

Eldex

Eldex® ReciPro Metering Pumps Operator's Manual

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	CAUTION: The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.
	ATTENTION: Le point d'exclamation dans un triangle équilatéral signale à alerter l'utilisateur qu'il y a des instructions d'opération et d'entretien très importantes dans la littérature qui accompagne l'appareil.
	ACHTUNG: Ein Ausrufungszeichen innerhalb eines gleichwinkligen Dreiecks dient dazu, den Benutzer auf wichtige Bedienungs- und Wartungsanweisungen in der dem Gerät beiliegende Literatur aufmerksam zu machen.

	CAUTION: We have tested this pump with 2 propanol. Residual amounts of 2 propanol may be in the pump. You may wish to flush with an appropriate, miscible solvent. You may be using a variety of fluids which require special handling procedures and safety precautions. Consult the appropriate MSDS (Material Safety Data Sheet) supplied with the materials you will be using. Be certain to follow all handling, safety, and disposal procedures appropriate for the materials you use.
	ATTENTION: Gardez à l'esprit que nous avons testé cette pompe avec le propanol-2. Les quantités résiduelles du propanol-2 peuvent se trouver sur le dispositif de raccordement du liquide et vous souhaitez certainement les chasser avec un solvant miscible approprié. Vous pouvez utiliser une variété de liquides qui nécessitent des manipulations et des précautions particulières. Consultez la fiche technique de sécurité appropriée; elle est fournie avec le matériel que vous utiliserez. Veillez à bien respecter toutes les procédures de manipulation, sécurité et élimination du matériel.
	ACHTUNG: Die Pumpe wurde mit 2-Propanol getestet. Geringe Restmengen von 2-Propanol können sich noch im System befindend, so dass wir Ihnen vor Inbetriebnahme das Spülen mit einem geeigneten Lösungsmittel empfehlen. Sie können eine Vielzahl von Lösungsmitteln einsetzen, deren Verwendung unter Umständen spezielle Sicherheitsvorkehrungen voraussetzt. Bitte beachten Sie in allen Fällen die, den Lösungsmitteln vom Hersteller beigelegten Sicherheitsdatenblätter.

INTRODUCTION

Eldex ReciPro Metering Pumps

Laboratory and industrial procedures often require metering precise amounts of fluids in a controlled and reproducible manner. Eldex pumps were developed in response to this need. These pumps are capable of delivering measured amounts of fluids against significant backpressure.

Principles of Operation

Eldex pumps attain precise metering at intermediate and high pressures by a positive displacement, reciprocating piston. The piston is driven by a constant-speed motor via a specially contoured cam. The cam design maximizes motor efficiency, and is contoured for rapid fluid intake and smooth, constant fluid delivery, minimizing pulsation.

The piston's stroke length is set by a precision micrometer, which assures reproducible metering. Flow rates are determined by piston displacement (diameter and length) and cam shaft revolutions per minute (rpm).

In Variable Speed pumps, flow rate control is achieved by varying the speed of the motor, which is accomplished either by turning the potentiometer on the front panel, or by a remote signal. The optional micrometer allows you the additional control flexibility of varying the piston's stroke length. Flow rates are determined by the piston displacement (diameter and length) and cam shaft revolutions per minute (rpm).

Materials of Construction

The materials used for the liquid end of your Eldex ReciPro Pump were carefully chosen for corrosion resistance. The piston is sapphire, and the inlet and outlet valves incorporate sapphire seats and ruby balls.

The standard piston seal material is Fluoroloy G®. Fluoroloy G®, made from ultra-high molecular weight (uhmw) polyethylene, has excellent chemical compatibility characteristics. For specialized applications, you may substitute a PTFE based seal.

The liquid end housing is made of passivated type 316 stainless steel because of its superior resistance to corrosion. In applications requiring the use of chemicals corrosive to type 316 stainless steel, you may order a CTFE or a PEEK (polyetheretherketone) liquid end.

About This Manual

This manual provides instructions and information on Eldex intermediate and high pressure pump models including the HP Series of micrometer controlled metering pumps and the VS Series of variable speed pumps.

Section II of this manual, beginning on page 6, describes the unpacking, location, and initial installation of your metering pump. Section III, beginning on page 8, covers routine operation. Section IV, beginning on page 12, describes maintenance procedures. Section V, beginning on page 17, lists spare parts and accessories for the various pump models.

A Guided Tour of the Eldex ReciPro Metering Pumps

As you look at your Eldex Metering Pump (Figure 1.1-1.3), you will see:

Inlet Valve: Provides for tubing connection to fluid source.

Outlet Valve: Provides for tubing connection for pump output.

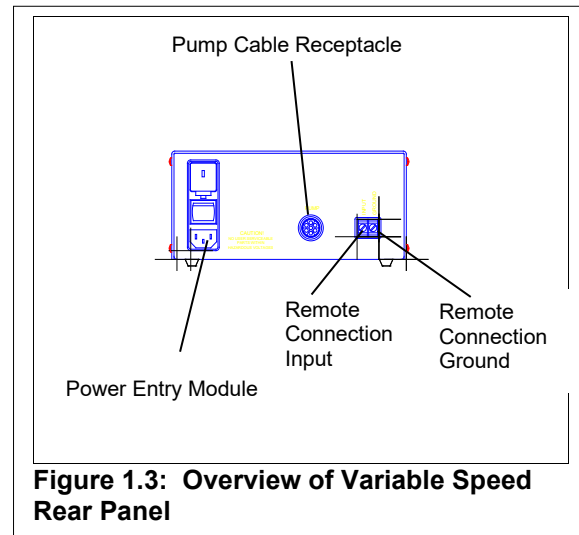
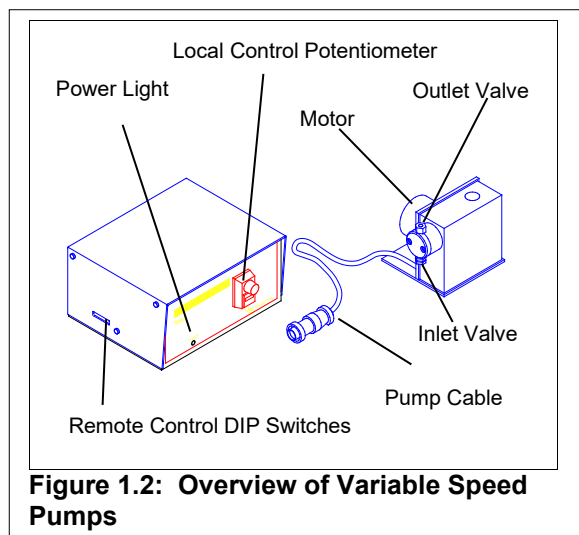
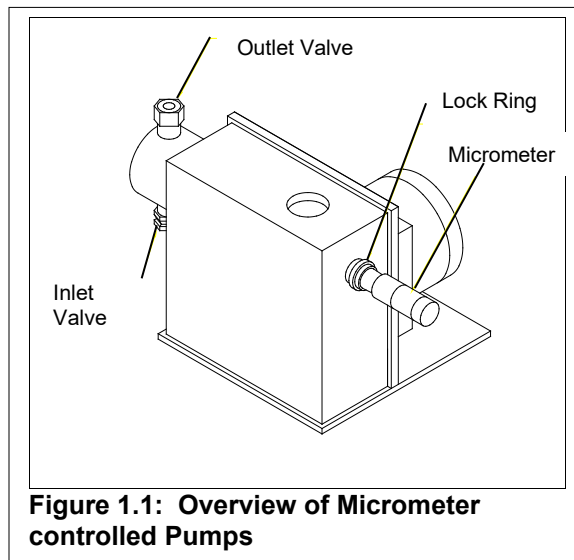
Micrometer: Provides for the precise control of the piston's stroke length.

Lock Ring: Prevents micrometer movement during pump operation.

Power Entry: Provides for power connection with modular cord.

Fuse: For fusing the pump.

On/Off: For turning the power to the pump on and off.



Specifications

Stainless Steel HP Metering Pump Specifications

Model	Part No.	Flow Rate Range (min.to max.) mL/min.	Max Pressure (psi)	Cam Shaft RPM	Piston Diameter (inches)	Max. Piston Stroke	Electrical	VA	Dimensions (L x W x H inches)	Weight (lbs.)
A-10-S	1000	0.02 - 0.5	5000	10	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-30-S	1003	0.05 - 1.5	5000	30	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-60-S	1005	0.1 - 3.0	2500	60	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-120-S	1384	0.2 - 6.0	1000	120	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-120-S-2	1385	0.5 - 6.0	1000	120	.125	.250"	230V/50Hz	10	8 x 8 x 5	6
B-100-S	1011	0.2 - 8.0	5000	100	.125	.400"	115V/60Hz	70	8 x 8 x 6	10
B-117-2 CE	6112	0.25 - 9.0	5000	117	.125	.400"	230V/50Hz	70	8 x 8 x 6	10
B-100-S-4	1013	1.0 - 32.0	2000	100	.250	.400"	115V/60Hz	70	8 x 8 x 6	10
B-117-4-2 CE	6113	1.2 - 35.0	2000	117	.250	.400"	230V/50Hz	70	8 x 8 x 6	10
AA-100-S	1018	0.2 - 10.0	5000	100	.125	.250"	115V/60Hz	70	7 x 11 x 7	11
AA-117-2 CE	6116	0.25 - 11.0	5000	117	.125	.250"	230V/50Hz	70	7 x 11 x 7	11
B-72-EXP	1472	0.2 - 5.7	5000	72	.125	.400"	120V/60Hz	72	8 x 8 x 6	14
B-72-4-EXP	1473	1.0 - 23.0	1250	72	.250	.400"	120V/60Hz	72	8 x 8 x 6	14
BBB-4	1020	1.0 - 100.0	5000	102	.250	.400"	115V/60Hz	185	13 x 10 x 6	30
BBB-4-2	1021	1.0 - 80.0	5000	84	.250	.400"	220V/50Hz	185	13 x 10 x 6	30

Stainless Steel Variable Speed Pump Specifications

Model	Part No.	Flow Rate Range (min.to max.) mL/min.	Max Pressure (psi)	Cam Shaft RPM	Piston Diameter (inches)	Max. Piston Stroke	Electrical	VA	Dimensions (L x W x H inches)	Weight (lbs.)
BBB-4-VS	1471	12.0 - 144.0	5000	150	.250	.400"	115V/50-60Hz	185	Pump: 12 x 9 x 5 Controller: 9 x 6 x 4	23 8
BBB-4-VS HAZ	1483	8.0 - 175.0	3000	150	.250	.400"	115V/50-60Hz	185	Pump: 12 x 9 x 5 Controller: 9 x 6 x 4	23 8

Maximum flow rate specifications are based on the theoretical volume displacement of all channels; actual flow rates will vary depending on such factors as fluid viscosity, compressibility, and temperature. Minimum flow rates are per channel.

Common Specifications:

Wetted Parts:	Type 316 stainless steel, inert polymers, sapphire, ruby, gold
Reproducibility:	±0.3% typical
Tubing Connections:	Inlet valve: ¼" –28 plastic fitting for 1/8" Teflon® tubing Outlet valve: 1/16" I.D. ferrule and tube nut, 10-32 thread Model BB and BBB pumps use 1/8" Swagelok® fittings on inlet and outlet valves Other connections available on request
Viscosity Limit:	500 Centipoise
Fuses:	Model A .125 A Model B & AA 1.0 A Model BBB 2.5 A (115V); 1.0 A (230V) Variable Speed Model A .400 A slo-blo (100/115VAC); .200 A slo-blo (230VAC) Variable Speed Model B, AA .800 A slo-blo (100/115VAC); .400 A slo-blo (230VAC) Variable Speed BB, BBB .8 A (motor); 15 A (line)
Operating Environment:	
Temperature:	5 – 40°C
Maximum Humidity:	85%, non-condensing
Maximum Altitude:	2,000 meters
Variable Speed Control Options:	
Models BB, BBB:	Voltage: 0-10VDC

PEEK® Metering Pump Specifications

Model	Part No.	Flow Rate Range (min.to max.) mL/min.	Max Pressure (psi)	Cam Shaft RPM	Piston Diameter (inches)	Max. Piston Stroke	Electrical	VA	Dimensions (L x W x H inches)	Weight (lbs.)
A-10-S-PK	1281	.02 - 0.5	4000	10	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-30-S-PK	1282	0.05 - 1.5	4000	30	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-60-S-PK	1284	0.1 - 3.0	2500	60	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-120-S-PK	1289	0.2 - 6.0	1000	120	.125	.250"	115V/60Hz	10	8 x 8 x 5	6
A-120-S-2-PK	1290	0.5 - 6.0	1000	120	.125	.250"	230V/50Hz	10	8 x 8 x 5	6
B-100-S-PK	1287	0.2 - 8.0	4000	100	.125	.400"	115V/60Hz	70	8 x 8 x 6	10
B-117-2-PK CE	6114	0.25 - 9.0	4000	117	.125	.400"	230V/50Hz	70	8 x 8 x 6	10
B-100-S-4-PK	1307	1.0 - 32.0	2000	100	.250	.400"	115V/60Hz	70	8 x 8 x 6	10
B-117-4-2-PK CE	6115	1.2 - 35.0	2000	117	.250	.400"	230V/50Hz	70	8 x 8 x 6	10
AA-60-S-PK	1475	0.2 - 6.0	4000	60	.125	.250"	115V/60Hz	60	7 x 11 x 7	11
AA-100-S-PK	1293	0.2 - 10.0	4000	100	.125	.250"	115V/60Hz	70	7 x 11 x 7	11
AA-117-2-PK CE	6117	0.25 - 11.0	4000	117	.125	.250"	230V/50Hz	70	7 x 11 x 7	11

Maximum flow rate specifications are based on the theoretical volume displacement of all channels; actual flow rates will vary depending on such factors as fluid viscosity, compressibility, and temperature. Minimum flow rates are per channel.

Common Specifications:

Wetted Parts:	Inert polymers, sapphire, ruby
Reproducibility:	±0.3% typical
Tubing Connections:	Inlet valve: ¼" -28 plastic fitting for 1/8" Teflon® tubing Outlet valve: 1/16" I.D. ferrule and tube nut, ¼"-28 thread for 1/16" tubing Model BB and BBB pumps use 1/8" Swagelok® fittings on inlet and outlet valves Other connections available on request
Viscosity Limit:	500 Centipoise
Fuses:	
Model A	.125 A
Model B & AA	1.0 A
Operating Environment:	
Temperature:	5 – 40°C
Maximum Humidity:	85%, non-condensing
Maximum Altitude:	2,000 meters

INSTALLATION

What You Will Need

The Unit

An Eldex Metering Pump consists of the pump assembly, a fittings kit for tubing connections, a syringe (except CTFE and PEEK® Model pumps), this manual and warranty card.

Tools

You will not need special tools for the routine use of your Eldex Metering Pump. For installation, all you will need are a few wrenches to attach the fittings. The sizes you will need will depend on the specific fittings used (and are referenced in the appropriate section of the instruction manual). Usually, ¼" and ½" open-end wrenches will do the job. If you have not already ordered a Preventive Maintenance Kit, we suggest you consider doing so now. A listing of the various PM Kits begins on page 17.

Unpacking

Before attempting to operate your pump, unpack it carefully. You should not discard any packing material, as you will want to re-use it for storage and shipping. If any damage is evident from improper handling from shipping, you should contact the freight company that delivered the unit to file a claim.

Location

You must use your Eldex Metering Pump in a clean, well ventilated and dust free environment, free of corrosive or explosive vapors. P/N 1472 and 1473 are rated for use in Class I Group D environments. Eldex pumps are designed for table top use; you should not install your pump on the floor. Your Eldex pump must be operated in a horizontal position. Safety may be impaired if use of your Eldex pump is not as instructed.

Electrical Connections

For Variable Speed Pumps, as you look at the Power Entry Module (Figure 2.1), you will see:

ON/OFF Switch

Power Inlet

Fuse Drawer

Voltage Selection Insert

Fuses

If the power entry module does not show the appropriate voltage through the window on the fuse drawer, remove the fuse drawer and voltage selection insert from the power entry module. Re-orient the voltage selection insert so the correct voltage is shown through the fuse drawer window. Replace the fuses with ones appropriate for the desired voltage. Install the voltage selector insert and fuse drawer.

For all models, remove the plastic oil plug on the gear box of the motor (if present on your model) and store it for re-use when storing or shipping the pump. Plug the power cord of the pump into a grounded, properly rated outlet and turn the power switch to ON. After you have confirmed there is electrical power, turn the power switch to OFF.

For B-72-EXP and B-72-4-EXP pumps, with their supplied resistor and capacitor, a trained electrical technician should connect the wires from the motor as illustrated in Figure 2.2. The wiring is usually enclosed in conduit and the resistor, capacitor and switch are usually located in a non-hazardous location.

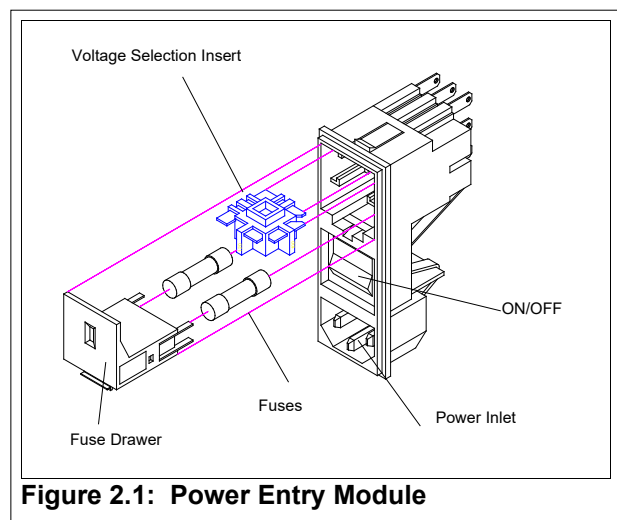
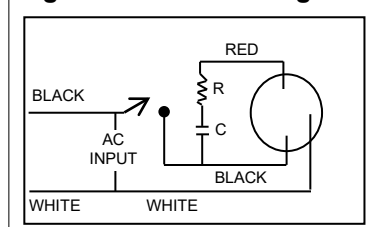


Figure 2.2: EXP Wiring



Liquid Connections

Remove the plastic caps from the inlet and outlet valves. The caps are used to prevent particulate material from entering the valves during shipment. You should store the caps, which you should re-use when shipping the pump or storing it for future use.

Attaching Inlet Tubing

Most Eldex pumps come supplied with a fittings kit, which includes the inlet tubing, as well as inlet and outlet nuts and ferrules. Attach the 1/8" Teflon tubing to the inlet (bottom) valve (see Figures 1.1-1.4; page 2). Hand tighten the nut onto the valve.

Model BB and BBB pumps use 1/8" Swagelok® fittings on the inlet and outlet valves and use 1/8" tubing (not supplied). Model BB and BBB pumps require a 7/16" wrench to tighten the fittings and a 1/2" wrench to tighten the valves.

Priming the Pump

You must filter your solvents. We recommend you install a 10 micron sintered stainless steel filter (Eldex Part No. 5776) on the inlet line. When you wish to avoid metal, a 10 micron plastic filter is available (Eldex Part No. 1279). After you attach the inlet tubing to the pump, place the other end of the tubing in a reservoir of the liquid you will be pumping. Be certain you completely submerge the end of the tubing (or the filter) in the liquid. Insert the syringe (not supplied with CTFE or PEEK® pumps) into the outlet (top) valve opening (see Figures 1.1-1.3; page 2). You should exercise care when handling the syringe. Improper use can cause the syringe to break off in the valve (and you will have to install a new valve).

Turn the power switch to ON. Manually draw a few milliliters of fluid into the syringe. Remove the syringe and look at the valve opening. There should not be traces of air bubbles. If the air bubbles persist, turn off the pump, check the liquid level in the reservoir and the tightness of the inlet fitting. If the inlet tubing is above the surface of the liquid, or if the inlet fitting is loose, you will need to correct the condition and repeat the priming procedure. When the pump is primed, turn the power switch to OFF.

Attach Outlet Tubing

With a 1/4" wrench, attach 1/16" stainless steel tubing (not supplied) to the outlet (top) valve using the tube nut and ferrule. Do not set the ferrule in the valve, since doing so may compress and damage the valve components. Instead, set the ferrule onto the tubing in a column or similar non-compressible fixture. Always stabilize the valve housing with a 1/2" wrench when attaching fittings. Never tighten fittings to beyond 40 in./lbs., or the point where no leakage occurs. Excessive force in tightening fittings can result in valve compression and damage. On Kel-F® pumps, the outlet fitting is the same as the inlet and you should attach it in the same manner as the inlet. On PEEK® pumps, the fitting on the outlet valve is hand tightened.

Model BB and BBB pumps use 1/8" Swagelok® fittings on the inlet and outlet valves and use 1/8" tubing (not supplied). Model BB and BBB pumps require a 7/16" wrench to tighten the fittings and a 1/2" wrench to tighten the valves.

OPERATION

Adjusting Stroke Volume

Pumps generally perform more reproducibly if there is some degree of backpressure (preferably at least 25 psi). In all cases, outlet resistance must exceed inlet pressure. Otherwise, the fluid will simply flow through the pump without being metered. If the system in which the pump is being used does not generate enough backpressure, we suggest you install a device, e.g., a “dummy” column or a backpressure regulator, to artificially maintain the appropriate backpressure.

For Micrometer Controlled Pumps

The stroke length of the piston determines the volume of liquid displaced. You will adjust the micrometer (see Figures 1.1-1.3; page 2) to set the piston’s stroke length.

Nominal piston stroke volume displacements over the range of micrometer settings are listed in Table 3.1. To prevent micrometer movement during pump operation, make certain the micrometer locking ring (see Figures 1.1-1.3; page 2) is hand tightened (clockwise rotation). You should leave the micrometer locking ring in its tightened position, even when adjusting the micrometer setting.

Mic. Setting (inches)	Stroke Volume (mm ³)	Mic. Setting (inches)	Stroke Volume (mm ³)	Mic. Setting (inches)	Stroke Volume (mm ³)	Mic. Setting (inches)	Stroke Volume (mm ³)	Mic. Setting (inches)	Stroke Volume (mm ³)
.000	00.00	.010	02.01	.110	22.12	.210	42.23	.310	62.34
.001	00.20	.020	04.02	.120	24.13	.220	44.24	.320	64.35
.002	00.40	.030	06.03	.130	26.14	.230	46.25	.330	66.36
.003	00.60	.040	08.04	.140	28.15	.240	48.26	.340	68.37
.004	00.80	.050	10.05	.150	30.16	.250	50.27	.350	70.38
.005	01.01	.060	12.07	.160	32.18	.260	52.28	.360	72.40
.006	01.21	.070	14.08	.170	34.19	.270	54.30	.370	74.41
.007	.0141	.080	16.09	.180	36.20	.280	56.31	.380	76.42
.008	01.61	.090	18.10	.190	38.21	.290	58.32	.390	78.43
.009	01.81	.100	20.11	.200	40.22	.300	60.33	.400	80.44

Table 3.1: Micrometer Setting:Stroke Volume

The micrometer is scaled in thousandths of inches. The stationary shaft of the micrometer is numbered 1, 2, 3, 4, and 5. These correspond to .100”, .200”, etc. The halfway divisions between 1, 2, 3, etc., correspond to .050”, and the smallest divisions on the stationary part of the micrometer correspond to .025”. The movable part of the micrometer is divided into .001” increments; each complete revolution of the movable part of the micrometer corresponds to .025”.

Most Eldex pumps use a piston stroke length of .250”; adjusting the micrometer beyond .250” will not increase the flow rate of these pumps. Some models use a stroke length of .400”. See the specifications section of this manual (beginning on page 3) to determine the maximum stroke length (and therefore also the maximum micrometer setting) of your model.

Calculating Flow Rates

Flow rates are determined by the speed of the cam shaft and the volume of the piston stroke. Nominal piston stroke volume displacements over the range of micrometer settings are listed in Table 3.1. A variety of factors, including the compressibility of the fluid and the compliance of the seals in the system, result in the actual piston displacement being somewhat less than nominal displacement.

You can measure actual flow rates with a stopwatch and graduated cylinder under actual backpressure conditions.

You can use the following formula to determine nominal flow rates for each pump piston:

1. For a 1/8” diameter piston:

$$\text{Flow rate in mL/min.} = \frac{(\text{stroke volume}) \times (\text{cam shaft RPM})}{1000}$$

$$\text{Flow rate in mL/hr.} = \frac{(\text{stroke volume}) \times (\text{cam shaft RPM}) \times 60}{1000}$$

2. For 1/4” diameter piston:

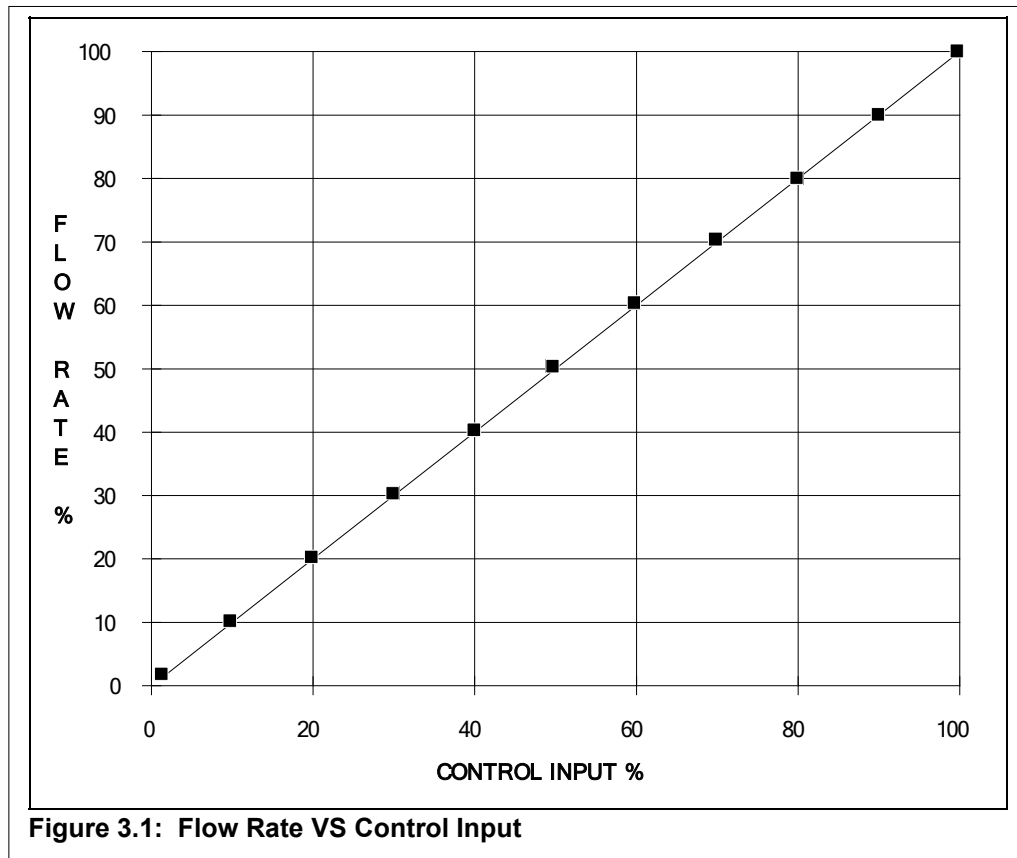
Multiply the above results by four (4)

These formulas can be arranged to solve for stroke volume, e.g.:

$$\text{Stroke volume} = \frac{(\text{flow rate}) \times 1000}{\text{Cam shaft RPM}}$$

For Variable Speed Pumps

Flow rates are either set via the potentiometer on the front panel or remotely. The following chart indicates the theoretical flow rate percentage at various percentages of the input signals.



The Variable Speed Metering Pump is shipped from the factory set for local control (via potentiometer on front panel). If you will be controlling the flow rate remotely by sending one of the indicated signals, set the DIP switches on the left side panel for the type of remote signal you are sending, following the switch settings in the chart below (Table 3.2). By using a small screwdriver, the DIP switches can be moved down (ON) or up (OFF). The DIP switches are referred to as numbers one through ten in the chart below, starting from the position closest the rear panel.

Selection	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW9	SW9	SW10
Local	ON	Off	Off	Off	Off	Off	Off	Off	Off	Off
5V	Off	Off	Off	ON	ON	Off	Off	Off	Off	Off
10V	Off	Off	Off	ON	Off	ON	Off	Off	Off	Off
12V	Off	Off	Off	ON	Off	Off	ON	Off	Off	Off
24V	Off	Off	Off	ON	Off	Off	Off	ON	Off	Off
1-5mA	Off	Off	ON	Off	Off	Off	Off	Off	ON	Off
4-20mA	Off	ON	Off	Off	Off	Off	Off	Off	Off	ON

Table 3.2: DIP Switch Settings

Once the DIP switches are properly set, connect the remote control signal wires to the controller's rear panel two position terminal block. Be certain to connect the ground wire to the ground position of the terminal block and the input signal wire to the input position of the terminal block.

The following examples show how to calculate the correct setting for the desired flow rate:

Example 1: Local potentiometer (000 – 999)

Pump: A-30-VS
Flow Rate Range: .025 – 1.5 mL/min.
Control: 10 turn pot
Desired Flow Rate: .75 mL/min
 $(.75 \text{ mL}/1.5 \text{ mL}) \times 1000 = 500$

With pump Model A-30-VS, to achieve the desired flow rate of .75 mL/min., the local potentiometer should be set to 500.

Example 2: Remote Voltage, 0-5V

Pump: A-60-VS
Flow Rate Range: .05 – 3.0 mL/min.
Control Input: 0-5V
Desired Flow Rate: 1.25 mL/min.
 $(1.25 \text{ mL}/3 \text{ mL}) \times 5 \text{ V} = 2.08 \text{ V}$

With pump Model A-60-VS, to achieve the desired flow rate of 1.25 mL/min., the voltage input should be 2.08V (using the 0-5V control option).

Example 3: Remote Current Loop, 4-20mA

Pump: B-125-VS
Flow Rate Range: .2 – 10 mL/min.
Control Input: 4-20mA
Desired Flow Rate: 3.8 mL/min.
 $(3.8 \text{ mL}/10 \text{ mL}) \times (20-4\text{mA}) + 4\text{mA} = 10.08\text{mA}$

With pump Model B-125-VS, to achieve the desired flow rate of 3.8 mL/min., the current loop input should be 10.08mA (using the 4-20mA control option).

For variable speed pumps fitted with a precision micrometer, you can also control the stroke length of the piston, as well as the speed of the motor. Follow the instructions detailed in the above section on setting for flow rates for micrometer controlled pumps.

For BB and BBB Variable Speed models, the potentiometer on the controller is scaled from 0 to 100 percent of motor speed (theoretical volume displacement).

For remote 0-10 VDC control the the BB and BBB Variable Speed models, connect speed control input (with 0.1 mA current capability) to terminal S2 on the control board and the common side of the signal to terminal S1 (both signals should be isolated).

Do not attempt to run the controller without attaching a pump.

Pump Limits

You should note the limits of your Eldex pump. Exceeding or violating these limits may damage your pump and will void your warranty.

Viscosity Limits

Liquids with viscosities of 100 centipoise or higher often reduce nominal flow rate values. You cannot pump liquids with viscosities exceeding 500 centipoise.

Chemical Limits

Some buffers, particularly halide salts at high concentrations, can cause corrosion of type 316 stainless steel. If you leave buffers in the pump, crystallization may occur and cause damage to the seal material. Some solvents can swell the plastic material in the valves or the piston seal. Usually, you can substitute less damaging fluids, and you can minimize potential damage by carefully flushing the pump and setting the micrometer to zero after use. You can sometimes substitute special materials; please consult with the factory.

When planning to use buffers or solvents which are particularly corrosive to type 316 stainless steel, we recommend you order a special pump model which eliminates stainless steel as a wetted part. Two options are presently available, CTFE and PEEK. When choosing your pump, we suggest you take into account the nature of the fluids being pumped and their affect on the wetted parts.

Mechanical Limits

Pumped fluids should be free of particulate matter, since clogged valves can result in erratic flow rates. We strongly recommend the use of a filter on the inlet line to protect the valves from small particles. A 10 micron sintered stainless steel filter is available from Eldex (Part No. 5776) and is suitable for most applications. When you need to avoid metal, a 10 micron plastic filter is available from Eldex (Part No. 1279).

Damage to the mechanical parts will result from subjecting the pump to excessive pressure. Do not try to pump fluid against pressures which exceed the maximum pressure capability of your model.

Temperature Limits

Eldex pumps are designed to operate under ambient temperature conditions. If you take appropriate precautions to prevent condensation, you can use the pump in a cold room. Do not use the pump in an environment which exceeds 40°C.

It is possible to pump fluids which are at elevated temperatures. Although the reaction of specific fluids at elevated temperatures to the wetted parts may vary, it is usually the plastic materials in the liquid end which will be of concern. Generally, the CTFE maintains integrity at temperatures up to 200°C. The Fluoroloy G® seal material is generally good to 120°C; and the graphite fiber reinforced PTFE seal to 260°C. You will want to consult the factory when pumping fluids at elevated temperatures if there is any question in your mind about how the wetted parts will react.

CAUTION: When the pump is operating, the motor will become quite warm. The temperature rise of the motor is about 30°C above ambient. Do not rest your hand (or any other thermally sensitive item) on the motor.

Shutdown Procedures

Eldex pumps are manufactured using materials selected to resist corrosion. However, some buffers, most notably halide salts at high concentration, are capable of corroding type 316 stainless steel, and some solvents are capable of distorting CTFE or other plastics used in the pumps. Therefore, it is important to flush the pump after using any potentially damaging materials.

To flush the pump, first pump distilled water to remove any salt(s) or solids. You should do this for a minimum of ten minutes at full piston stroke as soon as possible after using the pump. Next, you should flush the pump with an inert solvent such as methanol for at least five minutes. Once flushing is complete, you should set the micrometer to zero.

CAUTION: It is important to note that salts and buffers can lead to corrosion of stainless steel or distortion of plastics if they are left in contact with the pump for long periods of time. Failure to flush potentially corrosive substances from the pump may void your warranty.

MAINTENANCE

We have designed Eldex Metering Pumps to give years of trouble-free service. By following a few simple maintenance procedures, you can ensure the longevity of your pump.

Cleaning

Before cleaning your pump, disconnect the pump from the power supply. Cleaning can be accomplished by wiping down with a damp cloth.

Lubrication

For the Piston Pushrod

You should lubricate the pump once a month with one drop of SAE 30 oil. Turn the power switch to OFF. On Models A and B, drop the lubricant into the hold on top of the pump housing. On Model AA pumps, remove the liquid end (see step 3 below). Remove the piston and pushrod. Coat the pushrod surface with one drop of oil. Reassemble the piston and liquid end onto the pump.

For the Motor

Models B* and AA-100* may require periodic motor gearbox lubrication. You should inspect the oil level every five months or 600 operating hours. To inspect the oil level, turn the power switch to OFF. Remove the plug on the side of the motor gearbox, using a 3/8" wrench. The oil level should be even with the bottom of this view hole.

If the oil level is low, fill the gearbox with SAE 90. Pour the oil either in the view hole on the side of the motor gearbox, or in the vent hole on top of the motor gearbox. Use enough oil to reach the proper level. After lubrication, reinsert the plug on the side of the motor, tightening with a 3/8" wrench.

Piston Seal

A variety of seal materials are available for use in Eldex ReciPro pumps. The standard seal material used is Fluoroloy G®, which is a yellow colored ultra high molecular weight (uhmw) polyethylene. It is the standard seal material because of its broad range of chemical compatibility, its mechanical properties, and its stability in reciprocating applications. In cases where uhmw polyethylene is not chemically compatible, we offer a graphite fiber reinforced PTFE material.

TIP: We have found, especially with metal-free seals, that "breaking-in" the seals with IPS or methanol for an hour or so, under conditions similar to your expected operating conditions enhances seal life.

The length of service to be expected from any given piston seal depends on a wide variety of factors, including the fluid being pumped and the pressure of the system. It is critically important that the seal be replaced immediately upon failure, or better yet, before failure, because fluid can travel into the mechanical housing of the pump and cause corrosion damage.

When a leak occurs on single piston pumps, you may notice fluid just underneath the liquid end. On dual piston pumps, you may notice fluid on the side of the pump. However, a leak may not always be visible, particularly at low flow rates. We suggest you place a wick or litmus paper up the drain slots (on single piston pumps, just underneath the liquid end; on dual piston pumps, the holes on the sides of the pump). You should remove the wick or litmus paper periodically and check for wetness or color changes to see if leakage has occurred.

Piston Wash System

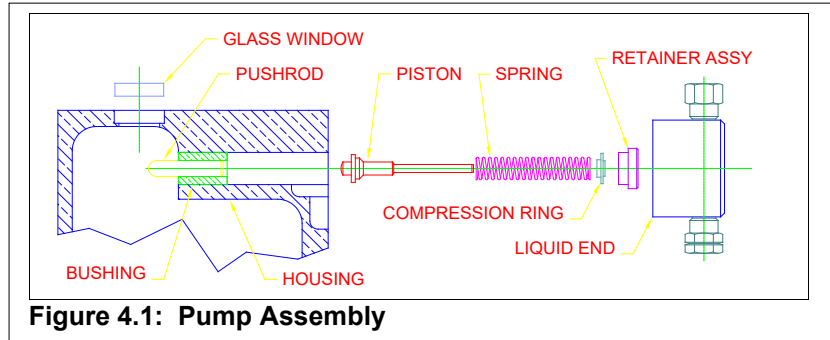
The use of buffers or solutions which crystallize when exposed to air can lead to abrasion of the piston seal. A piston wash system is available for pumps with 1/8" diameter pistons. By installing the piston wash system on your pump, you can significantly extend the life of the piston seal. The piston wash system part number is 5575. Contact the factory for details.

Replacing the Piston Seal

1. Use tools supplied with Eldex Part Nos 1022, 1476, 1362 (installation tool and 5/32 hex key), 1024, 1301, or 5724 (1/4" diameter dowel pin and 5/32 hex key).

2. Turn the power switch to OFF and turn the piston stroke setting device until it reads the maximum flow setting.
3. Remove the liquid end from the pump as follows: Unscrew the two 5/32" socket head bolts while holding the liquid end against the pump housing. Pull the liquid end straight out from the pump housing, in line with the axis of the piston. If you cock or tilt the liquid end, you may break the piston. See Figure 4.1.

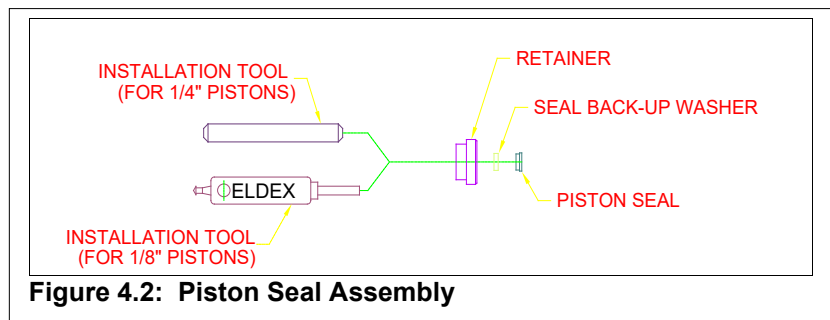
4. Remove the retainer from the liquid end, and insert the installation tool/dowel pin into the liquid end through the old backup washer (if present) and piston seal (if your pump uses a 1/8" diameter piston, the installation tool has a "hooked" end, which is



used to remove the seals). If you are using the 1/8" installation tool, hook the existing seals and remove and discard both the washer and the seal. If you are using the 1/4" dowel pin, rock the dowel pin back and forth gently, and remove and discard both the washer and seal. Do not scratch the walls of the piston seal gland in the liquid cylinder with the tool/dowel pin.

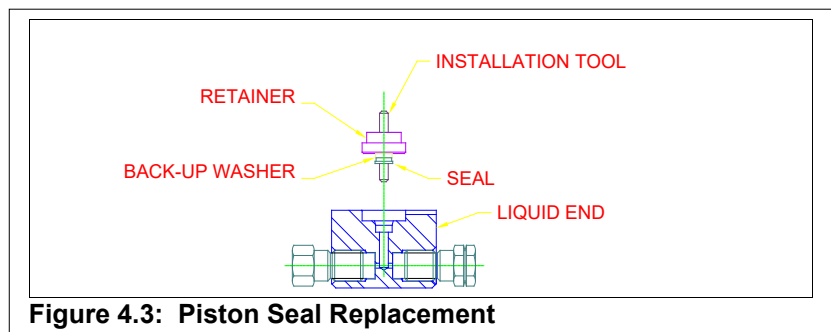
5. Inspect the piston. If the piston has scratches on the sapphire, or significant corrosion on the stainless steel piston holder, you should replace it. If there is minor corrosion on the piston holder, clean the piston holder. Also inspect for evidence of deposits on the sapphire. If deposits are present on the sapphire (discoloration or particulates), clean it. If the sapphire does not clean, you should replace the piston.

6. Inspect the retainer. Clean the retainer if necessary. If there is evidence of wear, or if the piston does not fit snugly in the retainer, or if the retainer grips the piston too tightly, you should replace the retainer.



7. Remove the piston push rod by tilting the pump forward. Inspect for wear or corrosion damage and clean or replace the push rod if necessary. Coat the push rod with a light film of SAE 30 oil.
8. Inspect the liquid cylinder, paying special attention to the gland for the piston seal. Any scratches or irregularities will require replacement of the liquid end.
9. Clean all parts with a liquid detergent, followed by a rinse. Clean any fluid in the mechanical end of the pump.

10. Insert the installation tool/dowel pin into the retainer and then into the new seal backup washer (not used in 1301, 1362, 1363, 1364, 1476, 1477, 1478) and new piston seal. When inserting the tool through the new piston seal, the piston seal should lay flat on a hard surface with the



spring side down (the seal will generally “snap” onto the tool). Position the parts on the tool as shown in Figure 4.2. Insert the tool into the liquid end bore as shown in Figure 4.3. **CAUTION:** The open side of the seal (side revealing the spring) should face the closed (fluid side) end of the liquid end.

11. Keeping the tool perpendicular with the face of the liquid end, push the piston seal and washer into the liquid end bore, by pressing down gently and evenly on the edge of the retainer with both thumbs.
12. Withdraw the tool, while holding the retainer and liquid end firmly in place.
13. Reinstall the liquid end on the pump. See Figure 4.1.

PRECAUTIONS:

1. Do not re-use the old piston seal or backup washer (if present).
2. Cleanliness is very important for optimal seal and check valve operation.
3. Note suggestion regarding seal “break-in” on page 13.

NOTE: If you retain the tools supplied with Eldex Part Nos. 1022, 1024, 1476, 1301, or 1362, you can purchase just the seals and re-use the tools.

Replacing Valves

Always replace valves in a clean area to prevent dust and dirt from entering the pump.

Removal of Existing Valves

The valves are the two hexagon-shaped components on the liquid end assembly (see Figure 4.4). Inlet valves can be distinguished from outlet valves by the groove on the hexagonal part of the valve. To prevent the internal components of the valve from falling out upon removal keep the pump in its normal position when removing the inlet valve and turn the pump upside down when removing the outlet valve (CAUTION: when appropriate, be sure to plug the oil hole on the top of the motor gearbox before turning the pump upside down). Remove the valves with a ½” wrench, turning in a counter-clockwise direction. After removal, be careful to keep the valve oriented so the translucent washers face upwards. If you wish to replace the cartridge in the valve, you may purchase replacement cartridges, which include the cartridge and instructions.

Installation of New Valves

1. Inlet valves can be distinguished from outlet valves by the groove on the hexagonal part of the valve.
2. Unscrew the shipping nut and remove the metal shipping washer, as these are not used for installation of the valves.
3. Insert the new valve into the liquid end assembly and tighten by hand until just finger-tight. Then use a ½” wrench and tighten ¼ turn more. You should tighten valves to the point at which no further leakage occurs, or not more than 4.5 ft./lbs.

OVERTIGHTENING THE VALVES CAN CAUSE THE SAPPHIRE SEATS TO CRACK.

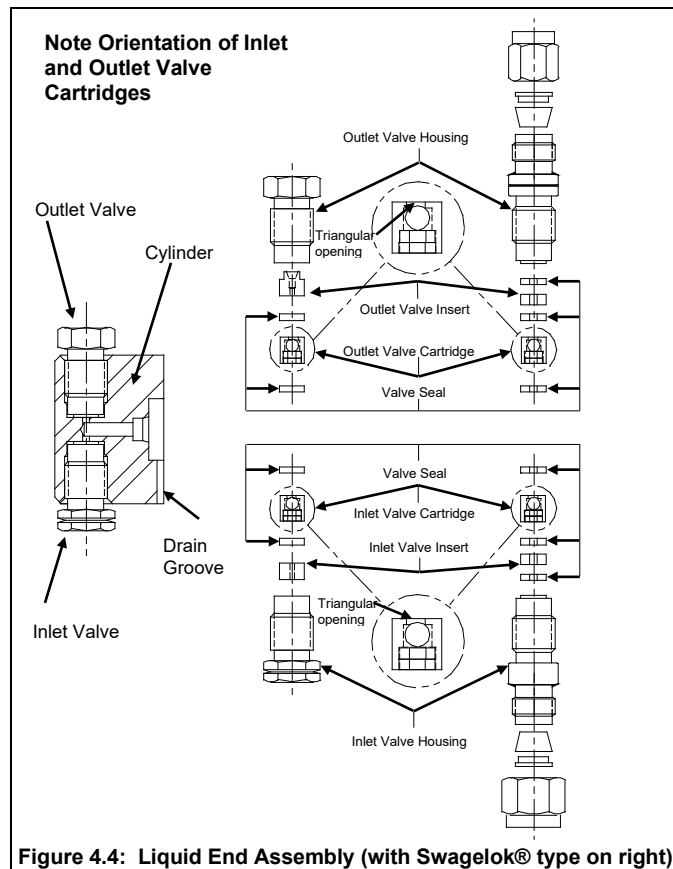


Figure 4.4: Liquid End Assembly (with Swagelok® type on right)

STABILIZE THE VALVE WITH A ½” WRENCH WHEN ATTACHING YOUR FITTINGS TO PREVENT FURTHER VALVE TIGHTENING. DO NOT TIGHTEN FITTINGS TO BEYOND 40 IN./LBS., OR THE POINT WHERE NO FURTHER LEAKAGE OCCURS.

Replacing Valve Cartridges

1. Remove the valve from the cylinder (see above for detailed instructions).
2. Using the smaller dowel pin provided (1-1/4” long by 1/8” diameter), press out the internal components of the valve assembly using a steady pressure. Do not hammer parts through with the dowel pin or hammer on the dowel pin. Do not allow the valve parts to fall out of the valve onto a hard surface.
3. Reassemble the valve by placing the valve insert in the valve housing using the larger (3/16”) dowel pin provided (1373 and 1374 valves use a total of 3 washers, one is installed before installing the valve insert). Make sure it is oriented correctly (see Figure 4.4). Press a new CTFE seal into place. Slide the valve cartridge into the valve housing making certain it is oriented correctly. Press another new CTFE seal into place. The CTFE seal will extend approximately 0.020 – 0.030” from the valve housing.
4. Re-install the rebuilt valve into the liquid end assembly and tighten by hand until just finger-tight. Then use a ½” wrench and tighten ¼ turn more. You should tighten valves to the point at which no further leakage occurs, or not more than 4.5 ft./lbs.

Troubleshooting

Symptom: No flow (probably cause(s) shown in bold)

Question	Answer	Solution
Is the motor turning?	No	Check electrical connections: 1. Is instrument plugged in? 2. Does outlet provide electricity? 3. Is fuse blown? If so, replace.
Is the micrometer properly set?	No	Set micrometer properly, not at zero.
Is fluid degassed prior to use?	No	Degas fluid prior to use: 1. Boil. 2. Bubble helium through fluid. 3. Subject fluid to a vacuum.
Is fluid filtered?	No	1. Do not pump fluids with suspended particles (a particle as small as ten microns can clog a valve). 2. Install an inlet line filter. 3. Flush with liquid detergent or 30% solution of nitric acid (at max. flow for about 10 minutes), or suck cleaning fluid through pump with a syringe. 4. Ultrasonicate valve assembly.
Is filter clogged?	Yes	Clean filter (clogged filter can create restriction to flow, causing cavitation).
Is mechanical assembly OK?	No	Inspect parts of mechanical assembly; is piston broken?, piston return spring broken?, pushrod frozen in bushing?
Are valves OK?	No	Rebuild or replace valves (excessive force used to tighten fittings to valves or valves to cylinder can cause sapphire seats to crack, chip, or shatter, thereby inhibiting flow).

Symptom: Erratic flow (probable cause(s) shown in bold)

Question	Answer	Solution
What is backpressure on pump	Less than 25 psi	Insufficient backpressure, create more pressure on pump so valves can work properly (install backpressure regulator, or length of small I.D. tubing).
Is fluid degassed prior to use?	No	Degas as per above.
Is fluid filtered?	No	Clean valves as per above, install inlet line filter.
Is filter clogged?	Yes	Clean filter.
Is there a leak at fitting(s)	Yes	Tighten fittings.
Is there a leak at valve connection?	Yes	Tighten valves
Are valves OK?	No	Rebuild or replace valves.

Symptom: Steadily increasing flow rate

Question	Answer	Solution
Is micrometer locked?	No	Tighten locking ring on micrometer.

Symptom: Leakage

Question	Answer	Solution
Are seals worn?	Yes	Replace piston seal.

Symptom: Steadily decreasing flow rate

Question	Answer	Solution
Is fluid degassed prior to use?	No	Degas as per above.

SPARE PARTS AND ACCESSORIES

For 1/8" Stainless Steel Pumps; Model A, B, AA

Order No.	Description
	Pump Options
5575	Piston Wash Kit; includes piston.
5728	Quick Connect Kit.
	Preventive Maintenance Kits
1388	Includes two uhmw polyethylene seals, backup washers, tools for installation, two valve cartridges, one retainer, a sintered stainless steel filter, and tube of lubrication oil.
1389	Includes two graphite fiber reinforced PTFE piston seals, tools for installation, two valve cartridges, one retainer, a sintered stainless steel filter, and tube of lubrication oil.
	Piston Seals
1022	Piston seal assembly kit; includes one uhmw polyethylene seal, backup washer, and tools for installation.
1180	Piston seal replacement kit; includes two uhmw polyethylene seals, backup washers.
1181	Piston seal replacement kit; includes five uhmw polyethylene seals, backup washers.
1362	Piston seal assembly kit; includes one graphite fiber reinforced PTFE seal, and tools for installation.
1363	Piston seal replacement kit; includes two graphite fiber reinforced PTFE seals.
1364	Piston seal replacement kit; includes five graphite fiber reinforced PTFE seals.
	Valves
1369	Inlet valve assembly, cartridge style, 1/4"-28 fitting.
1372	Outlet valve assembly, cartridge style, 10-32 fitting.
1373	Inlet valve assembly, cartridge style, 1/8" Swagelok® fitting.
1374	Outlet valve assembly, cartridge style, 1/8" Swagelok® fitting.
1371	Inlet valve assembly, cartridge style, 10-32 fitting.
1370	Outlet valve assembly, cartridge style, 1/4"-28 fitting.
1381	Valve cartridge kit (rebuilds one inlet or one outlet valve).
	Piston
1366	1/8" sapphire piston.
5576	1/8" sapphire piston for pumps with wash kit.
	Liquid End Assembly
1395	Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
	Fittings
1039	Includes 60 cm of 1/8" Teflon inlet tubing, inlet (1/4-28) and outlet (10-32) tube nuts, and outlet ferrule.
1249	Outlet fittings kit; includes three ferrules and three tube nuts (10-32).
1040	High Pressure outlet manifold for parallel operation of both channels on Model AA pumps.
1152	Inlet manifold for AA pumps.
	Filters
5776	10 micron sintered stainless steel filter, with 60 cm long Teflon inlet tube and tube nut.
	Other Parts
1209	Retainer assembly.
	For other parts, consult factory.

For 1/8" CTFE Pumps; Model A, B, AA

Order No.	Description
	Pump Options
5575	Piston Wash Kit; includes piston.
5728	Quick Connect Kit.
	Preventive Maintenance Kits
1388	Includes two uhmw polyethylene seals, backup washers, tools for installation, two valve cartridges, one retainer, a sintered stainless steel filter, and tube of lubrication oil.
1389	Includes two graphite fiber reinforced PTFE piston seals, tools for installation, two valve cartridges, one retainer, a sintered stainless steel filter, and tube of lubrication oil.
	Piston Seals
1022	Piston seal assembly kit; includes one uhmw polyethylene seal, backup washer, and tools for installation.
1180	Piston seal replacement kit; includes two uhmw polyethylene seals, backup washers.
1181	Piston seal replacement kit; includes five uhmw polyethylene seals, backup washers.
1362	Piston seal assembly kit; includes one graphite fiber reinforced PTFE seal, and tools for installation.
1363	Piston seal replacement kit; includes two graphite fiber reinforced PTFE seals.
1364	Piston seal replacement kit; includes five graphite fiber reinforced PTFE seals.
	Valves
1375	Inlet valve assembly, cartridge style.
1376	Outlet valve assembly, cartridge style.
1382	Valve cartridge kit (rebuilds one inlet or one outlet valve).
	Pistons
1366	1/8" sapphire piston.
5576	1/8" sapphire piston for pumps with wash kit.
	Liquid End Assembly
1396	Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
	Fittings
1178	Includes 60 cm of 1/8" Teflon inlet tubing, inlet (1/4-28) and outlet (1/4-28) tube nuts.
	Filters
1279	10 micron plastic filter, with 60 cm long Teflon inlet tube and tube nut.
	Other Parts
1209	Retainer assembly.
	For other parts, consult factory.

For 1/8" PEEK® Pumps; Models A, B, AA (grooved cylinder)

Order No.	Description
	Pump Options
5575	Piston Wash Kit; includes piston.
5728	Quick Connect Kit.
	Preventive Maintenance Kits
1479	Includes two uhmw polyethylene seals, tools for installation, two valve cartridges, one retainer, a 10 micron plastic filter, and tube of lubrication oil.
	Piston Seals
1476	Piston seal assembly kit; includes one uhmw polyethylene metal-free seal, and tools for installation.
1477	Piston seal replacement kit; includes two uhmw polyethylene metal-free seals.
1478	Piston seal replacement kit; includes five uhmw polyethylene metal-free seals.
1272	Piston seal assembly kit (for non-grooved cylinders, old-style); includes one uhmw polyethylene metal-free seal, backup washer, and tools for installation.
1273	Piston seal replacement kit (for non-grooved cylinders, old-style); includes two uhmw polyethylene metal-free seals, backup washers.
1274	Piston seal replacement kit (for non-grooved cylinders, old-style); includes five uhmw polyethylene metal-free seals, backup washers.
	Valves
1377	Inlet valve assembly, cartridge style.
1378	Outlet valve assembly, cartridge style.
1383	Valve cartridge kit (rebuilds one inlet or one outlet valve).
	Pistons
1366	1/8" sapphire piston.
5576	1/8" sapphire piston for pumps with wash kit.
	Liquid End Assembly
5751	Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
	Fittings
1280	Includes 60 cm of 1/8" Teflon inlet tubing, inlet (1/4-28) and outlet (1/4-28) tube nuts, and outlet ferrule.
	Filter
1279	10 micron plastic filter, with 60 cm long Teflon inlet tube and tube nut.
	Other Parts
1365	Retainer assembly.
	For other parts, consult factory.

For 1/4" Stainless Steel Pumps; Models B, BB, BBB

Order No.	Description
	Preventive Maintenance Kits
1393	Includes two uhmw polyethylene seals, backup washers, tools for installation, two valve cartridges, one retainer, a sintered stainless steel filter, and tube of lubrication oil.
	Piston Seals
1024	Piston seal assembly kit; includes one uhmw polyethylene seal, backup washer, and tools for installation.
1187	Piston seal replacement kit; includes three uhmw polyethylene seals, backup washers.
	Valves
1369	Inlet valve assembly, cartridge style, 1/4"-28 fitting.
1372	Outlet valve assembly, cartridge style, 10-32 fitting.
1373	Inlet valve assembly, cartridge style, 1/8" Swagelok fitting.
1374	Outlet valve assembly, cartridge style, 1/8" Swagelok fitting.
1371	Inlet valve assembly, cartridge style, 10-32 fitting.
1370	Outlet valve assembly, cartridge style, 1/4"-28 fitting.
1381	Valve cartridge kit (rebuilds one inlet or one outlet valve).
	Piston
1254	1/4" sapphire piston for B, BB.
1034	1/4" sapphire piston for BBB.
	Liquid End Assembly
1210	For B. Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
1038	For BBB. Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
5770	For BB. Includes inlet and outlet valve assemblies, cylinder, pistons seals and retainer. Piston not included.
	Fittings
1039	Includes 60 cm of 1/8" Teflon inlet tubing, inlet (1/4-28) and outlet (10-32) tube nuts, and outlet ferrule.
1249	Outlet fittings kit; includes three ferrules and three tube nuts (10-32).
1041	Manifold for parallel operation of all three channels on Model BBB pumps (either inlet or outlet).
	Filters
5776	10 micron sintered stainless steel filter, with 60 cm long Teflon inlet tube and tube nut.
	Other Parts
2078	Retainer assembly for B, BB.
2908	Retainer assembly for BBB.
	For other parts, consult factory.

For ¼” PEEK Pumps; Model B

Order No.	Description
	Preventive Maintenance Kits
1394	Includes two uhmw polyethylene seals, tools for installation, two valve cartridges, one retainer, a 10 micron plastic filter, and tube of lubrication oil.
	Piston Seals
1408	Piston seal assembly kit; includes one uhmw polyethylene metal-free seal, and tools for installation.
1409	Piston seal replacement kit; includes three uhmw polyethylene metal-free seals.
	Valves
1377	Inlet valve assembly, cartridge style.
1378	Outlet valve assembly, cartridge style.
1383	Valve cartridge kit (rebuilds one inlet or one outlet valve).
	Pistons
1254	1/4" sapphire piston.
	Liquid End Assembly
5096	Includes inlet and outlet valve assemblies, cylinder, piston seals and retainer. Piston not included.
	Fittings
1280	Includes 60 cm of 1/8" Teflon inlet tubing, inlet (1/4-28) and outlet (1/4-28) tube nuts, and outlet ferrule.
	Filter
1279	10 micron plastic filter, with 60 cm long Teflon inlet tube and tube nut.
	Other Parts
5049	Retainer assembly.
	For other parts, consult factory.

APPENDIX

Warranty

Eldex products are guaranteed against manufacturing defects for one year from the date of shipment. Parts and labor are both covered under the warranty. Seals, valves, and other disposable items are not included in the warranty. The warranty does not apply when there has been obvious misuse or mistreatment by the user or when damage has been caused by attempted repairs by the user. Exposure of Eldex products to inappropriate chemicals also voids the warranty.

Eldex Corporation will not assume responsibility for contingent liability through alleged failure(s) of its products.

There are no warranties, express or implied, which extend beyond this description. Eldex neither assumes, nor authorizes any person to assume for it, any other liability in connection with the sale and use of the products.

Damages are limited strictly to repair or replacement of the products. Eldex expressly disclaims liability for incidental and consequential damages resulting from the use of the products.

Return Procedure

To return an instrument for repair, contact our factory at (800)969-3533 or (707)224-8800 to obtain authorization. Describe the problem with the instrument to our factory personnel and receive a Return Authorization Number. Reference the number on the outside of the packing box in which you return the instrument. Also reference the Return Authorization Number on any paperwork you send with the unit. Be sure to enclose a brief note describing the problems, reference the serial number of the unit, and describe any chemicals used. Also reference your return address. Send the instrument freight prepaid to:

Eldex Corporation
30 Executive Ct.
Napa, CA 94558-6278

Trademarks

Eldex and ReciPro, Eldex Corporation; Fluoroloy G, Furon, Teflon, E.I. DuPont de Nemours, Inc.; Swagelok, Swagelok Co.; PEEK, Victrex plc

Eldex reserves the right to incorporate improvements and alter construction details without notice

