HAMILTON®

Liquid Handling Solutions

Proven products. Customized options. Reliable results.

A Partnership You Can Count On

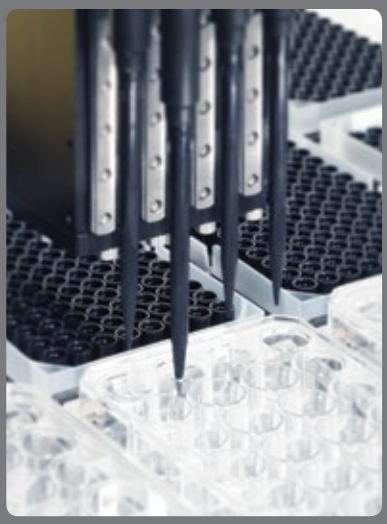
When your instrumentation requires fluid handling equipment, you need more than parts — you need a partner. And that partner is Hamilton Company.

Hamilton Company has been delivering liquid handling solutions to customers for over 60 years. We are an established partner to many top instrument manufacturers in the clinical diagnostic, chromatography, life science research, and other industries. From pumps to valves to pipetting modules and more, Hamilton Company offers a full line of off-the-shelf and customized products for every element in the fluid path. Our liquid handling components integrate seamlessly into your system and ensure the reliable operation of your high-performance instrumentation.

Your success is Hamilton's success.

Unlimited Customization Options

See more on page 13



Air Displacement Pipetting

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For more information on the full portfolio of Hamilton liquid handling solutions or to inquire about a product, please visit **www.hamiltoncompany.com** or refer to the back of this catalog for additional contact details.

The Benefits of Choosing Hamilton

Selecting the right fluid handling components for your device is critical. Parts that are unreliable or do not perform as promised can alter instrument performance, delay market release, greatly increase field service costs, and jeopardize the relationship with your customer.

You need a partner that offers product expertise, reduces the time and cost of development and production, simplifies your manufacturing process, and helps you gain market share.

Expertise. Commitment. Quality.

Hamilton Company excels at collaborating with you to find the perfect solution that meets every expectation, and that's why more and more customers are choosing us. Hamilton has been developing answers to countless liquid handling questions for over 60 years, and it's hard to imagine a challenge Hamilton hasn't already solved. We've developed and manufactured specialty and turnkey syringes, valves, diluters/dispensers, and pumps for all types of applications for companies of all sizes, all around the world. Our customers come to us for worry-free, cost-effective components, and Hamilton is proud to deliver every time.

Hamilton Company's engineering teams in Reno, Nevada and Bonaduz, Switzerland are committed to constantly reviewing and improving our liquid handling solutions. The feedback we receive from customers affects our engineering cycle and often results in improvements to existing items or the introduction of new products that fulfill unmet needs.

In addition to our comprehensive assortment of standard options, Hamilton also offers unlimited possibilities through our product modification process. Because Hamilton manufactures each element of the fluid path, we can customize any item to meet your unique requirements. And to ensure timeliness, whether your system utilizes standard, existing Hamilton products, or custom components, turnaround time is minimized so you can beat your competitors to the marketplace.

Hamilton blends liquid handling experience, technological innovation, and manufacturing quality to produce exactly what you need.

Design and Prototyping

In Hamilton's nearly 60 years' experience in liquid handling, we've learned each project is different and requires a fresh approach — which is why no two tasks are ever treated the same. Hamilton's dedicated team of designers openly work with you through an in-depth investigative phase that reveals all the requirements and dependencies of your instrument so the perfect match can be found or developed for you. Your design lead will frequently keep you up to date every step of the way so you can be confident of our mutual progress.

Hamilton's design engineers are supported by a fully staffed group of experienced machinists who are skilled in the latest modeling tools and familiar with a wide range of materials, including plastics and chemically resistant metals such as high grade stainless steel. This allows your designs to become prototypes faster. Minor schematic changes and exploratory components are handled quickly and easily. Every step in the development process is closely documented so when the correct design is achieved, the transition to full-production manufacturing happens seamlessly.

Quality Manufacturing

Hamilton's manufacturing facilities in Reno, Nevada and Bonaduz, Switzerland combine modern automated techniques with the fine-tuning of manual procedures. Every step of the process is analyzed and optimized for maximum throughput and efficiency. Assembly procedures are documented with controlled revisions to ensure each item is built to your exact specifications.

Hamilton's commitment to total quality empowers the factory team to draw attention to errors and make necessary improvements so each component is made right the first time. Hamilton is an ISO 9001 certified manufacturer accustomed to working with heavily regulated industries. Hamilton is a strictly controlled environment which is why it is capable of manufacturing RoHS-compliant products and providing components for in vitro diagnostic (IVD) instruments. Many of our products are subject to FDA review, and our quality system passes even the toughest audits.

Hamilton Facilities

Hamilton has headquarters in Reno, Nevada; Bonaduz, Switzerland; and Giarmata, Romania. The teams in each location work together to provide design, manufacturing, and technical support to customers worldwide.

Each facility features a fully-equipped manufacturing operation with room to accommodate projects of any size. Hamilton's talented teams in each office have the skills and experience to meet the demands of your project.

Bonaduz, Switzerland

Reno, Nevada, United States

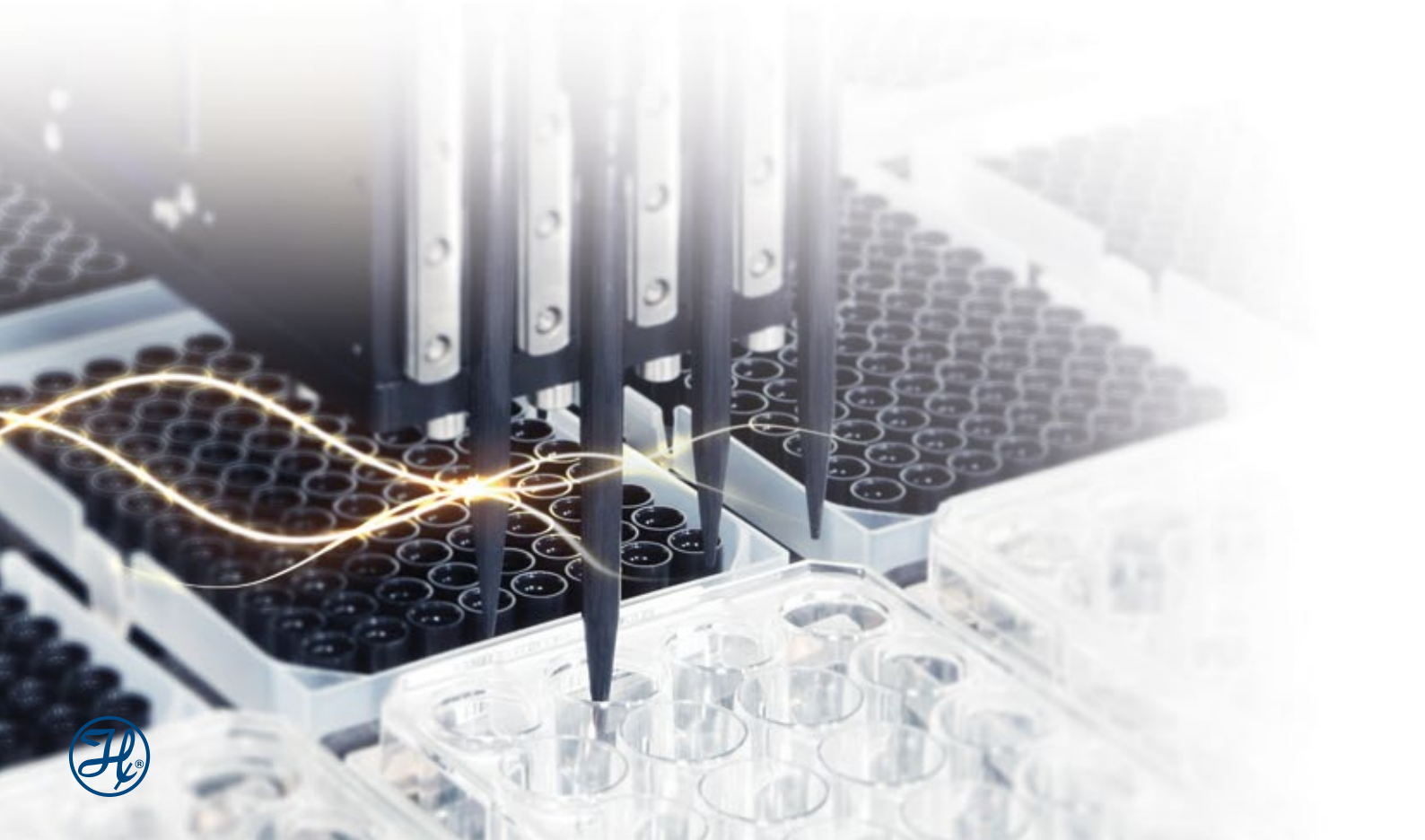
Giarmata, Romania

Obtaining Accuracy through Air Displacement Pipetting

Air displacement pipetting uses a piston to aspirate liquid into a disposable plastic tip. As the piston moves up, the air pressure in the tip is lowered and sample is pushed into the tip by the atmospheric pressure. With this method of pipetting the sample only contacts the pipette tip which can be discarded between samples to eliminate cross contamination. The ZEUS Pipetting Modules use a solid state piston that improves performance and minimizes maintenance when compared to liquid filled air displacement systems.

What are the Challenges with Air Displacement Pipetting?

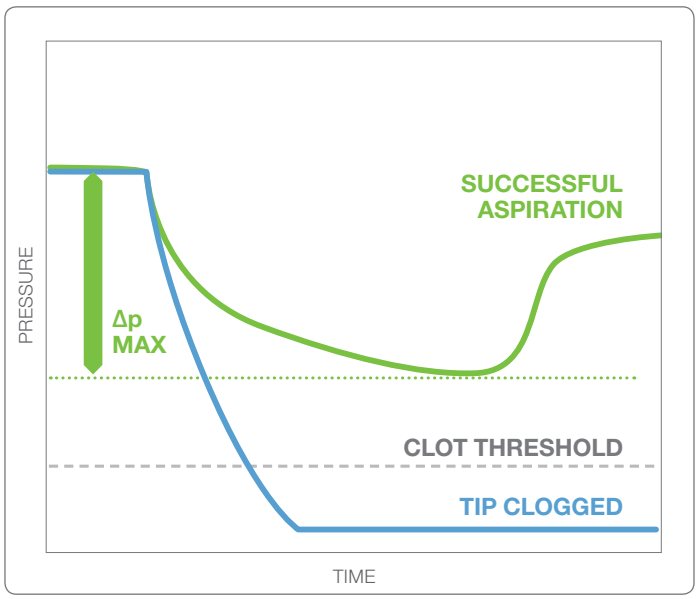
Air is compressible. This creates challenges and makes achieving acceptable pipetting accuracy and precision difficult if all the variables are not considered and properly compensated for. Characteristics like density, surface tension, volatility, viscosity, and more all have an impact on pipetting accuracy. Thankfully, ZEUS channels are designed to do all the thinking. Just enter the parameters and ZEUS handles the pipetting actions and uses pressure data to confirm a successful aspiration or dispense. If the proper parameters are unknown, Hamilton can even help with generating and validating liquid classes.



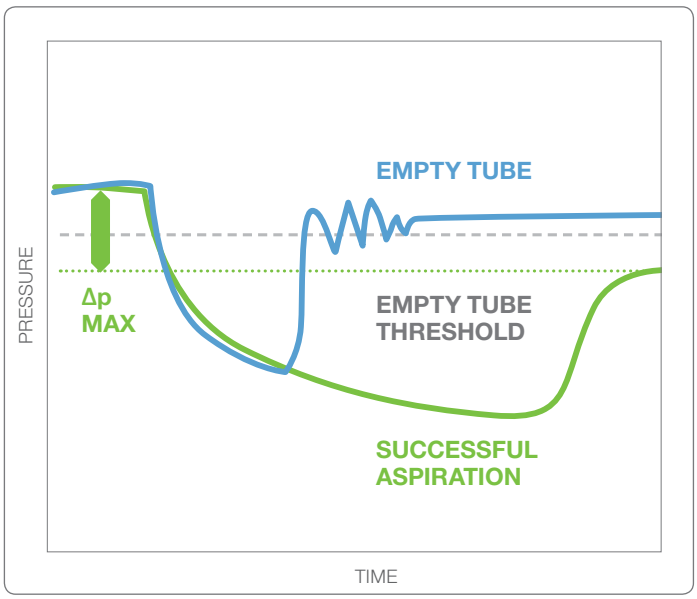
The Power of Qualitative Pipette Monitoring (QPM)

On the STAR Liquid Handling Platform, Hamilton pioneered the art of translating pressure curves into intelligent actions. With ZEUS, the benefit of this knowledge is available for integration into any liquid handling application. Some pipetting modules are capable of reporting pressure data, but ZEUS is the only one capable of interpreting the data and providing actionable information back to the system.

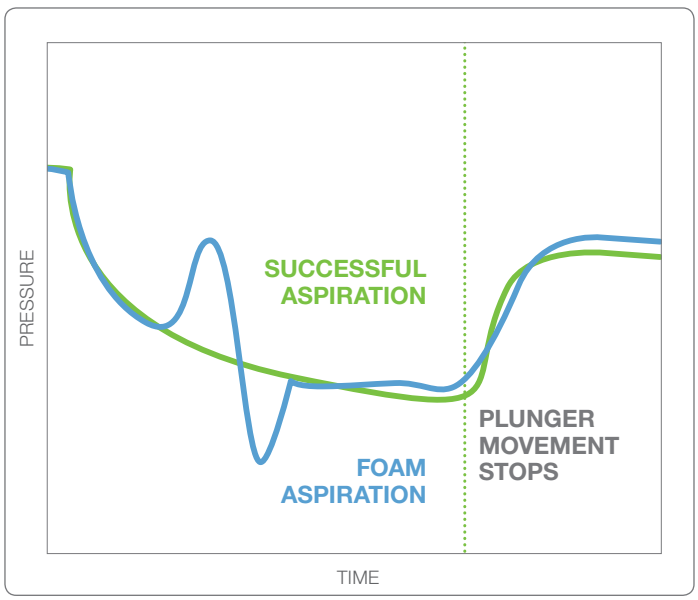
Clogged Tip Detection



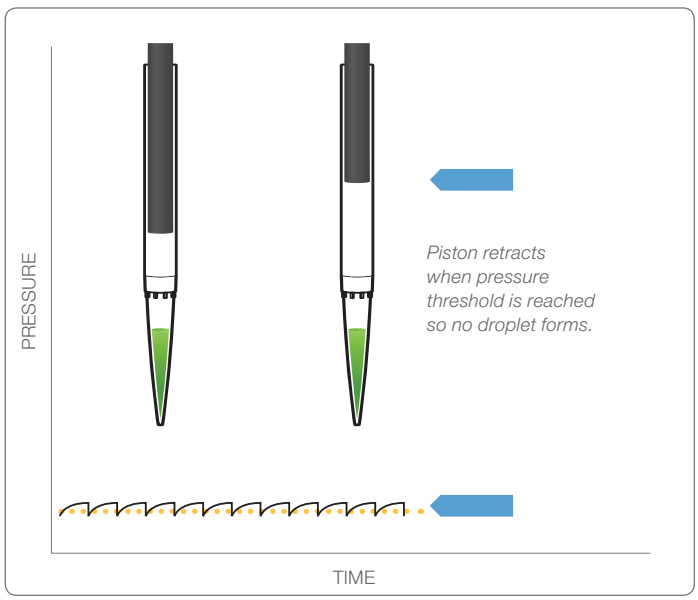
Insufficient Liquid Detection



Aspiration of Foam



Droplet Prevention



ZEUS and ZEUS LT Pipetting Channels

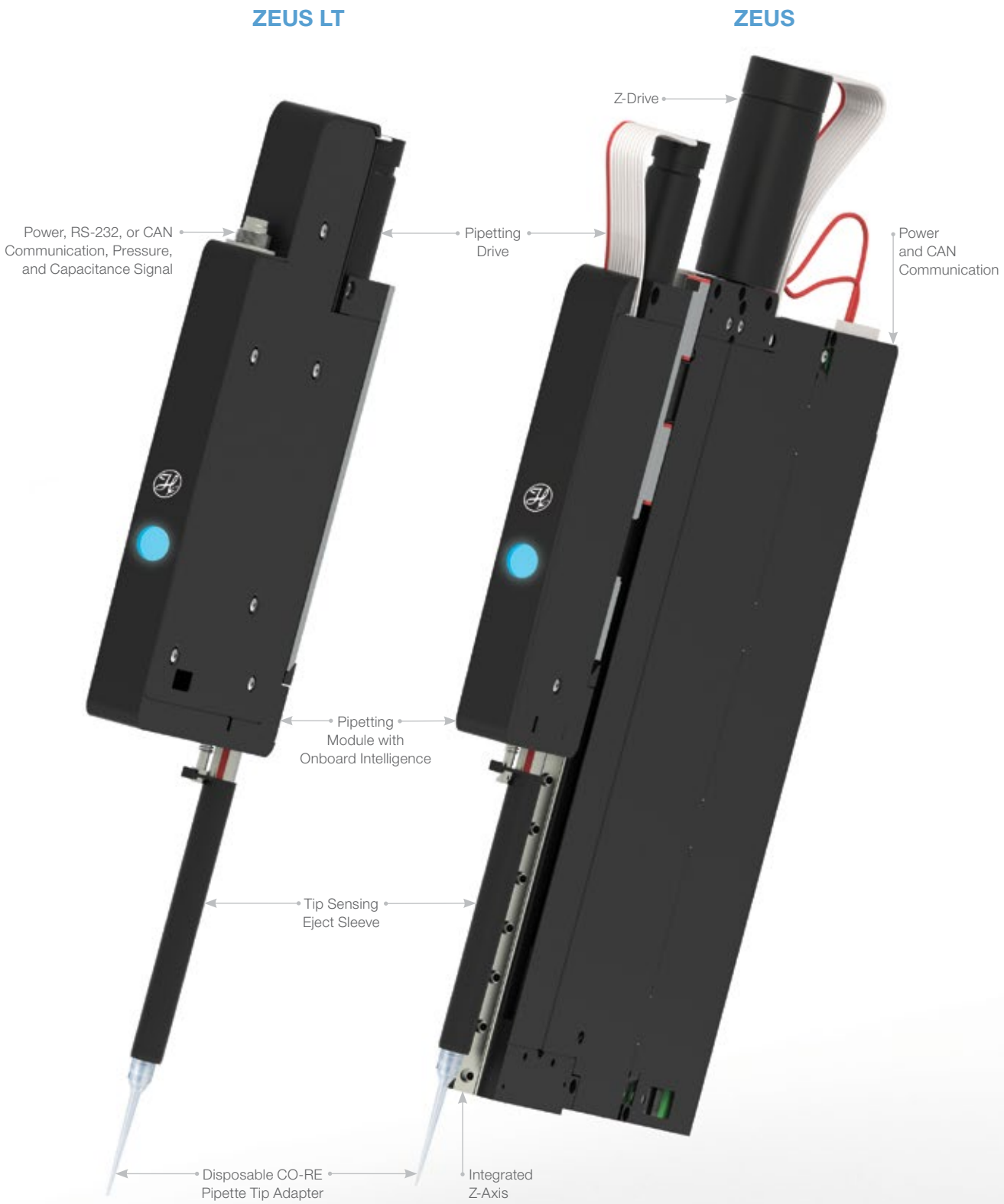
ZEUS channels are available as the ZEUS LT standalone pipette channel, or as ZEUS with a variety of different integrated z-axises. All ZEUS channels are self-contained liquid handling modules for integration into instruments requiring on-board pipetting. The ZEUS Pipetting Module utilizes Hamilton's revolutionary air displacement pipetting technology and CO-RE™ (compressed O-ring expansion) tips.

When ZEUS with integrated z-axis receives an aspirate command, it does more than simply move the plunger drive a set distance. ZEUS intelligently finds the surface of the liquid, aspirates the liquid while lowering the tip to follow the meniscus according to the container geometry, and adjusts the speed and plunger movement to compensate for the type of liquid that is being aspirated. Instead of just reporting back pressure data during the aspiration, ZEUS actively monitors the pressure for deviations that could indicate a tip clog or aspiration of air. These high level capabilities allow customers to significantly shorten development timelines, get product to market faster, and initiate a revenue stream sooner.

More Than Just a Component

Features	ZEUS	ZEUS LT	Competitive Models
Pipette Drive	✓	✓	✓
Pressure Sensor	✓	✓	✓
Capacitive Sensor with Conductive Tips	✓	✓	+
Tip Ejector	✓	✓	+
Tip Sensor	✓	✓	+
Qualitative Pipette Monitoring	✓	✓	✗
Liquid Class Definitions	✓	✗	✗
Z-Axis	✓	✗	✗
Liquid Level Identification	✓	✗	✗
Aspiration and Dispense Tip Following	✓	✗	✗
Container Geometry Definitions	✓	✗	✗

✓ *COMES STANDARD* + *OPTIONAL* ✗ *NOT AVAILABLE*


ZEUS LT
ZEUS
Z-Drive
Power, RS-232, or CAN Communication, Pressure, and Capacitance Signal
Pipetting Drive
Power and CAN Communication
Pipetting Module with Onboard Intelligence
Tip Sensing Eject Sleeve
Disposable CO-RE Pipette Tip Adapter
Integrated Z-Axis

Pipette Tips for Any Application

Hamilton offers a wide range of pipette tips to solve a variety of common automation challenges. Conductive, non-conductive, slim, and piercing tips are available in a variety of different volumes and packaging options. Below is an example of some off the shelf tips. Contact Hamilton to discuss which tips are most appropriate for your application.

Standard Pipette Tips

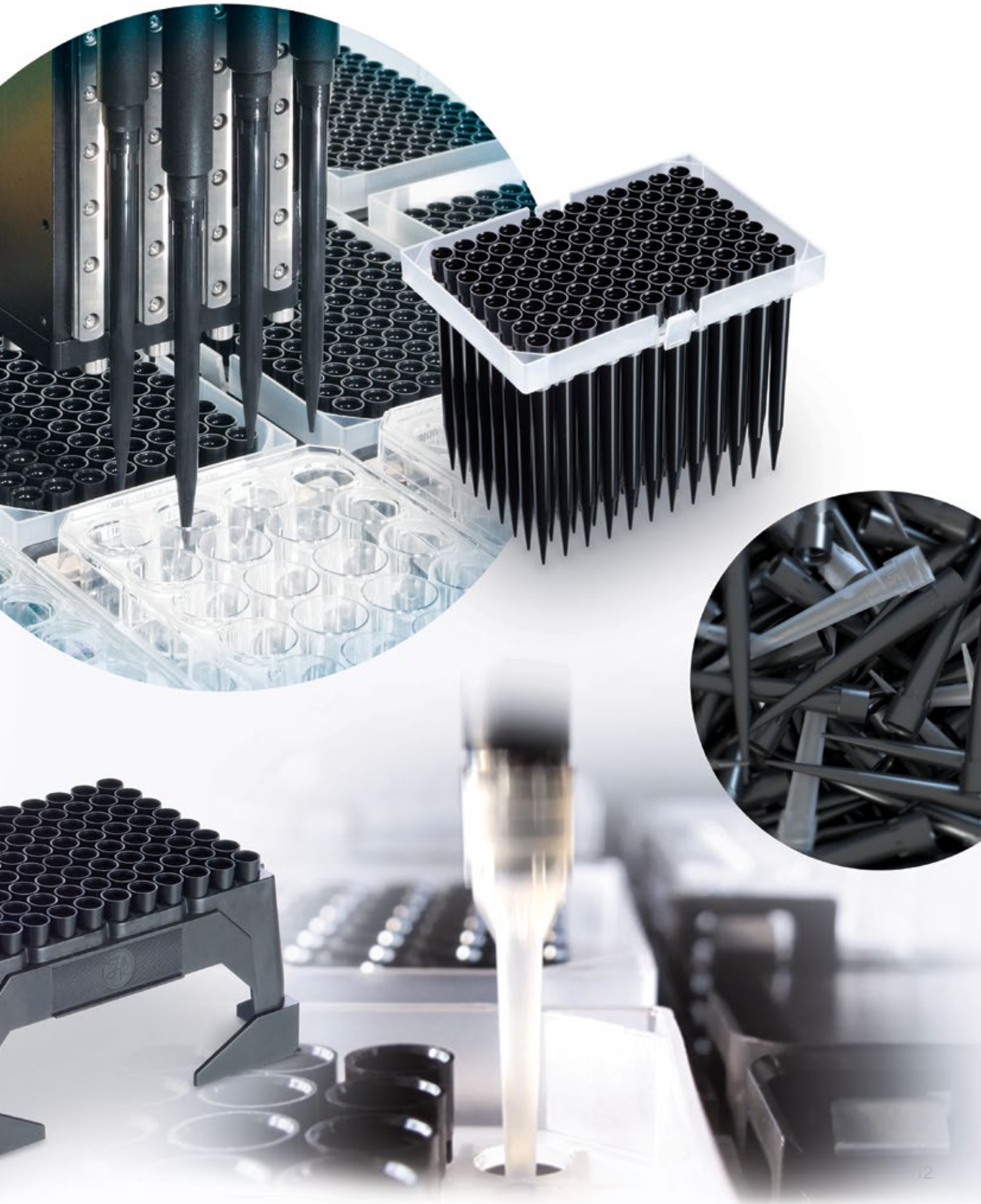
	Tip Volume					
Description	10 µL	50 µL	150 µL*	250 µL*	300 µL	1 mL
Conductive	✓	✓		✓	✓	✓
Conductive, Sterile	✓	✓		✓	✓	✓
Conductive, Filtered	✓	✓	✓		✓	✓
Conductive, Filtered, Sterile	✓	✓	✓		✓	✓
Conductive, Stacked	✓	✓			✓	
Conductive, Stacked, Sterile	✓	✓			✓	
Wide Bore, Conductive					✓	✓
Slim Tip, Conductive					✓	
Slim Tip, Conductive, Filtered					✓	
Non-Conductive, Clear Stacked	✓	✓			✓	

** 150 µL and 250 µL tip volumes are septum piercing design.*

ZEUS and ZEUS LT Accuracy and Precision by Tip Size

Tip Volume	Dispense Volume	Accuracy	Precision
10 µL	1 µL	5.0%	4.0%
10 µL	5 µL	2.5%	1.5%
10 µL	10 µL	1.5%	1.0%
10 µL	1 µL	5.0%	4.0%
50 µL	5 µL	2.5%	1.5%
50 µL	50 µL	2.0%	0.75%
300 µL	10 µL	5.0%	2.0%
300 µL	50 µL	2.0%	0.75%
300 µL	300 µL	1.0%	0.75%
1000 µL	10 µL	7.5%	3.5%
1000 µL	100 µL	2.0%	0.75%
1000 µL	1000 µL	1.0%	0.75%

** Pipetting specifications were determined gravimetrically using a high precision balance and strictly controlled environmental conditions: test temperature: 20 ± 2°C, relative humidity: 50% ± 5%, test liquid temperature range: ≤± 0.5°C of room temperature, balance used: Mettler Toledo MX5. The measurements were done in Hamilton Verification Solution (deionized water with 0.1% NaCl and 0.01% Tween detergent) using standard CO-RE conductive tips. A new tip was used for each pipetting cycle (aspiration and dispense). At least 10 points were taken for each volume and pipetting module. Volumes > 20 µL were dispensed in jet mode. Volumes ≤ 20 µL were dispensed in surface mode. Results may vary using other liquid or environmental conditions.*



Understanding Liquid-Filled Sub-Systems

The Hamilton syringe pumps are typically used to precisely transfer samples and reagents, do bulk dispensing, and enable processes where accurate dispenses are a must. The positive displacement syringe enables users to dispense liquids with high accuracy and precision. Due to the incompressibility of liquid, syringe pumps are normally not impacted by liquid and environmental factors like surface tension, viscosity, humidity, hydrostatic pressure, and barometric pressure.

Superior Form and Function Saves You Money

Hamilton designs and builds each element of the fluid sub-system including the syringe, valve, and pump. This integrated manufacturing process guarantees perfect compatibility between the components and results in superior performance of the whole unit, even in high throughput applications. The pumps' exceptional reliability results in reduced warranty repair costs and increased potential maintenance contract profit for you.

PSD pumps maximize syringe life because the syringes are made to precisely match the alignment and structure of the pump. And since Hamilton syringes are proven to last longer with no loss of performance, they can be replaced less often which increases profit in offered instrument maintenance contracts.

Other Benefits of Liquid-Filled Positive Displacement Systems

- **Large dispense range from 50 mL to nL**
- **Inert fluid path manages harsh chemicals like concentrated acids, bases, and volatile organic solvents**
- **Faster bulk dispensing compared to air displacement pipetting because sample does not need to be picked up from one location and transferred to another**
- **The valves, syringes and tubing can be exchanged in minutes, simplifying periodic maintenance service**
- **Multiple syringe pumps can be daisy chained (i.e., aspiration of one syringe while the other dispenses) to increase throughput**
- **Ability to use syringe pump valves to sample-inject into higher pressure carrier fluid**
- **Can be used to manage consistent flow rates in microfluidic applications**
- **Continuous multiple dispenses of the system liquid**

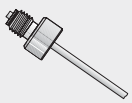
Complete Customization

These PSD pumps represent Hamilton's base offering. Every aspect of each unit can be customized, including the size, shape, power, casing, fluid path, firmware, mount, and more. Whatever your need, Hamilton can meet it.

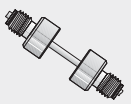
Custom Tubing

Hamilton offers a wide variety of chemically inert tubing assemblies. Different gauges, fittings, hub assemblies, and lengths are available to meet most connection needs. Assemblies are manufactured with CTFE threaded fittings and the choice of PTFE or FEP tubing. An optional strain relief spring prevents the tubing from bending and creasing.

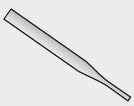
Single Hub Assemblies



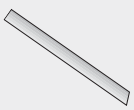
Dual Hub Assemblies



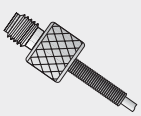
Tapered End



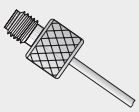
Blunt End



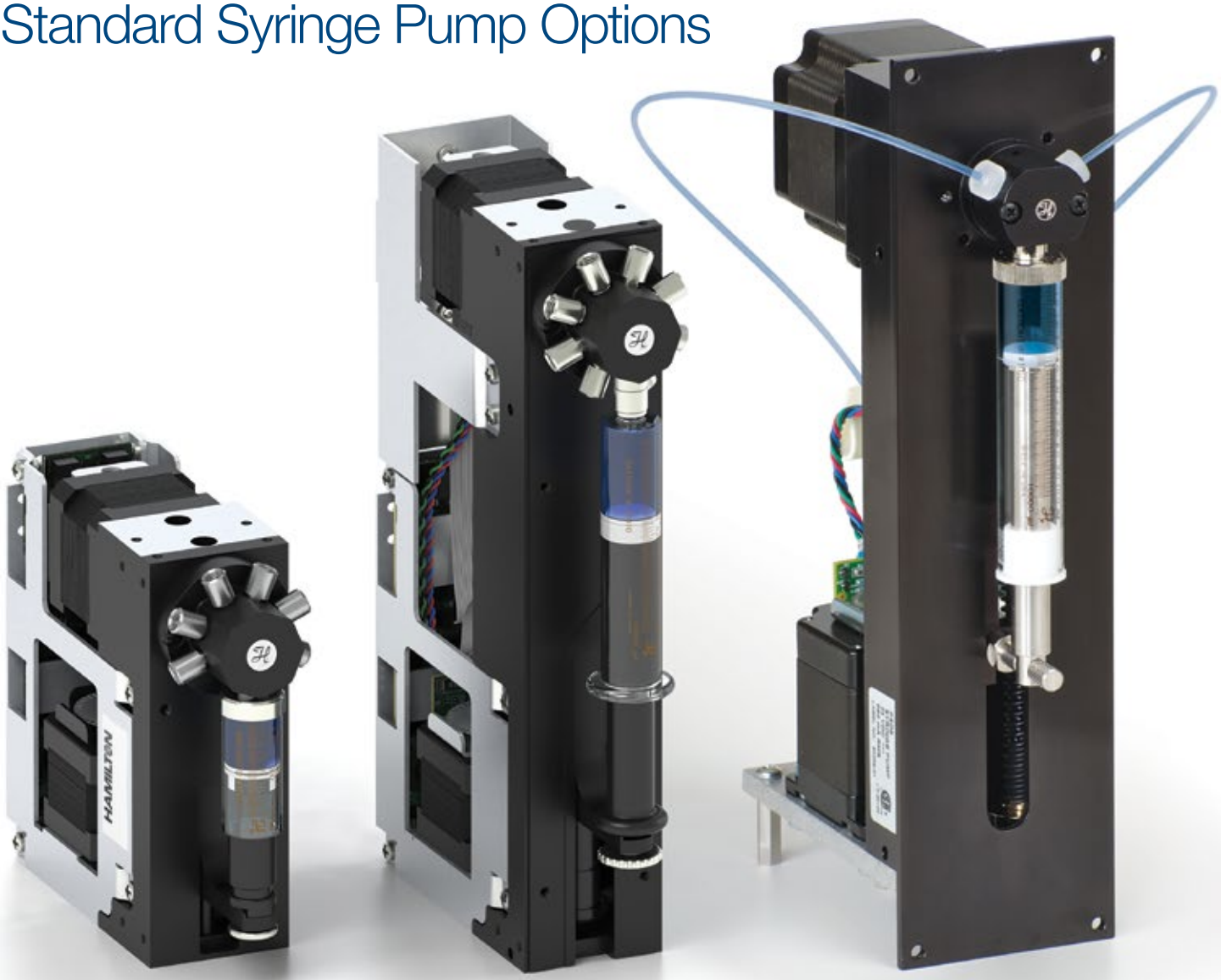
Strain Relief



Standard



Standard Syringe Pump Options



PSD/4

Most popular, compact,
30 mm stroke syringe pump

PSD/6

Largest dispense volume,
60 mm stroke syringe pump

PSD/8

Industrial strength valve and syringe
motors, 60 mm stroke syringe pump

PSD/4 Half-Height Syringe Pump

Design Flexibility with a Vast Range of Applications

The standard PSD/4 is a popular choice for customers looking for a high precision syringe pump at an economical price. From the semi-conductor to the medical device industries, this pump has proven a reliable addition to numerous continued projects with top automation manufacturers. The PSD/4 performs all liquid handling functions, including dispensing, serial dispensing, and diluting.

Optional Configurations

The PSD/4 is available with a variety of modifications to enhance performance in select applications. The Smooth Flow pump provides consistent flow rates in the 100 nL/min range with dispense times as high as 8 hours. The High Lift Force pump provides additional lift to avoid overloads from applications with large volume syringes with moderate back pressure. The High Valve Torque option provides an added safety margin for applications where the solution tends to result in a sticky valve.

Other Features and Benefits of the PSD/4

- 30 mm stroke length
- Variety of mounting options — front, back, top, bottom, and side
- Easy serviceability: Modular design allows quick plug and play replacement
- Small footprint suits limited spaces
- Operates alone or in a daisy chain
- Demo cables and software CD available
- Proven reliability
- RoHS and CE compliant

PSD/4 Specifications

PSD/4 Type	Highest Resolution (steps/stroke)	Fastest / Slowest (time/stroke)	Size = D x H x W (in)	Linear Force Capability (lbf)	Valve Torque Capability (in oz)	Syringe Volume Range (µL)	Weight (lbs)
Standard	24,000	1 sec / 50 min	4.4 x 5 x 1.75	20	25	12.5 to 12,500	2.6
Smooth Flow	192,000	14 sec / 8 hr	4.4 x 5 x 1.75	23	25	12.5 to 12,500	2.71
High Lift Force	54,857	2.3 sec / 114 min	4.4 x 5 x 1.75	40	25	12.5 to 12,500	3.14
High Valve Torque	24,000	1 sec / 50 min	5.4 x 5 x 1.75	20	75	12.5 to 12,500	2.71

*Visit **www.hamiltoncompany.com/OEM** for more information on Hamilton liquid handling solution products.*

PSD/6 Full-Height Syringe Pump

A Compact, Full-Height Pump, for Precision Dispensing of Small to Large Volumes

The PSD/6 is the newest syringe pump to join the Hamilton Precision Syringe Drive (PSD) family. It can be fitted with a variety of valves and the widest range of compatible syringe sizes. With up to 384,000 steps of resolution, syringes from 25 µL to 50 mL, and up to a 16 hour stroke rate, the PSD/6 is equipped for even the most demanding applications.

The PSD/6 performs all standard liquid handling functions, including dispensing, serial dispensing, and diluting. Syringe and drive movements are designed for simple integration and optimized to extend the life and time between maintenance cycles. The most compact full-height syringe pump available, this flexible platform can meet the demands of the most challenging applications in harsh chemical condition and heavy duty cycles.

Other Features and Benefits of the PSD/6

- 60 mm stroke length
- Variety of mounting options — front, back, top, bottom, and side
- Easy serviceability: Modular design allows quick plug and play replacement
- Small footprint suits limited spaces
- Operates alone or in a daisy chain
- Demo cables and software CD available
- RoHS and CE compliant

PSD/6 Specifications

PSD/6 Type	Highest Resolution (steps/stroke)	Fastest / Slowest (time/stroke)	Size = D x H x W (in)	Linear Force Capability (lbf)	Valve Torque Capability (in oz)	Syringe Volume Range (µL)	Weight (lbs)
Standard	48,000	2 sec / 100 min	4.4 x 9 x 1.75	20	25	25 to 50,000	3.65
Smooth Flow	384,000	28 sec / 16 hr	4.4 x 9 x 1.75	23	25	25 to 50,000	3.62
High Lift Force	109,714	4.6 sec / 228 min	4.4 x 9 x 1.75	40	25	25 to 50,000	3.79
High Valve Torque	48,000	2 sec / 100 min	4.5 x 9 x 1.75	20	75	25 to 50,000	3.62

PSD/8 Full-Height Syringe Pump

The Strongest, Fastest Pump for Heavy Duty Applications

If you have a demanding system or process that requires powerful liquid handling, then this is the pump for you. The PSD/8 is the strongest and fastest pump available from Hamilton Company. The PSD/8 has over 10 years of reliable, precise experience in the most strenuous situations.

The PSD/8 performs all standard liquid handling functions, including dispensing, serial dispensing, and diluting. By bolting the valve directly to the face, long-term alignment of the valve and syringe as well as increased accuracy are ensured. The pump is easy to service and replace, which minimizes field maintenance and system downtime. The PSD/8 has the most lift force (45 lbf) and fastest flow rate.

The PSD/8 integrates well into most operations using simple, intuitive command programming.

PSD/8 Specifications

Highest Resolution (steps/stroke)	Fastest / Slowest (speed/strokes)	Footprint = D x H x W (in)	Linear Force Capability (lbf)	Valve Torque Capability (in oz)	Syringe Volume Range (µL)	Weight (lbs)
24,000	1.2 / 1,200	4.76 x 10 x 2.56	45	65	50 to 25,000	5.4

A full list of compatible syringes, valves, and communication protocols is available in the Technical References section starting on page 31.

Other Features and Benefits of the PSD/8

- 60 mm stroke length
- Face and bottom mounting
- Stepper motor with 24,000 steps
- Easy serviceability: Modular design allows quick plug and play replacement
- Stepper motor with 24,000 steps per 60 mm stroke
- Strongest pump with the fastest flow rate
- Operates alone or in a daisy chain
- Demo cables and software CD for the best integration testing
- Simple communication protocol

Modular Valve Positioners

Hamilton Modular Valve Positioners are self-contained, bidirectional valve positioners used for fluid selection and redirection. There are two models to choose from, a standard or high torque valve positioner. Both models offer valves with several standard fluid paths. A built-in indicator and DC stepper motor with encoder ensure accurate valve port alignment and location for optimum fluid delivery.

Choosing the Right Model

The Modular Valve Positioners are designed for applications that can utilize RS-232, RS-485, and CAN communication. The MVP units may be daisy chained together up to a string of 16 instruments. There are two different models available, a valve positioner and a high torque valve positioner. The valve positioner may be used with the ceramic valves and 2- to 4- port PTFE valves. The high torque valve positioner will be required when using 6- and/or 8-port PTFE valves. This unit can accommodate all valve combinations.

Valve Options and Other Product Features

Hamilton Modular Valve Positioners are exceptionally easy to service and modify. It is very simple to remove and replace their snap-in valves with other configurations to achieve different fluid delivery with the same positioner unit, maximizing flexibility and value. You can choose from valves with two to eight ports that offer many different flow paths. Valves are available with chemically inert PTFE and CTFE, or ceramic flow paths, and can be customized per your requirements.

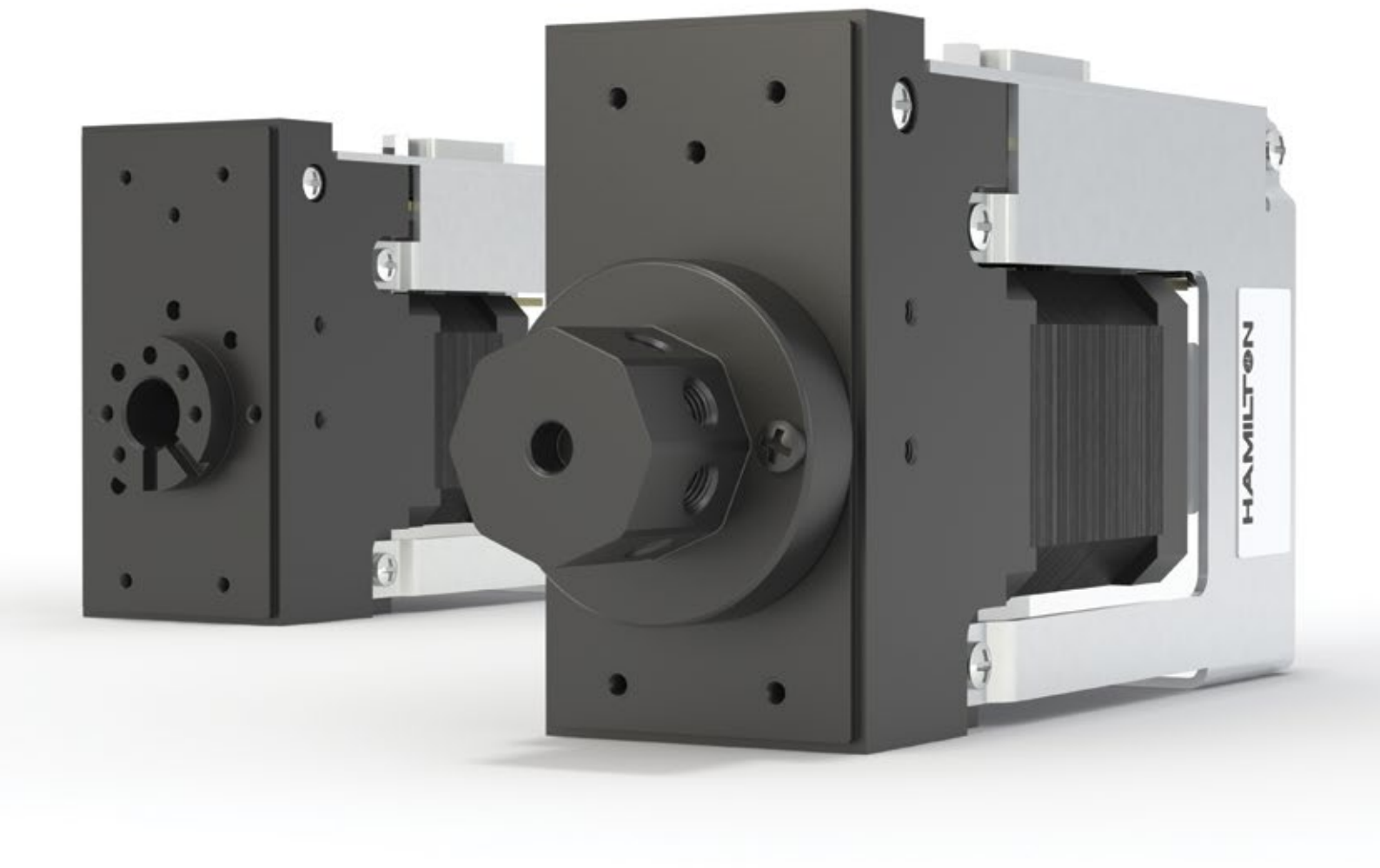
The Modular Valve Positioner works with all PSD syringe pumps but is especially compatible with the PSD/4, PSD/6, and PSD/8. The PSD/4, PSD/6, and PSD/8 can be used in a daisy chain with the Modular Valve Positioner because they can be controlled by the same RS-232 communication protocol.

Modular Valve Positioner Specifications

Rotational Speed (RPM)	Speed per 120 Degrees	Footprint = L x H x W (in)	Communication Interface	Valve Torque (in-oz)	Mounting Options	Maximum Daisy Chain Capability	Weight (lbs)
52.5 – 115.2	250 ms	5.5 x 3.4 x 1.8	RS-232, RS-485, or CAN	25[1] 75[2]	Front/face	16 units	1.75[1] 2.25[2]

[1] *P/N 94747-01*
[2] *P/N 94747-02*

A full list of compatible syringes, valves, and communication protocols is available in the Technical References section starting on page 31.



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Microlab® 600 Custom Program Syringe Pump

The Easiest Option That's Ready to Go Right Out of the Box

Take full command of your diluting and dispensing applications with the Microlab® 600 standalone syringe pump. Available in single and dual syringe configurations, the pump allows you to custom program methods and deploy commands to any instrument on your network from anywhere in the world, giving you unparalleled control of your process.

Precision That You Control

The Microlab 600 is a highly precise syringe pump. This positive displacement system provides better than 99% accuracy, independent of a liquid's viscosity, vapor pressure, and temperature. The inert fluid path minimizes sample carryover and is compatible with harsh chemicals.

The standalone pump offers two communication capabilities — Ethernet and RS-232. To simplify the programming via Ethernet, Hamilton provides an Application Programming Interface (API) that controls the pump through simple commands that use Microsoft® .NET 2.0 framework. For RS-232, signals can be sent from Programmable Logic Controllers (PLC) and from computers using simple ASCII commands which can be sent from any computer so there is no dependence on .NET framework.

Ready to Go with Minimal Effort

The Microlab 600 custom program syringe pump is perfect for in-between or smaller scale OEM applications when a limited number of pumps are needed. As a fully formed solution, it doesn't require you to create a housing, develop a power source, or design a communication board — it's ready to go right out of the box.

Microlab 600 Specifications

Accuracy	± 1.0%	**Communication Protocol**	.NET 2.0 Application Programming Interface (API)
Precision	± 0.2%	**Pump Memory**	One method stored in non volatile memory
Flow Rate	0.003–6,000 µL/second (depending on syringe selected)	**Calibration**	Factory tested and traceable to N.I.S.T. standards
Syringe Resolution	0.002% of the nominal syringe volume	**Certifications**	CE, CSA
Compatible Syringes	10, 25, 50, 100, 250, 500 µL, 1, 2.5, 5, 10, 25, and 50 mL	**Power Rating**	24 VDC, 2.5 A
Fluid Path	Borosilicate, PTFE, CTFE	**Dimensions**	7 x 5.5 x 10.5 inch (177.8 x 139.7 x 266.7 mm)
Communication Type	Ethernet 10/100 BASE-T, RS-232	**Weight**	13 lbs (5.9 kg)

For more information on the Microlab 600, visit ***www.hamiltoncompany.com/microlab600****.*

This custom coding solution is the perfect solution for a variety of conditions including:

- Sequential applications when automated liquid diluting or dispensing is part of a series of actions or traveling along a conveyor belt
- Control room environments where applications are managed remotely
- Dispensing volatile or complicated liquids such as mercury, epoxy, or radioactive materials as part of a manufacturing or testing process
- Settings that require a fully developed precision diluting or dispensing solution work in tandem with a larger system
- Liquid handling applications that require the integration of multiple electronic devices to accomplish a single task
- Any situation that could benefit from remote automation or custom programming

Instrument Valves

Hamilton instrument valves have all been thoughtfully designed and expertly manufactured to maximize value and performance. They can be used with automated valve actuators found on instruments such as the PSD pumps and the Modular Valve Positioner or in custom pumps of your own design. Hamilton offers two standard types of valves that are available off-the-shelf: PTFE plug valves and ceramic face seal valves.

All Hamilton Valves Share the Following Features

- Pressure compatibility up to 100 psi, though ceramic valves can be modified for higher pressures
- Housing — All valves are offered in aluminum. Stainless steel is available as a standard option on some valves, and any valve housing can be customized with PEEK, CTFE or other machineable materials.
- Chemically inert fluid paths
- Flat bottom ¼"-28 threaded ports
- Variety of fluid paths available that all minimize dead volume

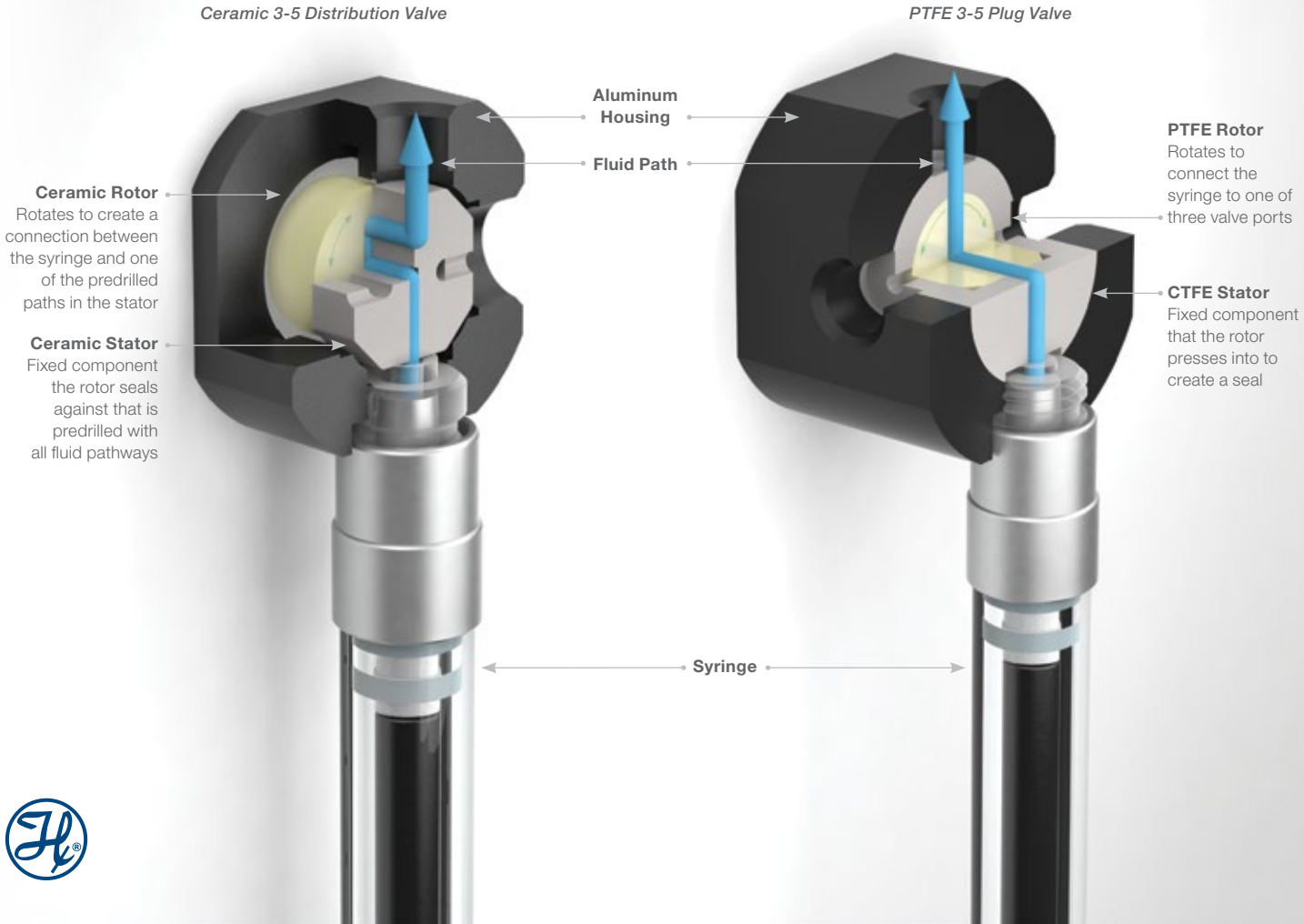
Features Unique to PTFE Plug Valves

- Lower cost
- Less dead volume
- Easier to flush

Features Unique to Ceramic Face Seal Valves

- Longer life, especially with crystalline solutions
- More complex custom fluid paths are possible
- Lower breakaway and rotational torque

Valve Construction Cutaway Illustration



Manual Valves

Hamilton manual plug valves are an economical and flexible way of custom building a fluid flow control system. They range from simple on/off valves to more complex multi-port arrangements using a combination of loop and distribution fluid logic. Hamilton manual valves feature chemically inert flow paths ideally suited for low pressure applications. All manual plug valves allow you to select and interchange a wide variety of fittings, adapters, and tubing (including male and female Luers), FEP tubing assemblies and adapters that thread directly into the valve providing an endless variety of valve configurations for any flow application. There are three types of Hamilton manual valves — HV, HVP, and HVX.

Diagrams illustrating the fluid logic and flow paths for all valves are available on page 34.

HV Standard PTFE Valves

The HV valve is physically the smallest valve and constitutes a basic unit for the control of fluids. It is ideal for low pressure applications; from a basic on/off flow to a four-way distribution system.

HVP Panel Mount PTFE Valves

The HVP valve is essentially the same as the HV valve except the HVP can be mounted into panels allowing for custom installation into control boards or instruments.

HVX Large Body Panel Mount PTFE Valves

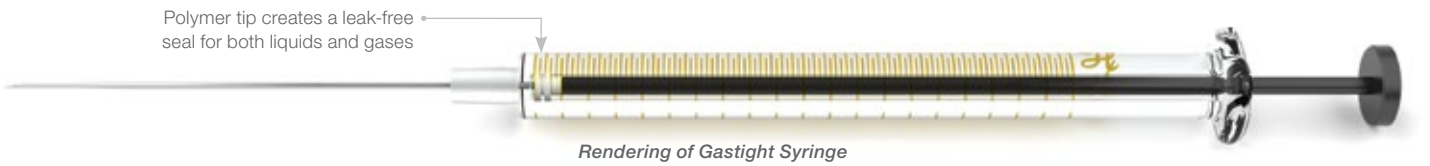
HVX valves are physically the largest valves. A larger port internal diameter allows increased fluid flow even with moderately viscous fluids. HVX valves can be used free standing or panel-mounted using an optional locking nut. It is the only body style to accommodate 6- and 8-port distribution and loop valves.

Instrument Syringes

Hamilton Company was founded on the invention of the Microliter™ syringe. The company has been designing and crafting the industry's best syringes since 1953. Hamilton syringes have been trusted for nearly 60 years and for good reason — they are The Measure of Excellence®. Hamilton syringes are guaranteed to be exceptional precision instruments that perform reliably in your application and to your expectations.

Instrument Syringe Overview

All Hamilton instrument syringes are either 1700 or 1000 series Gastight® syringes with a polymer plunger tip that creates a leak-free seal. Traditionally the tip is made from PTFE, but other materials are used for selected applications. The polymer tip essentially wipes the interior of the syringe barrel free of sample. This feature is useful for aqueous and low volatile organic samples because it reduces the chance a deposit will occur and result in cross-contamination or a damaged plunger.



Rendering of Gastight Syringe

Syringe Terminations

AD, AccuDil

These syringes have an axial fine thread M8 x 0.75. These syringes attach to instrumentation such as the Microlab 1000 series diluters and dispensers.

BFP, Bubble Free Prime

This syringe has 5/16 threads and is used on syringe pumps like the Microlab 600 diluters and dispensers conical plunger tip to flush all liquid from this termination. The resulting syringe is quicker to prime and flush during washes or solvent changes.

C, ChemSeal

The ChemSeal termination features a ¼"-28 UNF male fitting. This syringe is used in low volume applications where system dead volume needs to be minimized. These syringes can be screwed directly into Hamilton HV, HVP, and HVX valves.

PTFE Luer Lock

This termination has a PTFE, male Luer taper with nickel plated brass locking hub for use with Kel-F needles, metal hub needles, and universal connectors. Also, the TLL is used with many Hamilton syringe pumps, OEM applications, and manual operations. Autoclavable when disassembled, except on 25 mL and greater syringes. Repeated autoclaving will shorten syringe life.

Plunger Types

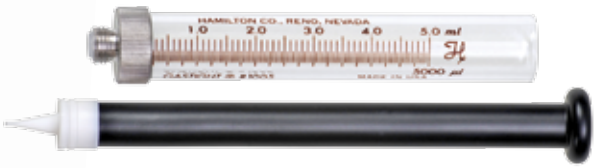
Hamilton instrument syringes are available with either PTFE-tipped plungers or a long-life Ultra High Molecular Weight Poly Ethylene (UHMWPE) material particularly good for aqueous saline solutions. The plunger shafts themselves coated or uncoated and constructed of either stainless steel or aluminum, although custom materials can be used.

Manual Plungers

Manual plungers come in two designs, one features a standard dome button and the other features a threaded plunger button. Syringes smaller than 1 mL have a stainless steel plunger for syringes, as shown in the picture on the bottom. Manual plungers 1 mL and larger are coated with PTFE and come with a 6-32 threaded hole that allows them to be mounted into automated syringe pumps, which is demonstrated by the image on the top.

Bubble Free Prime Plunger (BFP)

This plunger is used on the syringes for Microlab 600 diluters and dispensers. The plunger features a conical plunger tip that extends through the threaded termination of the syringe into the Microlab 600 valve. This design helps remove air from the system and reduces the priming cycles required.



X-Style Plunger

This plunger is used for syringes 500 µL and smaller intended for use in an automated syringe pump. A special plunger button protects the delicate plunger wire by stopping the pump at the zero line before damaging the tip. The stop also provides a 6-32 threaded hole that is used to mount the plunger into the syringe drive.

XP-Style Plunger

This plunger is used on XP modular syringe pumps and has a stop to limit damage to the plunger tip. This plunger is for half-height syringes with a 30 mm stroke length.

XL-Style Plunger

This plunger is used on the XL modular digital syringe pumps and has a stop to limit damage to the plunger tip. This plunger is for full-height syringe pumps with a 60 mm stroke length.

XB-Style Plunger

This plunger features a stop and a back bushing. The back bushing increases the plunger tip life, maintains proper plunger alignment, and reduces the particles generated by plunger and glass contact.

Syringe Longevity and Development

Accurate. Robust. Trustworthy. These are just a few of the words customers use to describe Hamilton syringes. Building exceptional syringes is an evolving science, which is why Hamilton is dedicated to the continuous research and development of this product line.

In addition to refinements made specifically to instrumentation syringes, Hamilton constantly enriches its entire syringe offering by either improving existing models or introducing new ones. Using customers' needs and feedback as a guide, we innovate in ways that maximize flexibility, performance, and value. Some of our recent syringe enhancements across our entire product line include:

- **Increase syringe life when handling saline liquids, acids, oxidants, and strong bases**
- **Deactivated coating to minimize sample carryover**
- **Spring-loaded plunger tips create a dynamic seal that can withstand higher temperatures and offer better longevity**

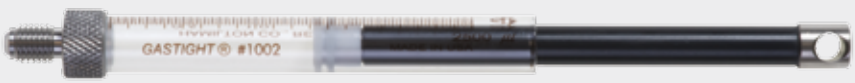
For more detailed information on instrument syringes and their intended use, please refer to page 31.

Any Syringe, Any Way You Want It

Hamilton specializes in custom syringes that satisfy the size, shape, termination, tip, fluid path, or other requirements of your application. Whatever your need, Hamilton can meet it.

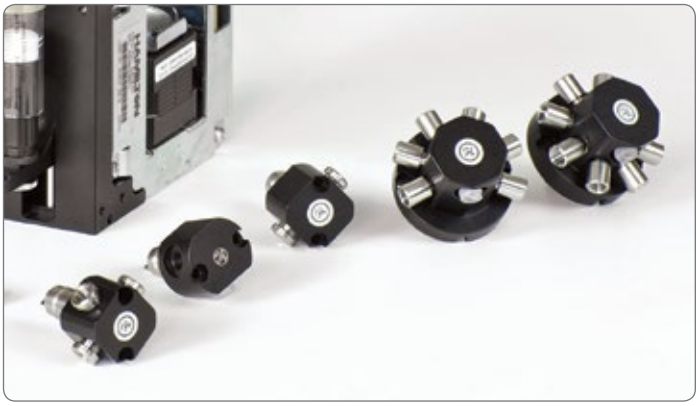
Technical References

Syringe Specifications, Intended Use, and Connections

Intended Use		Image
PSD/4 syringe pump	Standard	
PSD/4 syringe pump	Long-life	
PSD/6 syringe pump	Standard	
PSD/6 syringe pump	Long-life	
PSD/6 syringe pump	SaltLine™	
PSD/8 syringe pump	Standard	
PSD/8 syringe pump	Long-life	
Microlab 600 syringe pump	Bubble Free Prime	
Spark Holland autosamplers, Pumps requiring a syringe with ChemSeal termination and a XL-Style Plunger		
Pumps requiring a syringe with ChemSeal termination and a XP-Style Plunger		
Pumps requiring a syringe with PTFE Luer Lock termination and a XL-Style Plunger		

Termination	Plunger Connection Style (Plunger Button)	Plunger Tip Material	Stroke Length (mm)	Plunger Shaft Material	Volume Range	Wetted Path Material
TLL	X	PTFE	30	Coated AL or SST	12.5 µL to 12.5 mL	PTFE, CTFE, Borosilicate Glass
TLL	X	UHMW-PE	30	Stainless Steel	25 µL to 5 mL	PTFE, CTFE, UHMW-PE, Borosilicate Glass
TLL	X	PTFE	60	Coated Aluminum or Stainless Steel	25 µL to 50 mL	PTFE, CTFE, Borosilicate Glass
TLL	X	UHMW-PE	60	Stainless Steel	50 µL to 10 mL	PTFE, CTFE, UHMW-PE, Borosilicate Glass
TLL	X	UHMW-PE	60	Hastelloy C or Polyamid	250 µL to 10 mL	PTFE, CTFE, UHMW-PE, Borosilicate Glass
TLL	XL	PTFE	60	Coated Aluminum or Stainless Steel	50 µL to 25 mL	PTFE, CTFE, Borosilicate Glass
TLL	XL	UHMW-PE	60	Stainless Steel	50 µL to 10 mL	PTFE, CTFE, UHMW-PE, Borosilicate Glass
BFP	X	PTFE	60	Coated Aluminum or Stainless Steel	10 µL to 50 mL	PTFE, CTFE, Borosilicate Glass
C	XL	PTFE	60	Coated Aluminum or Stainless Steel	25 µL to 2.5 mL	PTFE, CTFE, Borosilicate Glass
C	XP	PTFE	30	Stainless Steel	50 µL to 5 mL	PTFE, CTFE, Borosilicate Glass
TLL	XL	PTFE	60	Stainless Steel	50 µL to 10 mL	PTFE, CTFE, Borosilicate Glass

Valve Types by Use



Precision Syringe Drive (PSD) Valves

Valve Model	Valve Description
HV	PTFE, Small Body, PSD Valve
HVC	Ceramic, Small Body, PSD Valve
HVCX	Ceramic, Large Body, PSD Valve

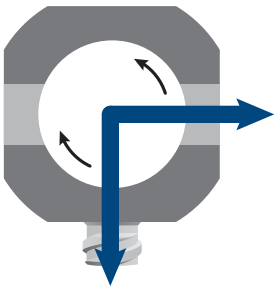
Modular Valve Positioner (MVP) Valves

Valve Model	Valve Description
HVM	PTFE, Small Body, MVP Valve
HVXM	PTFE, Large Body, MVP Valve
HVC	Ceramic, Small Body, MVP Valve
HVCX	Ceramic, Large Body, MVP Valve

Manual Valves

Valve Model	Valve Description
HV	PTFE, Small Body, Manual Valve
HVP	PTFE, Panel Mount, Small Body, Manual Valve
HVX	PTFE, Standard or Panel Mount, Large Body, Manual Valve

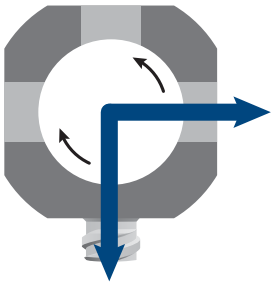
PSD Syringe Pump Fluid Paths



Fluid Logic: 3-2

Valve Description:
90° Flow Path
Two ports, plus syringe port

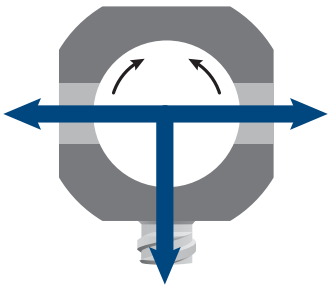
PSD/4, PSD/6, and PSD/8:
HVC



Fluid Logic: 4-2

Valve Description:
90° Flow Path
Three ports, plus syringe port

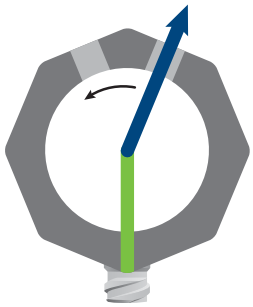
PSD/4, PSD/6, and PSD/8:
HVC



Fluid Logic: 3-3

Valve Description:
“T” Flow Path
Two ports, plus syringe port

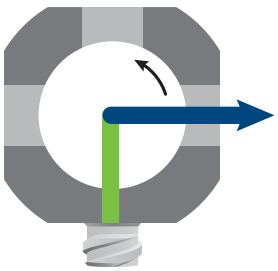
PSD/4, PSD/6, and PSD/8:
HVC, HV



Fluid Logic: Y-Valve

Valve Description:
“Y” Flow Path
Two ports, plus syringe port

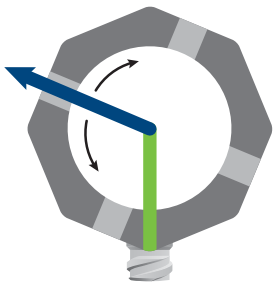
PSD/4, PSD/6, and PSD/8:
HV, HVC



Fluid Logic: 3-5

Valve Description:
Distribution Flow Path
Three ports, plus syringe port

PSD/4, PSD/6, and PSD/8:
HVC



Fluid Logic: 4-5

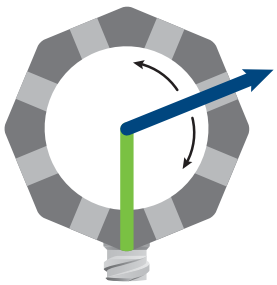
Valve Description:
Distribution Flow Path
Four ports, plus syringe port

PSD/4, PSD/6, and PSD/8:
HVCX

Fluid Logic: 6-5

Valve Description:
Distribution Flow Path
Six ports, plus syringe port

PSD/4, PSD/6, and PSD/8:
HVCX



Fluid Logic: 8-5

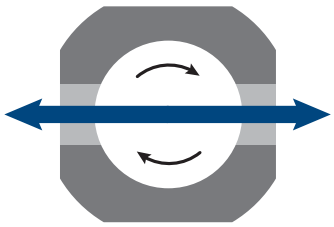
Valve Description:
Distribution Flow Path
Eight ports ,plus syringe port

PSD/4, PSD/6, and PSD/8:
HVCX

Legend

- Green line denotes a fixed path fluid always flows through
- Blue arrow is a path that rotates and can flow to any port, as indicated by the black directional arrows
- The syringe termination icon represents the fixed syringe connection port

Modular Valve Positioner and Manual Valve Fluid Paths

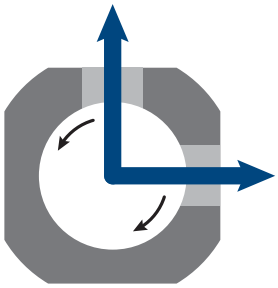


Fluid Logic: 1-1

Valve Description:
180° Flow Path
Two ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

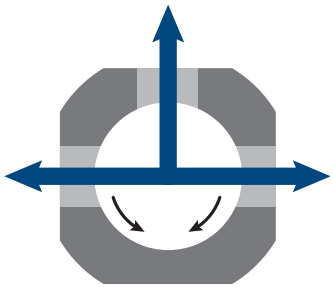


Fluid Logic: 2-2

Valve Description:
90° Flow Path
Two ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

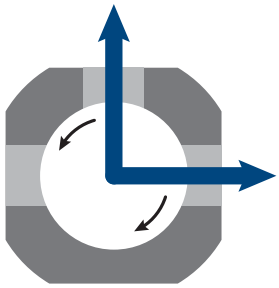


Fluid Logic: 3-3

Valve Description:
“T” Flow Path
Three ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

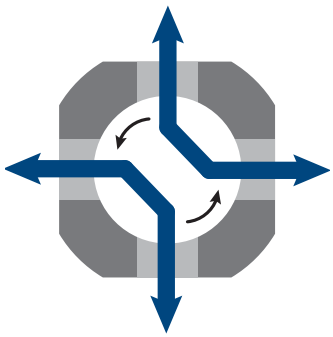


Fluid Logic: 3-2

Valve Description:
90° Flow Path
Three ports

Modular Valve Positioner Valve Types:
HVM, HVXM, HVC

Manual Valve Types:
HV, HVP, HVX

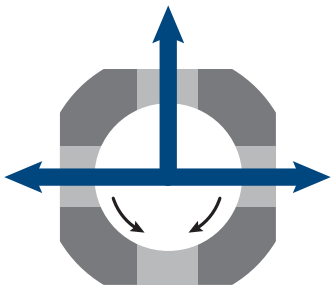


Fluid Logic: 4-4

Valve Description:
Loop Flow Path
Four ports

Modular Valve Positioner Valve Types:
HVM

Manual Valve Types:
HV, HVP, HVX

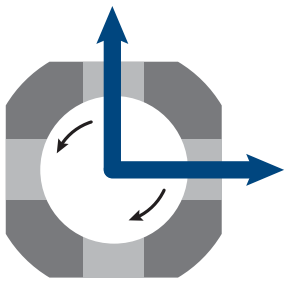


Fluid Logic: 4-3

Valve Description:
“T” Flow Path
Four ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

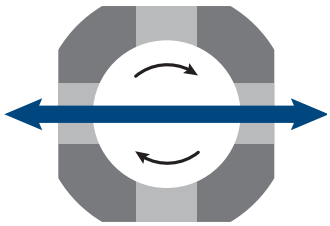


Fluid Logic: 4-2

Valve Description:
90° Flow Path
Four ports

Modular Valve Positioner Valve Types:
HVM, HVXM, HVC

Manual Valve Types:
HV, HVP, HVX



Fluid Logic: 4-1

Valve Description:
180° Flow Path
Four ports

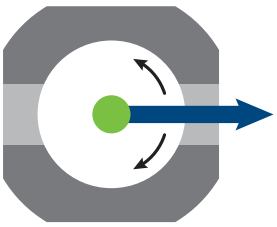
Modular Valve Positioner Valve Types:
HVM

Manual Valve Types:
HV, HVX

Legend

Green circle denotes a there is a fixed fluid path in the face of the valve fluid always flows through

Blue arrow is a path that rotates and can flow to any port, as indicated by the black directional arrows

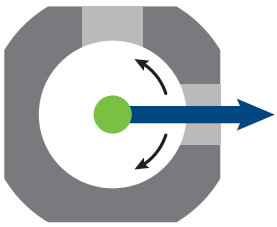


Fluid Logic: 1-5

Valve Description:
Distribution Flow Path
Two ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

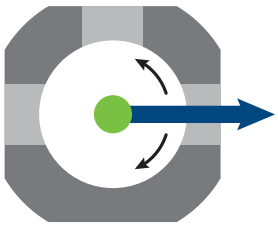


Fluid Logic: 2-5

Valve Description:
Distribution Flow Path
Two ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

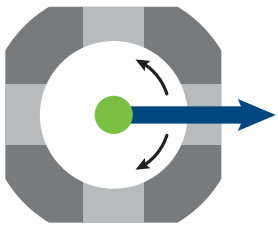


Fluid Logic: 3-5

Valve Description:
Distribution Flow Path
Three ports

Modular Valve Positioner Valve Types:
HVXM, HVC

Manual Valve Types:
HV, HVP, HVX

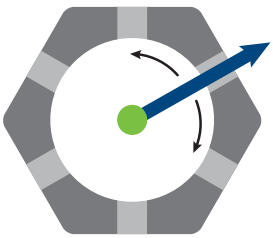


Fluid Logic: 4-5

Valve Description:
Distribution Flow Path
Four ports

Modular Valve Positioner Valve Types:
HVM, HVXM, HVC

Manual Valve Types:
HV, HVP, HVX

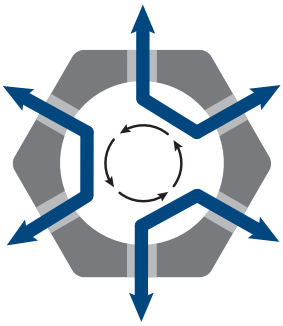


Fluid Logic: 6-5

Valve Description:
Distribution Flow Path
Six ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

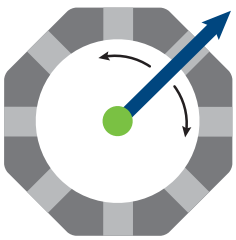


Fluid Logic: 6-6

Valve Description:
Loop Flow Path
Six ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HV, HVP, HVX

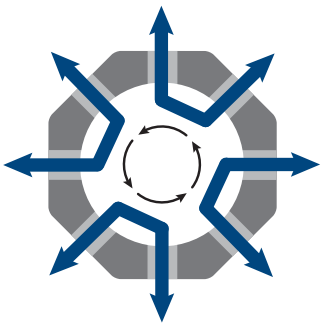


Fluid Logic: 8-5

Valve Description:
Distribution Flow Path
Eight ports

Modular Valve Positioner Valve Types:
HVXM, HVCX

Manual Valve Types:
HVX



Fluid Logic: 8-7

Valve Description:
Loop Flow Path
Eight ports

Modular Valve Positioner Valve Types:
HVXM

Manual Valve Types:
HVX

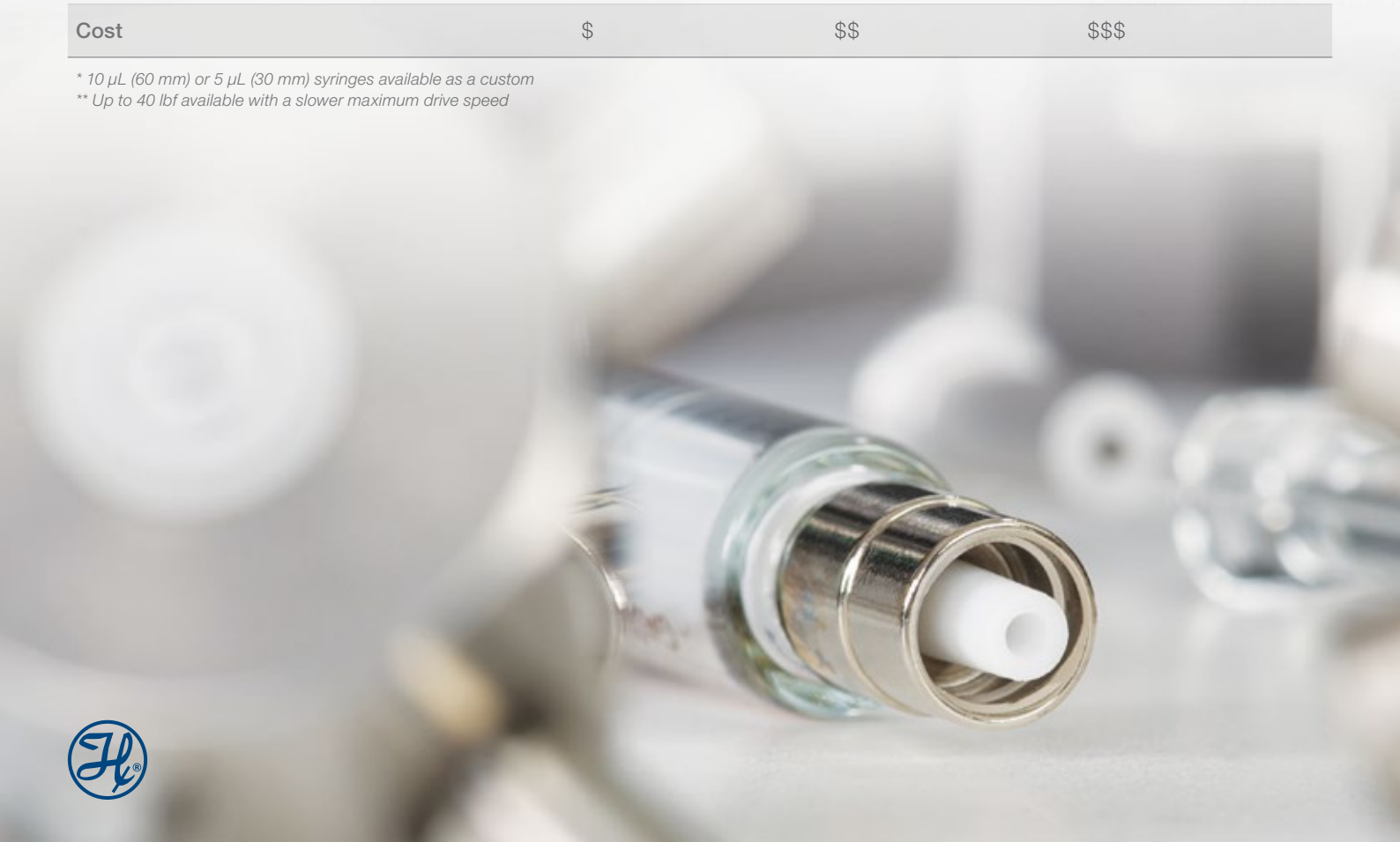
Communications Protocol

Communication Protocol	ZEUS	ZEUS LT	PSD/4	PSD/6	PSD/8	Microlab 600	Modular Valve Positioner
RS-232		X	X	X	X	X	X
RS-485			X	X	X		X
CAN	X	X	X	X			X
Ethernet						X	

Syringe Pump Feature Comparison

		PSD/4	PSD/6	PSD/8
Syringes	Maximum	12.5 mL	50 mL	25 mL
	Minimum*	12.5 µL*	25 µL*	50 µL
	Stroke	30 mm	60 mm	60 mm
Pump Size	Lift Force	20 lbf**	20 lbf**	45 lbf
	Height	5 in	9 in	10 in
	Width	1.75 in	1.75 in	2.56 in
	Depth	4.4 in	4.4 in	4.76 in
	Weight	2.6 lbs	3.7 lbs	5.4 lbs
Cost		$	$$	$$$

** 10 µL (60 mm) or 5 µL (30 mm) syringes available as a custom*
*** Up to 40 lbf available with a slower maximum drive speed*



About Hamilton

THE MEASURE OF EXCELLENCE®

Hamilton Company specializes in the development, manufacturing, and customization of precision measurement devices, automated liquid handling workstations, and sample management systems.

Hamilton's processes are optimized for quality and flexibility. Whether it's a custom needle with a quick delivery timeframe, a special length pH sensor, or a comprehensive solution to fully automate your assay workflow, trust that Hamilton's products will always meet your needs.

OUR COMPLETE PORTFOLIO

Laboratory Products

Hamilton Laboratory Products manufactures Microliter™ and Gastight® syringes that set the standard for analytical fluid measurement. Other products include custom needles, semi-automated diluters and dispensers, polymeric HPLC columns, pH electrodes, pipettes, and more.

Robotics

Hamilton Robotics provides automated liquid handling workstations and laboratory automation technology for the scientific community. With a focus on innovative design, our products incorporate Hamilton's patented liquid handling technologies for fully automated solutions. In addition to liquid handling platforms, we also offer application-specific solutions, small devices, and consumables.

Storage

Hamilton Storage offers ultra-low temperature automated sample management systems for storage of a variety of labware. Hamilton's line of biobanking and compound management systems, benchtop devices, and consumables are designed for sample integrity, flexibility, and reliability.

Process Analytics

Hamilton Process Analytics includes innovative solutions for the online measurement of pH, dissolved oxygen, conductivity, ORP, viable cell density, and total cell density. Hamilton's proprietary Arc® intelligent sensor technology eliminates the need for transmitters and moves the functionality to your smartphone or tablet.

OEM Solutions

Many of the world's top manufacturers utilize Hamilton products and expertise to get their innovations to market faster with lower development and manufacturing costs. As an OEM partner, we offer the ability to integrate our proven syringe pumps or pipetting channels, customize our proven liquid handling platforms, or design a complete system to automate your novel chemistry.

Hamilton Company has been a leading global manufacturer for more than 60 years, with headquarters in Reno, Nevada; Franklin, Massachusetts; Timisoara, Romania; and Bonaduz, Switzerland; and subsidiary offices throughout the world.

Your Hamilton Representative

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