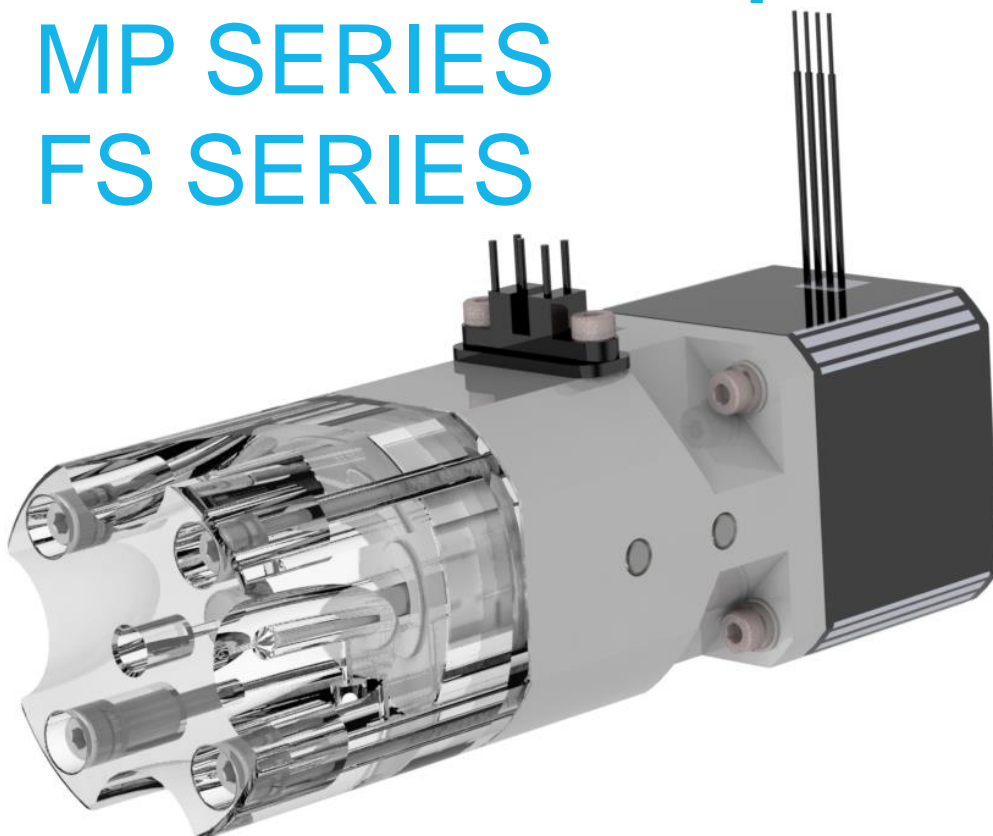


BIO•CHEM

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Maestro Piston Pump

MP SERIES
FS SERIES



User Manual

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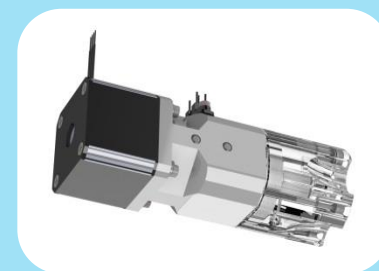
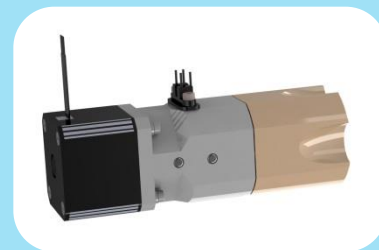
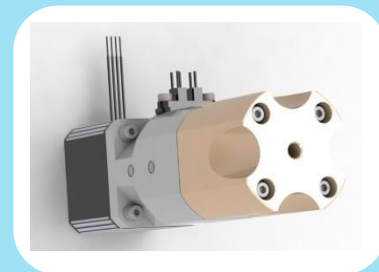
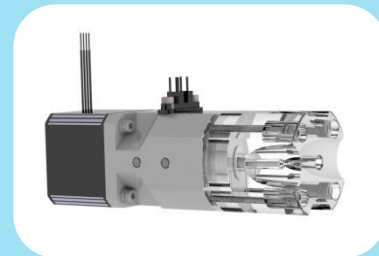
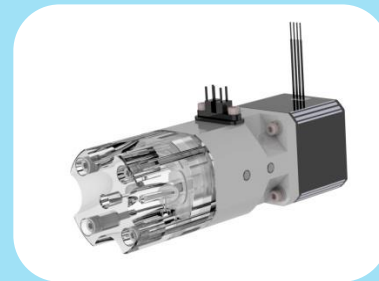


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1 Features

Bio Chem MP Series Piston Pump	
Expected life, DI Water	10M cycles
Expected life, Aggressive Fluids	5M cycles*
Accuracy	~0.5% at 2% to full dispense
Precision	full dispense volume: <0.03% Cv >=5% dispensing: 0.4% Cv <5% dispensing: 1% Cv;
Applied Pressure until leak:	500 PSI
Available Pump Volumes	50uL, 100uL, 250uL, 500uL, 1000uL, 2500uL, 5000uL
Port Configurations	Standard: 1/4-28 Optional: 10-32, M6
Head Material	Acrylic, PEEK™, Ultem®
Piston Material	Zirconia Ceramic, PEEK™

Table 1

*Contact your Bio-Chem representative for more information on fluids tested

2 Outline dimensions and components – not to scale

2.1 Without Flush Port Option [mm] in. Optional Mounting Bracket Shown.

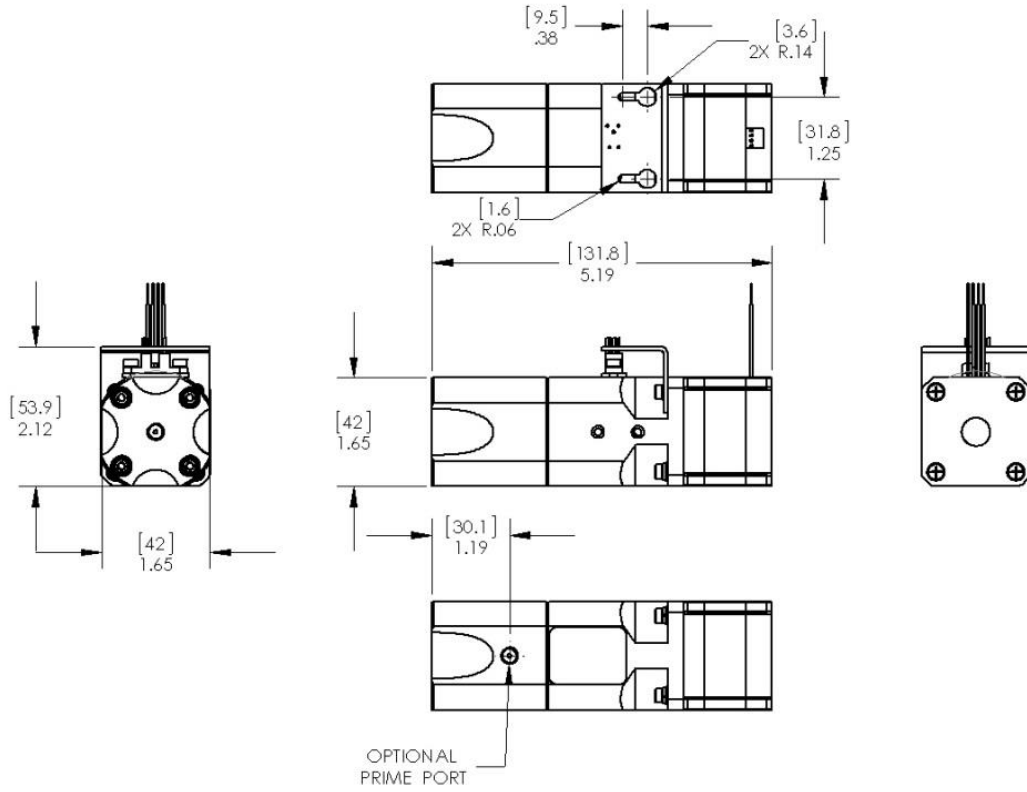


Figure 1

2.2 With Flush Port Option [mm] in.

2.3 With Encoder Option [mm] in.

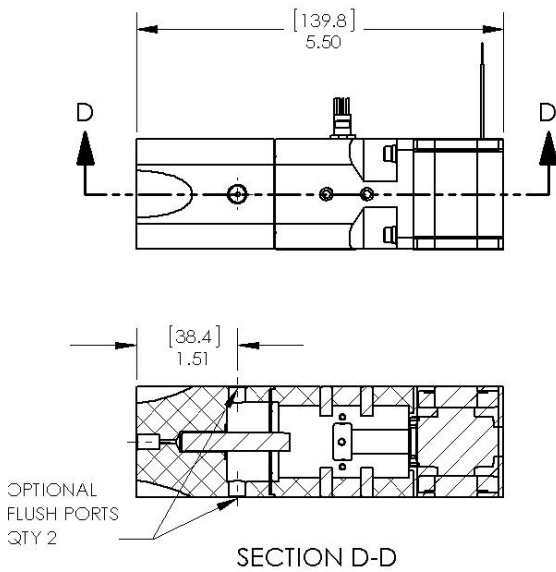


Figure 2

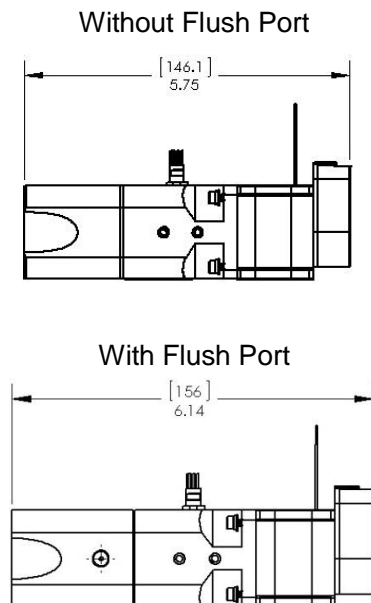


Figure 3

2.4 Main Components

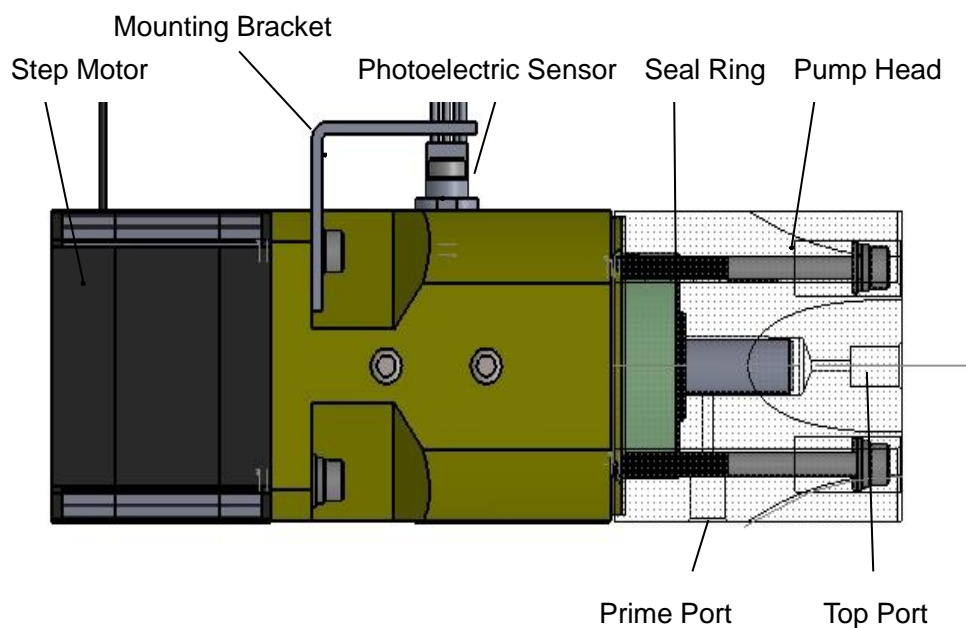


Figure 4

3 Function and Performance

3.1 Dispensing Function

The piston pump has 7 standard volumes: 50uL, 100uL, 250uL, 500uL, 1000uL, 2500uL, and 5000uL. The 25uL dispense volume is available as an option. Each volume pump can dispense full stroke or part of the stroke, depending on the control logic.

3.2 Piston stroke and speed

- Rated full stroke: 12.7mm
- Speed: Using our internal microcontrollers at maximum speed, the pump strokes at approximately 2.2s per cycle (full aspirate and dispense) with a 20 TPI thread

3.3 Chemical compatibility

Several written and online resources are available for chemical compatibility of wetted fluids. Compatibility is dependent upon each application; however by using the wetted part materials listed in Table 1 to look up compatibility, an idealistic overall fluid compatibility can be ascertained. Wetted materials are the piston, seal, and pump body. Compatibility should always be confirmed through applications testing.

-
- Piston material: Zirconia ceramic TZP; PEEK™
 - Seal material: UHMW-PE with VITON® O-ring
 - Pump head material: PMMA, PEEK™, and Ultem® as standard, other material optionally available

4 Working Conditions

- The stepper motor requires an appropriate controller, optionally available
- Maximum applied pressure until leak: 500 PSI minimum
- Operating conditions: Temperature 10-40°C, Relative humidity: 20%~80%

5 Operating Instructions

5.1 Tubing connections

- The pump head contains one top port and side prime port. Optionally, side flush ports are available to run flushing fluid through the backside of the piston. These ports are all flat bottom ports.
- Rigid-walled tubing is recommended for the top port, as it will not deform as much as soft walled tubing – this helps ensure optimal accuracy and precision of measured dispenses.
- Soft walled tubing may be used for the side wash ports, as washing is not a precision operation.
- Connect tubing to ports and tighten per fitting manufacturer's specifications.

5.1.1 Flush Seal Option

The flush seal option allows a flushing fluid to flow across the piston via two flush ports (see Figure 2). This flushing action helps remove deposits from the piston wall as it moves past the seal. This can help reduce deterioration of the seal due to deposit buildup over time. Note that the fluid can flow from either port to the other – there is no recommended direction of flow. **Maximum recommended pressure for flush fluid is 10PSI. Do not let the pump cycle without fluid in the flush area to prevent premature flush seal failure.** Pump flush cycles are application dependent, and can vary due to chemical compositions, duty cycle, and other factors. Testing in the end application with production fluids is highly recommended for an accurate cycle calculation.

5.2 External Control Interface



CAUTION: Risk of Permanent Product Damage



Never connect or disconnect motor or sensors to a control board with power applied.
This may result in damage to the control board and/or components.

5.2.1 Stepper Motor Interface

The stepper motor is provided with flying leads, colored as shown in the diagram below. Optional terminals and housings are available. Please consult your Bio-Chem representative for options.

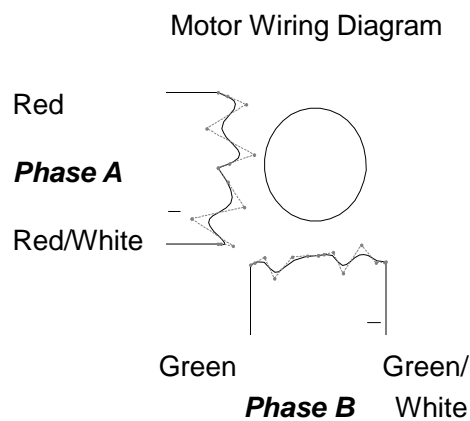


Figure 5

Motor Specifications			
Form Factor	NEMA 17	Phase Voltage	3.0V
Step Angle	1.8°	Phase Current	1.2A
Phase	2	Resistance	2.5Ω
Wire Gauge	26 AWG	Inductance	3.3mH

Table 2



The current ratings provided for the stepper motors are RMS ratings, not Peak-to-Peak ratings. For the 1.2 A_{RMS} motor, it is recommended that the power supply be capable of supplying a minimum of 1.7 amps current, as the motor can draw up to 1.7 A_{P-P}.

5.2.2 Photoelectric Sensor

Bio-Chem utilizes an Optek photoelectric sensor, P/N OPB990T55Z. The photoelectric sensor detects initial piston position. When this position is reached, output changes accordingly. **Note that current vendor data supersedes all data shown below, as applicable.**

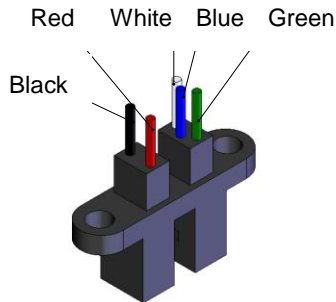


Figure 6

Color	Definition
Red	Anode
Black	Cathode
White	+V _{cc}
Blue	Output
Green	Ground

Table 3

Input Diode

Power Dissipation: 100 mW

Forward Current: 40mA

Reverse Voltage: 2 VDC

Sensor

Supply Voltage: 4.5-16VDC

Output Power Dissipation: 200mW

Low level output voltage: 0.4VDC max (V_{cc} = 4.5VDC)

Wiring instructions:

Red Wire: Connect Anode to power supply (+) output with supply voltage within ratings shown above. Before connecting the power supply, a current-limiting resistance should be connected between the power supply and the sensor matching ratings shown above.

Black Wire: Cathode, should be connected to power supply (-) output.

White Wire: Logic V_{cc} of output signal.

Blue Wire: Connect Output signal (piston position signal) to appropriate control system.

Green Wire: Ground of the Logic V_{cc}.

5.2.3 Optical Encoder

Bio-Chem utilizes the US Digital E5 series encoder. This encoder outputs 2 channel quadrature TTL square waves to determine both position and direction of travel. **Note that current vendor data supersedes all data shown below, as applicable.**

Supply Voltage: 4.5-5.5 VDC
 Supply Current: 27mA typ, no load
 Low Level Output: 0.5VDC max
 ESD, Human Body Model: ± 4 kV
 Max Acceleration: 250000 rad/sec²

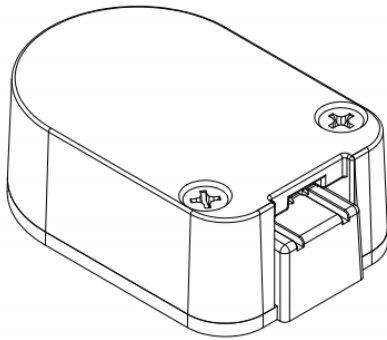


Figure 7*

Pin	Description
1	Ground
2	Index
3	A Channel
4	+VDC Power
5	B Channel

Table 4

*Note stock photo of encoder shown. Actual encoder may vary slightly in detail (holes, relief design, etc.).

5.3 Homing the Pump

The home sensor output is LOW when piston is in initial position and HIGH when piston is not in initial position. See section 5.2.2 for sensor wiring details. **Note the distance from the home sensor to the mechanical limit of the pump is approximately 100 steps (20 TPI Screw) or 200 steps (40 TPI Screw). Confirm the pump will decelerate and stop well before the mechanical limit to avoid mechanical lockup. Mechanical lockup may considerably affect the precision, accuracy, and lifetime of the pump.**

5.4 Pump Backlash

All pumps have backlash in some amount. The Bio-Chem Maestro pump has less than five (5) steps of backlash. For optimal performance, gravimetric calibration is recommended, however it is not required for operation.

5.5 Priming

Priming is essential for critical dispense applications in order to remove bubbles from the system, caused by trapped air in fluid lines and out-gassing of fluids. These bubbles get trapped in the hydrophobic acrylic pump

head. By following these recommended practices, these bubbles can be minimized, thus maximizing performance and dispense accuracy.

5.5.1 Recommended Practices

1. Using degassed DI water for initial priming will ensure the walls of the pump are properly wetted. Let the DI water sit for approximately 30 minutes prior to using the pump.
2. Ensure pump sensor and motor are properly wired – refer to the External Control Interface section 5.2.
3. Ensure the pump is in home position – refer to Homing section 0.
4. Confirm that all fluid connections are tightened per fitting manufacturer's specifications.

5.5.2 Standard Method for Priming

1. Pump Circuit Volume = Volume of fluid within the pump circuit, from input to reservoir
2. Total Circuit Volume = Pump Circuit Volume + input fluid circuit + unswept volumes (see Table 5)
3. $\frac{\text{Pump Circuit Volume}}{\text{Total Circuit Volume}} = \text{Number of cycles to fully prime system}$
4. When switching fluids, it may be desirable to add an additional partial cycle to ensure there is no additional intermixed fluid in the system.

Pump Volume	uL/Step	uL/Step	Unswept Volume, uL		Wash Volume, uL
	20 TPI Resolution	40 TPI Resolution	w/ Prime Port	w/o Prime Port	
50uL	0.0125	0.0063	100	78	131
100uL	0.0250	0.0125	126	105	156
250uL	0.0625	0.0313	188	169	186
500uL	0.1250	0.0625	305	287	229
1000uL	0.2500	0.1250	476	461	283
2500uL	0.6250	0.3125	1039	1029	445
5000uL	1.2500	0.6250	1965	1961	598

Table 5

6 Pump Mounting

6.1 Mounting Bracket on Pump

The mounting bracket is available as an option – see following Figure 8 for details.

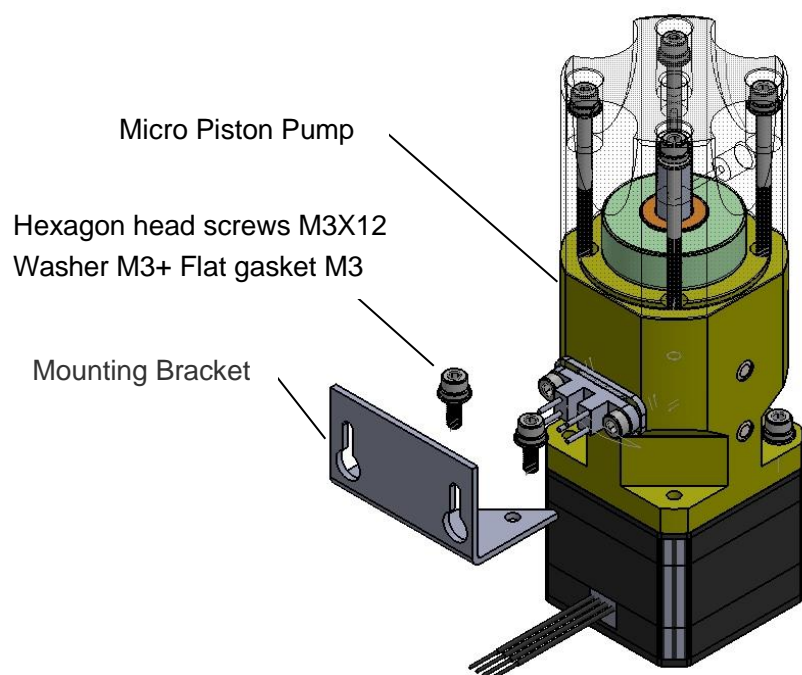


Figure 8

- Remove the two M3X12 hexagon head screws on the side of the photoelectric sensor.
- Mount the mounting bracket on the pump by using the two screws.
- Tighten screws to 11-13 in lbs.

6.2 Mounting the pump to Equipment

The pump can be mounted on equipment through the mounting bracket.

- Two 3.2 Dia. mounting holes are needed on equipment. Refer to Figure 1 for mounting dimensions.
- Mount the pump on equipment through the mounting bracket.

7 Pump Part Number Structure

TYPE	SIZE	PISTON	HEAD	SEAL	PORT SIZE	PRIME PORT	LEAD SCREW PITCH	ENCODER	VALVE
XX	XXX	X	X	X	X	X	X	X	X
MP - STD	0025	C - CERAMIC	A - PMMA	V - VITON	1 - 1/4-28	0 - NONE	2 - 20 TPI	0 - NONE	0 - NONE
FS - FLUSH SEAL	0050	P - PEEK™	P - PEEK		2 - M6	1 - YES	3 - 30 TPI	1 - 1000PPR	3 - 3 WAY
	0100		U - ULTEM		4 - 40 TPI				
	0250	M - MANIFOLD MOUNT							
	0500								
	1000								
	2500								
	5000								

Example:

MP0010CAV11400 = Standard, 100uL size, Ceramic piston, PMMA head, Viton seal, 1/4-28 port, prime port, 40 TPI screw, no encoder, no valve

Transportation and Storage

The micro piston pump is a precision product. Avoid shocks during the transport, storage and operation. Damage with evidence due to severe handling will not be covered under warranty.

8 Repair and Maintenance

1. Do not operate the pump without fluid.
2. Do not transfer solvents that easily erode the pump or expose pump to corrosive environments that are incompatible with pump materials.
3. No user serviceable parts exist inside the pump. Please contact your Bio Chem representative regarding any malfunctioning units. Any disassembly or modifications to any pump component will void warranty (see section 9, Warranty)
4. Flush periodically with deionized water to remove debris and buildup from internal components.

9 Warranty

Bio-Chem warrants the MP series piston pumps to be free from defects in material and workmanship, and for conformance to published specifications under normal use and service, for a period of one year from the date of manufacture.

Bio-Chem's sole obligation and liability under its warranty is limited to the repair or replacement (at Bio-Chem's discretion) at its factory of any piston pump which proves defective.

Bio-Chem makes no other warranty, express or implied, of the piston pump, including, without limitation, implied warranties of merchantability and fitness for particular purpose, and all such warranties are expressly excluded.

Bio-Chem reserves the right to modify published specifications at any time at its sole discretion.

Full details of the applicable warranty can be found in the Bio-Chem Fluidics Inc. Terms and Conditions of Sale. Contact Bio-Chem for further inquiries.

10 Life Support Policy

Bio-Chem does not authorize or warrant any of its piston pumps for use in life support systems.

Life support systems are defined as equipment intended to support or sustain life, whose failure to perform can be reasonably expected to result in personal injury or death.

Rev 0	Initial Production Release	1/11/16
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Bio Chem Piston Pump User Manual

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