THE DISCHARGE LINE whenever the fluid pressure in the discharge line is below atmospheric pressure. This can occur if the injection point is on the suction side of a water pump or against a "negative" head such as when feeding down into a well, SEE FIGURE G1.

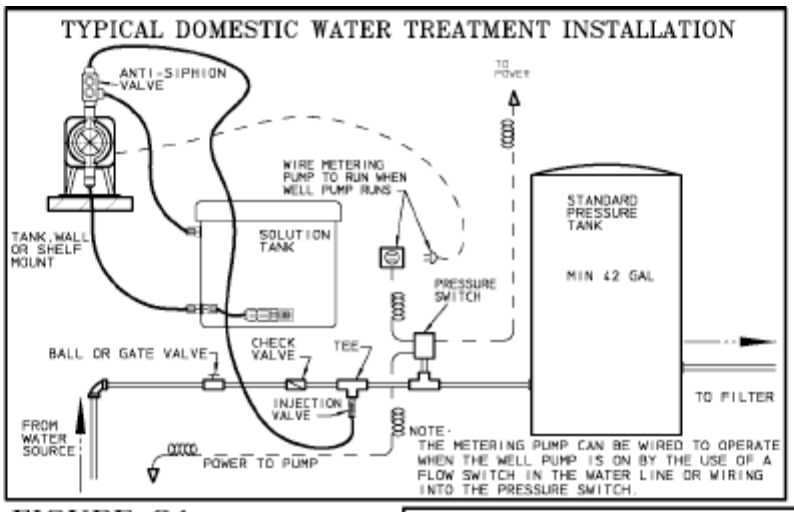


FIGURE G1

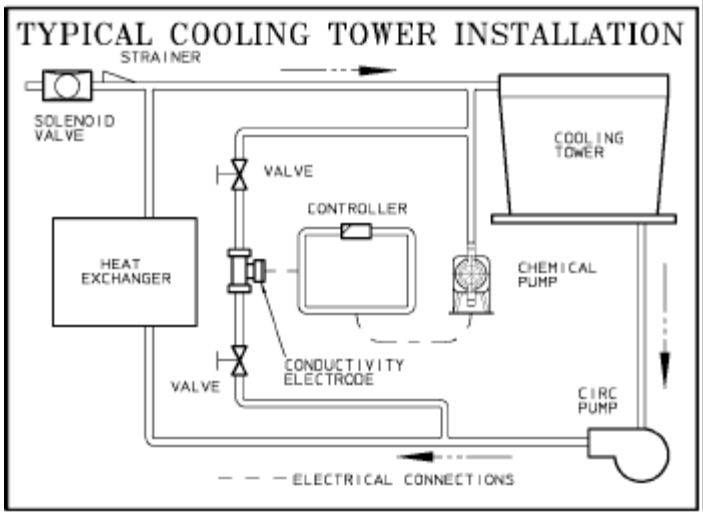


FIGURE G2

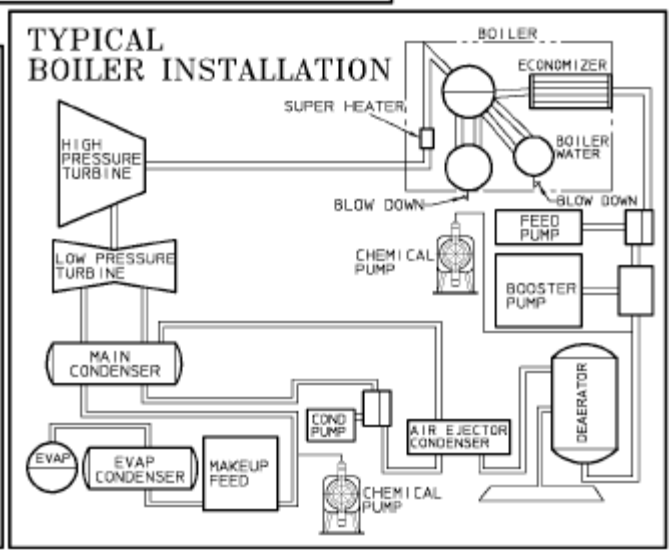


FIGURE G3

PIPING

1. Use provided tubing of specified size for connection. Connect tubing securely to prevent leakage of chemical and the entrance of air. Since plastic nuts are used for fittings, they should not be tightened excessively i.e. hand tighten only. NPT suction and discharge valves must **NOT** be over tightened. Hold fittings in place while adding piping and fittings. NPT suction and discharge valves should only be tightened 25 to 35 in. lbs. (4.46 to 6.25 kg/cm).
2. If the air bleed valve assembly is being used, a return line (tubing) should be securely connected and routed back to the storage tank. **To avoid possible injury from chemicals do not attempt to prime using a bleed valve without installing a return line.**
3. To maintain metering performance, a backpressure/injection valve is provided. The injection valve must be installed in the discharge line. Best practice is to install the injection valve at the point of chemical injection.
4. If the discharge tubing is going to be exposed to direct sunlight, black tubing should be used instead of the standard white translucent tubing supplied with each pump. To obtain, contact supplier.
5. To prevent clogging or check valve malfunction always install a strainer assembly to the end of the suction tubing (Figure E). This foot valve/strainer assembly should always be installed 1 to 2 inches (2.5 - 5 cm) above the bottom of the chemical tank. This will help prevent clogging the strainer with any solids that may settle on the tank bottom. The chemical tank and foot valve/strainer should be cleaned regularly, to ensure continuous trouble free operation. If the chemical being pumped regularly precipitates out of solution or does not dissolve easily or completely (e.g. calcium hydroxide), a mixer should be used in the chemical tank. These are readily available in many motor configurations and mountings. To obtain, contact supplier.
6. A flooded suction (tank liquid level always at a higher elevation than the pump) is recommended when pumping sodium hypochlorite (NaOCI) and hydrogen peroxide (H_2O_2) etc. which are liable to produce air bubbles. Maintaining a low liquid temperature will also help eliminate this problem.
7. Pipe corrosion can result if dilution at the injection point does not occur rapidly. This problem is easily prevented by observing this simple rule: install injection fitting so that the end is in the center of the flow stream of the line being treated. Trim injector tip as required. See Figure H. Note: Extended injection assemblies are available for large water lines. Consult your supplier for more information.

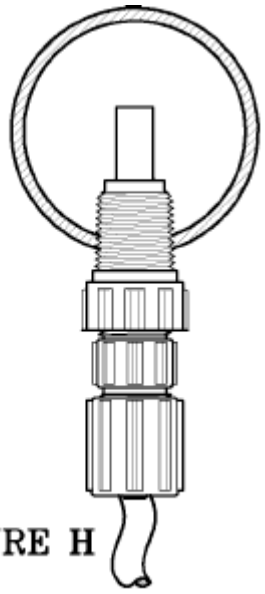
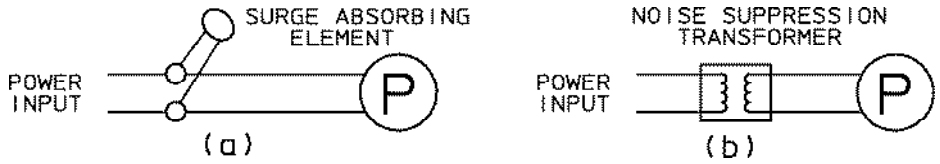


FIGURE H

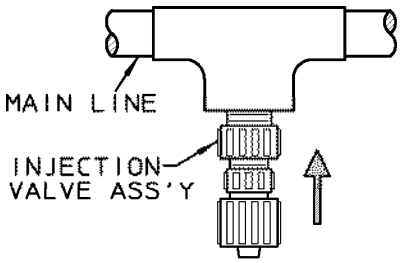
WIRING

1. ⚠ WARNING: **Risk of electrical shock. This pump is supplied with a three prong grounding type power plug. To reduce risk of electric shock, connect only to a properly grounded, grounding type receptacle.**
2. The metering pump should be wired to an electrical source which conforms to those on the pump nameplate. (Applying higher voltage than the pump is rated for will damage the internal circuit.)
3. In the electronic circuit of the control unit, measures for surge voltage are made by means of surge absorbing elements and high voltage semiconductors. Nevertheless, excessive surge voltage may cause failure in some areas. Therefore, the receptacle should not be used in common with heavy electrical equipment which generates high voltage. If this is unavoidable, however, measures should be taken by (a) the installation of a surge absorbing element (varistor of min. surge resistance 2000A) to the power supply connection of the pump, or (b) the installation of a noise suppression transformer.

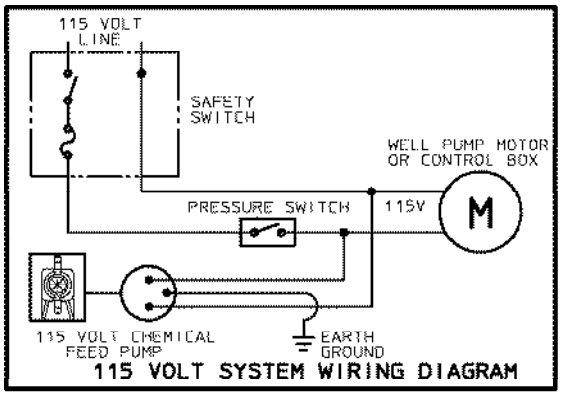


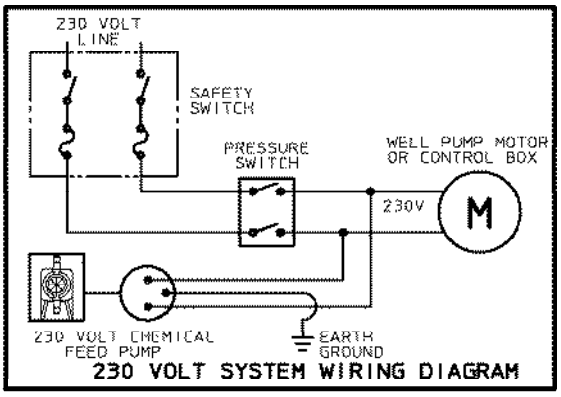
4. In the event of electrical power interruption during pump operation, the pump will remember its setting and automatically resume operation as before, whenever power is restored. If a manual reset is required to resume operation, the electrical circuit serving the pump must be suitably wired. Latching power relays which "drop out" upon loss of power, requiring manual reset, are typically used for this purpose.

WELL PUMP SYSTEM INSTALLATION



1. Ensure that the metering pump voltage matches the voltage of the well pump. Typical well pump electrical circuits are shown in Figure J. All electric wiring should be installed in accordance to local electrical codes by a licensed electrician.
2. Install the backpressure/injection (Figure I) on the discharge side of the metering pump into a tee which is installed into the water line going to the pressure tank. Typical installations are found in figures G1, G2 and G3.





Pumps carrying the "ETL Sanitation' approval (tested to NSF standard 50) are listed for swimming pools, spas, and hot tubs, and when proper materials are selected, are capable of handling but not limited to the following chemical solutions:

12% ALUMINUM SULPHATE	5% SODIUM CARBONATE
10% SODIUM HYDROXIDE	2%CALCIUM HYPOCHLORITE
12.5% SODIUM HYPOCHLORITE	10% HYDROCHLORIC ACID

DESCRIPTION OF CONTROLS AND OPERATION

INTRODUCTION

The pump performs the following functions:

Selected Controls
- Fixed Rate
- External Pulse
  - Straight Pulses
  - Pulse Storage
  - Division
  - Multiplication
- External Current Signal
  - 4-20 mA
  - 20-4 mA
- Stroke Counting
- Timed Operation (intervals)

Display Alarms
- Circuit Failure
- Signal Loss
- Full Count
- Pulse Overflow
- Pulse Rate High

Relay Output (one selected at a time)
- Relay Off
- Stop Function
- Current Signal Loss
- Full Count
- Flow Verification (if equipped with flow sensor)
- Pulse Overflow
- Repeat Strokes
- Circuit Failure

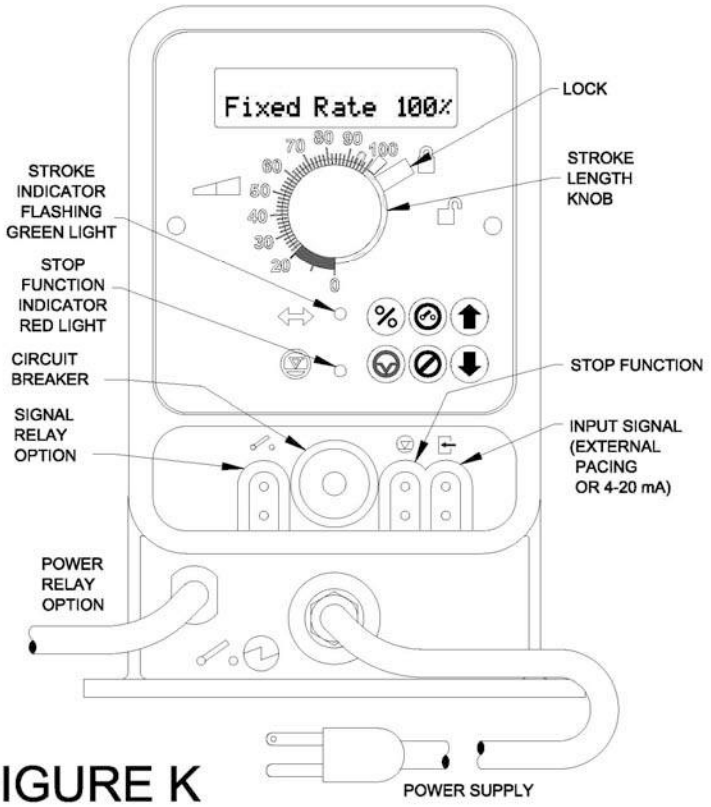


FIGURE K

USING THE TOUCHPAD

All adjustments and changes to pump operation (except stroke length) are made through the 6-button touchpad (figure L).

Except for alarm conditions, the LCD display (figure K) always presents either the present operating condition or a prompt which must be answered in order to commence operation.

There are two types of prompts:

Prompts in the form of questions (marked with a flashing question mark) are used to navigate through the menu options. These prompts are answered by pressing either the ⦿ or ⦸ buttons.

Prompts marked with alternating up and down arrows are always encountered when a numerical value must be selected (i.e., stroke rates, counts, run times, ratios). These prompts are answered by pressing either the ⬆ or ⬆ buttons to change the display value to the desired setting. After the desired value has been set in the display, press ⦿ to accept this value and continue or press ⦸ to return to the main menu.

To stop the pump at any time, press the red ⦿ button. To resume operation as before, press the ⦿ button.

To display the present stroking rate as a percentage of the maximum rate of the pump at any time, press the ⦿ button. Press any button to return to the normal display.

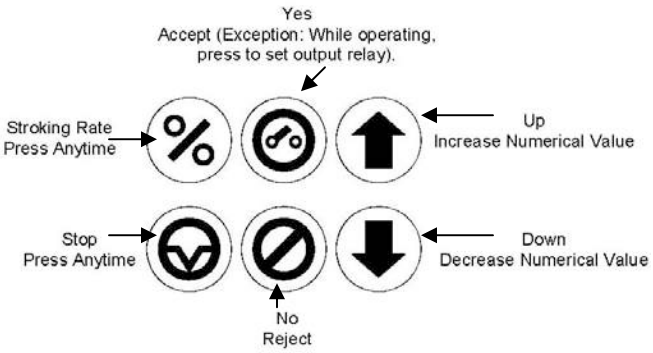


Figure L

HELPFUL HINTS

You can always get to where you want to go simply by accepting or rejecting choices presented.

If you find yourself within a menu where you don't want to be, keep selecting *No* until you return to the main menu.

If you go past the desired selection by mistake, keep selecting *No* and the pump will take you back to it.

A partly flashing display requires your response.

A flashing question mark requires a *Yes* or *No* answer.

Flashing arrows require an *Up* or *Down* numerical adjustment. To make large numerical adjustments quickly, hold down either the *Up* or *Down* arrow buttons. The value in the display will change at an increased rate.

A fully flashing display is an alarm.

If power is interrupted, the pump will automatically resume operating where it left off when power is restored. The pump will remember this while power is off.

CONTROL OPTIONS

FIXED RATE

The pump operates continuously at the set rate over the span 1-100% of maximum.

EXTERNAL PULSE CONTROL - STRAIGHT PULSES

Each pulse received from the external signal port causes the pump to immediately stroke once at a rate limited by the maximum rate of the pump, 125 strokes per minute.

In the *Pulse Storage* option, any pulse frequency received which is at a higher rate than the pump can respond to (125 contacts per minute), will cause excess pulses to be accumulated in memory. The pump will work off the excess pulses at a rate of 125 strokes per minute when the signal level drops below the maximum rate. If the accumulation exceeds 9,999 pulses, memory storage capacity is exceeded and the *Pulse Overflow* alarm is triggered. During the *Pulse Overflow* condition the pump operates at 125 strokes per minute; when the incoming rate drops below 125 pulses per minute, normal *Pulse Storage* operation resumes, starting with a full memory.

EXTERNAL PULSE CONTROL - DIVISION

The pump operates as described above except that incoming pulses are divided by a value from 1 to 999 prior to actuating the pump. For example, at a setting of 5, every fifth incoming pulse causes the pump to stroke once.

The *Pulse Storage* option operates as described above.

Pulse division makes it possible to "tune" the pump by adjusting its response to an external pulse signal, such as that from a flow meter, which is of too high a frequency to cause the desired feed by directly stroking the pump.

EXTERNAL PULSE CONTROL - MULTIPLICATION

The pump operates as described previously except that incoming pulses are multiplied by a value from 1 to 999 prior to actuating the pump and then worked off at a selected stroking rate. For example, at a multiplier of 5 and a stroking rate of 25%, each incoming pulse causes the pump to stroke five times at 25% stroking rate and then stop. During operation, the display shows the present value and the present count on a running basis. Unless Pulse Storage is in effect, additional external pulses received while responding to a previous pulse are ignored.

This option is similar to *Stroke Counting* (see below) except that action is initiated automatically by one or more external pulses rather than once manually by the user. There is no *Full Count* alarm as in *Stroke Counting* since it is always possible to receive additional external pulses.

The *Pulse Storage* option operates as described above.

EXTERNAL CURRENT SIGNAL CONTROL

In the *4-20 mA* option, the pump responds linearly to a current signal from the incoming signal port over the programmed operating rate. The rate can be any value from 0% to 100% and the current signal can be any value between 3.5 to 20.5 mA. The actual current signal can be calibrated to match that of the sending device.

For example: if the pump was set for a low signal of 4mA, a high signal of 12mA, a low rate of 0%, and a high rate of 80% - an incoming signal of 10mA would cause the pump to stroke at 60%.

The pump software allows the high and low rates to be inverted to produce a slower rate as the input signal is increased.

For example: if the pump was set for a low signal of 4mA, a high signal of 12mA, a low rate of 100%, and a high rate of 20% - an incoming signal of 8mA would cause the pump to stroke at 60%.

A *Signal Loss* alarm is triggered whenever the signal drops below approximately 2 mA. The pump stops operating during the loss of signal condition, and automatically resumes normal operation when the signal is restored.

STROKE COUNTING

The pump delivers a preset number of up to 9,999 strokes at a selected stroking rate. During operation, the display shows the preset value and the present count on a running basis. When the preset number of strokes has been delivered, the pump stops and the *Full Count* alarm is triggered. Pressing *Yes* when the *Full Count* alarm is displayed brings up the reset prompt. Continue pressing *Yes* to repeat the same stroking cycle or change the displayed values as they are presented to change the stroke count.

This option is similar to *External Pulse Control - Multiplication* (see above) except that action is initiated once manually by the user rather than by one or more external pulses.

TIMED OPERATION*

The pump operates for selected run times from 1 to 999 minutes (16.65 hours) at selected intervals from 1 to 999 hours (41.625 days) at a selected stroking rate. For example, the pump might be set to operate for 60 minutes every 168 hours (7 days), at a 50% stroking rate. During operation the pump displays the run time in minutes and the interval in hours.

RELAY SETTINGS

The following relay output options can be brought up on the menu by pressing the Yes button while the pump is in the menu settings (Relay options vary with operating condition). Press the *No* button to scan through the options available. Only one relay output option may be selected. When the desired option is displayed, press the *Yes* button. This will set the relay for the chosen option.

RELAY OFF

In all control options the relay remains open at all times.

STOP FUNCTION

In all control options the relay is normally open and closes while the *Stop Function* is activated through the stop port.

CURRENT SIGNAL LOSS

In any *Current Signal* control option, the relay is normally open and closes while the *Signal Loss* alarm is in effect.

FULL COUNT

In the *Stroke Counting* control option, the relay is normally open and closes while the *Full Count* alarm is in effect.

PULSE OVERFLOW

In any *External Pulse* control option with *Pulse Storage*, the relay is normally open and closes while the *Pulse Overflow* alarm is in effect.

REPEAT STROKES

In all control options, the relay is normally open and closes momentarily during each stroke of the pump. If the pump is equipped with a 24 VDC signal relay output, this function may be used to pace another externally paced pump.

CIRCUIT FAILURE

At all times, the relay is normally open and closes while the *Circuit Failure* alarm is in effect. The numbers which flash alternately with the alarm signal are for failure diagnosis at the factory.

FLOW VERIFY

If the pump is equipped with the flow verification option, the relay is normally open and closes while the *Flow Failure* alarm is in effect.

ALARMS

Alarms are distinguished by a fully flashing display.

CIRCUIT FAILURE

At all times, pumping is disabled and the pump will no longer operate until repaired.

SIGNAL LOSS

In any *Current Signal* option, the *Signal Loss* alarm is triggered whenever the signal drops below approximately 2 mA for several seconds. The pump stops operating during the loss of signal condition and resumes normal operation when the signal is restored. This includes the 20-4 mA option, in which a low current (4 mA) signal normally calls for full pump output in order to prevent overfeeding in the event of signal loss.

FULL COUNT

In the *Stroke Counting* control option, when the preset number of strokes has been delivered and the pump stops, the *Full Count* alarm is triggered.

PULSE OVERFLOW

In the *Pulse Storage* option, when memory capacity is exceeded the *Pulse Overflow* alarm is triggered. The pump continues to respond to external signal pulses as if 9,999 pulses were in storage.

PULSE RATE HIGH

In any *External Pulse Control* option without *Pulse Storage*, receipt of any pulses at a faster rate than maximum pump stroking rate, 125 strokes per minute, the *Pulse Rate High* alarm is triggered. The pump continues to operate at its maximum rate and does not respond to the excess pulses.

FLOW FAILURE

If the pump is equipped with the flow verification option, the pump will stop stroking and the screen will display *Flow Failure* when the flow sensor does not detect flow from the pumps discharge port.

CONTROL REFERENCE SUMMARY

CONTROL OPTIONS

Fixed Rate Fixed Rate 100%

External Pulse

Straight Straight Pulse

Pulse Storage *option* Pulse-Store 9999

Division Pulses) 999

Pulse Storage *option*:) 999 Store 999

Multiplication x999/999

Pulse Storage *option* x999 Store 999

External Current

Set High Rate Hi Rate 100%

Set Low Rate Low Rate 100%

Set High Signal Hi Sig 20.0mA

Set Low Signal Low Sig 4.0mA

Calibration Sig:xx.x Cal:xx.x

Run 4-20mA?

Count Strokes Count 9999/9999

Timed Interval 999m Every 999h

OUTPUT RELAY OPTIONS

Relay Off Relay Off

Stop Function Relay-Stop

Current Signal Loss Relay-No Signal

Full Count Relay-Full Count

External Pulse Overflow Relay-Overflow

Repeat Strokes Relay-Repeat

Circuit Failure Relay-Failure

ALARMS (full flashing display)

Circuit Failure Circuit Failure

Signal Loss Signal Loss

Full Count Full Count

Pulse Overflow Pulse Overflow

Pulse Rate High Pulse Rate High

SETTINGS OPTIONS

Settings?

Flow Verify? Yes=On No=Off

Relay Output?

- Relay-Stop?
- Relay-Repeat?
- Rel-No Signal?
- Rel-Full Count?
- Relay-Overflow?
- Relay-Failure?
- Rel-Flow Vrfy?
- Relay-Off?

Factory Init?

- Init Settings?
  - Are You Sure?

Volume-Units?

- Units = GPD?
- Units = LPD?
- Units = LPH?

Reset Totals?

- Are You Sure?

Calibrate Flow?

- Stroke = 100
  - Run Calib?

Language?

- English?
- French?
- German?
- Spanish?

START UP AND OPERATION

POWER

All metering pumps are available in 115 volts at 50/60 Hertz, single phase. Optionally 230 volts at 50/60 Hertz, single phase can be provided. **Prior to start-up always check to insure that the pump voltage/frequency/phase matches that of the power supply.**

⚠CAUTION: If pump is fitted with a PVC pump head (7th position of model number is "V". Note: PVC is gray, not black), uniformly hand tighten the four head screws before use (18-22 inch pounds / 3.21-3.93 kg/cm). Periodically tighten after installation.

PRIMING

⚠CAUTION: When working on or around a chemical metering pump installation, protective clothing and gloves and safety glasses should be worn at all times.

All pumps are tested with water. If the chemical to be pumped reacts when mixed with water (e.g. sulfuric acid, polymer) the pump head should be removed and dried thoroughly along with the diaphragm and valve seats.

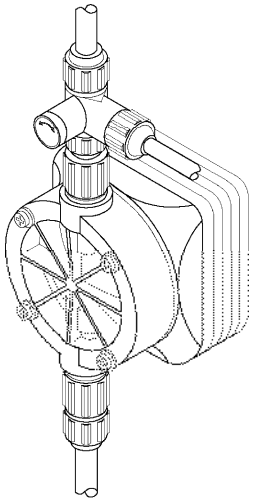
1. Turn on the power to the pump. Operate the pump in the fixed rate control mode at 100% (full) rate. The green LED will light up and flash off each time the pump strokes.
2. Adjust the stroke length knob to the 100% setting mark (for more information see "Stroke Length Adjustment" on the following page).
3. If the discharge line is connected directly to a pressurized system it should be temporarily bypassed during priming of the pump. A bleed valve will simplify this operation by allowing easy bypass of the discharge fluid. All air must be purged from the pump head before the pump will pump against pressure.

   Air Bleed Operation:

   A) While pump is running, turn adjustment screw counterclockwise.

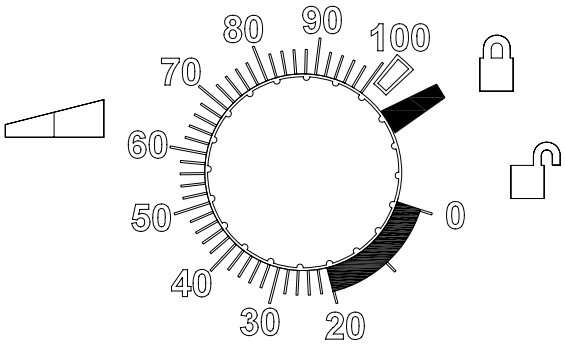
   B) Run with valve open until a solid stream of fluid comes out of the bypass tubing (1/4 x 3/8 supplied with valve), no air bubbles.

   C) Close air bleed valve by turning adjustment screw clockwise.



4. Chemical should reach the pump head after a few minutes of operation. If not, remove the discharge fitting and moisten the discharge valve area (ball check and valve seats) with a few drops of chemical being fed to the metering pump. **For safety, always use protective clothing and gloves, wear safety glasses and use a proper container to hold the chemical.**
5. If the pump continues to refuse to prime, refer to Troubleshooting Section of these instructions.
6. Turn the power on once more and adjust the pump flow to the desired rate (see "Controlling Procedure" below).
7. Always check the calibration of the pump after start-up. It's best to calibrate the pump under your typical use conditions.

STROKE LENGTH ADJUSTMENT



- Stroke length can be controlled within 0 to 100% of the diaphragm displacement. (It should be controlled within 20 to 100% for practical use.)
- Stroke length can be set by means of the stroke length adjusting knob while the pump is in operation. **Do not turn the knob while the pump is stopped.**

Controlling Procedure (for fixed rate):

Proper set points for stroke length should be determined after consideration of the pump and characteristics of the fluid. The following procedure is recommended from the viewpoint of pump performance. **Note: The closer the stroke length is to 100%, the better the pump performance will be.**

A) Set the stroke length to 100%. Measure the output capacity.
B) Adjust the stroke rate frequency to obtain the desired output. If adjustment by stroke rate alone does not bring the output low enough, the stroke length may be adjusted to lower the maximum output.
C) Measure the output capacity to ensure that the required value is obtained.

Example Selected Model	=	LMD4
Set Stroke Length	=	100%
Set Stroke Rate	=	100%
Output Capacity (Rated Pressure)	=	21 GPD*
Desired Flow	=	17 GPD
Adjust Stroke Rate to 81% Output Capacity	=	$\frac{17}{21}$ x 100 = 81% (approx.)*

Thus to obtain the desired flow, stroke length is set at 100% and stroke rate is set at 81% i.e. output capacity = 0.81 x 21 = 17 GPD*

* Check these values by measurement. Output capacity is higher when feeding against less than rated pressure.

OPERATION BY EXTERNAL INPUT SIGNALS:

The pump can be controlled by three types of input signals. All are fully isolated from AC input power and from Earth ground. The input socket connections are located at the bottom of the control panel face and the signal cords are provided with the pump. Remove rubber plugs to access plug sockets.

Stop Function:

Operation of the pump can be stopped by an external signal input. When the external signal is input to the stop terminals, the red light goes on and operation of the pump is stopped. The stop function overrides all control options and input signals at other terminals. Previous operation resumes when the stop signal is removed.

⚠CAUTION: Operation of more than one pump from the same contact closure will damage the pump circuits. When such operation is required, the pump circuits must be electrically isolated from one another by means of a multi-contact control relay or similar means.

- Input signals should be no-voltage signals from relay contacts, etc. and the input of other signals is prohibited. (In case of relay contacts, electric resistance must be 100 ohms or below when ON and 1 Mega ohm or above when OFF).

The stop function is commonly used in conjunction with a tank float switch. The float switch contacts are normally open but when the tank level falls past a certain point the contacts close and the pump stops. Signal cord is provided with the pump.

External Pacing Function:

Pump stroking can be controlled by an external pulse signal through the external signal terminals while the pump is in one of the external pacing control modes.

⚠CAUTION: Operation of more than one pump from the same contact closure will damage the pump circuits. When such operation is required, the pump circuits must be electrically isolated from one another by means of a multi-contact control relay or similar means.

- After receiving an input signal, the pump generates the necessary power pulse to actuate the solenoid. The external signal input is debounced by the pump circuit.
- Input signals should be no-voltage signals from relay contacts, etc. and the input of other signals is prohibited. (In the case of relay contacts, electric resistance must be 100 ohms or below when ON and 1 Mega ohm or above when OFF). The pulse duration of the input signal must be 10 milliseconds or over and the frequency of input signal must not exceed 125 times/min unless accommodated by pulse division or pulse storage. Signal cord is provided with the pump.

4-20 mA / 20-4 mA Function:

The pump stroking rate can be controlled by a 4-20mA current signal when in current signal mode.

The pump automatically adjusts the stroking rate according to the signal level provided to the pump.

Pumps may be wired in series to the current signal providing that the signal source is sufficient to handle the load (each pump has an impedance of 100 ohms).

The pump responds to a 4-20mA signal as follows when the high rate is 100%, the low rate is 0%, the high signal is 20mA and the low signal is 4mA. (Figure O below shows straight response)

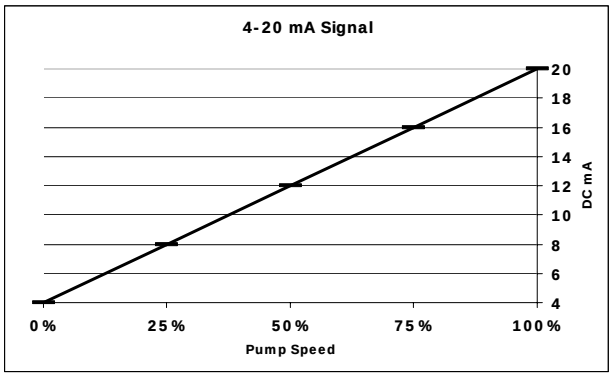


Figure N

The pump responds to a 20-4mA signal as follows when the high rate is 0% the low rate is 100%, the high signal is 20mA and the low signal is 4mA. However, the high signal can never be set below the low signal, and the low signal cannot be set above the high signal setting. Only the stroke rate may be inverted. (Figure O below shows straight response)

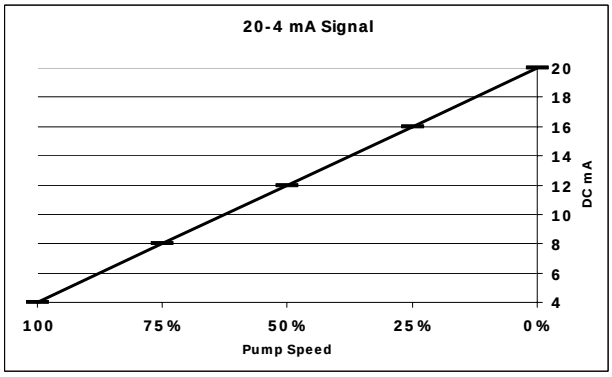


Figure O

The pump responds to a user defined scaled signal as follows when the high rate is 100% the low rate is 0%, the high signal is 20mA and the low signal is 12mA. (Figure O-1 below shows an example of a possible user defined scale)

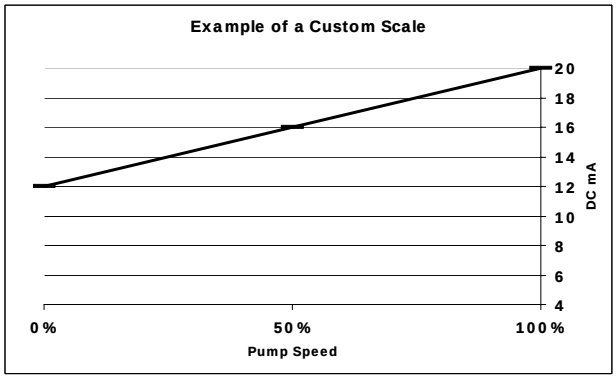


Figure O - 1

The signal cord is provided with the pump and has the following polarity:

White = Positive (+)
Black = Common

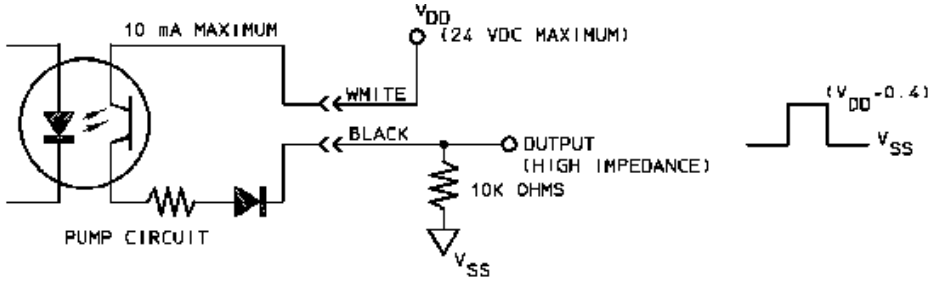
Signal input impedance is 100 ohms.

OUTPUT RELAY

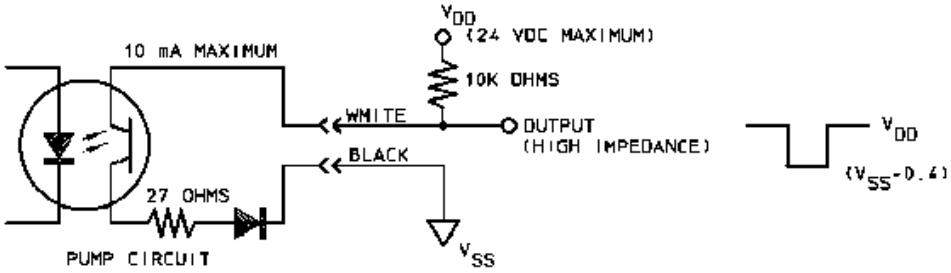
Each pump has the option of being provided with one of two separate normally open output relay options as described below. Relays close according to the option selected, and remain closed during the condition specified for the selected option except for the *Repeat Strokes* option.

The Signal Level output relay option is via the output signal terminals on the pump control panel. It is designed to provide direct or inverted voltage output signals as shown in figure O. The voltage input must have a high-impedance characteristic and must not exceed 24 VDC. The pump circuit can source or sink a maximum current of 10 mA. The signal cord is provided with the pump and has the following polarity when connected to the pump terminals.

White = Positive (+)
Black = Common



TYPICAL USER CIRCUIT(DIRECT OUTPUT)



TYPICAL USER CIRCUIT(INVERTED OUTPUT)

FIGURE P

The Power Level option is via the power relay cord which exits the pump below the control panel. The power level relay is a zero-crossing triac-type solid-state switch as seen in figure Q which is designed to switch AC current only and has the following ratings:

Voltage	Current	Power
Minimum = 12 VAC, 50/60 HZ	minimum = 10 mAmps	minimum = .12 watts (at 12 VAC)
Maximum = 250 VAC, 50/60 HZ	maximum = .5 Amps	maximum = 120 watts (at 240 VAC)

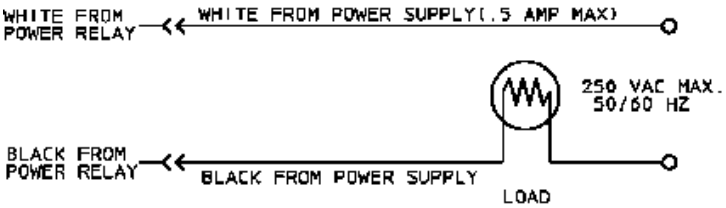


FIGURE Q

* Load can be any device which meets the above voltage and current limits (i.e., lamp, alarm, siren, relay, etc.)

⚠CAUTION: Do not apply power directly to the relay cord without a sufficient load to limit current as indicated above. Do not exceed the specified voltage rating. Excess current or voltage will damage the pump and cause fire and electrical shock hazards. Do not install any type of standard power plug to the relay cord.

ADDITIONAL SETTINGS:

"Flow Verify?" – used in conjunction with the flow verification meter; to activate this option:
Choose: "Settings?", press "YES"
"Flow Verify?", press "YES"
"Yes=On No=Off?", press "YES"
NOTE: Enabling flow verification on a pump with no flow meter will cause a flow failure.

"Factory Init?" – initializes the pump back to all original factory settings; to reinitialize the pump:
Choose: "Settings?", press "YES"
"Factory Init?", press "YES"
"Init Settings?", press "YES"
"Are You Sure?", press "YES"

"Volume-Units?" – allows the user to select how the flow data will be displayed (default is GPD); to change this setting:
Choose: "Settings?", press "YES"
"Volume-Units?", press "YES"
Use the up and down arrow to choose GPD, GPH, or LPH. Choose "YES" when the desired unit is displayed.

"Reset Totals?" – resets the flow totals; to reset the totals:
Choose: "Settings?", press "YES"
"Reset Totals?", press "YES"
"Are You Sure?", press "YES"
The display will read "Reset Done", press "YES" to get back to the settings menu.

"Calibrate Flow?" – allows the user to calibrate the system to obtain accurate flow totals; to calibrate the system:
Choose: "Settings?", press "YES"
"Calibrate Flow?", press "YES"
"Stroke=100%", use arrow keys to set the stroke per the dial, press "YES"
"Run Calib?", press "YES"
Run the pump for the desired amount of time while measuring the flow output. Press "YES" to stop the calibration period. Use the arrow keys to enter the measured flow in mL, press "YES". The display will read "Calibrated", press "YES" to return to the Settings menu. NOTE: If the stroke length is changed and the calibration is not re-run, the flow totals will not be accurate.

Additional Relay Functions: "Rel-Flow Vrfy?" – allows the relay to be activated if there is a flow failure. To set this option:
Choose: "Settings?", press "YES"
"Rel-Flow Vrfy?", press "YES"

"Language?" – allows the user to select English (default), German, Spanish or French; to set the language:
Choose: "Settings?", press "YES"
Use the arrow keys to select the desired language, press "YES".

MAINTENANCE

⚠ CAUTION: Before performing any maintenance or repairs on chemical metering pumps, be sure to disconnect all electrical connections and insure that all pressure valves are shut off and pressure in the pump and lines has been bled off.

Always wear protective clothing, gloves and safety glasses when performing any maintenance or repairs on chemical metering pumps.

ROUTINE MAINTENANCE

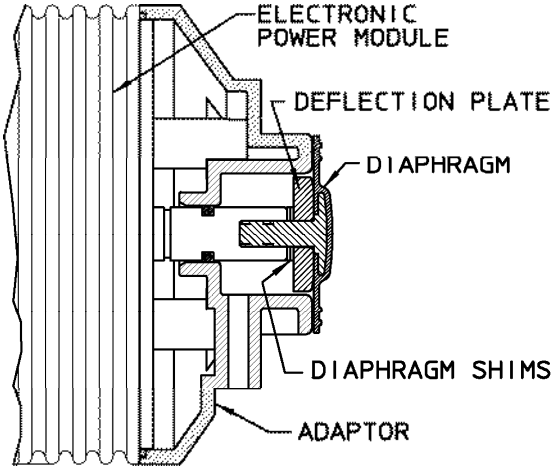
1. Routinely check the physical operating condition of the pump. Look for the presence of any abnormal noise, excessive vibration, low flow and pressure output or high temperatures [when running constantly at maximum stroke rate, the pump housing temperature can be up to 160°F (70°C)]
2. For optimum performance, cartridge valves should be changed every 4-6 months. Depending on the application, more frequent changes may be required. Actual operating experience is the best guide in this situation. Repeated short-term deterioration of valve seats and balls usually indicates a need to review the suitability of wetted materials selected for the application. Contact the supplier for guidance.
3. Check for leaks around fittings or as a result of deteriorating tubing e.g. when standard white translucent discharge tubing is exposed to direct sunlight. Take appropriate action to correct leak by tightening fittings or replacing components.
4. Keep the pump free of dirt/debris as this provides insulation and can lead to excessive pump temperatures.
5. If the pump has been out of service for a month or longer, clean the pump head/valve assemblies by pumping fresh water for approximately 30 minutes. If the pump does not operate normally after this “purging run”, replace cartridge valve assemblies.

DISASSEMBLY AND ASSEMBLY

DIAPHRAGM REMOVAL

1. Flush pump head and valve assemblies out by running pump on water or other suitable neutralizing solution. Wash outside of pump down if chemical has dripped on pump.
2. Set stroke length of pump to 0% and unplug pump.
3. Disconnect tubing or piping from the pump. Remove the four pump head screws and then remove the pump head assembly.
4. Remove the diaphragm by grasping it at the outer edges and turning it counterclockwise until it unscrews from the electronic power module (EPM). Don’t lose the deflection plate or diaphragm shims which are behind the diaphragm. Note shim quantity can be from 0 to 2.
5. Inspect diaphragm if it is intended to be used again. Look for indications of the TFE face being overstretched, (localized white areas) or the elastomer on the back of the diaphragm being worn. Excessive amounts of either condition require diaphragm replacement.

DIAPHRAGM REPLACEMENT



Refer to drawings in the back of the manual.

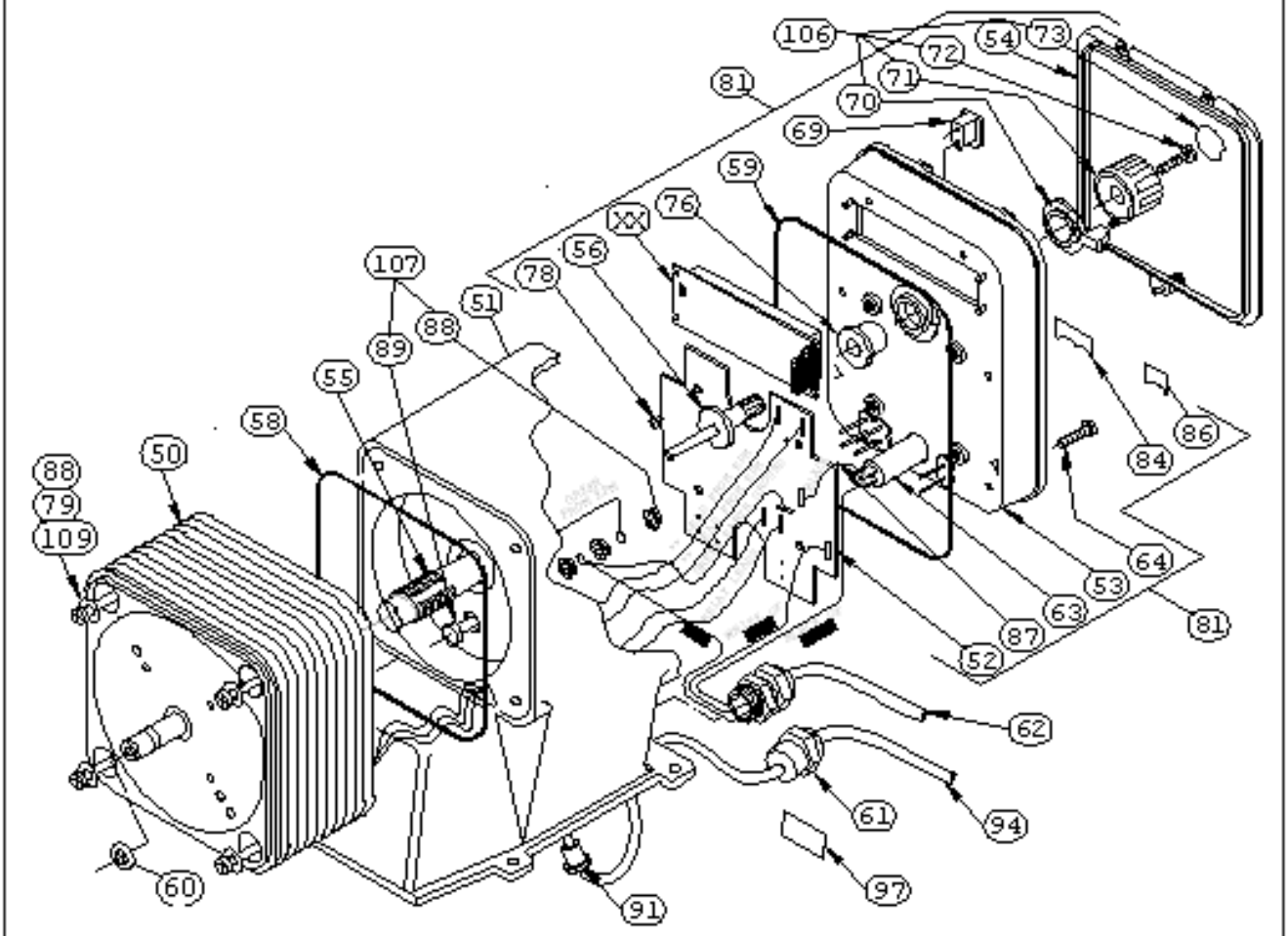
1. When replacing the diaphragm, it's always a good idea to replace the valve cartridges and other worn parts. A kit is available from your supplier with all parts necessary to completely rebuild your pump's wet end. All your supplier needs to know is the "KOPkit No." on your pump's nameplate to supply this kit.
2. Set pump stroke length to 0% and unplug the pump.
3. If you kept the shims from the original diaphragm or know the original quantity you can avoid Step #4 for shimming the diaphragm and go to Step #5.
4. Slide the diaphragm deflection plate onto the back of the diaphragm stud, radius side towards the diaphragm. Next slide two shims onto the diaphragm threaded stud and screw the diaphragm into the EPM unit. Refer to Figure R. Turn diaphragm clockwise until deflection plate and shims are tight against solenoid shaft, diaphragm stops turning. If there is a gap between the adaptor and diaphragm, repeat the procedure removing one shim each time until the diaphragm just touches the adaptor or is slightly recessed.
5. Apply grease to areas of the diaphragm that contact the deflection plate or radius on the adaptor.
6. Screw the diaphragm into the EPM unit's shaft with the deflection plate and appropriate number of shims in between.
7. Adjust stroke length to 50%. It is easier to do this if you temporarily turn the pump on. Place the pump head onto the adaptor with valve flow arrows pointing up and install and tighten pump head screws. Tighten screws until pump head pulls up against adaptor.
8. Adjust stroke length back to 100% for easier priming and place pump back into service.

VALVE REPLACEMENT

1. Flush pump to clean any chemical from pump head.
2. Unplug pump, release system pressure, and disconnect any tubing or piping.
3. Unscrew valve cartridges and discard. Also remove O-Rings down inside pump head.
4. Using new O-Rings, install new valve cartridges with stamped letters reading from top to bottom, and the arrow pointing in the direction of flow. Hand tighten only, do not use wrenches or pliers. This is especially important when the pump head is SAN material.
5. Reconnect tubing or piping and reinstall the pump.
6. Check for leaks around newly installed fittings.

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
LOSS OF CHEMICAL RESIDUAL	1. Pump setting too low.	1. Adjust to higher setting (pump must be operating during stroke length adjustment).
	2. Scale at injection point	2. Clean injection parts with 8% muriatic acid or undiluted
	3. Solution container allowed to run dry	3. Refill the tank with solution and prime. See start-up and operation section
TOO MUCH CHEMCIAL	1. Pump setting too high1.	1. Lower pump setting (pump must be operating to adjust stroke length knob).
	2. Chemical in solution tank is too rich	2. Dilute chemical solution. NOTE: For chemical that reacts with water, it may be necessary to purchase a more dilute grade of chemical direct from chemical supplier.
	3. Siphoning of chemical into well or main line.	3. Test for suction or vacuum at the injection point. If suction exists, install an anti-siphon valve.
LEAKAGE AT TUBING CONNECTIONS	1. Worn tube ends	1. Cut off end of tubing (about 1") and then replace as before
	2. Chemical attack	2. Consult your seller for alternate material.
FAILURE TO PUMP	1. Leak in suction side of pump	1. Examine suction tubing. If worn at the end, cut approximately an inch off and replace
	2. Valve seats not sealing	2. Clean valve seats if dirty or replace with alternate material if deterioration is noted
	3. Low setting on pump	3. When pumping against pressure, the dial should be set above 20% capacity for a reliable feed rate
	4. Low solution level	4. Solution must be above foot valve
	5. Diaphragm ruptured	5. Replace diaphragm as shown in the "Maintenance Section". Check for pressure above rated maximum at the injection point. NOTE: Chemical incompatibility with diaphragm material can cause diaphragm rupture and leakage around the pump head.
	6. Pump head cracked or broken	6. Replace pump head as shown in "Maintenance Section". Make sure fittings are hand tight only. Using pliers and wrench can crack pump head. Also, chemical incompatibility can cause cracking and subsequent leakage.
	7. Pump head contains air or chlorine gas	7. Bleed pump head, see "Air Bleed Operation".
	8. Breakdown or disconnection of wiring	8. Connect wiring properly. Check fuse or circuit breaker
	9. Voltage drop	9. Take measures after investigation of cause
	10. Malfunction of electronic control board	10. Contact supplier
PUMP LOSES PRIME	1. Dirty check valve	1. Remove and replace or clean off any scale or sediment
	2. Ball checks not seating or not sealing properly	2. Check seat and ball checks for chips, clean gently. If deformity or deterioration is noted, replace part with proper material. Resulting crystals can hold check valves open, therefore the valves must be disassembled and cleaned. Be sure to replace all parts as shown in the Parts Diagram at the end of the manual.
	3. Solution container allowed to run dry	3. Refill the tank with solution and prime. See Start-Up and Operation section
	4. Chemical outgassing	4. Bleed gas, use flooded suction, maintain chemical at room temperature (approx. 20° F / -6° C).
LEAKAGE AT FITTING	1. Loose fittings	1. Tighten hand tight. Replace gasket if hand tight does not stop leakage
	2. Broken or twisted gasket	2. Check gaskets and replace if broken or damaged
	3. Chemical attack	3. Consult your pump supplier for alternate material
PUMP WILL NOT PRIME	1. Too much pressure at discharge	1. Turn off all pressure valves, loosen outlet tubing connection at discharge point. Remove discharge valve cartridge. Dampen ball check and valve seats with a few drops of solution. Set pump dial to maximum rate. When pump is primed, reconnect all tubing connections.
	2. Check valves not sealing	2. Disassemble, loosen, clean and check for deterioration swelling. Reassemble and wet the valve assembly, then prime. See Start-Up Operation section.
	3. Output dials not set at maximum	3. Always prime pump with out dial set a maximum rated capacity
	4. Suction lift height too much	4. Decrease suction lift or pull vacuum on pump discharge until pump is primed
	5. Pump equipped with spring loaded high viscosity valves	5. Loosen discharge valve to aid in priming, take necessary safety precautions or apply vacuum to pump discharge



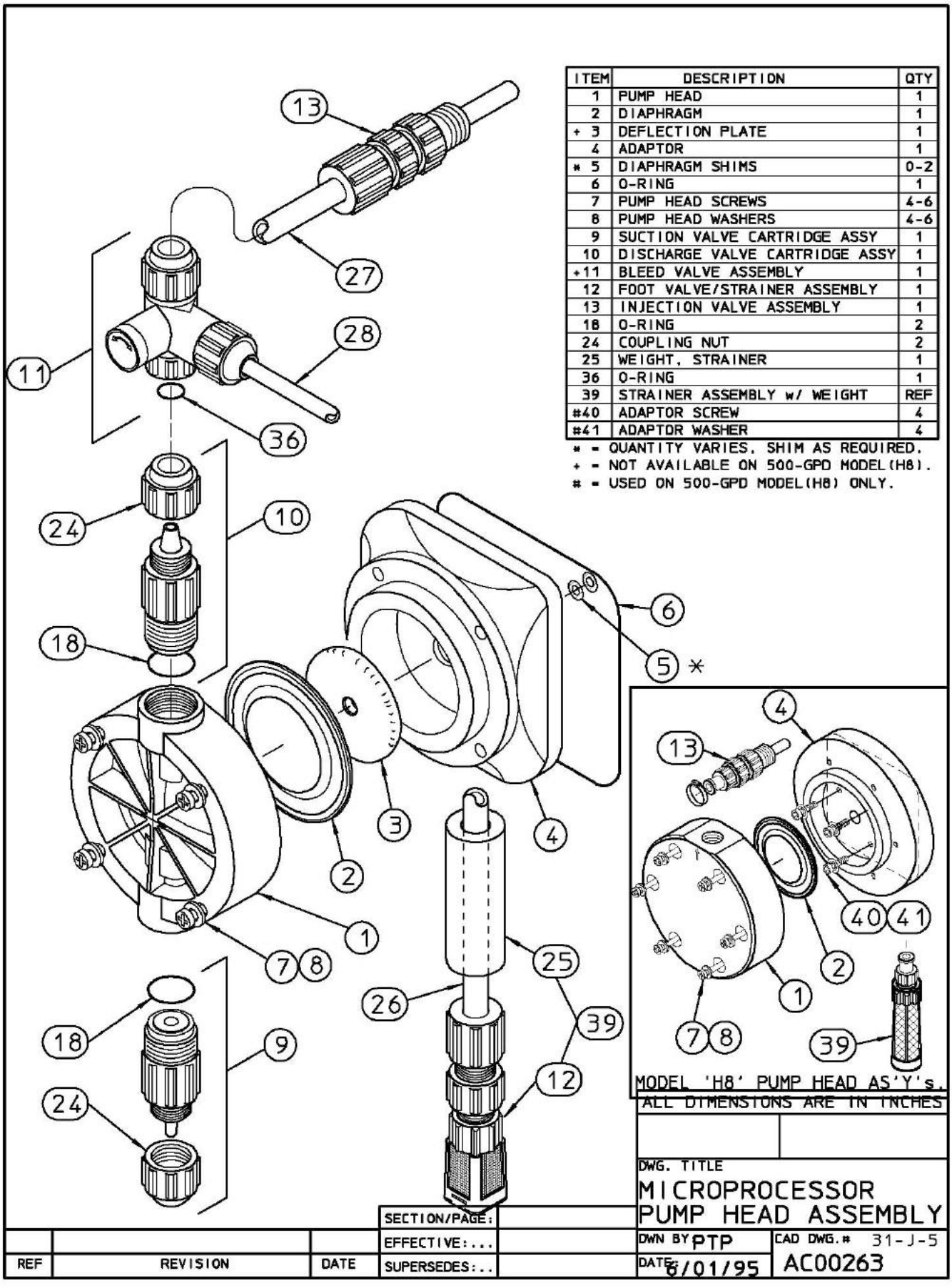
ITEM	DESCRIPTION	ITEM	DESCRIPTION
50	ELECTRONIC POWER MODULE EPM	73	KNOB STICKER,STROKE LG.
51	HOUSING	74	EPM MOUNTING SCREW
52	ELECTRONIC CONTROL BOARD	76	GROMMET,STROKE LENGTH
53	CONTROL PANEL	77	TOUCH PAD(NOT SHOWN)
54	DUST COVER ASSEMBLY	78	CIRCUIT MOUNT SCREW
55	FEMALE ADJUSTMENT SHAFT	79	EPM MOUNTING WASHER
56	MALE ADJUSTMENT SHAFT	81	CONTROL PANEL ASSEMBLY
57		84	STOP/SIGNAL LABEL
58	EPM/HOUSING O-RING	85	STOP/FUNC.CORD(NOT SHOWN)
59	CONTROL PANEL O-RING	86	RELAY LABEL
60	SECONDARY SEAL	87	JUMPER WIRE
61	STRAIN RELIEF,SIG CORD(OPTIONAL PWR RELAY)	88	GROUND LUG NUT w/ WASHER
62	POWER CORD ASSY	89	GROUND LUG BOLT
63	CIRCUIT BREAKER	91	BUSHING (OPTIONAL PWR RELAY)
64	CONTROL PANEL SCREW	92	BREAKER COVER(NOT SHOWN)
69	PIN PLUG	94	SIGNAL CORD (OPTIONAL PWR RELAY)
70	LOCKING TAB	97	SIGNAL PWR LBL (OPTIONAL PWR RELAY)
72	KNOB MOUNTING SCREW	106	KNOB KIT, STROKE LENGTH
		107	GROUND LUG KIT

** = 115 VOLT EPM UNITS HAVE GREY LEADS,
** = 230 VOLT EPM UNITS HAVE RED LEADS.
NOTE TERMINAL LOCATIONS ON THE CIRCUIT BOARD VARY DEPENDING ON THE CONTROL OPTION.

⚠ IT.#57 NO LONGER USED, MMK. 2-15-99

DWG. TITLE
MICROPROCESSOR DRIVE ASSEMBLY

DWN BY: PTP | CAD DWG.# 15-B-9
DATE 2/08/95 | AC00234.DWG



ITEM	DESCRIPTION	QTY
1	PUMP HEAD	1
2	DIAPHRAGM	1
+ 3	DEFLECTION PLATE	1
4	ADAPTOR	1
* 5	DIAPHRAGM SHIMS	0-2
6	O-RING	1
7	PUMP HEAD SCREWS	4-6
8	PUMP HEAD WASHERS	4-6
9	SUCTION VALVE CARTRIDGE ASSY	1
10	DISCHARGE VALVE CARTRIDGE ASSY	1
+11	BLEED VALVE ASSEMBLY	1
12	FOOT VALVE/STRAINER ASSEMBLY	1
13	INJECTION VALVE ASSEMBLY	1
18	O-RING	2
24	COUPLING NUT	2
25	WEIGHT, STRAINER	1
36	O-RING	1
39	STRAINER ASSEMBLY w/ WEIGHT	REF
#40	ADAPTOR SCREW	4
#41	ADAPTOR WASHER	4

* = QUANTITY VARIES, SHIM AS REQUIRED.
+ = NOT AVAILABLE ON 500-GPD MODEL(H8).
# = USED ON 500-GPD MODEL(H8) ONLY.

Specifications

Pressure, MAX, PSI/BAR @ GPD/GPH/LPD	300/20 3/.13/11
Capacity, MAX, GPD/GPH/LPD @ PSI/BAR	500/20.8/1890 20/1.4
Reproducibility, % MAX Capacity	2
Viscosity, MAX, CPS (1)	1000
Suction Lift @ 1 CPS, MAX, FT/M @ 3000 CPS	10/3.1 (once primed) 3.5/1.1
Controls	6-Station Membrane Switch
Status Display	16-Position LCD Dot Matrix Backlight
LED Indicator Lights, Panel Mount	Power On - Green Pulsing - Green Flashing Stop - Red
Stroke Frequency, MAX, SPM	125
External Stroke Frequency Control, (Automatic)	4-20 mADC, 20-4 mADC External Pacing
Stroke Frequency Turn Down Ratio	100:1
Stroke Length Turn Down Ratio	10:1
Output Relay (Signal Level Option)	24 VDC, 10 mA
Output Relay (Power Option)	250 VAC, 50/60 HZ, .5A
Power Input	115 VAC/50-60HZ/1ph 230 VAC/50-60HZ/1ph
Current Draw @ 115 VAC, AMPS	1
Average Input Power @MAX SPM, Watts	130
Circuit Board Protection	Circuit Breaker (Panel Mount)
Temperature, MAX, F/ C - Environmental (Shaded)	 104/40
Connections - Tubing (Suction & Discharge) . . . - Piping (Suction & Discharge)	.25" ID X .38" OD .38" ID X .50" OD .50" ID X .75" OD .25" FNPT .50" FNPT

REPAIR SERVICE

Normally following the instructions in the previous sections of the manual will rectify any pump problems. If, however, after following these instructions the pump does not perform properly, it can be returned for repair. Please follow the instructions below:

1. Pump cannot be serviced properly if the original pump nameplate or data contained on the nameplate is not intact.
2. Thoroughly flush pump head and outside of pump with water or a suitable fluid to neutralize any residual chemical left in pump.
3. Include written explanation of the following:
   - A) Problem _____
   - B) Pumped Fluid _____
     - Name _____
     - Viscosity _____
     - Fluid Temperature _____
   - C) Pressure @ Discharge _____
     - @ Suction _____
     - or Suction Lift _____
   - D) Environmental Temperature _____
   - E) Electrical Service _____
     - Volts _____
     - Hz _____
     - Phase _____
   - F) Nameplate Data _____
     - Series _____
     - Serial # _____
     - KOPkit # _____
4. Package the pump in the original box if available and send to the address specified by your pump supplier.

KOPkits™

Keep-On-Pumping kits that can save you time and money!

The manufacturer has built a reputation for superior reliability by supplying carefully-designed, high-quality equipment. Even the best equipment, however, requires a minimal amount of maintenance. KOPkits are designed to guard against unnecessary downtime and assure you the highest level of efficient and uninterrupted service.

KOPkits contain those recommended spare parts which will most likely require normal maintenance.

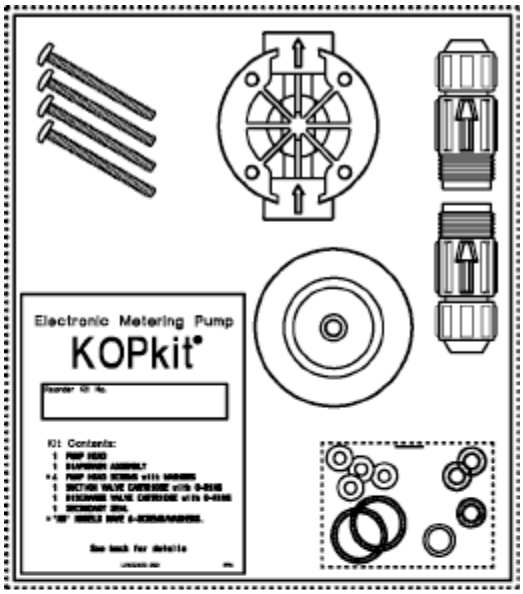
A typical KOPkit includes Valve Cartridges with O-Rings, Head, Diaphragm, Secondary O-ring Seal, Head Screws, Washers and an exploded view drawing.

KOPkits will save you money. When you need a part, you've got it! You can cut downtime and production loss from days to minutes. You also save by buying parts in KOPkit form compared with buying individual parts.

Each KOPkit part is vacuum-sealed to keep it clean even when stored for long periods of time.

A KOPkit is a troubleshooter's best friend. In the event of a breakdown, it will put you back in business fast! Preventive maintenance will insure continuous high performance of your pump.

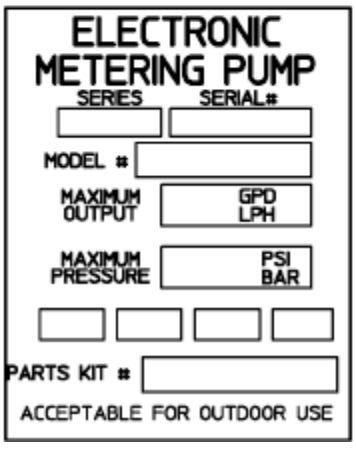
Keep on pumping! Get all the money-saving and security benefits of KOPkits immediately.



Typical KOPkit

Selecting a KOPkit

The KOPkit part number is displayed on the pump model label as shown. To order the proper KOPkit model, begin with the letter "K" followed by the 4th, 7th, 8th, 9th and the 10th digit of the pump model number.



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Revision B

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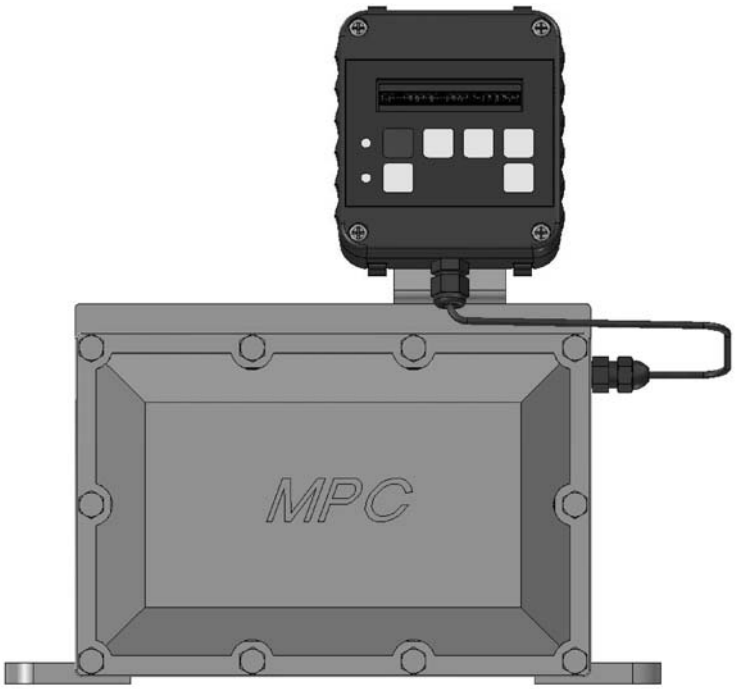
PULSAFEEDER®

A Unit of IDEX Corporation

MPC

Installation, Operation & Maintenance Manual



BULLETIN No. IOM-MPC-0104-H

PULSAFEEDER®

Manufacturers of Quality Pumps,
Controls and Systems

Engineered Pump Operations
2883 Brighton-Henrietta Townline Road
Rochester, New York 14623
Telephone: (585) 292-8000 Fax: (585) 424-5619
http://www.pulsa.com pulsa@idexcorp.com

MPC™ FACTORY SERVICE POLICY

Your MPC is a state of the art microprocessor based motor speed control for use with Pulsafeeder Diaphragm Metering Pumps. It includes extensive on-board diagnostics. If you are experiencing a problem with your MPC, first review the on-screen information, then consult the troubleshooting guide. If the problem is not covered or cannot be solved, please contact your local authorized Sales Representative or our Technical Service Department at (585) 292-8000 for further assistance.

Trained individuals are available to diagnose your problem and arrange a solution. Solutions may include purchasing a replacement unit or returning the MPC to the factory for inspection and repair. All returns require a Return Material Authorization (R.M.A.) number to be issued by Pulsafeeder. Replacements purchased under a possible warranty situation may be credited after an examination of the original MPC by Pulsafeeder personnel.

Certain components may be purchased for replacement. Refer to ***Section 17 – Spare Parts*** for more information and part numbers. Parts purchased to correct a warranty issue may be credited after examination of the original parts by Pulsafeeder personnel. Parts returned for warranty consideration that test satisfactorily, will be sent back to the originator via freight collect.

Any field modifications will void the Pulsafeeder MPC warranty. Out-of-warranty repairs will be subject to Pulsafeeder's standard bench fees and testing costs associated with replacement components.

FCC Warning

This equipment generates and uses radio frequency energy. If not installed and used properly, in strict accordance with the manufacturer's instructions, it may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures necessary to correct the interference.

Copyright

Table of Contents

Conventions

For the remainder of this bulletin, the following Conventions are in effect.

A WARNING DEFINES A CONDITION THAT COULD CAUSE DAMAGE TO BOTH THE EQUIPMENT AND THE PERSONNEL OPERATING IT. PAY CLOSE ATTENTION TO ANY WARNING.

Notes are general information meant to make operating the equipment easier.

Tips have been included within this bulletin to help the operator run the equipment in the most efficient manner possible. These "Tips" are drawn from the knowledge and experience of our staff engineers, and input from the field.

Revision History:

Rev E (3-25-05)
- Section 1.1 Description, added 3-phase vs. single-phase info
- Change description of digital output specification
- New figure 2 (pump mounting)
- Updated analog in, analog out, and flow calibration instructions
- Update error handling text, Section 9
- Add specifications for voltage range and ELCB's
- Add safety warnings about inrush current and capacitor discharge throughout

Rev F (7-25-06)
- Added nametag diagram and note on proper input voltage selection on page 9
- Added section 8.5 on adjusting motor base frequency
- Added sample digital output diagram in section 5.3.4

Rev H (9-26-07)
- Added clarification on digital output capability, *sections 1.2, 5.3.4, and 7.4*
- Motor information added, *sections 1.2, 1.3, and 11*
- Added missing step in calibration instructions, *section 8.1.1*

1. Introduction

The Metering Pump Controller (MPC) is a microprocessor based motor speed control device, for use with Pulsafeeder mechanical and hydraulic diaphragm metering pumps. It has been designed for simplicity, yet still has many advanced features that allow the MPC to operate in a wide variety of environments and applications.

This instruction manual covers the MPC only. All standard features are covered in this manual and most options have instructions where applicable. For information specific to the metering pump or any other accessories, please refer to the appropriate IOM.

1.1 Description

The MPC is an advanced pump controller that is physically attached and integrated into the pump's enclosure. Its purpose is to precisely adjust output flow of a process media by means of pump motor speed control.

The MPC is designed for a wide variety of control applications. The device is factory configured and calibrated for the attached pump. The human/machine interface is user friendly. Local setup and control is achieved through the keypad and a backlit two-line liquid crystal display. Basic operation is simple with dedicated function keys eliminating the need for a sophisticated menu system. The MPC responds immediately to user commands. Pump output is displayed as Gallons per Hour (GPH), Liters per Hour (LPH), Strokes per Minute (SPM), Percent Speed, or Percent Flow (% of total pump capacity).

Digital and analog inputs will support a variety of industry standard signals to offer flexible remote control.

The MPC is designed to simplify and automate the calibration of pump flow and analog signals. Flow calibration uses on-screen prompting and automated pump operation to eliminate stopwatches, calculators and human inaccuracies. Analog signal calibration is also accomplished by simple keypad entry. It includes a real-time display of signal level. This eliminates the need for external meters.

The MPC readily accepts PULSAlarm® leak detection and tank level inputs. These may be configured to stop the pump and/or activate an alarm relay.

The MPC will accept, and automatically adjust to, either 60 Hz or 50 Hz input. No special modifications, settings, or adjustments are required. All MPC controllers are supplied with a motor rated at 60 Hz, regardless of the supply frequency. The controller/motor combination allows for full pump speed and flow even when operating from a 50 Hz input. Users in locations with 50 Hz AC supply do not have to de-rate pump flow with this controller.

The motor used with the MPC is a three-phase motor, however the three-phase power is generated internally by the MPC itself. Do not be confused by the motor nameplate. Input power to the MPC is single-phase AC only, either 115 or 230 volts (see ***Section 11, Specifications*** for acceptable voltage range). The nameplate on the rear of your MPC controller will list the appropriate supply requirements for your controller.

At lower stroke frequencies (below 3:1 turndown), the MPC employs intermittent motor actuation technology. This allows the user to achieve reliable low-end performance not usually associated with variable speed controllers. By completing a full pump stroke at constant speed, and varying the interval between strokes, hydraulic stability and process consistency is maintained.

The AC drive used in the MPC maintains tight control over voltage and current supplied to the pump motor. This results in lower motor operating temperatures and less stress on motor windings, resulting in longer motor life and more reliable overall operation. This holds true even when metering in the lower flow ranges where the MPC uses intermittent operation.

1.2 MPC Standard Features

- Remote keypad and display for ease of operation
- Display pump flow in GPH, LPH, Strokes per Minute, or % of full pump flow
- One 4-20 mA analog input signal for flow control
- One 4-20 mA analog output signal for flow feedback
- Two configurable digital inputs
- Three configurable digital outputs
- Advanced turndown capability
- NEMA 4X and IP56 ratings
- Available for 115 or 230 Volts, 50 or 60 Hz, single phase AC power
- Security code lockout of menus
- Commercial duty motor as standard for indoor, dry locations only

1.3 Options

- Variable hand-held controller cable length, up to 1,000 feet from pump
- Alternate motor selections available for outdoor, washdown, chemical duty, and other special applications

2. Safety Considerations

- Read and understand all related instructions and documentation before attempting to install or maintain this equipment
- Observe all special instructions, notes, and cautions.
- Act with care and exercise good common sense and judgment during all installation, adjustment, and maintenance procedures.
- Ensure that all safety rules, work procedures, and standards that are applicable to your company and facility are followed during the installation, maintenance, and operation of this equipment.

2.1 General Safety

The MPC was designed as a controller for operation solely with Pulsafeeder metering pumps. Use for any other application is considered un-safe and voids all certification markings and warranties.

2.2 Electrical Safety

The MPC can be considered an industrial process controller. Improper application and use can be hazardous. You are solely responsible for its use.

The MPC's electrical installation must conform to all relevant electrical codes. Installation and electrical maintenance must be performed by a qualified electrician. Before installing or servicing this device, all power must be disconnected from the source at the main distribution panel.

The MPC emits electro-magnetic energy and may generate radio frequency interference. Its use is restricted to industrial applications. You are responsible for shielding this energy/interference.

Certain wiring procedures may require that the user wear a wrist strap to dissipate static charges.

Wait a minimum of 3 minutes after disconnecting power before servicing the MPC or pump motor. Capacitors retain a charge even after power is removed from the controller.

2.3 Mechanical Safety

Users should note that the pump motor is always under the control of the MPC, and as such may actuate without warning. Care should be taken to keep loose clothing and other objects away from the pump motor.

The MPC was designed to be service free. It contains no user-maintainable components. Disassemble the MPC enclosure only for initial field wiring, or as instructed to do so within this manual. Evidence of unauthorized disassembly shall void the warranty.

2.4 Hydraulic Safety

Thoroughly review and adhere to the contents of the your pump Installation, Operation, Maintenance and Instruction manual for installation of your Pulsafeeder metering pump. As a microprocessor controlled device, the MPC may activate the pump motor without warning – generating hydraulic pressure and fluid flow. Care should be taken to protect both users and systems should the pump activate.

3. Equipment Inspection

When you receive your order, check all equipment for:

- Completeness against the shipping document / purchase order
- For any evidence of shipping damage.

Shortages or damage should be reported immediately to the carrier and your Pulsafeeder Representative.

4. Storage Instructions

The MPC can be successfully stored for extended periods. The key to this success is temperature and humidity control.

4.1 Short Term (0 - 12 months)

The MPC should be stored in a temperature and humidity controlled environment. It is preferable to keep the temperature constant in the range of -18° to 60° Celsius (0° to 140° Fahrenheit). The relative humidity should be 0 to 90% non-condensing.

4.2 Long Term (12 months or more)

Storage of the MPC for periods of longer than twelve months is not recommended. If extended storage is unavoidable the MPC should be stored in accordance with those conditions stipulated for Short Term Storage. In addition, a porous bag of 85g (3 oz) silica gel or similar dessicant should be placed inside the enclosure. The cover should be re-installed to seal the desiccant within the enclosure. The conduit connections must be tightly capped.

Special note for long-term storage:

If AC input power has not been applied to the MPC for a period greater than 12 months, the controller must be prepared for operation. The MPC should have AC power applied at the input for a period of 8 hours before placing pump into normal operation. Refer to Installation and Wiring section for AC power connection instructions.

5. Installation and Wiring

5.1 Location

NOTE **Review the Safety section (*pg 3*) prior to installing the MPC. It contains information required to properly install and operate the MPC in an industrial environment.**

The site selected for the installation of your MPC is largely dependent on that of the metering pump. Review the Installation, Operation, and Maintenance manual provided with your metering pump. It details system related issues that are important to proper operation of the pump. Consider the following MPC related issues when selecting a site. Avoid locations where the MPC would be subjected to extreme cold or heat. Note the warning statement on the next page. The installation of this device must comply with national, state and local codes.

The MPC controller must be secured to an appropriate support before use. Use four 3/8" bolts or anchors to secure the MPC controller and pump to a fixed base. No assembly is required for the MPC controller itself.

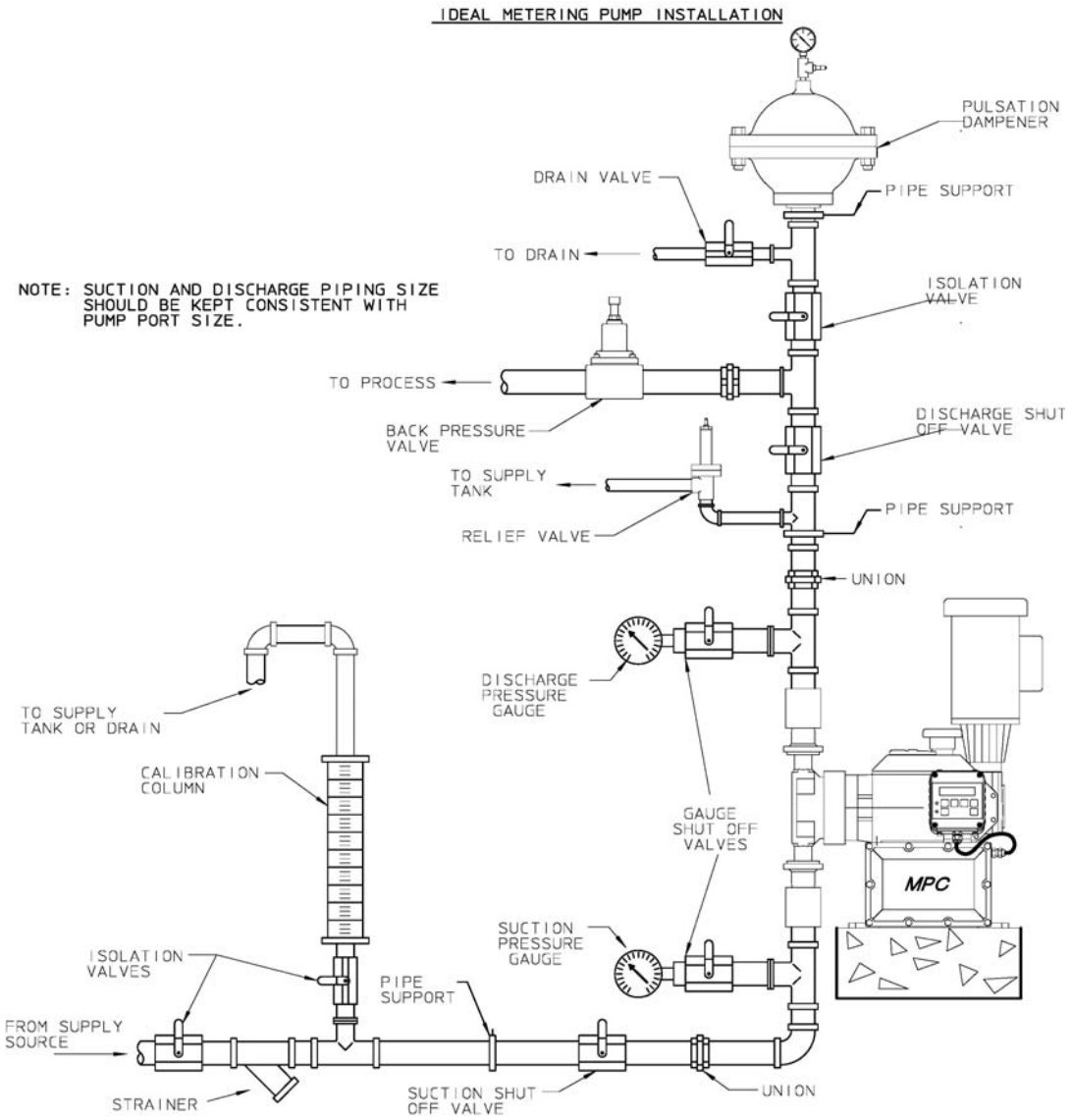


Figure 1 – Typical Installation.

AVOID LOCATIONS WHERE THE MPC WOULD BE SUBJECTED TO EXTREME COLD OR HEAT [LESS THAN 0° CELSIUS (32° FAHRENHEIT) OR GREATER THAN 40 ° CELSIUS (104 ° FAHRENHEIT)] OR DIRECT SUNLIGHT. FAILURE TO OBSERVE THIS WARNING COULD DAMAGE THE MPC AND VOID ITS WARRANTY.

5.2 Installation Notes

The MPC is a microprocessor-based controller that uses electro-static sensitive CMOS components. Do not make any (high or low voltage) electrical connections without adequately grounding the MPC and the worker to eliminate an electro-static charge between the two. **A conductive wrist strap worn by the worker and attached to the MPC enclosure is adequate to satisfy this requirement**.

Calibration is an important element of successful MPC operation. Permanent installation of a calibration column as depicted in *Figure 1* is strongly recommended.

Conduit connections can carry fluids and vapors into the MPC causing damage and void the warranty. Care should be taken when installing conduit to protect against fluid/vapor entry. If necessary, provide sealed entries or conduit drains near the point of entry. The controller comes equipped with liquid-tight connectors for signal cable entry points. The user must supply the correct connection for the power entry, as per the local codes and requirements. Any cable entrances that are not used should be appropriately sealed against moisture and vapors.

5.3 Electrical Wiring

The MPC has many advanced features that may make wiring the unit appear complicated. Wiring is actually very simple – one high voltage connection is all that is required to take advantage of the majority of the MPC's features.

If you will be mounting your handheld controller in a remote location, refer to ***Section 10*** at this time.

Wait a minimum of 3 minutes after disconnecting power before servicing the MPC or pump motor. Capacitors retain a charge even after power is removed from the controller.

It is highly recommended that you take a step-by-step approach to wiring and confirming proper MPC operation:

1. Make the high voltage connections (*ref. Section 5.3.2*). These will allow you to operate the MPC and attached Pulsafeeder pump.
2. Decide which low voltage Inputs and Outputs (e.g., 4-20mA in) will be used and make those connections (*ref. Section 5.3.3*).
3. Power-up and test the MPC to confirm the connections and check for proper operation.
4. Configure the software via the menu system for the desired operational conditions. Depending on the anticipated function, users may need to enter settings for the following:
    a. Analog input signals, so the MPC can accept a process input signal
    b. Analog output settings, so the MPC can provide a process feedback signal
    c. Digital input settings, for example start/stop and/or leak detection inputs
    d. Digital output settings, for example status and/or alarm outputs
5. Conduct a final power-up and test the MPC to confirm the connections and check for proper operation.
6. Go to the ***Section 6 – Start Up Instructions*** for details on how to perform the power-up tests.

5.3.1 Controller Layout

The design of the MPC incorporates all control circuitry onto one easily accessed circuit board. This board is located on the inside of the main controller cover. Gain access to this board by removing the 10 bolts and gently allowing the cover to hinge downwards.

WARNING **USE CARE NOT TO PULL ON OR ATTEMPT TO COMPLETELY SEPARATE THE COVER FROM THE MPC UNIT, AS THE ELECTRICAL CONNECTIONS CAN BE DAMAGED.**

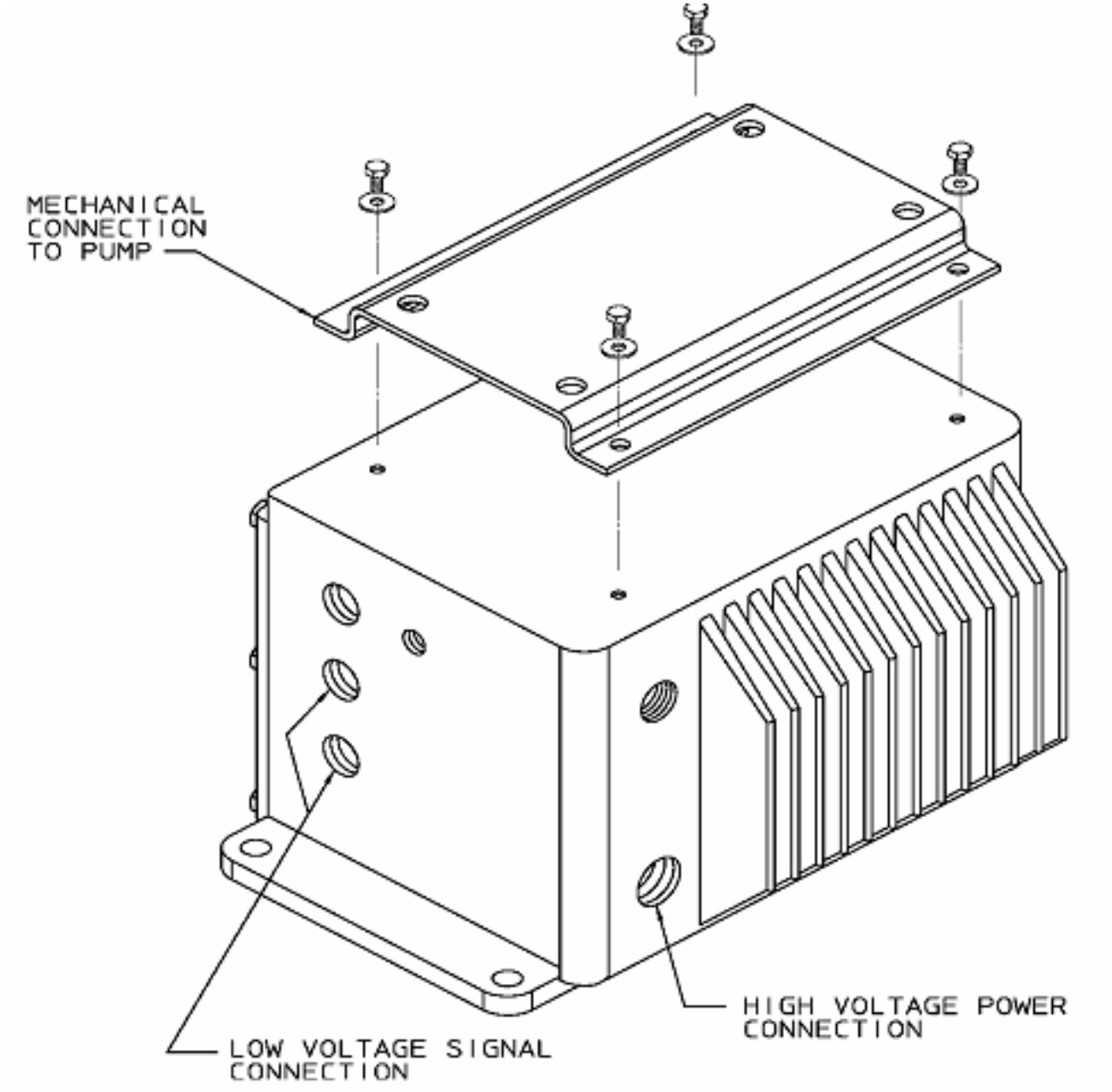


Figure 2 – Conduit Connection Layout

5.3.2 **Power Wiring Information**

NOTE

- **Verify the correct supply voltage (115VAC or 230VAC) with the nameplate affixed to your MPC. Ensure that your supply voltage matches the MPC configuration.**
- **Wires should be routed within the enclosure in a manner that maintains separation between high voltage and low voltage conductors.**
- **Incoming power wiring should adhere to all applicable local and national electrical codes and regulations.**
- **A circuit breaker or fuse must be provided as noted below.**
- **Upon initial application of AC power, a current inrush will occur to charge the DC bus capacitors. This is normal operation, and breakers and other circuit protection devices should be sized accordingly.**

The MPC requires one connection to an external power source. It uses this same connection to power it's own supply as well as the AC pump motor. You must take all of these loads into consideration when sizing the branch circuit (*see Table 1*). A circuit breaker or disconnect switch with fuses must be wired in series with terminals L1 and L2/N in accordance with all applicable local and national electrical codes and regulations. The circuit breaker or disconnect switch shall be located in close proximity to the MPC controller installation, and must be marked or labeled to identify it as the power disconnect for the MPC.

Power Requirements	***Recommended Minimum Wiring and Circuit Breaker***							
	120 VAC Operation				***240 VAC Operation***			
	Actual Draw	***Circuit Breaker***	***Wire Size***	***Wire Size***	***Actual Draw***	***Circuit Breaker***	***Wire Size***	***Wire Size***
MPC and 0.25 Hp motor	6.9 A	10 A	14 AWG	1.5 mm^2	3.5 A	10 A	14 AWG	1.5 mm^2
MPC and 0.33 Hp motor	6.9 A	10 A	14 AWG	2.5 mm^2	3.5 A	10 A	14 AWG	1.5 mm^2
MPC and 0.5 Hp motor	9.3 A	15 A	14 AWG	2.5 mm^2	5.1 A	10 A	14 AWG	1.5 mm^2
MPC and 0.75 Hp motor	16.7 A	25 A	12 AWG	4.0 mm^2	9.3 A	15 A	14 AWG	2.5 mm^2
MPC and 1.0 Hp motor	16.7 A	25 A	12 AWG	4.0 mm^2	9.3 A	15 A	14 AWG	2.5 mm^2
MPC and 1.5 Hp motor	24.1 A	35 A	10 AWG	4.0 mm^2	12.1 A	20 A	14 AWG	2.5 mm^2

Table 1 – Sizing Branch Circuits

The MPC controller is provided with a ¾" NPT inlet for incoming AC power wiring at the rear (pump gearbox end) of the enclosure. Utilize the appropriate conduit fittings to route and seal the supply wires into the MPC enclosure.

These wires are secured to the terminal strip at the right-hand end of the AC drive as per *Table 2*. Remove approximately 0.20 – 0.25" of insulation from the end of each conductor. Loosen the terminal strip screw, and insert the stripped wire end fully into the terminal. Tighten the screw to secure the conductor, making certain that the terminal grips the wire, not the insulation. Ensure that all wiring meets applicable local and national codes and requirements.

5.3.3 Power Wiring Diagram

MPC Drive Terminal	120 V operation	240 V operation
L1	Line	Line
L2 / N	Neutral	Line
Earth	Ground	Ground

Table 2 – AC Drive Terminals

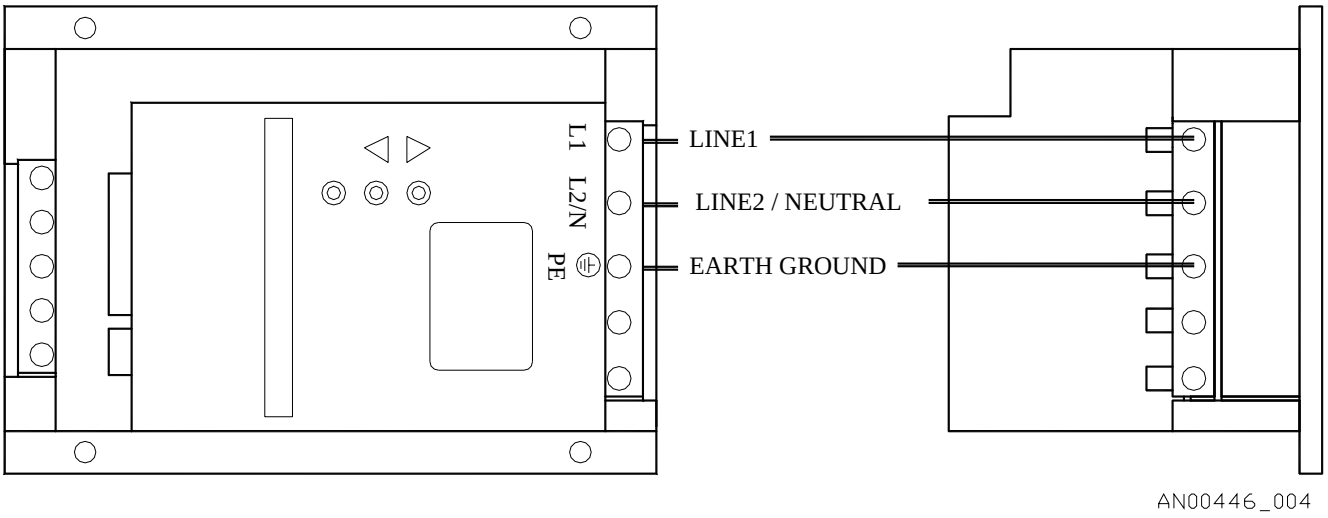
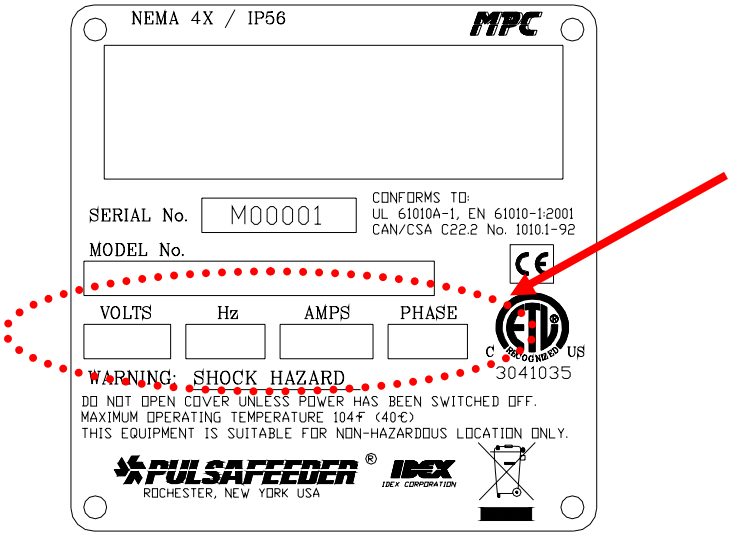


Figure 3 – AC Power Connections

Wait a minimum of 3 minutes after disconnecting power before servicing the MPC or pump motor. Capacitors retain a charge even after power is removed from the controller.



Find the proper AC input voltage for your MPC controller on the nameplate at the rear of the unit. MPC input is always single phase, and can be either 115 VAC or 230 VAC, determined at time of order.

5.3.4 Input/Output Signal Wiring

Signal wiring is routed through the two unused conduit openings at the side of the MPC. All input/output signals are connected to the terminal strips at the edge of the MPC circuit board. Use caution to observe proper wire location and signal polarity. Always cap or plug unused openings. Wires should be routed with in the enclosure in a manner that maintains separation between high voltage and low voltage conductors. Ensure all low voltage wiring is installed as per any applicable local and national electrical codes and regulations.

Utilize 20 or 22 AWG, 250 V, shielded cable, with a 105° C insulation rating (or better) for all signal input and output wiring. Recommended strip length is 0.39" or 10 mm. Refer to *Figure 4* below for signal connection locations.

NOTE **Unused conduit openings should be plugged as required to avoid ingress of moisture and contaminants into the MPC enclosure. Do not remove the factory provided plug from openings that are not required for field wiring.**

WARNING **IT IS RECOMMENDED THAT A WRIST STRAP BE WORN WHEN MAKING CONNECTIONS TO ANY PRINTED CIRCUIT BOARD.**

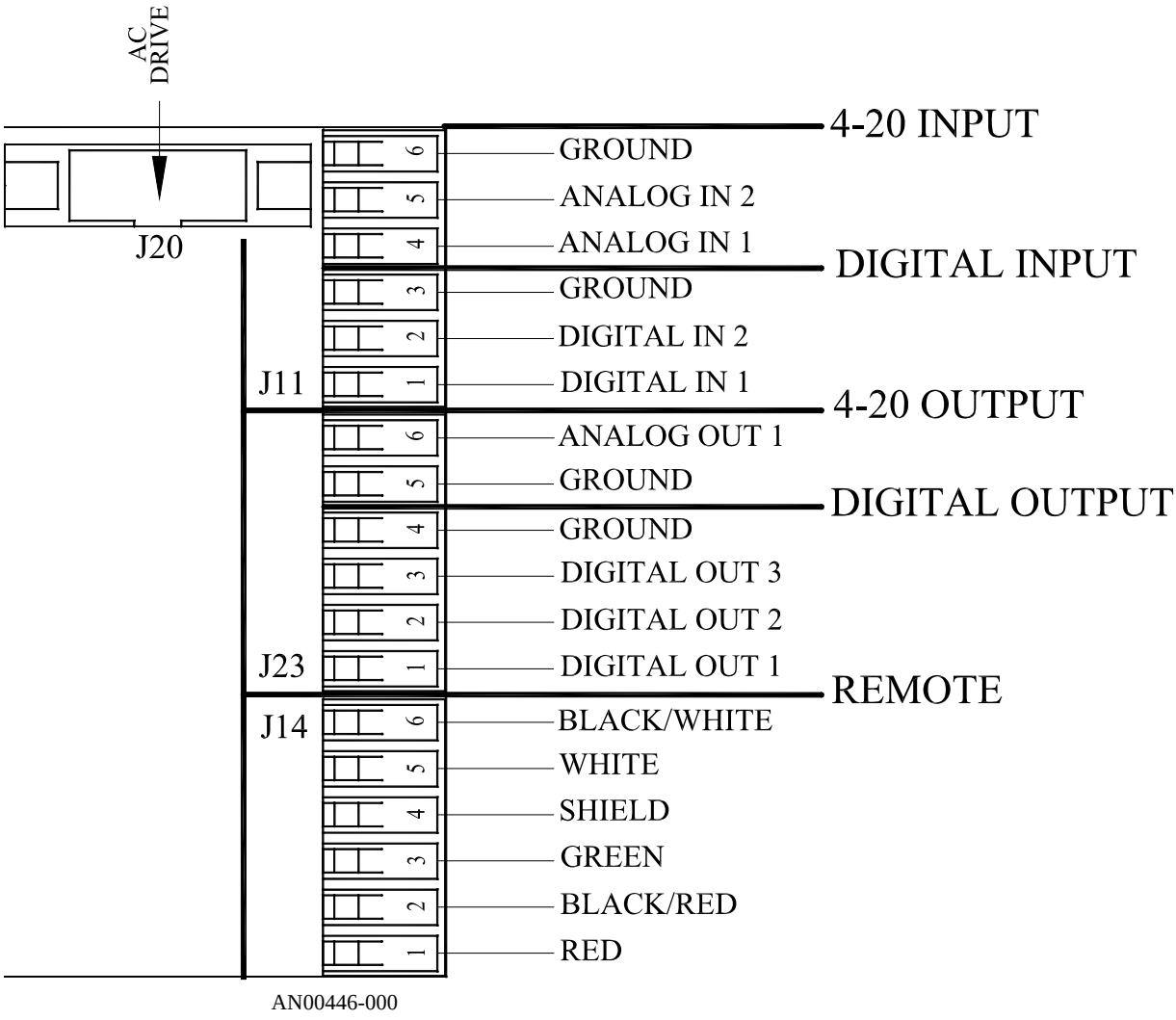


Figure 4 – Signal Connections

Digital output signals can drive devices such as relays or indicator lamps. 24 VDC power must be supplied from an external source. Each output has a maximum current capability of 500 mA. Maximum voltage capability of these circuits is 40 VDC (see ***Section 11, Specifications,*** for more information).

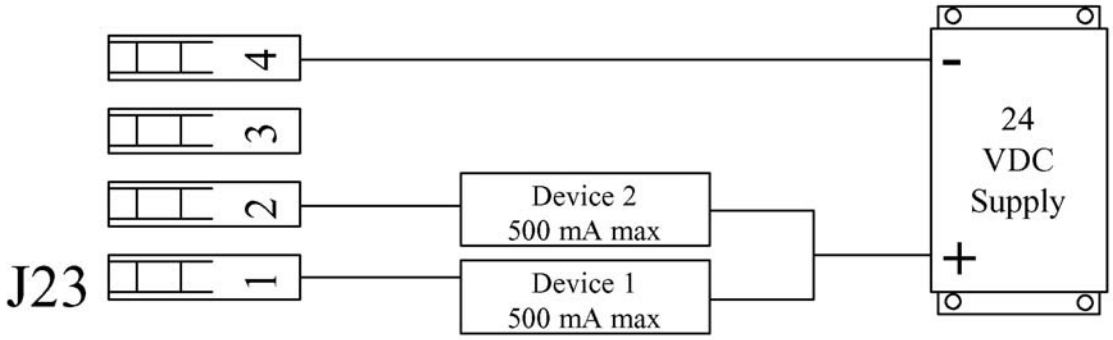


Figure 5 – Sample Digital Output Connections

5.4 Check Wiring and Close Access Cover

Double-check all of your electrical connections. Pay attention to polarity of all inputs and outputs – both low and high voltage. Additionally, insure that all terminals are clamping onto the bare conductor, not on its insulation. Ensure that wires will not be trapped or pinched when front cover is replaced and secured. Ensure that excess insulation is not removed from the wires, as this can lead to poor connections or faulty operation.

Replace the main access cover and secure the 10 bolts.

NOTE **Use a nut driver to tighten the retaining bolts evenly. Failure to do so may cause the cover to leak and void the warranty.**

5.5 Confirm Correct Incoming Power

WARNING **WITHOUT PRIOR OPERATING KNOWLEDGE, IT IS IMPOSSIBLE TO TELL IF THE PUMP MOTOR WILL RUN WHEN POWER IS APPLIED TO THE MPC. YOU ARE RESPONSIBLE FOR TAKING THE NECESSARY STEPS TO ENSURE THAT ALL ASPECTS OF SAFETY HAVE BEEN CONSIDERED (E.G., ELECTRICAL, HYDRAULIC, ETC.).**

Turn on power at the mains or distribution panel. If the MPC's incoming power is connected correctly, the backlighting on the MPC's display will illuminate (depending on lighting conditions, it may be necessary to shade the display to confirm illumination). If the display is not illuminated, first check the line voltage with a voltmeter. If the voltage is not correct, return to ***Section 5.3.2 – Installation: High Voltage Connections***. Otherwise, proceed with the next step.

6. Start Up and Operation

6.1 Overview

Once all electrical connections have been made, your MPC is ready for Start-up. The following sections detail the procedures required to complete the MPC start up.

WARNING

WHEN POWER IS SUPPLIED TO THE UNIT, LINE VOLTAGE IS PRESENT WITHIN THE MPC ENCLOSURE EVEN WHEN THE MOTOR IS OFF.

DURING START-UP, IT IS NECESSARY TO RUN THE PUMP MOTOR. THIS WILL CAUSE FLUID TO DISCHARGE FROM THE PUMP. YOU ARE RESPONSIBLE FOR SAFELY DIVERTING FLOW FROM THE PUMP DURING START-UP AND CALIBRATION.

6.2 Keypad/Lamp Operation

Key	Function	Description
	Motor On/Off	Press to start pump, press again to stop pump
	Auto/Manual	Press to toggle between automatic operation and manual control of the pump
	Menu	Press to adjust controller settings, to exit the menu system, to move cursor back when entering values, or to step back to higher level menus
	Enter	Press to accept changes in menus, to move cursor forwards when entering values, and to access lower level menus. Also used to toggle between pump output display options while in operating mode (% flow, spm, gph, etc)
	Arrow Up	Press to adjust values upwards, and to scroll through menu options
	Arrow Down	Press to adjust values downwards, and to scroll through menu options
Lamp	**Color**	**Description**
ON 	Green, Amber, Red, Off	Off = Motor off Green = Motor on Amber = Remote standby Red (blinking) = Error
MANUAL 	Green, Off	Green = Manual Control Off = Automatic Control

Table 3 – Keypad and Lamp Operation

6.3 Confirm Display and Keypad Functionality

The example display messages are shown in English for demonstration purposes. If an alternate language has been set, the text is displayed as a translation of the English version.

Now that you have confirmed that the MPC is receiving power, it is necessary to confirm that the display and keypad are functioning properly. On normal power-up, the display appears for approximately 2 seconds.

```
PULSAFEEDER INC.
FW: 00.00/00.00
```

The first four digits displayed are the software revision for the MPC base unit, and the second four indicate the software revision for the handheld display/keypad module.

The keypad can be tested by depressing each key separately. Most, but not all keys will cause the text on the display to change. Do not be alarmed if a single key does not invoke a change to the display. This is normal. Different keys become active/inactive depending on the current operating mode.

Please note that it may be necessary to adjust the display contrast, please refer to ***Section 8.4*** if this is required.

6.4 Flow Display

The MPC will display calibrated pump flow in GPH or LPH on the digital display. The MPC is capable of very high turndown ratios, limited only by pump configuration and system design. In some cases, the MPC display will be unable to display very low flow rates, in these situations the display may indicate 0.0 for flow, even though the pump is producing measurable flow. If the pump is being operated under these conditions, users may wish to perform extra flow calibrations to verify actual flow rates at certain setpoints. Note that even after the additional calibrations are done, the MPC will still not display the low flow that the pump is producing.

In situations where the pump stroke length is set to 0 (zero) %, the pump will also display 0 (zero) GPH or 0 (zero) LPH, regardless of motor speed setting. If the display registers no flow in this manner, check the setting of the stroke length mechanism on your pump.

6.5 Wrapping up

Your MPC is now commissioned for use. Note that you cannot configure the software in a way that would damage the MPC. Typically, whenever you are about to set a critical value (e.g., Calibrate Flow), you are always prompted to confirm your change before it takes effect. If you are ever dissatisfied with the configuration of your MPC, you can always return to the Factory Defaults by referring to *Section 6.6*.

6.6 Factory Re-Initialization

Factory Re-initialization is typically not required. When re-initializing your MPC, all of the system settings and calibration information will be overwritten by the original factory default settings. The controller must be re-configured and re-calibrated to your specifications.

A Factory Re-initialization should be performed only if there is reason to believe that the internal MPC memory has become corrupted. The condition usually manifests itself with inconsistent or erratic operation – often associated with meaningless characters on the display, or exaggerated numerical values.

Factory Re-Initialization:

1. Press the MENU key to access the System Setup Menu

```
-MENU-
CALIBRATION
```

2. Press the UP arrow key to display

```
-MENU-
SYSTEM SETUP
```

3. Press the ENTER key

```
SYSTEM SETUP
  SECURITY
```

4. Press the UP arrow key twice to display

```
SYSTEM SETUP
FACTORY INIT
```

5. Press the ENTER key

```
 PRESS ENTER
TO FACTORY INIT
```

6. Press the ENTER key

```
 ARE YOU SURE?
YES=ENTER  NO=MENU
```

7. Pres the ENTER key

```
RESETTING PUMP
TO FACTORY INIT
```

7. Input/Output Setup

Use the “DIGITAL I/O” menu to activate the functions required for the intended application.

Users may also reference ***Section 12 – Menu Maps*** for additional configuration assistance

7.1 Analog Input Setup

Use the “ANALOG I/O” menu to activate the analog input signal function.

The menu can be used to set the analog input to either ACTIVE or INACTIVE.

7.2 Digital Input Setup

Each of the 2 Digital INPUTS can be selected as:

- Inactive
- Leak Detection
- Tank Level Input
- Remote ON/OFF Input
- Flow Detection (delay time must be set)

Each can be set as normally OPEN or normally CLOSED. For example, if an input is set to ON/OFF and NORMALLY CLOSED, this means a CLOSED switch will activate the pump. A NORMALLY OPEN setup will give the opposite response.

7.3 Analog Output Setup

Use the “ANALOG I/O” menu to activate the analog output signal function.

The menu can be used to set the analog output to either ACTIVE or INACTIVE.

7.4 Digital Output Setup

Each of the 3 Digital OUTPUTS can be selected as:

- Inactive
- ON/OFF Status
- AUTO/MAN Status
- Stroke Indicator (Pulse Output)
- Alarm Indicator
- Leak Detection Status
- Tank Level Status

Each can be set as normally OPEN or normally CLOSED. For example, if an output is set to ON/OFF INDICATION and NORMALLY CLOSED, this means that when the motor is running (indicator lamp is ON) the output will be CLOSED. A NORMALLY OPEN setup will give the opposite response.

Digital output circuits are transistor based and limited to 40 VDC maximum, see ***Section 5.3.4, Input/Output Signal Wiring***, and ***Section 11, Specifications,*** for more information).

8. Calibrations

8.1 Pump Flow Calibration

Your MPC is factory calibrated at rated flow and pressure. Nevertheless, you should always perform a calibration with the MPC installed in your system. This will provide the most accurate flow display.

The only item required to calibrate your MPC is a means to measure the flow of the pump (i.e., calibration column, graduated cylinder, etc.). The most accurate calibration will be obtained by using a measurement device installed on the suction side of the pump. Note that calibration values for liquid volume will be in the user's chosen units, either gallons or liters.

There are two methods for completing the flow calibration routine, either "Volume" or "Flow".

Volume Method Calibration

The volume calibration is accomplished by running the pump at two different stroke length settings, 50% and 100%. During each run a volume of liquid will be pumped from the calibration column. This volume is then entered into the MPC for calibration. Note that for this calibration, the actual volume of liquid pumped is entered in gallons or liters. Do not enter a flow rate in gallons or liters per hour, as this will not result in a valid calibration. The MPC display will guide the user through the steps for calibration.

Please note that it must be safe to run the pump and dispense liquid into the system in order to complete this calibration. The pump should be fully primed with the product in order to complete an accurate calibration. Hydraulic diaphragm pumps must have a proper hydraulic prime as well.

Flow Method Calibration

The flow calibration is accomplished by entering values for flow that are already known to the user. The MPC will request flow values in gallons or liters per hour for each of the two calibration points, 50% and 100% stroke length. This calibration is useful if operational circumstances do not permit the pump to run for calibration. This calibration is also faster to complete if the flow values are already known. The MPC display will guide the user through the steps for calibration.

The nameplate flow rating of the pump can be used to complete the flow calibration routine, however there will always be some variance in the actual flow rate of a pump due to system conditions and product characteristics. Using the pump's nameplate rating will establish a baseline flow rate on the MPC display, however it will not guarantee absolute accuracy.

8.1.1 To Start Calibration

1. The starting display will be:

```
SETPT     XX.XXX
FLOW      XX.XXX
```

2. Press the MENU key

```
-MENU-
CALIBRATION
```

3. Press the ENTER key

```
CALIBRATION
 PUMP FLOW
```

4. Press the ENTER key

```
CALIBRATION
 "VOLUME"
```

5. To perform the Volume Method, press the ENTER key and go to ***Section 8.1.2***

6. To perform the Flow Method, press the UP arrow key

```
CALIBRATION
  "FLOW"
```

7. Press the ENTER key and go to ***Section 8.1.3***

<u>If you receive the following message during the Volume calibration:</u>

```
STROKE LENGTH OUT
    OF RANGE
```

Verify that the manually set stroke length is at the correct position, either 50% or 100%.

8.1.2 Volume Method

```
SET STROKE TO 50%
ENTER TO START
```

1. Manually adjust the stroke length of the pump to 50%
2. ** Fill your calibration column to the zero or starting point
3. Press the ENTER key

```
TIMER     XX SEC
ENTER TO STOP
```

4. Allow the pump to run for any length of time you choose, dependent on flow rate, calibration column size, process conditions, etc. The system will time out at a maximum of 300 seconds.
5. Press the ENTER key to stop the pump

```
ENTER VOLUME
VOL =     XX.XXX
```

6. Use the UP and DOWN arrow keys and the ENTER key to input the volume pumped from the calibration column (in gallons or liters, dependent on MPC setup).
7. Press ENTER to proceed

```
SET STROKE TO 100%
ENTER TO START
```

8. Manually adjust the stroke length of the pump to 100%
9. ** Fill your calibration column to the zero or starting point
10. Press the ENTER key

```
TIMER                XX SEC
ENTER TO STOP
```

11. Allow the pump to run for any length of time you choose, dependent on flow rate, calibration column size, process conditions, etc. The system will time out at a maximum of 300 seconds.
12. Press the ENTER key to stop the pump

```
ENTER VOLUME
VOL =     XX.XXX
```

13. Use the UP and DOWN arrow keys and the ENTER key to input the volume pumped from the calibration column (in gallons or liters, dependent on MPC setup).
14. Press ENTER to proceed

```
PUMP FLOW
CALIBRATED
```

15. Pump flow calibration is complete
16. Press the MENU key three times to exit back to the main operating screen.

8.1.3 Flow Method

```
SET STROKE 50%
FLOW = 0.0000 GPH
```

1. You do not have to adjust the actual stroke setting of the pump

2. Use the UP and DOWN arrow keys and the ENTER key to input the desired flow rate (in gallons or liters per hour, dependent on MPC setup). This should be the flow rate expected when the pump is set to 50% stroke length setting.

3. Press ENTER to proceed

```
SET STROKE 100%
FLOW = 000.00 GPH
```

4. You do not have to adjust the actual stroke setting of the pump

5. Use the UP and DOWN arrow keys and the ENTER key to input the desired flow rate (in gallons or liters per hour, dependent on MPC setup). This should be the flow rate expected when the pump is set to 100% stroke length setting.

6. Press ENTER to proceed

```
PUMP FLOW
CALIBRATED
```

7. Pump flow calibration is complete

8. Press the MENU key three times to exit back to the main operating screen.

8.2 Analog Input Calibration

If you are not using the 4-20mA input to the MPC for control, skip this section. To calibrate the Input Current you must first correctly wire an external signal source. Refer to ***Section 5 – Installation: Low Voltage Input Connections, Analog Input***. To perform a calibration, the signal-generating device must be active and capable of generating the full range (low to high) of potential input signals.

1. The starting display will be:

```
SETPT       XX.XXX
FLOW        XX.XXX
```

2. Press the MENU key

```
-MENU-
CALIBRATION
```

3. Press the ENTER key

```
CALIBRATION
 PUMP FLOW
```

4. Press the UP arrow key twice, to access the analog input calibration

```
CALIBRATION
ANALOG INPUT
```

5. Press the ENTER key

```
APPLY MIN MA
ENTER TO START
```

6. Apply your desired minimum mA control signal to the MPC (usually 4 mA)
7. Press the ENTER key

```
MIN SETPT  X.XX MA
 SPEED      000.0%
```

(The mA value will be equal to your input signal level)
(The speed value is the setting the MPC will use for this signal value)

8. Press the ENTER key three times to step through the speed setting value, most users will leave this at 000.0 %, however you an change it if you wish using the UP and DOWN arrows.
9. Press the ENTER key once more to accept the calibration value

```
APPLY MAX MA
ENTER TO START
```

10. Apply your desired maximum mA control signal to the MPC (usually 20 mA)

Procedure continues…

11. Press the ENTER key

```
MAX SETPT  X.XX MA
SPEED      100.0%
```

(The mA value will be equal to your input signal level)
(The speed value is the setting the MPC will use for this signal value)

12. Press the ENTER key three times to step through the speed setting value, most users will leave this at 100.0 %, however you an change it if you wish using the UP and DOWN arrows.
13. Press the ENTER key once more to accept the calibration value

```
ANALOG INPUT
CALIBRATED
```

14. Analog input signal calibration is complete
15. Press the MENU key three times to exit back to the main operating screen.

<u>If you receive the following message:</u>

```
CURRENT DELTA
OUT OF RANGE
```

This indicates that there is not a wide enough range between your maximum and minimum analog signals. The minimum signal range is 3 mA. The most likely source of this error is the user did not change the value of the incoming analog signal when moving from the MIN calibration to the MAX calibration.

The analog input signal calibration procedure should be performed again, ensuring that a minimum of 3 mA difference exsists between the MIN and MAX signal levels.

8.3 Analog Output Calibration

1. The starting display will be:

```
SETPT      XX.XXX
FLOW       XX.XXX
```

2. Press the MENU key

```
-MENU-
CALIBRATION
```

3. Press the ENTER key

```
CALIBRATION
 PUMP FLOW
```

4. Press the UP ARROW key to access the analog output calibration

```
CALIBRATED
ANALOG OUTPUT
```

5. Press the ENTER key

```
SET 0% FLOW TO
  04.0    MA
```

6. Use the UP and DOWN arrow keys to adjust the output signal as required. The actual output signal will vary and can be monitored with a meter or your facility control system. The value displayed on the screen may not match the actual output signal and is for visual reference only.
7. Press the ENTER key once more to accept the calibration

```
SET 100% FLOW TO
 20.0        MA
```

8. Use the UP and DOWN arrow keys to adjust as in step 6 above
9. Press the ENTER key once more to accept the calibration value

```
CALBRATION
ANALOG OUTPUT
```

10. Analog output signal calibration is complete
11. Press the MENU key three times to exit back to the main operating screen

<u>If you receive the following message:</u>

```
CURRENT DELTA
OUT OF RANGE
```

This indicates that the output current for 0% flow has been set greater than or equal to the output current setting for 100% flow. Repeat the process and ensure that the 0% calibrated signal is set to a value lower than the 100% calibrated signal.

8.4 Display Contrast Adjustment

Should adjustment of the contrast level of the display become necessary, use the following procedure while in the normal operating mode.

To increase contrast, press and hold   at the same time.

To decrease contrast, press and hold   at the same time.

8.5 Changing the Motor Base Frequency

This procedure will not be necessary during normal operation of the MPC controller. In the event that you need to install a different drive motor, and that motor has a different base frequency (50 Hz vs. 60 Hz) than the original unit, please refer to this procedure. These changes are made at the AC drive within the MPC enclosure and not at the hand-held unit.

THIS PROCEDURE IS PERFORMED WITH POWER APPLIED TO THE MPC. TAKE ALL NECESSARY PRECAUTIONS, KEEP FINGERS AND TOOLS CLEAR OF ENERGIZED CIRCUITS, AND PERFORM THIS PROCEDURE ONLY IF YOU ARE CERTAIN IT IS REQUIRED.

1. Open the front cover of the MPC control
2. There are three buttons on the face of the drive, **MODE**, **UP** and **DOWN**.
3. Press the **MODE** button
4. Scroll **UP** to display the default password "`001`"
5. Press **MODE** to enter the password
6. Scroll **UP** to the base frequency parameter which is "27" display will show "`P 27`"
7. Press **MODE** to display the current setting (will be either `50` or `60`)
8. Use the **UP** or **DOWN** keys to change the setting to the new value (either `50` or `60`)
9. Press **MODE** to store the new value
10. Drive will exit the program mode after it stores the new value

This procedure should be used only if the base frequency of the pump drive motor is changed.

9. Alarm and Error Messages

If a fatal error has occurred while in Operational Mode, the error will flash on the screen and the Red LED lamp will also flash. The menus can still be accessed by holding down the menu key. This allows the user to try and fix the source of the error if possible.

The following table gives an example of these messages and when you can expect them to be displayed.

Message	Displayed When:
FATAL ERRORS: The pump and controller will not run while one of these error conditions exists. The Red LED will blink and the error message will flash on the screen. Users can access the menu system by pressing the MENU key. The red LED and the message will cease when the error condition has been corrected.	
Analog Input #X Out of Range	The analog input is less than 2.4 mA or greater than 24 mA
ALARM LEAK DETECT	The leak detection input has triggered
ALARM LOW LEVEL	The level monitoring input has triggered
ALARM AC DRIVE FAULT	Internal fault
ALARM Motor error	The MPC has detected that the motor shaft is not rotating at the expected speed
ALARM CAM SENSOR	MPC controller is not receiving correct signals from the cam sensor in the pump eccentric box
COMMUNICATION ERROR	Communication error exists between the MPC controller and the handheld keypad/display module

Continues next page…

NON-FATAL ERRORS: The pump and controller can still be run while these conditions exist. The Red LED will flash, however no message will flash on the screen. The Red LED will stop flashing once the error condition has been corrected.	
ALARM STROKE SENSOR	MPC does not receive valid indication from the stroke position sensor, the flow display will not be accurate
SOFTWARE Fault Error = ####	Software related problem, record error number and consult factory
Hardware fault Error = ####	Hardware related problem, record error number and consult factory
CONSULT factory Error = ####	Unidentified error, record error number and consult factory
USER NOTIFICATIONS: These are errors in setup or calibration. They will display on the screen for several seconds. They can be corrected by properly completing the procedure involved.	
Cannot access With motor on	User is trying to change a setting that cannot be changed while the pump is running
Stroke length Out of range	Stroke length position is not set correctly for current operation
Current delta Out of range	Not enough difference between high and low signals during an analog input signal calibration (min 3 mA)
Stroke delta Out of range	Stroke length position is not set correctly for current operation
No remote Control	User is trying to activate the AUTO mode, but there is no remote input (mA signal or remote on/off) to the controller

.

For unlisted or numbered error codes, consult the factory for assistance. Pressing MENU will clear all non-fatal errors, provided the error condition is no longer present.

10. Extending your Hand-Held Controller

The hand-held controller for your MPC can be placed as far as 1000 feet from the pump. It is recommended that all calibrations be completed before the cable is lengthened, as these tasks are easier when the pump and hand-held controller are close to each other.

To replace the cable for the hand-held unit:

POWER TO THE UNIT MUST BE OFF! A GROUNDING WRIST STRAP SHOULD BE WORN WHEN MAKING CONNECTIONS TO ANY PCB

10.1 Obtain New Cable:

The following standard length cables are available from Pulsafeeder for use with the MPC:

Cable Length	Part Number	Notes
6 feet	NP530130-000	Standard, supplied with all MPC controllers
Others per foot	NP530147-000 (1 ft)	NOTE: do not exceed 1,000 feet total length

10.2 Removal and Connection of the Cable from the Handheld:

1. Open the handheld unit by removing the 4 screws on the face of the unit.
2. Open the unit by separating the cover from the base.
3. Disconnect the keypad from the Remote PCB by gently removing the connector at the end of the keypad's tail from the header on the PCB.
4. Make a note of what color lead is in each position of the terminal block "J5". Cut the tie-wrap that secures the cable. Lift each of the levers on the terminal block "J5" and remove each lead.
5. Loosen the outer domed nut on the liquid tight, releasing the tension on the cable. Pull the cable through the liquid tight. Thread the new cable through the liquid tight with enough length to reconnect to the terminal block.
6. Cut the shield wire as close as possible to the outer insulation at the remote end **only**.
7. Wrap the end of the cable with electrical tape to insulate any remaining shield so that it will not contact the circuit board, equipment case, or any other parts.
8. Referring to the notes taken earlier, connect each lead of the new cable to the proper position of the terminal block, lock the lever back in place to hold lead. NOTE: It is recommended that you insert and secure one lead at a time.
9. Tighten the dome nut of the liquid tight to secure/seal cable.
10. Replace cover and tighten screws. Be sure the o-ring is in its groove, paying special attention to the corners. NOTE: Do not over tighten.

10.3 Removal and Connection of the Cable from the Base Unit:

Wait a minimum of 3 minutes after disconnecting power before servicing the MPC or pump motor. Capacitors retain a charge even after power is removed from the controller.

1. Remove the 10 screws that are securing the cover to the side of the main unit.
2. CAUTION: The cover is wired and should be folded down gently being sure not to pull any of the wires that are connected to it.
3. Make a note of what color lead is in each position of the terminal block “J14”. Lift each of the levers on the terminal block “J14” and remove each lead.
4. Loosen the outer domed nut on the liquid tight, releasing the tension on the cable. Pull the cable through the liquid tight. Thread the new cable through the liquid tight with enough length to reconnect to the terminal block.
5. Prepare the end of the cable as per *figure 5b* on the following page. Ensure that the shield is fully insulated until the point where it enters the terminal. No part of the shield should be allowed to come in contact with the circuit board, equipment case, or any other surface.
6. Note that the black-green lead is not utilized at this end of the cable.
7. Referring to the notes taken earlier, connect each lead of the new cable to the proper position of the terminal block, and then lock the lever back in place to hold lead. NOTE: It is recommended that you insert and secure one lead at a time.
8. Tighten the dome nut of the liquid tight to secure/seal cable.
9. Replace cover carefully being sure not to crimp any of the cables/leads between cover and enclosure and tighten screws.
10. Power the unit on, if all connections were properly made the unit will power as normal and the display will show the start up screen.

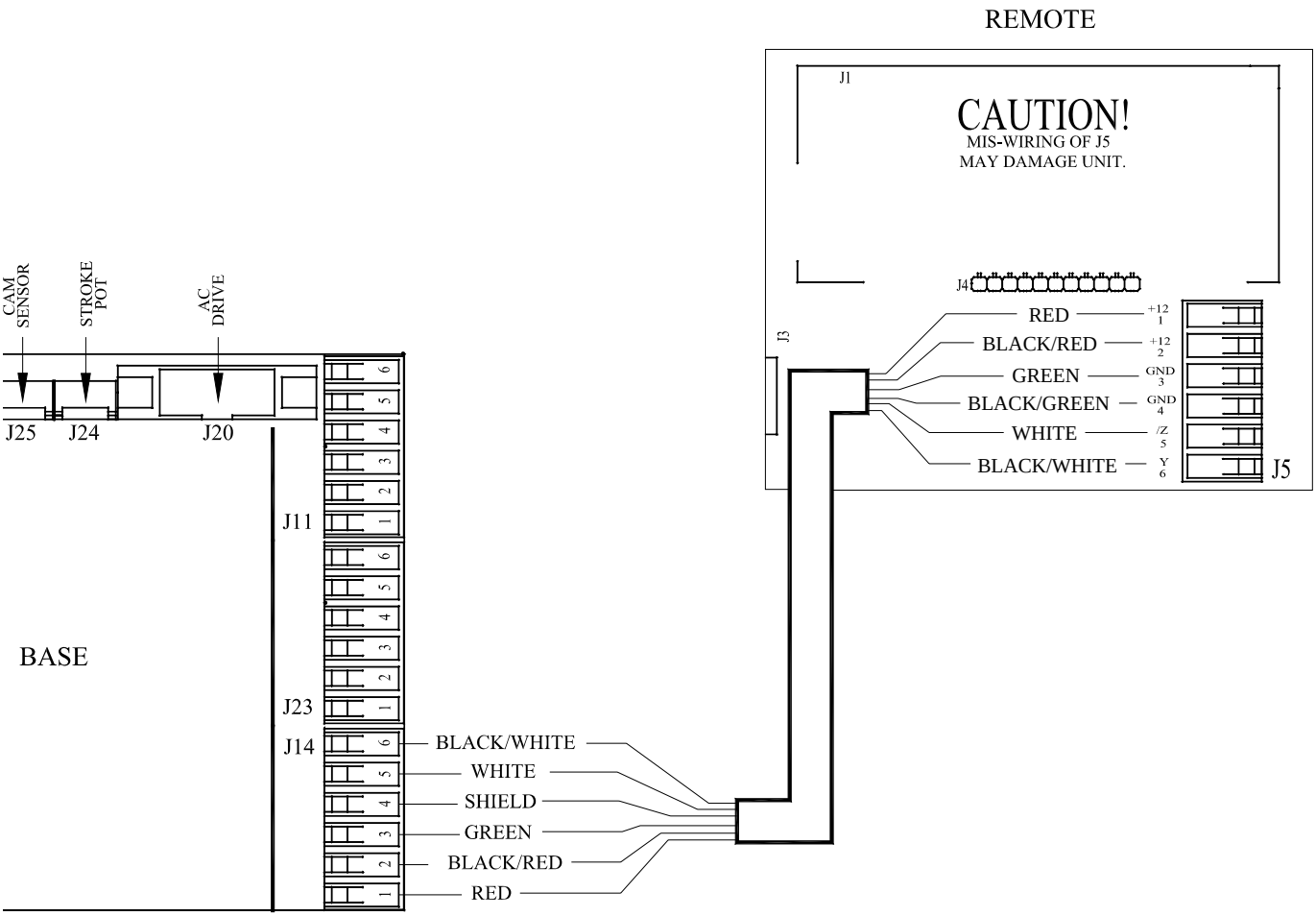


Figure 5a – Handheld Remote Wiring

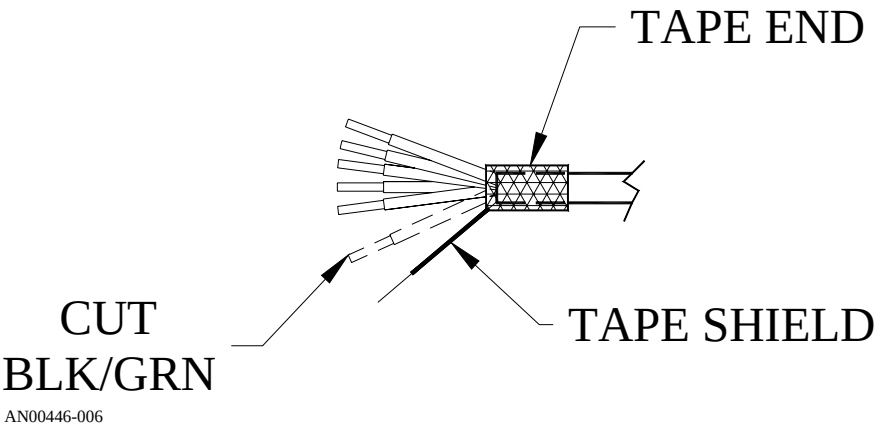


Figure 5b – Wire Preparation Detail, Base Unit End

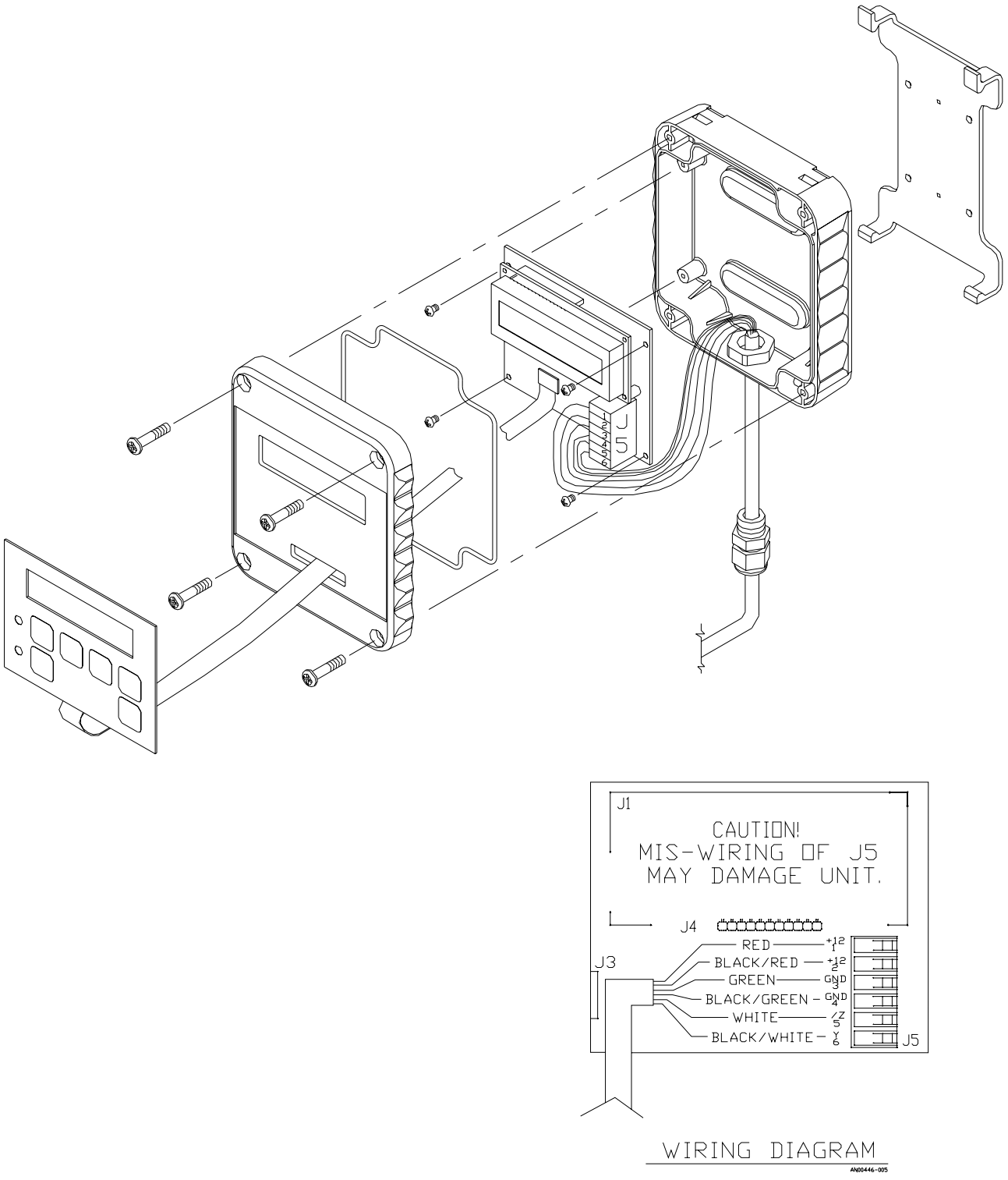


Figure 6 – Handheld Remote

11. Specifications

Turndown: Up to 1000:1 with a steady state accuracy of +/- 2 % (added to pump accuracy rating)
3:1 with a steady state accuracy of +/- 1 % (added to pump accuracy rating)

Operation mode: AC motor speed control with speed and stroke length feedback
Manual stroke length control

Power Requirements	***Recommended Minimum Wiring and Circuit Breaker***							
	120 VAC Operation				***240 VAC Operation***			
	Actual Draw	***Circuit Breaker***	***Wire Size***	***Wire Size***	***Actual Draw***	***Circuit Breaker***	***Wire Size***	***Wire Size***
MPC and 0.25 Hp motor	6.9 A	10 A	14 AWG	1.5 mm^2	3.5 A	10 A	14 AWG	1.5 mm^2
MPC and 0.33 Hp motor	6.9 A	10 A	14 AWG	2.5 mm^2	3.5 A	10 A	14 AWG	1.5 mm^2
MPC and 0.5 Hp motor	9.3 A	15 A	14 AWG	2.5 mm^2	5.1 A	10 A	14 AWG	1.5 mm^2
MPC and 0.75 Hp motor	16.7 A	25 A	12 AWG	4.0 mm^2	9.3 A	15 A	14 AWG	2.5 mm^2
MPC and 1.0 Hp motor	16.7 A	25 A	12 AWG	4.0 mm^2	9.3 A	15 A	14 AWG	2.5 mm^2
MPC and 1.5 Hp motor	24.1 A	35 A	10 AWG	4.0 mm^2	12.1 A	20 A	14 AWG	2.5 mm^2

NOTE: AC drive capacitors will cause in-rush current demand when power is first applied to the unit.

Control Inputs	***Wiring***	***Specification / Description***
Analog In #1	J11 pins 4-6	4-20mA control signal Max current 30mA; Input resistance 200 Ohm Internally protected with resetable fuse Minimum signal accepted = 2.4 mA Maximum signal accepted = 24 mA
Analog In #2	J11 pins 5-6	Not presently available – future release
Digital In #1	J11 pins 1-3	User to provide dry-contact input *
Digital In #2	J11 pins 2-3	User to provide dry-contact input *
		Do not apply power, maximum 2K Ohm resistance to register as "active"

* Digital input functions:

1. Remote on/off control of metering pump
2. Level input from supply tank
3. Leak detection of the metering pump
4. Flow detection, with use of external flow switch accessory

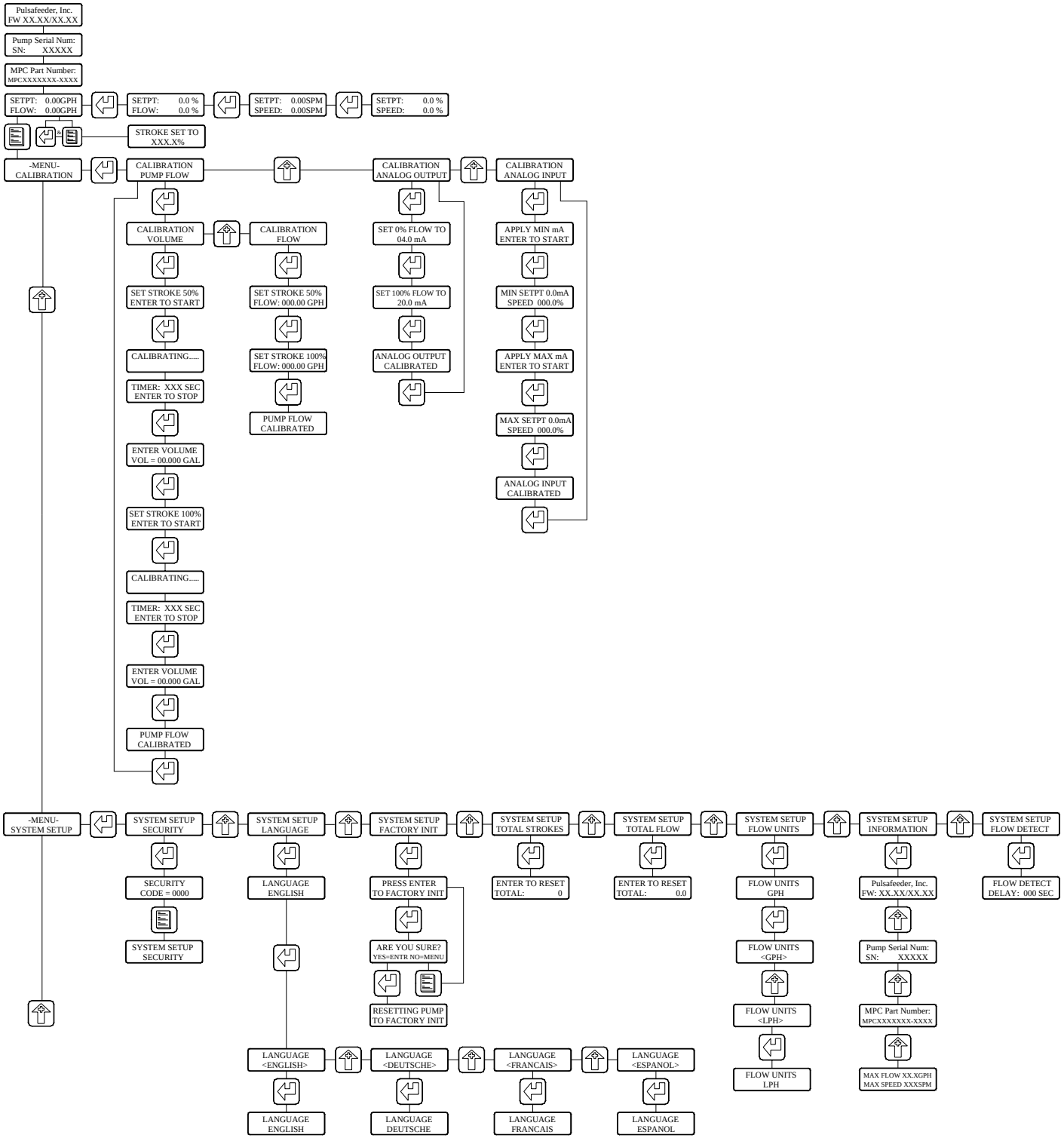
Control Outputs	*Wiring*	*Specification / Description*
Analog Out #1	J23 pins 5-6	4-20mA output for pump flow indication Max voltage out 12 Volts; Max current out 30mA; Max load resistance 300 Ohm Internally protected with resetable fuse
Digital Out #1	J23 pins 1-4	Transistor-based output, various functions *
Digital Out #2	J23 pins 2-4	Transistor-based output, various functions *
Digital Out #3	J23 pins 3-4	Transistor-based output, various functions *
		All digital outputs maximum 40 VDC, maximum 500 mA **NOTE: requires external power source**

* Digital output functions:

1. Triggering an external relay due to a fault condition
2. Auto/Manual status
3. On/Off status
4. Pulse output – Indication each time the pump strokes
5. Leak detection status indication
6. Tank level status indication

Calibration:	Controller includes an on board program for signal and flow calibration.
Input Voltage:	115 (105-125 acceptable range) or 230 (208 – 240 acceptable range) VAC Note: factory configured only for correct input voltage range (specified at time of purchase) Single phase input only 50 or 60 Hz.
Tolerance:	Input voltage +/- 10% maximum
	Input frequency range 48 Hz to 62 Hz
Motor Req:	Commercially available motor supplied by the manufacturer of the pump controller. Standard selection is rated for indoor, dry environment, other options available
Keypad:	Can be mounted on the pump or up to 1000’ away from the pump
	Standard cable length 6 feet
Display:	Backlit 2 line extended temperature 16 character LCD
Enclosure:	NEMA 4X and IP56 ratings
Altitude:	3300 Ft (1000 M) above sea level maximum
Humidity:	0-90% (non-condensing)
Temperature:	0^{o} C (32^{o} F) Minimum operating temperature
	40^{o} C (104^{o} F) Maximum operating temperature
Earth Leakage Current:	Size Earth Leakage Circuit Breakers (ELCB) to a detection level of 30 mA or greater

12. Menu Maps


Pulsafeeder, Inc.
FW XX.XX/XX.XX
Pump Serial Num:
SN: XXXXX
MPC Part Number:
MPCXXXXXXX-XXXX
SETPT: 0.00GPH
FLOW: 0.00GPH
SETPT: 0.0 %
FLOW: 0.0 %
SETPT: 0.00SPM
SPEED: 0.00SPM
SETPT: 0.0 %
SPEED: 0.0 %
STROKE SET TO
XXX.X%
-MENU-
CALIBRATION
CALIBRATION
PUMP FLOW
CALIBRATION
VOLUME
SET STROKE 50%
ENTER TO START
CALIBRATING.....
TIMER: XXX SEC
ENTER TO STOP
ENTER VOLUME
VOL = 00.000 GAL
SET STROKE 100%
ENTER TO START
CALIBRATING.....
TIMER: XXX SEC
ENTER TO STOP
ENTER VOLUME
VOL = 00.000 GAL
PUMP FLOW
CALIBRATED
CALIBRATION
FLOW
SET STROKE 50%
FLOW: 000.00 GPH
SET STROKE 100%
FLOW: 000.00 GPH
PUMP FLOW
CALIBRATED
CALIBRATION
ANALOG OUTPUT
SET 0% FLOW TO
04.0 mA
SET 100% FLOW TO
20.0 mA
ANALOG OUTPUT
CALIBRATED
CALIBRATION
ANALOG INPUT
APPLY MIN mA
ENTER TO START
MIN SETPT 0.0mA
SPEED 000.0%
APPLY MAX mA
ENTER TO START
MAX SETPT 0.0mA
SPEED 000.0%
ANALOG INPUT
CALIBRATED
-MENU-
SYSTEM SETUP
SYSTEM SETUP
SECURITY
SECURITY
CODE = 0000
SYSTEM SETUP
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SYSTEM SETUP
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FACTORY INIT
PRESS ENTER
TO FACTORY INIT
ARE YOU SURE?
YES=ENTR NO=MENU
RESETTING PUMP
TO FACTORY INIT
SYSTEM SETUP
TOTAL STROKES
ENTER TO RESET
TOTAL: 0
SYSTEM SETUP
TOTAL FLOW
ENTER TO RESET
TOTAL: 0.0
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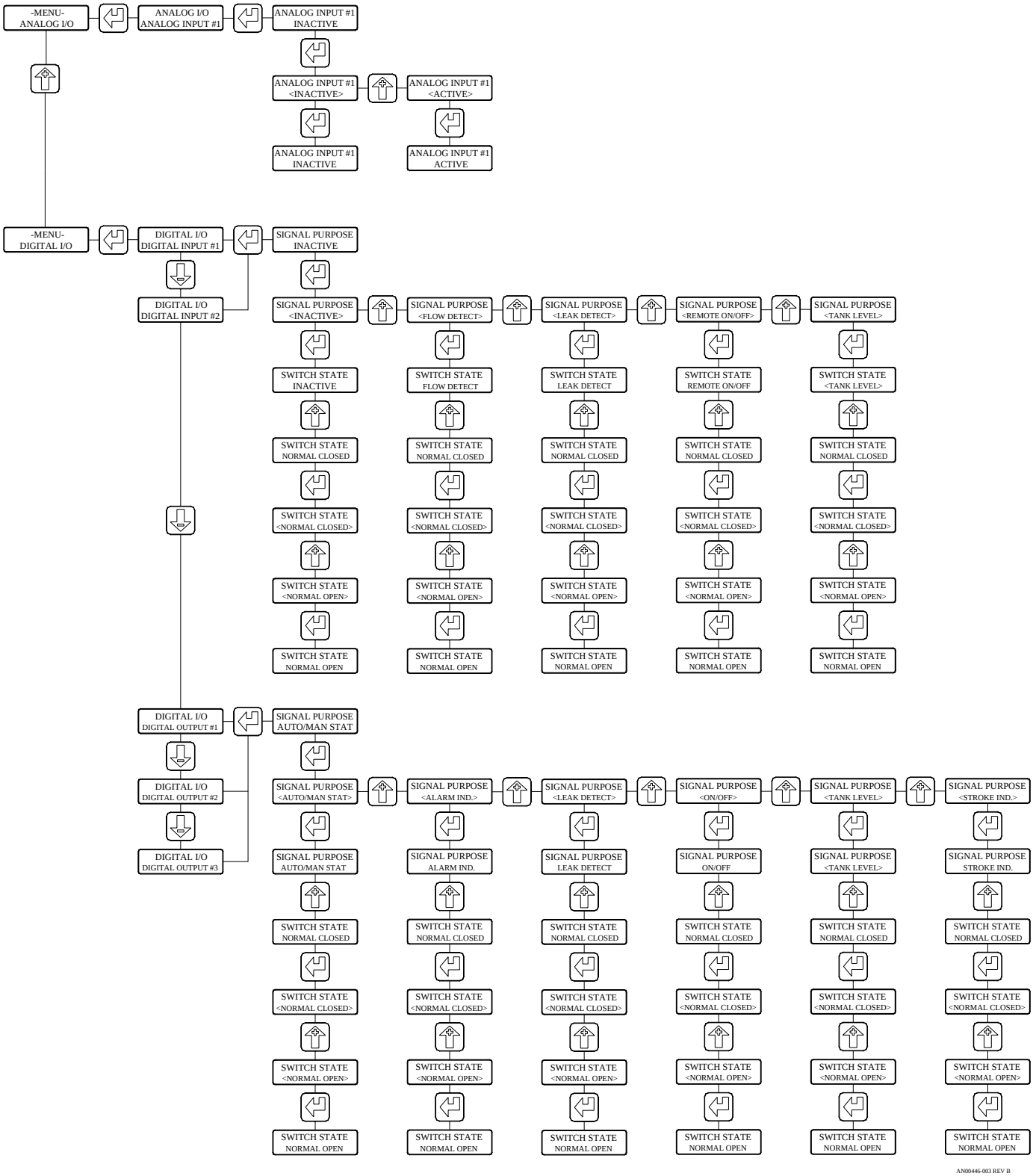
SYSTEM SETUP
INFORMATION
Pulsafeeder, Inc.
FW: XX.XX/XX.XX
Pump Serial Num:
SN: XXXXX
MPC Part Number:
MPCXXXXXXX-XXXX
MAX FLOW XX.XGPH
MAX SPEED XXXSPM
SYSTEM SETUP
FLOW DETECT
FLOW DETECT
DELAY: 000 SEC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13. Factory Default Values

Parameter	Factory Set Value
Digital Input #1	INACTIVE, normally closed
Digital Input #2	INACTIVE, normally closed
Analog Input #1	INACTIVE
Analog Input #2	NOT AVAILABLE this revision
Digital Output #1	STROKE Indication, normally closed
Digital Output #2	AUTO/MANUAL Indication, normally closed
Digital Output #3	Alarm Indication, normally closed
Security Code	Default = 0000
Language	ENGLISH
MODE	Local (Manual)
UNITS	GPH (gallons per hour)

14. Retrieval of Setup Information

Users can access the `system setup : information` menu, which will list the following data, this may be helpful in troubleshooting:

- Controller software revisions
- Pump serial number
- MPC model number
- Pump maximum flow
- Pump maximum speed

15. Special Keypress Access

In This SCREEN	Press MENU and ENTER at the same time to:
SETPT XX.XXX FLOW XX.XXX	View the stroke position of the pump
MENU ANALOG I/O	Show calibration and RAW data for analog inputs
MENU DIGITAL I/O	Shows current status of digital inputs and outputs Press DOWN arrow to see digital out #3

Press the MENU key to exit from any of these special screens.

16. Troubleshooting Guide

Problem	Potential Cause	Solution
	DISPLAY	
No Display Back-lighting	No power supplied.	Check power source. plug & circuit breaker
	Supply power wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against specification.
No Text on Display	Contrast out of adjustment.	Adjust as per section 8.4
	Software did not initiate properly.	Remove and re-apply Ac power
	POWER	
No power Indicators	No power supplied.	Check power source. Plug & Circuit Breaker
	Supply power wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against specification.

17. Spare Parts

User replaceable parts for the MPC.

Pulsafeeder P/N	Description
W770401-188	Housing cover bolt
W774030-188	Housing cover washer
NP460056-000	Housing cover gasket
NP530091-000	½” wiring liquidtight connector
NP530137-000	¼” wiring liquidtight connector
NP530511-006	Hand-held unit (complete)
NP140070-000	Hand-held unit angle-mount bracket
NP140066-PVC	Hand-held unit “snap-in” bracket
W213946-NTR	Hand-held enclosure gasket
NP550113-000	Membrane keypad for hand-held
NP530130-000	Cable, for hand-held, 6 foot length
NP83XXXXXP-XXXX	Stroke cover with position sensor
NP030013-000	Bearing cap with eccentric sensor
W772568-STL	½” conduit opening plug
W772585-018	¼” conduit opening plug

PULSAFEEDER

A Unit of IDEX Corporation

EC Declaration of Conformity

Manufacturer:
Pulsafeeder, Inc.
2883 Brighton Henrietta Townline Rd.
Rochester, NY 14623 USA

Pulsafeeder Inc. declares the following product(s) comply with the applicable standard(s) as listed below:

Device(s):
Metering Pump Controller (MPC)

Description:
Servo Controllers for Metering Pumps

Applicable EU Directive(s) for all MPC(s):
73/23/EEC - Low Voltage (LVD)

Applicable EU Directive(s) for only 230VAC Input MPC(s):
89/336/EEC - Electromagnetic Compatibility (EMC)

Applicable Harmonized Standard(s) for all MPC(s):
EN61010-1:2001

Applicable Harmonized Standard(s) for only 230VAC Input MPC(s):
EN61000-4-3, EN61000-4-4, EN61000-4-5,
EN61000-4-6, EN 61000-6-2, EN61000-6-4

DATE/APPROVAL/TITLE:
12 May 2004

Nick Valente, Vice President of Business Development

IDEX CORPORATION

BULLETIN No. IOM-MPC-0104-H

PULSAFEEDER®

A Unit of IDEX Corporation

Engineered Pump Operations
2883 Brighton-Henrietta Townline Road
Rochester, New York 14623
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http: //www.pulsa.com pulsa@idexcorp.com

IDEX CORPORATION

PULSAFEEDER®

A Unit of IDEX Corporation

PULSAR Shadow®

Mechanical Diaphragm Metering Pump

INSTALLATION OPERATION MAINTENANCE INSTRUCTION

BULLETIN No. PS-IOM-SHD-0303-Rev C

PULSAFEEDER®

Manufacturers of Quality Pumps,
Controls and Systems

Engineered Pump Operations
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Rochester, New York 14623
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http://www.pulsa.com pulsa@idexcorp.com

PULSAR® Factory Service Policy

Should you experience a problem with your *PULSAR* pump, first consult the troubleshooting guide in your operation and maintenance manual. If the problem is not covered or cannot be solved, please contact your local Pulsafeeder Sales Representative, or our Technical Services Department for further assistance. You may also visit our website at www.pulsa.com

Trained technicians are available to diagnose your problem and arrange a solution. Solutions may include purchase of replacement parts or returning the unit to the factory for inspection and repair. All returns require a Return Authorization number to be issued by Pulsafeeder. Parts purchased to correct a warranty issue may be credited, after an examination of original parts by Pulsafeeder. Warranty parts returned as defective which test good will be sent back freight collect. No credit will be issued on any replacement electronic parts.

Any modifications or out-of-warranty repairs will be subject to bench fees and costs associated with replacement parts.

Safety Considerations:

1. Read and understand all related instructions and documentation before attempting to install or maintain this equipment
2. Observe all special instructions, notes, and cautions.
3. Act with care and exercise good common sense and judgment during all installation, adjustment, and maintenance procedures.
4. Ensure that all safety and work procedures and standards that are applicable to your company and facility are followed during the installation, maintenance, and operation of this equipment.

Notice

Information and specifications in this document are subject to change without notice.

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PULSAR Shadow® is a registered trademark of Pulsafeeder, Inc.

Cruise Control®, ECA®, DLC®, and DLCM® are registered trademarks of Pulsafeeder, Inc.

Table of Contents

Conventions:

The following Conventions are used in this document.

A WARNING DEFINES A CONDITION THAT COULD CAUSE DAMAGE TO BOTH THE EQUIPMENT AND THE PERSONNEL OPERATING IT. PAY CLOSE ATTENTION TO ANY WARNING.

Notes are general information meant to make operating the equipment easier.

1. Introduction

PULSAR Shadow® metering pumps are positive displacement reciprocating pumps. They combine the high efficiency of the plunger pump with diaphragm sealing to prevent product leakage. Each pump consists of a power end and a process end separated by a mechanically operated diaphragm. Individual pumps will vary in appearance due to various liquid ends, accessories, and multiplexing; however, the basic principles of operation remain the same.

1.1 Overall Operation

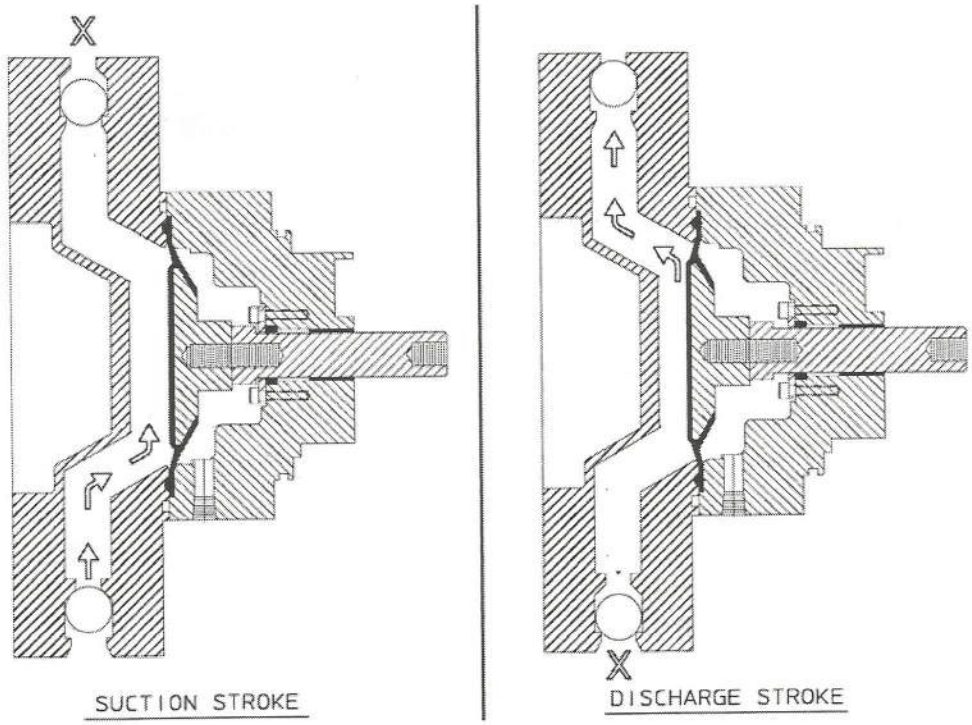


Figure 1

A diaphragm reciprocates at a preset stroke length, displacing an exact volume of process fluid. Diaphragm retraction causes the product to enter through the suction check valve. Diaphragm advance causes the discharge of an equal amount of the product through the discharge check valve.

1.2 Component Layout

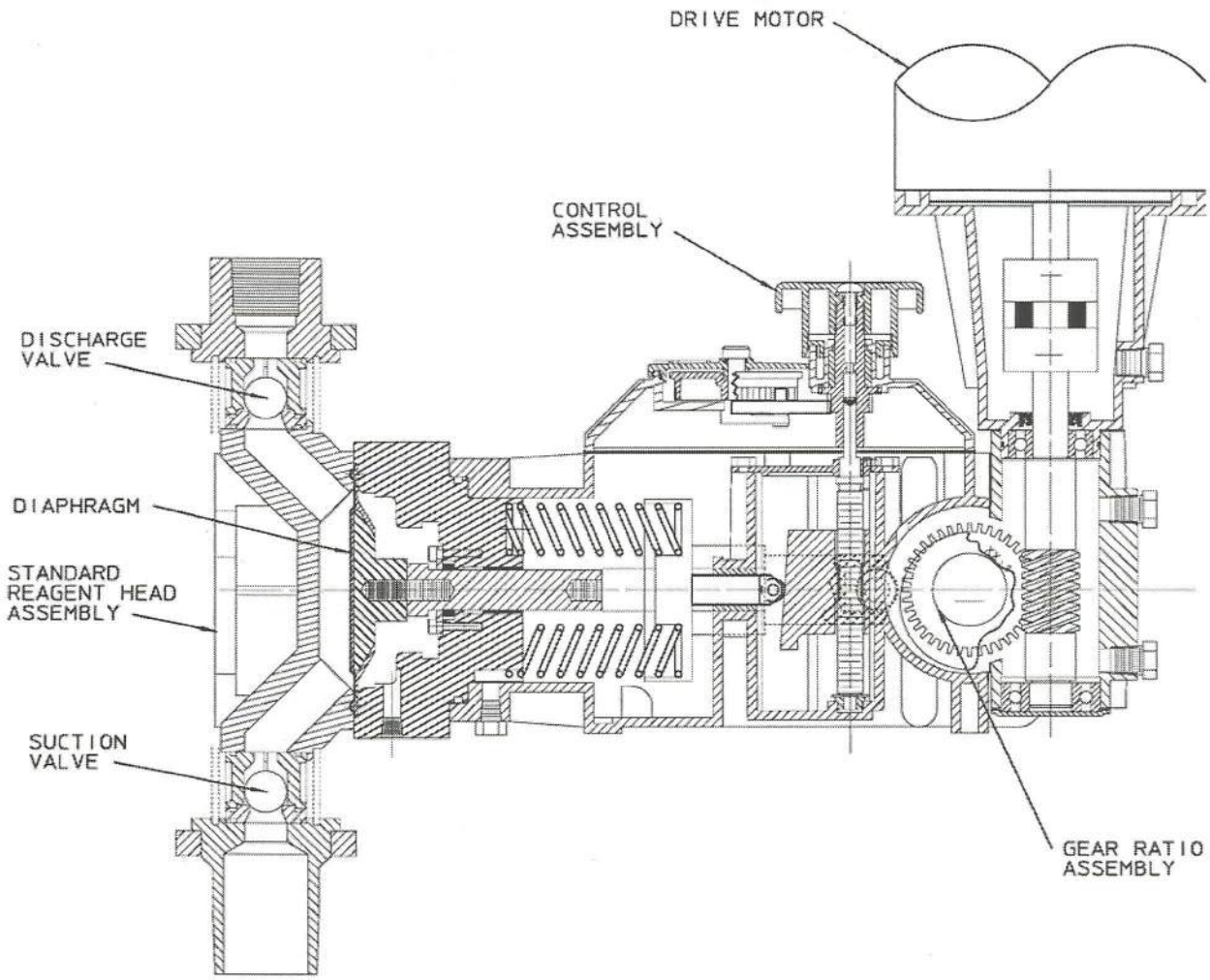


Figure 2

A typical model with manual external stroke adjustment is shown.

1.3 Standard Reagent Head Assembly

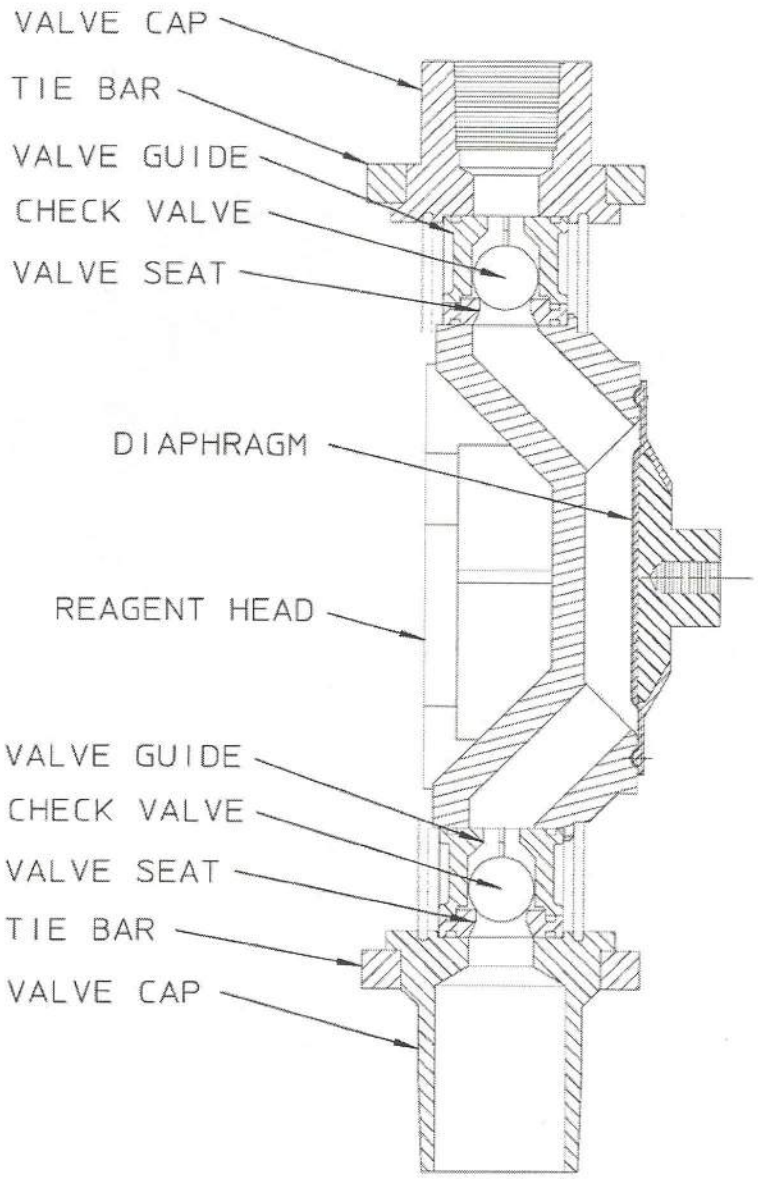


Figure 3

The typical reagent head assembly consists of reagent head, diaphragm, and suction and discharge check valves. This assembly is the only part of the pump to contact the process liquid; consequently, maintenance is critical to pump performance. For most pump configurations, suction and discharge check valve components are identical.

1.4 Leak Detection Assembly

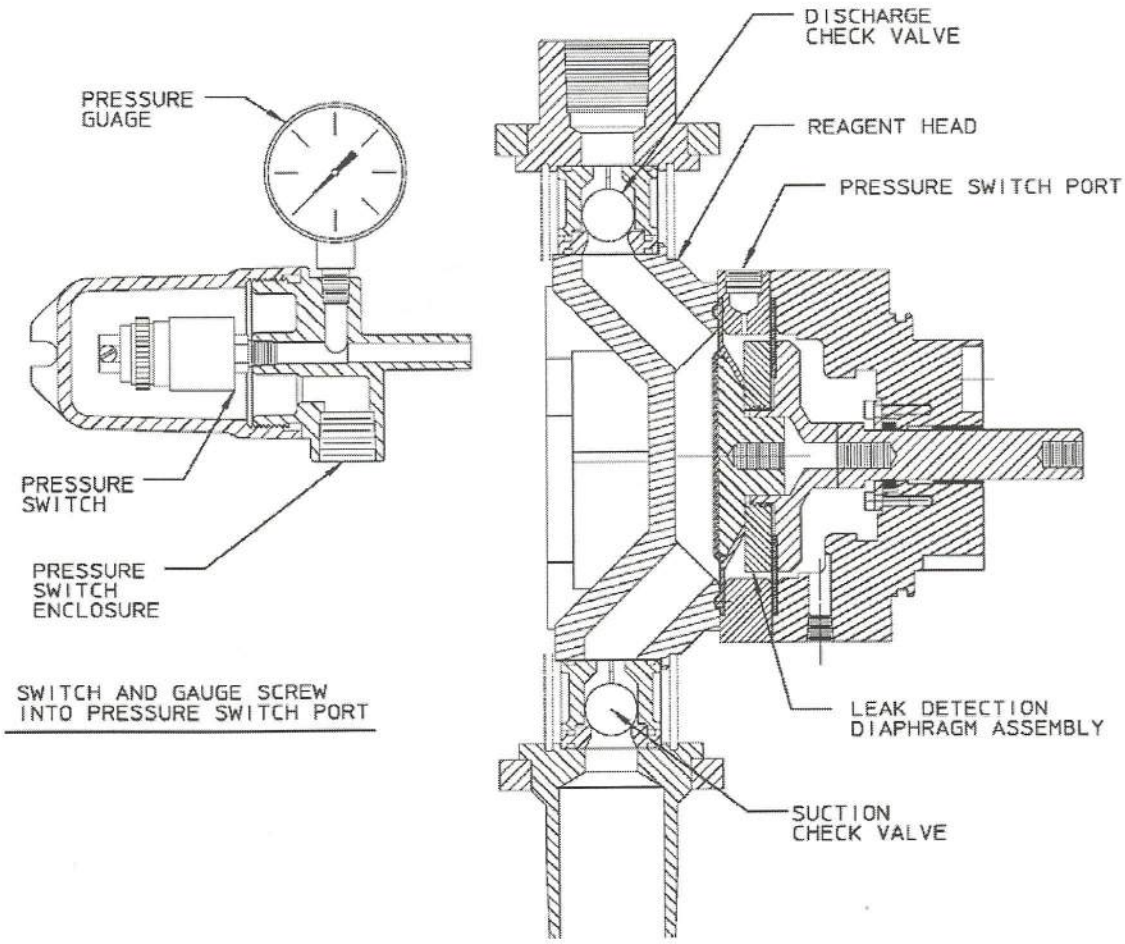


Figure 4

The Leak Detection Assembly (LDA) consists of a reagent head, suction and discharge check valves, primary diaphragm, leak detection diaphragm assembly, pressure switch port, and optional pressure switch and gauge. The reagent head, suction and discharge check valves, and primary diaphragm are the only parts of the pump to contact the process liquid; consequently, maintenance is critical to pump performance.

If there is a breach of the primary (product side) diaphragm, process liquid will enter the space between the primary and leak detection diaphragms. The liquid will be contained in this area and is prevented from contacting other components of the pump. On the discharge stroke, pressure will build in between the diaphragms. This pressure will activate the pressure switch. It is recommended that the pressure switch be integrated into a control system that will shut the pump off if a leak is detected. The pressure switch may be wired directly to a Pulsafeeder DLC or DLCM controller if the pump is so equipped.

1.5 Control Assembly

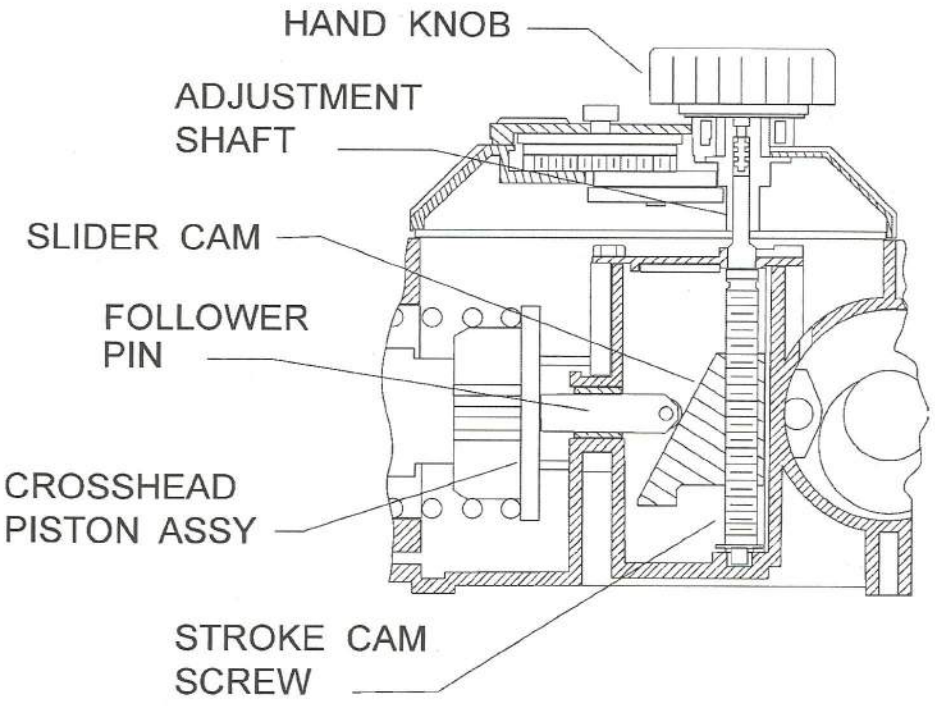


Figure 5

PULSAR Shadow® pumps incorporate a lost motion style of stroke length adjustment to limit diaphragm travel during the suction portion of each stroke. The stroke length setting is indicated by a (0 - 100) scale located on the top of the unit.

Stroke length is changed by depressing and turning the hand knob. This turns a screw, which locates a wedge-shaped slider cam to position the follower pin, which in turn limits rearward travel of the diaphragm.

To increase stroke length, the slider cam is moved downwards. This allows the follower pin to slide back, increasing the distance the diaphragm can travel with each pump stroke.

To decrease stroke length, the slider cam is moved upwards. This moves the follower pin forwards, decreasing the diaphragm travel, and therefore the flow rate of the pump.

1.6 Gear Ratio Assembly

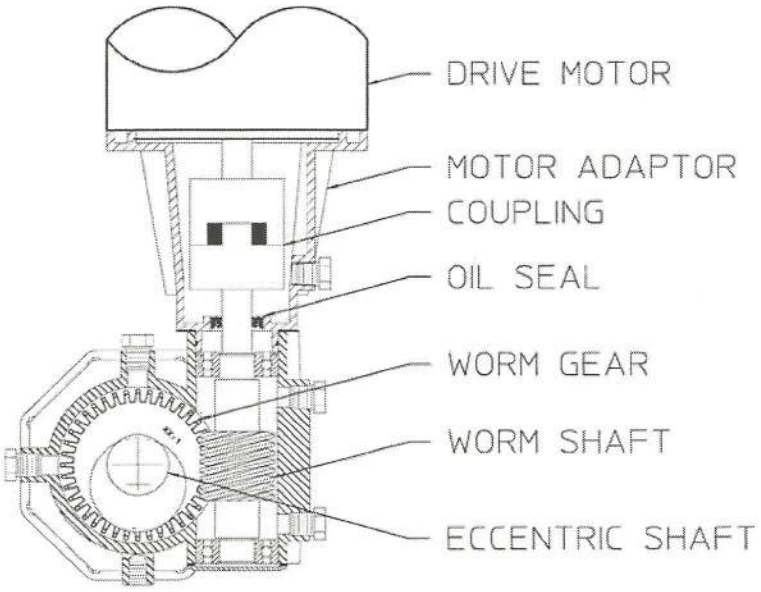


Figure 6

PULSAR Shadow® pumps are driven by a standard C-face electric motor mounted on the motor adaptor input flange. The motor drives a set of worm gears, which convert rotational speed into torque. They, in turn, power the eccentric shaft assembly that converts rotary motion into reciprocating motion. The drive motor can be wired to rotate in either direction.

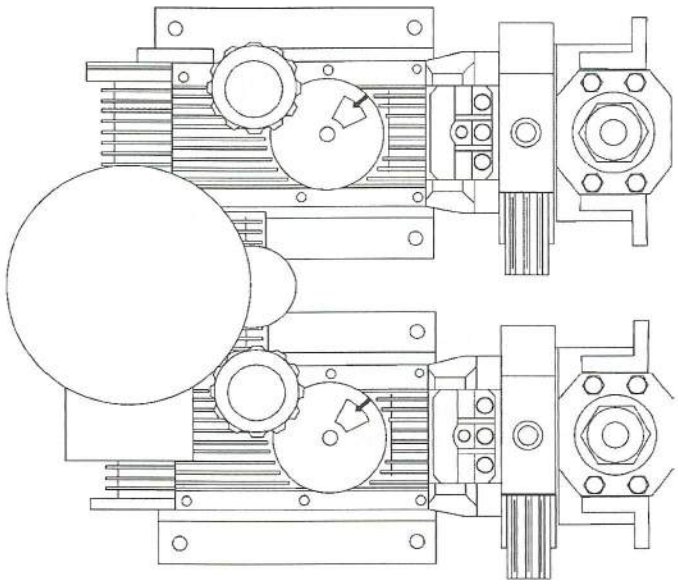


Figure 7

More than one pump can be driven through a single drive assembly. This is referred to as multiplexing. The pumps are mounted to a common gearbox assembly, and driven by a common motor. Each pump is mounted on a standard simplex base.

Whenever pumps are multiplexed, the eccentric shafts are positioned to place a uniform load on the driver. Before full disassembly, always note the relative positions of the eccentric shafts to each other so they can be reassembled back in the same orientation.

2. Equipment Inspection

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage should be reported immediately to the carrier and your authorized representative for PULSAR Shadow® pumps.

3. Storage Instructions

3.1 Short Term

Storage of PULSAR Shadow® pumps for up to 12 months is considered short-term. The recommended short-term storage procedures are:

1. Store the pump indoors at room temperature in a dry environment.
2. Within two months after date of shipment, fill the eccentric box to its normal operating level with Pulsalube 9M oil. If required by the operating environment, take any steps required to prevent entry of water or humid air into the eccentric enclosure.
3. Prior to start up, inspect housing, and gearbox. Replenish eccentric and gearbox oils as required to maintain operating levels. If water or condensation is present, change oil as described under Equipment Startup, Section 5.
4. Prior to startup, perform a complete inspection and then start up in accordance with instructions in this manual.

3.2 Long Term

Every twelve months, in addition to the above short-term procedures, power up the motor and operate the pump for a minimum of one hour. It is not necessary to have liquid in the reagent head during this operation, but the suction and discharge ports must be open to atmosphere.

After twelve months of storage, Pulsafeeder's warranty cannot cover items that are subject to deterioration with age such as seals and gaskets. If the pump has been in storage longer than 12 months it is recommended that such items be inspected and replaced as necessary prior to startup. Materials and labor to replace this class of item under these circumstance are the purchaser's responsibility. For a continuance of the initial warranty after extended storage, equipment inspection and any required refurbishing must be done by a Pulsafeeder representative.

4. Installation

4.1 Location

When selecting an installation site or designing a skid package, consideration should be given to access for routine maintenance.

PULSAR Shadow® pumps are designed to operate indoors and outdoors, but it is desirable to provide a hood or covering for outdoor service. External heating is required if ambient temperatures below 0^{O} C (32^{O} F) are anticipated. Check with the factory if concerned with the suitability of the operating environment.

The pump must be rigidly bolted to a solid and flat foundation to minimize vibration, which can loosen connections. When the pump is bolted down, care must be taken to avoid distorting the base and affecting alignments. The pump must be level within 5^{O}. This will assure that the eccentric and gear oils are maintained at the proper levels and that the check valves can operate properly.

4.2 Piping System

All piping systems should include:

1. A separate system relief valve to protect piping and process equipment, including the pump, from excess process pressures. *An external relief valve is required, as a mechanical diaphragm pump does not incorporate an internal relief.

2. Shutoff valves and unions (or flanges) on suction and discharge piping. This permits check valve inspection without draining long runs of piping. Shutoff valves should be of the same size as connecting pipe. Ball valves are preferred since they offer minimum flow restriction.

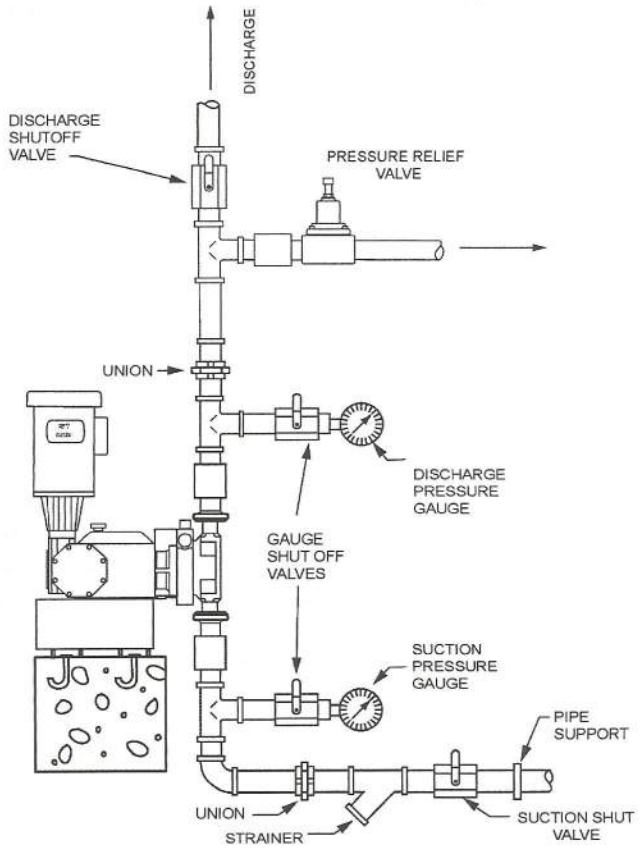


Figure 8

3. An inlet strainer, if the product is not a slurry. Pump check valves are susceptible to dirt and other solid contaminants unless designed for that service, and any accumulation can cause malfunction. The strainer should be located between the suction shutoff valve and the pump suction valve. It must be sized to accommodate the flow rate and the anticipated level of contamination. A 100-mesh screen size is recommended.

4. Vacuum/pressure gauges in the suction and discharge lines in order to check system operation. Gauges should be fitted with protective shutoff valves for isolation while not in use.

Piping weight must not be supported by valve housings or other portions of the reagent head, as the resulting stresses can cause leaks. If appropriate, provide for thermal expansion and contraction so that no excess force or moments are applied to the pump.

In piping assembly, use a sealing compound chemically compatible with the process material. Users of sealing tape are cautioned to ensure that the entering pipe thread ends are not taped, and that tape is removed from previously-used threads to the maximum practical extent prior to re-use. Both new and existing piping should be cleaned, preferably by flushing with a clean liquid (compatible with process material) and blown out with air, prior to connection to the pump.

4.3 Suction Pressure Requirements

Although PULSAR Shadow® metering pumps have suction lift capability, a flooded suction (i.e., suction pressure higher than atmospheric pressure) is preferable whenever possible. The pump should be located as close as possible to the suction side reservoir or other source.

For fluid with a vapor pressure of 5 psia or less (at operating temperature) the wet suction lift capability is ten (10) feet. If this requirement is not met, the pump will not provide reliable, accurate flow. The Net Positive Suction Head Required ($NPSH_R$) is 0.35 bar (5 psi).

The maximum inlet pressure is limited to 0.35 bar (5 psi) below the operating discharge pressure. Refer to Appendix I for procedures for the calculation of suction pressure.

4.4 Discharge Pressure Requirements

All PULSAR Shadow® Metering Pumps are designed for continuous service at the rated discharge pressure. If system suction pressure were to exceed system discharge pressure (a condition sometimes described as "pumping downhill"), flow would be generated (siphoning) in addition to that caused by the pump, resulting in a reduction in accuracy and loss of control over the metering process. To prevent this condition, commonly referred to as "flowthrough", the discharge pressure must exceed suction pressure by at least 0.35 Bar (or 5 psi). This can be achieved where necessary by the installation of a backpressure valve in the discharge line.

Damage to the pump will occur if operated at pressures beyond the maximum rating.

Refer to Appendix I for procedures for the calculation of discharge pressure.

4.5 Automatic Control

Pumps equipped with the DLC, DLCM, or ECA electronic stroke length controllers are provided with separate instructions. Refer to the latest Installation, Operation and Maintenance Manual specific to your controller. Follow all safety and operational information contained in those documents. Perform and verify all controller installation procedures prior to pump startup.

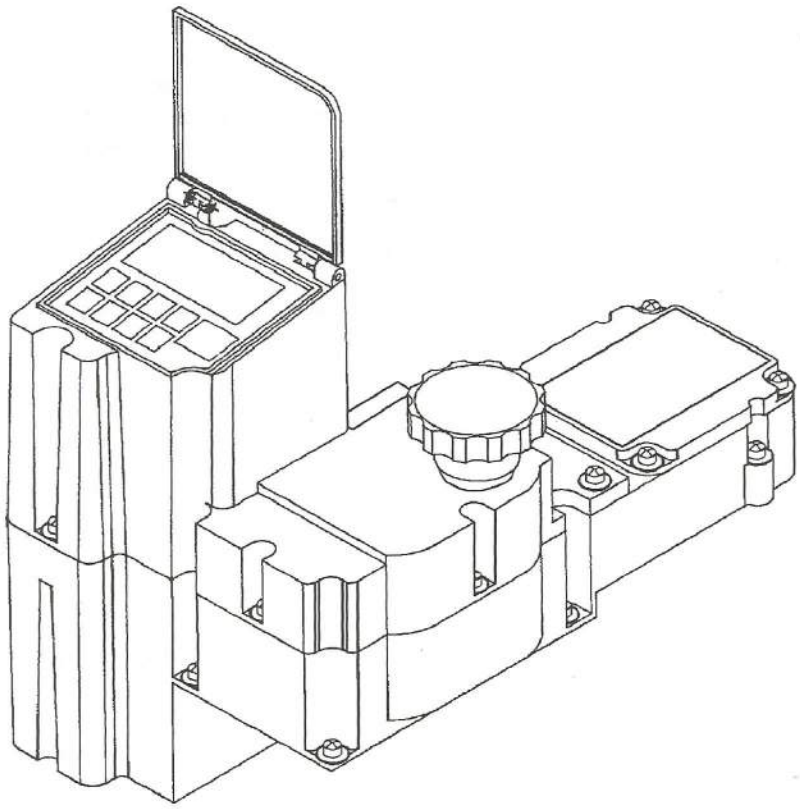
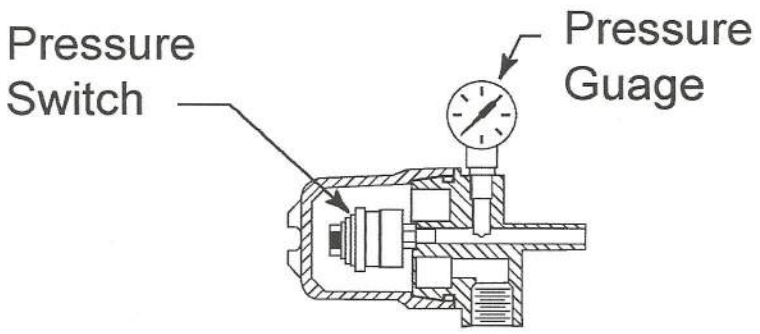


Figure 9

4.6 Leak Detection Assembly



Pressure Switch Enclosure

Figure 10

If the diaphragm leak detection system was specified with an optional pressure switch, install electrical wiring and conduit in accordance with local electrical codes. The switch is rated as follows:

The switch is rated as follows:

30 VDC or 125 VAC 1 Ampere Resistive.

The switch should be wired such that if a leak condition is detected, the pump will be shut down. The switch is the SPDT (single pole, double throw) type and can therefore be connected to either open or to close upon detection of diaphragm leak condition. Contacts or wires are identified as follows:

Normally Open (NO)	**wire color WHITE**
Normally Closed (NC)	**wire color RED**
Common (Com)	**wire color BLACK**

WARNING

THE ENCLOSURE IS LABELED WITH APPLICABLE SAFETY AGENCY RATINGS FOR HAZARDOUS AREA INSTALLATION. SINCE THE SWITCH IS OF THE MECHANICAL CONTACT TYPE, IT CAN NEVER QUALIFY AS NON-SPARKING (NON-INCENDIVE, OR "M") FOR OCCASIONAL AND SHORT-TERM HAZARDOUS AREA USE. PROTECTION MUST BE PROVIDED BY THE ENCLOSURE.

4.7 Drive Motor Installation

4.7.1 Motor Rotation

Motor can be operated in either direction, clockwise or counterclockwise. Verification of motor direction is not necessary at startup.

4.7.2 Motor Installation

PULSAR Shadow® pumps may be shipped with the drive motor packed separately. This is done to avoid damage during transport.

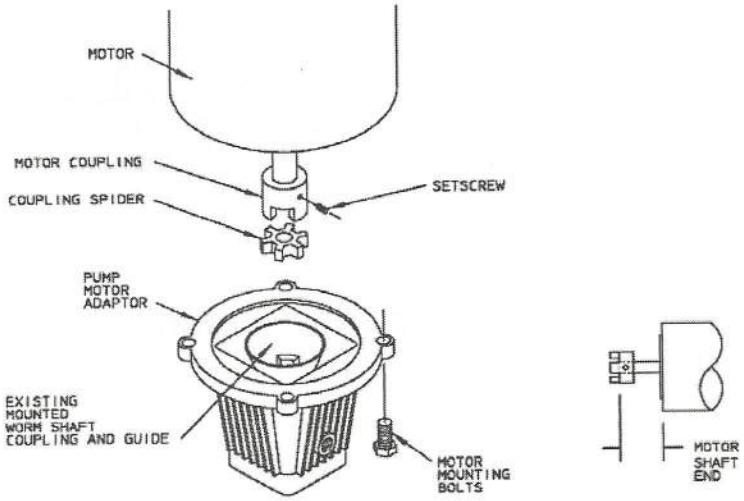


Figure 11

1. Remove the unattached coupling half from the motor adaptor. Ensure that the elastomer coupling spider remains in place, on the coupling half that remains attached to the worm shaft.
2. If applicable, remove any tape or retainer rings that hold the motor shaft key in place.
3. Place the loose coupling half on the motor shaft. Align the keyway with the key and align shaft end to inner coupling surface as shown in figure above.
4. Tighten the setscrew onto the shaft key.
5. Place the motor in a vertical position and align the coupling teeth.
6. Install the motor downwards onto the adaptor. The plastic guide will assist in aligning the coupling halves. Final position can be achieved by slightly rotating the motor until the coupling jaws align.
7. Rotate the motor until the clearance holes in the adaptor and the tapped holes in the motor align. Fasten the motor to the adaptor using the supplied bolts (4). Tighten bolts evenly to secure motor.

4.7.3 Electrical

Wire the PULSAR Shadow® drive motor according to the motor vendor's nameplates and instructions, and according to any appropriate national and local electrical codes and regulations.

If the motor is to be utilized with a Pulsafeeder controller, such as the DLC or DLCM, consult the appropriate Pulsafeeder IOM for further motor wiring instructions.

5. Equipment Startup

WARNING **PULSAR SHADOW® PUMP USE TWO SEPARATE OILS: PULSALUBE 9M OIL FOR THE ECCENTRIC BOX AND PULSALUBE 8G, GEAR OIL FOR THE GEARBOX. CONFUSION BETWEEN THE TWO REDUCES PERFORMANCE OF THE PUMP.**

5.1 Oil Capacities

Pulsalube 9M lubricating oil is available in 950 ml (1 quart) containers.
Pulsalube 8G gear oil is available in 200 ml (.21 quarts) or 950 ml (1 quart) containers.

It is recommended that adequate supplies of both PULSAlube oils be on hand for periodic changes and emergency requirements. The approximate amounts of oil required to fill PULSAR Shadow® pumps to specified levels are:

	Eccentric Box, all	Gearbox, Model 25B	Gearbox, Model 55B
Eccentric Oil, No. 9M	950 ml (1 Qt)	--	--
Gear Oil, No. 8G	--	150 ml (0.16 Qt)	200 ml (0.21 Qt)

5.2 Eccentric Oil Fill

Fill the eccentric box with oil by removing the manual cover assembly or DLC/M or ECA controller if so equipped. Fill with the proper oil (Pulsalube 9M) to the upper edge of the crosshead assembly and return spring(s) or slightly above. Replace the cover or controller. Take care not to disturb the stroke length setting when reinstalling. See figure 12.

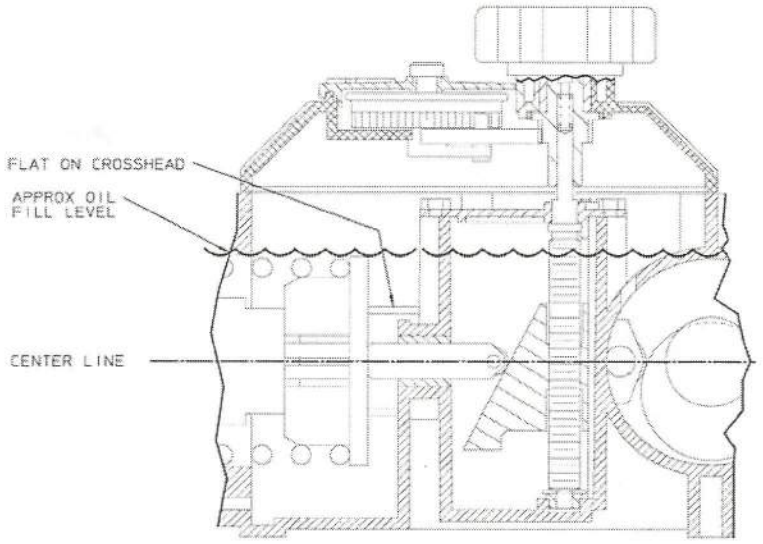


Figure 12

5.3 Gear Oil Fill

In all pump configurations, one pipe plug is present at the top of the gearbox and one is on the side at the centerline level. Remove the top plug and fill with Pulsalube 8G gear oil through the top port to the level of the eccentric shaft centerline, which is level with the side port. The side plug should be removed so that leakage from the side port indicates attainment of the required level. Replace both pipe plugs after filling.

NOTE **Gear oil is filled at the factory, and the gearbox is shipped full.**

NOTE **Do not add oil through the port on the side of the motor adaptor. This port is for motor coupling access only.**

5.4 Oil Changes

The recommended oil change intervals are dependent upon the operating environment and level of pump usage, classified as follows:

Normal service: Clean/dry atmosphere, an ambient operating temperature of 0^0 C to 40^0 C (32^0 F to 104^0 F) and up to 2,000 annual operating hours.

Severe Service: Humid atmosphere, an ambient operating temperature below 0^0 C (32^0 F) or above 40^0 C (104^0 F), and over 2,000 annual operating hours.

5.4.1 Eccentric Oil Change:

The recommended eccentric oil change interval is two (2) years for normal service and one (1) year for severe service. The procedure is as follows:

1. Disconnect the power source to the drive motor
2. Relieve all pressure from the piping system.
3. Remove the top cover or controller from the pump.
4. Drain the oil by removing the drain plug on the bottom of the eccentric box.
5. Replace the drain plug.
6. Fill the eccentric box with Pulsalube 9M oil as described under **Eccentric Oil Fill**.
7. Replace the top cover or controller.

5.4.2 Gear Oil Change:

The recommended gear oil change interval is five (5) years for normal service and two (2) years for severe service. The procedure is as follows:

1. Disconnect the power source to the drive motor
2. Relieve all pressure from the piping system.
3. Remove the fill plug from the top of the gearbox.
4. Drain the oil by removing the drain plug on the bottom of the gearbox.
5. Replace the drain plug.
6. Refill with fresh Pulsalube 8G (amber) gear oil as described under **Gear Oil Fill**.
7. Be sure to replace the top fill plug and side plug.

6. Startup

6.1 Output Adjustment

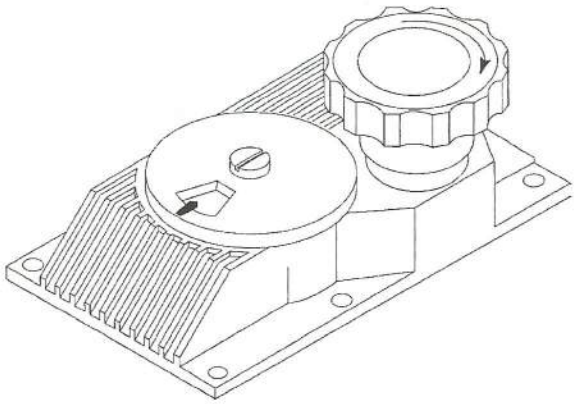


Figure 13

PULSAR Shadow® pumps have a handwheel for manual stroke length adjustment. Mounted atop the eccentric box, the handwheel can be adjusted at any point from (0 to 100%) stroke setting by pressing down and then rotating as required. Stroke length is locked during operation to prevent drift: pressing the handwheel down temporarily disengages the lock for adjustment; release after adjustment automatically resets the lock at the new setting. An indicator adjacent to the handwheel displays the output setting. Adjustments can be made while the pump is at rest or operating, although adjustments are easier to make while the pump is in operation. Manual adjustment serves as a backup for pumps provided with DLC/M controllers.

6.2 Priming the Reagent Head

1. Open the suction and discharge line shutoff valves.
2. If the piping system design and the storage tank are such that the product flows due to gravity through the pump, reduce the discharge pressure and the system will self prime when the pump is started. In the event the discharge line contains a significant amount of pressurized air or other gas, it may be necessary to lower the discharge pressure to enable the pump to self-prime.
3. If the installation involves a suction lift, it may be necessary to prime the reagent head and suction line. Try priming the reagent head first. Refer to the Maintenance Section on Check Valves. Remove the discharge valve assembly. Fill the head through the discharge valve port with process (or compatible) liquid, and then reinstall the valve.

4. Start the pump at the zero stroke length setting and slowly increase the setting to 100 to prime the pump. If this does not work, it will be necessary to fill the suction line.
5. Filling of the suction line will necessitate the use of a foot valve or similar device at the end of the suction line so that liquid can be maintained above the reservoir level. Remove the suction valve assembly, fill the line, replace the valve, then remove the discharge valve assembly and fill the reagent head as described in Step (3) above. The pump will now self-prime when started up per step (4) above.

6.3 Calibration

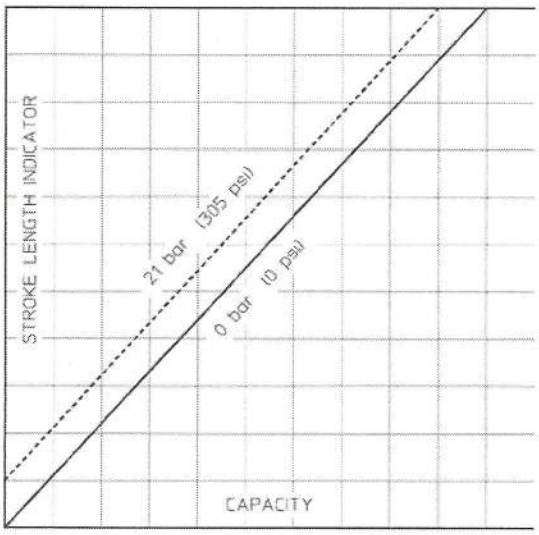


Figure 14

All metering pumps must be calibrated in order to accurately specify stroke length settings for required flow rates. For pumps provided with DLC/M electronic controls, refer to separate instructions provided with those controllers.

A typical calibration chart is shown in Figure 14. Although output is linear with respect to stroke length setting, an increase in discharge pressure decreases output uniformly, describing a series of parallel lines, one for each pressure (only two are shown).

The theoretical output flow rate at atmospheric discharge pressure is based on the displacement of the diaphragm, stroke length and the stroking rate of the pump. With increasing discharge pressure there is a some corresponding decrease in output flow. Pumps are rated at a certain flow at their rated pressure (check nameplate). Whenever possible, calibration should be performed under actual process conditions (i.e., the same or a similar process liquid at system operating pressure).

To construct a calibration chart, measure the flow rate several times at three or more stroke settings (i.e., 25, 50, 75, and 100), plot these values on linear graph paper, and draw a best-fit line through the points. For stable conditions, this line should predict settings to attain required outputs.

6.4 Leak Detection

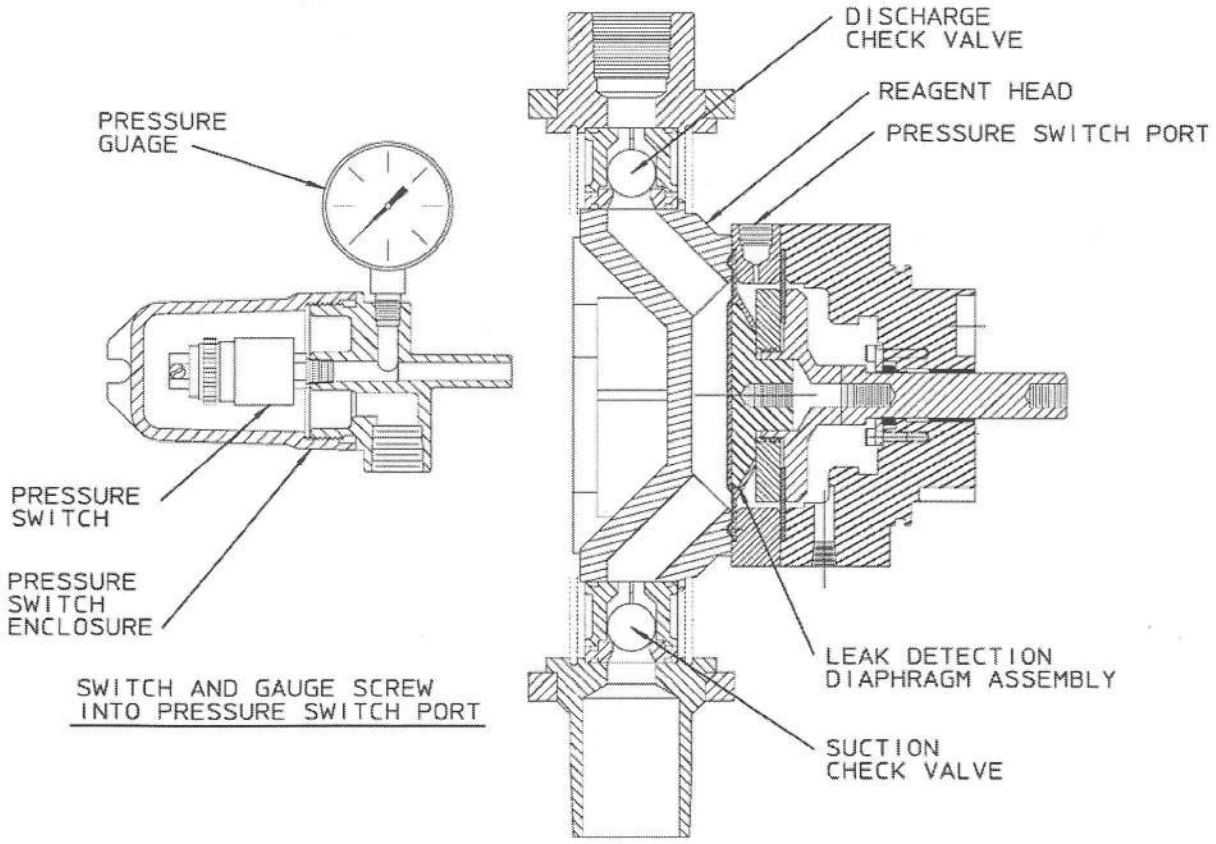


Figure 15

Follow the same priming procedure for a standard reagent for pumps equipped with the diaphragm leak detection system.

If the optional pressure switch has been supplied, apply power to the alarm circuit. It is recommended that this switch be integrated into the pump control system. If a failure of the diaphragm is detected, the pump should be shut down until a diagnosis of the fault can be made.

7. Maintenance

BEFORE PERFORMING ANY MAINTENANCE REQUIRING REAGENT HEAD OR VALVE (WET END) DISASSEMBLY, BE SURE TO RELIEVE PRESSURE FROM THE PIPING SYSTEM AND, WHERE HAZARDOUS PROCESS MATERIALS ARE INVOLVED, RENDER THE PUMP SAFE TO PERSONNEL AND THE ENVIRONMENT BY CLEANING AND CHEMICALLY NEUTRALIZING AS APPROPRIATE. WEAR PROTECTIVE CLOTHING AND EQUIPMENT AS REQUIRED.

Accurate records from the early stages of pump operation will indicate the type and levels of required maintenance. A preventative maintenance program based on such records will minimize operational problems. It is not possible to forecast the lives of wetted parts such as diaphragms and check valves. Since corrosion rates and operational conditions affect functional material life, each metering pump must be considered according to its particular service conditions.

PULSAR Shadow® KOPkits contain all replacement parts normally used in a preventative maintenance program. It is recommended that KOPkits and PULSAlube eccentric and gear oils be kept available at all times.

7.1 Wet End Removal, Inspection and Reinstallation

IF THE DIAPHRAGM HAS FAILED, PROCESS FLUID MAY HAVE CONTAMINATED THE PUMP ECCENTRIC OIL (ALTHOUGH NORMALLY, ANY PROCESS FLUID BEHIND A FAILED DIAPHRAGM WOULD PASS THROUGH THE BOTTOM DRAIN HOLE). HANDLE WITH APPROPRIATE CARE, CLEAN AND REPLACE OIL IF REQUIRED.

7.1.1 Standard Diaphragm

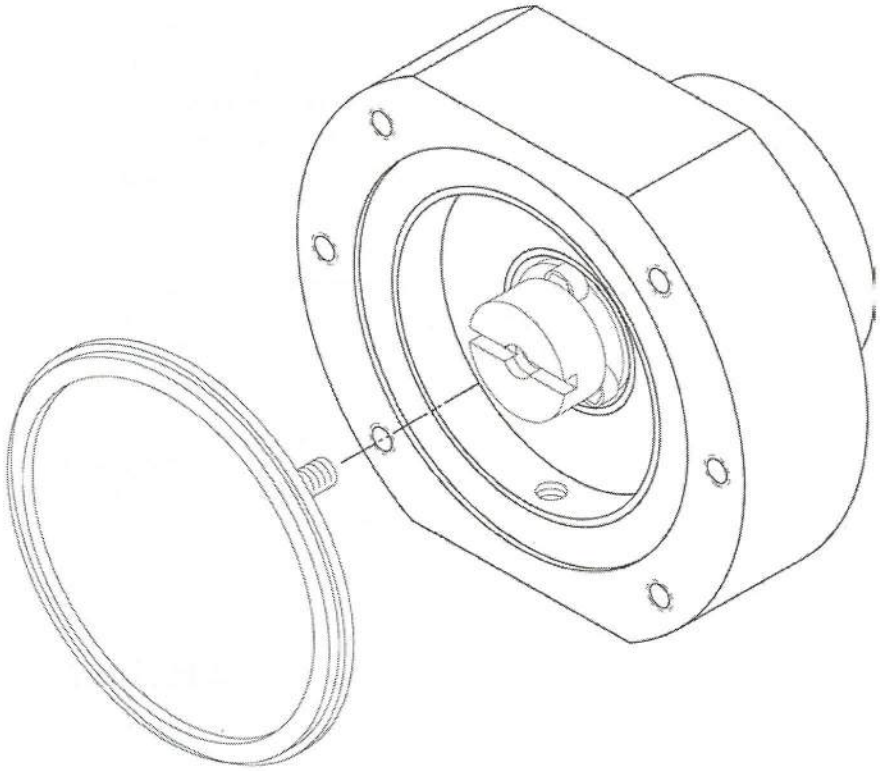


Figure 16

PULSAR Shadow® diaphragms do not have a specific cycle life; however, the accumulation of foreign material or debris sufficient to deform the diaphragm can eventually cause failure. Failure can also occur as a result of system over pressure or chemical attack. Periodic diaphragm inspection and replacement are recommended.

1. Adjust the stroke setting to 50 percent and disconnect the power source to the drive motor
2. Relieve all pressure from the piping system.
3. Take all precautions described in this manual to prevent environmental and personnel exposure to hazardous materials.
4. Close the inlet and outlet shutoff valves.
5. Disconnect piping to the reagent head and drain any process liquid, following material safety precautions described. Removal of the check valves may assist in this process.
6. Place a pan underneath the pump head adaptor to catch any liquid leakage.
7. Remove all but one top reagent head bolt. Product will leak out between the pump head adaptor and reagent head as the bolts are loosened.
8. Tilt the head and pour out any liquids retained into a suitable container, continuing to follow safety precautions as appropriate.

9. Remove the final bolt and rinse or clean the reagent head as required.
10. Remove the diaphragm by turning counter-clockwise and inspect the diaphragm. The diaphragm must be replaced if any surface is cracked, separated, or obviously damaged.
11. To install a diaphragm, first ensure that the critical sealing areas of diaphragm, reagent head, and pump head are clean and free of debris. Lubricate the elastomer (back) side of the diaphragm liberally, where it is in contact against the pump head and deflection plate, with a lubricant compatible to the fluid being pumped (silicone grease is preferred ex. Parker 'Super O-Lube').
12. Thread the diaphragm (clockwise) fully onto the shaft. When reinstalling a used diaphragm it is not necessary to maintain the previous orientation relative to the reagent head or pump head hole pattern.
13. Install the reagent head and tighten the bolts in an alternating pattern to ensure an even seating force. Torque to the values recommended in Appendix III.
14. Replace the check valve assemblies. It is recommended that new o-ring seals be utilized when these components have been disassembled for maintenance.
15. Reprime the pump per the procedure outlined in Section 6.2.

7.1.2 Leak Detection

Follow the same procedures as described for the standard diaphragm, steps 1-15.


NOTE

It is not necessary to remove or replace the LDA secondary (rear) diaphragm unless it has been damaged.


WARNING

IF DISASSEMBLY OF THE HEAD IS REQUIRED, EXERCISE CAUTION DURING REMOVAL SINCE THE RETURN SPRING OF THE PISTON IS UNDER FULL LOAD. CONSULT FACTORY PRIOR TO PERFORMING THIS PROCEDURE.

7.2 Check Valves

7.2.1 General Description

Most fluid metering problems are related to check valves. Problems usually stem from solids accumulation between valve and seat, corrosion of seating surfaces, erosion, or physical damage due to wear or the presence of foreign objects.

The valve incorporates a ball, guide, and seat. Flow in the unchecked direction lifts the ball off the seat, allowing liquid to pass through the guide. Reverse flow forces the ball down, sealing it against the sharp edge of the seat. The guide permits the ball to rotate but restricts vertical and lateral movement in order to minimize "slip" or reverse flow. Ball rotation prolongs life by distributing wear over the entire surface of the ball. Since ball return is by gravity, the valve must be in the vertical position in order to function properly. Parts are sealed by "O"-rings.

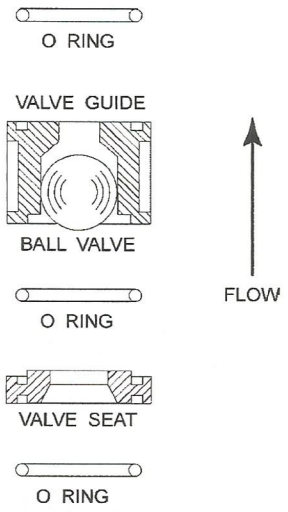


Figure 17

7.2.2 Removal, Inspection, and Reinstallation

Use the following procedure to remove, inspect and reinstall the check valves:

1. Disconnect the power source to the drive motor.
2. Relieve all pressure from the piping system.
3. Take all precautions to prevent environmental and personnel exposure to hazardous materials.
4. Close the inlet and outlet shutoff valves.
5. Loosen the suction valve tiebar bolts and spring the suction piping slightly to drain any liquid from the reagent head cavity. If the piping is closely connected it may be necessary to disconnect a union or flange.
6. Remove the suction check valve assembly (ball contained within guide and seat), holding it together as a unit.
7. Loosen the tiebar bolts on the discharge valve and spring the piping slightly to drain any liquid.
8. Remove the discharge check valve assembly, holding it together as a unit as before.
9. Disassemble both valves and examine components for wear. Seats should have sharp edges or a small chamfer, free from dents or nicks. Hold the ball firmly against its mating seat in front of a bright light to inspect for fit.

NOTE **Observation of light between ball and seat is cause for replacement of either or both components. For best results, always loosen the unions or flanges on either side of the system piping prior to re-tightening of the check valve assemblies. Retighten the unions or flanges after the check valves are securely tightened into position.**

continues next page...

10. Reassemble both valves using new parts as required. Sealing "O"-rings should generally be replaced.
11. Reinstall both valve assemblies, taking care to ensure that they are correctly oriented with balls above seats.
12. Tighten the tiebar bolts evenly, making sure the valve assemblies are assembled squarely. Refer to ***Appendix III*** for torque values.
13. Check for leaks and retighten tiebar bolts as necessary. Re-check any piping connections that may have been disturbed.

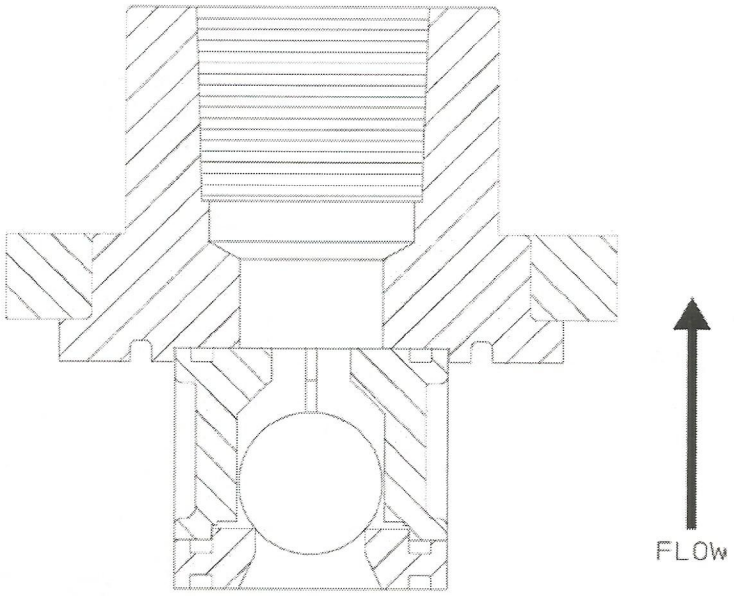


Figure 18

7.3 Oil Seals

7.4 General Description

The pump has four oil seals as follows:

Seal	Location
Pump shaft	Inside the pump head
Motor adapter	Inside the motor adapter, below the worm shaft coupling
Gearbox oil	Inside the screwed end play adjustment cap on the side of the gearbox
Eccentric box	On the side of the gearbox where the eccentric shaft protrudes.

7.5 Removal and Replacement

To replace the pump shaft seal:

Following the instructions in the previous sections, remove the reagent head assembly. Then remove the diaphragm. Remove the pump shaft by unscrewing counter-clockwise. Take care not to allow any shims to drop into the eccentric box when removing the shaft. A thread-locking compound is used between the pump shaft and the crosshead assembly. Remove the three (3) socket head screws and seal retainer plate. The seal can now be removed. DO NOT reuse a damaged pump shaft or polish an old one too smooth. A shaft that is too smooth will weep oil over time when running.

Reinstall by reversing the disassembly procedure. Lubricate the ID of the seal liberally with silicone grease (ex. Parker 'Super O-Lube'). Refill the eccentric box with Pulsalube Oil 9M per the Lubrication Section.

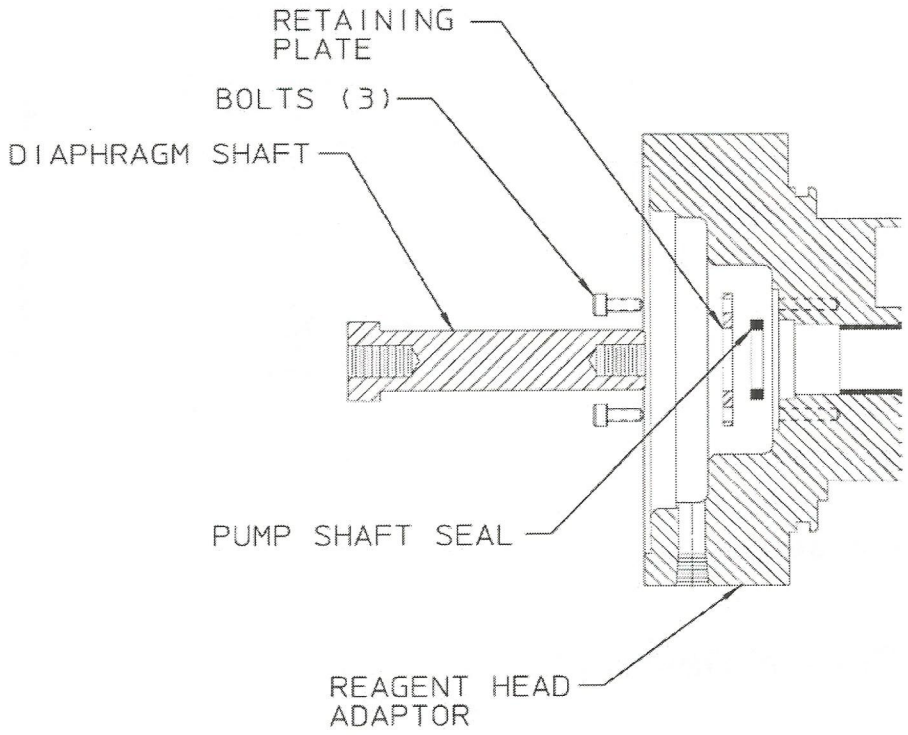


Figure 19

To replace the motor adapter seal:

First remove the motor per Motor Removal and Reinstallation. Loosen the coupling setscrew through the access hole in the motor adapter and remove the worm coupling half. Remove the four motor adapter bolts and withdraw the motor adapter from the gearbox. Take care not to lose the shims from between motor adapter and gearbox. Remove the oil seal from the motor adapter. Lubricate the replacement seal with Pulsalube 8G gear oil and install by pressing into position. Reassemble by reversing the above disassembly procedure.

To replace the gearbox oil seal:

First drain the gearbox per the lubrication instructions. Remove the four gearbox bolts, and withdraw the gearbox from the eccentric box, sliding it off the eccentric shaft. Remove the seal. Lubricate the replacement with Pulsalube 8G gear oil and install by pressing into position. Reinstall by reversing the disassembly procedure. Refill the gearbox with Pulsalube 8G gear oil per Lubrication.

To replace the eccentric box seal:

First remove the gearbox per step 3 above. Remove the four bolts, which retain the eccentric side cap to the eccentric box. Remove the eccentric side cap and withdraw the eccentric shaft. Remove the seal. Lubricate the replacement with Pulsalube 8G gear oil and install by pressing it into position. Reinstall by reversing the disassembly procedure. Refill the gearbox with Pulsalube 8G gear oil per the lubrication instructions.

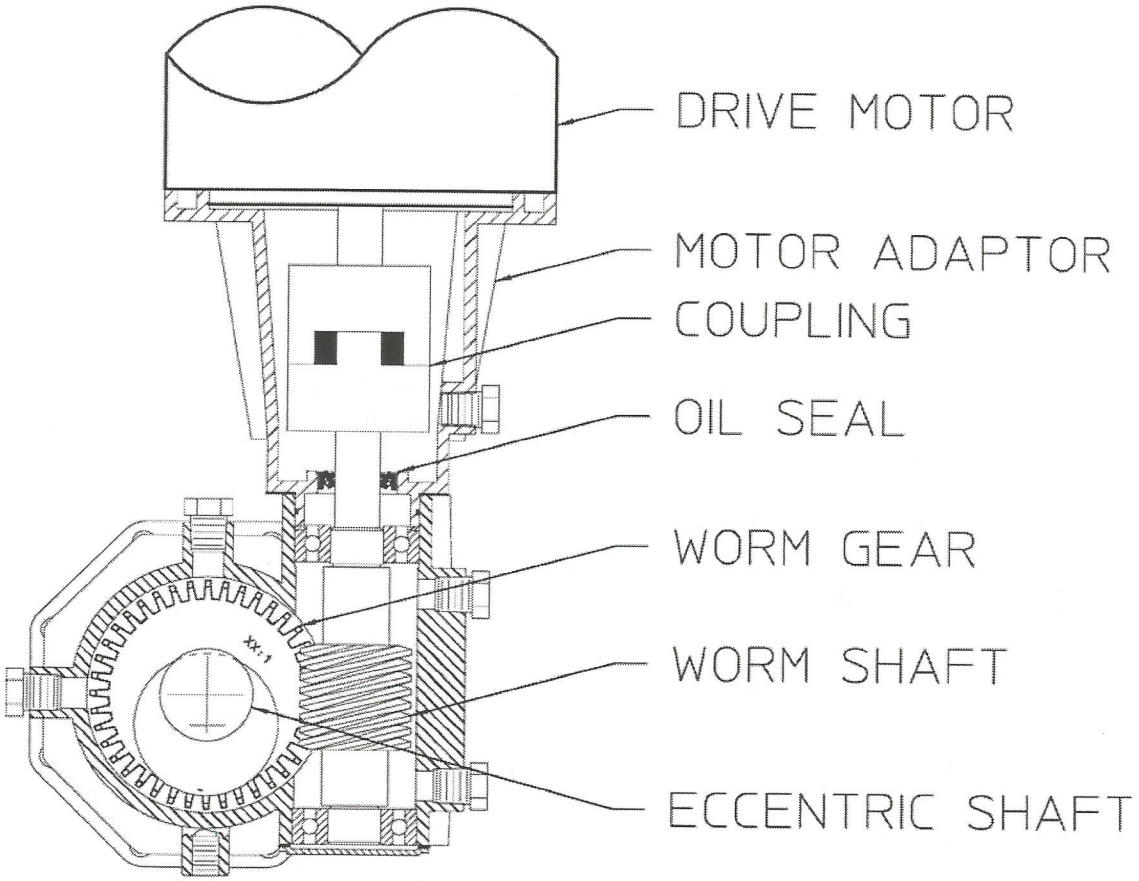


Figure 20

7.6 Cover Assembly

7.6.1 Removal and Reinstallation

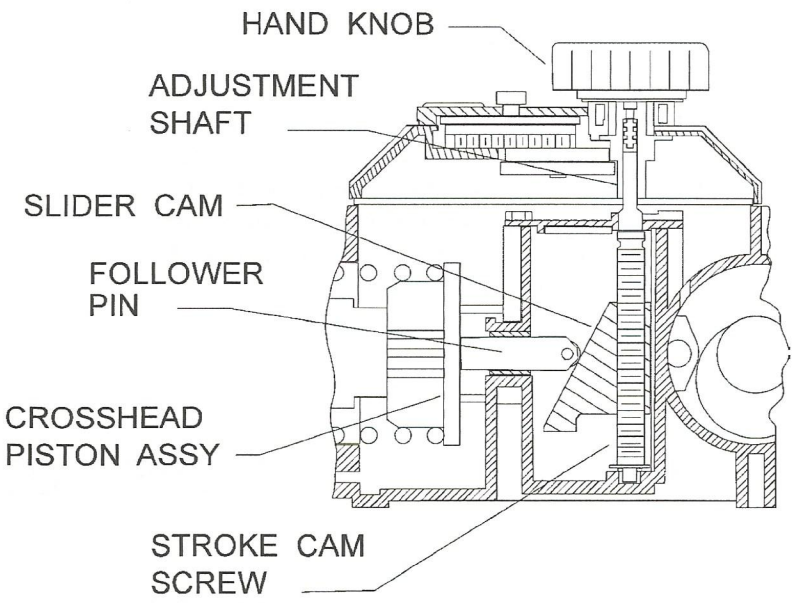


Figure 21

The hand knob linkage employs a slip type coupling which can be reassembled in either of two rotational orientations 180^0 apart from one another: therefore, the original orientation must be retained for reassembly so that pump calibration is retained.

7.6.2 Removal

1. Adjust the stroke length until the dial indicator is set at the zero stroke setting. Adjustment is easier with the drive motor running. Allow the locking mechanism to engage to the nearest detent
2. Disconnect the power source to the drive motor.
3. Remove the cover screws.
4. Using care not to rotate the adjustment shaft, remove the cover vertically from the eccentric box.

7.6.3 Reinstallation

1. Rotate the stroke cam screw clockwise until the slider cam is in a full upward position.
2. Verify that the cover dial indicates the zero stroke setting.
3. Using care not to disturb the adjustment shaft, install the cover assembly, engaging the drive coupling.
4. Replace the cover screws.
5. Press the adjustment knob down and rotate it clockwise until it stops. (Adjustment is easier with the drive motor running.) Verify that the cover dial indicates the zero stroke setting as before; if so, reinstallation is complete and if not, refer to step (6) below for realignment.
6. To re-align, loosen the screw in the center of the dial cover.
7. Adjust the dial cover to align the pointer with the 'zero' mark.
8. Retighten the screw in the center of the dial cover.

7.7 Motor

7.7.1 Removal

1. Disconnect the power source to the drive motor.
2. Disconnect the motor wiring from the motor.
3. Remove the four bolts retaining the motor to the motor adaptor and remove the motor.
4. The coupling is an interlocking jaw design and uses an elastomer spider between the two coupling halves. One half of the coupling remains on the worm shaft and the other coupling half on the motor shaft. Loosen the setscrew, which retains the coupling half to the motor shaft and remove the coupling half, taking care to not lose the shaft key.

7.7.2 Reinstallation

See instructions, Section 4.7

*Note: Motor rotation may be wired for CW or CCW rotation.

8. Replacement Parts

8.1 PULSAR Shadow® KOPkit Program

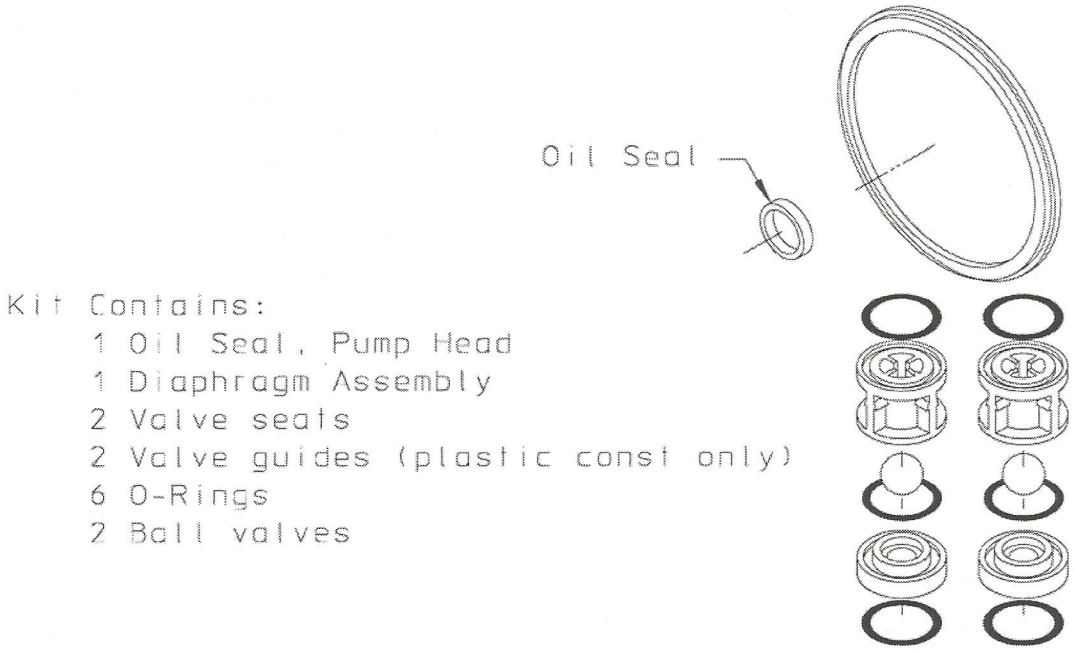


Figure *22*

PULSAR Shadow® KOPkits contain all replacement parts normally used in a preventative maintenance program. Having a KOPkit on hand can eliminate delays in repairing a pump and returning it to a critical service. Pulsalube 9M eccentric oil and Pulsalube 8G gear oils are also available for preventative maintenance programs, and should be kept on hand. There is a specific KOPkit for every PULSAR Shadow® pump model. Each KOPkit is vacuum-packed for extended storage. All PULSAR Shadow® pumps have the KOPkit number identified on the pump nameplate and Pulsafeeder order documents. KOPkits can also be selected from the technical data sheet shipped with the pump or with the assistance of a Pulsafeeder representative.

8.2 Ordering KOPkits or Parts

When ordering replacement parts always specify: Pump model and serial number (stamped on pump nameplate), e.g., Model No.L2 with Serial No. 9876303-1.

Provide the part number and description from the PULSAR Shadow® parts list. Include the three-character suffix. (Note: PULSAR Shadow® part numbers begin either with the letters 'NP', or the letter 'W', e.g., NP170001-TNR or W210221-001.)

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9. Troubleshooting Chart

Difficulty	Probable Cause	Remedy
Pump does not start.	1. Coupling disconnected.	Connect coupling.
	2. Faulty power source.	Check power source.
	3. Blown fuse, and circuit breaker.	Replace - eliminate overload.
	4. Broken wire.	Locate and repair.
	5. Wired improperly.	Check diagram.
	6. Pipe line blockage.	Open valves.
No delivery.	1. Motor not running.	Check power source. Check wiring diagram.
	2. Supply tank empty.	Fill tank.
	3. Lines clogged.	Clean and flush.
	4. Closed line valves.	Open valves.
	5. Ball check valves held open with solids.	Clean and inspect.
	6. Vapor lock, cavitation.	Increase suction pressure.
	7. Prime lost.	Reprime, and check for leak.
	8. Strainer clogged.	Remove and clean. Replace screen if necessary.
Low delivery.	1. Motor speed too low.	Check voltages, frequency, wiring, and Terminal connections. Check nameplate vs. Specifications.
	2. Check valves worn or dirty.	Clean, replace if damaged.
	4. Calibration system error.	Evaluate and correct.
	5. Product viscosity too high.	Lower viscosity by increasing product temperature. Increase pump and/or piping size.
	6. Product cavitating.	Increase suction pressure. Cool product as necessary.
Delivery gradually drops.	1. Check valve leakage.	Clean, replace if damaged.
	2. Leak in suction line.	Locate and correct.
	3. Strainer fouled.	Clean or replace screen.
	4. Product change.	Check viscosity.
	7. Supply tank vent plugged.	Unplug vent.
Delivery erratic.	1. Leak in suction line.	Locate and correct.
	2. Product cavitating.	Increase suction pressure.
	3. Entrapped air or gas in product.	Consult factory for suggested venting.
	4. Motor speed erratic.	Check voltage and frequency.
	5. Fouled check valves.	Clean, replace if necessary.
Delivery higher than rated.	1. Suction pressure higher than discharge pressure.	Install backpressure valve or consult factory for piping recommendations.
	3. Back pressure valve set too low.	Increase setting.
	4. Back pressure valve leaks.	Repair, clean, or replace.

Troubleshooting Chart (cont.)

Difficulty	Probable Cause	Remedy
Pump loses internal oil	1. Diaphragm ruptured.	Replace.
	2. Leaky seal.	Replace.
	3. Cover gasket leaks.	Replace or retighten.
	5. Pump overfilled.	Remove excess oil.
Noisy gearing, knocking	1. Discharge pressure too high.	Reduce pressure.
	2. Water hammer.	Install pulsation dampener.
	4. Stroke length at partial setting.	Nondestructive knocking is characteristic of lost motion pumps.
	5. No oil or level incorrect	Replace or refill oil
Piping noisy	1. Pipe size too small.	Increase size of piping - install pulsation dampener
	2. Pipe runs too long.	Install pulsation dampener in line.
	3. Surge chambers flooded.	Replace with air or inert gas. If a pulsation dampener is installed, replace diaphragm and recharge.
	4. No surge chambers used.	Install pulsation dampener.
Motor overheats	1. Pump overloaded.	Check operating conditions against pump design.
	2. High or low voltage.	Check power source.
	3. Loose wire.	Trace and correct.
	4. Excessive discharge pressure	Correct conditions so ratings of pump are not exceeded
Leak Detection – False Alarm	1. Vacuum/pressure leak.	Find and correct.
	2. Switch adjustment off.	Readjust switch.
	3. Switch malfunction.	Replace switch.
Leak Detection – Failure to Alarm	1. Switch adjustment off.	Readjust switch.
	2. Switch malfunction.	Replace switch.
	3. Power off.	Restore power.
	4. Alarm wiring discontinuity.	Find and correct.

10. APPENDIX I Piping Calculations

10.1 Suction Head Requirements

All reciprocating metering pumps require a net positive suction head ($NPSH_R$). The $NPSH_R$ for PULSAR Shadow® pumps is 5 psi (0.35 bar). The $NPSH_R$ is defined as the pressure required above the absolute vapor pressure of the process fluid at the pumping temperature. This pressure is required at the suction port of the pump throughout the entire pump stroking cycle in order to prevent cavitation of the process fluid within the reagent head. Satisfying the $NPSH_R$ is required to assure metering accuracy.

The net positive suction head available ($NPSH_A$) must be greater than the $NPSH_R$. The $NPSH_A$ of any given system is calculated as follows:

Equation 1. For fluid viscosity below 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \left(\frac{L_S R G Q}{C_1 d^2}\right)$$

Equation 2. For fluid viscosity at or above 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \sqrt{\left(\frac{L_S R G Q}{C_1 d^2}\right)^2 + \left(\frac{L_S \mu Q}{C_2 d^4}\right)^2}$$

The variables used in Equations 1 through 4 must be in the units shown in the table below for the constants listed below to be used correctly.

Variable	Units Set	
	English	Metric
NPSH	psi	bar
P_A	psia	bar(a)
P_H	psi	bar
P_V	psia	bar(a)
L_S	feet	meters
R	strokes/min	strokes/min
G	no units	no units
Q	gallons/hr	liters/hr
d	inches	millimeters
μ	centipoise	centipoise
L_D	feet	Meters
P_T	psi	bar
P_P	psi	bar
V_P	feet/sec	meters/sec
C_1	24,600	640
C_2	45,700	1.84

Note: If piping sizes vary throughout the suction line, different additive values may be used for the pressure losses attributed to the liquid's acceleration and deceleration. Use the last term of Equation 1 or 2 as many times as needed in the equation to adjust for different lengths of different pipe diameters in the suction line. (Everything but the pipe length and diameter will stay the same in the equation.)

10.2 System Backpressure

The system backpressure must exceed the suction pressure by at least 5 psi (0.35 bar) in order to prevent flowthrough, however it must not exceed the rated discharge pressure of the pump. Flowthrough can be defined as the process liquid flowing from a higher pressure to a lower pressure (downhill pumping), which results in a flow output greater than the pumps calibrated capacity, failure and undesired flow at pump shutdown. If the system backpressure is not at least 5 psi (0.35 bar) greater than the suction pressure, a backpressure valve must be installed in the discharge piping. To calculate the total system backpressure use Equation 3 or 4.

Equation 3. For fluid viscosity below 50 centipoise.

$$P_T = \left(\frac{L_D RGQ}{C_1 d^2}\right) + P_P \pm P_H$$

Equation 4. For fluid viscosity at or above 50 centipoise.

$$P_T = \sqrt{\left(\frac{L_D RGQ}{C_1 d^2}\right)^2 + \left(\frac{L_D \mu Q}{C_2 d^4}\right)^2} + P_P \pm P_H$$

NOMENCLATURE

$NPSH_R$ =Net positive suction head required, [psi, bar]

$NPSH_A$ =Net positive suction head available, [psi, bar]

P_A = Pressure at the surface of the liquid being pumped (atmospheric or supply tank blanket pressure) [psia, bar(a)]

P_H = Head pressure above (+) or below (-) the pump centerline, [psi, bar]

P_V = Absolute vapor pressure at pumping temperature of the process liquid at pump inlet, [psia, bar(a)]

L_S = Length of suction piping (actual, not equivalent), [ft, m]

R = Pump stroking rate, strokes/min [spm]

G = Specific gravity of process liquid, [unitless]

Q = Pump average flow rate, [gph, lph]

d = Internal pipe diameter, [inches, mm]

C_1 ,C_2 = Numeric constants used in Equations 1- 4

μ = Viscosity of process liquid at pumping temperature, centipoise [cp]

L_D = Length of discharge piping (actual, not equivalent), [ft, m]

P_P = System discharge pressure, [psig, bar(g)]

P_T = Pump discharge pressure at the discharge port, [psig, bar(g)]

11. APPENDIX II Oil Specifications

PULSAlube #8G

AGMA Number = 7 EP
ISO Viscosity Grade = 460
API Gravity (ASTM D 287) = 34.1
Viscosity (ASTM D 2161) SSU @ 100 degrees F = 2241
Viscosity (ASTM D 2161) SSU @ 210 degrees F = 225
Viscosity Index (ASTM D 2270) = 167
Pour Point (ASTM D 97) Degrees F8 = -40(-40)
Flash Point, COC (ASTM D 92) Degrees F8 = 490(254)
Timken OK Load (ASTM D 2782) Lb(kg) = 100+(45+)
Four Ball EP Test (ASTM D 2783)
Weld Point kg = 250
Load Wear Index = 47
Rust Test (ASTM D 665A&B) = Pass
Oxidation Test (ASTM D 2893) = Pass
Demulsibility Test (ASTM D 2711) = Pass
Foam Test (ASTM D 892) = Pass
Copper Corrosion (ASTM D 130) = 1-A
Color = amber

PULSAlube 9M

AGMA Number = 7
ISO Viscosity Grade = 460
API Gravity = 28.7
Viscosity (ASTM D 2161) SSU @ 100 degrees F = 2000
Viscosity (ASTM D 2161) SSU @ 210 degrees F = 141
Viscosity Index (ASTM D 2270) = 159
Pour Point (ASTM D 67) Degrees F8 = -10
Flash Point, COC (ASTM D 92) Degrees F8 = 560
Timken OK Load (ASTM D 2782) Lb(kg) = 100+(45+)
Four Ball EP Test (ASTM D 2783)
Weld Point kg = 255
Load Wear Index = 44
Rust Test (ASTM D 665A&B) = Pass
Oxidation Test (ASTM D 2893) = Pass
Demulsibility Test (ASTM D 2711) = Pass
Foam Test (ASTM D 892) = Pass
Copper Corrosion (ASTM D 130) = 1-A
Color = amber

12. APPENDIX III Bolt Torque Tables

PULSAR- Liquid End Bolt Torque Requirements

Metal Construction

Reagent Head Part#	Head Size	Head Bolts			Tie Bars		
		# Bolts and Size	Torque		#Bolts and Size	Torque	
			N-m	Ft-Lbs		N-m	Ft-Lbs
NP160001	A	(6) M10 * 1.5	39	29	(4) M8 * 1.25	8	6
NP160002	B	(6) M12 * 1.75	68	50	(4) M8 * 1.25	8	6
NP160003	C	(6) M10 * 1.5	39	29	(4) M8 * 1.25	8	6
NP160004	D	(6) M8 * 1.25	20	15	(4) M8 * 1.25	8	6

Plastic Construction

Reagent Head Part#	Head Size	Head Bolts			Tie Bars		
		# Bolts and Size	Torque		#Bolts and Size	Torque	
			N-cm	in-lbs		N-cm	in-lbs
NP160012	A	(6) M10 * 1.5	850	75	(4) M8 * 1.25	250	22
NP160014	B	(6) M12 * 1.75	850	75	(4) M8 * 1.25	250	22
NP160011	C	(6) M10 * 1.5	850	75	(4) M8 * 1.25	250	22
NP160013	D	(6) M8 * 1.25	850	75	(4) M8 * 1.25	250	22

13. Appendix V Pulsafeeder Accessories

13.1 Pulsation Dampeners

The PULSuppressor pulsation dampener is a pneumatically charged diaphragm-type chamber that intermittently stores energy. Used on the inlet, it can improve NPSHa (Net Positive Suction Head available) characteristics of the suction piping system. On the discharge line it will reduce peak pressures and pulsating flow variations.

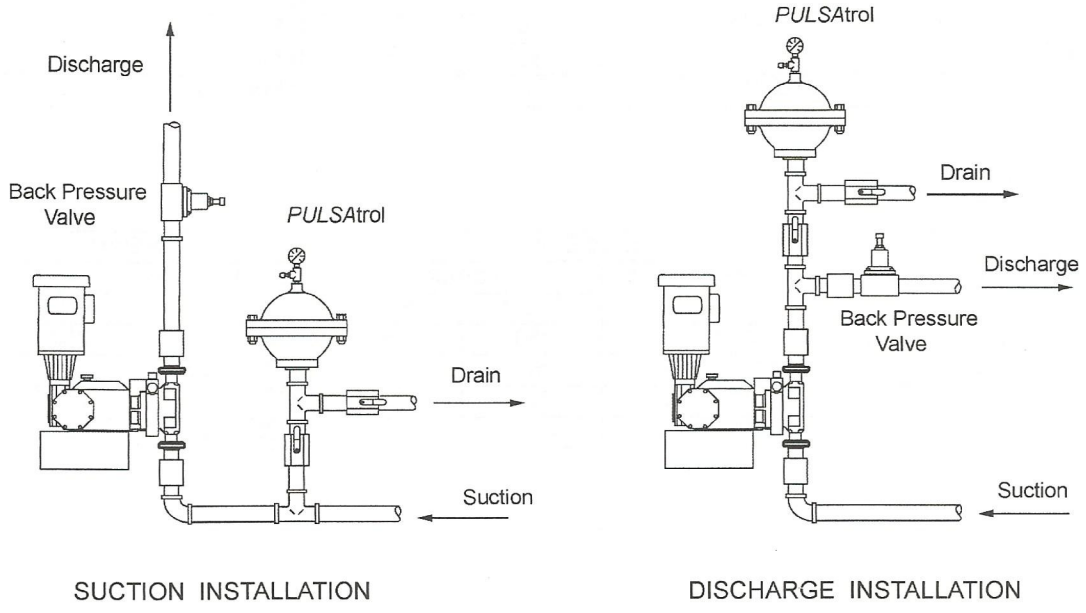


Figure 23

13.2 Dampener Installation

On both discharge and suction lines, it is desirable to mount the pulsation dampener as close to the pump connection as possible. It can be mounted in any position: horizontally, vertically, or at any angle. Vertical orientation places the process connection at the bottom, facilitating draining of the unit for maintenance or repair. A shutoff valve should always be used between the piping system and pulsation dampener. If the discharge line is open to atmospheric pressure, a backpressure valve should also be incorporated in the system beyond the pulsation dampener to assure proper operation. Pulsation dampeners do require regular maintenance and inspection. Charge pressure should be checked every 2-4 months and renewed as needed. Temperature, pressure, and other variables will affect charge life and diaphragm/bladder life.

NOTE **The diaphragm/bladder in a pulsation dampener is a wearable item that will need periodic inspection and replacement.**

A) Discharge Setup

The pulsation dampener may be precharged with air or nitrogen. When properly precharged the diaphragm is positioned against the bottom liquid chamber. It is therefore necessary to drain all liquid below the diaphragm and vent to atmospheric pressure when precharging.

Use the precharge pressure as determined from the pulsation dampener selection and sizing procedure (Catalog No. 211). This can vary from 50 to 80% of mean line pressure in accordance with fluctuation level selected. The pulsation dampener is now ready for service and the diaphragm will move to a neutral position as liquid enters the chamber.

Use the following to complete a Pre Charge Procedure for Discharge Installation

1. Calculate the precharge pressure
    a. Mean Line Pressure (PSIG) + Atmospheric Pressure = Absolute Pressure (PSIA)
    b. Absolute Pressure (PSIA) x Precharge Percentage (80% max) = Pressure Absolute
    c. Pressure Absolute – Atmospheric Pressure = Precharge Pressure (PSIG)
2. Isolate the pulsation dampener from the process line.
3. Carefully drain off process fluid by opening a drain valve (see recommend piping arrangement).
4. Apply precharge pressure (additional liquid may drain as diaphragm moves).
5. Close drain valve.
6. Place the pulsation dampener in the process stream.

B) Suction Setup (Flooded Suction)

Charge the pulsation dampener with adequate pressure to overcome the static suction head. Start up the pump. Depress the stem on the charge valve, but only during discharge strokes of the pump, until the gauge indicates pressure pulses. The diaphragm has now centered allowing the pulsation dampener to accumulate liquid while the pump is discharging. If too much air becomes released and the gauge will not indicate pressure pulses, recharge the pulsation dampener and repeat the procedure.

Use the following to complete a Pre Charge Procedure for Suction Installation

1. Isolate accumulator from line.
2. Carefully drain off process fluid by opening a drain valve
3. Apply 5-10 psi precharge pressure (additional liquid may drain as diaphragm moves).
4. Close drain valve.
5. Bleed off all pressure on the pulsation dampener.
6. Open the valve to put pulsation dampener in stream.
7. Push in on the stem of the charging valve during the discharge stroke of the pump and release during the suction stroke.
8. Continue this for about 10 times and observe the compound gauge. As accumulator functions, the needle will go from pressure to vacuum.

13.3 Pulsation Dampener Removal

When removing or disassembling a pulsation dampener, drain all piping and remove all air and process pressure. Assume that the diaphragm is broken and the chamber is flooded under pressure since the pressure gauge could be damaged. Separate chambers with caution in a direction away from the body.

WARNING

REMEMBER THAT THE PULSATION DAMPENER HOUSING WILL RETAIN SOME AMOUNT OF PROCESS FLUID, AND HANDLE ACCORDINGLY.

13.4 Diaphragm Back Pressure and Pressure Relief Valves

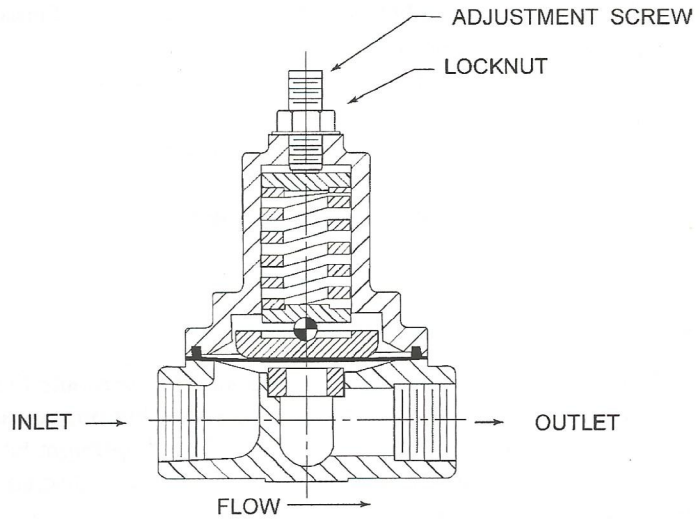
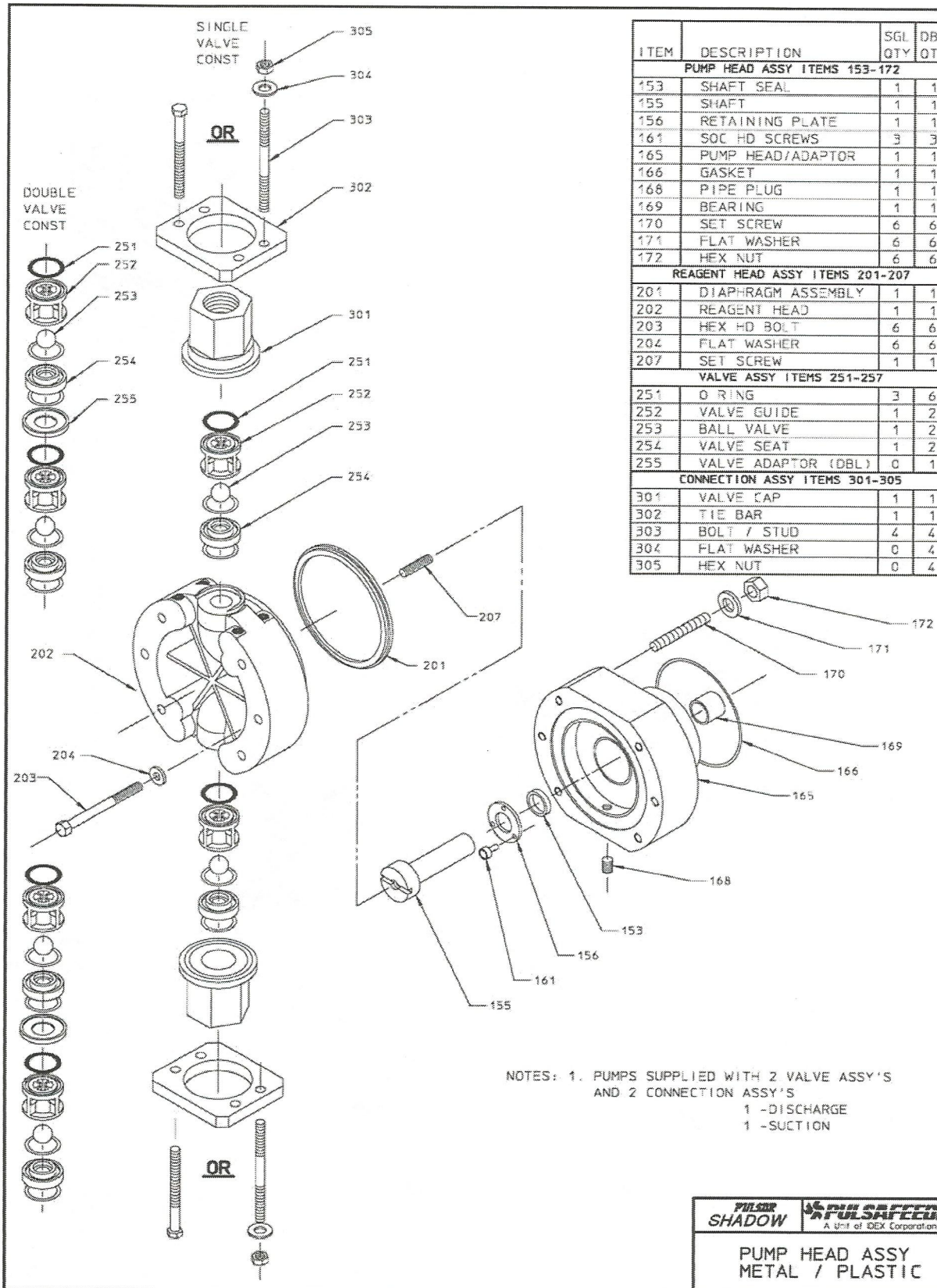


Figure 24

A diaphragm backpressure valve creates a constant system backpressure upstream of the valve. A TFE diaphragm, offering maximum chemical protection and service life, seals the spring and bonnet from the product. This diaphragm seals directly on a replaceable seat. In most systems, the setting of the backpressure valve will determine the overall system backpressure seen by the metering pump.

A diaphragm pressure relief valve protects system components from excessive pressure within the system. The valve is normally set to some value slightly above normal process pressure. If this pressure setting is exceeded, the pressure relief valve will open to control and limit system pressure. The outlet port of the pressure relief valve should be carefully directed back to the supply tank or to some other safe point. The use of a pressure relief valve is especially important in systems utilizing mechanical diaphragm pumps, as these pumps have no internal bypass or relief capability.

Be sure to install either type of valve with fluid flow in direction of arrow on valve body or label.



ITEM	DESCRIPTION	SGL QTY	DBL QTY
	PUMP HEAD ASSY ITEMS 153-172		
153	SHAFT SEAL	1	1
155	SHAFT	1	1
156	RETAINING PLATE	1	1
161	SOC HD SCREWS	3	3
165	PUMP HEAD/ADAPTOR	1	1
166	GASKET	1	1
168	PIPE PLUG	1	1
169	BEARING	1	1
170	SET SCREW	6	6
171	FLAT WASHER	6	6
172	HEX NUT	6	6
	REAGENT HEAD ASSY ITEMS 201-207		
201	DIAPHRAGM ASSEMBLY	1	1
202	REAGENT HEAD	1	1
203	HEX HD BOLT	6	6
204	FLAT WASHER	6	6
207	SET SCREW	1	1
	VALVE ASSY ITEMS 251-257		
251	O RING	3	6
252	VALVE GUIDE	1	2
253	BALL VALVE	1	2
254	VALVE SEAT	1	2
255	VALVE ADAPTOR (DBL)	0	1
	CONNECTION ASSY ITEMS 301-305		
301	VALVE CAP	1	1
302	TIE BAR	1	1
303	BOLT / STUD	4	4
304	FLAT WASHER	0	4
305	HEX NUT	0	4

NOTES: 1. PUMPS SUPPLIED WITH 2 VALVE ASSY'S AND 2 CONNECTION ASSY'S
1 -DISCHARGE
1 -SUCTION

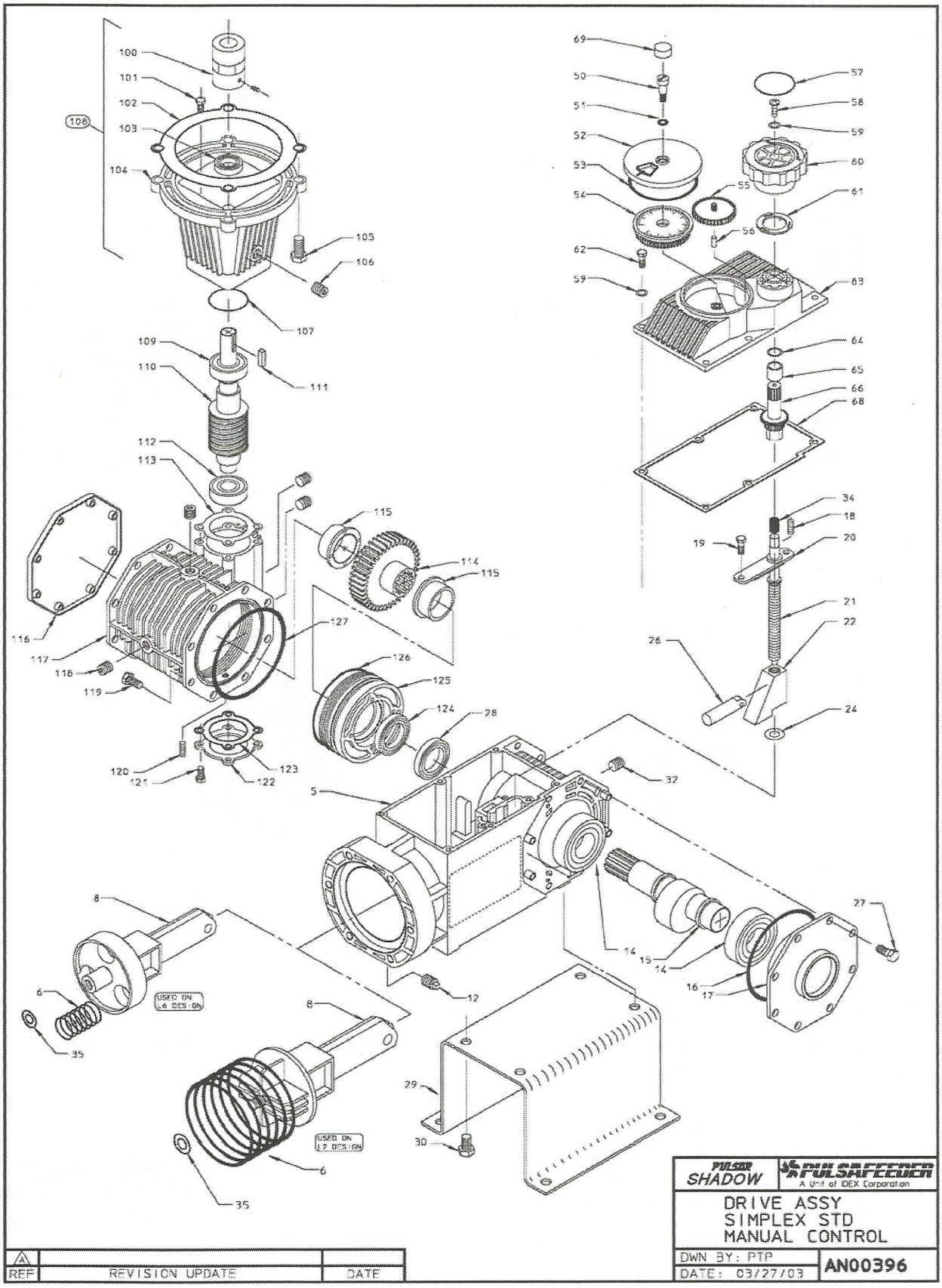
REF	REVISION UPDATE	DATE
A		

PULSAR SHADOW | PULSAFEEDER A Unit of IDEX Corporation

PUMP HEAD ASSY
METAL / PLASTIC

DWN BY: PTP
DATE: 03/27/03

AN00395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PULSAR SHADOW
PULSAFEEDER
A Unit of IDEX Corporation
DRIVE ASSY
SIMPLEX STD
MANUAL CONTROL
DWN BY: PTP
DATE: 03/27/03
AN00396
REF
REVISION UPDATE
DATE

ITEM	DESCRIPTION	QTY
	ECCENTRIC BOX ASSY ITEMS 5 -35	
5	ECCENTRIC BOX SUB-ASSY	1
6	RETURN SPRING	1-3
8	CROSSHEAD SUB-ASSY	1
12	PIPE PLUG	1
14	BEARING	2
15	ECCENTRIC	1
16	O RING	1
17	BEARING CAP	1
18	SET SCREW	1
19	HEX HD BOLT	2
20	WEDGE COVER	1
21	ADJUSTMENT SCREW	1
22	WEDGE	1
24	THRUST WASHER	1
26	FOLLOWER SUB-ASSY	1
27	HEX HD BOLT	4
28	OIL SEAL	1
29	BASE	1
30	HEX HD BOLT	4
31	TOLERANCE RING (NOT SHOWN)	2
32	PIPE PLUG	1
34	SPRING	1
35	SPACER SHIM	0-2
	MANUAL CONTROL ASSY ITEMS 50-69	
50	SHOULDER SCREW	1
51	O RING	1
52	SCALE COVER	1
53	GASKET	1
54	SCALE GEAR	1
55	GEAR	1
56	DOWEL PIN	1
57	LABEL	1
58	SCREW	1
59	FLAT WASHER	2
60	KNOB	1
61	CLICKER	1
62	HEX HD BOLT	6
63	COVER	1
64	O RING	1
65	BUSHING	1
66	GEAR SHAFT	1
68	COVER GASKET	1
69	SCREW CAP	1
	GEARBOX ASSY ITEMS 100-129	
100	COUPLING	1
101	HEX HD BOLT	4
102	GASKET	1
103	OIL SEAL	1
104	MOTOR ADAPTOR	1
105	HEX HD BOLT	4
106	PIPE PLUG	1
107	O RING	1
108	MOTOR ADAPTOR ASSY	1
109	BEARING	1
110	WORM	1
111	KEY	1
112	BEARING	1
113	SHIM PACKAGE	1
114	WORM GEAR	1
115	BEARING	2
116	COVER	1
117	GEARBOX	1
118	PIPE PLUG	4
119	HEX HD BOLT	4
120	SET SCREW	1
121	HEX HD BOLT	4
122	BOTTOM COVER	1
123	GASKET	1
124	OIL SEAL	1
125	GEARBOX CAP	1
126	O RING	1
127	O RING	1
128	NAME TAG (NOT SHOWN)	1
129	DRIVE SCREW (NOT SHOWN)	4

REF	REVISION UPDATE	DATE
A		

PULSAR SHADOW | PULSAFEEDER A Unit of IDEX Corporation

DRIVE ASSY
SIMPLEX STD
B.O.M

DWN BY: PTP
DATE: 03/27/03

AN00397

PULSAFEEDER®

A Unit of IDEX Corporation

PULSAR HypoPump® 2

Auto De-gas Metering Pump

USER NOTE: This addendum serves as additional information for Pulsafeeder PULSAR® and PULSAR Shadow® metering pumps equipped with the Auto De-gas Valve for purging trapped gasses from the reagent head. You must also reference the latest revision of the complete PULSAR® or PULSAR Shadow® pump IOM for critical safety and operational information.

BULLETIN No. PS-IOM-HYPO2-0111-A

PULSAFEEDER®

Manufacturers of Quality Pumps,
Controls and Systems

Engineered Pump Operations
2883 Brighton-Henrietta Townline Road
Rochester, New York 14623
Telephone: (585) 292-8000 Fax: (585) 424-5619
http://www.pulsa.com pulsa@idexcorp.com

FACTORY SERVICE POLICY

If you are experiencing a problem with your Pulsafeeder pump, first review the IOM, and consult the troubleshooting guide. If the problem is not covered or cannot be solved, please contact your local PULSA Series Sales Representative or our Technical Service Department at (585) 292-8000 for further assistance.

Trained individuals are available to diagnose your problem and arrange a solution. Solutions may include purchasing a replacement unit or returning the pump or components to the factory for inspection and repair. All returns require a Return Material Authorization (R.M.A.) number to be issued by Pulsafeeder.

Certain components may be purchased for replacement. Parts purchased to correct a warranty issue may be credited after examination of the original parts by Pulsafeeder personnel. Parts returned for warranty consideration that test satisfactorily, will be sent back to the originator freight collect.

Any field modifications will void the Pulsafeeder warranty. Out-of-warranty repairs will be subject to Pulsafeeder's standard bench fees and testing costs associated with replacement components.

Notice

Information and specifications in this document are subject to change without notice.

Revision History:

Rev A (01-01-11)
- Original Release Date

Copyright

Trademarks

PULSAR® is a registered trademark of Pulsafeeder, Inc.

PULSAR HypoPump® is a registered trademark of Pulsafeeder, Inc.

Cruise Control® is a registered trademark of Pulsafeeder, Inc.

PULSAR Shadow® is a registered trademark of Pulsafeeder, Inc.

Table of Contents

1. Conventions

For the remainder of this bulletin, the following Conventions are in effect.

A WARNING DEFINES A CONDITION THAT COULD CAUSE DAMAGE TO BOTH THE EQUIPMENT AND THE PERSONNEL OPERATING IT. PAY CLOSE ATTENTION TO ANY WARNING.

Notes are general information meant to make operating the equipment easier.

Tips have been included within this bulletin to help the operator run the equipment in the most efficient manner possible. These "Tips" are drawn from the knowledge and experience of our staff engineers, and input from the field.

The $HYPO_2$ Auto De-gas Pump, designed for purging entrained gas from the pump reagent head, is referred to in this manual as the "ADV".

2. General Safety

The Auto De-gas Valve (ADV) was designed as a gas handling/priming aid for operation solely with Pulsafeeder PULSAR® and PULSAR Shadow® metering pumps. Use for any other application is considered un-safe and voids all certification markings and warranties.

2.1 Explosive Atmosphere Safety

Explosion Hazard -- Do not perform installation or maintenance of any kind on this device while circuit is live and/or the area is known to be hazardous. This unit is not intended for use in explosive or hazardous locations.

2.2 Electrical Safety

Improper application and use of the ADV can be hazardous. You are solely responsible for its use.

The ADV electrical installation must conform to all relevant electrical codes. Installation and electrical maintenance must be performed by a qualified electrician. Before installing or servicing this device, all power must be disconnected from the source at the main distribution panel.

The ADV emits electro-magnetic energy. Its use is restricted to industrial applications. You are responsible for shielding this device if necessary.

It is recommended that the ADV be powered from a Ground Fault Circuit Interrupter (GFCI) protected electrical circuit.

2.3 Hydraulic Safety

Thoroughly review and adhere to the contents of the latest version of the PULSAR® or PULSAR Shadow® Installation, Operation, Maintenance (IOM) manual for hydraulic installation of your metering pump.

3. Equipment Inspection

When you receive your order, check all equipment for:

- Completeness against the shipping document / purchase order
- Evidence of shipping damage.

Shortages or damage should be reported immediately to the carrier and your PULSAFEEDER representative.

4. Storage

The ADV can be successfully stored for extended periods. The key to this success is temperature and humidity control.

Be certain to follow the additional storage instructions provided in the IOM for the PULSAR® or PULSAR Shadow® pumps, and also those included in the IOM for any controllers (DLC, DLCM, ECA) that are attached to the pump.

4.1 Short Term (0 - 12 months)

The ADV should be stored in a temperature and humidity controlled environment. It is preferable to keep the temperature constant in the range of -18 to 60° Celsius (0 to 140° Fahrenheit). The relative humidity should be 0 to 90% non-condensing.

If the ADV is installed on the pump, it should not be removed during this period – provided the above conditions can be applied to the pump as well. If the ADV was shipped in its own carton, it should be stored in that carton.

4.2 Long Term (12 months or more)

Storage of the ADV for periods of longer than twelve months is not recommended. If extended storage is unavoidable the ADV should be stored in accordance with those conditions stipulated for Short Term Storage. In addition, a porous bag of 85g (3 oz) silica gel or similar desiccant should be placed inside the ADV enclosure. The cover should be re-installed to seal the desiccant within the enclosure. The conduit connection must be tightly capped.

5. Retrofit

Retrofit kits including the HypoPump® reagent head assembly, the ADV, and other necessary parts and hardware, are available. These allow the conversion of an existing Pulsafeeder PULSAR® and PULSAR Shadow® metering pumps to a HypoPump®. This conversion can be performed in the field. Port-to-port dimensions and certain other specifications and ratings may change. Consult your local Pulsafeeder sales representative for more information.

6. Overall System Diagram

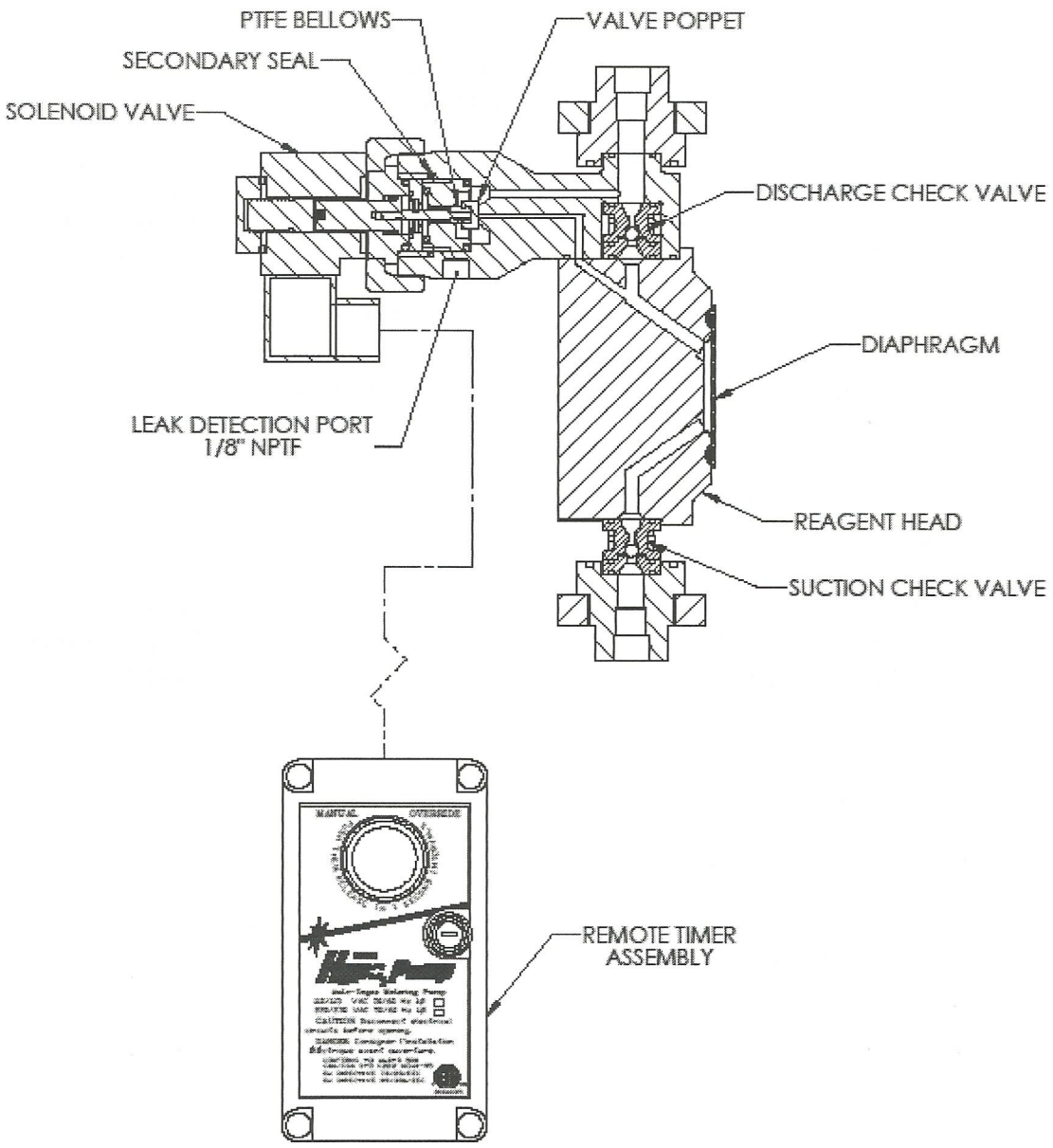


Figure 1

The ADV consists of a pressure balanced valve which opens periodically to allow fluid from the discharge line to bypass the discharge check valve and flow back into the pump head. The valve is actuated by a solenoid controlled by a solid-state timer. The ADV Valve Assembly incorporates a dual sealing design to insure the valve function even if the Primary Bellows seal fails. The Leak Detection Port (1/8" NPTF) allows visual indication of a Bellows failure while allowing the ADV to keep functioning. At the discretion of the user, this port may be used to pipe any leakage to a safe vessel or a leak detection device.

7. Installation

7.1 Location

NOTE **Review the Safety section prior to installing the pump with ADV. It contains information required to properly install and operate the ADV in an industrial environment.**

Review the PULSAR® or PULSAR Shadow® Installation Operation Maintenance manual provided with your metering pump. It details system related issues that are important to proper operation of the pump and also the ADV. The ADV should be mounted in an area where the operator has access to the front of the unit. Avoid locations where the ADV would be subjected to extreme cold or heat. Note the warning statement on the next page. The installation of this device must comply with national, state and local codes.

Allow 6 inches minimum clearance from the front of the ADV enclosure to allow for removal and re-installation of the ADV as a unit.

WARNING **AVOID LOCATIONS WHERE THE ADV WOULD BE SUBJECTED TO EXTREME COLD OR HEAT OR DIRECT SUNLIGHT. FAILURE TO OBSERVE THIS WARNING COULD DAMAGE THE ADV AND VOID ITS WARRANTY**

MINIMUM OPERATING TEMPERATURE	**0° CELSIUS / 32° FAHRENHEIT**
MAXIMUM (PVC CONSTRUCTION)	**49° CELSIUS / 120° FAHRENHEIT**
MAXIMUM (PVDF CONSTRUCTION)	**65° CELSIUS / 150° FAHRENHEIT**

7.2 Installation Notes

1. Do not make any electrical connections without adequate grounding.
2. Conduit connections can carry fluids and vapors into the ADV causing damage and voiding the warranty. Care should be taken when installing conduit to protect against fluid/vapor entry. If necessary, provide sealed entries or conduit drains near the point of entry.
3. It is recommended that the ADV be powered from a Ground Fault Circuit Interrupter (GFCI) protected electrical circuit.

7.3 Electrical Wiring

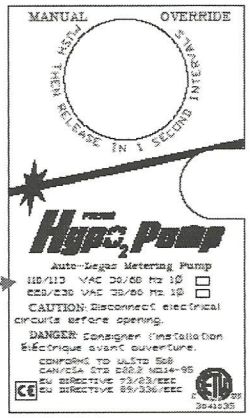
The ADV is available in two voltages, and is rated as follows:

115 VAC, 50/60 Hz, 0.2 A

OR

230 VAC, 50/60 Hz, 0.1 A

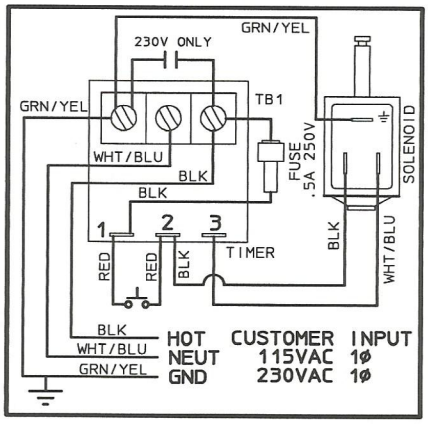
The ADV voltage is indicated on the enclosure label.



NOTE **Install wiring to the unit using a minimum of 18 inches of flexible conduit or cable attached to the auto valve assembly in order to facilitate removal of the valve assembly from the reagent head for cleaning or maintenance.**

Wiring must conform to all applicable codes. Prior to pump startup; always check to ensure that the ADV voltage and frequency matches that of the power supply. It is recommended that the ADV be powered from a Ground Fault Circuit Interrupter (GFCI) protected electrical circuit.

1. Remove the enclosure front cover. Note: The plastic screw hole plugs can be pried out using a flat bladed tool.
2. Bring AC power and ground wires into valve assembly enclosure through the 7/8" diameter hole in the side of the enclosure. Use #18 AWG 105 degree C insulation wire size minimum. Connect per the wiring diagram. The wiring diagram is also reproduced on a label affixed to the back of the enclosure cover.



Wiring Diagram

3. Apply power to the valve assembly with or without the pump running. Verify that the solenoid mounted on the pump reagent head clicks every 30 seconds.
4. Reattach cover and replace plastic hole plugs over screws.

8. Description and Operation

8.1 Principle of Operation

Reciprocating metering pumps are used with a wide variety of chemicals, such as sodium hypochlorite, that produce gas within the piping and pump systems. This gas can accumulate in the pump reagent head, causing the pump to "air bind" and lose prime.

The Auto De-gas Valve (ADV) prevents this by allowing a small amount of pressurized fluid from the discharge line to bleed back into the pump head, thereby helping to keep the pump head primed and also displacing gas through the discharge check valve. The system also has a Manual Override Button to enable faster pump priming at pump startup or other situations.

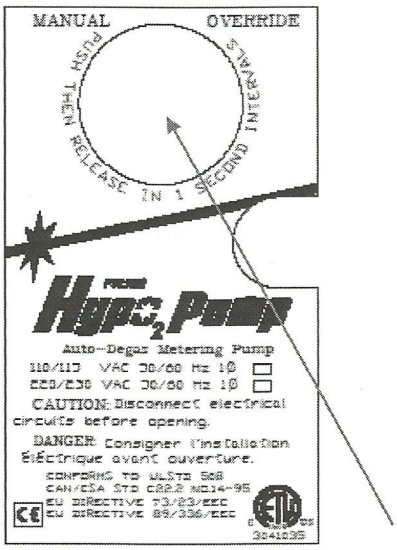
8.2 General Description

The PULSAR® and PULSAR Shadow® HypoPump® system consists of the pump reagent head, suction and discharge valves, and Auto De-gas Valve (ADV). The ADV consists of a pressure balanced valve which opens periodically to allow fluid from the discharge line to bypass the discharge check valve and flow back into the pump head. The valve is actuated by a solenoid controlled by a solid-state timer. This pre-set timer will operate properly in the majority of HypoPump applications.

Power supply required is 115 or 230 VAC, 50 or 60 hz. All electrical components are enclosed in a NEMA 4X (IP 65) enclosure, which is isolated from the pumped fluid. The timer is preset at the factory to open for 0.25 seconds every 30 seconds in order to achieve optimum gas handling time with minimal pump capacity loss. The valve assembly is easily removed from the pump head in order to access the discharge check valve for cleaning or replacement. The automatic valve assembly can be run independently of the pump motor and/or controls.

8.3 Operation of Manual Override Button

The Manual Override Button functions as a fast priming aid. For best results depress the button 1 second every few seconds. Do not hold the button down continuously.



Depress the button 1 second every few seconds

Figure 4

9. Maintenance

9.1 Maintenance Notes

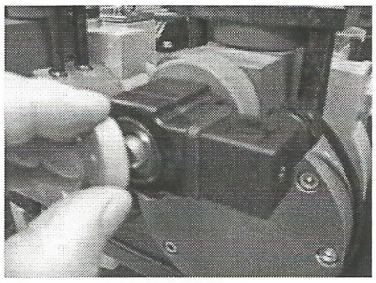
NOTE **The O-ring seals used in the check valve and ADV are critical to product containment and pump operation. All o-rings should be inspected carefully and any that show signs of damage or wear should be replaced. The owner may wish to replace these seals any time the ADV assembly is removed from the pump.**

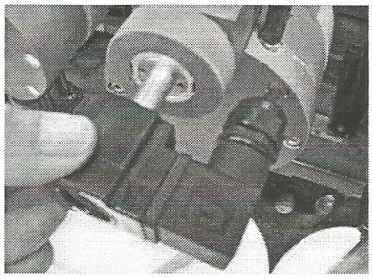
A complete cartridge seal assembly is available to the owner as a separate repair part. If necessary, the complete ADV assembly is available as a repair item.

9.2 Auto De-gas Valve Seal Kit Replacement

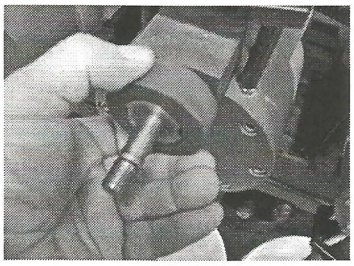
WARNING **CAUTION**: Take all precautions to prevent environmental and personnel exposure to hazardous materials. Any product being pumped will be released during this procedure.

1. Disconnect the power source to the pump drive motor and ADV.
2. Relieve all pressure from the piping system and follow safety requirements for contact / exposure to the fluid being pumped.
3. Remove Cap Nut from front of solenoid and slide off solenoid.

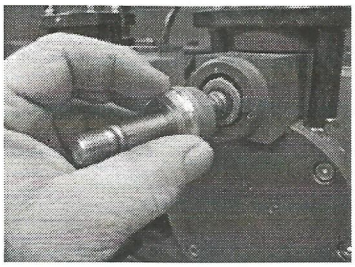




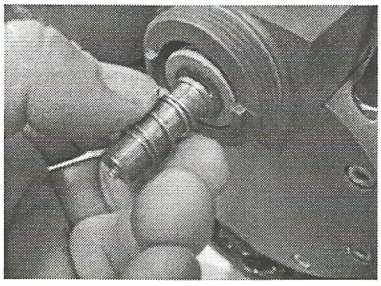
4. Loosen and remove the Union Nut. At this point fluid being pumped may be released from the assembly.

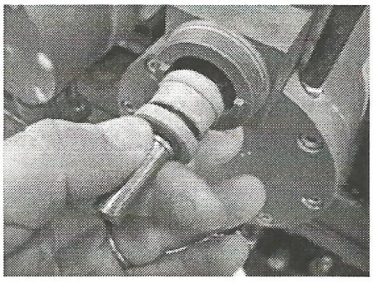


5. Remove Core Tube Assembly.

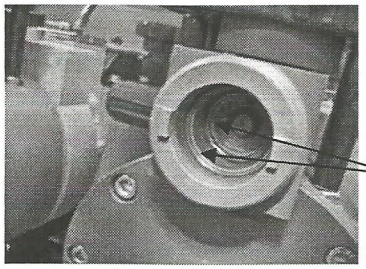


6. Remove outer spring from Core Assembly (Seal Kit Assembly) and pull Core Assembly out.

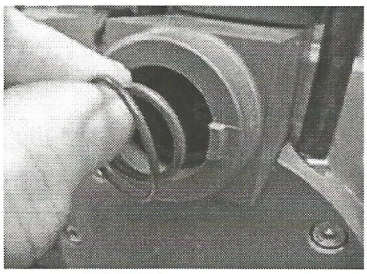




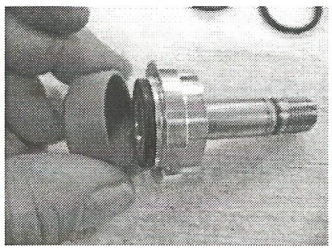
7. Inspect Valve Body for O-rings that may have been left in and remove.

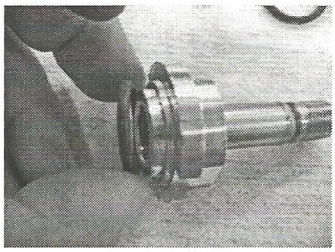


Locate and remove both O-rings



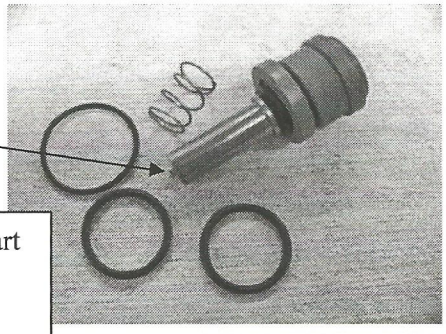
8. Remove the sleeve from the Core Tube and remove the O-ring.





9. Locate parts from the Seal Kit.

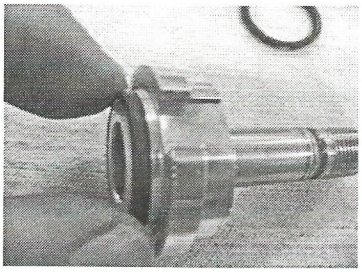
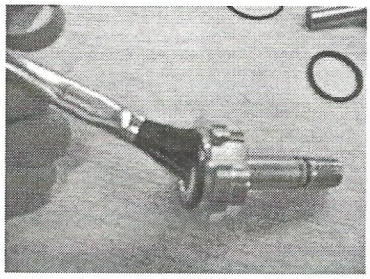
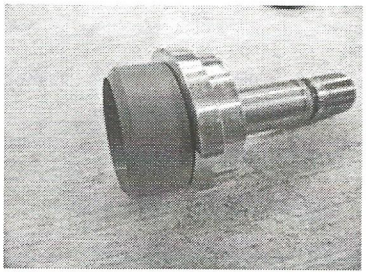
Inspect Seal Kit parts and insure the small spring is in the core.



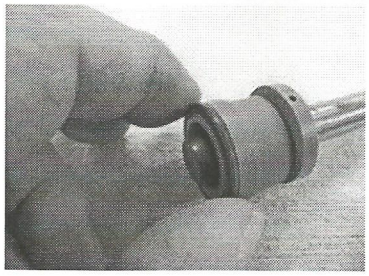
NOTE

CAUTION: Do not unscrew any part of the seal kit during inspection or reassembly. Any change in length will affect valve performance.

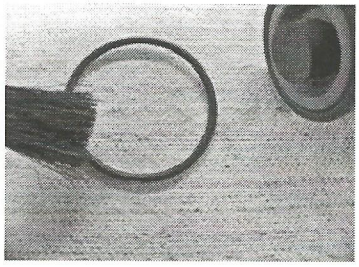
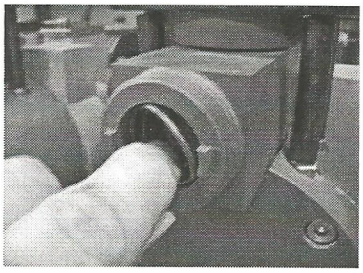
10. Install NEW O-ring onto core tube, lubricate with lubricant that is compatible with product being pumped, and reinstall sleeve over Core Tube.

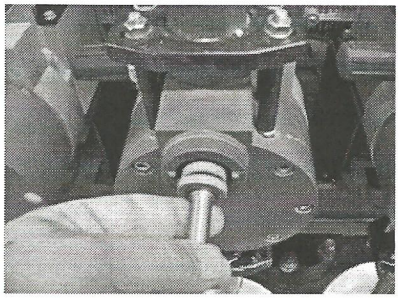
11. Install NEW O-ring on Seal Kit and with lubricant that is compatible with product being pumped.



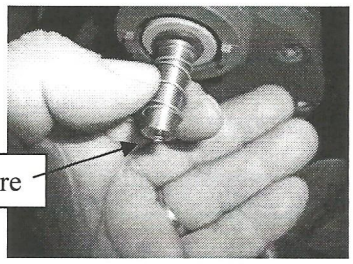

12. Apply a lubricant that is compatible with product being pumped to the Body O-ring and install into Valve Body.

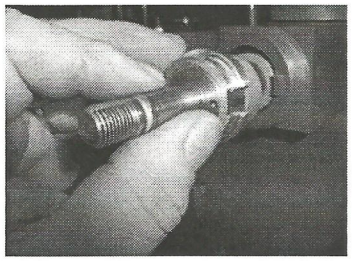
13. Install NEW Seal Kit into Valve Body. Use care to ONLY push straight into bore.

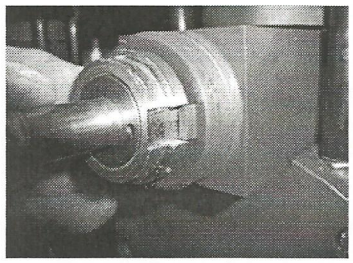


14. Install New spring over Core and check that Small Spring is still in the Core.

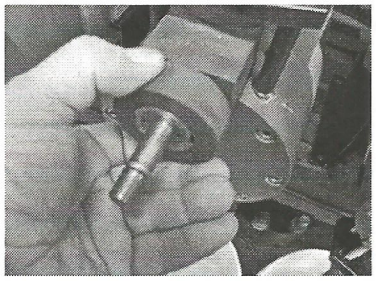


15. Slide Core Tube over core and align to the tabs on the Valve Body.

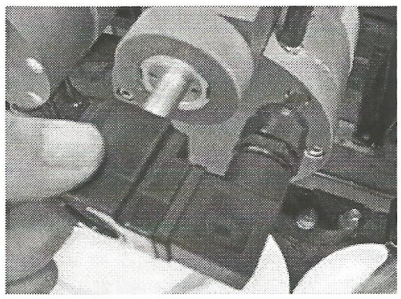


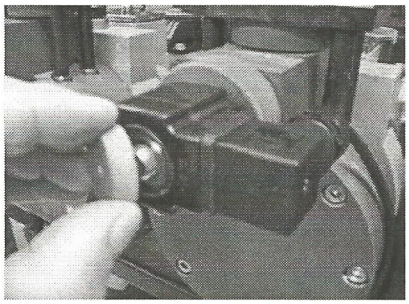


16. Slide Union Nut over Core Tube and tighten onto Body. Do not over tighten, hand tight is sufficient.



17. Slide the solenoid over the Core Tube and secure with Cap Nut. Hand Tight.





18. Reapply power to the pump and ADV and follow standard startup instructions from IOM supplied with pump.

9.3 Valve Body and Discharge Valve Assembly Removal

WARNING

CAUTION: Take all precautions to prevent environmental and personnel exposure to hazardous materials. Any product being pumped will be released during this procedure.

NOTE

The O-ring seals used in the check valve and ADV are critical to product containment and pump operation. All o-rings should be inspected carefully and any that show signs of damage or wear should be replaced. The owner may wish to replace these seals any time the ADV assembly is removed from the pump.

1. Disconnect the power source to the pump drive motor. If you plan to maintain the ADV itself, remove power from the ADV unit. For maintenance to the check valves only, the ADV need not be disconnected.
2. Relieve all pressure from the piping system.
3. Close the inlet and outlet shutoff valves.
4. Take all precautions to prevent environmental and personnel exposure to hazardous materials.

5. Loosen the suction valve tiebar bolts and shift the suction piping slightly to drain any liquid from the reagent head cavity. If the piping is closely connected it may be necessary to disconnect a union or flange.
6. Loosen the tiebar bolts on the discharge valve and shift the piping slightly to drain any liquid.
7. Slide the valve assembly away from the front of the reagent head. Take care to not let the check valve parts fall out of the bottom of the valve assembly as it is removed from the reagent head.
8. Once the ADV is separated, the discharge check valve components can be removed from the assembly and cleaned or replaced.
9. Installation is the reverse of the above procedure. Be sure that the oval shaped o-ring on the bottom of the valve assembly is in the proper position when reinstalling the valve assembly.

10. Troubleshooting Guide

Symptom	Probable Cause	Possible Solution
Pump does not prime (product side)	Purge relay not operational	Verify power is present at timing relay.
	Valve not actuating	Verify power is present at Valve Solenoid and there is a clicking noise every 30 seconds.
	Check valves fouled or damaged	Clean or replace suction and/or discharge check valves as per pump IOM.
	Power interruption	Check that power is connected to the ADV
	Valve stuck open	Clean or replace Seal Kit.
Low pump delivery	Check valves fouled or damaged.	Clean or replace suction and/or discharge check valves as per pump IOM.
	Calibration or testing error	Evaluate cause and correct
	ADV Valve fouled	Clean or replace Seal Kit
Leak detection port shows leakage	Failed Bellows Seal	Install New Seal Kit
Valve fails to actuate	Power interruption	Verify power is present at Valve Solenoid and there is a clicking noise every 30 seconds.
	Crystallized product in valve assembly	Clean or replace Seal Kit.