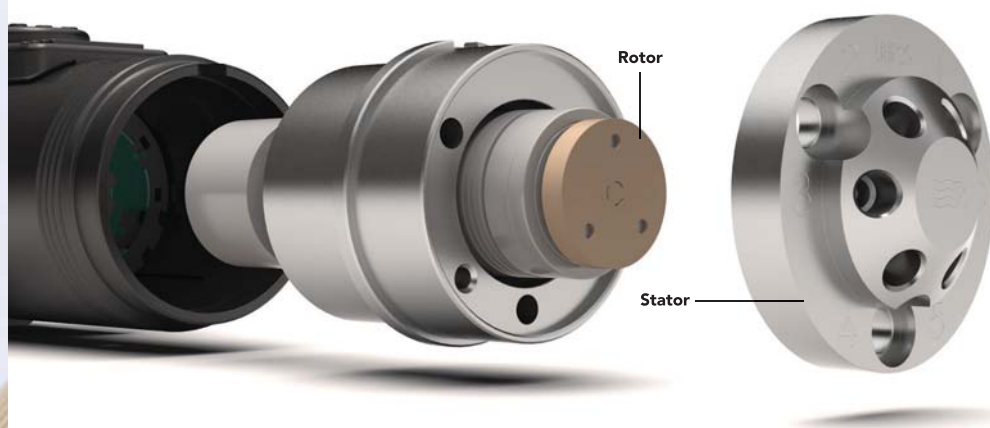


## Rotary Shear Valves

Rheodyne® Rotary Shear Valves were developed in tandem with the evolution of liquid chromatography, where combinations of elevated system pressures, aggressive chemicals, and ever-diminishing fluid volumes continually challenged system manufacturers who required highly precise fluid control and delivery. Today, many other disciplines utilize Rotary Shear Valves for their versatility, reliability, repeatability, long system uptime, and easy preventive maintenance.



## Valve Overview

Valve Module	Flow Configurations	Page
<b>ACTUATED VALVES</b>		
<b>UP TO 15,000 PSI</b>		
<b>Switching</b>	<ul style="list-style-type: none"> <li>• 2-Position, 6-Port</li> <li>• 2-Position, 10-Port</li> </ul>	130
<b>Injection</b>	• For Injection, add the appropriately sized Sample Loop to the Switching valves above	130
<b>Selection</b>	• 6-Position, 7-Port	130
<b>UP TO 6,000 PSI</b>		
<b>Switching</b>	<ul style="list-style-type: none"> <li>• 2-Position, 6-Port (Analytical and Nano Scale)</li> <li>• 2-Position, 10-Port (Analytical and Nano Scale)</li> </ul>	130
<b>Injection</b>	<ul style="list-style-type: none"> <li>• For Injection, add the appropriately sized Sample Loop to the Switching valves above</li> <li>• 2-Position, 6-Port (vertical port)</li> </ul>	130
<b>Selection</b>	• 6-Position, 7-Port	130
<b>UP TO 125 PSI</b>		
<b>Switching</b>	<ul style="list-style-type: none"> <li>• 2-Position, 6-Port</li> <li>• 2-Position, 6-Port (Double 3-Way)</li> </ul>	130
<b>Selection</b>	<ul style="list-style-type: none"> <li>• 6-Position, 7-Port</li> <li>• 10-Position, 11-Port</li> </ul>	130

Valve Module	Flow Configurations	Page
<b>MANUAL VALVES</b>		
<b>UP TO 15,000 PSI</b>		
<b>NEW!</b> <b>Injection</b>	• 2-Position, 6-Port (Front-Loading, 9,000 psi)	132
<b>UP TO 6,000 PSI</b>		
<b>Switching</b>	• 2-Position, 6-Port (Analytical and Micro Scale)	132
<b>Injection</b>	• 2-Position, 6-Port	132
<b>Selection</b>	• 6-Position, 7-Port	
<b>UP TO 1,000 PSI</b>		
<b>Switching</b>	<ul style="list-style-type: none"> <li>• 2-Way, Right Angle 4-Position, 4-Port</li> <li>• 3-Way, T-Shape 4-Position, 4-Port</li> <li>• 4-Way, Diagonal Flow 4-Position, 4-Port</li> </ul>	133
<b>Injection</b>	• 2-Position, 6-Port	133
<b>Selection</b>	• 6-Position, 7-Port	133

## Choosing a Rotary Shear Valve

Evaluating some simple variables will assist you in choosing the best valve for your needs.

### Identify the Operating Pressure of Your Instrument or Application

Valves are designed to repeatedly deliver specific fluids to different locations in a fluidic circuit. Achieving fluidic precision at 15,000 psi requires different valve-design features than what's required to achieve fluidic precision at 100 psi. A wide variety of variables such as valve architectures, metals, polymers, coatings, actuation speeds, and manufacturing techniques have been tested to achieve the fluidic accuracy and precision required for the full array of pressure conditions in life science applications. In this catalog, we define four separate pressure groupings:

<b>Up to 15,000 psi (1,035 bar)</b>	UHPLC/Fast Chromatography
<b>Up to 6,000 psi (410 bar)</b>	HPLC
<b>Up to 1,000 psi (69 bar)</b>	Upchurch Scientific®
<b>Up to 125 psi (8.5 bar)</b>	Low Pressure/Atmospheric Pressure

### Identify the Range of Flow Rates in Your System

Because Rotary Shear Valves have been used most often in chromatography systems, certain flow rate ranges have evolved functionally. However, these ranges can apply to any system, not just chromatography:

- ▶ Micro/Nano Scale — flow rates less than 100 µL per minute
- ▶ Analytical Scale — flow rates from 100 µL to 10 mL per minute
- ▶ Prep (or Semi-Prep) Scale — flow rates greater than 10 mL per minute

### Decide What You Want the Valve to Do

In this chapter Rotary Shear Valves perform three functions:

- ▶ Switching one or more flow paths to a different destination under pressure
- ▶ Injection into a flowing stream under pressure
- ▶ Selection/distribution of a variety of system liquids by means of a common port
- ▶ Read more about valve functions on pages 128–129

### Identify Whether You Want Automated or Manual Control

An automated valve offers more sophisticated functionality. Choose an automated valve if the application requires fast, consistent flow-stream switching. Some other advantages of automated valves include control options (PC- or instrument-triggered), higher torque operation, valve-position feedback, or very small flow paths.

Choose a manual valve if your application involves low frequency of use, demands operator control, or involves injection of smaller sample volumes. (See page 129 for more on Single Mode vs. Dual Mode operation.)

### Identify the Chemical Compatibility Requirements Related to Your Fluids

Consulting the chemical compatibility chart in the Technical Resources section at the back of The IDEX Health & Science Laboratory Products catalog helps identify what valve materials to use—and avoid—in your application. You can also find Chemical Compatibility information at [www.idex-hs.com](http://www.idex-hs.com) under Materials and Tools.

### Identify Fluidic Connection Requirements in Your System

The rotary shear valves in this catalog accommodate one or more of the following tubing outer diameters: 1/8", 1/16", or 1/32".

## Effects of Valves and Tubing on Resolution

The effect of tubing on analytical and microscale analyses can be significant. Since dispersion caused by tubing is proportional to the fourth power of diameter, large bore tubing should be avoided when performing analytical scale or microscale analyses. Tubing ID size  $\leq 0.25$  mm (0.010") is recommended.

Consider a system with injection and column switching valves and analytical columns with small-bore connecting tubing. The chromatograms below, made using a typical analytical chromatograph, show these effects. Scheme A is the control (injection valve  $\rightarrow$  column  $\rightarrow$  detector) with no valve in the system. In Schemes B and C, two model 7060 Six-Position Switching Valves were placed side by side (injection valve  $\rightarrow$  valve #1  $\rightarrow$  column  $\rightarrow$  valve #2  $\rightarrow$  detector).

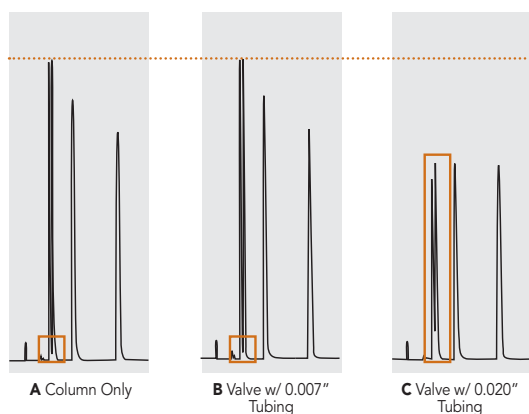
The injection valve and detector were connected to these valves by the same tubing used in the control. The extra tubing pieces required to connect the valves to the column were a 10 cm length for valve #1-to-column, and a 35 cm length for column-to-valve #2. The diameters of these tubes are indicated in the experimental details, below.

### Comparison of Observed Column Plates of Rheodyne® Analytical and MicroScale Injection Valves

	7725	8125	$\Delta$
$k' = 0.6$	2930	5054	72%
$k' = 1.5$	4653	6904	48%
$k' = 7.9$	7875	8305	5.0%

UV detector: 1  $\mu$ L volume, 4 mm path. Sample volume: 2  $\mu$ L, partial-filling method.  
 Column: 2 mm ID x 100 mm long, 4  $\mu$ m C-18. True plates of column = 11,570.

### Effects of Valves and Tubing on Resolution



Conclusion: These sequential chromatograms show the effect of adding volume to the flow path through the addition of components.

(A) Establishes a baseline quality of separation with the minimum volume of liquid in the flow path.

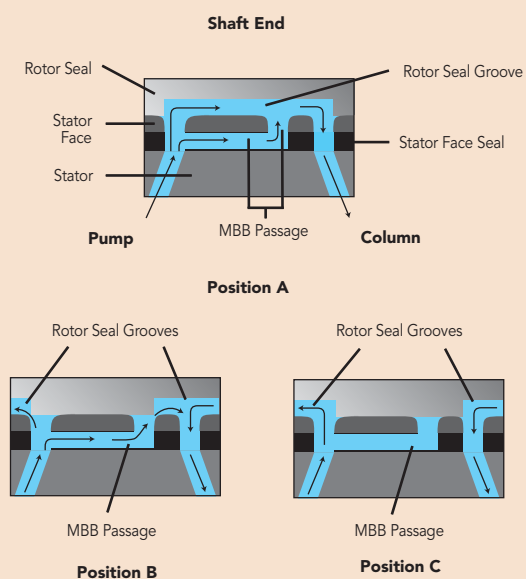
(B) Adding a valve plus smaller-ID tubing, and thereby increasing the liquid volume only marginally, barely affects the separation. However in

(C) Adding a valve plus larger-ID tubing, thereby increasing the liquid volume in the flow path to a greater degree, distinctly impairs the quality of the separation and the detectable sample.

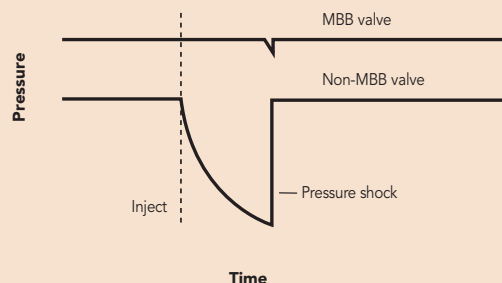
## What is Make-Before-Break™, and When Does it Matter?

Make-Before-Break is a unique design feature of certain dual-mode manual injection valves.

### Flow paths of model 7725(i) and 9725(i) with MBB design

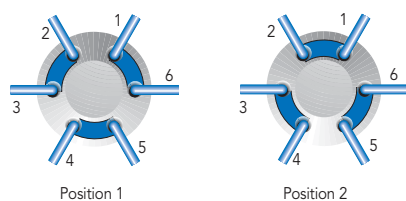


To maintain a constant, desired high-pressure flow, Rheodyne's Make-Before-Break (MBB®) design creates continuous flow between the LOAD and INJECT positions that virtually eliminates pressure transient shock to the system. A passage in the stator face makes a new connection before old connections break. The MBB design — an improvement over bypass-style injectors — does not dilute the sample and is easy to maintain and troubleshoot.

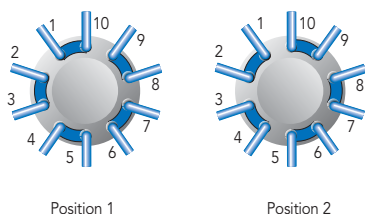


## Switching Valves

Switching valves dynamically alternate between two fluid paths without manually disconnecting plumbing. In Chromatography, these valves can be used for column switching, backflushing, sample enrichment, and other techniques. In Diagnostic or Sequencing applications, the switching valve may alternate flow paths to enable back flushing or other fluidic tasks within the instrument.



**Flow path of Two-Position, Six-Port Switching Valve**

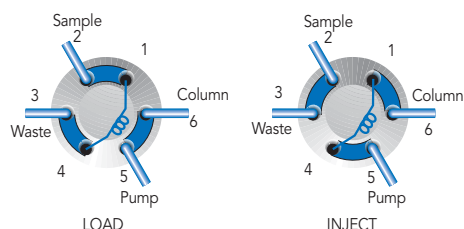


**Flow path of Two-Position, Ten-Port Switching Valve**

Rheodyne® switching valves operate between two positions, and may have 6 or 10 ports on the face of the stator (2/6 or 2/10). The flow paths connect ports around the circumference of the stator. The Upchurch Scientific® manual switching valves (to 1,000 psi) described on page 133 have different flow path geometry as noted.

## Injection Valves

Rheodyne injection valves are a form of switching valve. Injection valves can be automated or manual, and they are generally utilized in the two-position, six-port (2/6) configuration and have a sample loop attached.



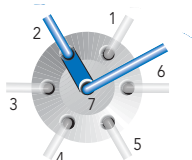
**Flow path of Two-Position, Six-Port Injection Valve**

The purpose of an Injection valve is to introduce a sample of a solution into a flowing stream of liquid. Some Switching valves become Injection valves by the addition of a Sample Loop (a defined length of tubing and fittings configured to match the angle of the valve ports). Sample is loaded and held in the loop until injection is triggered, either manually or mechanically.

Rheodyne injection valves are classified as either Single or Dual Mode, and either Front or Rear-loading, based on how the Sample Loop can be filled. A Single Mode Injection valve requires complete filling of the sample loop and is configured for Rear loading, generally in an auto-sample configuration. A Dual Mode Injection valve allows either partial or complete filling of the loop, and introduces sample by syringe through the needle port built into the valve shaft. Complete filling of the sample loop in both the Dual and Single Mode Injection valves provides greater repeatability injection to injection. (See the Application Note, page 129 for greater detail on partial vs. complete loop filling.)

## Selection Valves

Selection valves enable discrete connections among multiple system liquids (mobile phase, reagents, buffers) by means of a common port (inlet or outlet) connected to a number of different reciprocal ports. In Diagnostic or Sequencing applications, the selection valve alternates between different reagents or sample streams. Selection valves also enable fractionation for multiple sample analyses.

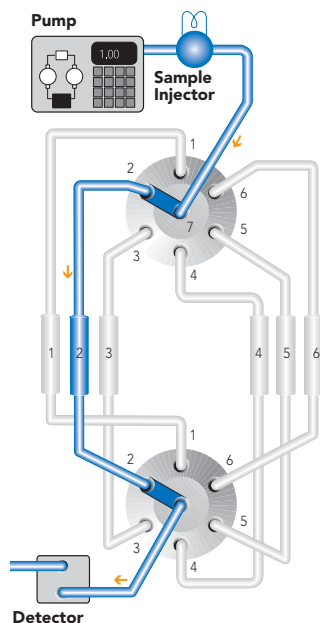


Flow path of Six-Position, Seven-Port Selector Valve

Numerous configurations exist among selection valves (e.g., 6-position 7-port, or 10-position 11-port), but these valves always operate between more than two positions. The ports are usually spaced radially, or outward in some manner around the center port of the stator.

### APPLICATION NOTE

Six column selection using two selection valves.



### APPLICATION NOTE

#### Dual Mode Sample Loop Loading: Partial-Filling vs. Complete-Filling

##### Partial-Filling

Use the partial-filling method if you need to conserve sample, or if you want to vary sample volume frequently.

In partial-filling, the syringe sets the volume injected onto the column. There is no sample waste, and the volume injected onto the column is equal to that dispensed from the syringe. Reproducibility is 1.0% relative standard deviation (RSD). The volume of the sample loaded is limited to half the sample loop volume. For example, the most you can load into a 200  $\mu$ L sample loop is 100  $\mu$ L.

##### Complete-Filling

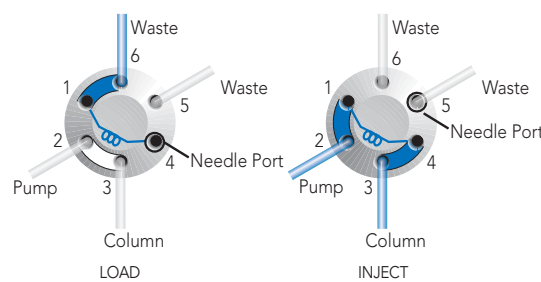
Use the complete-filling method if you have plenty of sample, if you do not vary sample volume, or if you need high reproducibility.

In complete-filling, the loop sets the volume loaded onto the column. Use excess sample (two to five loop volumes) to replace all the mobile phase in the loop. See Figure 2. Change the loop to vary the sample volume. Reproducibility is typically 0.1% RSD for loop sizes  $\geq 5 \mu$ L. Accuracy is limited as loop volumes are nominal.

**Q:** "Which method should I use and which Rheodyne® sample injection valves use this method?"

**A:** There are two types of injection valves available: dual mode and single mode. Dual mode injection valves allow both partial- and complete-filling whereas single mode injection valves allow only complete-filling. See manual injection valves, page 132.

If you are collecting experimental data, sample is scarce, and/or you want to use different sample volumes, a dual mode injector with a large volume sample loop is appropriate. Only dual mode injection valves allow the partial-filling method for easily varying your volumes (up to half your sample loop volume) by setting the syringe volume. Once you begin routine analysis, and/or you have an abundance of sample, either a dual mode or single mode injector is appropriate. Both types of injection valves allow the complete-filling method in which you overflow the sample loop. Complete-filling maximizes the reproducibility of your results.



Flow path for the typical dual mode injector

## Actuated Valves

An automated valve offers more sophisticated functionality. Choose an automated valve if the application requires fast, consistent flow-stream switching. Some other advantages of automated valves include control options (PC- or instrument-triggered), higher torque operation, valve-position feedback, or very small flow paths.

### Actuated Valves up to 15,000 psi

Part No.	Description	Ports, Connections	Wetted Material	Rapid Replacement Pod
<b>UP TO 15,000 PSI (1,035 BAR)</b>				
<b>SWITCHING</b>				
<b>MXT715-000</b>	2-Position, 6-Port	10-32 Ports for 1/16" OD Tubing	UltraLife	PD715-000
<b>MXT715-102</b>	2-Position, 10-Port	10-32 Ports for 1/16" OD Tubing	UltraLife	PD715-102
<b>INJECTION</b> For Injection, add the appropriately sized Sample Loop to the Switching valves above				
<b>SELECTION</b>				
<b>MXT715-105</b>	6-Position, 7-Port	10-32 Ports for 1/16" OD Tubing	UltraLife	PD715-105

All of these MXX valves include a set of 1/16" and 1/8" ferrules. Replacement Fittings for MXX valves can be located on page 144.

### Actuated Valves up to 6,000 psi

Part No.	Description	Ports, Connections	Wetted Material	Rapid Replacement Pod
<b>UP TO 6,000 PSI (410 BAR)</b>				
<b>SWITCHING</b>				
<b>MXP7900-000</b>	2-Position, 6-Port	10-32 Ports for 1/16" OD Tubing	DuraLife*	PD7900
<b>MXP7960-000</b>	2-Position, 10-Port	10-32 Ports for 1/16" OD Tubing	DuraLife	PD7960
<b>MXP7980-000</b>	2-Position, 6-Port, Nano, 5,000 psi (345 bar)	M4 Ports for 1/32" OD Tubing	DuraLife II	PD7980
<b>MXP7986-000</b>	2-Position, 10-Port, Nano, 5,000 psi (345 bar)	M4 Ports for 1/32" OD Tubing	DuraLife II	PD7986
<b>MXP9900-000</b>	2-Position, 6-Port, Biocompatible, 5,000 psi (345 bar)	10-32 Ports for 1/16" OD Tubing	PEEK	PD9900
<b>MXP9960-000</b>	2-Position, 10-Port, Biocompatible, 5,000 psi (345 bar)	10-32 Ports for 1/16" OD Tubing	PEEK	PD9960
<b>INJECTION</b> For Injection, add the appropriately sized Sample Loop to the Switching valves above				
<b>MXP7920-000</b>	2-Position, 6-Port, Vertical Port	10-32 Ports for 1/16" OD Tubing	DuraLife	PD7920
<b>SELECTION</b>				
<b>MXP7970-000</b>	6-Position, 7-Port	10-32 Ports for 1/16" OD Tubing	DuraLife II**	PD7970

\* DuraLife is a proprietary material combination of SST and an advanced polymer.

\*\* DuraLife II is a proprietary material combination consisting of Titanium and an advanced polymer.

All of these MXX valves include a set of 1/16" and 1/8" ferrules. Replacement Fittings for MXX valves can be located on page 144.

### Actuated Valves to 125 psi

Part No.	Description	Ports, Connections	Wetted Material	Ferrule Size
<b>UP TO 125 PSI (8.5 BAR)</b>				
<b>SWITCHING</b>				
<b>MXX777-601</b>	2-Position, 6-Port	Accepts Either 1/16" or 1/8" Tubing	RPC-7*	1/16" and 1/8"
<b>MXX777-603</b>	2-Position, Double Three Way	Accepts Either 1/16" or 1/8" Tubing	RPC-7	1/16" and 1/8"
<b>MXX777-612</b>	2-Position, 6-Port, Large Bore	Accepts Either 1/16" or 1/8" Tubing	RPC-7	1/16" and 1/8"
<b>SELECTION</b>				
<b>MXX777-605</b>	6-Position, 7-Port	Accepts Either 1/16" or 1/8" Tubing	RPC-7	1/16" and 1/8"
<b>MXX777-616</b>	6-Position, 7-Port, Large Bore	Accepts Either 1/16" or 1/8" Tubing	RPC-7	1/16" and 1/8"
<b>MXX778-605</b>	10-Position, 11-Port	Accepts Either 1/16" or 1/8" Tubing	RPC-7	1/16" and 1/8"

\* RPC-7 Proprietary Polymer Combination.

All of these MXX valves include a set of 1/16" and 1/8" ferrules. Replacement Fittings for MXX valves can be located on page 144.

## MX Series II

### Actuated Valves

- ▶ **MXT** to 15,000 psi (1,035 bar)
- ▶ **MXP** to 6,000 psi (410 bar)
- ▶ **MXX** to 125 psi (8.5 bar)

Add Rheodyne® MX Series II™ actuated valves to your existing instrument or use in stand-alone lab configurations. MX valves can be controlled remotely or operated manually using the push-button front panel with LED position indicator. MX valves connect to your instrument or PC through contact closure, BCD, serial port, or USB. Commands can be sent to the MX valves using your chromatography software or the included proprietary software for timed-events programmability.

Available flow rates include options for Analytical, Micro/Nano, or Semi-Prep in a range of pressure capabilities. Valve liquid ends are available in materials chosen to be chemically inert and biocompatible. Routine maintenance using authorized RheBuild® kits (page 136) or — for the higher-pressure MXP and MXP valves — the Rapid Replacement Pods™ (page 135) assures optimal performance.

 Biocompatible



**MXX**  
Up to 125 psi  
(9 bar)



**MXT**  
Up to 15,000 psi  
(1,034 bar)



**MXP**  
Up to 6,000 psi  
(414 bar)

## Manual Valves

Choose a manual valve if your application involves low frequency of use, demands operator control, or involves injection of smaller sample volumes.



NEW!

**7725i-188**  
Manual Injection Valve  
Up to 9,000 psi (600 bar)



**7060**  
Manual Switching Valve  
Up to 7,000 psi (483 bar)

## SPECIFICATIONS & DETAILS

Part No.	Stator Passage Diameter	Factory Set Pressure	Maximum Field Set Pressure	Maximum Temperature (°C)
3000, 3030 (PEEK)	1.0 mm (0.040")	3,000 psi (207 bar)	4,000 psi (276 bar)	50°
3000-038 (SST)	1.0 mm (0.040")	4,000 psi (276 bar)	5,000 psi (340 bar)	50°
7000, 7010 (SST)	0.6 mm (0.024")	5,000 psi (340 bar)	7,000 psi (483 bar)	150°
7000L (SST)	1.0 mm (0.040")	3,000 psi (207 bar)	5,000 psi (340 bar)	150°
7030 (SST)	0.6 mm (0.024")	5,000 psi (340 bar)	7,000 psi (483 bar)	150°
7030L (SST)	1.0 mm (0.040")	3,000 psi (207 bar)	5,000 psi (340 bar)	150°
7060 (SST)	0.4 mm (0.016")	5,000 psi (340 bar)	7,000 psi (483 bar)	80°
7060L (SST)	1.0 mm (0.040")	3,000 psi (207 bar)	5,000 psi (340 bar)	80°

*SST = Stainless Steel*

### Manual Valves up to 15,000 psi

Part No.	Description	Tubing/Fitting Size	Wetted Material	Configuration
<b>UP TO 15,000 PSI (1,035 BAR)</b>				
<b>INJECTION</b>				
<b>NEW! 7725i-188</b>	2-Position, 6-Port, 9,000 psi (600 bar)	10-32 Ports for 1/16" OD Tubing	Stainless Steel, PEEK, Ceramic	Front loading

### Manual Valves up to 6,000 psi

Part No.	Description	Tubing/Fitting Size	Wetted Material	Configuration
<b>UP TO 6,000 PSI (410 BAR)</b>				
<b>SWITCHING</b>				
<b>3000</b>	2-Position, 6-Port, Prep Scale	5/16-24 Ports for 1/8" Tubing	PEEK	—
<b>3000-038</b>	2-Position, 6-Port, Prep Scale	5/16-24 Ports for 1/8" Tubing	Stainless Steel & PEEK	—
<b>3030</b>	2-Position, 6-Port, Prep Scale	5/16-24 Ports for 1/8" OD Tubing	PEEK	Double 3-Way
<b>7000</b>	2-Position, 6-Port, Large Bore	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel®	—
<b>7000L</b>	2-Position, 6-Port, Large Bore	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	—
<b>7030</b>	2-Position, 6-Port	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	Double 3-Way
<b>7030L</b>	2-Position, 6-Port, Large Bore	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	Double 3-Way
<b>INJECTION*</b>				
Part No.	Description	Tubing/Fitting Size	Wetted Material	Sample Loop Volume
<b>7010</b>	2-Position, 6-Port Single Mode	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	20 µL*
<b>9010</b>	2-Position, 6-Port Single Mode (Switching, Injection)	10-32 Ports for 1/16" OD Tubing	PEEK, ETFE, Ceramic	20 µL*
<b>3725-038</b>	2-Position, 6-Port, Prep Scale Dual Mode	5/16-24 Ports for 1/8" Tubing	Stainless Steel & PEEK	10 mL*
<b>3725i</b>	2-Position, 6-Port, Prep Scale Dual Mode with Switch	5/16-24 Ports for 1/8" Tubing	PEEK	10 mL*
<b>3725i-038</b>	2-Position, 6-Port, Prep Scale Dual Mode with Switch	5/16-24 Ports for 1/8" Tubing	Stainless Steel & PEEK	10 mL*
★ <b>7725</b>	2-Position, 6-Port, Analytical Scale Dual Mode	10-32 Ports for 1/16" OD Tubing	Stainless Steel, Ceramic, Vespel	20 µL*
★ <b>7725i</b>	2-Position, 6-Port, Analytical Scale Dual Mode with Switch	10-32 Ports for 1/16" OD Tubing	Stainless Steel, Ceramic, Vespel	20 µL*
<b>8125**</b>	2-Position, 6-Port, Micro Scale Dual Mode with Switch	10-32 Ports for 0.020" (0.5 mm) or 1/16" Tubing	Stainless Steel, Ceramic, Vespel	5 µL*
<b>9725</b>	2-Position, 6-Port, Analytical Scale Dual Mode	10-32 Ports for 1/16" OD Tubing	PEEK, ETFE, Ceramic	20 µL*
★ <b>9725i</b>	2-Position, 6-Port, Analytical Scale Dual Mode with Switch	10-32 Ports for 1/16" OD Tubing	PEEK, ETFE, Ceramic	20 µL*
<b>SELECTION</b>				
<b>7060</b>	6-Position, 7-Port	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	6-Way
<b>7060L</b>	6-Position, 7-Port, Large Bore	10-32 Ports for 1/16" OD Tubing	Stainless Steel & Vespel	6-Way

\* Ships with a sample loop attached to ports 1 and 4.

\*\* The 8125 requires special ferrules for 0.020" (0.5 mm) tubing. 8125-084-0.5 mm ferrule for 8125; 8125-086-0.5 mm ferrule for 8125 — 4-pk.