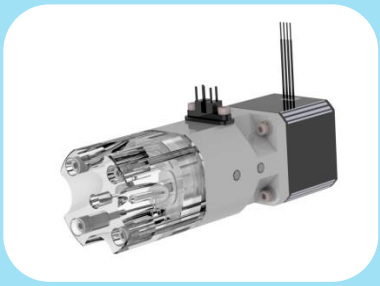
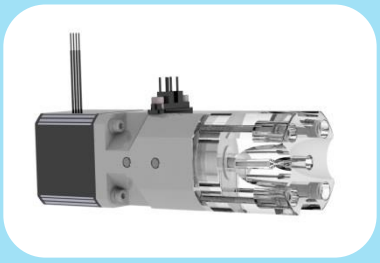
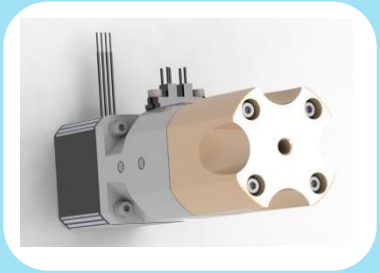
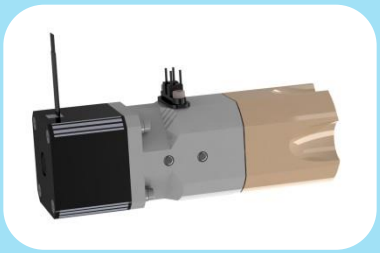
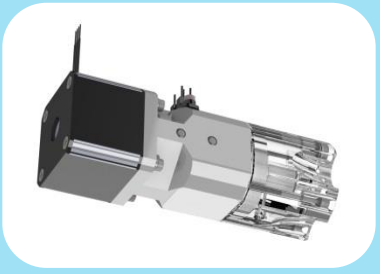
BIO·CHEM





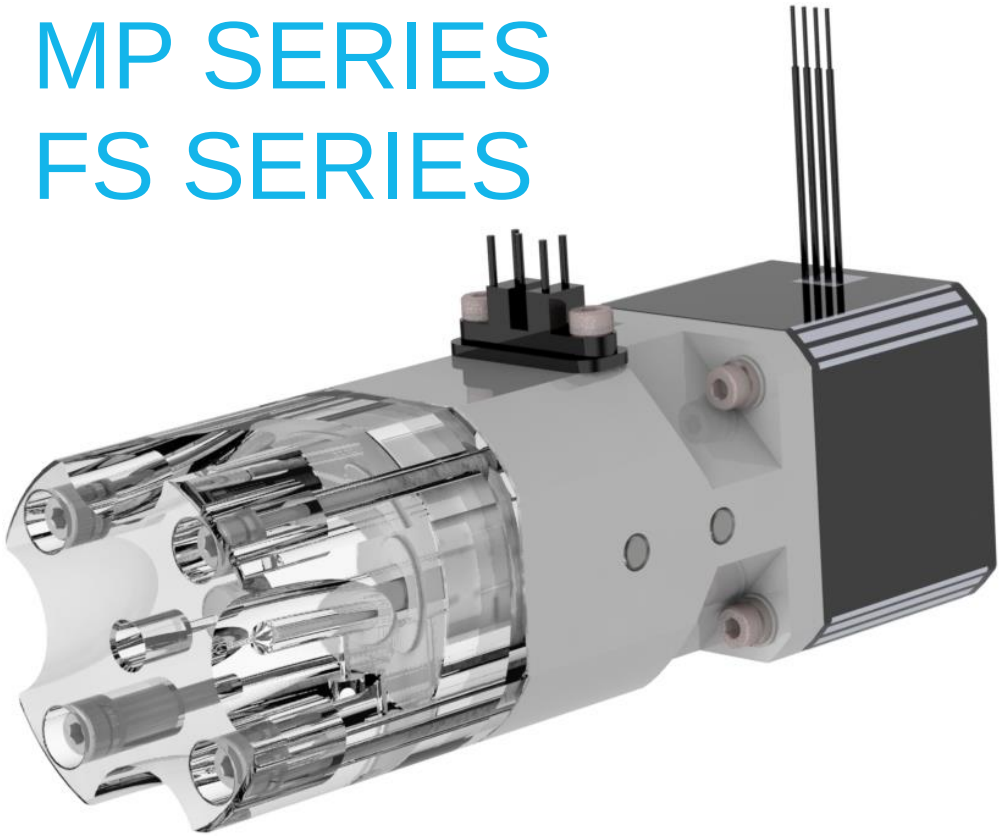






# Maestro Piston Pump

## MP SERIES
## FS SERIES



# User Manual

BIO·CHEM

A HALMA COMPANY

# Table of Contents

# 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<br>>=5% dispensing: 0.4% Cv<br><5% dispensing: 1% Cv |
| **Applied Pressure until leak:** | 500 PSI |
| **Available Pump Volumes** | 50µL, 100µL, 250µL, 500µL,<br>1000µL, 2500µL, 5000µL |
| **Port Configurations** | Standard: 1/4-28<br>Optional: 10-32, M6 |
| **Head Material** | Acrylic, PEEK™, Ultem® |
| **Piston Material** | Zirconia Ceramic, PEEK™ |
| **Seal Material** | UHMW-PE with VITON® O-ring |

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 (BCF Part Number MB-MAESTRO)**

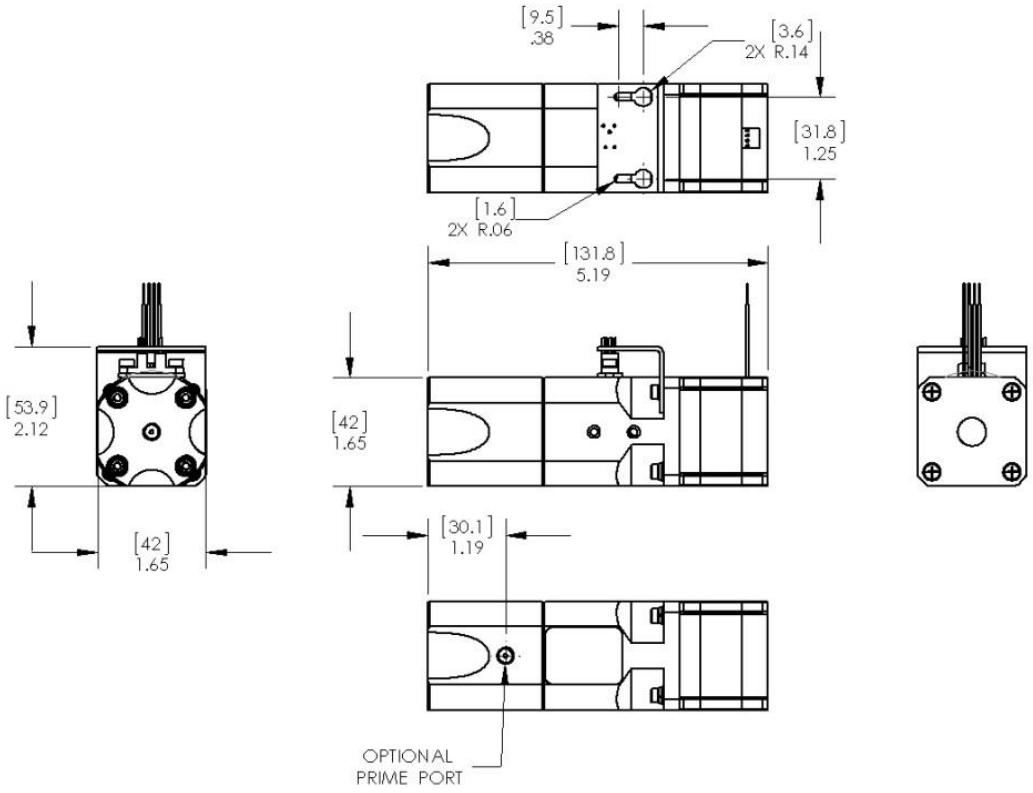



Figure 1

## 2.2 With Flush Port Option [mm] in.

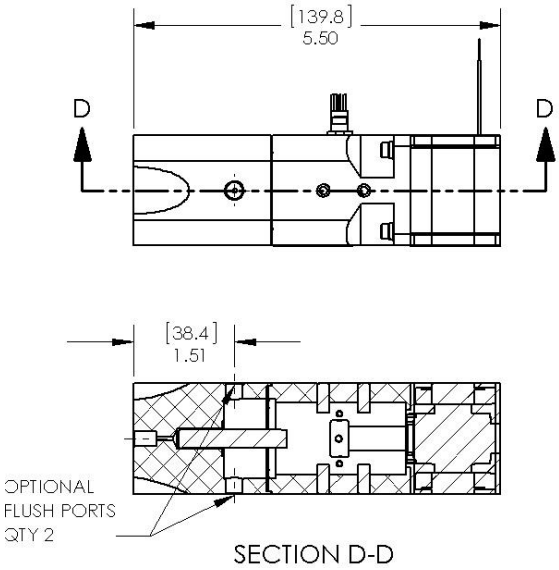
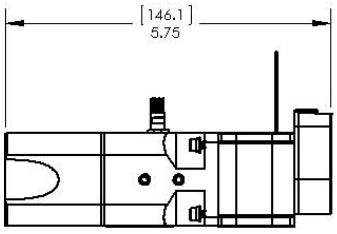



Figure 2

## 2.3 With Encoder Option [mm] in.

Without Flush Port




With Flush Port

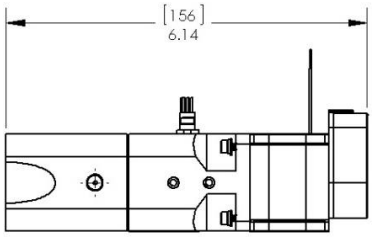



Figure 3

## 2.4 Main Components

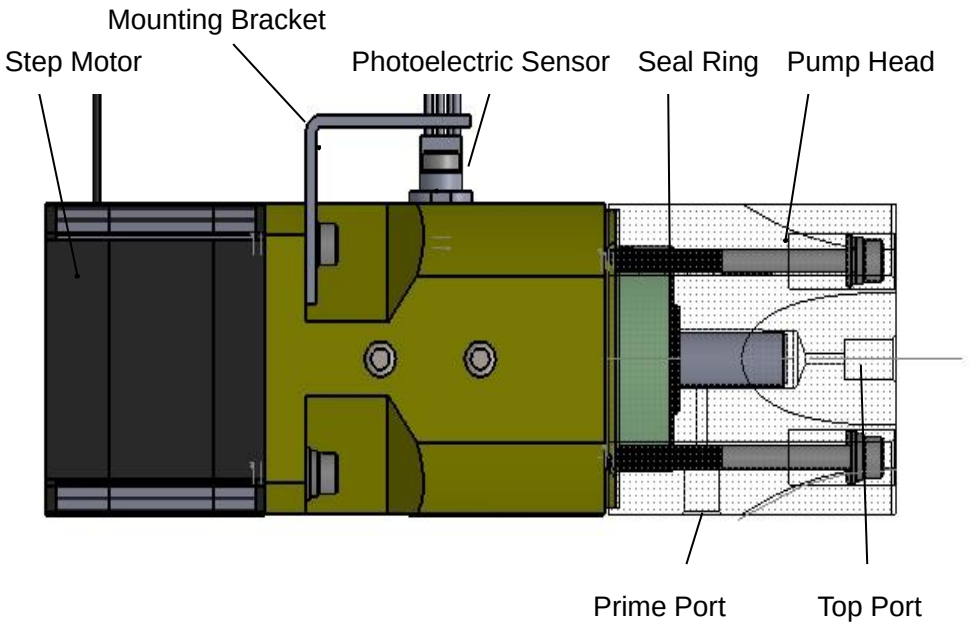



Figure 4

# 3 Function and Performance

## 3.1 Dispensing Function

The piston pump has 7 standard volumes: 50µL, 100µL, 250µL, 500µL, 1000uL, 2500µL, and 5000uL. 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 (VITON® O-ring is NOT a wetted material)
- 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 an optional side prime port. Also as an option, 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.

Motor Wiring Diagram

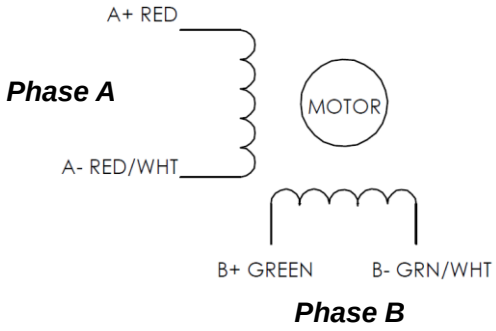



Figure 6

| **Motor Specifications** (24VDC recommended for operation) | | | |
|---|---|---|---|
| Form Factor | NEMA 17 | Phase Voltage | 3.0V |
| Step Angle | 1.8° | Phase Current | 1.2$A_{RMS}$ * |
| 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.**

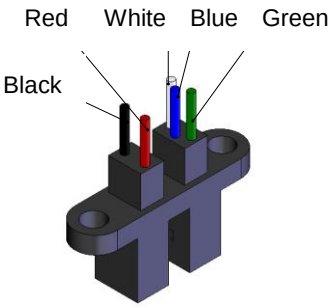



Figure 7

| Color | Definition |
|---|---|
| Red | Anode |
| Black | Cathode |
| White | $+V_{cc}$ |
| Blue | Output |
| Green | Ground |

Table 3

Input Diode
Power Dissipation: 100 mW
Forward Current: 40mA
Applied $V_{cc}$: see below
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. The LED requires a 5VDC power supply. LED will fail suddenly and without warning without a proper resistor. Resistor should be rated at 360Ω with a 24VDC supply.

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 (Optional)

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/sec$^2$

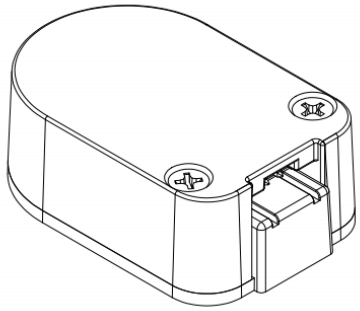


Figure 8*

| 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. $\frac{\text{Total Circuit Volume}}{\text{Pump Circuit Volume}}$ = 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 | µL/Step | µL/Step | Unswept Volume, µL | | Wash Volume, µL |
|---|---|---|---|---|---|
| | 20 TPI Resolution | 40 TPI Resolution | w/ Prime Port | w/o Prime Port | |
| 50µL | 0.0250 | 0.0125 | 100 | 78 | 131 |
| 100µL | 0.0500 | 0.0250 | 126 | 105 | 156 |
| 250µL | 0.1250 | 0.0625 | 188 | 169 | 186 |
| 500µL | 0.2500 | 0.1250 | 305 | 287 | 229 |
| 1000µL | 0.5000 | 0.2500 | 476 | 461 | 283 |
| 2500µL | 1.2500 | 0.6250 | 1039 | 1029 | 445 |
| 5000µL | 2.5000 | 1.2500 | 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 9 for details.

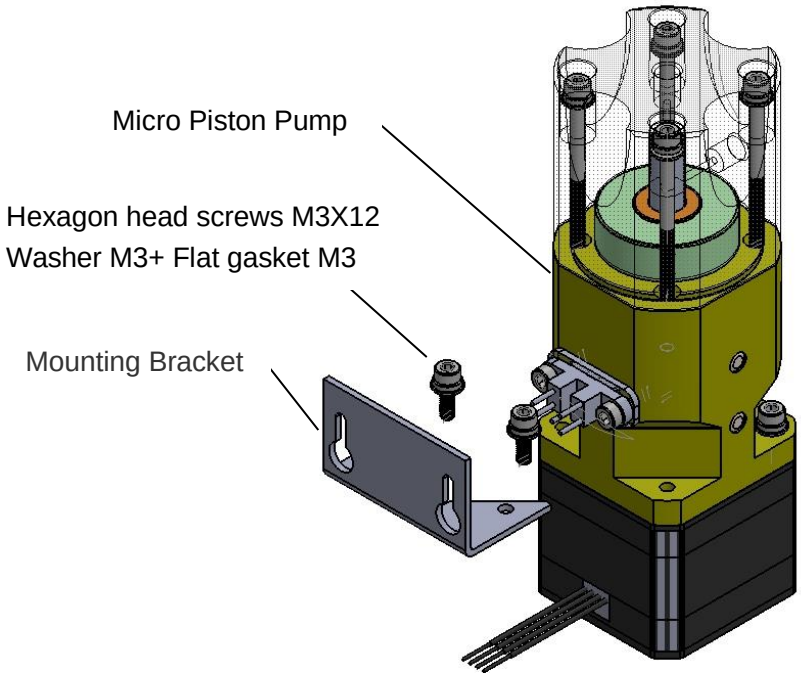



Figure 9

- 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 (BCF Part Number: MB-MAESTRO).

- 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/ HOME POSITION | 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/ FULL DISPENSE | **0** - NONE |
| **FS** – FLUSH SEAL | **0050** | **P** - PEEK™ | **P** - PEEK | | **2** - M6 | **1** - YES | **4** - 40 TPI | **1** - 1000PPR/ FULL DISPENSE | **3** - 3 WAY, HORIZONTAL MOUNT VALVE |
| | **0100** | | **U** - ULTEM | | **3** - 10/32 | | | **2** – NONE/ FULL ASPIRATE | **4** – 3 WAY, VERTICAL MOUNT VALVE |
| | **0250** | | **M** - MANIFOLD MOUNT | | | | | **3** – 1000PPR/ FULL ASPIRATE | |
| | **0500** | | | | | | | | |
| | **1000** | | | | | | | | |
| | **2500** | | | | | | | | |
| | **5000** | | | | | | | | |

Example:

**MP0010CAV11400** = Standard, 100uL size, Ceramic piston, PMMA head, Viton seal, ¼-28 port, prime port, 40 TPI screw, no encoder/full dispense home position, 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 two years 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 |
| Rev 1 | Updated per ECN 5808 | 3/2/17 |

BIO·CHEM



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