





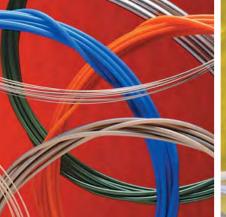


# VALCO CHEMINERT CATALOG

## **TOOLS FOR SCIENCE AND MEDICINE**

INJECTORS
VALVES
DETECTORS
FITTINGS
SYRINGES
TUBING

#### **CATALOG 65 INT**







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#### To order

#### **EUROPE, MIDDLE EAST, ASIA, and AFRICA**

#### VICI AG International

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#### NORTH AMERICA (except Canada), **SOUTH and CENTRAL AMERICA. AUSTRALIA and NEW ZEALAND**

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#### **CANADA**

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#### **REGULATIONS**









As a worldwide supplier of products for the analytical instrument market, we work hard to make sure those products comply with regulatory requirements around the world. All machined products (valves, fittings, etc.) are fully RoHS/REACH/WEEE compliant. Most of the electrical products we manufacture are also CE tested and certified. Only a few legacy products are not CE certified.

See page 263 for a list of non-CE items.

#### Welcome to VICI

VICI is an acronym for Valco Instruments Company Inc. VICI now defines multiple companies which manufacture various products for the analytical industry.

#### **VICI Valco Instruments**

For over 40 years, Valco Instruments has been the leading designer and manufacturer of standard and custom components for precision analytical, biomedical, and biocompatible instrumentation. In addition to Valco and Cheminert® valves and fittings, we offer a wide range of related products such as electric and pneumatic actuators, tubing and sampling loops, heated enclosures, valve sequence and temperature controllers, gas purifiers, GC detectors, and digital interfaces.



Fafnir, one of a long line of Valco Saint Bernards, at the Houston, Texas office

#### **VICI AG International**

VICI AG International, in Schenkon, Switzerland, is an independent site for the manufacturing of Valco and Cheminert valves and the handling of all VICI product lines in Europe, Africa, the Middle East, and the Far East. Present certification is ISO 9001:2008 and 14001:2004.

#### **VICI Metronics**

VICI Metronics, Inc. is the leading manufacturer of devices and instruments that are used in the generation of calibration gas standards. The line includes Dynacal and G-Cal permeation tubes, Dynacalibrator calibration gas generators, and gas monitors. Metronics is the leading provider of



Our engineering/development facility on Waterbury Drive in Houston



VICI AG International in Schenkon, Switzerland



VICI Metronics Poulsbo, Washington

explosives, narcotics, and chemical warfare dopants for TSA airport security (ammonia, DCM), law enforcement, border patrol, military, and other trace detection industry professionals.

We offer high performance gas specific purifers suitable for use in GC/MS and LC/MS systems. The helium, hydrogen, nitrogen, and air purifiers remove sulfur and nitrogen compounds, halocarbons, hydrocarbons, moisture, oxygen, and other contaminants.

The Metronics facility also houses production of and support for Valco-Bond and ValcoPLOT capillary columns.

#### **VICI Precision Sampling**

Your resource for syringes, Mininert® valves, probes, and tubing. Our pre-cut stainless steel tubing is available in standard lengths, or cut and bent to your specifications. All our syringes feature ultra smooth bores, easily replaceable parts, low dead volume, crisp clean gradations, and precision calibrations.

#### **VICI Valco Canada**

Products from all VICI companies are available in Canada directly from this location. We also supply and support our Canadian dealers and OEMs.



VICI Precision Sampling Baton Rouge, Louisiana



VICI Valco Canada Brockville, Ontario

**CONTACT US** 

Tel

See box on facing page for: VICI Valco Instruments VICI AG International VICI Valco Canada VICI Metronics

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## New products THE LATEST FROM VICE

#### **NEW**

## Fast GC conversion kit for 6890/7890 GCs

Components for Fast GC .....page 4

These kits include everything you need to turn your standard GC into a high-speed analytical machine. Just specify the column you want and we'll provide the rest. The typical kit takes just an hour to install, with complete step-by-step instructions included. All that's required is a small hole in the top of the column oven, and we even provide the drill bit!



#### **NEW**

## Fast GC components turbocharge analyses

Column temperature controller .....page 5

Our Fast GC controller provides programmable temperature control for analysis-optimized column bundles. The programmable controller coupled with a column bundle (we can provide one using our fused silica column or yours) slashes conventional analytical times. The result of years of research, these systems provide high throughput analyses at a fraction of the cost of a conventional GC.







#### NEW

#### Mini PDD detector helps pay for itself

miniPDD Model D-2-IM ..... page 222

The miniature D-2-IM consumes less than one fifth as much helium as its big brothers, our popular D-3 and D-4 pulsed discharge detectors. With the ever-increasing price of helium, this can represent savings of hundreds of dollars per year. With robust performance, easy maintenance, and nearly the same sensitivity as the larger models, the mini PDD is the clear choice for field portable applications and for labs concerned about operational costs.



#### NEW

#### New modular universal actuator to replace the microelectric

Modular universal actuator ...... page 194

This new version of the popular universal actuator gives greater flexibility for the instrument manufacturer working in the limited space frequently encountered in modern instruments. The design also makes it possible to mount the more sensitive electronics module away from the liquid end of the valve. The modular unit has all the features of the composite model, allowing instrument manufacturers to use a single motor and control software to operate virtually any Valco or Cheminert rotary valve, with greater programmability plus optional communication interfaces.



#### NEW

#### Special adapters ease connectivity to 360 micron tubing

Internal reducers for 360 µm tubing..... page 38 External to internal reducer for 360 µm tubing.......... 39

Our unique 360 micron fittings permit direct connection to any capillary tubing with 360 µm OD. But making the transition to valves or other fittings with larger tubing meant using a union. Now you can minimize the number of connections using our IZR and EZR adapters. IZRs permit plumbing 360 µm tubing directly into a 1/16" or 1/32" Valco fitting detail, and the EZR permits the same connection to 1/16" external details. Available in PEEK or stainless steel.

#### **NEW**

#### Components for fast GC

#### **The Problem**

In the quest for more rapid chromatographic results, there are two distinct avenues – the small, portable instruments made specifically for use in the field, and traditional GCs which are modified to accelerate the analysis. The components developed by Valco engineering exceed the requirements of both approaches.

#### The Solution

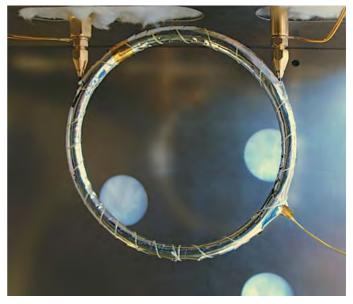
Valco now offers a variety of components which can be used individually or in concert with others to provide the optimal solution for the analysis.

- Resistively-heated low mass columns
- Fast temperature controller
- Pulsed discharge detector (PDD)

Our valves can provide the necessary sample injection, and resistively-heated columns dramatically decrease analysis time. The fast temperature controller offers provisions for multiple ramp temperature programming with a user-friendly Windows interface and a compact size suitable for use in the lab or in the field. Column temperature is controlled by regulating the amount of current applied to the wire-wrapped or nickel-clad capillary column.

We offer a variety of detector options to suit a wide array of applications – from our TCD to our popular PDDs (pulsed discharge detectors), which can be tuned for optimal analyte specificity. Our new miniPDD (page 222) is ideal for portable applications or for areas where helium use must be minimized.

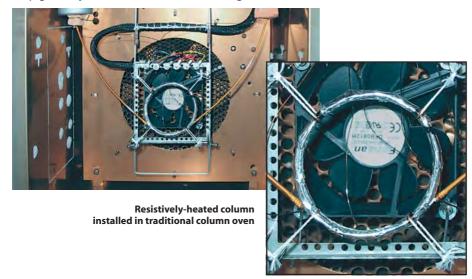
So whether you have a traditional lab GC that you want to turbo-charge or are building a portable GC for rapid analyses, our extensive line of fast GC components can help get the job done on time and on budget.



Column kit installed in Agilent 6890 column oven



View of relocated Agilent FID to permit use of fast GC column kit



TO DISCUSS YOUR REQUIREMENTS IN DETAIL, CONTACT OUR TECHNICAL DEPARTMENT

#### **MORE INFORMATION**

#### NEW



#### Column temperature controller

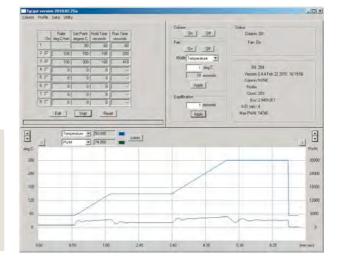
CE

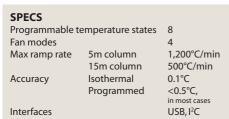
- For use with nickel-wire and nickel-clad resistively-heated columns
- Programmable 8-state temperature profile
- Compatible with any GC or analyzer
- User-friendly Windows-based control and monitor program
- OEM and end user versions available

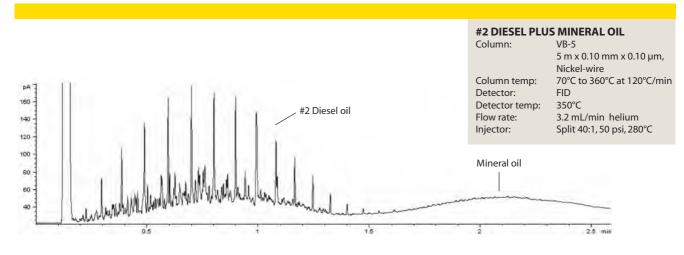
The VICI column heating unit is designed for precise temperature programming with rapid heating and cooling of a low mass nickel-clad or nickel-wire column. The column is resistively-heated by applying a low-voltage current to the column coating or wire, eliminating the need for a traditional GC column oven and heating element with their power and space requirements. Column temperature is controlled by regulating the amount of current, with a small fan for quickly cooling the low-mass column to near-ambient temperature.

These features plus speed, compact size, and low power requirement make this unit an ideal component in fast, portable GCs, but it can be easily employed on any GC or analyzer.

The Windows-based control program (screen capture below) facilitates simple creation of temperature profiles with as many as eight states, and allows multiple columns to be tuned with each configuration saved for reloading. Multiple data parameters can be graphed, with data logged and analyzed.







# Valco fittings THE INDUSTRY STANDARD

The compression fitting (**Figure 1**), in which a one- or two-piece ferrule is compressed onto the tube as a nut is tightened, offers reliability in high pressure situations and in connecting metal tubing. Valco excels in all critical areas of the design and manufacture of such fittings. Quality considerations, which cannot be ignored if an analytical system is to reach and maintain optimum performance levels, include interchangeability, counterbore tolerances, ID/OD concentricity, mixing potential, cleaning procedures, and the method employed to "make up" the ferrule on the tube.

#### **No Tubing Deformation**

The basic concept of compression fittings carries the inherent danger of tube deformation (**Figure 2**). While some manufacturers emphasize this positively as a method of ensuring that the tubing doesn't blow out of the ferrule, the flow anomalies introduced by the restricted ID make these fittings a poor choice for many instrument applications.

Valco metal ferrules cut a ring near the end of the tube (**Figure 3**), which prevents tube release at high pressures without significantly deforming and restricting the tube interior. Because our ferrules have a sharp edge at the ID near the nose, this usually takes only about 1/4 turn beyond the point where the ferrule first starts to grab the tubing. There is so little tube distortion that they are routinely used with glass-lined tubing! Only Valco's polymer fittings rely on friction to hold a tube.

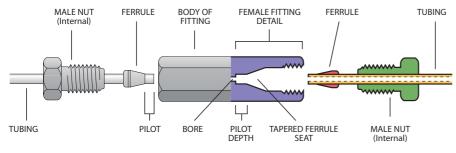


Figure 1
Valco compression fitting

#### **CAUTION!**

The analytical devices market has attracted numerous companies which copy Valco/ Cheminert designs. Please exercise caution in the use of copies, which may not be compatible with the original versions in this catalog.

Because of VICI's high volume production and dedicated machinery, our fittings are often less expensive and of consistently higher quality than competing copies.

#### **TECH TIP**

For optimal zero dead volume connections, make sure your tubing meets the best industry standards – OD tolerance should be nominal dimension ± .002".

Fractional dimension	Nominal dimension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500



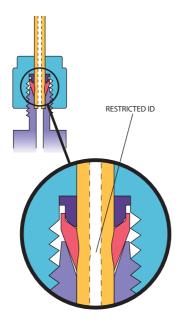


Figure 2 **ID** restriction in common compression fitting

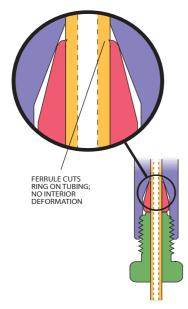


Figure 3 No ID restriction in Valco compression fitting

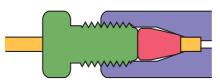
#### Interchangeability

Valco fitting details are designed with a consistent pilot depth, permitting reliable interchangeability as connections are revised or fittings are replaced. This interchangeability extends throughout the Valco and Cheminert fitting and valve product lines. Indeed, the Valco standard has been so widely copied that Valco and Cheminert fittings are, in general, fully interchangeable with those of our major competitors.\* In initial installations, Valco ferrules will often improve other manufacturers' fitting connections.

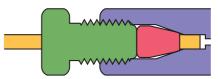
Because of variations in tubing OD and in pilot and taper designs from manufacturer to manufacturer, the amount of tubing extending beyond the made up ferrule can vary. (The most radical variation is in the fittings manufactured by Waters. Based on the old Swagelok design, they have a pilot depth considerably longer than standard.) Figure 4a shows a properly made up fitting. If that same fitting is installed in a detail which was designed for a slightly longer tube extension (as in Figure 4b), dead volume will be introduced. In the opposite case, with the pilot shorter than the pilot depth (Figure 4c), the tube will bottom out before the ferrule has sealed. However, our tests prove that except in the most extreme cases, a Valco ferrule will "creep" on the tubing until it reaches the bottom of the ferrule taper, making a proper seal.

#### **Reliably Clean**

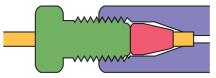
Most of our state of the art CNC machines use water-based lubricants. After each part comes off the machine, it is cleaned with watersoluble detergents and then rinsed in hot deionized water. Finally, every metal fitting that we make is given a thorough cleaning with steam from deionized water at 140°C. Any critical parts processed with oil-based lubricants are baked to remove all traces. The practical result of the extra effort is this: you don't have to be concerned about solvent residues.



a. Tubing seats correctly at bottom of detail



b. Tubing doesn't reach bottom of detail, introducing dead volume



c. Tubing reaches bottom of detail before ferrule seats

Figure 4

<sup>\*</sup> An exception is the longer pilot depth on Cheminert high pressure valves with polymeric stators.

#### **Precision Machining, Finishing, and Tolerances**

The machining methods used by different manufacturers to finish the detail of compression fittings vary in several ways that affect performance, as shown below. The fitting in **Figure 5** is the best choice for high performance fittings, as the tube fits squarely into the bottom of the detail. This is the detail used in Valco and Cheminert high pressure fittings.

Some fitting manufacturers omit a critical finishing operation which makes the bottom of the detail square, leaving the shape of the typical tapered drill bit instead. This results in the fitting shown in Figure 6, which introduces extra volume and mixing potential. VICI uses proprietary tooling specifically designed to produce the same high precision detail in every Valco and Cheminert fitting.

Although sometimes the tube end may seal in the bottom of the detail, the intent is for the seal to be made at the ferrule. This leaves the possibility of seepage up around the tube and into the minute cavities between the end of the ferrule and the bottom of the ferrule seat. The probability of this seepage increases when there is an excessive variance between the tubing OD and the diameter of the counterbored pilot in which it sits, and between the ferrule OD and the ferrule ID at the point where it "bites" or crimps the tubing. The possibility is virtually eliminated in VICI's fittings, which are manufactured with the precise dimensions that chromatographic applications demand. Use of VICI precut tubing, which is manufactured to quality standards in excess of most commercial tubing, further assures the best fitting connection.

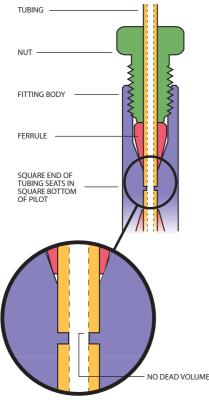


Figure 5 Valco/Cheminert high pressure compression fitting

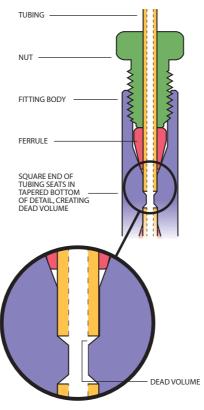


Figure 6 Poor quality compression fitting

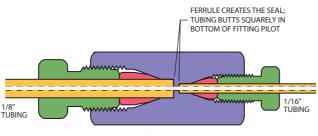
#### **Comparison of Compression Fitting Designs**

The potential for dead volume and mixing is a consideration in other aspects of fitting design as well, and varies considerably among manufacturers. For example, the common gas distribution reducing union in Figure 7 illustrates two problems for instrumentation: a large connecting volume, and various steps and restrictions which cause mixing. While there are many uses for these fittings upstream of the analytical system (such as bulk gas distribution), they cause problems when used downstream in critical applications.

LARGE CONNECTING VOLUME

1/8"
TUBING

**Figure 7**Common commercial reducing union



**Figure 8** Valco zero dead volume reducing union

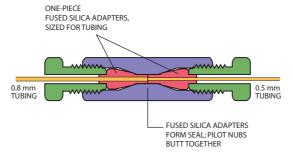


Figure 9
Valco zero dead volume through-bore union

Additional difficulties may be encountered if this type of fitting is loosened and retightened repeatedly. The male threaded part can become flared to the point where it is impossible to get the nut on, and the tube end often flares out in the fitting detail so that it's difficult to remove the tube.

The Valco internal union (**Figure 8**) has a larger mass surrounding the ferrule, so that even with repeated remakes or overtightening, it's impossible to flare the fitting as in the external design. When a union is selected with a bore to match the ID of the connecting tubing, mixing and dead volume are virtually eliminated.

For connection of fused silica tubing of the same or differing sizes, the through-bore union shown in **Figure 9** is recommended. This fitting permits the use of our one-piece fused silica adapters to effect a true zero dead volume connection. The ferrule features an integrated pilot which adapts to the ID of the unions, resulting in an inert, zero volume connection.

Every Valco and Cheminert fitting is manufactured to exacting specifications. Fitting concentricity – the relationship of the center of one fitting to another – is held to within 10% of the bore size (0.05 mm in a typical 1/16" union with 0.5 mm bore), which is better than that of commonly used *tubing*. This results in fittings which contribute no "extra column effects" or loss of efficiency to the chromatographic system.

Valco metal compression fittings can be used safely at UHPLC and SFC pressures when the fitting size is 1/16" or smaller. Our fittings of this type have been tested at pressures exceeding 50,000 psi. The pressure limitation with these is generally the safe working pressure of the tubing, and not the fitting itself.

#### Internal nuts - stainless steel

Nuts with product numbers starting with Z are for use with all standard Valco internal fittings and most valves. They may be used with fittings from other manufacturers as well. The L (long) and XL (extra-long) types are for situations where the fitting head may be otherwise inaccessible or where interference between fittings exists, as on many Valco multiposition valves. Standard material is 300 series stainless.

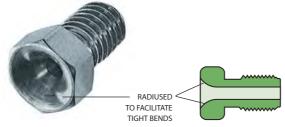
Package of 10:	Length	Stainless nuts Prod No
1/32" nut 1/32" nut 1/16" nut 1/16" nut 1/16" nut 1/16" nut 1/16" nut	.30" .45" .43" .50" .625" .75"	ZN.5-10 LZN.5-10 ZN1-10 MZN1-10 IZN1-10 LZN1-10 XI 7N1-10
1/8" nut 1/8" nut 1/8" nut 1/8" nut	.57" .82" 1.07"	ZN2-10 LZN2-10 LZN2-10 XLZN2-10 ZN4-10
1/4" nut	1.11"	LZN4-10



#### Controlled radius nuts - stainless steel and PEEK

These patented\* special purpose nuts facilitate a tight bend as the tube exits the fitting, and can also help prevent kinks in very thin wall tubing. Controlled radius nuts are available in a range of sizes. Note that the short version (ZSN1R) can *only* be used in certain applications. Call for more information.

-					
Description	Length	Prod No		1	
<b>Stainless steel</b> 1/16", standard	.43"	ZN1R	E-min		
1/10 , standard	.73	ZIVIII	marifoldis.		
1/16", short	.30"	ZSN1R		1	
1/8", standard	.57"	ZN2R			
PEEK			_		
1/16", hex	.45"	ZN1RPK			
1/16", fingertight	.88"	ZN1RFPK			
	-				
		3/1			



\*U.S. patent number 6,247,731.

Controlled radius nut Standard length

#### **TECH TIP**

Fittings for **360 micron** tubing are available on pages 57-58.

#### MORE INFORMATION

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HPLC column end
fittings42-46
Reducing unions
Internal29
External 30
External/internal31
Internal/external31
Unions
Internal26
External 27
External/internal27

#### CONVERSIONS

ONVERSI	ONS
0.25 mm	= .010"
0.50 mm	= .020"
0.75 mm	= .030"
1.0 mm	= .040"
1.5 mm	= .060"
2.0 mm	= .080"
4.6 mm	= .180"
6.0 mm	= .236"
6.4 mm	= .253"
7.0 mm	= .275"
10.0 mm	= .400"
27.0 mm	= 1.08"
1/32" =	0.8 mm
1/16" =	1.6 mm
1/8" =	3.2 mm
1/4" =	6.4 mm
3/8" =	9.5 mm

1/2" = 12.7 mm



#### External nuts - stainless steel

External nuts are used with external fittings, such as our column end fittings (ECEF series) and external unions (EZU and EZRU series). They may also be used with Valco ferrules on Parker CPI and Swagelok type fittings. Standard material is 300 series stainless.

\* PTFE-coated threads standard.

Description	Stainless nuts Prod No
1/32" e xternal nut	EN.5
1/32" external nut, knurled	EN.5KN
1/16" external nut	EN1
1/8" external nut	EN2
1/4" external nut	EN4 *
3/8" external nut	EN6 *
1/2" external nut	EN8 *
1" external nut	EN1K *



#### Plugs - stainless steel and high pressure

Stainless plugs consist of a zero volume nut with a ferrule made up on a solid rod. For high pressure applications such as UHPLC, SFE, and SFC (>7000 psi), we recommend the special high pressure plugs with the ferrule and rod machined as a single, solid piece.

•	olugs stainless plugs rod No Prod No
1/16" .75" Z	P.5 ZP.5H P1 ZP1H ZP1 LZP1H
1/8" 1.40" L	P2 ZP2H ZP2 LZP2H P4 —



#### Caps - stainless steel

A cap is essentially a piece of hex stock with a zero volume fitting detail machined into it, but with no through-hole.

Description	So Length of cap*	tainless caps Prod No
1/32"	.55"	ZC.5
1/16"	.77"	ZC1
1/8"	1.01"	ZC2
1/4"	1.24"	ZC4

#### MORE INFORMATION

Valco metal ferrules cut a ring near the end of the tube, preventing tube release at high pressures without significantly deforming and restricting the tube interior. (However, if the hardness of the tubing is equal to or greater than that of the ferrule, deformation of the tube rather than a cut ring is likely.) Make up usually takes only about a 1/4 turn beyond the point where the ferrule first starts to grab the tubing. Polymeric ferrules seal by the increased friction from compression.

Valco zero volume ferrules may be used with all Valco fittings and with those of most other manufacturers. The maximum pressure limit is generally determined by the yield strength of the tubing. The maximum pressure for softer materials (such as brass and polymers) is



lower, and depends on the tubing used. If in doubt about a particular combination, consult our technical staff.

For trace gas analysis, use gold-plated ferrules to achieve sealing with <10<sup>-9</sup> cc/atm/sec leakage.

#### **Metal ferrules**

	Prod No	Prod No	Prod No
Package of 10:	Stainless,	Stainless,	Stainless,
	Type 303	Type 316	Gold-plated
1/32"	ZF.5-10	ZF.5S6-10	ZF.5GP-10
1/16"	ZF1-10	ZF1S6-10	ZF1GP-10
1/8"	ZF2-10	ZF2S6-10	ZF2GP-10
1/4"	-	ZF4S6-10	ZF4GP-10
Sold individually:	Hastelloy C	Nickel	Titanium
1/32"	ZF.5HC	ZF.5NI	ZF.5TI
1/16"	ZF1HC	ZF1NI	ZF1TI
1/8"	ZF2HC	ZF2NI	ZF2TI
1/4"	ZF4HC	ZF4NI	ZF4TI
Package of 10:	Brass		
1/32" 1/16"	ZF.5B-10 ZF1B-10		
1/8" 1/4"	ZF2B-10 ZF4B-10		

- Not available

Larger sizes and/or specific materials may be available on special order.

FERRULE IDENTIFI	CATION	
To differentiate		
among the most		
commonly ordered		
metal ferrules, ring(s)	316 STAINLESS	303 STAINLESS
are engraved on the		
non-sealing surfaces.		
	100000	A CONTRACTOR OF THE PARTY OF TH
	HASTELLOY C	TITANIUM

METALS AT A GLANCE Hastelloy C ® HC Resistant to pitting; Resists oxidizing atmo- spheres
Nickel NI Resistant to caustics, high temp halogens, and hydrogen halides
Stainless steel, Gold-platedGP More inert than stan- dard stainless
Stainless steel, Type 303 GC, gas lines, general purpose
Stainless steel, Type 316
TitaniumTI Outstanding resistance to most media except hydrofluoric acids
Brass
For more detailed information on metals, refer to the discussion on pages 254-255.
CONVERCIONS

CONVERSION	ONS
0.25 mm 0.50 mm 0.75 mm	= .020"
1.0 mm 1.5 mm 2.0 mm	= .060"
4.6 mm 6.0 mm 6.4 mm	= .236"
7.0 mm 10.0 mm	= .400"
1/4" =	

1/2" = 12.7 mm

#### **Polymeric ferrules**



	Prod No	Prod No	Prod No
Package of 10:	PTFE, Virgin	PTFE, Glass-filled	FEP
1/32"	ZF.5TF-10	ZF.5TFG-10	ZF.5FEP-10
1/16"	ZF1TF-10	ZF1TFG-10	ZF1FEP-10
1/8"	ZF2TF-10	ZF2TFG-10	ZF2FEP-10
1/4"	ZF4TF-10	ZF4TFG-10	ZF4FEP-10
3/8"	ZF6TF-10	ZF6TFG-10	ZF6FEP-10
1/2"	ZF8TF-10	ZF8TFG-10	ZF8FEP-10
Package of 10:	PFA	CTFE	PEEK
1/32"	ZF.5PFA-10	ZF.5KF-10	ZF.5PK-10
1/16"	ZF1PFA-10	ZF1KF-10	ZF1PK-10
1/8"	ZF2PFA-10	ZF2KF-10	ZF2PK-10
1/4"	ZF4PFA-10	ZF4KF-10	ZF4PK-10
3/8"	ZF6PFA-10	ZF6KF-10	ZF6PK-10
1/2"	ZF8PFA-10	ZF8KF-10	ZF8PK-10
Package of 5:	Polyimide,	Polyimide,	Polyimide,
	Graphite	Valcon	Virgin
1/32"	ZF.5GV-5	ZF.5V-5	ZF.5V1-5
1/16"	ZF1GV-5	ZF1V-5	ZF1V1-5
1/8"	ZF2GV-5	ZF2V-5	ZF2V1-5
1/4"	ZF4GV-5	ZF4V-5	ZF4V1-5
3/8"	ZF6GV-5	ZF6V-5	ZF6V1-5
1/2"	ZF8GV-5	ZF8V-5	ZF8V1-5

POLYMERS AT A GLANCE CTFE
corrosives. Produced as Kel-F®
FEPFEP Chemical resistance equals PTFE, but lower creep and higher friction
PEEKPK  Chemical resistance;  up to 225°C
PTFE, Glass-filledTFG Inert, mechanically stable
PTFE, VirginTF Inert; very soft, easily cold flows. Produced as Teflon ®
Polyimide, GraphiteGV Soft, easy to form fer- rules
Polyimide, Valcon V High temp, graphite reinforced
Polyimide, VirginV1 High temp, electrical insulator
For more detailed information on polymers, refer to the discussion on

page 256.

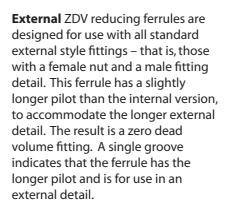
Grooved PEEK

MORE INFORMATION

ferrules..... page 63

Reducing ferrules provide an inexpensive way to connect small temporary transfer lines to valves or fittings designed for larger tubing. For long term use, we recommend our reducing unions, internal reducers (IZRs), or external reducers (EZRs), as appropriate.

Internal ZDV (zero dead volume) reducing ferrules are designed for use with all standard Valco internal style fittings – that is, those with a male nut and female fitting detail. The ferrule features an integral pilot which fills the pilot cavity (the space between the end of the ferrule and the bottom of the detail), yielding a zero dead volume fitting.

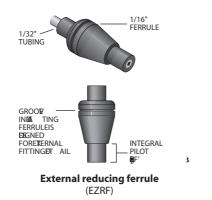


**Standard** reducing ferrules can be used where mixing is not a problem, such as with liquid or gas delivery. A 1/16" to 1/32" ferrule of this style is simply a 1/16" ferrule with a 1/32" hole.





**Internal reducing ferrules** 





(RF)

Use these ferrules in internal type fitting details, with nuts that have external threads.

		Prod No	Prod No	Prod No
Packag	ge of 5:	PTFE, Glass-filled	PEEK	Polyimide, Valcon
	1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	ZRF1.5TFG-5 ZRF2.5TFG-5 ZRF21TFG-5	ZRF1.5PK-5 ZRF2.5PK-5 ZRF21PK-5	ZRF1.5V-5 ZRF2.5V-5 ZRF21V-5
	1/4" to 1/16" 1/4" to 1/8"	ZRF41TFG-5 ZRF42TFG-5	ZRF41PK-5 ZRF42PK-5	ZRF41V-5 ZRF42V-5
Packag	ge of 5:	CTFE	Polyimide, Virgin	
Packag	ge of 5: 1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	ZRF1.5KF-5 ZRF2.5KF-5 ZRF21KF-5		



PEEK reducing ferrule and internal nut (Order nut separately.)

#### TECH TIP

Fittings for **360 micron** tubing are available on pages 57-58.

#### **TECH TIP**

If you are doing resistive heating of traps or columns, note that our virgin polyimide reducing ferrules are effective electrical insulators.

Virgin polyimide is produced as Vespel <sup>®</sup>.

#### MORE INFORMATION

For 1/16" and 1/32" reducing ferrules with smaller ODs for use with fused silica, see the FS and FSR adapters on pages 16-17.

#### **External reducing ferrules**

**OPTION** 

Available in Virgin Polyimide.

Use these ferrules in external type fitting details, with nuts that have internal

	Prod No	Prod No	Prod No	
Package of 5:	PTFE, Glass-filled	PEEK	Polyimide, Valcon	
1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	EZRF1.5TFG-5 EZRF2.5TFG-5 EZRF21TFG-5	EZRF2.5PK-5	EZRF1.5V-5 EZRF2.5V-5 EZRF21V-5	
1/4" to 1/16" 1/4" to 1/8"	EZRF41TFG-5 EZRF42TFG-5		EZRF41V-5 EZRF42V-5	
Package of 5:	CTFE			
1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	EZRF1.5KF-5 EZRF2.5KF-5 EZRF21KF-5			
1/4" to 1/16"	EZRF41KF-5			
1/4" to 1/8"	EZRF42KF-5		•	
				PEEK reducing ferrule and external nut (Order nut separately.)



#### **Standard reducing ferrules**

Use these ferrules for bulk distribution only, since the resulting connection will not be zero dead volume. These ferrules can be used in either internal or external type fitting details.

	Prod No	Prod No	Prod No
Package of 5:	PTFE, Glass-filled	PEEK	Polyimide, Valcon
1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	RF1.5TFG-5 RF2.5TFG-5 RF21TFG-5	RF1.5PK-5 RF2.5PK-5 RF21PK-5	RF1.5V-5 RF2.5V-5 RF21V-5
1/4" to 1/16" 1/4" to 1/8"	RF41TFG-5 RF42TFG-5	RF41PK-5 RF42PK-5	RF41V-5 RF42V-5
Package of 5:	CTFE		
1/16" to 1/32" 1/8" to 1/32" 1/8" to 1/16"	RF1.5KF-5 RF2.5KF-5 RF21KF-5		
1/4" to 1/16" 1/4" to 1/8"	RF41KF-5 RF42KF-5		

0.75 mm = .030"

1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"

4.6 mm = .180"

6.0 mm = .236" 6.4 mm = .253"

7.0 mm = .275"  $10.0 \, \text{mm} = .400$ "

27.0 mm = 1.08"

1/32" = 0.8 mm 1/16" = 1.6 mm 1/8" = 3.2 mm

1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm

Fused silica adapters are available in Valcon polyimide for use up to 350°C and in PEEK for lower temperature applications (up to 175°C). Valcon polyimide is a unique graphitereinforced composite, specially prepared to maximize mechanical stability at high temperatures. Small blocks are subjected to extreme loads by a process known as hot isostatic pressing, with individual

ferrules subsequently machined from these blocks. The result of this two-step process is a fused silica adapter with high temperature stability which far exceeds that of parts produced by conventional molding. Note that the determining factor in adapter size selection is the fused silica tubing's outer diameter, or OD. Typical ODs for common columns are included in the product number tables.



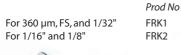
#### One piece fused silica adapter (FS)

The one piece FS adapter, essentially a reducing ferrule, is recommended for use in fittings where the polyimide ferrule will not be removed. Connections are made and disconnected by loosening the fitting nut and sliding the tube out.

Package	of 5:	Polyimide, Valcon	PEEK	Polyimide, Virgin
		Prod No	Prod No	Prod No
1/32" Ad	dapters			
	Tubing OD:			
	< 0.20 mm	FS.2-5	FS.2PK-5	
	0.20 ≤ 0.25 mm	FS.25-5	FS.25PK-5	FS.25V1-5
	0.25 ≤ 0.36 mm	FS.36-5	FS.36PK-5	_
	0.36 ≤ 0.40 mm	FS.4-5	FS.4PK-5	FS.4V1-5
	0.40 ≤ 0.50 mm	FS.5-5	FS.5PK-5	FS.5V1-5
	$0.50 \le 0.80 \text{ mm}$	ZF.5V-5	ZF.5PK-5	ZF.5V1-5
1/16" A	dapters			
	Tubing OD:			
	< 0.20 mm	FS1.2-5	FS1.2PK-5	FS1.2V1-5
	0.20 ≤ 0.25 mm	FS1.25-5	FS1.25PK-5	FS1.25V1-5
	0.25 ≤ 0.30 mm	FS1.3-5	FS1.3PK-5	FS1.3V1-5
	0.30 ≤ 0.40 mm	FS1.4-5	FS1.4PK-5	FS1.4V1-5
	0.40 ≤ 0.50 mm	FS1.5-5	FS1.5PK-5	FS1.5V1-5
	$0.50 \le 0.80 \text{ mm}$	FS1.8-5	FS1.8PK-5	FS1.8V1-5
	0.80 ≤ 0.90 mm	FS1.9-5	FS1.9PK-5	FS1.9V1-5
	0.90 ≤ 1.0 mm	FS11.0-5	FS11.0PK-5	FS11.0V1-5

#### **Ferrule removal kits**

Remove polymeric ferrules stuck in fitting details. One version is for 1/32" and 360 micron ferrules, and the other version is for 1/16" and 1/8" ferrules.





WHICH ADAPTER FOR WHICH COLUMN?			
Column	Typical	1/32"	1/16"
ID		adapter	adapter
	OD		
< 0.20 mm	0.25 mm	FS.25	FS1.25
0.25 mm	0.4 mm	FS.4	FS1.4
0.32 mm	0.5 mm	FS.5	FS1.5
0.53 mm	0.8 mm	ZF.5V	FS1.8

#### OPTIONS

Other sizes may be available in some materials. Contact Tech Support for availability.

### TEMPERATURE RATINGS

Polyimide adapters can be used at temperatures up to 350°C.

PEEK adapters are not recommended for use above 175°C.

#### **TECH TIP**

Virgin polyimide adapters are effective electrical insulators, making them the ideal choice for capillary electrophoresis.

Virgin polyimide is produced as Vespel®.

#### **TECH TIP**

If a fused silica tube breaks off in a throughtype union, remove the nuts and the tube opposite the broken one. Clear the fitting by passing a drill or wire of the appropriate diameter into the unbroken side and through the center of the fitting.

Our **ferrule removal kit**, left, can be used to remove ferrules from all types of fittings.

#### Removable fused silica adapters (FSR)

Package of 5:



The FSR adapter is the only adapter recommended for use in valves. It consists of a liner which slides over the fused silica tubing and a ferrule which makes up on the liner. The liner has an enlarged diameter at one end which is captured by the nut, so the liner and the tube within it are removed as the nut is unscrewed from the valve. The 1/16" FSR adapter includes a special counterbored 1/16" nut. The 1/32" FSR adapter uses a standard Valco 1/32" nut.

Polyimide, Valcon

_		Prod No	
1/22" -	emovable adapters	1100110	
1/32 10	Tubing OD:		
	< 0.25 mm	FSR.25-5	
	0.30 ≤ 0.35 mm	FSR.25-5 FSR.3-5	
	0.35 ≤ 0.40 mm	FSR.4-5	
	$0.40 \le 0.50 \text{ mm}$	FSR.5-5	
1/32" r	eplacement liners		
	Tubing OD:		
	< 0.25 mm	FSL.25-5	
	0.25 ≤ 0.40 mm	FSL.4-5	
	0.40 ≤ 0.50 mm	FSL.5-5	
Package	e of 5:	Polyimide, Valco	
		Prod No	Prod No
	and a control of a second and a second		
1/16" r	emovable adapters		
1/16" r	Tubing OD:		
1/16" r	•	_	FS1R.15PK-5
1/16" r	Tubing OD:	— FS1R.2-5	
1/16" r	Tubing OD: < 0.15 mm	— FS1R.2-5 FS1R.4-5	
1/16" r	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm	FS1R.4-5	FS1R.2PK-5 FS1R.4PK-5
1/16" r	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm 0.40 ≤ 0.50 mm	FS1R.4-5 FS1R.5-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5
1/16" r	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5
1/16" r	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm 0.40 ≤ 0.50 mm	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5
	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5
	Tubing OD: < 0.15 mm < 0.20 mm 0.20 ≤ 0.40 mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm $0.90 \le 1.0$ mm	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5
	Tubing OD: < 0.15 mm < 0.20 mm $0.20 \le 0.40$ mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm $0.90 \le 1.0$ mm eplacement liners	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5
	Tubing OD: < 0.15 mm < 0.20 mm $0.20 \le 0.40$ mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm $0.90 \le 1.0$ mm eplacement liners Tubing OD:	FS1R.4-5 FS1R.5-5 FS1R.8-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5 FS1R1.0PK-5
	Tubing OD: < 0.15 mm < 0.20 mm $0.20 \le 0.40$ mm $0.40 \le 0.50$ mm $0.50 \le 0.80$ mm $0.90 \le 1.0$ mm eplacement liners Tubing OD: < 0.15 mm	FS1R.4-5 FS1R.5-5 FS1R.8-5 FS1R1.0-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5 FS1R1.0PK-5
	Tubing OD:  < 0.15 mm  < 0.20 mm  0.20 ≤ 0.40 mm  0.40 ≤ 0.50 mm  0.50 ≤ 0.80 mm  0.90 ≤ 1.0 mm  eplacement liners  Tubing OD:  < 0.15 mm  < 0.20 mm	FS1R.4-5 FS1R.5-5 FS1R.8-5 FS1R1.0-5	FS1R.2PK-5 FS1R.4PK-5 FS1R.5PK-5 FS1R.8PK-5 FS1R1.0PK-5 FS1L.15PK-5 FS1L.2PK-5

 $0.90 \le 1.0 \text{ mm}$ 

#### MORE INFORMATION

Fused silica Unions .... pages 19,61 Fittings....16-21, 58-61 A pin vise and drill index are useful for enlarging the inner diameters of the FS adapters. Pin vise and

drill index ..... 55

#### **CONVERSIONS**

 $150 \, \mu m = .006$ "  $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040"

 $100 \, \mu m = .004$ "

1.5 mm = .060" 2.0 mm = .080"

4.6 mm = .180"  $6.0 \, \text{mm} = .236$ "  $6.4 \, \text{mm} = .253$ "

7.0 mm = .275"

 $10.0 \, \text{mm} = .400$ " 27.0 mm = 1.08"

 $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm $1/8" = 3.2 \, \text{mm}$ 

1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm

1/2" = 12.7 mm

#### **REPLACEMENT PARTS Ferrules**

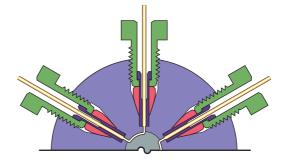
(package of 5) 1/32" Polyimide ZF.5V-5 1/16" Polyimide ZF1V-5 (package of 10)

ZF1PK-10

Nuts

1/16" PEEK

(package of 10) 1/32" SS ZN.5-10 Special nuts for FSRs: 1/16" SS ZCN1-10 1/16" SS long LZCN1-10



FS1L1.0-5

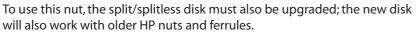
Removable FSR adapters in a valve

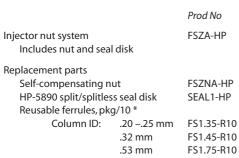
FS1L1.0PK-5

#### Injector nut for Agilent 6850, 6890, 7820, 7890, and 5890, Series I and II

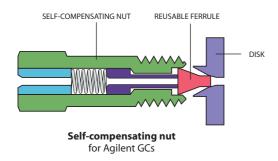
This self-compensating nut is a direct replacement for the standard nut on the split/splitless injectors of the Agilent GCs listed above. This retrofit offers enhanced ferrule reusability and temperature stability, resulting in fingertight leak-free connections over the full programmed temperature range of mass spectrometry and gas chromatography.

The design of our fused silica fittings ensures stable, leak-free connections at temperatures up to 400°C, and undistorted ferrules that are easily removed and reused. Columns may be changed without the risk of the leaks which can devastate systems such as mass spectrometers or atomic emission detectors. This is accomplished with a spring-loaded self-compensating nut which provides a constant sealing force as the temperature varies.





<sup>\*</sup>These reusable ferrules seal at the tip, and are different from standard ferrules.



#### **Replacement ferrules**

for injector nuts, above

These reusable ferrules seal at the tip, and are different from standard ferrules. For use with FSZNA-HP nuts above.

Package of 10	:	Prod No
Column ID:	.20 –.25 mm	FS1.35-R10
	.32 mm	FS1.45-R10
	.53 mm	FS1.75-R10





#### **CONVERSIONS**

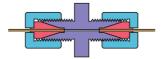
 $100 \, \mu m = .004$ "  $150 \, \mu m = .006$ " 0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" $4.6 \, \text{mm} = .180''$ 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1.6 mm 1/16" =  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm



#### 1/32" Ultra low mass external unions

The 1/32" external union is specially designed for use with capillary columns in GC. It has very low mass and does not require wrenches to seal. Use only with one-piece fused silica adapters, since metal ferrules will distort the detail. Order fused silica adapters separately, below.

Bore	Prod No
0.25 mm	EU.5
0.50 mm	EU.5L
1/32"	EU.5T



1/32" external union for use with capillary columns in GC

#### 1/32" One piece fused silica adapters (FS)

The 1/32" one piece FS adapter is recommended for use in 1/32" ultra low mass external unions, and for use in fittings where the polyimide ferrule will not be removed. Connections are made and disconnected by loosening the fitting nut and sliding the tube out.

Fused silica adapters are available in Valcon polyimide for use up to 350°C and in PEEK for lower temperature applications (up to 175°C). Valcon polyimide is a unique graphite-reinforced composite, specially prepared to maximize mechanical stability at high temperatures. Small blocks are subjected to extreme loads by a process known as hot isostatic pressing, with individual ferrules subsequently machined from these blocks. The result of this two-step process is a fused silica adapter with high temperature stability which far exceeds that of parts produced by conventional molding.

Note that the determining factor in adapter size selection is the fused silica tubing's outer diameter, or OD. Typical ODs for common columns are included in the product number tables.

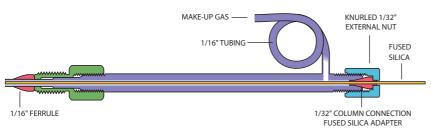
Package of 5:	Polyimide, Valcon	PEEK	Polyimide, Virgin
	Prod No	Prod No	Prod No
Tubing OD:			
< 0.20 mm	FS.2-5	FS.2PK-5	_
$0.20 \le 0.25 \text{ mm}$	FS.25-5	FS.25PK-5	FS.25V1-5
$0.25 \le 0.36  \text{mm}$	FS.36-5	FS.36PK-5	_
0.36 ≤ 0.40 mm	FS.4-5	FS.4PK-5	FS.4V1-5
$0.40 \le 0.50 \text{ mm}$	FS.5-5	FS.5PK-5	FS.5V1-5
0.50 ≤ 0.80 mm	ZF.5V-5	ZF.5PK-5	ZF.5V1-5

#### Fused silica make-up adapters

The fused silica make-up adapter connects a fused silica capillary column to a valve or detector while adding a make-up gas. In the reverse mode it works like a splitter, without the uneven or erratic split seen with basic tees. Two lengths are available. Order 1/32" fused silica adapter ferrules separately (see box on facing page).

Description	Length	Bore	Prod No
1/16" to 1/32"	1.5" 1.5" 1.5"	0.5 mm 0.75 mm 1.0 mm	FSMUAS1.5M FSMUAS1.5 FSMUAS1.5L
	3.5"	0.75 mm	FSMUA1.5





Fused silica make-up adapter (FSMUA1.5)

#### **CONVERSIONS**

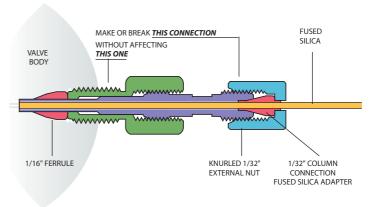
 $100 \, \mu m = .004"$  $150 \, \mu \text{m} = .006$ " 0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm



#### Internal to external reducer/adapters

Internal fittings provide the smallest possible fitting volume. But there are situations, such as when you're using graphite ferrules which tend to become lodged in internal details, when an external fitting might be more desirable. A typical situation of that nature is the connection of a fused silica capillary to a valve. Our unique design permits the 1/32" nut to be tightened or loosened without affecting the 1/16" connection. Order 1/32" fused silica adapter ferrules separately (see box below).

Description	Bore	Prod No
1/16" to 1/32"	0.25 mm	IZERA1.5C
	0.5 mm	IZERA1.5M
	1.0 mm	IZFRA15



Internal to external FS adapter (IZERA1.5) shown installed in a valve

#### **CAUTION**

Polymeric ferrules are strongly recommended for 1/16" and 1/32" external details. Metal ferrules may distort the fitting.

#### **MORE INFORMATION**

1/32" fused silica adapter ferrules...... page 19

## **1/32" FUSED SILICA FERRULES** (package of 5)

Tubing OD:

	≤ 0.25 mm	FS.25-5
0.25 mm	≤ 0.4 mm	FS.4-5
0.4 mm	≤ 0.5 mm	FS.5-5
0.5 mm	≤ 0.8 mm	ZF.5V-5

Micro-unions, -tees, -crosses, and -Y's have a unique twopiece design which allows us to provide an extremely small bore in a conventional ferrule and nut fitting. The actual connection area is separated from the nut threads, with the ferrule detail in a metal or polymer insert and the threads machined into a stainless steel or polymer ring. Since the insert has a much smaller diameter than a standard one-piece fitting, it can be drilled with much shorter tools; and, since a shorter drill has less tendency to wander or break, holes as small as .006" (0.15 mm) can be machined with the same high degree of concentricity found in all Valco fittings.

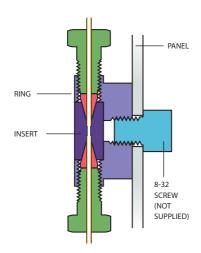
Valco microvolume fittings make it possible to couple 100 micron ID capillary GC, HPLC, or CZE columns without special nuts and ferrules.

A stainless ring with one of the plastic inserts provides electrical insulation within the insert, while the PEEK ring achieves total isolation.

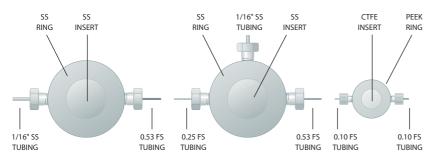
The ring containing the threads is made from PEEK or stainless steel. Inserts are made of stainless steel, Hastelloy C, Titanium, PEEK, or CTFE. PEEK rings are not as robust as stainless steel, and are not usable above 75°C. The stainless steel ring with a metal insert can operate at up to 10,000 psi (liquid) for HPLC or SFC.

All standard Valco zero dead volume reducing ferrules (ZRF, FS, and FSR) will work in these fittings. They are uniquely designed to fill the void between the fitting pilot and the smaller tubing OD, eliminating any dead volume in the fitting. (Reducing ferrules such as Valco's RF series should be avoided, since they leave dead volume.)





#### Panel mounting



Stainless to fused silica union 1/16" fittings

Make-up adapter 1/16" fittings

**CZE** union 1/32" fittings

#### **MORE INFORMATION**

FS fused silica adapters..... page 16 FSR fused silica adapters.....17 ZRF internal reducing ferrules ..... 14 Ferrules Metal.....12 Polymeric ......13

**CONVERSIONS**  $100 \, \mu m = .004$ "  $150 \, \mu m = .006$ " 0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" $4.6 \, \text{mm} = .180''$ 6.0 mm = .236" 6.4 mm = .253"  $7.0 \, \text{mm} = .275$ " 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" 1.6 mm

1/8"

1/4"

3/8"

1/2"

 $= 3.2 \, \text{mm}$ 

 $= 12.7 \, \text{mm}$ 

6.4 mm

9.5 mm

#### 1/32" Microvolume connectors

Includes ring, nuts, and ferrules. With metal inserts: ferrules are the same material as the insert, and ring and nuts are stainless steel. With polymer inserts: ferrules are the same material as the insert, and ring and nuts are PEEK.

Insert Material:	Stainless steel	Hastelloy C	Titanium	PEEK	CTFE
	Prod No	Prod No	Prod No	Prod No	Prod No
0.15 mm bore					
Union	MU.5XCS6	MU.5XCHC	MU.5XCTI	MU.5XCPK	MU.5XCKF
Tee	MT.5XCS6	MT.5XCHC	MT.5XCTI	MT.5XCPK	MT.5XCKF
Υ	MY.5XCS6	MY.5XCHC	MY.5XCTI	MY.5XCPK	MY.5XCKF
Cross	MX.5XCS6	MX.5XCHC	MX.5XCTI	MX.5XCPK	MX.5XCKF
0.25 mm bore					
Union	MU.5CS6	MU.5CHC	MU.5CTI	MU.5CPK	MU.5CKF
Tee	MT.5CS6	MT.5CHC	MT.5CTI	MT.5CPK	MT.5CKF
Υ	MY.5CS6	MY.5CHC	MY.5CTI	MY.5CPK	MY.5CKF
Cross	MX.5CS6	MX.5CHC	MX.5CTI	MX.5CPK	MX.5CKF

#### 1/16" Microvolume connectors

Includes ring, nuts, and ferrules. With metal inserts: ferrules are the same material as the insert, and ring and nuts are stainless steel. With polymer inserts: ferrules are the same material as the insert, and ring and nuts are PEEK.

Insert Materia	ıl: Stainl	ess steel Ha	stelloy C	Гitanium	PEEK	CTFE
	Pr	od No	Prod No	Prod No	Prod No	Prod No
0.15 mm bore	•					
Unio	n M	U1XCS6	MU1XCHC	MU1XCTI	MU1XCPK	MU1XCKF
Tee	M	T1XCS6	MT1XCHC	MT1XCTI	MT1XCPK	MT1XCKF
Υ	M	Y1XCS6	MY1XCHC	MY1XCTI	MY1XCPK	MY1XCKF
Cros	s M	X1XCS6	MX1XCHC	MX1XCTI	MX1XCPK	MX1XCKF
0.25 mm bore	!					
Unio	n M	U1CS6	MU1CHC	MU1CTI	MU1CPK	MU1CKF
Tee	M	T1CS6	MT1CHC	MT1CTI	MT1CPK	MT1CKF
Υ	M	Y1CS6	MY1CHC	MY1CTI	MY1CPK	MY1CKF
Cros	s M	X1CS6	MX1CHC	MX1CTI	MX1CPK	MX1CKF

#### **Replacement components**

Description	1/32" connectors Prod No	1/16" connectors
SS ring for union, tee, or cross	MRX.5S6	MRX1S6
SS ring for Y	MRY.5S6	MRY1S6
PEEK ring for union, tee, or cross	MRX.5PK	MRX1PK
PEEK ring for Y	MRY.5PK	MRY1PK
Nuts for SS ring	ZN.5	ZN1
Nuts for PEEK ring	ZN.5FPK	ZN1FPK

Inserts for any connector:

To order an insert, add an "I" after the "M" in the product number.

For example, to order an insert for a 1/16" microvolume union MU1CS6, order part number MIU1CS6.

#### **OPTIONS**

0.50, 0.75, and 1.0 mm bores are available in most materials and configurations.

## NANOBORE CONNECTIONS

For 0.10 mm (100  $\mu$ m) bore fittings, see pages 57-61.

Unions join two pieces of tubing of the same OD. Select the union with the bore that matches the ID of the tubing. If the IDs are different, choose the union with a bore which matches the smaller tube bore. Standard material is 300 series stainless steel.

- Internal unions have female threads and a fitting detail for zero volume fittings. The nuts have male (external) threads.
- External unions have male threads, requiring a nut with internal threads.
- External/internal unions have male threads on one end and female threads on the other, for connecting a standard zero dead volume fitting to an existing tube which already has an external nut made up on it.

Internal fittings are almost always the best with tubing of 1/8" OD or smaller. They make a stronger connection and offer the lower volume necessary for high performance instrumentation. Also, because 1/16" external fittings have very thin, easily distorted walls, they are not as durable as 1/16" internal fittings. In sizes larger than 1/8", external fittings are generally easier to make up because of less thread friction.

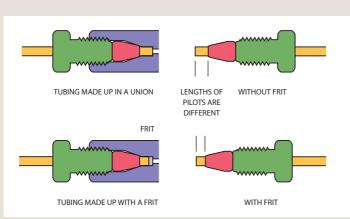


**Bulkhead** versions can be mounted through an instrument panel or on a bracket. The fitting body is undercut so that it bites into the panel when the mounting nut is tightened, eliminating the need for a lock washer. An O-ring can be installed between the body and the panel to allow operation in purged environments. Typically the mounting nut goes inside the instrument, so that the long threaded portion will be out of sight. In the external/internal bulkhead unions, the mounting nut is on the side with the Valco internal fitting.

#### **TECH TIP**

Filtering capability can be added to a union by inserting a screen or frit into it before making up the fittings. However, when a fitting detail has a screen or frit in it, the pilot depth is reduced, so that the ferrule makes up closer to the tube end than it otherwise would. If that tube is used in any other Valco fitting, it will introduce unswept volume. Our filter design takes this into account, allowing our fittings to remain truly interchangeable.

Filters ...... pages 48-52 Frits and screens......53



#### CONVERSIONS

 $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" $4.6 \, \text{mm} = .180''$ 6.0 mm = .236"  $6.4 \, \text{mm} = .253$ "  $7.0 \, \text{mm} = .275$ " 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm 1/8"  $= 3.2 \, \text{mm}$ 

 $= 6.4 \, \text{mm}$ 

 $= 9.5 \, \text{mm}$ 

= 12.7 mm

1/4"

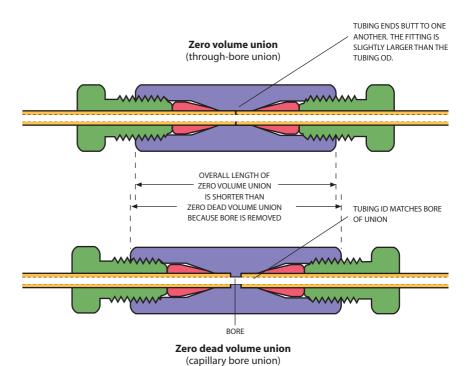
3/8"

1/2"

#### Zero Volume vs. Zero Dead Volume

A true zero volume fitting is one in which no part of the fitting actually becomes a part of the flow path. The only Valco fittings which fit this description are our through-bore unions, which allow tubing to butt end-to-end. (So these are only zero volume if the tube ends are perfectly square.)

All other fittings are designed with zero *dead* volume: that is, there is no volume introduced by the fitting which is not cleanly swept.



## TECH TIP Through-bore Union Installation

Because the tubing will pass all the way through a through-bore union, we suggest making up the first tube in a standard Valco fitting to establish the proper length of tubing extending beyond the ferrule. Install this made-up connection in the through-bore union; then the second tube can be butted against it for a zero volume connection.

#### **MORE INFORMATION**

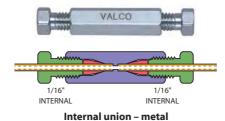
Reducing unions to connect two tubes with different ODs....p 28-31 Unions with 1/4-28 fittings....72-73

#### Internal unions - stainless steel

Standard material is 300 series stainless. Also available in Hastelloy C, gold-plated stainless, and titanium.

#### Standard internal unions

Tubing		
OD	Bore	Prod No
1/32"	0.15 mm 0.25 mm 0.50 mm 1/32"	ZU.5XC ZU.5 ZU.5L ZU.5T
1/16"	0.15 mm 0.25 mm 0.50 mm	ZU1XC ZU1C ZU1M
	0.75 mm 1.0 mm 1/16"	ZU1 ZU1L ZU1T
1/8"	0.75 mm 2.0 mm 1/8"	ZU2 ZU2L ZU2T
1/4"	0.75 mm 4.6 mm 1/4"	ZU4 ZU4L ZU4T



## Standard bore version (ZU1) Ends of tubing seat squarely at bottoms of fitting details

#### **Bulkhead internal unions**

Tubing OD	Bore	Prod No	Bulkhead panel hole diameter
1/32"	0.15 mm	ZBU.5XC	5/16"
	0.25 mm	ZBU.5	5/16"
	0.50 mm	ZBU.5L	5/16"
	1/32"	ZBU.5T	5/16"
1/16"	0.15 mm	ZBU1XC	5/16"
	0.25 mm	ZBU1C	5/16"
	0.50 mm	ZBU1M	5/16"
	0.75 mm	ZBU1	5/16"
	1.0 mm	ZBU1L	5/16"
	1/16"	ZBU1T	5/16"
1/8"	0.75 mm	ZBU2	7/16"
	2.0 mm	ZBU2L	7/16"
	1/8"	ZBU2T	7/16"
1/4"	0.75 mm	ZBU4	5/8"
	4.6 mm	ZBU4L	5/8"
	1/4"	ZBU4T	5/8"



Bulkhead internal union – metal (ZBU1)

#### MORE INFORMATION

Internal unions, high pressure PEEK . . p 57,65

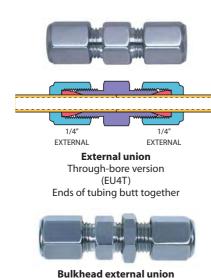
### For special materials and/or smaller bores:

Microvolume connectors offer a complete range of 1/32" and 1/16" unions in various metals and polymers, with bore sizes ranging from .006" (0.15 mm) to .040" (1.0 mm). Refer to pages 22-23.

#### **CONVERSIONS**

0.25 mm 0.50 mm 0.75 mm	= .020"
1.0 mm 1.5 mm 2.0 mm	= .060"
4.6 mm 6.0 mm 6.4 mm	= .236"
7.0 mm 10.0 mm	= .400"
27.0 mm	
1/32" = 1/16" = 1/8" =	1.6 mm
1/4" = 3/8" = 1/2" =	9.5 mm
5/16" = .312	" = 7.9 mm

3/8" = .375" = 9.5 mm 7/16" = .437" = 11.1 mm



#### **External unions**

Standard material is 300 series stainless. Also available in Hastelloy C and gold-plated stainless.

*Note:* Because 1/16" external fittings have very thin, easily distorted walls, they are not as durable as 1/16" internal fittings. We recommend the use of external/internal unions (below) when connecting to an installed external nut.

Tubing	Bore	Standard	Bulkhead	Bulkhead panel
OD		Prod No	Prod No	hole diameter
1/16"	See note abov	e		
1/8"	1.0 mm	EU2	—	—
	2.0 mm	EU2L	EBU2L	5/16"
	1/8"	EU2T	EBU2T	5/16"
1/4"	2.0 mm	EU4	EBU4	7/16"
	4.6 mm	EU4L	EBU4L	7/16"
	1/4"	EU4T	EBU4T	7/16"

## 1/32" 1/32" EXTERNAL EXTERNAL

(EBU2L)

## **1/32" external union** (EU.5) For use with GC capillary columns

#### External unions - 1/32" ultra low mass

The 1/32" external union is specially designed for use with capillary columns in GC. It is very low mass and does not require wrenches to seal. Use *only* with one-piece fused silica adapters, since metal ferrules will distort the detail. Order fused silica adapters separately (*page 16*). Standard material is 300 series stainless.

Bore	Prod No
0.25 mm	EU.5
0.50 mm	EU.5L
1/22"	FII 5T

# 1/16" 1/16" EXTERNAL INTERNAL

## External/internal union Standard bore (EZU1)

Adapts existing external fittings to Valco zero volume internal fittings

#### **External/internal unions**

Standard material is 300 series stainless. Also available in Hastelloy C and gold-plated stainless.

Tubing	Bore	Standard	Bulkhead	Bulkhead panel
OD		Prod No	Prod No	hole diameter
1/32"	0.25 mm	EZU.5	_	_
	0.50 mm	EZU.5L	_	_
1/16"	0.25 mm	EZU1C	EZBU1C	5/16"
	0.50 mm	EZU1M	EZBU1M	5/16"
	0.75 mm	EZU1	EZBU1	5/16"
	1/16"	EZU1T	EZBU1T	5/16"
1/8"	1.0 mm	EZU2	EZBU2	7/16"
	2.0 mm	EZU2L	EZBU2L	7/16"
	1/8"	EZU2T	EZBU2T	7/16"



Bulkhead external/internal union (EZBU1)

#### **TECH TIP**

1/16", 1/8", and 1/4" external Valco fitting components are compatible with Parker and Swagelok fittings.

Reducing unions join two tubes of different outside diameters. Standard material is 300 series stainless.

- Internal reducing unions have female threads and a fitting detail for zero volume fittings. The nuts have male (external) threads.
- External reducing unions have male threads, requiring a nut with internal threads.
- External/internal and internal/ external reducing unions have male threads on one end and female threads on the other. We recommend the use of external/ internal fittings when connecting to an existing external nut.

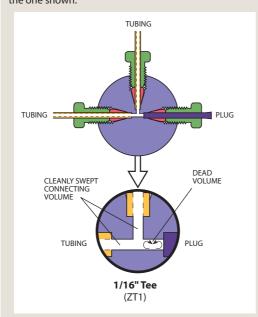
Internal fittings are almost always the best with tubing of 1/8" OD or smaller. They make a stronger connection and offer the lower volume necessary for high performance instrumentation. Also, because 1/16" external fittings have very thin, easily distorted walls, they are not as durable as 1/16" internal fittings. In sizes larger than 1/8", external fittings are generally easier to make up because of less thread friction.

**Bulkhead** versions can be mounted through an instrument panel or on a bracket. The fitting body is undercut so that it bites into the panel when the mounting nut is tightened, eliminating the need for a lock washer. An O-ring can be installed between the body and the panel to allow operation in purged environments. Typically the mounting nut goes inside the instrument, so that the long threaded portion will be out of sight. In the external/internal bulkhead unions. the mounting nut is on the side with the Valco internal fitting.



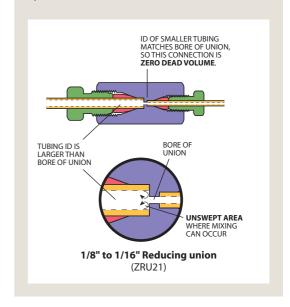
#### **DEAD VOLUME**

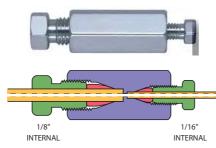
"Dead volume" is created in obvious situations such as the one shown.



#### **UNSWEPT VOLUME**

Even in connections which are by most definitions "zero dead volume", unswept volume may be created where large ID transitions occur. The amount of mixing depends on the amount of mismatch in the IDs.





Internal reducing union - metal Standard bore (ZRU21)

#### Internal reducing unions - stainless steel

These unions connect two sizes of tubing, using zero dead volume internal fittings on each end. In the bulkhead version, the bulkhead nut is on the side with smaller tubing.

Standard material is 300 series stainless. Also available in Hastelloy C, gold-plated stainless, and titanium.

#### Standard internal reducing unions

Tubing OD	Bore	Prod No
1/16" to 1/32"	0.15 mm 0.25 mm 0.50 mm 1/32"	ZRU1.5XC ZRU1.5 ZRU1.5L ZRU1.5T
1/8" to 1/32"	0.25 mm 0.50 mm 1/32"	ZRU2.5 ZRU2.5L ZRU2.5T
1/8" to 1/16"	0.25 mm 0.75 mm 1/16"	ZRU21C ZRU21 ZRU21T
1/4" to 1/16"	0.25 mm 0.75 mm 1/16"	ZRU41C ZRU41 ZRU41T
1/4" to 1/8"	0.75 mm 2.0 mm 1/8"	ZRU42 ZRU42L ZRU42T

#### **Bulkhead internal reducing unions**

			<b>Bulkhead panel</b>
Tubing OD	Bore	Prod No	hole diameter
1/16" to 1/32"	0.25 mm 0.50 mm 1/32"	ZBRU1.5 ZBRU1.5L ZBRU1.5T	5/16" 5/16" 5/16"
1/8" to 1/32"	0.25 mm 0.50 mm 1/32"	ZBRU2.5 ZBRU2.5L ZBRU2.5T	5/16" 5/16" 5/16"
1/8" to 1/16"	0.25 mm 0.75 mm 1/16"	ZBRU21C ZBRU21 ZBRU21T	5/16" 5/16" 5/16"
1/4" to 1/16"	0.25 mm 0.75 mm 1/16"	ZBRU41C ZBRU41 ZBRU41T	7/16" 7/16" 7/16"
1/4" to 1/8"	0.75 mm 2.0 mm 1/8"	ZBRU42 ZBRU42L ZBRU42T	7/16" 7/16" 7/16"



Bulkhead internal reducing union - metal (ZBRU21)

#### **MORE INFORMATION**

Internal reducing unions, high pressure PEEK ..... pages 57,65 External/internal reducing unions . . . . 31 Internal/external reducing unions . . . . 31 Standard unions....24-27 Unions with 1/4-28 fittings ....72-73

#### **CONVERSIONS**

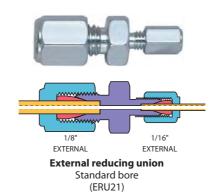
 $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180"  $6.0 \, \text{mm} = .236$ " 6.4 mm = .253" 7.0 mm = .275"  $10.0 \, \text{mm} = .400$ " 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" =  $1.6 \, \text{mm}$ 1/8" = 3.2 mm 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm

#### **External reducing unions**

These unions connect two sizes of tubing, using external fittings on each end. Standard material is 300 series stainless. Custom bulkhead versions are available in OEM quantities.

#### Standard external reducing unions

Tubing OD	Bore	Prod No
1/8" to 1/16"	0.75 mm 1.00 mm 1/16"	ERU21 ERU21L ERU21T
1/4" to 1/16"	0.75 mm 1/16"	ERU41 ERU41T
1/4" to 1/8"	0.75 mm 2.0 mm 1/8"	ERU42 ERU42L ERU42T



#### **Bulkhead external reducing unions**

T. /		2 (1)	Bulkhead panel
Tubing OD	Bore	Prod No	hole diameter
1/8" to 1/16"	1.0 mm 1/16"	EBRU12L6 EBRU12T	5/16" 5/16"
1/4" to 1/16"	1.0 mm 1/16"	EBRU14L EBRU14T	7/16" 7/16"
1/4" to 1/8"	2.0 mm	EBRU24L	7/16"



Bulkhead external reducing union (EBRU12L)

#### **TECH TIP**

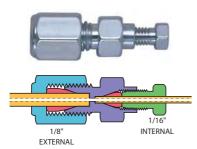
1/16", 1/8", and 1/4" external Valco fitting components are compatible with Parker and Swagelok fittings.

#### **TECHTIP**

**Note:** Because 1/16" external fittings have very thin, easily distorted walls, they are not as durable as 1/16" internal fittings. We recommend the use of 1/16" internal fittings when possible.

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" 4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm 5/16" = .312" = 7.9 mm 3/8" = .375" = 9.5 mm 7/16" = .437" = 11.1 mm



#### **External/internal reducing union**Standard bore

(EZRU21)



Bulkhead external/internal reducing union (EZBRU21)

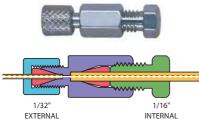
#### **External/internal reducing unions**

In these reducing unions, the larger size tubing is made up with an external fitting and the smaller size tubing is made up with an internal fitting. In the bulkhead version, the bulkhead nut is on the side with the internal fitting. Other configurations, such as an external nut on the locking nut side, are available on special request.

Standard material is 300 series stainless. Also available in Hastelloy C, gold-plated stainless, and titanium.

D. Illehaad

Tubing OD	Bore	Standard Prod No	<b>Bulkhead</b> <i>Prod No</i>	Bulkhead panel hole diameter
1/16" to 1/32	0.25 mm 0.50 mm 1/32"	EZRU1.5 EZRU1.5L EZRU1.5T	EZBRU1.5L EZBRU1.5T	 5/16" 5/16"
1/8" to 1/32"	0.25 mm	EZRU2.5	—	
	0.50 mm	EZRU2.5L	EZBRU2.5L	5/16"
	1/32"	EZRU2.5T	EZBRU2.5T	5/16"
1/8" to 1/16"	0.25 mm	EZRU21C	—	—
	0.75 mm	EZRU21	EZBRU21	5/16"
	1/16"	EZRU21T	EZBRU21T	5/16"
1/4" to 1/16"	0.25 mm	EZRU41C	—	—
	0.75 mm	EZRU41	EZBRU41	7/16"
	1/16"	EZRU41T	EZBRU41T	7/16"
1/4" to 1/8"	1.0 mm	EZRU42	EZBRU42	7/16"
	2.0 mm	EZRU42L	EZBRU42L	7/16"
	1/8"	EZRU42T	EZBRU42T	7/16"



Internal/external reducing union Standard bore (EZRU.51)

#### Internal/external reducing unions

These reducing unions are the opposite of the ones above. The larger size tubing is made up with an internal fitting and the smaller size tubing is made up with an external fitting. In the bulkhead version, the bulkhead nut is on the side with the internal fitting. Standard material is 300 series stainless.

Internal/external reducing unions are typically used to connect 1/16" stainless steel tubing to fused silica tubing.

These unions include a stainless steel ferrule for the 1/16" SS tube, but because of the variety of fused silica ODs and corresponding ferrules, a 1/32" fused silica adapter must be ordered separately. (See page 16.) Only polymeric or soft metal ferrules should be used with 1/32" external details.

Tubing OD	Bore	Standard Prod No	<b>Bulkhead</b> <i>Prod No</i>	panel hole hole diameter
1/16" to 1/32"	0.25 mm	EZRU.51	EZBRU.51	5/16"
	0.50 mm	EZRU.51L	EZBRU.51L	5/16"
	1/32"	EZRU.51T	EZBRU.51T	5/16"



Bulkhead internal/external reducing union (EZBRU.51)

#### **TECH TIP**

1/16", 1/8", and 1/4" external Valco fitting components are compatible with Parker and Swagelok fittings.

#### **MORE INFORMATION**

Fused silica adapters.... page 16-17 Polymeric ferrules .... 13 External unions..... 27 Internal reducing unions ..... 29 Internal unions ..... 29 Internal unions ..... 26

#### **Tees**

Tees connect three lines. Standard material is 300 series stainless. Also available in Hastelloy C, gold-plated stainless, and titanium.

Tubing OD	Bore	Prod No
1/32"	0.25 mm 0.50 mm	ZT.5 ZT.5L
1/16"	0.25 mm 0.50 mm 0.75 mm 1.00 mm	ZT1C ZT1M ZT1 ZT1L
1/8"	0.75 mm 2.00 mm	ZT2 ZT2L
1/4"	1.00 mm 4.60 mm	ZT4 ZT4L



#### **Crosses**

Crosses connect four lines. Standard material is 300 series stainless. Also available in Hastelloy C, gold-plated stainless, and titanium.

Tubing OD	Bore	Prod No
1/32"	0.25 mm 0.50 mm	ZX.5 ZX.5L
1/16"	0.25 mm 0.50 mm 0.75 mm 1.00 mm	ZX1C ZX1M ZX1 ZX1L
1/8"	0.75 mm 2.00 mm	ZX2 ZX2L
1/4"	1.00 mm 4.60 mm	ZX4 ZX4L



## SURFACE MOUNTING TEES AND CROSSES

1/8" and 1/4" tees and crosses have two threaded mounting holes (8-32). For 1/32" and 1/16", order mounting kit below. Mounting kit includes:

Standard bracket SABB Clamp ring CR4 Screws and nuts.

Mounting kit .... DVBRKIT

Some configurations are available with two through holes. Consult factory.

#### SPECIAL METALS AND/OR SMALLER BORES

See microvolume connectors: 1/32" and 1/16" tees, crosses, Y's, and unions in various metals and polymers, with smaller bores.

Microvolume connectors . .

connectors ....pp 22-23 High pressure PEEK connectors...62-66

Nanovolume

connectors .....57-61

#### TECH TIP

To join tubes of different ODs, use the fitting sized for the largest tube along with IZR reducers for the smaller tubes.

IZR reducer..... page 38

#### **MORE INFORMATION**

PEEK tees.... pages 57, 64 PEEK crosses ......57, 64





#### 1/16" Manifolds

1/16" manifolds connect 4 - 16 inlet lines to a single outlet, and are often used to connect the outlets from several columns to a single detector. The unique angled entry of our design reduces dispersion to a minimum. Available with 1.00 mm inlet/outlet bore. Standard materials are PEEK or 300 series stainless.

	Inlet bore	Outlet bore	Material	Prod No
4 inlets	0.25 mm	0.75 mm	Stainless steel	Z4M1
	0.25 mm	0.75 mm	PEEK	Z4M1PK
6 inlets	0.25 mm	0.75 mm	Stainless steel	Z6M1
	0.25 mm	0.75 mm	PEEK	Z6M1PK
8 inlets	0.25 mm	0.75 mm	Stainless steel	Z8M1
	0.25 mm	0.75 mm	PEEK	Z8M1PK
10 inlets	0.25 mm	0.75 mm	Stainless steel	Z10M1
	0.25 mm	0.75 mm	PEEK	Z10M1PK
12 inlets	0.25 mm	0.75 mm	Stainless steel	Z12M1
	0.25 mm	0.75 mm	PEEK	Z12M1PK
14 inlets	0.25 mm	0.75 mm	Stainless steel	Z14M1
	0.25 mm	0.75 mm	PEEK	Z14M1PK
16 inlets	0.25 mm	0.75 mm	PEEK	Z16M1PK

#### 1/8" Manifolds

1/8" manifolds connect 4 - 12 inlet lines to a single outlet, and are typically used in a gas distribution system to minimize the number of fitting connections. A manifold pipe fitting version is also available. (*See page 34*.) Standard material is 300 series stainless steel.

	Inlet bore	Outlet bore	Prod No
4 inlets	2.00 mm	2.00 mm	Z4M2
6 inlets	2.00 mm	2.00 mm	Z6M2
8 inlets	2.00 mm	2.00 mm	Z8M2
10 inlets	2.00 mm	2.00 mm	Z10M2
12 inlets	2.00 mm	2.00 mm	Z12M2



## SURFACE MOUNTING MANIFOLDS

Mounting kit DVBRKIT

#### **TECH TIP**

A manifold used with an SD flowpath multiposition valve allows HPLC column selection with a single valve. See page 141 for an illustration.

SD UW valves... page 134

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"

1.5 mm = .060" 2.0 mm = .080"

4.6 mm = .180" 6.0 mm = .236"

6.4 mm = .253" 7.0 mm = .275"

10.0 mm = .400" 27.0 mm = 1.08"

1/32" = 0.8 mm 1/16" = 1.6 mm 1/8" = 3.2 mm

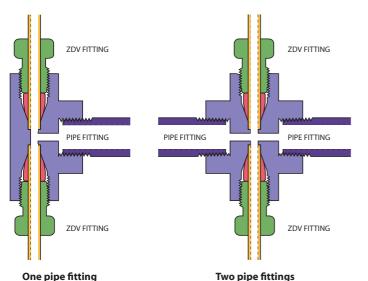
1/4" = 6.4 mm 3/8" = 9.5 mm

1/2" = 12.7 mm

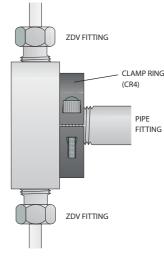
#### Manifold pipe adapters

These manifolds, which go from one or two pipe fittings to three or more Valco zero dead volume fittings, minimize the number of connections between a regulator and the various carrier gas lines in a chromatographic system. The models with two pipe fittings go a step further, allowing the support of a gauge, a second regulator, or a valve leading to a separate system. Additional Valco zero dead volume fittings can be machined on a special order basis. Standard material is 300 series stainless. Also available in Hastelloy C and titanium by special order.

Bore	Prod No				
1.0 mm 2.0 mm 4.6 mm	FP1Z3M21 FP1Z3M22 FP1Z3M24				
1.0 mm	FP1Z3M41				
2.0 mm	FP1Z3M42				
4.6 mm	FP1Z3M44				
Two 1/8" female pipe to:					
1.0 mm	FP2Z3M21				
2.0 mm	FP2Z3M22				
4.6 mm	FP2Z3M24				
Two 1/4" female pipe to:					
1.0 mm	FP2Z3M41				
2.0 mm	FP2Z3M42				
4.6 mm	FP2Z3M44				
	1.0 mm 2.0 mm 4.6 mm 1.0 mm 2.0 mm 4.6 mm 1.0 mm 2.0 mm 4.6 mm				



to Valco ZDV fittings



Adapter with optional mounting clamp ring



#### SURFACE MOUNTING **MANIFOLDS**

**DVBRKIT** Mounting kit

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020"

0.75 mm = .030"

1.0 mm = .040" 1.5 mm = .060"

2.0 mm = .080"4.6 mm = .180"

6.0 mm = .236"

6.4 mm = .253" 7.0 mm = .275"

10.0 mm = .400" 27.0 mm = 1.08"

 $1/32" = 0.8 \, \text{mm}$ 

1/16" = 1.6 mm 1/8" = 3.2 mm

1/4" = 6.4 mm 3/8"  $= 9.5 \, \text{mm}$ 

1/2" = 12.7 mm

to Valco ZDV fittings



# Male pipe to Valco internal adapters

Male pipe adapters make a minimum volume connection from the female pipe fittings on pressure gauges and regulators to Valco zero dead volume internal fittings. Standard material is 300 series stainless. Also available in Hastelloy C and titanium.

Description	on	Bore	Prod No
1/8" NPT	male to:		
	1/16" ZDV fitting	1.0 mm	PZA21
	1/16" ZDV fitting	1/16"	PZA21T
	1/8" ZDV fitting	1.0 mm	PZA22
1/4" NPT	male to:		
	1/16" ZDV fitting	1.0 mm	PZA41
	1/8" ZDV fitting	1.0 mm	PZA42
	1/8" ZDV fitting	2.0 mm	PZA42L
	1/4" ZDV fitting	4.6 mm	PZA44L
1/2" NPT	male to:		
	1/16" ZDV fitting	1.0 mm	PZA81
	1/8" ZDV fitting	1.0 mm	PZA82
	1/8" ZDV fitting	2.0 mm	PZA82L
	1/4" ZDV fitting	4.6 mm	PZA84L

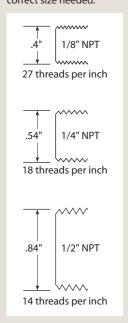
# Female pipe to Valco internal adapters

Female pipe adapters make a minimum volume connection from the male pipe fittings typically found in gas distribution plumbing to Valco zero dead volume internal fittings. Standard material is 300 series stainless. Also available in Hastelloy C and titanium.

	Description		Bore	Prod No
	1/8" NPT female to	0:		
	1/16" ZI	DV fitting	1.0 mm	FPZA21
	1/8" ZD	V fitting	1.0 mm	FPZA22
	1/8" ZD	V fitting	2.0 mm	FPZA22L
	1/4" NPT female to	0:		
	1/16" ZI	DV fitting	1.0 mm	FPZA41
	1/8" ZD	V fitting	1.0 mm	FPZA42
	1/8" ZD	V fitting	2.0 mm	FPZA42L
	1/4" ZD	V fitting	4.6 mm	FPZA44L
	1/2" NPT female to	0:		
	1/16" ZI	DV fitting	1.0 mm	FPZA81
	1/8" ZD	V fitting	1.0 mm	FPZA82
	1/8" ZD	V fitting	2.0 mm	FPZA82L
	1/4" ZD	V fitting	4.6 mm	FPZA84L
V				
	VALC	0		
	-			

#### **TECH TIP**

NPT, National Pipe Thread, is a standard developed a long time ago by people without rulers. 1/8" NPT is nowhere close to 1/8"! Measure the diameter of the fitting across the narrow end. You can also count the number of threads in a 1" section. Then look at the diagrams below to determine the correct size needed.



#### **MORE INFORMATION**

Pipe to Valco external adapters..... page 36

#### Male pipe to Valco external adapters

Male pipe adapters make a minimum volume connection from the female pipe fittings typically found on pressure gauges and regulators to Valco external fittings. Standard material is 300 series stainless.

*Note:* We do not manufacture adapters with 1/16" external fittings because they have very thin, easily distorted walls. We recommend use of the PZAs on the previous page.

Description	Bore	Prod No
1/8" NPT male to:	2.0	DEAGO
1/8" external fitting	2.0 mm	PEA22
1/4" external fitting	4.6 mm	PEA24
1/4" NPT male to:		
1/8" external fitting	2.0 mm	PEA42
1/4" external fitting	4.6 mm	PEA44
1/2" NPT male to:		
1/8" external fitting	2.0 mm	PEA82
1/4" external fitting	4.6 mm	PEA84



# Female pipe to Valco external adapters

Female pipe adapters make a minimum volume connection from the male pipe fittings typically found in gas distribution plumbing to Valco external fittings. Standard material is 300 series stainless.

*Note:* We do not manufacture adapters with 1/16" external fittings because they have very thin, easily distorted walls. We recommend use of the FPZAs on the previous page.

Description		Bore	Prod No	
1/8" NPT female to 1/8" exte	: ernal fitting	2.0 mm	FPEA22	
1/4" exte	ernal fitting	4.6 mm	FPEA24	
1/4" NPT female to	:			
	ernal fitting	2.0 mm	FPEA42	
1/4" exte	ernal fitting	4.6 mm	FPEA44	
1/2" NPT female to	:			
1/8" exte	ernal fitting	2.0 mm	FPEA82	
1/4" exte	ernal fitting	4.6 mm	FPEA84	

#### **TECH TIP**

Because of their dead volume and the risk of thread leaks, pipe fittings are a poor choice for trace gas analysis. Thread sealants, particularly PTFE tape, cannot boost their performance to adequate levels. For trace gas applications, choose Valco zero dead volume fittings with gold-plated stainless ferrules. (See page 12.)

#### MORE INFORMATION

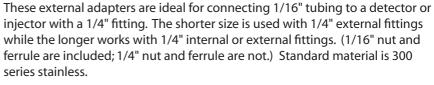
Our manifold pipe adapters on page 34 allow you to connect one or two pipe fittings to three Valco zero dead volume fittings.

Pipe to Valco internal adapters..... page 35

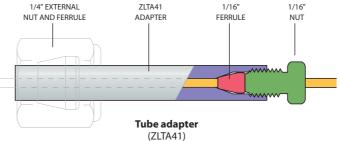
#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm

# **Tube adapters**







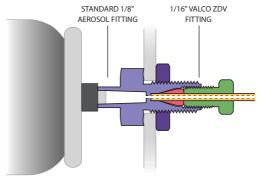


# Aerosol adapter bulkhead union

This unique fitting provides an easy, direct method of connecting the nozzle of a standard aerosol can to a 1/16" Valco zero dead volume fitting.

As with all Valco bulkhead fittings, the flange is undercut to act as a "lock nut" against the instrument wall. Standard material is 300 series stainless.

DescriptionProd NoAerosol adapter bulkhead unionZBAA1



Aerosol adapter bulkhead union (ZBAA1)

#### Internal reducers **NEW**

for 360 µm tubing

Directly connect 360  $\mu$ m tubing into a 1/16" or 1/32" Valco valve or fitting detail, providing a positive leak-free seal with zero dead volume. These are the same design as our larger internal reducers (*illustration below*). All versions have a stainless steel body, with 360  $\mu$ m nut/ferrule material as indicated.

Tubing OD	Nut/ferrule material	For use with	Prod No
1/32" to 360 μm	Stainless/stainless	Metal tubing	C360IZR.5TS6
	PEEK/ GF* PEEK	PEEK tubing	C360IZR.5TS6PK
	SS/gold-plated nickel	Fused silica	C360IZR.5TS6FS
1/16" to 360 μm	Stainless/stainless	Metal tubing	C360IZR1S6
	PEEK/GF* PEEK	PEEK tubing	C360IZR1S6PK
	SS/aluminum	Fused silica	C360IZR1S6AL
	SS/gold-plated nickel	Fused silica	C360IZR1S6FS

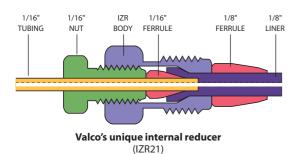


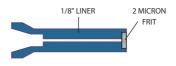
#### Internal reducers

Valco's internal reducer (IZR) allows smaller tubing to be used in valves with fitting details for larger tubing, forming a positive leak-free seal with zero dead volume. The small line from your system goes directly into the IZR and the sample goes directly into the valve, without the short pieces of connecting tubing required if a reducing union was used instead. (A reducing ferrule would also work, but makes a seal of less integrity.) Once the fitting is installed, only one wrench is required to remove and reinstall it.

A second version has a 2 micron stainless steel frit pressed into the end of the liner, adding filtering capability. However, we suggest using these only as a final or backup filter, with a standard filter (see pages 48-52) as the primary filter. Because IZRs have a much smaller surface area than the standard filter, they tend to plug too often if used in a stand-alone capacity.

Tubing OD	<b>W</b> Bore	Ithout frit Prod No	With 2µ frit Prod No
1/16" to 1/32"	0.25 mm	IZR1.5	IZR1.5F
	0.50 mm	IZR1.5L	IZR1.5LF
	1/32"	IZR1.5T	—
1/8" to 1/16"	0.25 mm	IZR21C	IZR21CF
	0.50 mm	IZR21	IZR21F
	1.00 mm	IZR21L	IZR21LF
	1/16"	IZR21T	—
1/4" to 1/16"	1.00 mm	IZR41	IZR41F
1/4" to 1/8"	1.00 mm	IZR42	IZR42F
1/4" to 1/8"	2.00 mm	IZR42L	IZR42LF





IZR liner with pressed-in frit

# 360 MICRON FITTINGS

See our extensive line of 360 µm fittings . .pp 57-58

# CONVERSIONS

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" 4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08" 1/32" = 0.8 mm

1/16" =

1/8"

1/4"

3/8"

1.6 mm

 $= 3.2 \, \text{mm}$ 

 $= 6.4 \, \text{mm}$ 

 $= 9.5 \, \text{mm}$ 

1/2" = 12.7 mm

<sup>\*</sup> glass-filled

# **External to internal reducer**

**NEW** 

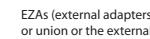
for 360 µm tubing



Directly connect 360 µm tubing into a 1/32" Valco external union or the external type fittings common on injectors and detectors with a Valco zero dead volume connection.

Tubing OD	Nut/ferrule material	Bore	For use with	Prod No
1/32" to 360 µm	Stainless	150 µm	Metal tubing	C360EZR.5XC

**External to internal adapters (injector/detector adapters)** 



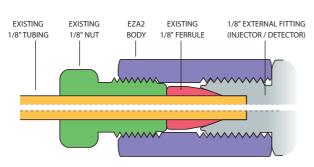
EZAs (external adapters) and EZRs (external reducers) adapt an external tee or union or the external type fittings common on injectors and detectors to Valco zero dead volume connections. Since EZAs are commonly used to connect an external fitting to an existing tube already made up with a Valco internal fitting, a nut and ferrule are not included.

Only one wrench is required to change tubes after the fitting is made up. While an external to internal union or reducing union plus a length of tubing can accomplish the same thing, these adapters do the trick with a single fitting.

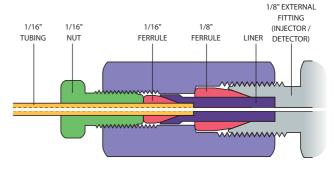
Standard material is 300 series stainless. The EZA does not include a nut or ferrule. The EZR includes a liner, one nut, and two ferrules.

	Description	Bore	Prod No
External to	internal adapters		
	1/16" ext. to 1/16" int.	_	EZA1
	1/8" ext. to 1/8" int.	_	EZA2
External re	ducers		
	1/16" ext. to 1/32" int.	0.25 mm 1/32"	EZR1.5 EZR1.5T
	1/8" ext. to 1/32" int.	0.25 mm	EZR2.5
	1/8" ext. to 1/16" int.	0.50 mm	EZR21
		1/16"	EZR21T
	1/4" ext. to 1/16" int.	1.00 mm	EZR41
		1/16"	EZR41T
	1/4" ext. to 1/8" int.	1.00 mm	EZR42
		1/8"	EZR42T





External to internal adapter (EZA2)



**External to internal reducer** (EZR21)

#### Zero dead volume fill ports

The ZVISF-1 is a unique fill port fitting designed so that a leaktight seal is formed against the face of the bottom of the fitting detail instead of at the end of an angular ferrule, resulting in a true zero dead volume connection with no carry over or sample loss. The polymer bushing snaps into the knurled PEEK nut, providing the convenience of a one-piece fitting. An ultrathin metal sleeve surrounds and supports the portion of the bushing which extends into the pilot of the fitting detail, preventing the bushing from mushrooming and getting stuck in the pilot as the fitting is tightened.

For use with 22 gauge blunt tip needle.

Description Prod No

# For high pressure 1/16" ZDV Cheminert injectors with polymeric stators

(C2, C3, C4, and C52 series)

Most applications PFA bushing ZVISF-1PFAH High throughput applications High density polyethylene bushing ZVISF-1PEH



Most applications PFA bushing ZVISF-1PFA High throughput applications High density polyethylene bushing ZVISF-1PE



#### Fill ports

#### for 1/16" polymeric Cheminert valves

These fill ports provide direct syringe connections to polymeric valves and fittings. Since the fitting detail in the high pressure Cheminert valve is unique, be sure to order the high pressure version for polymeric HPLC injectors. For use with 22 gauge blunt tip needle.

Description	Prod No	
For high pressure injectors (C2, C3, C4, and C52 series injectors)	C-VISF-1H	
For fittings and low pressure injectors (C22Z and C62Z series injectors)	C-VISF-1	
Replacement liners and ferrules		
Liner for C-VISF-1	VISL-1	
Liner for C-VISF-1H	VISL-1H	
Ferrule for C-VISF-1 (or 1H)	ZF1VISF	
For fittings and low pressure injectors (C22Z and C62Z series injectors)  Replacement liners and ferrules  Liner for C-VISF-1  Liner for C-VISF-1H	VISL-1 VISL-1H	

#### Fill ports

# for Valco and metal Cheminert valves

Fill ports provide direct syringe connections to valves and fittings, with the polymeric ferrule compressing a liner to seal around the needle. These fill ports are for use with metal valves.

Description	Prod No
For use with blunt tip needle For 1/32" fittings and injectors - 26 ga	VISF.5FPK
For 1/16" fittings and injectors - 22 ga	VISF-1
For use with 2" 22 gauge blunt tip needle	
For 1/16" fittings and injectors	VISF-2
For 1/8" fittings and injectors	VISF-A
Replacement liners and ferrules	
Liner for VISF-1	VISL-1
Liner for VISF-2 or VISF-A	VISL-2
Ferrule for VISF-1 or VISF-2	ZF1VISF



# Loop fill port assembly

for Cheminert C2 and C4 valves

The loop fill port assembly, for use with Cheminert high pressure valves (C2 and C4 series), permits sample loading and manual injection from the front of the valve. It includes an aluminum bracket, two syringe fill ports (for 3/4" or 2" needles), a bulkhead union, and two pieces of stainless tubing: one piece is 0.013" ID with a volume of 7  $\mu$ l, and the other is 0.50 mm ID and 17  $\mu$ l.

> Description Prod No Loop fill port assembly C-LFP

# Female luer adapters

Female luer adapters provide direct syringe connections to zero dead volume fittings and valves.

Description		Prod No
Female luer to:	1/32" fitting	ZLA5
	1/16" fitting	ZLA-1
	1/8" fitting	ZLA-2

# Septum injector nuts

Description

Septum injector nuts are a simple way to provide syringe access to any point of a gas or liquid system. The injector nut includes a Valcon T polyimide septum support which accepts a standard 1/4" GC septum. The nut's 1/8" external fitting detail can connect directly to common external type fittings, or can be adapted to Valco internal fittings using an external/internal union or reducing union.

Prod No

Septum injector no with support Replacement supp Septum, low bleed	EN2SI port ZF2SI	
<b>*</b>		— SYRINGE
		SEPTUM INJECTOR NUT  SEPTUM SEPTUM SUPPORT  1/8" EXTERNAL FITTING

Septum injector nut with septum and support (EN2SI)

# MORE INFORMATION

External/internal reducing unions . . pg 31 External/internal unions ......27

#### **Cheminert valves**

Model C2..... 160, 163 Model C4..... 161, 164

#### **CONVERSIONS**

 $0.25 \, \text{mm} = .010$ "

 $0.50 \, \text{mm} = .020$ "

0.75 mm = .030"

1.0 mm = .040" 1.5 mm = .060"

2.0 mm = .080"

4.6 mm = .180"

 $6.0 \, \text{mm} = .236$ "

6.4 mm = .253"

 $7.0 \, \text{mm} = .275$ "

 $10.0 \, \text{mm} = .400$ "

27.0 mm = 1.08"

 $1/32" = 0.8 \, \text{mm}$ 1.6 mm

1/8" = 3.2 mm

1/4"  $= 6.4 \, \text{mm}$ 

3/8" = 9.5 mm

1/2" = 12.7 mm

Although our column end fittings look like ordinary reducing unions, they are machined with a conical recess to match a specific column ID so that there are no abrupt or irregular diameter changes which can cause loss of theoretical plates. (See illustrations, below.) This optimization results in an assortment of column end fittings for each column OD. To receive full benefit of this design, use column end fittings only with the specific column ID for which they are intended. We can design special fittings for unusual sizes or OEM use.

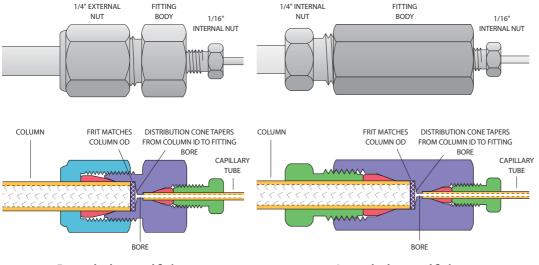
If a temporary frit is used during column packing, the frit OD should match the column OD. Permanent frits should have an OD matched to the column ID, and should be pressed in to give the lowest dead volume.

Our frits are available in a variety of pore sizes, and we offer titanium and Hastelloy C frits for systems sensitive to exposed stainless steel.

All column end fittings are rated to 10,000 psi. However, the functional limit is dictated by the yield strength of the tubing used with the fitting. Standard 1/4", 3/8", and 1/2" columns are usually packed at 8,000 -10,000 psi, which is right at the yield strength for the tubing commonly used. Columns with 1" ID have a yield strength of 6,000 - 8,000 psi, and the fitting will not hold if the system pressure exceeds that limit.

The newest addition to the line is the Nanovolume® column end fitting. (See page 61.) These all-PEEK fittings feature fingertight zero dead volume connections with 100 or 150 micron bore. PEEK sleeves permit use with any fused silica tubing.





**External column end fitting** 1/4" to 1/16", 4.6 mm column ID, with removable frit (ECEF414.6F)

Internal column end fitting 1/4" to 1/16", 4.6 mm column ID, with removable frit (CEF414.6F)

#### **TECH TIP**

Standard column end fittings are Type 316 stainless, but since the column wall and frit form over 99% of the column surface area, standard fittings with titanium frits can generally be used on inert columns.

#### **TECH TIP**

When packing columns, use Valco "through-type" unions to couple the column to the packing reservoir.

Prod No Size 1/16" union 7U1T 1/8" union **7U2T** 1/4" union ZU4T

Through-type unions for packing columns..... page 26

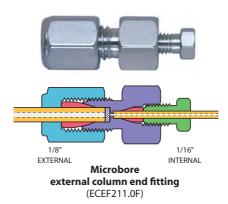
MORE INFORMATION Frits..... page 45

# Microbore column end fittings

(1.0 mm – 2.0 mm column ID)

Standard material is Type 316 stainless.

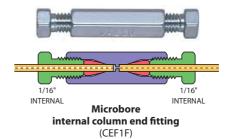
			Without frit	Removable 2µ frit
	Bore	Column ID	Prod No	Prod No
External column end fit	tings			
1/16" to 1/16"	0.25 mm	1.0 mm	ECEF111.0	ECEF111.0F
1/8" to 1/16"	0.25 mm	1.0 mm	ECEF211.0	ECEF211.0F



			Without frit	Removable 2µ frit			
	Bore	Column ID	Prod No	Prod No			
Internal column end fittings							
1/16" to 1/32"	0.25 mm	1.0 mm	CEF1.5	CEF1.5F			
1/16" to 1/16"	0.25 mm	1.0 mm	CEF1	CEF1F			
1/8" to 1/32"	0.25 mm	1.0 mm	CEF2.51.0	CEF2.51.0F			
1/8" to 1/16"	0.25 mm	1.0 mm	CEF211.0	CEF211.0F			

0.25 mm

1/8" to 1/16"



2.0 mm

CEF212.0

CEF212.0F

# NANOBORE COLUMN END FITTINGS

See our complete line of 100  $\mu$ m and 150  $\mu$ m bore fittings on page 61.

#### **CONVERSIONS**

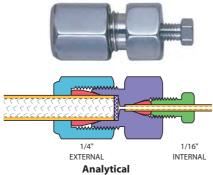
 $100 \, \mu m = .004$ "  $150 \, \mu m = .006$ "  $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180"  $6.0 \, \text{mm} = .236$ " 6.4 mm = .253" 7.0 mm = .275"  $10.0 \, \text{mm} = .400$ " 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" =  $1.6 \, \text{mm}$ 1/8" = 3.2 mm 1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm 1/2" = 12.7 mm

# **Analytical column end fittings**

(2.0 mm – 4.6 mm column ID)

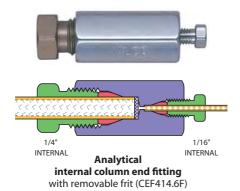
Standard material is Type 316 stainless.

			Without frit	Removable 2µ frit			
	Bore	Column ID	Prod No	Prod No			
External column end fittings							
1/4" to 1/16"	0.4 mm	2.1 mm	ECEF412.1	ECEF412.1F			
1/4" to 1/16"	0.4 mm	3.0 mm	ECEF413.0	ECEF413.0F			
1/4" to 1/16"	0.4 mm	4.0 mm	ECEF414.0	ECEF414.0F			
1/4" to 1/16"	0.4 mm	4.6 mm	ECEF414.6	ECEF414.6F			



external column end fitting with removable frit (ECEF414.6F)

			Without frit	Removable 2µ frit			
	Bore	Column ID	Prod No	Prod No			
Internal column end fittings							
1/4" to 1/16"	0.4 mm	2.1 mm	CEF412.1	CEF412.1F			
1/4" to 1/16"	0.4 mm	3.0 mm	CEF413.0	CEF413.0F			
1/4" to 1/16"	0.4 mm	4.0 mm	CEF414.0	CEF414.0F			
1/4" to 1/16"	0.4 mm	4.6 mm	CFF414 6	CFF414.6F			



# NANOBORE COLUMN END FITTINGS

See our complete line of 100 µm and 150 µm bore fittings on page 61.

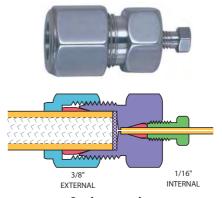
# CONVERSIONS

100 µm	= .004"
150 µm	= .006"
0.25 mm	= .010"
0.50 mm	= .020"
0.75 mm	= .030"
1.0 mm	= .040"
1.5 mm	= .060"
2.0 mm	= .080"
4.6 mm	= .180"
6.0 mm	= .236"
6.4 mm	= .253"
7.0 mm	= .275"
10.0 mm	= .400"
27.0 mm	= 1.08"
1/32" =	0.8 mm
1/16" =	1.6 mm
1/8" =	3.2 mm
1/4" =	6.4 mm
3/8" =	9.5 mm
1/2" =	12.7 mm

# Semi-preparative and preparative column end fittings

Standard material is Type 316 stainless.

			Without frit	Removable 2µ frit			
	Bore	Column ID	Prod No	Prod No			
External column end fittings							
3/8" to 1/16"	0.40 mm	6.0 mm	ECEF616.0	ECEF616.0F			
3/8" to 1/16"	0.40 mm	7.0 mm	ECEF617.0	ECEF617.0F			
1/2" to 1/16"	0.75 mm	9.0 mm	ECEF819.0	ECEF819.0F			
1/2" to 1/16"	0.75 mm	10.0 mm	ECEF8110.0	ECEF8110.0F			
1" to 1/16"	0.75 mm	20.0 mm	ECEF1K1	ECEF1K1F			



Semi-preparative external column end fitting (ECEF616.0F)



# **Replacement frits**

1/16", 1/8" and 1/4" frits are sold in packages of 10. 3/8", 1/2", and 1" frits are sold individually. Other sizes may be available or special-ordered in OEM quantities.

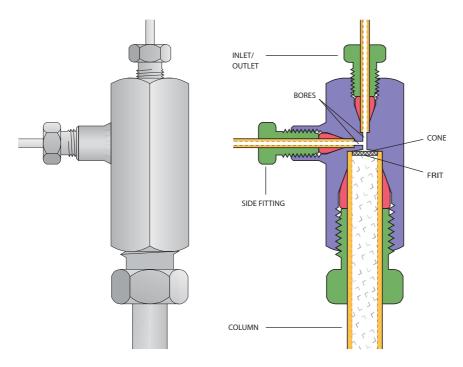
			Stainless steel	Hastelloy C	Titanium
	Pore	Frit	Prod No	Prod No	Prod No
Package of 10:	Size	thickness			
1/16" frits	0.5µ	0.75 mm	.5FR1-10	.5FR1HC-10	_
	2μ	0.75 mm	2FR1-10	2FR1HC-10	2FR1TI-10
	10μ	0.75 mm	10FR1-10	_	_
1/8" frits	0.5μ	1.00 mm	.5FR2-10	_	_
	2μ	1.00 mm	2FR2-10	2FR2HC-10	2FR2TI-10
	10µ	1.00 mm	10FR2-10	_	_
1/4" frits	0.5μ	1.00 mm	.5FR4-10	_	_
	2μ	1.00 mm	2FR4-10	2FR4HC-10	2FR4TI-10
	10µ	1.00 mm	10FR4-10	10FR4HC-10	_
Each: 3/8" frits	2μ	1.00 mm	2FR6	2FR6HC	2FR6TI
1/2" frits	2μ	1.00 mm	2FR8	2FR8HC	2FR8TI
1" frits	2µ	1.50 mm	2FR1K	2FR1KHC	2FR1KTI

# Post-column reaction tee fitting

The tee column end fitting (TCEF) has a third connection perpendicular to the normal flowpath. The TCEF permits post-column derivation, or may be used as a curtain flow column inlet fitting. Standard material is Type 316 stainless.

Column OD	Cone OD	Inlet/outlet OD	Bore	Side OD	Bore	Prod No
1/16"	1.0 mm	1/32"	0.25 mm	1/32"	0.25 mm	TCEF1.5.5C
1/16"	1.0 mm	1/32"	0.90 mm	1/32"	0.25 mm	TCEF1.5.5T
1/16"	1.0 mm	1/16"	0.25 mm	1/16"	0.25 mm	TCEF111
1/8"	1.0 mm	1/16"	0.75 mm	1/16"	0.75 mm	TCEF211
1/8"	1.0 mm	1/16"	1.65 mm	1/16"	0.40 mm	TCEF211T
1/4" 1/4" 1/4" 1/4"	4.6 mm 4.6 mm 4.6 mm	1/16" 1/16" 1/16" 1/8"	0.25 mm 0.75 mm 1.65 mm 0.75 mm	1/16" 1/16" 1/16" 1/16"	0.25 mm 0.75 mm 0.75 mm 0.75 mm	TCEF411C TCEF411 TCEF411T TCEF421
3/8"	6.0 mm	1/16"	0.75 mm	1/16"	0.75 mm	TCEF611
3/8"	6.0 mm	1/16"	1.65 mm	1/16"	0.75 mm	TCEF611T
1/2"	9.0 mm	1/16"	0.75 mm	1/16"	0.75 mm	TCEF811
1/2"	9.0 mm	1/16"	1.65 mm	1/16"	0.75 mm	TCEF811T





Post-column reaction fitting (TCEF411)

#### **TECH TIP**

Tee column end fittings (TCEFs) for 1/16" OD tubing/columns have a round profile. For other sizes, they are made of hexagonal bar stock.

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm $1/8" = 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm 1/2" = 12.7 mm



#### **Precolumns (guard columns)**

Precolumns are available in 2 cm and 5 cm lengths, and can be filled with either  $5\mu$  packing or 37 -  $44\mu$  pellicular packing. Both lengths are used in conjunction with a column end fitting. When packed for high efficiency they can be used as analytical columns, but a more typical use is as a guard column installed between the injector and the analytical column. Standard material is Type 316 stainless.

Description Prod No

1/4" x 2 cm precolumn system PCS412F

Includes:

One precolumn insert

One internal column end fitting

One 2µ frit

1/4" x 5 cm precolumn system PCS415F

Includes:

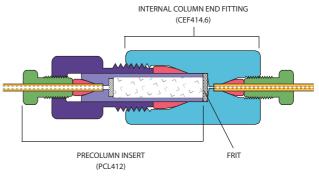
One precolumn insert

One external column end fitting

One 2µ frit

Precolumns (for use with existing column end fittings)

1/4" x 2 cm precolumn insert PCL412 1/4" x 5 cm precolumn insert PCL415



1/4" x 2 cm precolumn system (PCS412F)



# **Fingertight HPLC cartridge precolumns**

This cartridge-based system is designed for use as a precolumn or concentrator column in HPLC and FIA applications. It is particularly suited to applications requiring frequent changes; snap-on seals are replaceable, the cartridge is reusable, and the tubing connections are stable since the end fittings do not rotate as the assembly is tightened. Standard material is Type 316 stainless, with PEEK seals and  $2\mu$  titanium frits.

Description Prod No

0.25 ml (4.0 mm ID x 2 cm)

Fingertight cartridge assembly SFECH412
Replaceable cartridge SFEC42

#### NOTE

As a courtesy to our OEM customers, VICI does not supply pre-packed columns.

There are many flow elements of analytical instruments which require protection from foreign particles, such as orifices that may become plugged or surfaces that may get scratched. However, conventional filtering devices may have too large a volume to be consistent with good system performance – particularly in chromatographic applications.

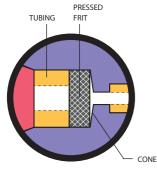
Valco's unique filter design results in extremely low internal volume and simplifies filter element replacement. Filter bodies are "coned" for uniform flow and maximum filter surface area. The filters are made entirely of metal, so they can be used at any instrumentation temperature. While the standard metal is 316 series stainless, filters can be made from alloys that can be used in virtually any application.

We offer a choice of three different filtering elements. All styles are available in bulkhead configurations for mounting on a panel or instrument wall. (Please note that since frits and screens have

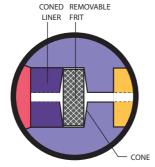
significantly different thicknesses, they cannot be used interchangeably in the same filter body.)

- Pressed frits, permanently installed in the filter, are recommended where contaminants are the exception and not the rule. The frits are 2µ stainless.
- Removable frits are the best choice for maximum filtration, or if the application requires Hastelloy C or titanium. However, they allow more mixing and tend to clog more than screens. A 2µ frit is included with the filter, but 0.5, 2, and 10u replacement frits are available in three materials.
- Removable screens plug less rapidly and provide lower pressure drop than frits. Since they are thinner, there is less mixing and dispersal than might occur with a frit, but frits provide better filtration. A 2µ screen is included with the filter, and 2 and 10u stainless replacement screens may be ordered.

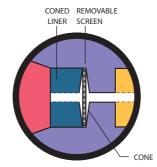








Removable frit



Removable screen

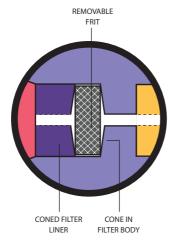
# MORE INFORMATION

Biocompatible filter . p 78 In-line filters for 1/4-28 fittings ...... 78 Mobile phase filters.....79-80

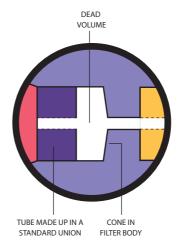
Filters with removable frits are designed to compensate for the thickness of the filter element - the resulting pilot depths are identical with the rest of the Valco product line, facilitating interchangeability of made up fittings. Therefore, although our filters look very much like our unions, they are not interchangeable with unions; a filter with its frit removed should not be substituted for a union, because the space

designed for the frit introduces dead volume into the system. In addition, since filter bodies are coned, they will have dead volume when used as a union even if the tubing is made up in the filter with a longer, nonstandard pilot length.

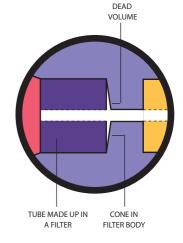
An arrow imprinted on all filter bodies serves to differentiate them from unions and to indicate recommended flow direction.



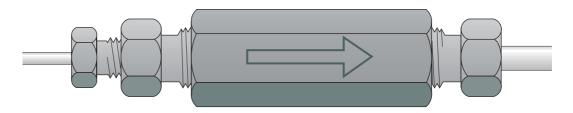
#### Filter with removable frit Coned for uniform flow and maximum filter surface



Filter with frit removed being used as a reducing union Dead volume is created where frit should be



Filter with frit removed being used as a reducing union Cone in filter body creates dead volume



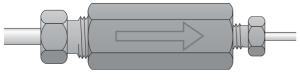
Arrow imprinted on filter body showing recommended direction of flow

#### Filters with a pressed frit

Pressed frit filters contain a permanently installed stainless steel  $2\mu$  frit, and are recommended for applications where contaminants are the exception and not the rule – that is, when the sample is generally clean but you wish to guard against the stray burr from a carelessly prepared tube end that might find its way into the flowpath. Standard material is Type 316 stainless.

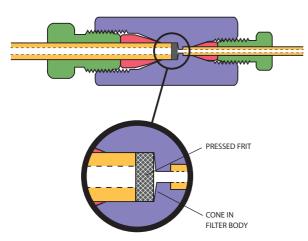
Description	Bore	<b>Standard</b> <i>Prod No</i>	Bulkhead Prod No
1/16" to 1/32"	0.25 mm	ZRUF1.5	ZBRUF1.5
1/16" to 1/16"	0.75 mm	ZUF1	ZBUF1
1/8" to 1/16"	0.75 mm	ZRUF21	ZBRUF21
1/8" to 1/8"	0.75 mm	ZUF2	ZBUF2
1/4" to 1/8"	2.00 mm	ZRUF42	ZBRUF42
1/4" to 1/4"	4.60 mm	ZUF4	ZBUF4





1/8" FITTING

1/16" FITTING



Reducing filter with a pressed frit 1/8" to 1/16" (ZRUF21)

# **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm  $3/8" = 9.5 \, \text{mm}$ 1/2" = 12.7 mm



#### Filters with a removable frit

These filters come with a removable  $2\mu$  frit. The standard frit can be replaced with any frit of the proper diameter, *but not by a screen*. These filters are suitable for streams with frequent contamination, since the filtering element is easily changed. Standard material is Type 316 series stainless.

		Standard	Bulkhead
Description	Bore	Prod No	Prod No
1/32" to 1/32"	0.25 mm	ZUFR.5F	ZBUFR.5F
1/16" to 1/32" 1/16" to 1/16"	0.25 mm 0.25 mm 0.50 mm	ZRUFR1.5F ZUFR1CF ZUFR1F	ZBRUFR1.5F ZBUFR1CF ZBUFR1F
1/8" to 1/16" 1/8" to 1/8"	0.75 mm 2.00 mm	ZRUFR21F ZUFR2F	ZBRUFR21F ZBUFR2F
1/4" to 1/16" 1/4" to 1/8"	1.00 mm 2.00 mm	ZRUFR41F ZRUFR42F	ZBRUFR41F ZBRUFR42F

#### TECH TIP Should you use a filter with a frit or one with a screen?

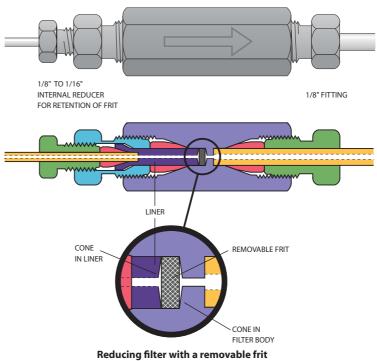
Screens have much higher flow capacity (Cv), but frits are the best choice for maximum filtration or if your application requires Hastelloy C or titanium. However, since they are thicker than screens, frits allow more mixing, and the downside of their superior filtration is that they clog more often than screens.

Note! The difference in thickness also means that frits and screens cannot be used interchangeably in the same fitting body:

A frit must always be replaced with a frit.

A screen must always be replaced with a screen.

Replacement frits ..... page 53



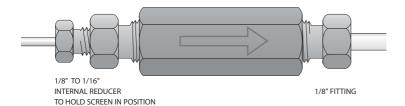
Reducing filter with a removable frit 1/8" to 1/16" (ZRUFR21F)

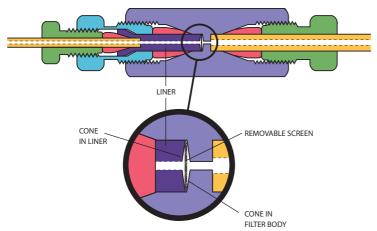
#### Filters with a removable screen

These filters come with a removable 2µ screen. The standard screen can be replaced with any screen of the proper diameter, but not by a frit. These filters are suitable for streams with frequent contamination, since the filtering element is easily changed. Standard material is Type 316 series stainless.

Description	Bore	<b>Standard</b> <i>Prod No</i>	<b>Bulkhead</b> <i>Prod No</i>
1/32" to 1/32"	0.25 mm	ZUFR.5	ZBUFR.5
1/16" to 1/32" 1/16" to 1/16"	0.25 mm 0.25 mm 0.50 mm	ZRUFR1.5 ZUFR1C ZUFR1	ZBRUFR1.5 ZBUFR1C ZBUFR1
1/8" to 1/16" 1/8" to 1/8"	0.75 mm 2.00 mm	ZRUFR21 ZUFR2	ZBRUFR21 ZBUFR2
1/4" to 1/16" 1/4" to 1/8"	1.00 mm 2.00 mm	ZRUFR41 ZRUFR42	ZBRUFR41 ZBRUFR42







Reducing filter with a removable screen 1/8" to 1/16" (ZRUFR21)

#### **TECH TIP** Should you use a filter with a frit or one with a screen?

Screens have much higher flow capacity (Cv), but frits are the best choice for maximum filtration or if your application requires Hastelloy C or titanium. However, since they are thicker than screens, frits allow more mixing, and the downside of their superior filtration is that they clog more often than screens.

Note! The difference in thickness also means that frits and screens cannot be used interchangeably in the same fitting body:

> A frit must always be replaced with a frit.

A screen must always be replaced with a screen.

Replacement screens..... page 53

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" 4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253"7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm 5/16" = .312" = 7.9 mm 3/8" = .375" = 9.5 mm 7/16" = .437" = 11.1 mm

**Stainless** 

# **Replacement frits**



Other sizes may be available or special ordered in OEM quantities. *Note:* If a filter was ordered with a removable frit, the frit *cannot* be replaced with a screen.

**Stainless** 

			Steel	Hastelloy C	Titanium
	Pore	Frit	Prod No	Prod No	Prod No
	Size	Thickness			
1/32" frits	0.2μ	0.25 mm	.2FR.5-5	_	_
	0.5µ	0.25 mm	.5FR.5-5	_	_
	2μ	0.25 mm	2FR.5-5	_	_
1/16" frits	0.5µ	0.75 mm	.5FR1-10	.5FR1HC-10	_
	2µ	0.75 mm	2FR1-10	2FR1HC-10	2FR1TI-10
	10µ	0.75 mm	10FR1-10	_	_
1/8" frits	0.5µ	1.00 mm	.5FR2-10	.5FR2HC-10	_
	1μ	1.00 mm	1FR2-10	1FR2HC-10	
	2µ	1.00 mm	2FR2-10	2FR2HC-10	2FR2TI-10
	10μ	1.00 mm	10FR2-10	_	_
1/4" frits	0.5µ	1.00 mm	.5FR4-10	_	_
	2µ	1.00 mm	2FR4-10	2FR4HC-10	2FR4TI-10
	10µ	1.00 mm	10FR4-10	10FR4HC-10	_
	1/16" frits 1/8" frits	Size	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Pore Size         Frit Thickness         Prod No           1/32" frits         0.2μ 0.25 mm 0.25 mm 0.5FR.5-5 0.5μ 0.25 mm 2FR.5-5         .5FR.5-5           2μ 0.25 mm 2FR.5-5         .2FR.5-5           1/16" frits         0.5μ 0.75 mm 2FR1-10 2μ 0.75 mm 10FR1-10           1/8" frits         0.5μ 0.75 mm 10FR1-10           1/8" frits         0.5μ 1.00 mm 1FR2-10 2μ 1.00 mm 2FR2-10 10μ 1.00 mm 10FR2-10           1/4" frits         0.5μ 1.00 mm 2FR2-10 1.00 mm 2FR2-10 1.00 mm 2FR4-10 2μ 1.00 mm 2FR4-10	Pore Size         Frit Thickness         Prod No         Prod No           1/32" frits         0.2μ 0.25 mm 5.FR.5-5         —           0.5μ 0.25 mm 2FR.5-5         —         —           1/16" frits         0.5μ 0.75 mm 2FR.5-5         —           1/16" frits         0.5μ 0.75 mm 2FR1-10 2FR1HC-10         2FR1HC-10           1μ 0.75 mm 10FR1-10         —           1/8" frits         0.5μ 1.00 mm 1FR2-10 5FR2HC-10           1μ 1.00 mm 1FR2-10 1FR2HC-10         2FR2HC-10           2μ 1.00 mm 10FR2-10 —         —           1/4" frits         0.5μ 1.00 mm 1.00 mm 2FR4-10 2FR4HC-10           2μ 1.00 mm 2FR4-10 2FR4HC-10         —

# WHICH FRIT FITS MY FILTER? 1/16" frit fits:

ZUFR.5F ZBUFR.5F

ZRUFR1.5F ZBRUFR1.5F

#### 1/8" frit fits:

ZUFR1CF ZBUFR1CF

ZUFR1F ZBUFR1F

ZRUFR21F ZBRUFR21F

#### 1/4" frit fits:

ZUFR2F ZBUFR2F

ZRUFR41F

ZBRUFR41F ZRUFR42F

ZBRUFR42F

# WHICH SCREEN FITS MY FILTER? 1/16" screen fits:

ZUFR.5 ZBUFR.5

ZRUFR1.5 ZBRUFR1.5

#### 1/8" screen fits:

ZUFR1C ZBUFR1C

ZUFR1 ZBUFR1

ZRUFR21 ZBRUFR21

# 1/4" screen fits:

ZUFR2 ZBUFR2

ZRUFR41 ZBRUFR41

ZRUFR42 ZBRUFR42

#### **Replacement screens**

Other sizes may be available or special ordered in OEM quantities.  $20\mu$  and  $75\mu$  screens are also available. *Note:* If a filter was ordered with a removable screen, the screen *cannot* be replaced with a frit.



			Jeanness
			Steel
Package	Pore	Screen	Prod No
of 10:	Size	Thickness	
1/32" screens	<1µ	0.040 mm	.5SR.5-10
	1μ	0.050 mm	1SR.5-10
	$2\mu$	0.075 mm	2SR.5-10
	10µ	0.125 mm	10SR.5-10
1/16" screens	<1µ	0.040 mm	.5SR1-10
	1μ	0.050 mm	1SR1-10
	$2\mu$	0.075 mm	2SR1-10
	10µ	0.125 mm	10SR1-10
1/8" screens	<1µ	0.040 mm	.5SR2-10
	1μ	0.050 mm	1SR2-10
	$2\mu$	0.075 mm	2SR2-10
	10μ	0.125 mm	10SR2-10
1/4" screens	<1µ	0.040 mm	.5SR4-10
	1μ	0.050 mm	1SR4-10
	2µ	0.075 mm	2SR4-10
	10µ	0.125 mm	10SR4-10

#### **TECH TIP**

Our screen materials are described in terms of *nominal* micron retention. For example, a screen with a 2  $\mu$  pore size will retain *most* particles 2  $\mu$  or larger, but the *absolute* retention will be of particles 7-8  $\mu$  in diamter or larger. This is true only of the smallest pore screens:

Pore size	Nominal retention	Absolute retention
<1µ	<1µ	5-6µ
1μ	1μ	6-7µ
2μ	2μ	7-8µ
10µ	10µ	11-13µ

#### **Custom socket wrenches**

These socket wrenches have a slot to slip over the tubing, making them especially useful when nuts are difficult to access with an open end wrench. The SWH4 works with all types of 1/4" hex nuts, such as Valco 1/16" ZDV fitting nuts. The SWH3 fits our 1/32" nuts.

Size	Prod N
3/16"	SWH3
1/4"	SWH4



#### Ferrule removal kits

Remove polymeric ferrules stuck in fitting details. One version is for 1/32" and 360 micron ferrules, and the other version is for 1/16" and 1/8" ferrules.



#### Hex key set

The hex key set has a wrench to fit any socket head screw on any VICI valve or actuator. Includes the following sizes: .050", 1/16", 5/64", 3/32", 7/64", 1/8", 9/64", and 5/32".



#### **TECH TIP**

If a fused silica tube breaks off in a throughtype union, remove the nuts and the tube opposite the broken one. Clear the fitting by passing a drill or wire of the appropriate diameter into the unbroken side and through the center of the fitting.

Our ferrule removal kit can be used to remove ferrules from tee and cross fittings.



# **Open end wrenches**

Size	For use with	Prod No
3/16" x 1/4" 3/8" x 7/16" 1/2" x 9/16"	1/32" and 1/16" nuts 1/8" nuts 1/4" nuts	OEW OEW-2 OEW-3



# Pin vise and drill index

The drill index has drills sized from 0.0135" to 0.039" (0.34 to 1 mm). These are useful tools when a fused silica tube breaks in a union (see Tech Tip on the facing page), and for enlarging the inner diameter of fused silica adapters.

Prod No PV

#### **Template**

This tool is just what you need when you're working out plumbing and valve switching schematics. It features templates for two position valves with 4, 6, 8, and 10 ports with indications of both positions, as well as various flow symbols. For added convenience, the sides are edged with metric and inch rulers.

Prod No TEMPLATE1



#### Mirror

Helpful to get access to valve serial numbers and to check discharge on pulsed discharge detectors (PDD).



# **MORE INFORMATION**

Tools for valves
Pencil magnet ... p 210
Valve spanner
handle.......211
Tightening tools
for PEEK fittings.....67
Tubing accessories .90,92

# Cheminert® fittings

Cheminert fittings are available for high and low pressure applications, and are ideally suited for applications requiring an inert, biocompatible, metal-free flowpath. Wetted materials are PFA, FEP, CTFE, or PEEK, and uniform flow passages minimize mixing. All connections have zero dead volume.

# High pressure fittings

Cheminert high pressure fittings are rated at 5000 psi with fingertight nuts, well beyond the burst strength of most PEEK tubing. These fittings are machined from high quality inert polymers to the same exacting tolerances as our popular Valco zero dead volume fittings, and the taper angle and detail design conform to the industry standard established by the Valco line.

# High pressure Nanovolume® fittings

VICI Nanovolume® fittings generally have bore sizes of 100-150  $\mu m$  (.004" - .006"), with some as small as 50  $\mu m$  (.002"). The minimal transfer volume contributed by Nanovolume® components makes them especially beneficial in applications with flow rates in the  $\mu l/min$  range, when the transfer volume can be critical.

# 360 Micron Nanovolume® Fittings

Our newest high pressure fittings permit direct connection of 360 micron OD fused silica, PEEK, stainless, or electroformed nickel tubing without the use of liners. The ferrule snaps into the nut so that the fitting is "one-piece", but the ferrule remains free to rotate as the nut is tightened so that the tube doesn't twist. Because of the compact size and fine 2-56 threads, a leak-free connection that seals at pressures in excess of 20,000 psi can be easily formed with the available manual tool.

# 1/32" Nanovolume® Fittings

1/32" fittings, with 50 - 150  $\mu$ m bore, are ideal for high resolution capillary chromatography. Rated at 5,000 psi with fingertight nuts, they will remain leak-tight well beyond the burst strength of most PEEK tubing. These fittings are machined from high quality inert polymers to the same exacting tolerances as our popular Valco zero dead volume fittings, and the taper angle and detail design conform to the industry standard established by the Valco line.

#### **TECH TIP**

For optimal zero dead volume connections, make sure your tubing meets the best industry standards. OD tolerance should be nominal dimension ± .002".

Fractional dimension	Nominal dimension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500

#### **MORE INFORMATION**

#### **CONVERSIONS**

10,000 psi = 689.5 bar20,000 psi = 1,378.9 bar





- For direct connection of 360 µm tubing
- Work with metal, fused silica, or PEEK
- Up to 20,000 psi (liquid) with metal or fused silica tubing
- Snap-in rotating ferrule for "one-piece" fitting with no tubing twist
- Eliminate use of liners

Our new high pressure fittings permit direct connection of 360 micron OD fused silica, PEEK, stainless, or electroformed nickel tubing without the use of liners. The ferrule snaps into the nut so that the fitting is "one-piece", but the ferrule remains free to rotate as the nut is tightened so that the tube doesn't twist. Because of the compact size and fine 2-56 threads, a leak-free connection that seals at pressures in excess of 20,000 psi can be easily formed with the available

manual tool. 360 µm fittings are dedicated for use with either fused silica, metal, or PEEK tubing; components cannot be mixed or used with a different tubing material.

Tees and crosses offer a choice of three bore sizes, and feature a "quickmount" base with adhesive backing to make sure that the fitting is stable and fragile tubing doesn't get broken. There is also a quick-mount PEEK union.

# For PEEK or fused silica tubing — up to 10,000 psi liq\*

These fittings are constructed from premium grade natural PEEK material. They are intended for use with PEEK or fused silica tubing at pressures up to 10,000 psi, or the maximum pressure for which the tubing is rated, whichever is lower. Quick-mount versions have an integral base with double stick tape to secure fittings to a surface.

\*or burst pressure of tubing

#### **DIRECT CONNECTIONS** TO 1/32" AND 1/16"

Valco 360 micron reducers directly connect 360 µm tubing to 1/16" or 1/32" Valco valve or fitting details, providing a positive leakfree seal with zero dead volume.

Internal fittings...pg 38



#### **MORE INFORMATION**

Nanovolume® fittings For fused silica tubing, 10,000+ psi liq . . pg 58 For metal tubing, up to 20,000 psi liq . 58 1/32" Nanovolume® fittings .....59-61 Injectors with 360 micron fittings...154

#### **CONVERSIONS** 50 µm

 $100 \, \mu m = .004$ "  $150 \, \mu m = .006$ "  $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030""

= .002"

 $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm

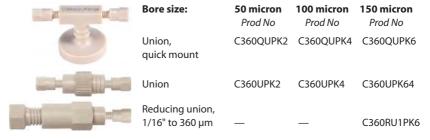
# Nut/ferrules, caps, plugs, tightening tool

for 360 µm tubing

		Prod No
The state of the s	Nut/ferrule	C360NFPK
	Cap	C360CPK
	Plug	C360PPK
	Tightening tool	C360ET

#### Unions and reducing unions

for 360 µm tubing



#### Tees and crosses

for 360 µm tubing



Bore size:	<b>50 micron</b> <i>Prod No</i>	<b>100 micron</b> <i>Prod No</i>	150 micron Prod No
Tee, quick mount	C360QTPK2	C360QTPK4	C360QTPK6
Cross, quick mount	C360QXPK2	C360QXPK4	C360QXPK6

# For fused silica tubing — 10,000 psi liq and above\*

These fittings are constructed from HPLC grade stainless steel, with a stainless steel nut and a special ferrule which is precision machined from electroformed nickel. For optimal sealing characteristics, the ferrule is gold plated.

\*or burst pressure of tubing

#### **Nut/ferrules and caps**

for 360 µm FS tubing

Prod No

Nut/ferrule C360NFFS

Cap C360CFS

#### Unions and reducing unions

for 360 µm FS tubing

	Bore size:	<b>50 micron</b> <i>Prod No</i>	100 micron Prod No	150 micron Prod No
	Union	C360UFS2	C360UFS4	C360UFS6
====	Reducing unions, 1/32" to 360 µm	C360RU.5FS2	C360RU.5FS4	C360RU.5FS6
	Reducing union, 1/16" to 360 µm	_	_	C360RU1FS6

# For metal tubing — up to 40,000 psi liq\*\*

Our highest pressure Nanovolume® fittings are constructed of HPLC grade stainless steel, including stainless steel nut and ferrule. These fittings are optimized for use with stainless or electroformed nickel tubing.

Prod No

\*\*or burst pressure of tubing. Higher pressures may be possible with smaller IDs. Consult factory.

#### **Nut/ferrules and caps**

for 360 µm tubing



Nut/ferrule C360NFS6

Cap C360C

# **Unions and reducing unions** for 360 μm tubing



#### NOTE

For metal 360 µm tees and crosses, contact the factory.

#### DIRECT CONNECTIONS TO 1/32" AND 1/16"

Valco 360 micron reducers directly connect 360 µm tubing to 1/16" or 1/32" Valco valve or fitting details, providing a positive leakfree seal with zero dead volume.

Internal fittings . . . . p 38 External fittings . . . . . 39



#### **TECH TIP**

Use these **metal 360 micron nuts** with nano injectors:

injectors:

C72MU .....p 154

C72MX ......154

#### **MORE INFORMATION**

360 µm Nanovolume® fittings for use below 10,000 psi liq. . 57 360 µm tubing Electroformed nickel. 87

#### CONVERSIONS

50 µm = .002" 100 µm = .004" 150 µm = .006" 1/32" = 0.8 mm 1/16" = 1.6 mm



Designed for high resolution capillary HPLC, Cheminert Nanovolume® connectors include our one-piece 1/32" fingertight fittings, with a patented\* collapsible ferrule that makes fingertight nanovolume connections a snap. These fittings work with a variety of tubing,

including PEEK, fused silica, and 1/32" electroformed nickel. Liners adapt the fittings for use with fused silica.

To avoid potential confusion, all fittings utilizing the Cheminert collapsible ferrule are made of black PEEK; fittings with a standard Valco ZDV fitting detail are natural PEEK.

#### Nuts, ferrules, and plugs

for 1/32" tubing

Valves and fittings are supplied with the appropriate quantity of nuts and ferrules. However, if additional fittings are required, they may be ordered separately. The two internal nuts include collapsible ferrules as an integral part of the fitting; the external nut must be used with the separate ferrule listed below.

Internal nut with collapsible ferrule

C-NNFFPK

For use with: Fittings on pages 59-61 **External nut** 

C-EN.5FPKB

ZGF.5PK

C-NPFPK

Prod No

For use with: Unions on page 60

Column end fittings on page 61

Note: Requires collapsible PEEK ferrule, below

**Collapsible PEEK ferrule** For use with: External nut, above

Internal plug

For use with: Fittings on page 59-60

#### **TECH TIP**

Our liners adapt Nanovolume® tees, Y's, and crosses for use with fused silica tubing. They must be ordered separately.

Liners ..... page 60

MORE INFORMATION

360 µm fittings . .pp 57-58 1/32" Nanovolume® column end fittings..61 Tubing PEEK ......90 Electroformed nickel.....87 Unions for fused silica

tubing......60

**Unions** 

for 1/32" tubing

Union for 1/32" PEEK or

100 µm bore 150 µm bore Prod No Prod No C-NEU.5XFPK C-NEU.5FPK

electroformed nickel tubing

Does not require or include liners.

#### **Reducing unions**

1/16" to 1/32" tubing



150 µm bore Prod No

Reducing union, 1/16" to 1/32" tubing C-NERU1FPK

for 1/32" tubing or FS\* tubing

# Tees, y's, and crosses

100 um bore 150 um bore

Prod No Prod No C-NTXFPK C-NTFPK Tee 1/32" tubing or fused silica\* 1/32" tubing or fused silica\* C-NYXFPK C-NYFPK Cross 1/32" tubing or fused silica\* C-NXFPK C-NXXFPK

> \*A liner is needed for use with fused silica. Order 27 mm length, page 60.



#### **TECH TIP**

Use our internal nuts with collapsible ferrules for old style Cheminert CN2 and CN4 valves.

C-NNFFPK

C-NNFLFPK

For use with: 10 port valve CN2-4340

For use with: 6 port valve CN2-4346 4 port internal sampling injector CN4-4344



C-NVISF fill port for 26 gauge needles For use with: CN2 valves.



Consult factory regarding CN2 and CN4 valves.

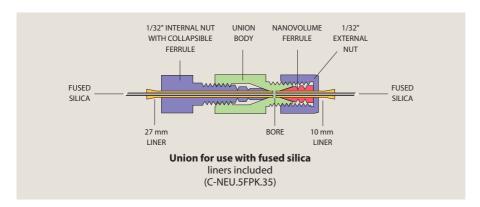
\*U.S. patent no. 6,575,501

#### **Unions**

### for fused silica tubing

	FS tubing OD	<b>100 μm bore</b> Prod No	150 µm bore Prod No
Union for fused silica tubing Includes liners.	125 -175 μm	C-NEU.5XFPK.15	C-NEU.5FPK.15
	175 -225 μm	C-NEU.5XFPK.20	C-NEU.5FPK.20
	225 -275 μm	C-NEU.5XFPK.25	C-NEU.5FPK.25
	275 -325 μm	C-NEU.5XFPK.30	C-NEU.5FPK.30
	325 -375 μm	C-NEU.5XFPK.35	C-NEU.5FPK.35





### Liners for 1/32" connectors

# for use with fused silica tubing

Use these natural PEEK liners to adapt 1/32" connectors to the most common sizes of fused silica tubing.

The 27 mm liners are for internal nuts with collapsible ferrules. 10 mm liners are for use with external nuts. Sold in packages of 5.

#### 27 mm liners

Use with internal nuts C-NNFFI	PK or C-NNFLFPK	
	For tubing OD	Prod No
	125 - 175 μm 175 - 225 μm 225 - 275 μm	C-NL.15L-5 C-NL.20L-5 C-NL.25L-5
	275 - 325 μm 325 - 375 μm	C-NL.30L-5 C-NL.35L-5
10 mm liners		
Use with external nut C-EN.5FF	PKB	
	For tubing OD	Prod No
	125 - 175 μm 175 - 225 μm 225 - 275 μm	C-NL.15S-5 C-NL.20S-5 C-NL.25S-5
	275 - 325 μm 325 - 375 μm	C-NL.30S-5 C-NL.35S-5

#### 1/32" Nanovolume® frits

These frits are the answer to filtration of 1/32" Nanovolume® fitting connections. A mere .25 mm (0.010") thin and 1/32" in diameter, they can be placed in any 1/32" fitting detail and add minimal volume. Price is for a package of 5 frits.

Pkg/5:	Pore size	Prod No
	0.2 micron	.2FR.5-5
	0.5 micron	.5FR.5-5
	2 micron	2FR.5-5



#### 

silica .....19,58

MORE INFORMATION



Screen embedded in end of liner for column end fittings

Nanovolume® column end fittings include two liners to adapt the 1/32" fitting to fused silica. The 27 mm liner, used inside the internal nut, has a 1 µm 316 stainless steel screen embedded in the PEEK to provide closure for fused silica columns. The 10 mm liner is used with the external nut.

The design utilizes our one-piece 1/32" fingertight fittings, with a patented\* collapsible ferrule. To avoid potential confusion, all fittings utilizing the Cheminert collapsible ferrule are made of black PEEK. The liners are natural PEEK.

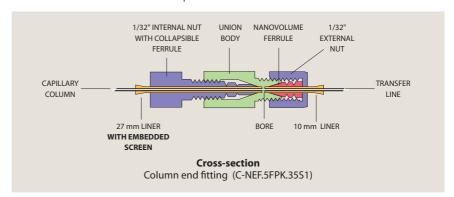
\*U.S. patent no. 6,575,501.

# **Column end fittings**

#### for fused silica capillary columns



		100 µm bore	150 µm bore
Each:	For tubing OD	Prod No	Prod No
Column end fitting	125 - 175 µm	C-NEF.5XFPK.15S1	C-NEF.5FPK.15S1
for fused silica tubing	175 - 225 μm	C-NEF.5XFPK.20S1	C-NEF.5FPK.20S1
Includes liners	225 - 275 μm	C-NEF.5XFPK.25S1	C-NEF.5FPK.25S1
	275 - 325 μm	C-NEF.5XFPK.30S1	C-NEF.5FPK.30S1
	325 - 375 um	C-NEF.5XFPK.35S1	C-NEF.5FPK.35S1



#### **TECH TIP**

Liners with embedded screens are also available for 1/16" PEEK tubing. Consult the factory for sizes and product numbers.

#### **CONVERSIONS**

 $100 \, \mu m = .004$ "  $150 \, \mu m = .006$ "  $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ "  $0.75 \, \text{mm} = .030$ " 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" $4.6 \, \text{mm} = .180''$  $6.0 \, \text{mm} = .236$ "  $6.4 \, \text{mm} = .253''$  $7.0 \, \text{mm} = .275$ "  $10.0 \, \text{mm} = .400$ " 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm 1/8"  $= 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 3/8"  $= 9.5 \, \text{mm}$ 

1/2"

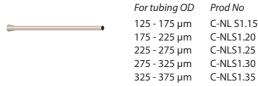
= 12.7 mm

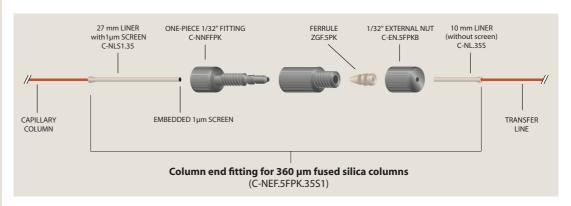
#### Replacement liners for column end fittings

for FS capillaries

Use these liners with Nanovolume® column end fittings to adapt to the most common sizes of fused silica tubing. Natural PEEK, with embedded screen to provide full closure for fused silica capillaries. Sold individually.

#### 27 mm liners for column end fittings





#### No twist one-piece fittings

for 1/32" and 1/16" tubing

These patented\* fittings offer the convenience of a one-piece fitting while solving a problem inherent to such designs. In other one-piece designs, the ferrule rotates against the fitting detail, creating particulates. The no twist design has a separate ferrule that snaps into the nut, so it's attached but still free to avoid rotation during tightening.

Since the ferrule is not machined onto the nut, it can be made from a different material; PEEK nut with PEEK ferrule, or PEEK nut with CTFE ferrule – the possibilities are endless.

Optional ferrule materials available – FEP, PFA, PTFE, and glass-filled PTFE. Call for availability.

Package of 5:		Glass-filled PEEI ferrule	C PEEK	CTFE ferrule
	Length	Prod No	Prod No	Prod No
1/32" hex	Short	ZNF.5PKG-5	ZNF.5PK-5	_
1/16" hex	Short Medium Long	ZNF1PKG-5 MZNF1PKG-5 LZNF1PKG-5	ZNF1PK-5 MZNF1PK-5 LZNF1PK-5	ZNF1KF-5 MZNF1KF-5 LZNF1KF-5
1/16" fingerti	ght	ZNF1FPKG-5	ZNF1FPK-5	ZNF1FKF-5

<sup>\*</sup> Patent No. 7,316,777



#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm



### Internal nuts – high pressure PEEK

PEEK nuts are used in Cheminert polymeric valves with zero dead volume fittings. They can also be used as alternatives to standard stainless steel Valco nuts when polymeric ferrules are used (up to approximately 125°C). Fingertight nuts have a knurled surface designed to provide sufficient sealing force on the ferrule without wrenches. Hex style nuts allow wrench tightening; however, since they are polymeric, they can break and are recommended for use only when space is limited and fingers won't fit.

**Caution:** PEEK nuts are intended for use only with polymeric ferrules, which seal with lower force than their stainless steel counterparts. Overtightening can result in breakage.

Package of 10:	Prod no	Length
1/32" fingertight 1/32" fingertight	ZN.5FPK-10 LZN.5FPK-10	.42" .54"
1/16" fingertight	ZN1FPK-10	.88"
1/16" hex 1/16" hex 1/16" hex	ZN1PK-10 MZN1PK-10 LZN1PK-10	.45" .62" .87"
1/8" hex	ZN2PK-10	.62"

# Ferrules – high pressure PEEK and glass-filled PEEK



PEEK ferrules seal by the increased friction from compression. Use PEEK ferrules with PEEK fittings and glass-filled PEEK with stainless steel fittings.

	PEEK Gla	ss-filled PEEK
Package of 10:	Prod No	Prod No
1/32"	ZF.5PK-10	ZF.5PKG-10
1/16"	ZF1PK-10	ZF1PKG-10
1/8"	ZF2PK-10	ZF2PKG-10
1/4"	ZF4PK-10	ZF4PKG-10
3/8"	ZF6PK-10	ZF6PKG-10
1/2"	ZF8PK-10	ZF8PKG-10

# Ferrules - grooved PEEK



These patented ferrules\* feature a grooved design that permits the ferrule to grip the tube in multiple places. They work great on tubing that is softer than the ferrule material. For example, PEEK grooved ferrules work well on PTFE or FEP tubing. They are not recommended for use with PEEK tubing.

Package of 10:	Prod No
1/32"	ZGF.5PK-10
1/16"	7GF1PK-10

<sup>\*</sup> Patent no. 6,575,501.

# POLYMERS AT A GLANCE

#### **MORE INFORMATION**

Tightening tool for hex-head PEEK nuts..67

# Plugs and caps - high pressure PEEK

PEEK plugs and caps are available in knurled fingertight and wrench-tight hex nut designs, for use in valves or fittings. (See discussion of PEEK nuts on page 63.) PEEK caps include a PEEK nut and ferrule.

Description	Length	PEEK plugs	PEEK caps
	of nut*	Prod No	Prod No
1/32" fingertight	.42"	ZP.5FPK	ZC.5FPK
1/32" fingertight	.54"	LZP.5FPK	—
1/16" fingertight	.87"	ZP1FPK	ZC1FPK
1/16" hex	.62"	MZP1PK	ZC1PK
1/16" long hex	.87"	LZP1PK	—
1/8" hex	.62"	ZP2PK	ZC2PK



# PEEK plugs for high pressure polymeric valves

These PEEK plugs are for use *only* in Cheminert HPLC PAEK valves (C1-C5 series) since the fitting detail in these valves has an extended pilot length.

Description	Length of nut*	Prod No
1/16" hex	.62"	C-MZP1PK
1/16" long hex	.87"	C-LZP1PK
1/16" fingertight	.88"	C-ZP1FPK



#### Tees and crosses - high pressure PEEK

Tees connect three lines. Crosses connect four lines. The 1/32" and 1/16" nuts are fingertight; 1/8" nuts are hex, for wrench tightening.

Tubing OD	Rore	PEEK tees	PEEK crosses
02	20.0		7.704.770
1/32"	0.25 mm	ZT.5FPK	ZX.5FPK
	0.50 mm	ZT.5LFPK	ZX.5LFPK
1/16"	0.25 mm	ZT1CFPK	ZX1CFPK
	0.50 mm	ZT1MFPK	ZX1MFPK
	0.75 mm	ZT1FPK	ZX1FPK
	1.00 mm	ZT1LFPK	ZX1LFPK
1/8"	0.75 mm	ZT2PK	ZX2PK
1,0			
	2.00 mm	ZT2LPK	ZX2LPK



#### POLYMERS AT A GLANCE

PEEK (PK)..... page 256 Chemical resistance; up to 125°C

#### **TECH TIP**

Ferrules for high pressure PEEK fittings are available in PEEK and PFA.

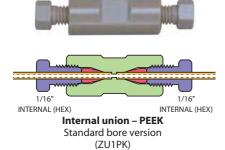
EEK ferrules					. 63	
PFA ferrules .					. 13	

#### MORE INFORMATION

Low pressure plugs....71 Tightening tool for hex-head PEEK nuts..67

# CONVERSIONS

0.25 mm	= .010"
0.50 mm	= .020"
0.75 mm	= .030"
1.0 mm	= .040"
1.5 mm	= .060"
2.0 mm	= .080"
4.6 mm	= .180"
6.0 mm	= .236"
6.4 mm	= .253"
7.0 mm	= .275"
10.0 mm	= .400"
27.0 mm	= 1.08"
4 (2.01)	
1/32" =	0.8 mm
1/16" =	1.6 mm
1/8" =	3.2 mm
1 / 4 !!	C 4
1/4" =	6.4 mm
3/8" =	9.5 mm
1/2" =	12.7 mm





**Bulkhead fingertight** internal union - PEEK (ZBU1FPK)

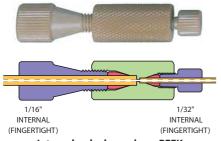


**Bulkhead hex** internal union - PEEK (ZBU1PK)

# Internal unions - high pressure PEEK

The 1/32" nuts are fingertight; 1/16" nuts are available in a choice of fingertight or hex; and 1/8" nuts are hex, for wrench tightening.

Tubing OD	Bore	Standard Prod No		Bulkhead el hole diameter
1/32" fingerti	ght			
	0.25 mm	ZU.5FPK	ZBU.5FPK	5/16"
	0.50 mm	ZU.5LFPK	ZBU.5LFPK	5/16"
	1/32"	ZU.5TFPK	ZBU.5TFPK	5/16"
1/16" fingerti	aht			
	0.25 mm	ZU1CFPK	ZBU1CFPK	3/8"
	0.50 mm	ZU1MFPK	ZBU1MFPK	3/8"
	0.75 mm	ZU1FPK	ZBU1FPK	3/8"
	1/16"	ZU1TFPK	ZBU1TFPK	3/8"
1/16" hex				
	0.25 mm	ZU1CPK	ZBU1CPK	3/8"
	0.50 mm	ZU1MPK	ZBU1MPK	3/8"
	0.75 mm	ZU1PK	ZBU1PK	3/8"
	1/16"	ZU1TPK	ZBU1TPK	3/8"
1/8" hex	0.75 mm	ZU2PK	ZBU2PK	7/16"
	2.0 mm	ZU2LPK	ZBU2LPK	7/16"
	1/8"	ZU2TPK	ZBU2TPK	7/16"



Internal reducing union - PEEK Standard bore (ZRU1.5FPK)



**Bulkhead internal reducing union - PEEK** (ZBRU1.5FPK)

# Internal reducing unions - high pressure PEEK

These unions connect two different sizes of tubing, with zero dead volume internal fittings on each end. In the bulkhead version, the bulkhead nut is on the side with smaller tubing. The 1/32" and 1/16" nuts are fingertight; 1/8" nuts are hex, for wrench tightening. A version with 1/16" and 1/8" hex nuts is also available.

Tubing OD	Bore	Standard Prod No		ulkhead el hole diameter
1/16" to 1/32"	0.25 mm 0.50 mm 1/32"	ZRU1.5FPK ZRU1.5LFPK ZRU1.5TFPK		5/16" 5/16" 5/16"
1/8" to 1/32"	0.25 mm 0.50 mm 1/32"	ZRU2.5FPK ZRU2.5LFPK ZRU2.5TFPK	20.102.02.11	3/8" 3/8" 3/8"
1/8" to 1/16"	0.25 mm 0.75 mm 1.00 mm 1/16"	ZRU21CFPK ZRU21FPK ZRU21LFPK ZRU21TFPK	ZBRU21CFPK ZBRU21FPK ZBRU21LFPK ZBRU21TFPK	3/8" 3/8" 3/8" 3/8"



Nanovolume® reducing union - PEEK (ZERU1.5FPK)

# Internal/external reducing union - high pressure PEEK

Tubing OD	Bore	Prod No
1/16" to 1/32"	0.20 mm	ZERU1.5FPK

### One-piece fingertight fittings - color-coded PEEK

These molded fingertight fittings are rated to 5000 psi (350 bar), so they can be used in virtually any HPLC fitting detail with 10-32 threads. Six colors allow easy identification of tubing lines.

#### Package of 5:

Color	Prod No
Natural	JR-55020-5
Black	JR-55021-5
Red	JR-55022-5
Yellow	JR-55023-5
Blue	JR-55024-5
Green	JR-55025-5



# One-piece PEEK fingertight fittings – narrow hex-head

This natural PEEK machined fitting has a narrow hex head and 10-32 threads.

#### Package of 5:

Color Prod No

Natural JR-5508-5



#### **Color-It fingertight adapters**

Use Color-It snap-on extensions to color-code our 1/4" hex-head nuts, and turn the nut into a fingertight fitting at the same time. Color-It adapters are available in six different colors, and can be used with PEEK and stainless hexhead nuts.

#### Package of 5:

Color	Prod No
Blue	JR-55010-5
Yellow	JR-55011-5
Green	JR-55012-5
Black	JR-55013-5
White	JR-55014-5
Red	JR-55015-5



Color Prod No
Multi-color JR-55016-12
(2 of each color)



#### **CAUTION**

One-piece combination nuts and ferrules are not for high pressure gas service.

#### **MORE INFORMATION**

Color-coded PEEK tubing . . . page 91

# **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040"1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm  $1/8" = 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm

1/2" = 12.7 mm



#### **PEEK starter kit**

In LC applications involving proteins, peptides, nucleic acids, or other samples of biological origin, metal systems may interact with samples or release transition metals that will deactivate columns. The PEEK starter kit facilitates replacement of stainless steel tubing, fittings, ferrules, mobile phase filters, etc., to create a biocompatible environment for samples and mobile phase.

Prod No

JR-35P PEEK starter kit

Includes:

- Plastic box 1
- 10 PEEK one-piece fittings, 10-32
- PEEK fingertight fittings
- 5 PEEK nuts, hex-head, long
- 20 PEEK ferrules, double-ended, 1/16"
  - PEEK union, HP body only, 10-32
- Tubing elbows, 90°
- Tubing elbows, 180°
- PEEK filter, in-line, incl. PAT frit, 5 µm
- Clean-cut tubing cutter
- Last Drop PTFE filter, 5 µm

3m PEEK tubing, 1/16" x 0.25 mm ID, blue stripe

3m PEEK tubing, 1/16" x 0.50 mm ID, orange stripe

Tweezers



# **Tightening tools for Valco and Cheminert fittings**

These handy tools make it fast and easy to tighten hexhead fittings. The red version is for use with the C360 series fittings shown on pages 57-58. The green tool is for any 1/32" fitting with a 3/16" hex head nut, and the blue version fits the 1/4" hex common in fittings for 1/16" tubing. The black tool is designed especially for the unique 1/16" tube fittings with 6-40 threads used in the new C25G selector on page 178.

Color For use with Prod No 360 µm fittings C360ET Red 1/32" fittings (6-40 threads) CNFT Green Blue 1/16" fittings **ZNFT** 6-40 fittings for C25G valves **CGFT** Black

#### MORE INFORMATION

Hex-head PEEK fittings 360 μm..... page 57 1/32".....62-63 1/16" High pressure...62-63 Low pressure ..... 71

C25G selectors ......178

Cheminert low pressure fittings are ideally suited for flow injection analysis, low pressure liquid chromatography, and stream sampling devices. They may be safely used at pressures up to 500 psi and temperatures to 50°C. Two designs of low pressure tube end fittings

are available. Flangeless tube end fittings utilize a collapsible ferrule, which grips the tubing as the fitting is tightened without significantly reducing the tube ID. Standard tube end fittings are retained on polymeric tubing by a flange formed with a Cheminert flanging tool.

#### Flangeless tube end fittings

1/4-28

Flangeless tube end fittings eliminate the flanging tool required with standard tube end fittings. The nut turns on the tubing as freely as with our flanged fitting, eliminating the possibility of cracking or unscrewing that can occur when plastic tubing is subjected to twisting as fittings are connected.

Cheminert flangeless fittings include our patented\* collapsible ferrule design. This innovative design utilizes a one-piece ferrule engineered to collapse as it is tightened. The collapse occurs in a narrow area, resulting in a very effective seal with virtually no distortion of the tubing ID and no dead volume. The assembly is rated at 500 psi liquid when tightened by hand. Since only the tubing and the ferrule come into contact with the solution, the result is an inert system.

Cheminert tube end fittings come in twelve different colors for system color coding, and work with any 1/16" or 1/8" OD polymeric tubing. Use CTFE ferrules for soft tubing (PTFE, FEP, etc.) and PEEK ferrules for harder tubing (PEEK, ETFE, polyurethane, etc.)

1/8" OD

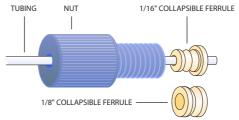


\* Patent No. 6,575,501

Flangeless fittings

with CTFE fe	rrules		
(pkg)	<i>(</i> 5)	Prod No	Prod No
Black Blue Brow		CFL-1BK CFL-1BE CFL-1BR	CFL-2BK CFL-2BE CFL-2BR
Gree	gray n nder/pink	CFL-1DG CFL-1G CFL-1L	CFL-2DG CFL-2G CFL-2L
Natu Oran Purp	ge	CFL-1N CFL-1E CFL-1P	CFL-2N CFL-2E CFL-2P
Red Whit Yello	_	CFL-1R CFL-1W CFL-1Y	CFL-2R CFL-2W CFL-2Y
	ngeless fitting /12, one of eac		
with	CTFE ferrule PEEK ferrule	CFL-1A	CFL-2A CFL-2A-PK
Replacemen	ts		
PEEK ferrules CTFE ferrules PEEK nuts	(pkg/10)	CFL-CB1PK CFL-CB1KF CFL-1PK	CFL-CB2PK CFL-CB2KF CFL-2PK
Setting tool		CST	CST

1/16" OD



Flangeless tube end fitting

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm  $1/8" = 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 

> $= 9.5 \, \text{mm}$ 1/2" = 12.7 mm

3/8"

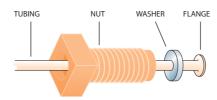
# Standard flanged tube end fittings

1/4-28

The basic component of the Cheminert system is the polypropylene nut, retained on PTFE or FEP tubing by a flange formed with a Cheminert flanging tool (page 70). This is an excellent method for connecting fluorocarbon tubing, as there is no reduction of the inside diameter and no binding or twisting of the tubing when the fitting is tightened. A mating of the parts is achieved with zero dead volume, making this an ideal fitting for biological systems.

Cheminert tube end fittings come in twelve different colors for system color coding, and are available for 1/16" or 1/8" OD fluorocarbon tubing. (While in theory other polymers could be molded to form a flange, only fluorocarbons such as PTFE, PFA, or FEP have low-temperature malleability and good form retention at operating temperatures.) Tube end fittings attach directly to Cheminert valves and fittings, and are easily joined to each other with a union. Tightening by hand is all that is required to make a leak-free seal at 500 psi liquid, although for long term reliability a wrench could be used to apply an additional 1/8 turn.

Packages include the same number of washers as fittings.



Flanged tube end fitting

Flanged fittings (pkg/10)	<b>1/16" OD</b> <i>Prod No</i>	1/8" OD Prod No
Black	CF-1BK	CF-2BK
Blue	CF-1BE	CF-2BE
Brown	CF-1BR	CF-2BR
Dark gray	CF-1DG	CF-2DG
Green	CF-1G	CF-2G
Lavender/pink	CF-1L	CF-2L
Natural	CF-1N	CF-2N
Orange	CF-1E	CF-2E
Purple	CF-1P	CF-2P
Red	CF-1R	CF-2R
White	CF-1W	CF-2W
Yellow	CF-1Y	CF-2Y
Assorted flangeless fittings (pkg/12, one of e		CF-2A
Washers (pkg/10)	CF-W1	CF-W2

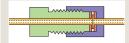
#### **TECH TIP**

To make up standard flanged tube end fittings, use the flanging tool on page 70.

A flanging starter kit, complete with flanging tool, flanging tips, and an array of tubing and fittings, is also available. (See page 70)

# **TECH TIP**

Use our external nut tube end fittings to make true zero volume butt connections without a coupling.



#### **MORE INFORMATION**

High pressure fittings ......pp 57-67 PTFE and FEP tubing......92

# **External nuts for flanged tube ends**

1/4-20

External nuts with female 1/4-28 threads are designed for use on tubing with a flanged end, just like the standard tube end fittings. Use them instead of a union or coupling to make a zero volume butt connection.

Package of 5:	PEEK	CTFE
Tubing OD	Prod No	Prod No
1/16"	CEN1PK	CEN1KF
1/8"	CEN2PK	CEN2KF



### **Cheminert flanging tools**

(Non-CE)

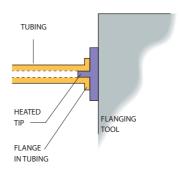
The flanging tool makes the flange which retains the standard 1/4-28 tube end fitting and washer on PTFE or FEP tubing. With this tool, lengths of tubing may be easily assembled to any required dimension. The time required is approximately 5 to 10 seconds per flange.

Flanging tools are available for 110 VAC or 230 VAC, and come complete with tips for 0.75 mm, 1.0 mm, and 2.00 mm ID tubing, a tubing holder for gripping the tubing during the flanging operation, a razor blade for tube cutting, and instructions.

		Proa No
Flanging tools	110 VAC	CFT-110
	230 VAC	CFT-220
Flanging tool accessorie	25	
Flanging tips		
for tubing	ID ≤ 0.25 mm	CFT-TXC
	< 0.75 mm	CFT-TC

Drad Na

Razor blades (pkg/10) CFT-R Tubing holder CFT-H



Forming a tubing flange



#### **Cheminert starter kits**

(Non-CE)

Starter kits come in either 1/16" or 1/8" versions, with flanging tools for 110 VAC or 230 VAC.

	110 VAC	230 VAC
	Prod No	Prod No
Starter kits		
1/16" tubing	CFT1K-110	CFT1K-220
1/8" tubing	CFT2K-110	CFT2K-220

The starter kit includes:

1 flanging tool with 3 flanging tips
1 tubing holder
20 standard tube end fittings
20 stainless steel washers
10 couplings
20 feet of PTFE tubing
1/16" OD x 0.030" ID or
1/8" OD x .060" ID
1 male luer adapter
1 female luer adapter
1 plug
1 tee
1 glass connector



#### MORE INFORMATION

Standard tube end
fittings page 69
Stainless steel
washers 69
Couplings
Male luer adapter76
Female luer adapter 76
Plug71
Tee74
Glass connector 73



#### **Easy-Flange kit**

The Easy-Flange flange-rolling tool uses mechanical force to form a flange on 1/16" - 1/8" OD PTFE tubing, offering an excellent non-electric alternative to the heated flanging tool.

The quality of the flange is excellent, since it is formed without stressing the tubing by heat. The specially designed negative conical profile of the flange-forming component yields an ideal shape for maximum sealing properties.

Prod No

JR-201540 Easy-Flange kit

Includes:

Plastic box

Flanging discs with:

0.5 mm SS pin for PEEK tubing

0.8 mm polymer pin

0.8 mm titanium pin

1.3 mm polymer pin 1.3 mm titanium pin

Clean-cut tubing cutter

6 feet of PTFE tubing, 1/16" x 0.75 mm ID



#### **Plugs**

1/4-28 and 1/2-20

Plugs can be used to close off an unused port in a 1/4-28 valve or manifold.

		PEEK	CTFE	Delrin
		Prod No	Prod No	Prod No
Pkg/5:	1/4-28	CPPK	CPKF	_
Pkg/1:	1/2-20	_	CP-4K	CP-4D



#### **Low pressure PEEK plugs**

10-32

These all-PEEK plugs are for use in Cheminert PEEK fittings and low pressure polymeric valves (C20Z and C30Z series). For high pressure polymeric valves (C1-C5 series), use the plugs on page 64.

		PEEK
Package of 1:	Length of nut*	Prod No
1/16" hex	.62"	MZP1PK
1/16" long hex	.87"	LZP1PK
1/16" fingertight	.88"	ZP1FPK



#### Caps

1/4-28

Caps are used to close off lines with 1/4-28 tube end fittings.

	PEEK	CTFE
Package of 5:	Prod No	Prod No
	CCPK-5	CCKF-5

#### MORE INFORMATION

Clean-cut tubing cutter ..... page 92 Tightening tool for hex-head PEEK nuts..67

#### **CONVERSIONS**

 $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060"

2.0 mm = .080"4.6 mm = .180"  $6.0 \, \text{mm} = .236$ "

6.4 mm = .253"

7.0 mm = .275"  $10.0 \, \text{mm} = .400$ "

27.0 mm = 1.08"

 $1/32" = 0.8 \, \text{mm}$ 1/16" =  $1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 

1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm

1/2" = 12.7 mm



#### **Unions** Cheminert to Cheminert

1/4-28 to 1/4-28

PEEK and CTFE unions include flangeless 1/4-28 fittings for tubing OD indicated. Polypropylene union bodies are for use with flanged tubing only and do not include any fittings.

Tubing OD	Bore	<b>PEEK</b> Prod No	<b>CTFE</b> Prod No
1/16" 1/16" 1/16"	0.25 mm 0.50 mm 0.75 mm	CUCPK CUPK CUMPK	CUCKF CUKF CUMKF
1/8"	1.50 mm	CULPK	CULKF



#### Polypropylene

Package/5:		Prod No	
1/8"	Butt	CUTPP	

**Unions** *Cheminert to 1/16" ZDV* 

1/4-28 to 10-32

Include flangeless 1/4-28 and ZDV 10-32 fittings for 1/16" tubing.

Tubing OD	Bore	<b>PEEK</b> Prod No	<b>CTFE</b> Prod No	316 Stainless Prod No
1/16"	0.25 mm	CZUCPK	CZUCKF	CZUCS6
1/16"	0.50 mm	CZUPK	CZUKF	CZUS6
1/16"	0.75 mm	CZUMPK	CZUMKF	CZUMS6



Unions

Components

CTFE ferrule

1/2-20 nut, CTFE

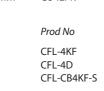
1/2-20 nut, Delrin

Cheminert to 1/4" tubing

1/4-28 to 1/2-20

Include flangeless 1/4-28 and 1/2-20 fittings.

Tubing		PEEK	CTFE
OD	Bore	Prod No	Prod No
1/8" to 1/4"	1 50 mm	CHALPK	CHALKE





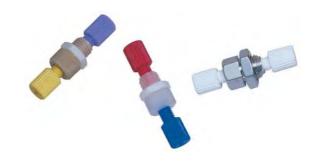
#### CONVERSIONS

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$  $1/16" = 1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm

**Bulkhead unions** Cheminert to Cheminert 1/4-28 to 1/4-28

Include flangeless 1/4-28 fittings for tubing OD indicated.

Tubing OD	Bore	<b>PEEK</b> Prod No	CTFE Prod No	316 Stainless Prod No
1/16" 1/16" 1/16"	0.25 mm 0.50 mm 0.75 mm	CBUCPK CBUPK CBUMPK	CBUCKF CBUKF CBUMKF	CBUCS6 CBUS6 CBUMS6
1/8"	1.50 mm	CBULPK	CBULKF	CBULS6



**Bulkhead unions** Cheminert to 1/16" ZDV 1/4-28 to 10-32

Include flangeless 1/4-28 and ZDV 10-32 fittings for 1/16" OD tubing.

Tubing		PEEK	CTFE	316 Stainless
OD	Bore	Prod No	Prod No	Prod No
1/16"	0.25 mm	CZBUCPK	CZBUCKF	CZBUCS6
1/16"	0.50 mm	CZBUPK	CZBUKF	CZBUS6
1/16"	0.75 mm	CZBUMPK	CZBUMKF	CZBUMS6



1/4-28 **Tees** 

Include flangeless 1/4-28 fittings for tubing OD indicated.

Tubing OD	Bore	<b>PEEK</b> Prod No	<b>CTFE</b> Prod No
1/16" 1/16" 1/16"	0.25 mm 0.50 mm 0.75 mm	CTCPK CTPK CTMPK	CTCKF CTKF CTMKF
1/8"	1.50 mm	CTLPK	CTLKF



**Crosses** 1/4-28

Include flangeless 1/4-28 fittings for tubing OD indicated.

Tubing OD	Bore	<b>PEEK</b> Prod No	CTFE Prod No
1/16" 1/16" 1/16"	0.25 mm 0.50 mm 0.75 mm	CXCPK CXPK CXMPK	CXCKF CXKF CXMKF
1/8"	1.50 mm	CXLPK	CXLKF



**Manifolds** 1/4-28

Include flangeless 1/4-28 fittings for tubing OD indicated.

Tubing	Bore	<b>PEEK</b>	CTFE
OD		Prod No	Prod No
<b>5 ports</b> 1/16" 1/8"	0.75 mm	C5M1PK	C5M1KF
	1.50 mm	C5M2PK	C5M2KF
<b>9 ports</b> 1/16" 1/8"	0.75 mm	C9M1PK	C9M1KF
	1.50 mm	C9M2PK	C9M2KF



#### MORE INFORMATION

Flangeless tube end fittings ..... page 68

#### **CONVERSIONS**

0.25 mm = .010" 0.50 mm = .020"

0.75 mm = .030"

1.0 mm = .040" 1.5 mm = .060"

2.0 mm = .080"

4.6 mm = .180"

6.0 mm = .236"

6.4 mm = .253"

7.0 mm = .275" 10.0 mm = .400"

27.0 mm = 1.08"

1/32" = 0.8 mm 1/16" = 1.6 mm

 $1/8" = 3.2 \, \text{mm}$ 1/4"

 $= 6.4 \,\mathrm{mm}$ 3/8" = 9.5 mm

1/2" = 12.7 mm



#### Mixing tees

1/4-28

Include flangeless 1/4-28 fittings for tubing OD indicated.

Tubing		PEEK	CTFE
OD	Bore	Prod No	Prod No
1/16"	0.75 mm	CM1XPK	CM1XKF
1/8"	1.50 mm	CM2XPK	CM2XKF

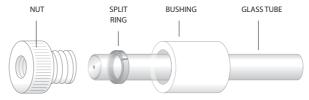


#### **Glass connectors**

1/4-28 female to 1/4" glass tube

Glass connectors join a Cheminert tube end fitting to 1/4" OD glass tubing. Complete assemblies include a bushing and nut, a polypropylene or CTFE split ring, and a 1/4" OD x 3-1/4" long piece of 1 mm or 2 mm ID glass tube. This connector works only with our glass tubes.

	Acetal	CTFE
Description	Prod No	Prod No
Complete assembly		
1 mm ID glass tubing	CGC41	CGC41KF
2 mm ID glass tubing	CGC42	CGC42KF
Components		
Bushing	CGCB	CGCBKF
Nut	CGCN	CGCNKF
Glass tube, 3-1/4" long		
1 mm ID	CGCG41	_
2 mm ID	CGCG42	_
Split rings (package of 5)	CGCR	CGCRKF



Glass connector

#### **Tube adapters**

1/4-28

Tube adapters have male 1/4-28 threads going to 1/4" or 1/8" OD tubing.

Tubing		PEEK	CTFE	316 Stainless
OD	Bore	Prod No	Prod No	Prod No
1/8"	1.5 mm	CTA2PK	CTA2KF	CTA2S6
1/4"	1.5 mm	CTA4PK	CTA4KF	CTA4S6



#### Luer adapters

Luer to 1/4-28 or 10-32

Luer adapters make a leak-tight connection from male or female luer to 1/4-28 threads.

		PEEK	CTFE	PFA
Description	Bore	Prod No	Prod No	Prod No
Female luer				
to 1/4-28 male	1.50 mm	CFLAPK	CFLAKF	CFLAPFA
to 10-32 female	0.75 mm	ZUFLPK	ZUFLKF	_
Male luer				
to 1/4-28 male	1.50 mm	CMLAPK	CMLAKF	CMLAPFA



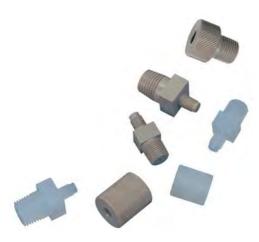
#### Luer adapter bulkhead unions

Luer to 1/4-28 or 10-32

Our luer adapter bulkhead union connects a male or female luer to 1/4-28 or 10-32 fittings. These are the ideal fittings for through-the-panel syringe injections. The 1/4-28 versions include flangeless fittings for 1/16" OD tubing. Versions with 10-32 connections (for 1/16" OD tubing) include a fingertight PEEK nut and a ferrule of the same material as the union.

Description	Bore	<b>PEEK</b> Prod No	<b>CTFE</b> Prod No
Female luer to 1/4-28 to 10-32	1.50 mm 1.00 mm	CBUFLPK ZBUFLPK	CBUFLKF ZBUFLKF
Male luer to 10-32	1.00 mm	ZBUMLPK	ZBUMLKF





#### **Pipe adapters**

1/4-28 to NPT

Versions adapt male or female 1/4-28 fittings to male or female NPT.

		PEEK	CTFE	
NPT	Bore	Prod No	Prod No	
Female '	1/4-28 to male N	PT		
1/8"	1.5 mm	CPA2PK	CPA2KF	
1/4"	1.5 mm	CPA4PK	CPA4KF	
Male 1/4-28 to male NPT				
1/8"	1.5 mm	CEPA2PK	CEPA2KF	
1/4"	1.5 mm	CEPA4PK	CEPA4KF	
Female 1/4-28 to female NPT				
1/8"	1.5 mm	CFPA2PK	CFPA2KF	
1/4"	1.5 mm	CFPA4PK	CFPA4KF	



#### Cheminert 1/4-28 to Valco 10-32 ZDV adapter

This adapter permits Valco 10-32 fittings to be installed into any 1/4-28 fitting detail. (Nut and ferrule are not included.)

Description Bore Prod No Port adapter 0.50 mm ZLCA1PK

#### One-piece fingertight column coupler

Choose from a variety of coupler IDs, indicated by the color of the sleeve (which parallels the color-coding of our PEEK tubing on page 91). A unique feature of this column coupler is that it adapts automatically to fit all pilot lengths – Valco, Waters, Upchurch, Rheodyne, etc. Since the tubing bottoms out in any fitting detail, added void volume is minimal. Material is PEEK.

Color	Bore	Prod No	
Red	0.13 mm ID	JR-26501	10th
Yellow	0.17 mm ID	JR-26502	min
Blue	0.25 mm ID	JR-26503	
Orange	0.50 mm ID	JR-26504	The state of the s

#### **CONVERSIONS**

 $0.25 \, \text{mm} = .010$ "  $0.50 \, \text{mm} = .020$ " 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180"  $6.0 \, \text{mm} = .236$ "  $6.4 \, \text{mm} = .253"$ 7.0 mm = .275"  $10.0 \, \text{mm} = .400$ " 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" =  $1.6 \, \text{mm}$  $1/8" = 3.2 \, \text{mm}$ 

 $= 6.4 \, \text{mm}$  $3/8" = 9.5 \, \text{mm}$ 1/2" = 12.7 mm

1/4"

#### Perifit fittings for peristaltic pump tubing

The Cheminert Perifit is a unique fitting with a barb on one end and a 1/4-28 female fitting on the other end, for connecting a FIA line with the most commonly used peristaltic tubing. The fitting is compact and easy to install while providing a secure, trouble-free connection. A Perifit can be used as a "stop" on standard inexpensive Tygon® tubing, eliminating the need to buy the more expensive pre-cut tubing with pre-installed stops. Unlike many competitive systems, Perifits are reusable as the tubing wears.

Three sizes of Perifits are available to cover the range of tubing most commonly used in FIA.

For use with tubing sizes	Prod No
0.50 to 1.02 mm ID 1.12 to 1.65 mm ID 1.85 to 2.29 mm ID	C-PFS C-PFM C-PFL
Kit with 2 of each size above	C-PF



#### **In-line filters**

1/4-28

These convenient filters can be simply dropped into any 1/4-28 fitting detail. Constructed of PTFE and CTFE, with a 316 stainless low-pressure-drop screen. (Fitting shown is not included.)

Pore size	Prod No
2 micron 10 micron	CFE-S2 CFE-S10
75 micron	CFE-S75



#### **Biocompatible filter**

This all-PEEK filter can be placed in any 1/16" line, providing filtration to 0.5 microns. The filter can be changed without tools, since both the filter housing and the fittings are designed to be tightened by hand.

Tubing OD	Bore	Prod No
1/16"	0.5 mm	ZU1FPK.5

#### Replacement elements (PEEK-encapsulated titanium)

Pore size	Prod No
0.5 micron	C-F1.5TI



#### CONVERSIONS

CONVERSIONS			
0.50 mm	= .010" = .020" = .030"		
1.5 mm	= .040" = .060" = .080"		
4.6 mm = 6.0 mm = 6.4 mm			
10.0 mm			
27.0 mm = 1/32" = 1/16" = 1/8" =	0.8 mm		
3/8" =	6.4 mm 9.5 mm 12.7 mm		



#### Last Drop mobile phase filter

The Last Drop mobile phase filter allows more analyses per batch of mobile phase and helps reduce hazardous waste. The flat filter element sits parallel to the bottom of the reservoir, allowing the Last Drop to filter all but the last 2% of the mobile phase from the reservoir without drawing air into the system. Compare this with conventional cylindrical filters that can begin to draw air into the system when nearly 10% of the solvent remains in the reservoir.

The Last Drop mobile phase filter consists of a 316 stainless or PTFE filter element pressed into an inert PTFE housing. The top of the housing has a PEEK tripod which slips into 1.5, 2.2, or 3.5 mm ID pump inlet lines. It will also work with our 1/16" and 1/8" flangeless fittings.

Use the metal-free PTFE version for sensitive biochromatography applications in which metal surfaces may corrode or interact with samples.

	Filter element	Prod No
Last Drop filter, 2.5µm	PTFE	JR-9000-0520
	Stainless steel	JR-9000-0530



#### **Last Drop filter/spargers**

The Last Drop filter/sparger combines filtration and sparging in a single unit. The PTFE housing contains a mobile phase filter with either a stainless steel or a PTFE filter element. The filter/sparger features a PEEK tripod connector for the solvent line, and a nut and ferrule for the sparging line.

	Filter element	Prod No
Last Drop filter/sparger		
2.5 µm filter, 10 µm sparger	PTFE	JR-9000-0602
	Stainless steel	JR-9000-0640



#### Mobile phase filters

Direct connect

Cheminert mobile phase filters provide point-of-use filtering of common HPLC or FIA solvents. They are designed to connect directly to 1/8" OD PTFE or PEEK tubing using a simple press fit. The filter housing is PTFE and includes a 2 or 10 micron titanium frit.

Pore size	Prod No
2 micron	C-MPFTI2
10 micron	C-MPFTI10

#### No-Met biocompatible mobile phase filter

In the growing number of applications involving the separation of biomolecules, stainless steel in the flowpath is not acceptable. High salt buffers can corrode stainless steel, and the metal ions released from metallic filters may contaminate or otherwise react with the biomolecules of interest.

The No-Met polyethylene filter is designed for these applications, with inert polymeric fittings and 20  $\mu m$  filter effectively eliminating metal contamination from the fluid path. Use them for IC and biochromatography applications.

Because they are hydrophobic, No-Met filters may initially require some priming with methanol or acetonitrile. They can be used up to a maximum flow rate of 500 ml/min\*.

	Prod No
No-Met mobile phase filter, 1/8"	JR-32178
Replacement element	JR-32179

<sup>\*</sup> Flow rates measured with methanol/water (1:1), ultrasonically degassed. Flow rates can vary with solvent and tubing ID.



#### Stainless steel mobile phase filters and helium spargers

Mobile phase filters protect your HPLC system from small particles in the mobile phase. These filters are made from 316 stainless and PEEK or PTFE, and are suitable for use with most solvents.

Helium spargers offer an inexpensive way to prepare and maintain mobile phases free of dissolved gases. Connect these spargers to a regulated supply of helium gas (0 - 400 ml/min) to remove dissolved gases from the mobile phase. Spargers are made from 10 micron porosity stainless steel.

Tubing OD	Porosity I	Suggested Max. Flow Rate (ml/min)*	Prod No
1/16"	2 µm	35	JR-367016-2
1/16"	10 µm	35	JR-367016-10
1/16"	20 µm	35	JR-367016-20
1/8"	2 µm	35	JR-367008-2
1/8"	10 µm	100	JR-367008-10
1/8"	20 µm	120	JR-367008-20

<sup>\*</sup> Flow rates measured with methanol/water (1:1), ultrasonically degassed. Flow rates can vary with solvent and tubing ID.

#### CONVERSIONS

0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm  $1/8" = 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 3/8" = 9.5 mm 1/2" = 12.7 mm



#### Mobile phase or solvent reservoirs

1/4-28

These high density polyethylene reservoirs for in-line solvent use come with polypropylene caps, 1/4-28 flangeless fittings, and 1/8" PTFE tubes for one or two lines plus vent. Plugs are included for conversion to solvent storage when the reservoir is removed from the system. Optional PTFE filters with titanium frits are available at the bottom of page 79.

Capacity	Сар	Prod No
0.5 liter	2-hole	C-MPR2
0.5 liter	3-hole	C-MPR3
0.5 liter	plain	C-BOT16
1.0 liter	plain	C-BOT32

#### **VICI** caps



The VICI cap is the most economical way to helium sparge and deliver HPLC mobile phases. The insert is manufactured from PTFE, with a polypropylene screw cap and an EPDM\* O-ring which is resistant to commonly used HPLC solvents.

VICI caps fit GL45 threaded bottles, and are available with 2, 3, or 4 ports with 1/4-28 threads for 1/8" or 1/16" tubing. Unused ports can be plugged as required.

Each VICI cap includes the cap with insert and o-ring, and the appropriate number of PPS nuts, ETFE ferrules, and colored polypropylene fingertight sleeves for solvent line identification.

\*Ethylene Propylene Diene Monomer

		Prod No
VICI-cap	2 ports	JR-S-11001
	3 ports	JR-S-11002
	4 ports	JR-S-11003

#### TECH TIP

The VICI cap is intended only for continuous helium sparging, not for building up a helium atmosphere within the solvent bottle.

#### **MORE INFORMATION**

Bulkhead connectors ... page 73
Flangeless fittings ... 68
Plugs ... 71
Polymeric tubing ... 90-92



#### Valves for vials

Screw-cap Mininert valves are available in a variety of sizes. The crimp-top valve for 13 mm ID glassware slides into the neck of the vial and features a threaded flange, which is turned to provide a leak-tight fit.

Pkg/12:	Cap/thread size	Prod No
	13 mm-425 15 mm-425	PS-614158 PS-614160
	18 mm-400 20 mm-400 24 mm-400	PS-614161 PS-614170 PS-614163
	Crimp top	PS-614250

# Liquid handling PUMPS AND ULTRA-HIGH PRESSURE VALVES

Diluter/dispensers, M series (Non-CE)

- Full liquid handling functionality
- Self-priming
- No syringes
- Largest volume range available
- Easy to use Wizard format does away with math problems and charts



Cheminert M Series diluter/ dispensers simplify the sample preparation process for dispensing and diluting liquids. A user-friendly Wizard format eliminates all the math calculations and charts usually associated with diluting and dispensing applications. Just enter the dilution ratio and the final volume, and the correct volume is calculated and automatically dispensed for each ratio. For multiple dispenses, simply enter the volume and the number of dispense repetitions, and the Wizard calculates the total volume to be aspirated. It's that easy!

The diluter/dispenser is built around a patented syringe-free, bi-directional, positive displacement pump. This design approach gives the largest volume range available, and eliminates the inconvenience of having to change and refill syringes.

#### **M10 Diluter/Dispensers**

10 nl - 10 ml - M10 diluter/dispenser

*Prod No* CD10-4841-M1A

#### **M50 Diluter/Dispensers**

50 µl - 50 ml – M50 diluter/dispenser

Prod No

CD50-8182-M2A

#### **Additional Features**

#### "Smart" hand probe

The hand probe signals the operator when an aspirate or dispense step is completed. The unique design also allows the use of fixed or disposable probe tips, as well as other accessories.

#### **Program memory**

Up to 100 programs can be permanently stored.

#### **Multi-solvent option**

A multiposition stream selection valve can be easily integrated with the pump for multi-solvent applications.

#### **Printer option**

Print out methods, sequential steps, time/date/operator stamp, titration, and tubing volume values.

#### **Applications**

- Simple dispensing of reagents using the manual dispense mode
- Micro dispensing in microplates and genomic arrays
- Dilutions for AA, ICP, GC, and HPLC samples
- Serial dilutions for all samples
- Multi-sample and reagent additions, micro-plates, tube to plate, tube to tube
- Small and large volume dispensing of reagents
- Titrations



#### LIQUID HANDLING

### Liquid handling pumps, M series

 $C \in$ 

The Cheminert® M Series liquid handling pump is a syringe-free pump capable of delivering a bidirectional flow over six orders of magnitude.

The M Series is a positive displacement pump, which means that it is self-priming and tolerant of any gas which may find its way into the fluid lines. There is no separate fill cycle, and the capacity is unlimited.

RS-232 and RS-485 communication protocols are incorporated into the microprocessor-driven controller. (USB interface requires an adapter.) The included software package controls flow rates, flow direction, and metered volumes.

#### **Operating principle**

At the core of the pump is a polymeric rotor housing four 1/8" diameter pistons in sapphire cylinders. As the microstepper motor turns the rotor, the pistons float on a stationary cam; at any given moment, one piston is filling, one is dispensing, and the other two are in transit between the fill and dispense positions.

SPECS		
	M6	M50
Continuous minimum dispense	100 nl	50 μl
Continuous maximum dispense	•	25 ml/min
Maximum back pressure	100 psi	100 psi
Gravimetric precision		
for 125 μl	0.5%	0.8%
for 1.25 ml	0.05%	0.1%
Pump internal volume (µl)	100 ± 2 μl	625 ± 10 μl

#### **Applications**

- Flow cytometry, cell and drug perfusion
- HTS and robotic systems
- Infusion and micro-dialysis
- Micro diluters/dispensers for nl to ml range applications
- Micro liquid transfers (nl) for micro arrays
- Microtiter plate dispensing using multiposition valves



#### M6 pumps

10 nl - 10 ml

	Prod No
M6 pump with:	
Controller and stepper motor	CP2-4841-100M1
Stepper motor (no controller)	CP2-4841-100SM
M6 pump only	CP2-4841-100D

#### M50 pumps

50 μl - 50 ml

M50 pump with:	
Controller and stepper motor	CP3-8182-625M2
Stepper motor (no controller)	CP3-8182-625SM2
M50 pump only	CP3-8182-625D

Prod No

#### **Accessories and replacement parts**

		Prod No
Pump motor		
M6		CP-DSM
M50		CP-DSM2
Controller, MicroLynx-4	ŀ	CP-CM1-P
Standoff assembly *	2"	2SOAMPCP
	3"	3SOAMPCP
	4"	4SOAMPCP
	6"	6SOAMPCP

separated from the pump head. Standoffs are available in lengths of 2", 3", 4", and 6".

**TECH TIP** 

Use a standoff assembly if the motor must be separated from the pump

<sup>\*</sup> Note: Adding a standoff will change the backlash. Consult factory for further information.

#### LIQUID HANDLING

#### 40,000 psi ultra-high pressure injector system

The VICI 40K injector is comprised of six miniature air actuated needle valves, plumbed to simulate the flow path of a conventional rotor/stator injector. An integral controller sends the on/off positioning signals to each valve, coordinating them to perform load, inject, and flush functions.

There are three methods for sending positioning commands to the injector:

- Manual control with the pushbuttons on the controller
- Laboratory computer via serial port communication
- Contact closure inputs

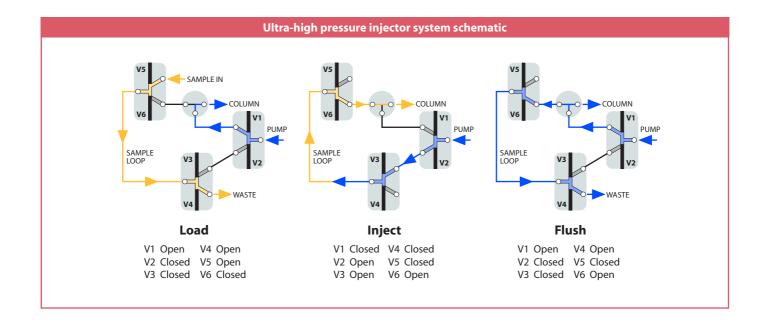
For more information, contact our technical department.

#### Ultra-high pressure injector system

for liquids

Prod No SPSS40





#### LIQUID HANDLING

## 40,000 psi ultra-high pressure valves

The ultra-high pressure valves that are the heart of our SPSS40 (previous page) are now available individually, in 1/16", 1/32", and 360 micron versions. There are three types – a two port on/off valve, a dual on/off valve, and a 3-way prime/purge valve. (See page 213 for flowpath schematics.) The dual on/off configuration has two individually controlled outlets with a common inlet (or vice versa), emulating a rotary three way valve.

Implementation requires a single three-way solenoid: application of 50 psi opens the valve; venting the air allows the spring to return the valve to the closed position. A fitting for 1/8" air supply tubing is included; two fittings are included for dual valves. (Fitting: prod no EAOR21, page 219)



On/off valve 360 µm ZDV fittings

On/off valves	for liquids
---------------	-------------

SPECS		Fitting size	Bore	Prod No
Temp	Pressure	360 µm	0.15 mm	ASFVO40K360
50°C	40,000 psi liq	1/32"	0.15 mm	ASFVO40K.5
		1/16"	0.15 mm	ASFVO40K1

#### Prime/purge valves for liquids

SPECS		Fitting size	Bore	Prod No
Temp	Pressure	360 µm	0.15 mm	ASFV40K360
50°C	40,000 psi liq	1/32"	0.15 mm	ASFV40K.5
		1/16"	0.15 mm	ASFV40K1



SPECS		Fitting size	Bore	Prod No
Temp	Pressure	360 µm	0.15 mm	ASFVOD40K360
50°C	40,000 psi liq	1/32"	0.15 mm	ASFVOD40K.5
		1/16"	0.15 mm	ASFVOD40K1



Prime/purge valve 360 µm ZDV fittings



#### STANDARD ON/OFF AND PRIME/ PURGE VALVES

2,000 psi to 10,000 psi valves . . . . . pp 212-213



#### **TECH TIP**

Three dual on/off valves comprise the ultra-high pressure injector system, SPSS40, on the facing page.



We offer chromatography grade tubing in ODs of 360  $\mu$ m, 1/32", 1/16", and 1/8". Tubing can be ordered in economical pre-cut standard lengths, or can be custom cut to meet your specific instrumentation requirements. All VICI metal tubing is chromatographic grade seamless drawn tubing of the highest available quality. Stainless tubing is 316 series.

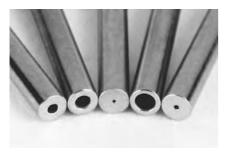
#### **Cutting and Cleaning**

The improper cutting and cleaning of metal tubing is the largest single cause of chromatographic problems and premature valve failure. The use of our precision cut and finished tubing with VICI fittings and valves maintains the flow uniformity and cleanliness that high performance systems require.

VICI's electrolytic cutting process yields polished tubing with flat ends, minimizing the potential for dead volumes or leaks caused by the uneven ends and burrs left by the tools common in the general laboratory environment – wire cutters, files, jewelers' saws, and most

tubing cutters. These non-precision cutters are likely to generate particulates and deform inner and outer diameters, which can introduce dead volume and flow anomalies.

Each piece of VICI pre-cut metal tubing is specially cleaned with micro-filtered steam from deionized water to remove both organic and inorganic contaminants, representing a major improvement over the common practice of using organic solvents to "clean" tubing. Our test reports have been confirmed by most of the major instrument suppliers: the VICI process provides analytically clean tubing.



Electrolytically cut and polished



File cut



Plier cut

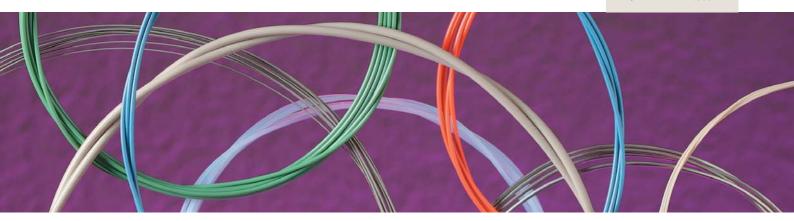
#### **TECH TIP**

Forty years of Valco experience show that the particles left in poorly cut tubing are the number one cause of valve damage.

#### **TECH TIP**

For optimal zero dead volume connections, make sure your tubing meets the best industry standards—OD tolerance should be nominal dimension ± .002".

Fractional dimension	Nominal dimension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500





Three sizes of electroformed nickel tubing

#### Electroformed nickel tubing

Our microbore EFNi tubing is made by electroplating nickel over a diamond-drawn mandrel in a continuous process. When the mandrel is removed, an internal surface with a mirror-like 1-2 microinch finish remains. The ductile nature of nickel allows the tubing to be easily manipulated. Unlike glass- or silica-lined stainless, EFNi can accept tight bends and cutting without heating, and does not release damaging glass fragments or silica particles.

A comparison of the interiors of commonly used tubing (below) shows the quality of the electroformed nickel tubing surface. (All photos are x500 magnification.) The rough interior surface of the mill-drawn Nickel 200 tubing has potential for carryover or cross contamination, and both the Nickel 200 and the stainless steel contain pits, voids, striations, and particles – problems which intensify as the ID decreases.

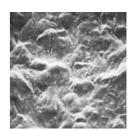
Custom IDs/ODs are available upon request.



Electroformed nickel (EFNi)



Nickel 200 alloy



Type 316 stainless steel

#### 360 µm OD EFNi tubing

Custom lengths

Prices are per foot. See pricing note in box at left.

.001" TEFNI.101 1 foot .002" TEFNI.102 2 feet .004" TEFNI.104 20 feet .005" TEFNI.105 30 feet .007" TEFNI.110 50 feet	Tubing ID	Prod No	Max lengtl
.004" TEFNI.104 20 feet .005" TEFNI.105 30 feet	.001"	TEFNI.101	1 foot
.005" TEFNI.105 30 feet	.002"	TEFNI.102	2 feet
	.004"	TEFNI.104	20 feet
.007" TEFNI.110 50 feet	.005"	TEFNI.105	30 feet
	.007"	TEFNI.110	50 feet

#### 1/32" OD EFNi tubing

Custom lengths

Prices are per foot. See pricing note in box at left.

Tubing ID	Prod No	Max length
.002"	TEFNI.502	2 feet
.004"	TEFNI.504	20 feet
.005"	TEFNI.505	30 feet
.007"	TEFNI.507	50 feet
.010"	TEFNI.510	50 feet
.012"	TEFNI.512	50 feet
.015"	TEFNI.515	50 feet
.020"	TEFNI.520	50 feet

#### 1/16" OD EFNi tubing

Custom lengths

Prices are per foot. See pricing note in box at left.

Tubing ID	Prod No	Max length
.020"	TEFNI120	25 feet
.030"	TEFNI130	35 feet
.040"	TEFNI140	50 feet

#### PRICING PER FOOT

For pricing purposes, the length is rounded up to the next foot. For example, a 5" piece is charged as one foot; an 18" piece as two feet. The price per foot is based on the length of each piece, not the total quantity ordered. Cutting and cleaning charges are included in the price per foot for EFNi tubing.

#### CONVERSIONS

0.05 mm = .002" 0.10 mm = .004" 0.12 mm = .005" 0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180"  $6.0 \, \text{mm} = .236$ "  $6.4 \, \text{mm} = .253$ "  $7.0 \, \text{mm} = .275$ " 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1.6 mm 1/8"  $= 3.2 \, \text{mm}$ 1/4"  $= 6.4 \, \text{mm}$ 3/8"  $= 9.5 \, \text{mm}$ 1/2" = 12.7 mm

#### **TUBING**

VICI electrochemically plates PEEK and fused silica tubing with pure nickel. This strengthens the tubing and allows direct connections using metal ferrules while maintaining the chemical benefits of the wetted surfaces inside.



#### Nickel-clad fused silica

- Inert, flexible transfer lines
- Improved heat transfer
- Thick wall version allows direct connection using metal ferrules
- Rated for up to 40,000 psi (dependant on size and plating thickness)

We take polyimide-coated fused silica (FS) and remove the polyimide layer. Then we electrochemically plate the FS with pure nickel. The resulting nickel-plated FS tube provides superior heat transfer to the FS lining, permitting use as a flexible transfer line with the best qualities of silica-lined stainless but with improved heat transfer and a shorter bend radius.

For high pressure applications, we recommend using our 1/32" 316 stainless ferrules.

1/32" OD tubing is available in IDs from 10 to 250 µm, permitting use of metal ferrules for improved leak-tight connections.

#### 800µm (1/32") OD nickel-clad fused silica Custom lengths

Tubing ID	Prod No
10 μm	TNFS800360010
15 μm	TNFS800360015
20 μm	TNFS800360020
25 μm	TNFS800360025
50 μm	TNFS800360050
100 μm	TNFS800360100
180 μm	TNFS800360180
250 μm	TNFS800360250



## Nickel-clad polyimide-coated fused silica

- Thin wall version for resistive heating offers improved heat transfer as compared to wire-wrapped designs
- Thin wall version results in column packages with even less mass, critical when temperature measurement is based on the change in resistance

Any polyimide-coated FS can be electroplated with pure nickel. This results in a ruggedized traditional FS column (or transfer line with deactivated FS), which can be resistively heated, if desired. Temperature is measured using the resistance of the nickel, removing any need for external sensors. A thin-wall, low mass version optimized for resistive heat applications is available in eight different diameters. We offer several options for tubing connections.

Please contact the factory to discuss your application.

#### **TECH TIP**

For best results, order clad tubings in the precise length required. Clean cuts are difficult to achieve with the tools normally available.

#### PRICING PER FOOT

For pricing purposes, the length is rounded up to the next foot. For example, a 5" piece is charged as one foot; an 18" piece as two feet. The price per foot is based on the length of each piece, not the total quantity ordered. Cutting and cleaning charges are included in the price per foot for TNF tubing.



#### **Nickel-clad PEEK**

1015 μm

- Permits use of PEEK tubing at 30,000 psi
- Direct connection with metal ferrules

Since we can manufacture virtually any size of PEEK tubing from 360 µm OD/.002" ID on up, the possibilities are endless. In any size, the mechanical properties of nickel combined with the chemical properties of PEEK produce enhanced performance with robust metal ferrule connections.

<b>NEW</b> Nicke	l-clad PEEK		Custom lengths
<b>Tubing OD:</b> <i>Tubing ID</i>	<b>800 μm (1/32")</b> Prod No	<b>1600 μm (1/16")</b> <i>Prod No</i>	
50 μm	TNPK800360050	TNPK16001140050	
75 μm	TNPK800360075	TNPK16001140075	
100 μm	TNPK800360100	TNPK16001140100	
125 μm	TNPK800360125	TNPK16001140125	
180 µm	TNPK800360180	TNPK16001140180	
205 μm	TNPK800360205	_	
250 μm	TNPK800404250	TNPK16001140250	
305 µm	TNPK800510305	TNPK16001140305	
380 μm	TNPK800535380	_	
510 μm	TNPK800660510	TNPK16001140510	
760 µm	_	TNPK16001140760	

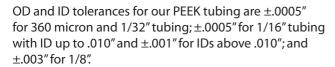
#### CONVERSIONS

50 µm = .002" 75 µm = .003" 100 µm = .004" 125 µm = .006" 150 µm = .006" 180 µm = .007" 205 µm = .010" 305 µm = .012" 380 µm = .015" 510 µm = .020" 760 µm = .030" 1015 µm = .040" 800 µm = 1/32" 1600 µm = 1/16" TNPK160011401015

#### **TUBING**

#### **Natural PEEK tubing**

PEEK tubing has the strength required to withstand continuous use at HPLC pressure without swelling or bursting, and is not affected by halide salts, high strength buffers, or other aggressive mobile phases that corrode stainless steel. The polymer surface will not leach metal ions into the eluent or extract metal-sensitive components from the sample. Note, however, that dichloromethane, THF, and DMSO may cause swelling in PEEK, and concentrated nitric and sulphuric acid will attack PEEK.





#### 360 µm PEEK tubing

Custom lengths

Custom-length 360  $\mu m$  PEEK tubing is square-cut and ready to use. Specify the length required, in meters

	.002" ID	.004" ID	.005" ID	.006" ID
	Prod No	Prod No	Prod No	Prod No
Priced per meter	TPK.102	TPK.104	TPK.105	TPK.106

#### 1/32" OD PEEK tubing

	.0025" ID	.005" ID	.010" ID	.015" ID
Length	Prod No	Prod No	Prod No	Prod No
5 meters	TPK.502-5M	TPK.505-5M	TPK.510-5M	TPK.515-5M
10 meters	TPK.502-10M	TPK.505-10M	TPK.510-10M	TPK.515-10M
25 meters	TPK.502-25M	TPK.505-25M	TPK.510-25M	TPK.515-25M

#### 1/16" OD PEEK tubing

	.006" ID	.010" ID	.020" ID	.030" ID
Length	Prod No	Prod No	Prod No	Prod No
5 meters	TPK106-5M	TPK110-5M	TPK120-5M	TPK130-5M
10 meters	TPK106-10M	TPK110-10M	TPK120-10M	TPK130-10M
25 meters	TPK106-25M	TPK110-25M	TPK120-25M	TPK130-25M

#### 1/8" OD PEEK tubing

	.060" ID
	לו 1000.
Length	Prod No
5 meters	TPK260-5M
10 meters	TPK260-10M
25 meters	TPK260-25M

#### **PEEK TUBING ELBOWS**

Tubing elbows (90° and 180°) are ideal for routing 1/16" PEEK tubing through an LC system. These elbows are proportioned to bend PEEK tubing at the optimum radius for maximum chemical resistance and burst pressure. Installation is simple – just snap the tubing into the elbow.

 Package of 5:
 Prod No

 90° elbow
 JR-357090-5

 180° elbow
 JR-357180-5



#### MORE INFORMATION

Polymeric tubing
PTFE ...... page 92
FEP...........92
ETFE.........92

## CUSTOM PEEK TUBING

We offer PEEK tubing custom-manufactured to meet your specific OD, ID, and color requirements. The OD range is .014" (360 micron) to 1/8", with a minimum ID of .002" for tubing up to 1/16" OD. (Maximum ID varies according to the OD.) Color coding can be solid or striped.



## Color-coded PEEK tubing

Color-coded tubing helps you identify the ID of your PEEK tubing – each ID is coded with a different color. Use this tubing where maximum chemical resistance and biocompatibility are required.

#### 1/16" OD dual layer color-coded PEEK tubing

Custom lengths

Our dual layer PEEK tubing eliminates any concern that a critical sample stream could be contaminated by the pigments used to color code the tubing.\* It looks like any other color-coded tubing at first glance, but a closer look reveals that the pigmented layer surrounds a separate but integrally-bonded inner layer of natural PEEK.

Tubing ID	Color	bar	psi	Prod No
.004"	Black	460	6700	JR-TD-5804
.005"	Red	420	6100	JR-TD-6007
.007"	Yellow	400	5800	JR-TD-6008
.010"	Blue	386	5600	JR-TD-6009
.020"	Orange	350	4500	JR-TD-6010
.030"	Green	240	3500	JR-TD-6011



#### 1/16" OD striped color-coded PEEK tubing

Custom lengths

A stripe is added to the outside, so dye never contacts the fluid stream.\*

Specify the length required, in inches or feet. For pricing custom tubing, the length is rounded up to the next foot. For example, a 5" piece is charged as one foot; an 18" piece as two feet.

Tubing ID	Color	bar	psi	Prod No
.004"	Black	460	6700	JR-T-5804
.005"	Red	420	6100	JR-T-5999
.007"	Yellow	400	5800	JR-T-6000
.010"	Blue	386	5600	JR-T-6001
.020"	Orange	350	4500	JR-T-6002
.030"	Green	240	3500	JR-T-6003
.040"	Grey	165	2400	JR-T-60031

#### 1/16" OD striped color-coded PEEK tubing

Pre-cut kits

A stripe is added to the outside, so dye never contacts the fluid stream.\*

Includes 15 pieces of tubing; 5 each of 5 cm, 10 cm, and 20 cm pre-cut lengths.

Tubing ID	Color	bar	psi	Prod No	
.005"	Red	420	6100	JR-T-98013	
.007"	Yellow	400	5800	JR-T-98017	
.010"	Blue	386	5600	JR-T-98025	
.020"	Orange	350	4500	JR-T-98050	
.030"	Green	240	3500	JR-T-98075	•
	ne of each ab ces total)	ove product	number	JR-T-98200	

<sup>\*</sup>All colorants used in the manufacture of this tubing are RoHS-compliant (Restriction of Hazardous Substances)

#### CONVERSIONS

10 ft = 3.05 m 25 ft = 7.62 m 100 ft = 30.48 m  $50 \mu\text{m} = .002"$   $100 \mu\text{m} = .004"$   $125 \mu\text{m} = .005"$   $150 \mu\text{m} = .006"$  0.25 mm = .010" 0.50 mm = .020" 0.75 mm = .030" 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080" 4.6 mm = 180"

6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400"

27.0 mm = 1.08"

1/32" = 0.8 mm 1/16" = 1.6 mm 1/8" = 3.2 mm 1/4" = 6.4 mm

1/4" = 6.4 mm 3/8" = 9.5 mm 1/2" = 12.7 mm

#### **TUBING**

## PTFE, FEP, and ETFE tubing

Polymeric tubing is square cut and ready to use. Each package of polymeric tubing contains one piece of the specified length.

See also PEEK tubing, pages 90-91.



#### 1/16" OD polymeric tubing

	Prod No	.006" ID Prod No	.010" ID Prod No	.015" ID Prod No	<b>.020" ID</b> Prod No	.030" ID
PTFE	1100110	1100110	1100110	1100110	1100110	
	5 meters	TTF106-5M	TTF110-5M	TTF115-5M	TTF120-5M	TTF130-5M
	10 meters	TTF106-10M	TTF110-10M	TTF115-10M	TTF120-10M	TTF130-10M
	25 meters	TTF106-25M	TTF110-25M	TTF115-25M	TTF120-25M	TTF130-25M
FEP						
	5 meters	_	TFEP110-5M	_	TFEP120-5M	TFEP130-5M
	10 meters	_	TFEP110-10M	_	TFEP120-10M	TFEP130-10M
	25 meters	_	TFEP110-25M	_	TFEP120-25M	TFEP130-25M
ETFE						
	5 meters	_	TTZ110-5M	_	TTZ120-5M	TTZ130-5M
	10 meters	_	TTZ110-10M	_	TTZ120-10M	TTZ130-10M
	25 meters	_	TTZ110-25M	_	TTZ120-25M	TTZ130-25M

#### 1/8" OD polymeric tubing

DTEE	Prod No	.030" ID Prod No	.060" ID Prod No	.085" ID
PTFE	5 meters	TTF230-5M	TTF260-5M	TTF285-5M
	Jilleters	111230-3111		
	10 meters	TTF230-10M	TTF260-10M	TTF285-10M
	25 meters	TTF230-25M	TTF260-25M	TTF285-25M
FEP				
	5 meters	_	TFEP260-5M	_
	10 meters	_	TFEP260-10M	_
	25 meters	_	TFEP260-25M	_
ETFE				
	5 meters	_	TTZ260-5M	_
	10 meters	_	TTZ260-10M	_
	25 meters	_	TTZ260-25M	_
<ul><li>Not a</li></ul>	vailable			

#### **CLEAN-CUT POLYMER TUBING CUTTER**

For leak-free tubing connections in an LC system, right angles and clean cuts are essential. The Clean-Cut makes burr-free perpendicular cuts on polymeric tubing without distorting the outside diameter or closing the inside diameter. The handy pocket-sized tool features a unique safety locking mechanism to secure the blade when not in use.

Prod No
Clean-Cut tubing cutter JR-797
Replacement blade JR-798





#### **TUBING CLIP - THE LC TUBING ORGANIZER**

The tubing clip holds 1/16" and 1/8" polymer tubing precisely where you want them in your beakers, flasks, bottles, etc. up to 4 mm wall thickness. The stainless steel spring ensures a long lifetime.

Package of 5: Prod No
Tubing clip JR-9001-5

#### MORE INFORMATION

PEEK tubing	
Natural	. page 90
Color-coded	91
Striped	91

#### **CUSTOM LENGTHS**

Custom lengths of PTFE tubing up to a maximum of 250' available on request. Additional charges may apply.

#### **TUBING POLYMERS**

PTFE Inert; very soft, easily cold flows. Produced as Teflon®

FEP Chemically resistant like PTFE, but lower creep and higher friction. More transparent than PTFE.

ETFE Resistant to most chemical attack; some chlorinated solvents will cause tubing to swell.
Produced as Tefzel®

#### **CONVERSIONS**

10 ft = 3.05 m 25 ft = 7.62 m 100 ft = 30.48 m

## Metal tubing, bulk quantities

Bulk metal tubing is not electrolytically cut or cleaned. The annealing process provides tubing which is sufficiently clean for most chromatography applications. (See note at left for custom-cleaned tubing.)

To order, specify the length required in one meter increments.

## CLEANED CUSTOM LENGTH TUBING

You can order custom length tubing which has been electrolytically cut, deburred, and steam cleaned. Please contact VICI or your local distributor for product numbers and pricing.

The maximum lengths available depends on the ID of the tubing:

Tubing	Max
ID	length
.005"	90 cm
.007"	150 cm
.010"	300 cm
.020"	600 cm
.026"	1200 cm
.030"	1500 cm
>.030"	1500 cm

Tubing up to 6 feet in length will be supplied straight. Longer tubes will be supplied coiled.

#### CONVERSIONS

CONVERSIONS						
50 μm	= .002"					
100 μm	= .004"					
125μm	= .005"					
150 μm	= .006"					
0.25 mm	= .010"					
0.50 mm	= .020"					
0.75 mm	= .030"					
1.0 mm	= .040"					
1.5 mm	= .060"					
2.0 mm	= .080"					
4.6 mm	= .180"					
6.0 mm	= .236"					
6.4 mm	= .253"					
7.0 mm	= .275"					
10.0 mm	= .400"					
27.0 mm	= 1.08"					
1/32" =	0.8 mm					
1/16" =	1.6 mm					
1/8" =	3.2 mm					
1/4" = 3/8" =	6.4 mm 9.5 mm					

1/2" = 12.7 mm

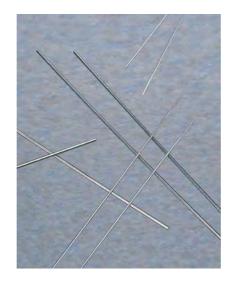
316 s	tainless				Bulk quantities	
	Tubing ID	<b>1/32" OD</b> <i>Prod No</i>	<b>1/16" OD</b> <i>Prod No</i>	<b>1/8" OD</b> Prod No		
	.005" .007"	TSS.505 TSS.507	TSS105	_		
	.010"	TSS.510	TSS110	_		
	.015" .020"	— TSS.520	TSS115 TSS120	<u> </u>		
	.026" .030" .040"	_ _ _	TSS126 TSS130 TSS140	— TSS230 TSS240		
	.060" .070" .085"	_ _ _	_ _ _	TSS260 TSS267 TSS285		
Nicke	l 200				Bulk quantities	
	T. 1. 10	1/32" OD	1/16" OD	1/8" OD		
	Tubing ID	Prod No	Prod No	Prod No		
	.005" .010"	— TNI.510	TNI105	_		
	.020"	TNI.520	TNI120	_		
	.030"	_	TNI130	_		
	.040" .085"	_	TNI140 —	TNI285		
Haste	lloy C				Bulk quantities	
	Tubing ID	<b>1/32" OD</b> <i>Prod No</i>	<b>1/16" OD</b> <i>Prod No</i>	1/8" OD Prod No		
	.010" .020"	_	THC110 THC120	_		
	.030" .040"	_	THC130 THC140			
	.070" .085"	_		THC270 THC285		
Inconel 600 Bulk quantities						
	Tubing ID	<b>1/32" OD</b> <i>Prod No</i>	<b>1/16" OD</b> <i>Prod No</i>	1/8" OD Prod No		
	.061" .082"	_	_	TINCO261 TINCO282		
- Not normally available						

#### **TUBING**

#### Pre-cut stainless tubing

These packages of pre-cut Type 316 stainless tubing provide an economical solution to the problems that are caused by "seat-of-the-pants" cutting in the lab or field. They are priced to give a saving over the charge for custom-cut tubing.

All tubing is electrolytically cut and specially steam-cleaned with micro-filtered steam from deionized water, which removes both organic and inorganic contaminants.



#### 1/32" OD stainless tubing

Pre-cut lengths

		<u>,                                     </u>	
	.005" ID	.010" ID	.020" ID
Length	Prod No	Prod No	Prod No
2 pieces per packag	е		
5 cm	T5N5D	T5N10D	T5N20D
10 cm	T10N5D	T10N10D	T10N20D
20 cm	T20N5D	T20N10D	T20N20D
30 cm	T30N5D	T30N10D	T30N20D
50 cm	T50N5D	T50N10D	T50N20D
100 cm	_	T100N10D	T100N20D
10 pieces per packa	ge		
5 cm	T5N5-10	T5N10-10	T5N20-10
10 cm	T10N5-10	T10N10-10	T10N20-10
20 cm	T20N5-10	T20N10-10	T20N20-10
30 cm	T30N5-10	T30N10-10	T30N20-10
50 cm	T50N5-10	T50N10-10	T50N20-10
100 cm	_	T100N10-10	T100N20-10
50 pieces per packa	ge		
5 cm	T5N5-50	T5N10-50	T5N20-50
10 cm	T10N5-50	T10N10-50	T10N20-50
20 cm	T20N5-50	T20N10-50	T20N20-50
30 cm	T30N5-50	T30N10-50	T30N20-50
50 cm	T50N5-50	T50N10-50	T50N20-50
100 cm	_	T100N10-50	T100N20-50
100 pieces per pack	age		
5 cm	T5N5-100	T5N10-100	T5N20-100
10 cm	T10N5-100	T10N10-100	T10N20-100
20 cm	T20N5-100	T20N10-100	T20N20-100
30 cm	T30N5-100	T30N10-100	T30N20-100
50 cm	T50N5-100	T50N10-100	T50N20-100
100 cm	_	T100N10-100	T100N20-100

#### **TECH TIP**

Forty years of Valco experience show that the particles left in poorly cut tubing are the number one cause of valve damage.

#### CONVERSIONS

5 cm = 1.97" 10 cm = 3.94" 20 cm = 7.87" 30 cm = 11.82" 50 cm = 19.68" 100 cm = 39.37" 0.12 mm = .005" 0.25 mm = .010" 0.50 mm = .020"  $0.75 \, \text{mm} = .030$ " 1.0 mm = .040" 1.5 mm = .060" 2.0 mm = .080"4.6 mm = .180" 6.0 mm = .236" 6.4 mm = .253" 7.0 mm = .275" 10.0 mm = .400" 27.0 mm = 1.08"  $1/32" = 0.8 \, \text{mm}$ 1/16" = 1.6 mm $1/8" = 3.2 \, \text{mm}$ 1/4" = 6.4 mm $3/8" = 9.5 \, \text{mm}$ 1/2" = 12.7 mm

#### 1/16" OD stainless tubing

#### Pre-cut lengths

	Length	.005" ID Prod No	<b>.010" ID</b> <i>Prod No</i>	<b>.020" ID</b> <i>Prod No</i>	<b>.030" ID</b> <i>Prod No</i>	<b>.040" ID</b> <i>Prod No</i>
2 pieces p	er package					
	5 cm 10 cm 20 cm	T5C5D T10C5D T20C5D	T5C10D T10C10D T20C10D	T5C20D T10C20D T20C20D	T5C30D T10C30D T20C30D	T5C40D T10C40D T20C40D
	30 cm 50 cm 100 cm	T30C5D T50C5D —	T30C10D T50C1 0D T100C10D	T30C20D T50C20D T100C20D	T30C30D T50C30D T100C30D	T30C40D T50C40D T100C40D
10 pieces	per packag	e				
	5 cm 10 cm 20 cm	T5C5-10 T10C5-10 T20C5-10	T5C10-10 T10C10-10 T20C10-10	T5C20-10 T10C20-10 T20C20-10	T5C30-10 T10C30-10 T20C30-10	T5C40-10 T10C40-10 T20C40-10
	30 cm 50 cm 100 cm	T30C5-10 T50C5-10	T30C10-10 T50C10-10 T100C10-10	T30C20-10 T50C20-10 T100C20-10	T30C30-10 T50C30-10 T100C30-10	T30C40-10 T50C40-10 T100C40-10
50 pieces	per packag	e				
	5 cm 10 cm 20 cm	T5C5-50 T10C5-50 T20C5-50	T5C10-50 T10C10-50 T20C10-50	T5C20-50 T10C20-50 T20C20-50	T5C30-50 T10C30-50 T20C30-50	T5C40-50 T10C40-50 T20C40-50
	30 cm 50 cm 100 cm	T30C5-50 T50C5-50	T30C10-50 T50C10-50 T100C10-50	T30C20-50 T50C20-50 T100C20-50	T30C30-50 T50C30-50 T100C30-50	T30C40-50 T50C40-50 T100C40-50
100 piece	s per packa	ge				
	5 cm 10 cm 20 cm	T5C5-100 T10C5-100 T20C5-100	T5C10-100 T10C10-100 T20C10-100	T5C20-100 T10C20-100 T20C20-100	T5C30-100 T10C30-100 T20C30-100	T5C40-100 T10C40-100 T20C40-100
	30 cm 50 cm 100 cm	T30C5-100 T50C5-100	T30C10-100 T50C10-100 T100C10-100	T30C20-100 T50C20-100 T100C20-100	T30C30-100 T50C30-100 T100C30-100	T30C40-100 T50C40-100 T100C40-100

#### **CLEANED CUSTOM LENGTH TUBING**

You can order custom length tubing which has been electrolytically cut, deburred, and steam cleaned. Please contact VICI or your local distributor for product numbers and pricing.

The maximum lengths available depends on the ID of the tubing:

Tubing ID	Max length
.005"	90 cm
.007"	150 cm
.010"	300 cm
.020"	600 cm
.026"	1200 cm
.030"	1500 cm
>.030"	1500 cm

Tubing up to 6 feet in length will be supplied straight. Longer tubes will be supplied coiled.

VOLUME	CHART					
Tubing	Volu	me	Tubing	Volu	me	
ID			ID			
	μl/cm	μl/in		μl/cm	μl/in	
.005"	0.13	0.32	.030"	4.56	11.58	
.010"	0.51	1.29	.040"	8.11	20.59	
.015"	1.14	2.90	.060"	18.24	46.33	
.020"	2.03	5.15	.070"	24.83	63.06	
.025"	3.17	8.04	.085"	36.61	92.99	

Typical ID tolerances for our tubing are  $\pm .001$ ". This is much tighter than normal commercial grades of tubing; however, it is enough to result in noticeable error if exact volumes are not measured.

# Valve selection

#### **QUICK OVERVIEW OF OUR LINE-UP**

Following is an overview of the many types of valves available from VICI.

#### **Valco Injectors and Valves for GC**

pages 98-101, 104-113

For over 40 years Valco valves have been the industry standard in gas chromatography. Models are available with 3, 4, 6, 8, 10, 12, or 14 ports, with 1/32", 1/16", 1/8", or 1/4" fittings, and with bore sizes from 0.25 mm (.010") to 4 mm (.156"). In addition, Valco valves offer the widest range of rotor and body materials of any valve available, with alloys and polymer composites capable of meeting virtually any system requirement. All models can be ordered in manual, pneumatic, or electrically actuated versions.



#### **Valco Injectors and Valves for HPLC**

pages 101, 114-118

A pioneer and industry leader in products for HPLC, Valco continues to offer the market's most diverse line in terms of number of ports, fitting sizes, materials of construction, and actuation. Versions with 3, 4, 6, 8, 10, 12 port are offered, with 1/32", 1/16", or 1/8" fittings. As with the GC line, Valco valves offer the widest range of rotor and body materials of any valves available, with alloys and polymer composites capable of meeting virtually any system requirement. All models can be ordered in manual, pneumatic, or electrically actuated versions.



#### **Valco Selectors**

pages 102-103, 124-135

One inherent benefit of the Valco conical rotary design is that it allows multiple planes of ports, facilitating unique multiposition configurations useful for stream selection, column selection, or trapping. Versions are available for GC and HPLC applications, with 1/16", 1/8", or 1/4" fittings, with bore sizes from 0.40 to 4.0 mm (.016" to .156"). Selectors are available for up to 16 streams (34 ports), all with Valco's trademark flexibility in terms of actuation and material options.



#### **Diaphragm Valves for GC**

pages 142-145

A diaphragm valve consists of plungers and ports arranged in a circular pattern, with the plungers controlled by the reciprocating action of two air actuated pistons. Extremely long lifetime (typically 1,000,000 cycles at ambient temperature; approximately 500,000 cycles at elevated temperatures), very short actuation time (10 milliseconds), minimum internal dead volume, and reliability have made this type of valve very successful in process gas chromatography for both sample injection and column switching. Our miniature version features 1/16" or 1/32" zero dead volume fittings, and is the first to offer a 10 port configuration in addition to the 6 port and internal sample 4 port models.





#### **VALVE SELECTION**









#### **Cheminert UHPLC Injectors**

pages 146-148, 154-157

Many current analytical techniques require systems capable of pressures as high as 20,000 psi. UHPLC injectors from Cheminert feature a proprietary rotor material and stator coating that permit these pressures. Injectors are available in a variety of configurations, including models with a vertical injection port.

Nanovolume® UHPLC injectors feature a uniform flowpath as small as 100 microns (.004"). Specially-designed fittings allow direct connection of 360 micron OD PEEK, fused silica, or electroformed nickel tubing. Versions are also available with standard 1/32" or 1/16" fittings. Microbore UHPLC injectors offer flowpaths of 0.25 mm (.010"), with a choice of 1/32" or 1/16" fittings.

#### **Cheminert HPLC Injectors and Valves**

pages 146-149, 158-165

The Cheminert HPLC line includes 4, 6, 8, and 10 port versions. The submicroliter injector has an injection volume as small as 10 nanoliters, and Nanovolume internal sample injectors offer a volume down to 4 nanoliters. Valves feature 1/32" and 1/16" zero dead volume fittings, with bore sizes from 100  $\mu m$  (.006") to 0.75 mm (.030") for nanobore, microbore, and analytical applications. Most models are available in manual, air, or electrically actuated versions, and some can be ordered with a proprietary coated stainless stator and high-strength PAEK rotor to ensure long periods of maintenance-free operation.

#### Cheminert Injectors and Valves for Low Pressure Applications

pages 146, 150, 166-169

Cheminert's two position design offers 4,6,8, or 10 port configurations. The design features a choice of Valco 1/16" zero dead volume fittings or 1/4-28 Cheminert internal fittings for 1/16" or 1/8" OD tubing. All models are available in manual, air, or electrically actuated versions.

#### **Cheminert Selectors**

pages 152-153, 172-179

Choose among 4, 6, 8, 10, 14, 20, 24, or 28 position stream selection valves, in high pressure and low pressure models, plus UHPLC selectors for up to 10 streams. A variety of configurations are available with bore sizes from 0.10 mm (.004") for HPLC column selection to 4.6 mm (.180") for applications requiring minimal restriction across the valve. Metal or all-polymeric valves can be ordered, with models available in manual, pneumatic, or electrically actuated versions.

#### 40,000 psi Ultra-High Pressure Injector System

page 84

The VICI 40K injector is comprised of six miniature air actuated needle valves, plumbed to simulate the flow path of a conventional rotor/stator injector. An integral controller sends the on/off positioning signals to each valve, coordinating them to perform load, inject, and flush functions.

#### **FOR OEMs**

See our injectors for autosamplers and our new low and high pressure integrated motor/injector and motor/selector assemblies designed specifically to be built into OEM systems.

HPLC ....... pages 151, 180-183 Low pressure ......151, 184-185 Selectors ......153, 186-187



# Valco valves

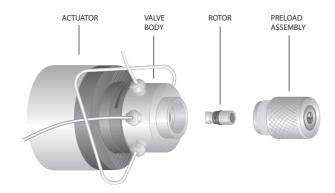
## FOR INJECTION, SWITCHING, AND STREAM SELECTION

- 1/32", 1/16", 1/8", or 1/4" Valco ZDV fittings
- 3,4,6,8,10,12, and 14 port and internal sample two position versions
- Five multiposition flowpath configurations with as many as 16 positions
- A variety of materials for hostile environments and continuous use at elevated temperature
- Can be configured for use at temperatures up to 350°C or pressures up to 5,000 psi

The Valco design lends itself to a unique variety of connecting slots and port arrangements. The rotor is held in place by a preload assembly, which allows rotor replacement without removing loops and tubing and without disengaging the valve from the actuator or mounting bracket.

In addition, the preload assembly ensures that the valve is always reassembled to the factory-set tension.

**Two position injector** and valve descriptions are on page 101; product numbers and prices begin on page 104. For information on **selectors**, refer to pages 102-3.



#### **TECH TIP**

For optimal zero dead volume connections, make sure your tubing meets the best industry standards. The OD tolerance should be nominal dimension ± .002".

Fractional dimension	Nominal dimension
aimension	diffiension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500

#### MORE INFORMATION

Decoding Valco valve product no's... 266-269

#### **Valve descriptions**

Cheminert injectors and valves..... 146-151 Cheminert selectors ...146, 152-153 Diaphragm...... 142-143 Valco two position.....101 Valco selectors ... 102-103

#### Valco valve prices

GC	104-113
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The standard valve body material is Nitronic 60, a gall-resistant stainless steel which has proven superior to Type 316 or 303 in the majority of applications. Valves may also be ordered in Hastelloy C-22, Inconel 600, Type 316 stainless, Monel 400, Nickel 200, Nitronic 50, or Titanium.

Medium temperature GC valves have a rotor made of Valcon E, a polyaryletherketone/PTFE composite. The high temperature versions use a polyimide/PTFE/carbon composite designated Valcon T. Valcon H, a carbon-fiber-reinforced, PTFElubricated inert polymer, is standard in HPLC valves.

Appropriate fittings are supplied with all valves. Valves rated at 1000 psi or less have Type 303 stainless ferrules; those rated above 1000 psi have Type 316 stainless ferrules. A valve ordered with an optional body material is supplied with ferrules of the same material as the body, with Type 316 stainless nuts.

#### **Specifying a Special Body Material**

To specify a special valve body material, add the material code to the end of the valve product number. Contact the factory for the additional cost.

#### Example:

An A4C6WE (air actuated 1/16" 6 port WE valve with a 4" standoff) made of Hastelloy C-22 would be designated A4C6WEHC.

Due to design requirements, several special grades of stainless steel may be used where "HPLC grade" is noted. The specific types include Nitronic 60, Type 316 stainless steel, and Type 316L stainless steel. VICI will select the material to be used based on availability and quality. HPLC grade stainless is the standard material for all Valco two position valves and high pressure multiposition valves.

SPECIAL BODY I	MATERIAL — COI	DES	
<b>TWO POSITION</b> Body material	<b>VALVES</b> <i>Code</i>	MULTIPOSITIO Body material	ON VALVES Code
HPLC grade Stainless steel	SS	HPLC grade Stainless steel	SS
Hastelloy C-22	HC	Hastelloy C-22	HC
Inconel 600	IN	Inconel 600	IN
Monel 400	M4	Monel 400	M4
Nickel	NI	Nickel	NI
Nitronic 50	N5	Nitronic 50	N5
Titanium *	TI	Titanium *	TI
* Not available for	WT, UWT, or T series	valves (high temp) due to	material temperature limit.

#### MORE INFORMATION

Materials

Metals..... pp 254-255 Polymers . . . . . . . . . . . 256 Valve rotors.....257

#### **Reliably Clean**

All finished valve bodies are ultrasonically cleaned with water soluble detergents and then rinsed with hot deionized water. Finally they are given a thorough cleaning with steam from deionized water.

During valve assembly each part is cleaned with isopropanol and dried with filtered and dehumidified air. The valves are then heated and switched prior to being leak tested.

#### **Precautions**

After unpacking the valve, do not remove the protective tape from the valve ports until you are ready to install the valve. As supplied, all surfaces are clean and free of contaminants, and must be kept clean to prevent valve damage. Open ports and fittings cause unnecessary risk of particulate matter entering the valve and scratching the sealing surfaces, which is the most frequent cause of premature valve failure.

The most common source of contamination is particulates from tubing or unfiltered samples, or samples which leave

a solid residue on drying (e.g. buffers).

Care should be taken that particles do not enter the valve.

TECH TIP
See Technical Note 201,
"Operation Notes and
Cleaning Instructions"
for more detailed
information about
unpacking and handling

the valve.

## **Leak Testing**

The standard test methods for cross-port and outport leakage insure valve performance at pressures and temperatures up to the specifications listed. For valves used on mass spectrometers or for ultra-trace fixed gas analysis, we recommend an optional test method utilizing a helium mass spectrometer, which provides data on mechanical leaks and on those due to seal porosity and permeability. With this method, we can certify leak rates as low as  $10^{-10}$  cc-atm/sec.

Please consult the factory prior to ordering, since the minimum leak rate will vary widely depending on valve configuration.

# Leak Rates for Gas Sampling Valves

The actual minimum leak rates attainable vary widely with seal material and valve type. In general, the acceptable leak rates fall into three ranges. (See chart below.)

In order to seal to less than 10<sup>-7</sup>, the valve loading tension is increased, which somewhat lowers the maximum operating temperature and the valve lifetime. Currently, only select material can seal to 10<sup>-8</sup> in most valve styles. Valcon M rotor material can seal to 10<sup>-10</sup>, but has a temperature limit of 50°C.

Not all valves can achieve these leak rates. As a general rule, the larger the valve seal and port size, the higher the leak rate.

# Test Method for Liquid Sampling Valves

The standard test method for liquid valves is a pressure drop over time for both crossport and outport leakage, using isopropanol at the specified test pressure. This test is designed to ensure proper performance at the specification limit.

#### **RANGES FOR ACCEPTABLE LEAK RATES**

10<sup>-4</sup> to 10<sup>-5</sup> cc-atm/sec

**Commercial use** 

Not normally sold by VICI

10<sup>-6</sup> to 10<sup>-7</sup> cc-atm/sec

**General GC use** 

10<sup>-8</sup> to 10<sup>-10</sup> cc-atm/sec

Standard tension and components

Ultra trace gas analysis (ppb range)

Higher tension and specially

processed stator and rotor material

#### OPTIONAL LEAK TESTING with Helium Mass Spectrometer

To order a valve certified to have helium leak rates less than 10<sup>-7</sup> cc-atm/sec, add the suffix "Z" to the valve product number and contact the factory for the price.

Certified valves are supplied with gold-plated stainless steel ferrules.

We can generally tell you what leak rate is possible prior to manufacturing the valve.



Two position injectors and switching valves have many applications, as shown in the section beginning on page 119. In this catalog, Valco two position valves are divided into GC and HPLC sections, with the GC section starting on page 104 and the HPLC section on page 114.

#### **Sample Injectors**

Since the most common method of sample injection utilizes a 6 port valve with an external sample loop, 6 port valves are often referred to as "injectors". However, as the Applications section shows, 6 port valves can do more than inject sample, and 8 and 10 port valves can be sample injectors at the same time they're also being backflushers or column switchers. One more variation is the 4 port internal sampling valve (pages 104-5 and 114), which is used when the sample size must be smaller than the smallest available loop. The internal sample "loop" is actually an engraved connecting slot on the rotor which is sized to contain a specified amount of sample.

#### **Sample Loops**

Loops are electrolytically cut and electrochemically polished to ensure square, burr-free ends, then cleaned with microfiltered steam from deionized water. Standard material is Type 316 stainless, but loops can be supplied in electroformed nickel, Hastelloy C, Nickel 200, titanium, or several polymers. Consult the factory for availability.

Valco sample loops are accurately sized for each valve type. However, with small volume loops, the tolerance on the ID of the tubing (±0.001") can have a significant effect on the volume. Therefore, loop volumes and loop appearance may differ from batch to batch.

#### **SPECIFICATIONS VALCO TWO POSITION VALVES** Standard Valve Max Max Max Max pressure type rotor temp pressure temp material Sampling and Internal sample injectors switching valves GC W and UW Valcon E 1000 psi liq 175°C 400 psi gas 225°C Valcon T 330°C 300 psi gas MW Valcon E2 100 psi gas 75°C **HPLC** W and UW Valcon H 5000 psi liq 75°C 5000 psi liq 75°C

#### **VALVE TYPES** Standard **Fitting** port diameter W Type 1/32" 0.25 mm (.010") 1/16" 0.40 mm (.016") **UW** Type 1/16" 0.75 mm (.030") 1/8" 0.75 mm (.030") MW Type 1/4" 4.0 mm (.156") For special port diameters, please consult the factory.

OPTIONAL	L ROTORS				
Valcon M	400 psi	50°C			
Valcon P	400 psi	175°C			
Valcon R	400 psi	75°C			
Valcon TF	200 psi	50°C			
See page 257 for a discussion of these optional rotor materials.					

# **MORE INFORMATION Actuation** .. pp 188-209

Applications . 119-123

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#### Valve descriptions

Cheminert injectors and valves . . . . 146-151 Cheminert selectors . . 146, 152-153 Diaphragm . . . . 142-153 Valco selectors . . 102-103

#### Valco valve prices

Instead of the back and forth switching of two position valves, selectors (multiposition valves) step incrementally through continuous revolutions (bi-directionally with universal and modular universal actuators). While we can supply older models, all the valves in this catalog have a preload assembly. This design allows the rotor to be inspected or replaced without taking the valve off the actuator, and valves ordered with a microelectric actuator are permanently aligned.

#### **Flowpath Configurations**

SD (dead-ended) valves select one of 4 to 16 dead-ended streams, directing it through the valve outlet to a sample valve, pressure sensor, detector, column, etc. The same configuration can also direct one stream to a number of outlets for fraction collection.

SC (common outlet) selectors are similar to SDs, except that instead of being dead-ended the non-selected streams flow to a common outlet.

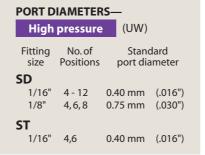
SF (flow-through) selectors are similar to SDs and SCs, selecting a stream and sending it to the outlet. However, SFs allow the non-selected streams to flow through individual outlets instead of a common outlet.

**ST** (trapping) selectors are used for multi-column, multi-sample, or multitrap operations.

#### STF (trapping/flow-through)

selectors are similar to STs, with the single difference being that the nonselected streams are returned to their own vents or sources rather than being dead-ended or trapped as they are in the standard ST configuration.

Low	pressure	(	MW)	
Fitting size	No. of Positions	n	Stand ort dia	dard Imeter
SD	1 051110115	P.	or c are	iiiictci
1/16"	4 - 16	0.75	mm	(.030"
1/8"	4 - 16	1.0	mm	(.040"
1/4"	4 - 10	4.0	mm	(.156"
sc				
1/16"	4 - 16	1.0	mm	(.040"
1/8"	4 - 16	1.0	mm	(.040"
1/4"	4 - 8	4.0	mm	(.156"
SF				
1/16"	4 - 16	1.0	mm	(.040"
1/8"	4 - 16	1.0	mm	(.040"
1/4"	4 - 8	4.0	mm	(.156")
ST				
1/16"	4 - 16	0.75	mm	(.030"
1/8"	4 - 16	1.0	mm	(.040"
STF				
1/16"	4 - 16	0.75	mm	(.030"
1/8"	4 - 16	1.0	mm	(.040"





#### MORE INFORMATION **Actuation** . . pp 188-209

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#### **Materials**

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#### **Selector prices**

ow pressure	
SD	124-125
SC	126-127
SF	128-129
ST	130-131
STF	132-133
High pressure	
SD	134
ST	135

Loops, if required, are found on corresponding valve pages.

For special port diameters, please consult the factory.

#### **Low Pressure Selectors**

Valco **MW Type** selectors are available with 1/16", 1/8", or 1/4" fittings. (For port diameters, refer to the chart on the preceding page.) The 1/16" and 1/8" selectors can be ordered with 4,6,8,10,12, or 16 positions, in any of the five flowpath configurations. Selectors with 1/4" fittings are available in SD, SC, and SF flowpaths: SDs have 4,6,8, or 10 positions; SCs and SFs have 4,6, or 8.

Although not shown in this catalog, MW selectors are also available in a higher temperature version. While actual specifications vary with the configuration, typical specifications are 200 psi and 330°C. Consult our technical staff for more information.

SPECI	FICATIONS	;						
VALC	O SELECTO	RS – Lo	w pressure	(MW)				
Fittings size	Number of positions	Standard rotor material	Max pressure	Max temp	Max pressure	Max temp	Max pressure	Max temp
	•		SD	)	SC			
			Dead- flowp		Common flowpa			
1/16" 1/8" 1/4"	4 - 16 4 - 8 10 - 16 4 - 8	Valcon E Valcon E Valcon E Valcon E2	400 psi gas 400 psi gas 200 psi gas 100 psi gas	200°C 200°C 200°C 75°C	200 psi gas 200 psi gas 200 psi gas 100 psi gas	200°C 200°C 200°C 75°C	.,	1/8" valves are ole in versions
			SF Flow-th flowp	rough	ST Trappi flowpa		ST Trapping/Flo flowp	w-through
1/16" 1/8" 1/4"	4 - 16 4 - 16 4 - 8	Valcon E Valcon E Valcon E2	200 psi gas 200 psi gas 100 psi gas	200°C 200°C 75°C	200 psi gas 200 psi gas –	200°C 200°C −	200 psi gas 200 psi gas –	200°C 200°C –

#### **High Pressure Selectors**

Valco **UW Type** high pressure selectors are available in SD and ST flowpaths. SD selectors with 1/16" fittings are available in 4, 6, 8, 10, or 12 positions, while 1/8" selectors can be ordered with 4, 6, 8, or 10 positions. ST flowpath UW selectors have 1/16" fittings, with either 4 or 6 positions. (For port diameters, refer to the chart on the preceding page.)

01 2011	FICATIONS SELECTO		n pressure	(UW)		
Fittings size	Number of positions	Standard rotor material	Max pressure	Max temp	Max pressure	Max temp
			SD Dead-e flowpa		ST Trappi flowpa	-
1/16" 1/8"	4 - 12 4 - 8	Valcon E Valcon E	5000 psi liq 5000 psi liq	75°C 75°C	5000 psi liq	75°C

#### Internal sample injectors, 1/32" fittings, 0.25 mm ports (.010")

W Type

**Med temp** 

0.25 mm

1/32"

Includes 2" standoff. Manual version is not available without standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply



Sample volume	<b>.06 μl</b>	<b>.1 μl</b>	<b>.2 μl</b>	<b>.5 μl</b>
	Prod No	Prod No	Prod No	Prod No
Manual with standoff	2NI4WE.06	2NI4WE.1	2NI4WE.2	2NI4WE.5
With air actuator	A2NI4WE.06	A2NI4WE.1	A2NI4WE.2	A2NI4WE.5
With microelectric actuator	EP2NI4WE.06	EP2NI4WE.1	EP2NI4WE.2	EP2NI4WE.5
Replacement valve	DNI4WE.06	DNI4WE.1	DNI4WE.2	DNI4WE.5
Replacement rotor	SSANI4WE.06	SSANI4WE.1	SSANI4WE.2	SSANI4WE.5

#### **SPECS** 1000 psi liq 175°C max

Nitronic 60 valve body Valcon E rotor

#### **OPTIONS**

- 3",4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

#### Internal sample injectors, 1/16" fittings, 0.40 mm ports (.016")

W Type

**Med temp** 0.40 mm Includes 2" standoff. Manual version has no standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply

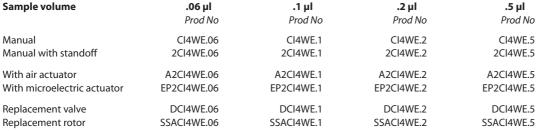


.5 µl Prod No CI4WE.5 2CI4WE.5

**SPECS** 1000 psi liq 175°C max Nitronic 60 valve body Valcon E rotor

#### **OPTIONS**

- 6 and 8 port valves available
- 3",4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)





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#### Internal sample injectors, 1/16" fittings, 0.75 mm ports (.030")

**UW Type** 

#### SPECS 1000 psi liq 175°C max

Nitronic 60 valve body Valcon E rotor

#### **OPTIONS**

- 6 and 8 port valves available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

Includes 2" standoff. Manual version has no standoff.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply



Med temp
Internal sample
1/16" 0.75 mm

Sample volume	<b>.2 μl</b>	. <b>5 μl</b>	<b>1 μl</b>	<b>2 μl</b>
	Prod No	Prod No	Prod No	Prod No
Manual	CI4UWE.2	CI4UWE.5	CI4UWE1	CI4UWE2
Manual with standoff	2CI4UWE.2	2CI4UWE.5	2CI4UWE1	2CI4UWE2
With air actuator With microelectric actuator	A2CI4UWE.2	A2CI4UWE.5	A2CI4UWE1	A2CI4UWE2
	ED2CI4UWE.2	ED2CI4UWE.5	ED2CI4UWE1	ED2CI4UWE2
Replacement valve	DCI4UWE.2	DCI4UWE.5	DCI4UWE1	DCI4UWE2
Replacement rotor	SSACI4UWE.2	SSACI4UWE.5	SSACI4UWE1	SSACI4UWE2

#### Internal sample injectors, 1/8" fittings, 0.75 mm ports (.030")

**UW Type** 

#### SPECS 1000 psi liq 175°C max

Nitronic 60 valve body Valcon E rotor

#### **OPTIONS**

- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

Includes 2" standoff. Manual version has no standoff.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply



Med temp
nternal sample
0.75 mm

Sample volume	<b>.2 μl</b>	<b>.5 μl</b>	<b>1 μl</b>	<b>2 μl</b>
	Prod No	Prod No	Prod No	Prod No
Manual	14UWE.2	14UWE.5	14UWE1	I4UWE2
Manual with standoff	214UWE.2	214UWE.5	214UWE1	2I4UWE2
With air actuator	A2I4UWE.2	A2I4UWE.5	A2I4UWE1	A2I4UWE2
With microelectric actuator	ED2I4UWE.2	ED2I4UWE.5	ED2I4UWE1	ED2I4UWE2
Replacement valve	DI4UWE.2	DI4UWE.5	DI4UWE1	DI4UWE2
Replacement rotor	SSAI4UWE.2	SSAI4UWE.5	SSAI4UWE1	SSAI4UWE2



#### Sampling and switching valves, 1/32" fittings, 0.25 mm ports (.010")

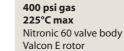
W Type

**Med temp** 

1/32"

Includes 4" standoff. Manual version not available without standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual with standoff	4N4WE	4N6WE	4N8WE	4N10WE
With air actuator	A4N4WE	A4N6WE	A4N8WE	A4N10WE
With microelectric actuator	EH4N4WE	EH4N6WE	EH4N8WE	EH4N10WE
Replacement valve	DN4WE	DN6WE	DN8WE	DN10WE
Replacement rotor	SSAN4WE	SSAN6WE	SSAN8WE	SSAN10WE



**SPECS** 

**OPTIONS** ■ 3 and 12 port valves

available ■ 2",3", and 6" standoffs

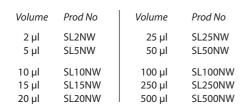
For 300 psi, 350°C max, see facing page.

■ Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)



#### 1/32" Stainless steel loops for W Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.





#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Nickel 200, PEEK, and PTFE
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

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#### Sampling and switching valves, 1/32" fittings, 0.25 mm ports (.010")

W Type

#### SPECS 300 psi gas 350°C max

Nitronic 60 valve body Valcon T rotor

For 400 psi, 225°C max, see facing page

#### **OPTIONS**

- 3 and 12 port valves available
- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

Includes 4" standoff. Manual version not available without standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

High temp	
1/32"	0.25 n

	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual with standoff	4N4WT	4N6WT	4N8WT	4N10WT
With air actuator	A4N4WT	A4N6WT	A4N8WT	A4N10WT
With microelectric actuator	EH4N4WT	EH4N6WT	EH4N8WT	EH4N10WT
Replacement valve	DN4WT	DN6WT	DN8WT	DN10WT
Replacement rotor	SSAN4WT	SSAN6WT	SSAN8WT	SSAN10WT



#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Nickel 200, PEEK, and PTFE
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 1/32" Stainless steel loops

for W Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



Volume	Prod No	Volume	Prod No
2 μl	SL2NW	25 μl	SL25NW
5 μl	SL5NW	50 μl	SL50NW
10 μl	SL10NW	100 μl	SL100NW
15 μl	SL15NW	250 μl	SL250NW
20 μl	SL20NW	500 μl	SL500NW

#### Sampling and switching valves, 1/16" fittings, 0.40 mm (.016")

W Type

**Med temp** 

0.40 mm

Includes 4" standoff Manual version has no standoff Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

				(
	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual	C4WE	C6WE	C8WE	C10WE
Manual with standoff	4C4WE	4C6WE	4C8WE	4C10WE
With air actuator	A4C4WE	A4C6WE	A4C8WE	A4C10WE
With microelectric actuator	EH4C4WE	EH4C6WE	EH4C8WE	EH4C10WE
Replacement valve	DC4WE	DC6WE	DC8WE	DC10WE
Replacement rotor	SSAC4WE	SSAC6WE	SSAC8WE	SSAC10WE



**OPTIONS** ■ 3 and 12 port valves available

**SPECS** 

400 psi gas

225°C max

Nitronic 60 valve body Valcon E rotor

For 300 psi, 350°C max, see page 110.

■ 2",3", and 6" standoffs

- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Smaller and larger bores available in most configurations.



### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and **Titanium**
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

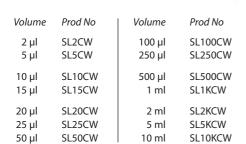
#### MORE INFORMATION

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#### 1/16" Stainless steel loops

for W Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



**Med temp** 

#### Sampling and switching valves, 1/16" fittings, 0.75 mm ports (.030")

Manual

Manual with standoff

With microelectric actuator

With air actuator

Replacement valve

Replacement rotor

**UW Type** 

0.75 mm

#### **SPECS** 400 psi gas 225°C max

Nitronic 60 valve body Valcon E rotor

For 300 psi, 330°C max, see page 111.

#### **OPTIONS**

- 3,12 and 14 port valves available
- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Larger bore available

Includes 4" standoff. Manual version has no standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

Prod No

C4UWE

4C4UWE

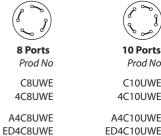
A4C4UWE

ED4C4UWE

SSAC4UWE

DC4UWE

(l)	



DC8UWE

SSAC8UWE

Prod No C10UWE 4C10UWE A4C10UWE ED4C10UWE DC10UWE SSAC10UWE



Prod No

C6UWE

4C6UWE

A4C6UWE

ED4C6UWE

DC6UWE

SSAC6UWE

#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and **Titanium**
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 1/16" Stainless steel loops

for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.

Volume	Prod No	Volume	Prod No
5 μl	SL5CUW	100 µl	SL100CUW
10 μl	SL10CUW	250 µl	SL250CUW
15 μl	SL15CUW	500 μl	SL500CUW
20 μl	SL20CUW	1 ml	SL1KCUW
25 μl 50 μl	SL25CUW SL50CUW	2 ml 5 ml 10 ml	SL2KCUW SL5KCUW SL10KCUW

#### Sampling and switching valves, 1/16" fittings, 0.40 mm ports (.016")

High temp

0.40 mm

Includes 4" standoff

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual with standoff	4C4WT	4C6WT	4C8WT	4C10WT
With air actuator	A4C4WT	A4C6WT	A4C8WT	A4C10WT
With microelectric actuator	EH4C4WT	EH4C6WT	EH4C8WT	EH4C10WT
Replacement valve	DC4WT	DC6WT	DC8WT	DC10WT
Replacement rotor	SSAC4WT	SSAC6WT	SSAC8WT	SSAC10WT



#### W Туре

#### SPECS 300 psi gas 350°C max

Nitronic 60 valve body Valcon T rotor

For 400 psi, 225°C max, see page 108.

#### **OPTIONS**

- 3 and 12 port valves available
   UW type: 3, 12, and 14 port valves available
- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Smaller and larger bores available in most configurations.

#### ABOUT LOOPS

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

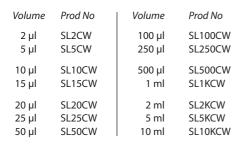
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#### 1/16" Stainless steel loops

for W Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



#### Sampling and switching valves, 1/16" fittings, 0.75 mm ports (.030")

**UW Type** 

#### SPECS

#### 300 psi gas 330°C max

Nitronic 60 valve body Valcon T rotor

For 400 psi, 225°C max, see page 109.

#### **OPTIONS**

- 3,12 and 14 port valves available
- 2",3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Larger bore available

Includes 4" standoff

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

#### High temp

110 511 0 7

/16" 0.75 mi

	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual with standoff	4C4UWT	4C6UWT	4C8UWT	4C10UWT
With air actuator	A4C4UWT	A4C6UWT	A4C8UWT	A4C10UWT
With microelectric actuator	ED4C4UWT	ED4C6UWT	ED4C8UWT	ED4C10UWT
Replacement valve	DC4UWT	DC6UWT	DC8UWT	DC10UWT
Replacement rotor	SSAC4UWT	SSAC6UWT	SSAC8UWT	SSAC10UWT



#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 1/16" Stainless steel loops

for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.

Volume	Prod No	Volume	Prod No
volullie	FIOUNO	Volume	FIOUTIO
5 µl	SL5CUW	100 µl	SL100CUW
10 µl	SL10CUW	250 μl	SL250CUW
15 µl	SL15CUW	500 μl	SL500CUW
20 µl	SL20CUW	1 ml	SL1KCUW
25 µl	SL25CUW	2 ml	SL2KCUW
50 µl	SL50CUW	5 ml	SL5KCUW
		10 ml	SL10KCUW

#### Sampling and switching valves, 1/8" fittings, 0.75 mm ports (.030")

**UW Type** 

**Med temp** 

0.75 mm

Includes 4" standoff. Manual version has no standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately (see facing page).

	4 Ports	6 Ports	8 Ports	10 Ports
	Prod No	Prod No	Prod No	Prod No
Manual	4UWE	6UWE	8UWE	n/a
Manual with standoff	44UWE	46UWE	48UWE	410UWE
With air actuator	A44UWE	A46UWE	A48UWE	A410UWE
With microelectric actuator	ED44UWE	ED46UWE	ED48UWE	ED410UWE
Replacement valve	D4UWE	D6UWE	D8UWE	D10UWE
Replacement rotor	SSA4UWE	SSA6UWE	SSA8UWE	SSA10UWE

#### **SPECS** 400 psi gas

225°C max

Nitronic 60 valve body Valcon E rotor

For 300 psi, 330°C max, see facing page.

#### **OPTIONS**

- 3, 12, and 14 port valves available
- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Larger bore available

#### Sampling and switching valves, 1/4" fittings, 4.0 mm ports (.156")

Low temp

4.0 mm

Includes 4" standoff. Manual version not available without standoff. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not available.

	4 Ports	6 Ports	8 Ports
	Prod No	Prod No	Prod No
Manual with standoff	4VL4MWE2	4VL6MWE2	4VL8MWE2
With air actuator	A4VL4MWE2	A4VL6MWE2	A4VL8MWE2
With microelectric actuator	ET4VL4MWE2	ET4VL6MWE2	ET4VL8MWE2
Replacement valve	DVL4MWE2	DVL6MWE2	DVL8MWE2
Replacement rotor	SSAVL4MWE2	SSAVL6MWE2	SSAVL8MWE2

#### **MW Type**

#### **SPECS** 100 psi gas 75°C max

Nitronic 60 valve body Valcon E2 rotor

- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)



**High temp** 

#### Sampling and switching valves, 1/8" fittings, 0.75 mm ports (.030")

Manual with standoff

With microelectric actuator

With air actuator

Replacement valve

Replacement rotor

**UW Type** 

0.75 mm

#### **SPECS** 300 psi gas 330°C max

Nitronic 60 valve body Valcon T rotor

For 400 psi, 225°C max, see facing page.

#### **OPTIONS**

- 3, 12, and 14 port valves available
- 2", 3", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Larger bore available

Includes 4" standoff. Manual version not available without standoff. Microelectric actuator: 24 VDC, with Sample loops are not included with v

110/230 VAC to 24 VDC power supply		
valves. Order separately.		

10 Ports	8 Ports	6 Ports	4 Ports
Prod No	Prod No	Prod No	Prod No
410UWT	48UWT	46UWT	44UWT
A410UWT	A48UWT	A46UWT	A44UWT
ED410UWT	ED48UWT	ED46UWT	ED44UWT
D10UWT	D8UWT	D6UWT	D4UWT
SSA10UWT	SSA8UWT	SSA6UWT	SSA4UWT



#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- Loops <100 µl are made from 1/16" OD tubing with brazed or welded 1/8" tube ends.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### **MORE INFORMATION**

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#### 1/8" Stainless steel loops

for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



Volume	Prod No	Volume	Prod No
10 μl	SL10UW	250 μl	SL250UW
15 μl	SL15UW	500 μl	SL500UW
20 μl	SL20UW	1 ml	SL1KUW
25 μl	SL25UW	2 ml	SL2KUW
50 μl	SL50UW	5 ml	SL5KUW
100 μl	SL100UW	10 ml	SL10KUW
		20 ml	SL20KUW

#### Internal sample injectors, 1/16" fittings, 0.40 mm ports (.016") 0.25 mm column port diameter (.010")

W Type

5,000 psi

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply

1/16" 0.40 mm



Sample volume	.06 µl	.1 µl	.2 µl	.5 µl
	Prod No	Prod No	Prod No	Prod No
Manual	CI4W.06	CI4W.1	CI4W.2	CI4W.5
With air actuator	ACI4W.06	ACI4W.1	ACI4W.2	ACI4W.5
With microelectric actuator	EPCI4W.06	EPCI4W.1	EPCI4W.2	EPCI4W.5
Replacement valve	DCI4W.06	DCI4W.1	DCI4W.2	DCI4W.5
Replacement rotor	SSACI4W.06	SSACI4W.1	SSACI4W.2	SSACI4W.5



**SPECS** 5000 psi liq 75°C max Nitronic 60 valve body Valcon H rotor

#### **OPTIONS**

- 2",3",4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- 1/32" fittings with 0.25 mm bore (.010") also available. Consult factory for product number and pricing.



W Type 1/16" fittings

#### Internal sample injectors, 1/16" fittings, 0.75 mm ports (.030")

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply

**UW Type** 

5,000 psi

1/16" 0.75 mm



Sample volume	<b>.2 μl</b>	<b>.5 μl</b>	<b>1 μl</b>	<b>2 μl</b>
	Prod No	Prod No	Prod No	Prod No
Manual with 2" standoff	2CI4UW.2	2CI4UW.5	2CI4UW1	2CI4UW2
With air actuator	ACI4UW.2	ACI4UW.5	ACI4UW1	ACI4UW2
With microelectric actuator	EDCI4UW.2	EDCI4UW.5	EDCI4UW1	EDCI4UW2
Replacement valve	DCI4UW.2	DCI4UW.5	DCI4UW1	DCI4UW2
Replacement rotor	SSACI4UW.2	SSACI4UW.5	SSACI4UW1	SSACI4UW2



75°C max Nitronic 60 valve body Valcon H rotor

#### **OPTIONS**

**SPECS** 

5000 psi liq

- 2", 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- 1/32" fittings with 0.25 mm bore (.010") also available. Consult factory for product number and pricing.



#### NOTE

These valves are not available in manual closemount version.

1/16" fittings

5,000 psi

**Analytical** 

#### Injectors and switching valves, 1/16" fittings, 0.40 mm ports (.016")

Manual

With air actuator

Replacement valve

Replacement rotor

With microelectric actuator

W Type

#### SPECS 5000 psi liq 75°C max

Nitronic 60 valve body Valcon H rotor

#### **OPTIONS**

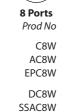
- 3 and 12 port valves available
- 2", 3", 4", and 6" standoffs
- 1/32" and 1/16" versions available with 0.25 mm (.010") bore
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.



<b>4 Ports</b> Prod No	<b>6 Ports</b> <i>Prod No</i>
C4W	C6W
AC4W	AC6W
EPC4W	EPC6W
DC4W	DC6W
SSAC4W	SSAC6W







0.40 mm

000
10 Ports Prod No
C10W AC10W EPC10W
DC10W SSAC10W



W Type 1/16" fittings

#### OPTIONAL FLOWPATH

Model C6W 6 port valves can also be ordered with a dual 3-way rotor, as described in EPA Method 555.

To specify this flowpath, substitute "2X3" for "6" in the valve or rotor product number.



#### **MORE INFORMATION**

Polymers .......256 Valve rotors .....257 Standoff

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#### ABOUT LOOPS

- Other materials available in many sizes:
   Electroformed Nickel, Hastelloy C, Nickel
   200, PEEK, PTFE, and Titanium
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 1/16" Stainless steel loops

for W Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



Volume	Prod No	Volume	Prod No
2 μl	SL2CW	100 µl	SL100CW
5 μl	SL5CW	250 µl	SL250CW
10 μl	SL10CW	500 μl	SL500CW
15 μl	SL15CW	1 ml	SL1KCW
20 μl	SL20CW	2 ml	SL2KCW
25 μl	SL25CW	5 ml	SL5KCW
50 µl	SL50CW	10 ml	SL10KCW

#### Injectors and switching valves, 1/16" fittings, 0.75 mm ports (.030")

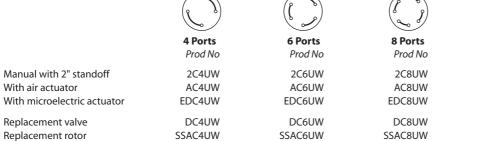
**UW Type** 

5,000 psi

Semi-prep

0.75 mm

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.





10 Ports Prod No

2C10UW AC10UW EDC10UW

DC10UW SSAC10UW ■ 2", 3", 4", and 6" standoffs ■ 1/32" and 1/16" versions available with

**SPECS** 

5000 psi liq

Valcon H rotor

Nitronic 60 valve body

75°C max

**OPTIONS** ■ 3,12, and 14 port valves available

0.25 mm (.010") bore ■ Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)

■ Larger bore available.

#### **NOTE**

These valves are not available in manual closemount version.



**UW Type** 1/16" fittings

#### 1/16" Stainless steel loops

for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.



Volume	Prod No	Volume	Prod No
3 μl	SL3CUW	100 µl	SL100CUW
5 μl	SL5CUW	250 µl	SL250CUW
10 μl	SL10CUW	500 μl	SL500CUW
15 μl	SL15CUW	1 ml	SL1KCUW
20 μl	SL20CUW	2 ml	SL2KCUW
25 μl	SL25CUW	5 ml	SL5KCUW
50 µl	SL50CUW	10 ml	SL10KCUW

#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and **Titanium**
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### Injectors and switching valves, 1/8" fittings, 0.75 mm (.030")

Manual with 2" standoff

With microelectric actuator

With air actuator

Replacement valve

Replacement rotor

**UW Type** 

#### **SPECS** 5000 psi liq 75°C max

Nitronic 60 valve body Valcon H rotor

#### **OPTIONS**

- 3 and 12 port valves available
- 2", 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium, Zirconium (see pages 254-5)
- Larger bore available. (see page 118)

#### **NOTE**

These valves are not available in manual closemount version.

Manual 10 port includes 2" standoff.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply Sample loops are not included with valves. Order separately.

Semi-pre

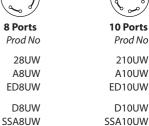
0.75 mm 1/8"

5,000 psi

0	
(م	8)
6	$\mathcal{I}$

<b>4 Ports</b> Prod No	<b>6 Ports</b> <i>Prod No</i>
24UW	26UW
A4UW	A6UW
ED4UW	ED6UW
D4UW	D6UW
SSA4UW	SSA6UW







**UW Type** 1/8" fittings

#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- Loops < 100 µl are made from 1/16" OD tubing with brazed or welded 1/8" tube ends.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

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#### 1/8" Stainless steel loops

for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.

Volume	Prod No	Volume	Prod No
10 μl	SL10UW	250 µl	SL250UW
15 μl	SL15UW	500 µl	SL500UW
20 μl	SL20UW	1 ml	SL1KUW
25 μl	SL25UW	2 ml	SL2KUW
50 μl 100 μl	SL50UW SL100UW	5 ml 10 ml 20 ml	SL5KUW SL10KUW SL20KUW

#### Injectors and switching valves, 1/8" fittings, large bore

**UW Type** 

5,000 psi

Manual with 2" standoff

With microelectric actuator

With air actuator

Replacement valve

Replacement rotor

1/8" Large bore

Manual 10 port includes 2" standoff.

1.7 mm (.067")

Prod No

2L4UW

AL4UW

EDL4UW

DL4UW

SSAL4UW

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Sample loops are not included with valves. Order separately.

6 Ports

1.7 mm (.067")

Prod No

2L6UW

AL6UW

EDL6UW

DL6UW

SSAL6UW

8 Ports 1.3 mm (.050")

SSAL8UW



1.0 mm (.040")

DL10UW SSAL10UW

#### (see page 117)

**SPECS** 

5000 psi liq

Valcon H rotor

standoffs

Nitronic 60 valve body

 3 port valve available ■ 2", 3", 4", and 6"

■ Materials: Hastelloy C,

Inconel 600, Monel 400,

Nickel 200, Nitronic 50,

Titanium, Zirconium

(see pages 254-5) ■ Smaller bore available.

75°C max

**OPTIONS** 

**NOTE** These valves are not available in manual closemount version.



**UW Type** 1/8" fittings

#### **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- Loops < 100 µl are made from 1/16" OD tubing with brazed or welded 1/8" tube ends..
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 1/8" Stainless steel loops for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately.

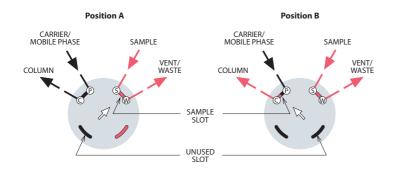
Volume	Prod No	Volume	Prod No
100 µl	SL100UW	2 ml	SL2KUW
250 µl	SL250UW	5 ml	SL5KUW
500 µl	SL500UW	10 ml	SL10KUW
1 ml	SL1KUW	20 ml	SL20KUW



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Universal 193			
Materials			
Metals 254-255			
Polymers256			
Valve rotors257			
Standoff			

assemblies ......205

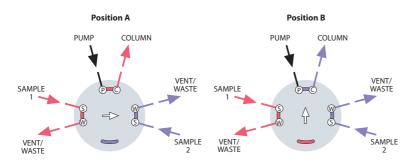
#### 4 port internal sample injector



#### MICROVOLUME SAMPLE INJECTION

The internal sample (fixed volume) flowpath is used when very small sample volumes are required. The sample size is determined by a passage engraved on the valve rotor, allowing precise, repeatable injections. In Position A, the sample flows through the sample passage while the mobile phase flows through to the column. The third passage is inactive. In Position B, the sample passage is in line with the column and the mobile phase injects the contents of the sample passage onto the column. The passage which was inactive in Position A allows the sample to continue flowing without interruption.

#### 6 port internal sample injector

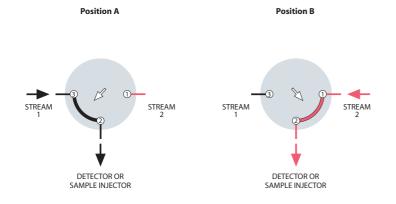


#### DUAL MICROVOLUME SAMPLE INJECTION

This microvolume injector can be used to alternate between two different samples. Each time the valve is switched, a sample is injected. By connecting the two sample inlets in series, the valve injects the sample each time the valve switches. This is particularly useful in heavy duty cycle operations to minimize valve wear. The valve can also be used to make alternating injections of the same sample onto two different columns by swapping sample/waste and pump/column connections.

*Note:* This CI6 valve is not shown in this catalog. Call for details.

#### 3 port switching valve



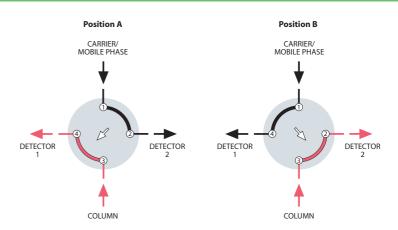
#### STREAM SELECTION WITHOUT MAINTAINED FLOW

This arrangement allows one of two sample points to flow to a sample injector or detector while blocking the other sample point's flow.

#### **DETECTOR SELECTION FROM TWO COLUMNS OR ONE COLUMN AND AUXILIARY CARRIER**

This unique configuration allows analyses of different parts of one analysis with two different detectors, without splitting or multiple injections. For example, fixed gases can be analyzed with a thermal conductivity detector, followed by the analysis of a hydrocarbon fraction with a flame ionization detector.

#### 4 port switching valve

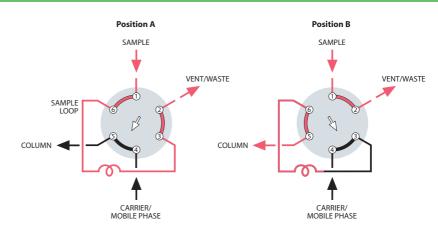


#### **SAMPLE INJECTION**

With the valve in Position A, sample flows through the external loop while the mobile phase flows directly through to the chromatographic column. When the valve is switched to Position B, the sample contained in the sample loop and valve flow passage is displaced by the mobile phase and is carried onto the column.

Note: This is especially critical for partiallyfilled loops. The flow direction of the mobile phase through the loop should be opposite (backflush) to the flow direction during the loading of the loop.

#### 6 port external sample injector

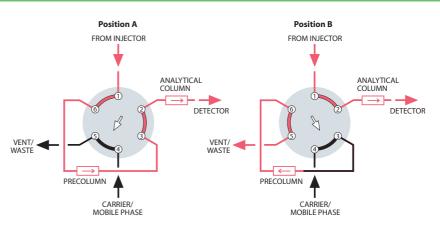


#### **BACKFLUSH OF PRECOLUMN TO VENT**

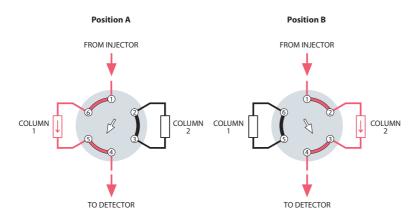
This plumbing scheme allows slower eluting components (end cut) which are not of interest to be backflushed to vent. Often a shorter version of the analytical column is used as the precolumn. Once all the components of interest have entered the main column (at port 2), the valve switches, backflushing the precolumn to vent and reducing analysis time.

Note: An auxiliary source of carrier or mobile phase is required for this application.

#### 6 port column switching



#### 6 port column selection

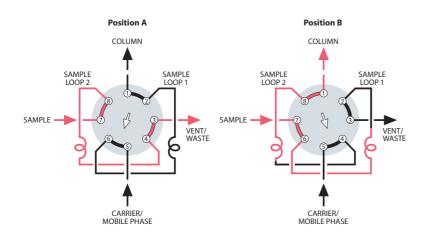


#### **TWO COLUMN SELECTION**

When two different columns are required at frequent intervals at similar oven temperatures, a 6 port valve can provide rapid selection of the one to be used. The column not in use is protected by a blanket of inert mobile phase and may be rapidly brought to equilibrium when required.

*Note:* If flow must be maintained to the non-selected column, an 8 or 10 port valve is required.

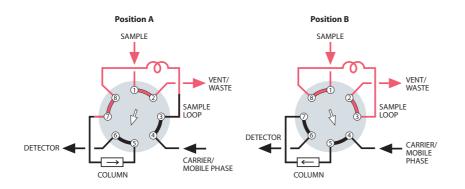
#### 8 port dual external sample injector



#### **SAME SAMPLE TO DIFFERENT LOOPS**

In a dual external sample loop configuration, sample is injected in both positions. In Position A, Loop 2 is loaded while the mobile phase flows through Loop 1 and onto the column. In Position B, the Loop 2 sample is injected into the column and another sample is loaded into Loop 1. When the valve is returned to Position A, the Loop 1 sample is injected onto the column and Loop 2 is reloaded.

#### 8 port sampling/switching



#### LOOP SAMPLING WITH BACKFLUSH TO DETECTOR

One valve functions as both a sampling and a backflush valve, simplifying operation and reducing cost. When components of interest are detected, the strongly retained components are backflushed and removed from the column without temperature programming.

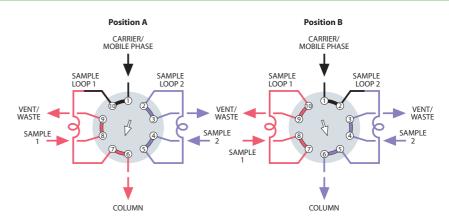
#### TWO DIFFERENT SAMPLES TO **SAME COLUMN**

A 10 port valve permits alternate injections from the two loops, which may be identical or of different sizes. This technique replaces a 4 port sample selector and a 6 port sample injector.

In Position A, Loop 2 is loaded with sample 2 while the mobile phase flows through Loop 1 and onto the column.

In Position B, the Loop 2 sample is injected onto the column and Loop 1 is loaded with sample 1. When the valve is returned to Position A, the Loop 1 sample is injected onto the column and Loop 2 is reloaded with sample 2.

#### 10 port dual external sampling

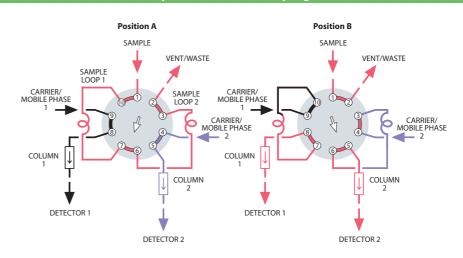


#### SIMULTANEOUS INJECTION OF THE **SAME SAMPLE ONTO SEPARATE COLUMNS**

In Position A, sample fills the two loops in series. In Position B, the sample is simultaneously injected into two separate flow systems. A single autosampler used with this flowpath can automate two analytical procedures for the same sample.

In an important non-chromatographic application, the roles of carrier and sample are reversed, permitting two different quantities of two different materials to be dispensed together, as in automatic dilution.

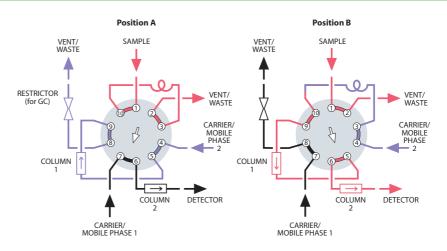
#### 10 port dual external sampling



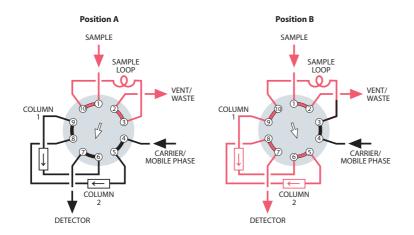
#### LOOP SAMPLING WITH BACKFLUSH OF PRE-COLUMN TO VENT

When components of interest have low boiling points, this plumbing scheme allows "heavy" components with long retention times to be backflushed to waste. After the sample loop is loaded in Position A, the valve is switched to Position B to inject the sample onto column 1. As soon as all components of interest have entered column 2, the valve is switched back to Position A. Column 1 is backflushed to vent during the analysis, reducing the total analysis time.

#### 10 port sampling/switching



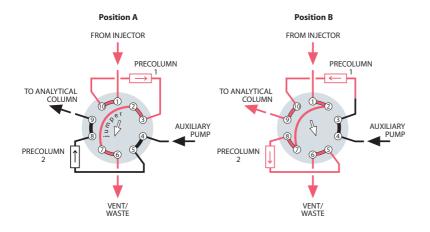
#### 10 port sampling/switching



#### LOOP SAMPLING WITH TWO COLUMN SEQUENCE REVERSAL

This is ideal for fixed-gas-from-CO $_2$  analysis where no "high boilers" are present. Column 1 is packed with a porous polymer and Column 2 with molecular sieve. The sample loop is loaded in Position A. When the valve is switched, the loop contents are sent onto Column 1. As the inorganic gases and methane leave Column 1 and enter Column 2, the valve is returned to Position A, reversing the column sequence.  $CO_2$  now leaves Column 1, becoming the first peak. The inorganics and methane are separated by the molesieve and pass through the porous polymer column to the detector.

#### 10 port column switching

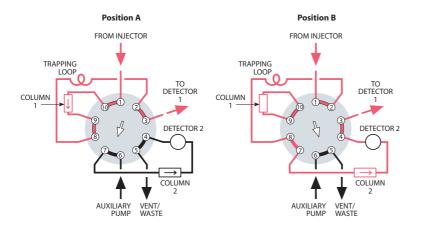


#### SAMPLE ENRICHMENT (CLEANUP) USING DUAL PRECOLUMNS

Sample is injected by a separate injector onto one of two precolumns (stripper). Early eluting components vent at port 6 while components of interest are retained on the stripper. When the valve is switched, a new injection is made onto the second stripper while components retained on the first stripper are backflushed onto the analytical column at port 9.

*Note:* This application requires an auxiliary pump at port 4.

#### 10 port column switching

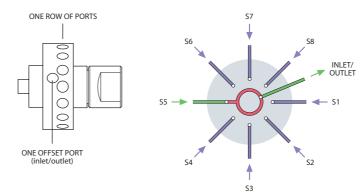


## HEART CUT TRAPPED IN A LOOP AND INJECTED ONTO A SECOND COLUMN

Sample is injected (using a separate injector) onto an analytical column. Early eluting components (front cut) pass through a trapping loop and are detected (at port 3). The valve is then switched, and the center (or heartcut) which was retained in the trapping loop is injected onto the second column to the detector (at port 4). Late eluting components (end cut) are trapped on the first column. When the valve is switched again, the end cut passes through the trapping loop to the first detector, completing the analysis.

#### Dead-end flowpath -SD configuration

SD valves select one of 4 to 12 dead-ended streams. The selected stream flows from the outlet to a sample valve, pressure sensor, detector, column, etc. The same flowpath can also be used to direct one stream to a number of outlets in applications such as fraction collection. For an application suggestion, see page 136.



#### 1/16" fittings, 0.75 mm ports (.030")

**MW Type** 

Low pressure

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available except 16 position

	6 Position	10 Position	12 Position	16 Position
	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2CSD6MWE	2CSD10MWE	2CSD12MWE	2CSD16MWE
W ith air actuator	A2CSD6MWE	A2CSD10MWE	A2CSD12MWE	A2CSD16MWE
With microelectric actuator	EMT2CSD6MWE	EMT2CSD10MWE	EMT2CSD12MWE	EMT2CSD16MWE
Replacement valve	DCSD6MWE	DCSD10MWE	DCSD12MWE	DCSD16MWE
Replacement rotor	SSACSD6MWE	SSACSD10MWE	SSACSD12MWE	SSACSD16MWE



#### **SPECS** 400 psi gas 200°C max Nitronic 60 body Valcon E rotor

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#### 1/8" fittings, 1.0 mm ports (.040")

#### **MW Type**

#### **SPECS**

4-8 Positions:

400 psi gas

200°C max 10-16 Positions:

> 200 psi gas 200°C max

Nitronic 60 body Valcon E rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### Low pressure

1/8" 1.0 mm

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available

	<b>6 Position</b> Prod No	<b>10 Position</b> <i>Prod No</i>	<b>12 Position</b> <i>Prod No</i>	<b>16 Position</b> <i>Prod No</i>
Manual (not recommended)	2SD6MWE	2SD10MWE	2SD12MWE	2SD16MWE
With air actuator	A2SD6MWE	A2SD10MWE	A2SD12MWE	A2SD16MWE
With microelectric actuator	EMT2SD6MWE	EMT2SD10MWE	EMT2SD12MWE	EMT2SD16MWE
Replacement valve	DSD6MWE	DSD10MWE	DSD12MWE	DSD16MWE
Replacement rotor	SSASD6MWE	SSASD10MWE	SSASD12MWE	SSASD16MWE

#### 1/4" fittings, 4.0 mm ports (.156")

MW Type

**SPECS** 100 psi gas 75°C max

Nitronic 60 body Valcon E2 rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Manual version not available.

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

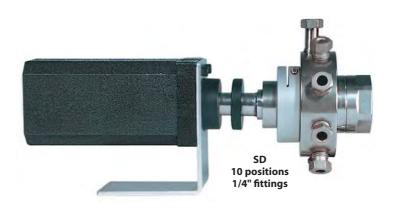
Low pressure

**Dead-end** 

4.0 mm

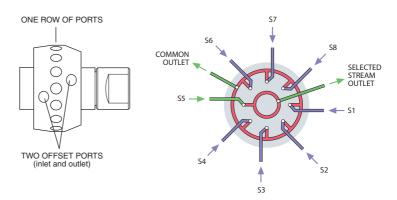
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> Prod No	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
With air actuator	AH2VLSD4MWE2	AH2VLSD6MWE2	AH2VLSD8MWE2	AH2VLSD10MWE2
With microelectric actuator	EMT2VLSD4MWE2	EMT2VLSD6MWE2	EMT2VLSD8MWE2	EMT2VLSD10MWE2
Replacement valve	DVLSD4MWE2	DVLSD6MWE2	DVLSD8MWE2	DVLSD10MWE2
Replacement rotor	SSAVLSD4MWE2	SSAVLSD6MWE2	SSAVLSD8MWE2	SSAVLSD10MWE2



#### Common outlet flowpath -SC configuration

SC selectors are similar to the SD configuration, except that instead of being dead-ended the non-selected streams flow to a common outlet. For an application suggestion, see page 137.



#### 1/16" fittings, 1.0 mm ports (.040")

**MW Type** 

**SPECS** 

200 psi gas 200°C max

Nitronic 60 body

Valcon E rotor

Low pressure

SC **Common outlet** 

1.0 mm

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

- 4 and 8 positions available
- **3**", 4"
- Mate

", and 6" standoffs erials: Hastelloy C, Inconel	600, Monel 400, Nickel 200, Nit	tronic 50, Titanium (see pages 2	254-255)
6 Position	10 Position	12 Position	16 Position
Prod No	Prod No	Prod No	Prod No

	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2CSC6MWE	2CSC10MWE	2CSC12MWE	2CSC16MWE
With air actuator	AH2CSC6MWE	A2CSC10MWE	A2CSC12MWE	A2CSC16MWE
With microelectric actuator	EMT2CSC6MWE	EMT2CSC10MWE	EMT2CSC12MWE	EMT2CSC16MWE
Replacement valve	DCSC6MWE	DCSC10MWE	DCSC12MWE	DCSC16MWE
Replacement rotor	SSACSC6MWE	SSACSC10MWE	SSACSC12MWE	SSACSC16MWE



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#### 1/8" fittings, 1.0 mm ports (.040")

MW Type

SPECS
200 psi gas
200°C max
Nitronic 60 body
Valcon E rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

Low pressure

SC Common outlet

1/8"

1.0 mm

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available except 16 position

	6 Position	10 Position	12 Position	16 Position
	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2SC6MWE	2SC10MWE	2SC12MWE	2SC16MWE
With air actuator	AH2SC6MWE	A2SC10MWE	A2SC12MWE	A2SC16MWE
With microelectric actuator	EMT2SC6MWE	EMT2SC10MWE	EMT2SC12MWE	EMT2SC16MWE
Replacement valve	DSC6MWE	DSC10MWE	DSC12MWE	DSC16MWE
Replacement rotor	SSASC6MWE	SSASC10MWE	SSASC12MWE	SSASC16MWE

#### 1/4" fittings, 4.0 mm ports (.156")

MW Type

SPECS 100 psi gas 75°C max Nitronic 60 body

Nitronic 60 body Valcon E2 rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Manual version not available.

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### Low pressure

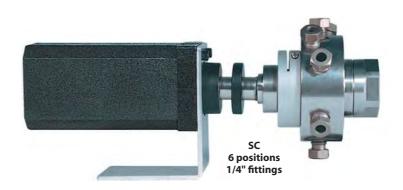
SC Common outlet

1/4"

4.0 mm

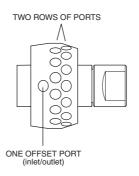
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

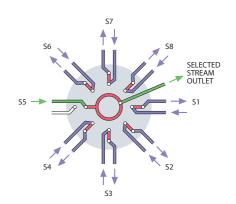
	Prod No	Prod No
	AH2VLSC6MWE2 EMT2VLSC6MWE2	AH2VLSC8MWE2 EMT2VLSC8MWE2
DVLSC4MWE2	DVLSC6MWE2	DVLSC8MWE2 SSAVLSC8MWE2
	Prod No H2VLSC4MWE2 T2VLSC4MWE2 DVLSC4MWE2 SAVLSC4MWE2	H2VLSC4MWE2 AH2VLSC6MWE2 T2VLSC4MWE2 EMT2VLSC6MWE2 DVLSC4MWE2 DVLSC6MWE2



#### Flow-through flowpath -SF configuration

SD and SC valves select and isolate one of 4 to 16 streams, with the remainder dead-ended in the SD and flowing to a common outlet in the SC. The SF selector is similar, but carries the evolution a step further with the non-selected streams flowing through individual outlets. For an application suggestion, see page 138.





#### 1/16" fittings, 1.0 mm ports (.040")

**MW Type** 

Low pressure

1.0 mm

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

**SPECS** 200 psi gas 200°C max Nitronic 60 body Valcon E rotor

	<b>6 Position</b>	<b>10 Position</b>	<b>12 Position</b>	<b>16 Position</b>
	Prod No	<i>Prod No</i>	<i>Prod No</i>	<i>Prod No</i>
Manual (not recommended)	2CSF6MWE	2CSF10MWE	2CSF12MWE	2CSF16MWE
With air actuator	AH2CSF6MWE	A2CSF10MWE	A2CSF12MWE	A2CSF16MWE
With microelectric actuator	EMT2CSF6MWE	EMT2CSF10MWE	EMT2CSF12MWE	EMT2CSF16MWE
Replacement valve	DCSF6MWE	DCSF10MWE	DCSF12MWE	DCSF16MWE
Replacement rotor	SSACSF6MWE	SSACSF10MWE	SSACSF12MWE	SSACSF16MWE



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#### 1/8" fittings, 1.0 mm ports (.040")

**MW Type** 

**SPECS** 200 psi gas 200°C max Nitronic 60 body Valcon E rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

Low pressure

1/8" 1.0 mm

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available except 16 position

	6 Position	10 Position	12 Position	16 Position
	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2SF6MWE	2SF10MWE	2SF12MWE	2SF16MWE
With air actuator	AH2SF6MWE	A2SF10MWE	A2SF12MWE	A2SF16MWE
With microelectric actuator	EMT2SF6MWE	EMT2SF10MWE	EMT2SF12MWE	EMT2SF16MWE
Replacement valve	DSF6MWE	DSF10MWE	DSF12MWE	DSF16MWE
Replacement rotor	SSASF6MWE	SSASF10MWE	SSASF12MWE	SSASF16MWE

#### 1/4" fittings, 4.0 mm ports (.156")

MW Type

**SPECS** 100 psi gas 75°C max

Nitronic 60 body Valcon E2 rotor

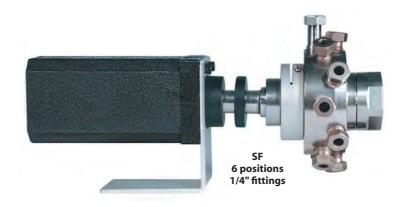
Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Manual version is not available.

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

Low pressure

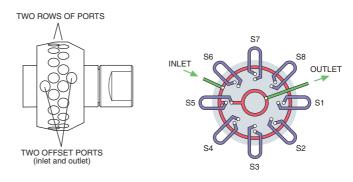
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

	<b>4 Position</b>	<b>6 Position</b>	<b>8 Position</b>
	Prod No	Prod No	Prod No
With air actuator	AH2VLSF4MWE2	AH2VLSF6MWE2	AH2VLSF8MWE2
With microelectric actuator	EMT2VLSF4MWE2	EMT2VLSF6MWE2	EMT2VLSF8MWE2
Replacement valve	DVLSF4MWE2	DVLSF6MWE2	DVLSF8MWE2
Replacement rotor	SSAVLSF4MWE2	SSAVLSF6MWE2	SSAVLSF8MWE2



## Trapping flowpath – ST configuration

ST selectors are used for multi-column, multi-sample, or multi-trap operations, and are available for use with 4 to 16 loops, or positions. For an application suggestion, see page 139.



#### 1/16" fittings, 0.75 mm ports (.030")

MW Type

Low pressure

ST Trapping

1/16"

0.75 mm

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

SPECS 200 psi gas 200°C max Nitronic 60 body Valcon E rotor

	6 Position	10 Position	12 Position	16 Position
	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2CST6MWE	2CST10MWE	2CST12MWE	2CST16MWE
With air actuator	AH2CST6MWE	A2CST10MWE	A2CST12MWE	A2CST16MWE
With microelectric actuator	EMT2CST6MWE	EMT2CST10MWE	EMT2CST12MWE	EMT2CST16MWE
Replacement valve	DCST6MWE	DCST10MWE	DCST12MWE	DCST16MWE
Replacement rotor	SSACST6MWE	SSACST10MWE	SSACST12MWE	SSACST16MWE



#### 1/16" Stainless steel loops for MW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately. Request matched loops when loops will be installed on a single valve.

Volume	Prod No	Volume	Prod No
50 μl	SL50CSTP	1 ml	SL1KCSTP
100 μl	SL100CSTP	2 ml	SL2KCSTP
250 μl	SL250CSTP	5 ml	SL5KCSTP
500 μl	SL500CSTP	10 ml	SL10KCSTP

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#### 1/8" fittings, 1.0 mm ports (.040")

MW Type

1.0 mm

SPECS 200 psi gas 200°C max

Nitronic 60 body Valcon E rotor Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

Low pressure

ST

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available except 16 position

6 Position	10 Position	12 Position	16 Position
Prod No	Prod No	Prod No	Prod No
2ST6MWE	2ST10MWE	2ST12MWE	2ST16MWE
AH2ST6MWE	A2ST10MWE	A2ST12MWE	A2ST16MWE
EMT2ST6MWE	EMT2ST10MWE	EMT2ST12MWE	EMT2ST16MWE
DST6MWE	DST10MWE	DST12MWE	DST16MWE
SSAST6MWE	SSAST10MWE	SSAST12MWE	SSAST16MWE

Manual (not recommended) With air actuator With microelectric actuator Replacement valve Replacement rotor

#### **ABOUT LOOPS**

- Other materials are available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and Titanium
- 1/16" loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- 1/8" loops < 100 µl are made from 1/16" OD tubing with brazed or welded 1/8" tube ends.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.



1/8" Stainless steel loops

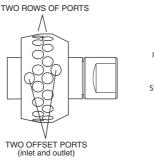
for MW Type valves

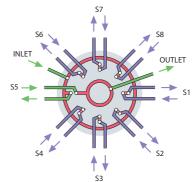
Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately. **Request matched loops when loops will be installed on a single valve.** 

Volume	Prod No	Volume	Prod No
100 μl 250 μl	SL100STP SL250STP	1 ml 2 ml	SL1KSTP SL2KSTP
500 μl	SL500STP	5 ml 10 ml	SL5KSTP SL10KSTP

## Trapping/flow-through flowpath – STF configuration

The STF selector is a variation of the ST flowpath, with the single difference that the non-selected streams are returned to their own vents or sources rather than being dead-ended or trapped as they are in the standard ST configuration. For an application suggestion, see page 140.





#### 1/16" fittings, 0.75 mm ports (.030")

MW Type

STF
Trap/ flow-throw

1/16" 0.75 mm

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

#### **OPTIONS**

- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)

SPECS 200 psi gas 200°C max Nitronic 60 body Valcon E rotor

	<b>6 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>	<b>12 Position</b> <i>Prod No</i>	<b>16 Position</b> <i>Prod No</i>
Manual (not recommended)	2CSTF6MWE	2CSTF10MWE	2CSTF12MWE	2CSTF16MWE
With air actuator	AH2CSTF6MWE	A2CSTF10MWE	A2CSTF12MWE	A2CSTF16MWE
With microelectric actuator	EMT2CSTF6MWE	EMT2CSTF10MWE	EMT2CSTF12MWE	EMT2CSTF16MWE
Replacement valve	DCSTF6MWE	DCSTF10MWE	DCSTF12MWE	DCSTF16MWE
Replacement rotor	SSACSTF6MWE	SSACSTF10MWE	SSACSTF12MWE	SSACSTF16MWE

# MORE INFORMATION Application.... page 140 Actuators Air ....... 196 Microelectric .... 192 Universal .... 193 Materials Metals .... 254-255 Polymers .... 256 Valve rotors .... 257 Mounting hardware Closemount .... 208

Standoff......205

#### 1/8" fittings, 1.0 mm ports (.040")

MW Type

1.0 mm

SPECS 200 psi gas 200°C max Nitronic 60 body Valcon E rotor

Includes 2" standoff. Ask about closemount assembly if valve will not be heated. Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

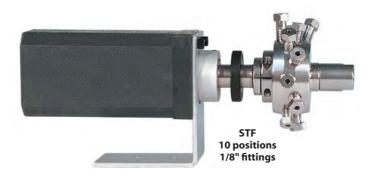
Low pressure

#### STF Trap/ flow-throw

1/8"

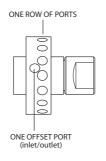
- 4 and 8 positions available
- 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see pages 254-255)
- Larger bore available except 16 position

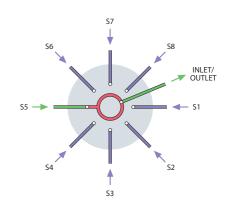
	6 Position	10 Position	12 Position	16 Position
	Prod No	Prod No	Prod No	Prod No
Manual (not recommended)	2STF6MWE	2STF10MWE	2STF12MWE	2STF16MWE
With air actuator	AH2STF6MWE	A2STF10MWE	A2STF12MWE	A2STF16MWE
With microelectric actuator	EMT2STF6MWE	EMT2STF10MWE	EMT2STF12MWE	EMT2STF16MWE
Replacement valve	DSTF6MWE	DSTF10MWE	DSTF12MWE	DSTF16MWE
Replacement rotor	SSASTF6MWE	SSASTF10MWE	SSASTF12MWE	SSASTF16MWE



#### Dead-end flowpath -SD configuration

SD valves select one of 4 to 12 dead-ended streams. The selected stream flows from the valve outlet to a sample valve, pressure sensor, detector, column, etc. This configuration may also be used to direct one stream to a number of outlets for applications such as fraction collection. For an application suggestion, see page 141.





#### 1/16" fittings, 0.4 mm ports (.016")

**UW Type** 

5,000 psi

0.40 mm

**OPTIONS** 

- 8 and 12 positions available
- 2", 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see p. 254-255)

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

- Low pressure, high temperature versions available
- Larger bore available except 10 and 12 positions

	4 Position	6 Position	10 Position
	Prod No	Prod No	Prod No
Manual (not recommended)	CSD4UW	CSD6UW	CSD10UW
With air actuator	ACSD4UW	ACSD6UW	ACSD10UW
With microelectric actuator	EMTCSD4UW	EMTCSD6UW	EMTCSD10UW
Replacement valve	DCSD4UW	DCSD6UW	DCSD10UW
Replacement rotor	SSACSD4UW	SSACSD6UW	SSACSD10UW

**SPECS** 5000 psi liq 75°C max Nitronic 60 body Valcon E rotor

#### 1/8" fittings, 0.75 mm ports (.030")

5,000 psi

0.75 mm

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply)

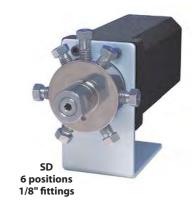
#### **OPTIONS**

- 2", 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see p. 254-255)
- Low pressure, high temperature versions available
- Larger bore available except 8 position

	4 Position	6 Position	8 Position
	Prod No	Prod No	Prod No
Manual (not recommended)	SD4UW	SD6UW	SD8UW
With air actuator	ASD4UW	ASD6UW	ASD8UW
With microelectric actuator	EMTSD4UW	EMTSD6UW	EMTSD8UW
Replacement valve	DSD4UW	DSD6UW	DSD8UW
Replacement rotor	SSASD4UW	SSASD6UW	SSASD8UW

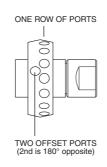
**SPECS** 5000 psi liq 75°C max Nitronic 60 body Valcon E rotor

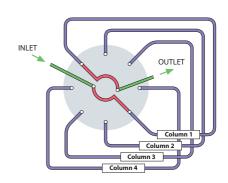
**UW Type** 



#### Both column ends selected -ST configuration

ST selectors are used for multi-column, multi-sample, or multitrap operations. This valve can be used between an injector and detector to permit manual or automated HPLC column selection. For an application suggestion, see page 141.





#### 1/16" fittings, 0.4 mm ports (.016")

**UW Type** 

**SPECS** 5000 psi liq 75°C max

Nitronic 60 body Valcon E rotor

Manual versions are not available.

Microelectric actuators: 24 VDC (includes a 110/230 VAC to 24 VDC power supply).

#### **OPTIONS**

- 2", 3", 4", and 6" standoffs
- Materials: Hastelloy C, Inconel 600, Monel 400, Nickel 200, Nitronic 50, Titanium (see p. 254-255)
- Low pressure, high temperature versions available. (Consult factory.)

5,000 psi

0.40 mm

	<b>4 Columns or Loops</b> <i>Prod No</i>	<b>6 Columns or Loops</b> Prod No
With air actuator	ACST4UW	ACST6UW
With microelectric actuator	EMTCST4UW	EMTCST6UW
Replacement valve	DCST4UW	DCST6UW
Replacement rotor	SSACST4UW	SSACST6UW



4 position 1/16" fittings

#### **ABOUT LOOPS**

- Other materials are available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, PEEK, PTFE, and **Titanium**
- Loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.



#### 1/16" Stainless steel loops for UW Type valves

Each stainless steel loop includes two stainless nuts and two stainless ferrules. Order special fittings separately. Request matched loops when loops will be installed on a single valve.

Volume	Prod No	Volume	Prod No
10 μl	SL10CSTUW	250 μl	SL250CSTUW
15 μl	SL15CSTUW	500 μl	SL500CSTUW
20 μl	SL20CSTUW	1 ml	SL1KCSTUW
25 μl	SL25CSTUW	2 ml	SL2KCSTUW
50 μl	SL50CSTUW	5 ml	SL5KCSTUW
100 μl	SL100CSTUW	10 ml	SL10KCSTUW

#### STREAM SELECTION WITH DEAD-ENDED STREAMS

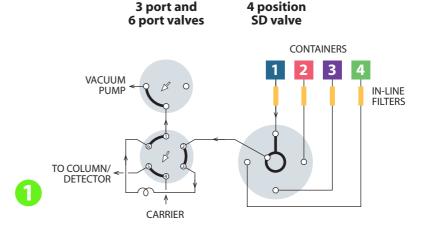
SD valves select one of 4 to 16 dead-ended streams. The selected stream flows from the valve outlet to a sample valve, pressure sensor, detector, column, etc. The same configuration may also be used to direct one stream to a number of outlets for applications such as fraction collection.

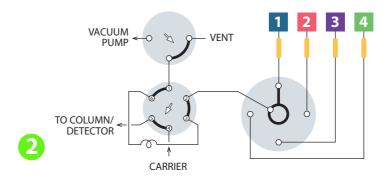
This example illustrates automated sampling of non-pressurized containers.

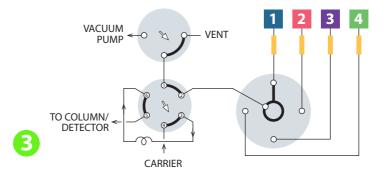
1 A vacuum pump is used to move sample from the containers to a 6 port sampling valve. 2 The 3 port valve is used to block the vacuum flow through the sampling valve to allow the sample within the loop to equilibrate at atmospheric pressure. 3 The 6 port valve is then switched, injecting the sample. This method eliminates any possible effect from pressure differences among the containers, providing accurate and repeatable results. All three valves can be automated with air or electric actuators for unattended operation.

The SD flowpath isolates the unselected sample streams, but the potential exists for extraneous sample or contaminants to be in the lines when containers are first connected. To avoid problems, either prepurge each line or allow sufficient sampling time for the line to purge prior to injection.

#### SD flowpath — low pressure





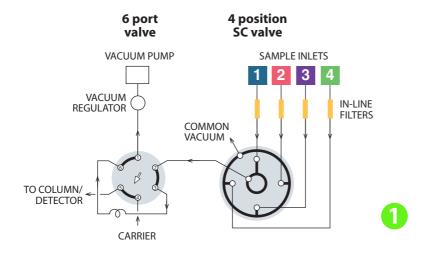


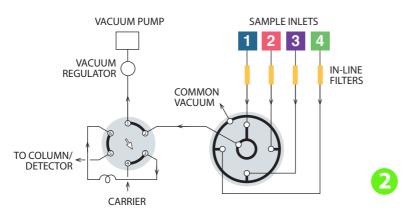
#### MORE INFORMATION

SD prices

High pressure SD ...141

#### **SC flowpath**





## STREAM SELECTION WITH CONTINUOUS FLOW TO A COMMON OUTLET

SC selectors are similar to the SD configuration, except that instead of being dead-ended the non-selected streams flow to a common outlet. They are also available in 4, 6, 8, 10, 12, or 16 position versions.

The SC configuration is ideal for air quality monitoring, illustrated in this example.

The application is essentially the same as the one shown for the SD selectors on the previous page, except that the non-selected streams are continuously pulled through the valve, insuring that the most current sample will be provided as each point is selected for analysis. 1 The sample loop on the 6 port valve is loaded from Stream 1. 2 The 6 port valve is switched, injecting the sample. Both valves can be automated with air or electric actuators for unattended operation.

#### **TECH TIP**

Because the most common cause of valve failure is stray particulates entering the valve, we strongly recommend the use of in-line filters at sample entry points.

Our ZUFR filters feature inexpensive and easily replaceable low pressure drop filter screens (2 or 10 micron). The filters are available in 1/16", 1/8", and 1/4" standard, reducing, and bulkhead versions.

Filters ..... pages 50-52

#### MORE INFORMATION

Actuators

Air page 196
Mod. universal 194
Universal 193

SC prices . . . . . 126-127

## STREAM SELECTION WITH CONTINUOUS FLOW TO INDIVIDUAL OUTLETS

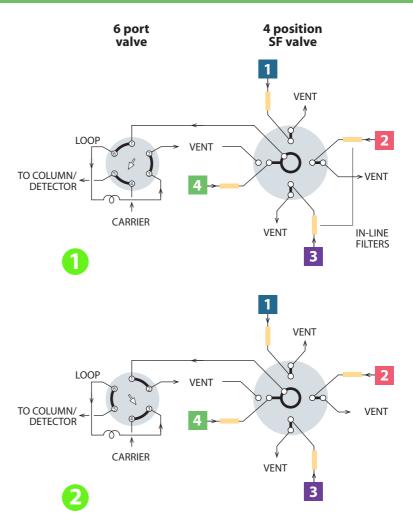
SD and SC valves select and isolate one of 4 to 16 streams, with the remainder dead-ended in the SD and flowing to a common outlet in the SC. The SF selector is similar, but carries the evolution a step further with the non-selected streams flowing through individual outlets.

This is the ideal solution when reactions or process streams with differing upstream pressures must be analyzed, and can also provide independent containment of toxic or noxious streams. An SF selector together with a 6 port sampling valve and pneumatic or electric actuators comprise a complete sampling system for the automated analysis of up to 16 sample points.

Note that streams 1 and 4 are vented while streams 2 and 3 are returned to their sources in this example.

Mode 1 shows sample loading from stream 4, while mode 2 shows sample injected onto the analytical column.

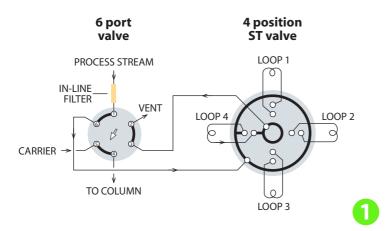
#### **SF flowpath**

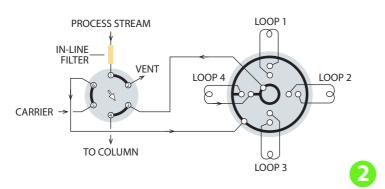


#### **MORE INFORMATION**

Actuators	
Air	page 196
Mod. universal	194
Universal	193
SE prices	128-129

#### ST flowpath — low pressure





#### SAMPLE TRAPPING APPLICATIONS FOR 4 TO 16 STREAMS

ST selectors are used for multicolumn, multi-sample, or multi-trap operations. The ST configuration is available in both MW and UW type designs.

A typical application, shown here, is the collection of fractions at timed intervals for analysis at a later time. Valves can be ordered with matched loops already installed.

In this example, the 6 port valve shown is used to select between collection/trapping and analysis/desorption. Both valves can be supplied with pneumatic or electric actuators to automate these functions.

#### **TECH TIP**

Because the most common cause of valve failure is stray particulates entering the valve, we strongly recommend the use of in-line filters at sample entry points.

Our ZUFR filters feature inexpensive and easily replaceable low pressure drop filter screens (2 or 10 micron). The filters are available in 1/16", 1/8", and 1/4" standard, reducing, and bulkhead versions.

Filters ..... pages 50-52

#### MORE INFORMATION

ST prices

Low pressure . . . 130-131 High pressure . . . . . . 135 Application

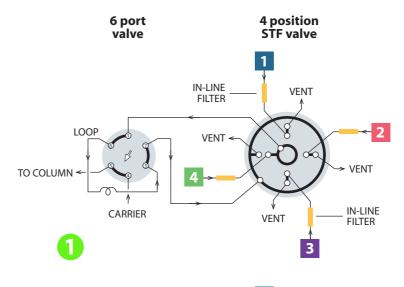
High pressure ST ...141

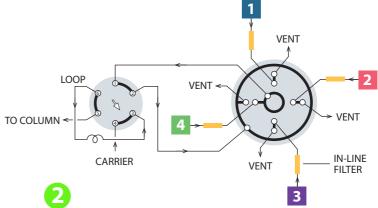
## SAMPLE TRAPPING WITH CONTINUOUS FLOW TO INDIVIDUAL OUTLETS

The STF selector is a variation of the ST flowpath, with the single difference that the non-selected streams are returned to their own vents or sources rather than being dead-ended or trapped as they are in the standard ST configuration. This is ideal for reactor processes in which removal of substantial amounts of sample would upset the equilibrium within the reactor, or if the stream is toxic or noxious and must be isolated.

An STF selector on an air or electric actuator along with a similarly equipped 6 port valve comprise a complete sampling system for the automated analysis of up to 16 sampling points.

#### **STF flowpath**





#### MORE INFORMATION

Actuators

Air ...... page 196 Mod. universal ..... 194 Universal ..... 193

STF prices . . . . . 132-133

#### **TECH TIP**

Because the most common cause of valve failure is stray particulates entering the valve, we strongly recommend the use of in-line filters at sample entry points.

Our ZUFR filters feature inexpensive and easily replaceable low pressure drop filter screens (2 or 10 micron).

The filters are available in 1/16", 1/8", and 1/4" standard, reducing, and bulkhead versions.

Filters ..... pages 50-52

#### SD flowpath — high pressure

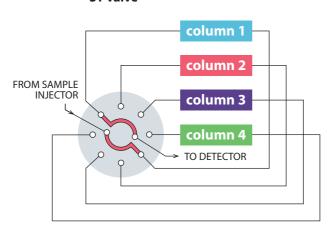
#### Manifold 8 position SD valve FROM SAMPLE column 1 TO DETECTOR **INJECTOR** column 2 column 3 column 4 column 5 column 6 column 8

#### **HPLC COLUMN SELECTION FOR UP TO** 10 COLUMNS

This example illustrates an SD (UW type) selector used for HPLC column selection. This allows multiple columns to be installed permanently in the system, eliminating instrument downtime and leakage potential resulting from having to change columns repeatedly. The SDUW valve selects only column inlets – the column outlets are connected to the detector via a low-volume manifold. The manifold is sold separately.

#### ST flowpath — high pressure

#### 4 position **ST** valve



#### **HPLC COLUMN SELECTION FOR 4 OR 6 COLUMNS**

Up to 6 HPLC columns can be rapidly accessed by column selection valves, eliminating the instrument downtime involved in exchanging columns and the leakage due to repeated changing of tubing fittings. The columns are installed as a part of the loop system, as shown in this drawing. A 6 position valve can support 6 columns.

#### **MORE INFORMATION**

Prices

SD high pressure ...134 ST high pressure....135 Application

Low pressure SD... 136

Low pressure ST ... 139 Manifolds ......33

## Diaphragm valves FOR CONTINUOUS AUTOMATED OPERATION

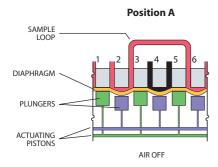
- Only 35 mm (1.375") in diameter
- >1,000,000 cycle lifetime
- Three configurations 6 port, 10 port, and 4 port internal sample
- Built in actuator
- 1/16" or 1/32" Valco zero dead volume fittings

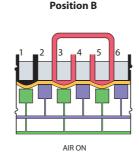
The VICI mini diaphragm valve is designed for trouble-free use in applications requiring minimal maintenance and maximum lifetime, making it an ideal choice for the process industry, automated lab analyzers, or continuous-monitoring environmental analyses.

#### **Design**

The mini diaphragm valve consists of plungers and ports arranged in a circular pattern, with the plungers

controlled by the reciprocation action of two air actuated pistons. Maintenance procedures are greatly simplified, since a single screw holds the valve together and locating pins ensure proper alignment. Extremely long lifetime, very short actuation time (10 milliseconds), minimum internal dead volume, and reliability have made this type of valve very successful in process gas chromatography for both sample injection and column switching.





#### TECH TIP

For optimal zero dead volume connections, make sure your tubing meets the best industry standards. OD tolerance should be nominal dimension ± .002".

Fractional dimension	Nominal dimension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500



#### **Dimensions**

Valve diameter is 35 mm (1.375"), height is 42 mm (1.625"), and weight is less than 255 g (9 oz).

#### **Valve Fittings**

The valve cap has Valco 1/32" or 1/16" ZDV fitting details – a rugged design which allows easy replacement of tubing or of the valve itself.

Standard bore size is 0.40 mm (.016"). Optional bore sizes are 0.25 mm (.010") and 0.75 mm (.030").

#### Lifetime

Diaphragm valve lifetime can exceed 1,000,000 cycles at ambient temperature or 500,000 cycles at 175°C.

#### **Actuation**

Actuator air (50-60 psi) is supplied to a side port with 10-32 female threads, permitting use of a variety of compression or barbed fittings. A 3-way solenoid is required for actuation. (See page 198.)

#### **Optional Mounting Kit**

The mounting kit consists of a ring which is mounted on a flat surface. A slot allows the ring to be tightened around the collar of the valve.

# Temperature/Pressure Specifications

Diaphragm valves can be operated at temperatures up to 200°C, at 300 psi. The standard valve is for applications in which the sample is above ambient pressure. An optional version works with subambient pressures, such as when the sample is "pulled" through the valve by a vacuum pump.

#### **Materials of Construction**

The cap is Nitronic 60 stainless (optional Hastelloy C or Type 316 stainless), with remaining metal parts of 300 series stainless. The diaphragm is formed from a specialized polyimide.

#### **Purge Option**

Purging improves sensitivity when a diaphragm valve is used in conjunction with a VICI Pulsed Discharge Detector, for example, since air cannot diffuse into the flow path.

The optional purge ring, easy to install on any VICI diaphragm valve, is equipped with two 1/16" ports for the purge gas inlet and outlet.



Purge ring Page 144

#### **ACTUATION**

A 3-way solenoid is required for actuation.
3-way solenoid ... p 198

### MORE INFORMATION Materials

Metals..... 254-255

#### Valve descriptions

#### Valve prices

#### **DIAPHRAGM VALVES**

#### Diaphragm valves, 1/32" fittings, 0.25 mm ports (.010")

**Process GC** 

1/32"

Includes stainless steel nuts and ferrules.

A 3-way solenoid is required for actuation. Order separately on page 198.



4 port .5 µl internal sample Prod No

DV12-1114-.5



4 port 1 µl internal sample Prod No

DV12-1114-1



6 port sampling/switching Prod No

DV12-1116



10 port multifunctional Prod No

DV12-1110

#### **SPECS**

Internal sample:

750 psi liq 50°C max

175°C max

Sampling/switching: 300 psi gas

Sample:

Above ambient pressure\*

Nitronic 60 valve body Polyimide diaphragm

\* For vacuum applications, contact the factory.

#### Diaphragm valves, 1/16" fittings, 0.40 mm ports (.016")

**Process GC** 

0.40 mm

Includes stainless steel nuts and ferrules.

A 3-way solenoid is required for actuation. Order separately on page 198.

4 port

1 µl internal sample

Prod No

4 port .5 µl internal sample Prod No

DV22-2114-.5

DV22-2114-1

6 port sampling/switching

Prod No DV22-2116

10 port multifunctional Prod No

DV22-2110

#### **SPECS**

Internal sample: 750 psi liq

50°C max

Sampling/switching:

300 psi gas 175°C max

Sample:

Above ambient pressure\*

Nitronic 60 valve body Polyimide diaphragm

\* For vacuum applications, contact the factory.

#### Diaphragm valves, 1/16" fittings, 0.75 mm ports (.030")

**Process GC** 

0.75 mm

Includes stainless steel nuts and ferrules.

A 3-way solenoid is required for actuation. Order separately on page 198.

4 port
.5 µl internal sample
Prod No

DV22-3114-.5

4 port 1 µl internal sample Prod No

DV22-3114-1

6 port sampling/switching Prod No

DV22-3116

10 port multifunctional Prod No

DV22-3110

#### **SPECS**

Internal sample:

750 psi liq 50°C max

Sampling/switching:

300 psi gas 175°C max

Sample: Above ambient pressure\*

Nitronic 60 valve body Polyimide diaphragm

\* For vacuum applications, contact the factory.

#### 1/16" sample loops

Each stainless steel loop includes two 1/16" stainless nuts and ferrules.

Volume	Prod No
2 μl	CSL2
5 μl	CSL5
10 μl	CSL10
20 μl	CSL20
50 μl	CSL50
100 μl	CSL100
250 μl	CSL250
500 μl	CSL500
1 ml	CSL1K
2 ml	CSL2K
5 ml	CSL5K
10 ml	CSL10K

#### 1/32" sample loops

CSLN10K

Each stainless steel loop includes two 1/32" stainless steel nuts and ferrules.

Volume Prod No CSLN1K CSLN2K  $2 \mu l$ CSLN5K 5 µl

10 µl





6 port 1/16" fittings

#### Replacement diaphragms

Prod No Polyimide diaphragm .010" bore DV22-21D .016" bore DV22-21D .030" bore DV22-31D PTFE diaphragm DV22-22D

#### **Accessories**

Prod No **DV22-PURGE** Purge ring Mounting kit **DVBRKIT** 

#### **OPTIONS**

Materials:

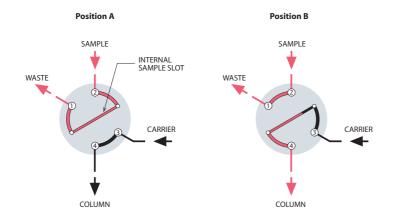
Hastelloy C Type 316 stainless For more information, refer to the metals discussion on page 254-5.

#### MORE INFORMATION

applications..pp 119-123 3-way solenoid ......198

#### **DIAPHRAGM VALVES**

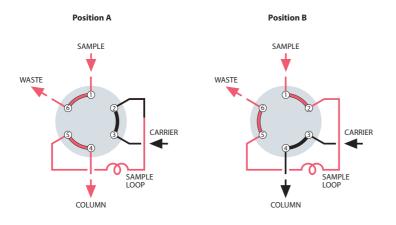
#### 4 port sample injector



#### MICROVOLUME SAMPLE INJECTION

The internal sample (fixed volume) flowpath is used when very small sample volumes are required. The sample size is determined by a passage engraved on the valve cap, allowing precise, repeatable injections. In Position A, the sample flows through the sample passage while the carrier flows through to the column. In Position B, the sample passage is in line with the column and the carrier injects the contents of the sample passage into the column.

#### 6 port sample injector



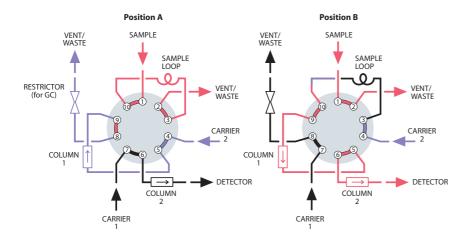
#### **SAMPLE INJECTION**

With the valve in Position A, sample flows through the external loop while the carrier flows directly through to the column. When the valve is switched to Position B, the sample contained in the sample loop and valve flow passage is injected into the column.

#### MORE INFORMATION

More applications .....pages 120-121

#### 10 port sample injecto



### LOOP SAMPLING WITH BACKFLUSH OF PRE-COLUMN TO VENT

When components of interest are low boiling, this plumbing scheme allows "heavy" components with long retention times to be backflushed to waste. After the sample loop is loaded in Position A, the valve is switched to Position B to inject the sample into column 1. As soon as all components of interest have entered column 2, the valve is switched back to Position A. Column 1 is backflushed to vent during the analysis, reducing the total analysis time.

#### **MORE INFORMATION**

More applications . . . . . . . . pages 122-123

# Cheminert® valves

### FOR INJECTION, SWITCHING, AND STREAM SELECTION

- Pressure ratings from 100 psi to 20,000 psi liq
- Inert, biocompatible construction
- Easy field service
- Automated operation pneumatic or electric
- 4,6,8, and 10 port and internal sample two position models
- Stream selection versions with up to 26 positions

#### Design

The basic Cheminert design involves a flat rotor which is engraved with slots which connect the ports. A stator is held at a constant, preset force against the rotor.

When repairs are required, all that is necessary for rotor access is the removal of two or three screws. Remove the old rotor and replace it, put the screws back in and tighten them, and the valve is ready for use at the factory-set pressure specification. No adjustments are possible, much less required. Other advantages of the design include easy panel mounting, low actuating torque, and compact size.

The flat plate design offers flow paths for basic flow switching, sample injection, and stream selection up to 10 positions (28 positions in some models).



#### **Materials of Construction**

**UHPLC** models have stators of specially coated stainless steel, with PAEK rotors.

**HPLC** models have stators of Nitronic 60 stainless steel, PAEK, Hastelloy C, or titanium, all of which are compatible with common HPLC solvents. Many are available with a proprietary longlife coating. Valcon H rotors are used with metal stators, and Valcon E with PAEK.

**Low pressure** models have PPS stators and rotors of Valcon E2, a proprietary reinforced PTFE composite.

Metal valves are supplied with stainless nuts, with ferrules of the same material as the stator. Fittings for polymeric valves vary with the valve design. The valve price lists contain more detailed information.

Sample injection loops are available in a variety of materials, and are found on the pages with their corresponding valves.

#### **TECH TIP**

For optimal zero dead volume connections, make sure your tubing meets the best industry standards. OD tolerance should be nominal dimension ± .002".

Fractional	Nominal
dimension	dimension
1/32"	.031
1/16"	.062
1/8"	.125
1/4"	.250
3/8"	.375
1/2"	.500

#### MORE INFORMATION

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### Cheminert valve

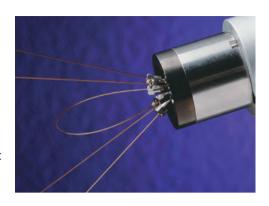
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### Nanovolume<sup>®</sup>

Cheminert Nanovolume® injectors, switching valves, and selectors are ideal for high speed, high throughput techniques which demand a valve and fitting system that minimize internal volume and eliminate dead volume.

A proprietary rotor material and stator coating achieve pressures to 20,000 psi, suitable for the most demanding analytical techniques. All models are compatible with any VICI actuation option.



#### Nanovolume® Injectors and switching valves

Application	Fittings		Bore size	Model	Pressure rating	More info			
UHPLC	360 micron		100 or 150 μm	C72MU	20,000 psi	p. 154			
20,000 psi				C72MX	15,000 psi	p. 154			
15,000 psi				C72MH	10,000 psi	vici.com			
15,000 psi	1/32" stainless		100 or 150 μm	C72NU	20,000 psi	vici.com			
10,000 psi				- amm	- Contract of the Contract of		C72NX	15,000 psi	p. 155
				C72NH	10,000 psi	vici.com			
	1/16" stainless			150 µm	C72X	15,000 psi	vici.com		
				C72H	10,000 psi	vici.com			
HPLC 5,000 psi	1/32" PEEK or stainless		100 or 150 μm	C2N	5,000 psi	p. 158			

#### Nanovolume® Internal sample injectors

Application	Fittings		Bore size	Sample sizes available	Model	Pressure rating	More info
UHPLC	1/32" stainless 100 μm		100 µm	4, 10, or 20 nl	C74NU	20,000 psi	vici.com
20,000 psi					C74NX	15,000 psi	vici.com
15,000 psi					C74NH	10,000 psi	vici.com
			150 µm	10, 20, or 30 nl	C74NU	20,000 psi	vici.com
10,000 psi	1/16" stainless				C74NX	15,000 psi	p. 155
					C74NH	10,000 psi	vici.com
		5" stainless 150 μm 10,20	10, 20, or 50 nl	C74U	20,000 psi	vici.com	
					C74X	15,000 psi	vici.com
					C74H	10,000 psi	vici.com
HPLC 5,000 psi	1/32" PEEK or stainless		100 or 150 μm	4, 10, or 20 nl	C4N	5,000 psi	p. 159

#### NANOVOLUME® VALVES AT VICI.COM

For more information on all valve options listed here, go to:

www.vici.com/



#### Nanovolume® Selectors

Application	Fittings		Bore size	Model	Pressure rating	More info	
UHPLC	1/32" stainless		100 or 150 μm	C75NU	20,000 psi	vici.com	
20,000 psi					C75NX	15,000 psi	p. 172
15,000 psi				C75NH	10,000 psi	vici.com	
	1/16" stainless		150 µm	C75U	20,000 psi	vici.com	
10,000 psi				C75X	15,000 psi	vici.com	
				C75H	10,000 psi	vici.com	

#### **UHPLC**

Cheminert UHPLC injectors, switching valves, and selectors are ideal for high speed, high throughput techniques which demand a valve and fitting system that minimize internal volume and eliminate dead volume.

VICI offers UHPLC versions for nanobore and microbore applications.

#### Nanovolume® UHPLC valves

See previous page for information about Nanovolume® UHPLC injectors, switching valves, and selectors.



#### Microbore **UHPLC** injectors and switching valves

Application	Fittings		Bore size	Model	Pressure rating	More info											
UHPLC	1/32" stainless		250 μm	C72NU	20,000 psi	vici.com											
20,000 psi															C72NX	15,000 psi	vici.com
15,000 psi				C72NH	10,000 psi	vici.com											
10,000 psi	1/16" stainless				1/16" stainless	250 μm	C72U	20,000 psi	vici.com								
					C72X	15,000 psi	p. 156										
				C72H	10,000 psi	p. 156											

#### Microbore **UHPLC** internal sample injectors

Application	Fittings		Bore size	Sample sizes available	Model	Pressure rating	More info	
UHPLC	1/32" stainless		250 µm		C74NU	20,000 psi	vici.com	
20,000 psi			-		100 nl	C74NX	15,000 psi	vici.com
15,000 psi					C74NH	10,000 psi	vici.com	
10,000 psi	1/16" stainless	ainless 250 µI	Total Control of the		C74U	20,000 psi	vici.com	
			Primitin —	100 nl	C74X	15,000 psi	p. 157	
					C74H	10,000 psi	p. 157	

#### Microbore **UHPLC selectors**

Application	Fittings		Bore size	Model	Pressure rating	More info
UHPLC	1/32" stainless		250 µm	C75NU	20,000 psi	vici.com
20,000 psi				C75NX	15,000 psi	p. 172
15,000 psi				C75NH	10,000 psi	vici.com
10,000 psi	1/16" stainless		250 µm	C75U	20,000 psi	vici.com
				C75X	15,000 psi	vici.com
				C75H	10,000 psi	p. 173

#### **UHPLC VALVES** AT VICI.COM

For more information on all valve options listed here, go to:

www.vici.com/ cval/cval\_uhplc.php



**MORE INFORMATION** Nanovolume® injectors and selectors .....147

### **HPLC** injectors

#### **Nanobore**

Nanovolume® HPLC injectors and internal sample injectors include 1/32" PEEK nuts and ferrules. See page 147 for an overview of these valves.

#### **Microbore**

**Model C2** valves can be used as injectors or switching valves.

**Model C4** is an internal volume sample injector with sample sizes ranging from 10 nl to 50 nl.

**Model C6** continuous flow injector is designed to maintain pump flow during most of the switching cycle, virtually eliminating pressure spikes.

**Model C1CFI** is a 6 port through-thehandle continuous flow injector. An engraving on the stator maintains pump flow between ports 2 and 3 during most of the switching cycle, virtually eliminating pressure spikes. Because the handle is integral to the design, all Model C1CF valves are manual, with position feedback standard.

#### **Analytical**

Models C2, C6, and C1CFI are also available for analytical injection and switching, with port sizes of 0.40 mm (.016"). Model C4 offers internal volume sample sizes ranging from 0.1 to 0.5  $\mu$ l.

#### **Semi-Preparative HPLC**

**Model C2** valves are available with flow passages optimized for semi-preparative HPLC. Choose from 4, 6, 8, or 10 port versions. Contact our sales or technical support departments for more information.

#### **Autosampler Replacements**

We supply direct replacements for injectors in many popular autosamplers. Call technical support to determine which replacement is best for your application.



**Model C2** Microbore, page 160 Analytical, page 163

5,000 psi



**Model C4** Microbore, page 161 Analytical, page 164

5,000 psi



Model C6 Microbore, page 162 Analytical, page 165

5,000 psi

**Continuous flow** 



Microbore, page 162 Analytical, page 165

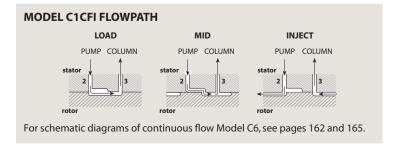
5,000 psi

Through-handle

**Continuous flow** 

#### **MORE INFORMATION**

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#### Low pressure injectors

#### With Valco Zero Dead Volume (ZDV) Fittings

C20Z Series valves with zero dead volume fittings (10-32 thread) are shipped with standard PEEK nuts and ferrules. Zero dead volume fingertight fittings and nuts and ferrules of other materials may be ordered separately. Standard specifications are 100 psi gas/250 psi liquid at 75°C. On request, the pressure rating can be as high as 600 psi liquid. *Caution:* Metal fittings will damage the threads and details of C20Z series valves. Use of metal fittings in a C20Z valve voids the warranty.

The **Model C22Z** is a conventional two position sample injector and switching valve, with 4, 6, 8, or 10 ports. Sample injection requires a loop, ordered separately.

The **Model C24Z** is an internal sample injector, for applications in which the sample size is smaller than that of any available external loop. Sample sizes available are 0.2, 0.5, and 1  $\mu$ l.





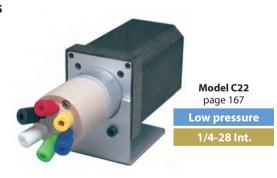
#### With Cheminert 1/4-28 Fittings

C20 Series valve caps have female threads for direct connection of lines – no couplings are required. C20 Series valves are available in 4, 6, 8, and 10 port versions. Standard specifications are 100 psi gas/250 psi liquid at 75°C.

Multicolored Cheminert 1/4-28 flangeless fittings for 1/16" or 1/8" OD tubing (depending on the valve model) are included.

**Model C22** valves are used for sample injection or switching. (Functionally equivalent to Model C22Z) Sample injection requires a loop, ordered separately.

The **Model C24** is an internal sample injector like the C24Z, available with 0.5, 1.0, or 2.0 µl sample size.





#### **CAUTION**

Metal fittings will damage the threads and details of C20Z series valves (models C22Z, C24Z, C25Z). Use of metal fittings in a C20Z valve voids the warranty.

#### **TECHTIP**

Our life tests indicate that these valves will typically give more than 100,000 cycles before requiring any service. This assumes that the fluid used is free of particulates and not reactive toward the valve components. If the stream may contain particulates, or if it has high salt content which could precipitate within the sample lines, use an in-line filter. Note: Valves with purge ports are available on

#### MORE INFORMATION

request.

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#### For OEMs







#### **Integrated Motor/Injector Assemblies**

Cheminert's **Model C52** (HPLC) and **Model C62(Z)** (low pressure) injectors are integrated motor/valve assemblies designed specifically to be built into an OEM system. Using the well-proven Cheminert injector designs and the 24 volt motor from our popular microelectric actuators, the C52 and C62 need only to be connected to the instrument's power supply.

Control is simplified to require a single contact closure; the injector's position is determined by whether the closure is held high or low. There's even an easy way for the instrument to confirm the valve's position by sensing the output from a built-in sensor.

In the default control mode, one contact closure shifts the injector to inject and a second is required to shift it back to load. A simple jumper change shifts the mode to single contact closure, in which a contact closure moves the injector from load to inject, where it remains until the contact is broken and the injector reverts to the load position. Jumper settings can also be modified to change the motor's degree of rotation so it can be used with any of the valve models available.

All these features are built into a compact and light-weight package and are available in 4, 6, 8, and 10 port configurations. Serial communication via RS-232 is optional.

#### **Autosampler and Other OEM Injectors**

**Model C3** is a unique injector with a syringe injection port centered on the rear face of the valve (opposite the handle or actuator), allowing convenient syringe insertion when the valve is mounted on an actuator inside an instrument.

**Model C2V** is designed specifically for use in an autosampler. It is like the standard C2 except that the sample port is perpendicular to the valve axis. This permits the valve and actuator to be installed horizontally, while the syringe loads the injector vertically.

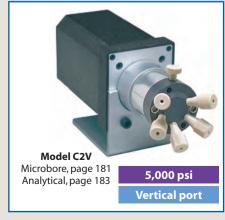
### UNIVERSAL ACTUATOR

The new universal actuator operates virtually any Valco or Cheminert rotary valve – two position and selector alike – greatly simplifying the electronic aspect of instrument design......193

### OEM SELECTOR VALVES

See pages 153 and 186-187 for selector (multiposition) valves for OEMs.





### UHPLC and high pressure selectors

UHPLC Model C75 selectors offer pressure ratings of 20,000 psi, 15,000 psi and 10,000 psi with 1/32" and 1/16" fittings for nanobore and microbore applications. See charts on pages 147 and 148 for all options.



**Model C75** See chart on page 147

20,000 psi

15,000 psi

10,000 psi

Standard

Model C5

page 174

5,000 psi



HPI C column selector system page 175

5,000 psi

HPLC Model C5, with Valco ZDV fitting details, is available with 4, 6, 8, or 10 positions. Stators are available in Nitronic 60 stainless, titanium, and Hastelloy C-22, with rotors of Valcon H, all of which are compatible with common HPLC solvents. PAEK stators are used in combination with Valcon E rotors.

The C5 valve is the backbone of the Cheminert HPLC column selector system, which includes two stream selection valves mounted on a single microelectric actuator.

Columns are not included

Consult the factory for information about a UHPLC column selector system.

**ACTUATOR** The new universal actuator operates virtually any Valco or Cheminert rotary valve -

**UNIVERSAL** 

two position and selector alike – greatly simplifying the electronic aspect of instrument design. ... 193

#### **CAUTION**

Metal fittings will damage the threads and details of C25Z, C25G, and C65Z series valves.

Use of metal fittings in these valves voids the warranty.

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#### **PORT DIAMETERS**

Model Fitting

	size	port diameter		
High I	Pressure			
C5	1/16" ZDV	0.15 mm	(.006")	
		0.25 mm	(.010")	
		0.40 mm	(.016")	
		0.75 mm	(.030")	
Low P	ressure			
C25Z	1/16" ZDV	0.75 mm	(.030")	
C25	1/4-28	0.75 mm	(.030")	
	for 1/16"			
	tubing			
	1/4-28	1.50 mm	(.060")	
	for 1/8"			
	tubing			
C25G	1/16" ZDV	0.67 mm	(.026")	
C45	1/2-20	4.6 mm	(.180")	
	for 1/4"			
	tubing			
OEM -	OEM – High Pressure			
	_			

OEM -	- High Press	sure	
C55	1/16" ZDV	0.25 mm	(.010")
		0.40 mm	(.016")
		0.75 mm	(.030")
OEM -	- Low Press	ure	
C65Z	1/16" ZDV	0.75 mm	(.030")
			( 000 OII)

#### C65 1/4-28 0.75 mm (.030") for 1/16" tubing 1/4-28 1.50 mm (.060")

### for 1/8" tubing

#### **SPECIFICATIONS**

<b>CHEMI</b> Model	NERT SE Stator material	Std rotor material	Max pressure	Max temp	Number of positions
High P	ressure				
C5	Metal PAEK	Valcon H Valcon E	5000 psi liq 5000 psi liq	75°C 50°C	4, 6, 8, 10 4, 6, 8, 10
Low Pr	essure				
C25Z	PPS	Valcon E2	100 psi gas/ 250 psi liq	75°C	4, 6, 8, 10, 12, 14
C25	PPS	Valcon E2	100 psi gas/ 250 psi liq	75°C	4, 6, 8, 10
C25G	PEEK	Valcon M	100 psi liq	50°C	20, 24, 28
C45	PPS	Valcon TF	100 psi liq	50°C	4, 6, 8
OEM -	High Pro	essure			
C55	Metal PAEK	Valcon H Valcon E	5000 psi liq 5000 psi liq	50°C 50°C	4, 6, 8, 10 4, 6, 8, 10
OEM – Low Pressure					
C65Z	PPS	Valcon E2	100 psi gas/ 250 psi liq	50°C	4, 6, 8, 10
C65	PPS	Valcon E2	100 psi gas/ 250 psi liq	50°C	4, 6, 8, 10



Model C25Z page 176

Low pressure 10-32 ZDV



Model C25 page 177

Low pressure

1/4-28 Internal



Model C25G page 178

Low pressure 6-40 flat bottom



Model C45 page 179

Low pressure

1/2-20 Int.

#### Low pressure selectors

#### **With Valco Zero Dead Volume Fittings**

**Model C25Z** valves feature the popular 1/16" Valco ZDV details for 1/16" OD tubing. Available in 4, 6, 8, 10, 12, and 14 positions, with a variety of actuator options. Standard materials are PPS stator and Valcon E2 rotor, with other materials optional.

#### With Cheminert 1/4-28 Fittings

The **Model C25** has female 1/4-28 threaded fitting details for direct connection of lines – no couplings are required. The C25 is available in 4, 6, 8, and 10 position models. Multicolored Cheminert 1/16" or 1/8" flangeless fittings are included. Rotors are made of Valcon E2 with stators of PPS.

#### With 6-40 Fittings for 1/16" or 1/32" tubing

**Model C25G** valves feature 6-40 flat bottom details that can accommodate 1/16" (standard) or 1/32" (optional) tubing. The fitting is one piece PEEK with a stainless steel retainer. available with 20, 24, or 28 positions. Universal actuator is required.

#### With Cheminert 1/2-20 Fittings

**Model C45** valves feature 1/2-20 threaded fitting details for use with 1/4" OD tubing. This is a tapered rotor valve with large bore for high flow applications. Rotors are made from Valcon E2, with valve body made from PPS. Available in 4 and 6 position configurations only.

#### For OEMs

#### **Integrated Motor/Stream Selectors**

Cheminert's new **Model C55** (HPLC) and **Model C65(Z)** (low pressure) stream selectors are integrated motor/valve assemblies designed specifically to be built into an OEM system. The compact, lightweight package is available in 4, 6, 8, and 10 position configurations.

Using the well-proven Cheminert stream selector design and the 24 volt motor from our microelectric actuators, the Models C55, C65, and C65Z need only to be connected to an instrument's power supply. A single momentary contact closure steps the valve to the next position; a separate contact closure moves the valve to position 1 (Home).

See how our stream selectors can simplify your instrument design and minimize time to market – all while trimming your costs.

Serial communication via RS-232 is optional.





#### **OEM INJECTORS** See pages 151, 180-185 for injectors for OEMs.

#### 20,000 psi UHPLC Nanovolume® valves 360 micron fittings, 100 micron bore (.004")

20,000 psi

Nanobore

360 μm 100 μm

Includes stainless 360 micron fittings. Valves for use with fused silica tubing have gold-plated ferrules. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



Prod No Prod No

#### Coated stainless stator for use with stainless tubing

C72MU-4676 Manual C72MU-4674 C72MU-4674A C72MU-4676A With air actuator With microelectric actuator C72MU-4674EH C72MU-4676EH Replacement valve C72MU-4674D C72MU-4676D Replacement rotor C72M-46R4 C72M-46R6 Replacement stator C72M-4C74 C72M-4C76

#### For use with fused silica tubing

C72MFSU-4674 C72MFSU-4676 Manual With air actuator C72MFSU-4674A C72MFSU-4676A C72MFSU-4674EH C72MFSU-4676EH With microelectric actuator Replacement valve C72MFSU-4674D C72MFSU-4676D C72M-46R4 C72M-46R6 Replacement rotor Replacement stator C72M-4C74 C72M-4C76

#### Model C72MU

### **SPECS**

20,000 psi liq 50°C max

Stainless w/ inert coating stator

Valcon E3 rotor

#### **OPTIONS**

- 150 micron (.006") bore
- Internal sample injector (4 - 20 nl)
- 10,000 and 15,000 psi versions available



**Model C72MU** 360 micron fittings (Model C72MX is similar)

#### 15,000 psi UHPLC Nanovolume® valves 360 micron fittings, 150 micron bore (.006")

15,000 psi

**Nanobore** 

360 µm

150 µm

Includes stainless 360 micron fittings.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



6 Port Prod No

Prod No

#### **Coated stainless stator**

Manual C72MX-6676 C72MX-6670 With air actuator C72MX-6676A C72MX-6670A C72MX-6670ED With microelectric actuator C72MX-6676EH C72MX-6676D C72MX-6670D Replacement valve C72M-66R6 C72M-66R0 Replacement rotor Replacement stator C72M-6C76 C72M-6C70

### Model C72MX

#### **SPECS**

15,000 psi liq 50°C max

Stainless w/ inert coating stator

Valcon E3 rotor

#### **OPTIONS**

- 100 micron (.004") bore
- Internal sample injector (4 - 20 nl)
- 10,000 psi version available
- 4 and 8 port versions available

#### MORE INFORMATION

360 micron Nanovolume® fittings ..... page 58

#### 15,000 psi UHPLC Nanovolume® valves 1/32" Valco stainless fittings, 150 micron bore (.006")

Model C72NX

15,000 psi

Nanobore

150 µm

1/32"

#### **SPECS**

15,000 psi liq 50°C max

Stainless w/ inert coating stator

Valcon E3 rotor

#### **OPTIONS**

- 100 micron (.004") bore
- 250 micron (.010") bore
- 10,000 psi version available
- 4 and 8 port versions available

Includes stainless nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 5 µl loop of the stator material.





Prod No Prod No

Manual With air actuator With microelectric actuator

**Coated stainless stator** 

Replacement valve Replacement rotor Replacement stator

C72NX-6676 C72NX-6670 C72NX-6676A C72NX-6670A C72NX-6670ED C72NX-6676EH

C72NX-6676D C72NX-6670D C72N-66R6 C72N-66R0 C72N-6C76 C72N-6C70



**Model C72NX** 1/32" Valco stainless fittings

#### Sample loops for C72NX valves

Each stainless loop includes two stainless 1/32" Valco fittings.

Volume	<b>Stainless</b> <i>Prod No</i>
1 μl	CSLN1K5
2 μl	CSLN2K
5 μl	CSLN5K
10 μl	CSLN10K







#### 15,000 psi UHPLC Nanovolume® internal sample injectors 1/32" Valco stainless fittings, 150 micron bore (.006")

Model C74NX

### **SPECS**

15,000 psi liq 50°C max

Stainless w/ inert coating stator Valcon E3 rotor

#### **OPTIONS**

- 100 micron (.004") bore
- 250 micron (.010") bore
- 10,000 and 20,000 psi versions available

#### MORE INFORMATION

1/32" Valco fittings .....pages 10,12 1/16" Nanovolume® injectors C72X ..... vici.com

C74X ..... vici.com

Includes stainless nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



15,000 psi

**Nanobore** 

1/32"

150 µm

	10 nanoliters	20 nanoliters	30 nanoliters
	Prod No	Prod No	Prod No
Coated stainless stator			
Manual	C74NX-667401	C74NX-667402	C74NX-667403
With air actuator	C74NX-667401A	C74NX-667402A	C74NX-667403A
With microelectric actuator	C74NX-667401EH	C74NX-667402EH	C74NX-667403EH
Replacement valve	C74NX-667401D	C74NX-667402D	C74NX-667403D
Replacement rotor	C74N-66R01	C74N-66R02	C74N-66R03
Replacement stator	C74N-6C7	C74N-6C7	C74N-6C7

#### 15,000 psi UHPLC microbore valves, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C72X

15,000 psi

Microbore

With microelectric actuator

Replacement valve Replacement rotor

Replacement stator

1/16"

Manual With air actuator

Includes stainless steel nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 5 µl stainless steel sample loop.



C72X-1674A

C72X-1674EH

C72X-1674D

C72-16R4

C72-1C74



C72X-1676A

C72X-1676EH

C72X-1676D

C72-16R6

C72-1C76





C72-1C78



Prod No C72X-1670 C72X-1670A C72X-1670ED C72X-1670D

C72-16R0

C72-1C70

**OPTIONS** 

**SPECS** 

15,000 psi liq

Stainless stator

50°C max

■ 0.15 mm ports (.006")

with inert coating Valcon E3 rotor

#### 10,000 psi UHPLC microbore valves, 1/16" Valco fittings, 0.25 mm ports (.010")

10,000 psi

Microbore

Manual

1/16"

With air actuator

Replacement valve

Replacement rotor

Replacement stator

With microelectric actuator

Includes stainless steel nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 5 µl stainless steel sample loop.



<b>4 Port</b> Prod No
C72H-1674 C72H-1674A C72H-1674EH
C72H-1674D C72-16R4

C72-1C74







C72-1C76



8 Port Prod No C72H-1678 C72H-1678A



Prod No C72H-1670

C72H-1670A C72H-1670ED C72H-1670D

C72-16R0 C72-1C70

#### Model C72H

**SPECS** 10,000 psi liq

50°C max Stainless stator with inert coating Valcon E3 rotor

#### **OPTIONS**

■ 0.15 mm ports (.006")



Model C72H (C72X similar) 1/16" ZDV fittings

#### Stainless steel sample loops

for C72X and C72H valves

Each loop includes two stainless steel nuts and ferrules.

Metal loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.

Volume	Prod No	Volume	Prod No	Volume	Prod No
2 µl	CSL2	50 µl	CSL50	1 ml	CSL1K
5 µl	CSL5	100 µl	CSL100	2 ml	CSL2K
10 µl	CSL10	250 µl	CSL250	5 ml	CSL5K
20 µl	CSL20	500 µl	CSL500	10 ml	CSL10K

#### **ABOUT LOOPS**

■ Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 15,000 psi UHPLC microbore internal sample injectors, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C74X

#### **SPECS**

15,000 psi liq 50°C max

Stainless stator with inert coating Valcon E3 rotor

Includes stainless steel nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



15,000 psi

Microbore

0.25 mm

#### **OPTIONS**

■ 0.15 mm ports (.006")

Sample volume	<b>20 nanoliters</b> <i>Prod No</i>	<b>50 nanoliters</b> <i>Prod No</i>	<b>100 nanoliters</b> <i>Prod No</i>
Manual With air actuator With microelectric actuator	C74X-167402 C74X-167402A C74X-167402EH	C74X-167405 C74X-167405A	C74X-16741 C74X-16741A
Replacement valve	C74X-167402EH C74X-167402D	C74X-167405EH C74X-167405D	C74X-16741EH C74X-16741D
Replacement rotor Replacement stator	C74-16R02 C74-1C7	C74-16R05 C74-1C7	C74-16R1 C74-1C7

#### 10,000 psi UHPLC microbore internal sample injectors, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C74H

#### **SPECS** 10,000 psi liq 50°C max

Stainless stator with inert coating Valcon E3 rotor

#### **OPTIONS**

■ 0.15 mm ports (.006")

Includes stainless steel nuts and ferrules. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



10,000 psi

**Microbore** 

1/16" 0.25 mm

Sample volume	20 nanoliters	50 nanoliters	100 nanoliters
	Prod No	Prod No	Prod No
Manual	C74H-167402	C74H-167405	C74H-16741
With air actuator	C74H-167402A	C74H-167405A	C74H-16741A
With microelectric actuator	C74H-167402EH	C74H-167405EH	C74H-16741EH
Replacement valve	C74H-167402D	C74H-167405D	C74H-16741D
Replacement rotor	C74-16R02	C74-16R05	C74-16R1
Replacement stator	C74-1C7	C74-1C7	C74-1C7



**Model C74H** (C74X similar) 1/16" ZDV fittings

#### Actuators Air ..... page 197 Microelectric ......190 Universal . . . . . . . . . . . . 193 Materials Metals..... 254-255 Polymers . . . . . . . . . . . . . 256 Valve rotors......257 Standoff

assemblies ......205

**MORE INFORMATION** 

#### 5,000 psi Nanovolume® valves, 1/32" fittings, 100 micron ports (.004")

Model C2N

5,000 psi

Nanobore

1/32" 100 μm

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 250 nl PEEK loop.

	6 Port*	10 Port
	Prod No	Prod No
N60 stainless stator		
Manual	C2N-4006	C2N-4000
With microelectric actuator	C2N-4006EH	C2N-4000EH
Replacement valve	C2N-4006D	C2N-4000D
Replacement rotor	C2N-40R6	C2N-40R0
Replacement stator	C2N-4C06	C2N-4C00
PAEK stator		
Manual	C2N-4346	C2N-4340
With microelectric actuator	C2N-4346EH	C2N-4340EH
Replacement valve	C2N-4346D	C2N-4340D
Replacement rotor	C2N-43R6	C2N-43R0
Replacement stator	C2N-4C46	C2N-4C40

#### **SPECS**

5000 psi liq

75°C max

Metal stator

Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

■ 150 micron (.006") and 250 micron (.010") bores



**Model C2N** 1/32" ZDV fittings

#### **Sample loops**

for C2N valves

Each stainless loop includes two stainless steel nuts and ferrules. Each PEEK loop includes two PEEK nuts and ferrules.

Stainless steel		
Prod No	Prod No	
CSLN1K	CSLN1KPK	
CSLN2K	CSLN2KPK	
CSLN5K	CSLN5KPK	
CSLN10K	CSLN10KPK	
	Prod No CSLN1K CSLN2K CSLN5K	



#### **ABOUT LOOPS**

■ Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### 5,000 psi Nanovolume® internal sample injector, 1/32"fittings, 100 micron ports (.004")

Model C4N

#### **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

■ 150 micron (.006") bore

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



5,000 psi

Nanobore

1/32" 100 μm

Sample volume	<b>4 nanoliters</b> <i>Prod No</i>	<b>10 nanoliters</b> <i>Prod No</i>	<b>20 nanoliters</b> <i>Prod No</i>
<b>N60 stainless stator</b> Manual With microelectric actuator	C4N-4004004 C4N-4004004EH	C4N-400401 C4N-400401EH	C4N-400402 C4N-400402EH
Replacement valve Replacement rotor Replacement stator	C4N-4004004D C4N-40R004 C4N-4C0	C4N-400401D C4N-40R01 C4N-4C0	C4N-400402D C4N-40R02 C4N-4C0
PAEK stator Manual With microelectric actuator	C4N-4344004 C4N-4344004EH	C4N-434401 C4N-434401EH	C4N-434402 C4N-434402EH
Replacement valve Replacement rotor Replacement stator	C4N-4344004D C4N-43R004 C4N-4C4	C4N-434401D C4N-43R01 C4N-4C4	C4N-434402D C4N-43R02 C4N-4C4



**Model C4N** 1/32" ZDV fittings

#### Microbore valves, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C2

5,000 psi

Microbore

1/16" 0.25 mm

Includes nuts and ferrules.

Valves with metal stators have stainless steel nuts and ferrules of the stator material. Valves with PAEK stators have PEEK nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 5 µl loop of the stator material.

	<b>4 Port</b>	<b>6 Port*</b>	<b>8 Port</b>	<b>10 Port</b>
	Prod No	Prod No	Prod No	Prod No
N60 stainless stator Manual With air actuator With microelectric actuator	C2-1004 C2-1004A C2-1004EH	C2-1006 C2-1006A C2-1006EH	C2H-1008 C2H-1008A C2H-1008EH	C2H-1000 C2H-1000A C2H-1000EH
Replacement valve	C2-1004D	C2-1006D	C2H-1008D	C2H-1000D
Replacement rotor	C2-10R4	C2-10R6	C2-10R8H	C2-10R0H
Replacement stator	C-1C04	C-1C06	C-1C08H	C-1C00H
PAEK stator Manual With air actuator With microelectric actuator	C2-1344 C2-1344A C2-1344EH	C2-1346 C2-1346A C2-1346EH	C2H-1348 C2H-1348A C2H-1348EH	C2H-1340 C2H-1340A C2H-1340EH
Replacement valve	C2-1344D	C2-1346D	C2H-1348D	C2H-1340D
Replacement rotor	C2-13R4	C2-13R6	C2-13R8H	C2-13R0H
Replacement stator	C-1C44	C-1C46	C-1C48H	C-1C40H
<b>Titanium stator</b> Manual With air actuator With microelectric actuator	C2-1034	C2-1036	C2H-1038	C2H-1030
	C2-1034A	C2-1036A	C2H-1038A	C2H-1030A
	C2-1034EH	C2-1036EH	C2H-1038EH	C2H-1030EH
Replacement valve	C2-1034D	C2-1036D	C2H-1038D	C2H-1030D
Replacement rotor	C2-10R4	C2-10R6	C2-10R8H	C2-10R0H
Replacement stator	C-1C34	C-1C36	C-1C38H	C-1C30H



Model C2 1/16" ZDV fittings

#### **SPECS**

5000 psi liq 75°C max

Metal stator

Valcon H rotor

#### 5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

- Continuous flow version is available as Model C6. See page 162.
- Hastelloy C stators
- Loop fill port assembly for injection from front of the valve. See page 41.
- 0.15 mm (0.006") bore

#### **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.



Order loops from page 161.

#### **MORE INFORMATION**

#### Nanoliter sample injector, 1/16" Valco fittings, 0.15 mm ports (.006")

Model C4

#### **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

#### 5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

- 100, 200, and 500 nl sample volumes are also available in 0.25 mm bore. See page 164.
- Loop fill port assembly for injection from front of the valve.

  See page 41.
- 0.25 mm (0.010") bore

#### NOTE

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



5,000 psi Microbore

Internal sample

1/16"

0.15 mm

Sample volume	<b>10 nanoliters</b> <i>Prod No</i>	<b>20 nanoliters</b> <i>Prod No</i>	<b>50 nanoliters</b> <i>Prod No</i>
<b>N60 stainless stator</b> Manual With air actuator With microelectric actuator	C4-000401	C4-000402	C4-000405
	C4-000401A	C4-000402A	C4-000405A
	C4-000401EH	C4-000402EH	C4-000405EH
Replacement valve	C4-000401D	C4-000402D	C4-000405D
Replacement rotor	C4-00R01	C4-00R02	C4-00R05
Replacement stator	C4-0C0	C4-0C0	C4-0C0
PAEK stator Manual With air actuator With microelectric actuator	C4-034401 C4-034401A C4-034401EH	C4-034402 C4-034402A C4-034402EH	C4-034405 C4-034405A C4-034405EH
Replacement valve	C4-034401D	C4-034402D	C4-034405D
Replacement rotor	C4-03R01	C4-03R02	C4-03R05
Replacement stator	C4-0C4	C4-0C4	C4-0C4



Model C4 1/16" ZDV fittings

#### ABOUT LOOPS

- Other materials are available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, and PTFE. See pages 254-255.
- Metal loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### Sample loops

Carloles

for C1, C2, C2V, C3, and C6 valves

Each metal loop includes two stainless steel nuts and ferrules. Each PEEK loop includes two PEEK nuts and ferrules.

	Stainless	PEEK	Titanium
Volume	<b>Steel (</b> Prod No	for PAEK stators) Prod No	Prod No
2 μl	CSL2	CZSL2PK	—
5 μl	CSL5	CZSL5PK	—
10 μl	CSL10	CZSL10PK	CSL10TI
20 μl	CSL20	CZSL20PK	CSL20TI
50 μl	CSL50	CZSL50PK	CSL50TI
100 μl	CSL100	CZSL100PK	CSL100TI
250 μl	CSL250	CZSL250PK	CSL250TI
500 μl	CSL500	CZSL500PK	CSL500TI
1 ml	CSL1K	CZSL1KPK	CSL1KTI
2 ml	CSL2K	CZSL2KPK	_
5 ml	CSL5K	CZSL5KPK	_
10 ml	CSL10K	—	_



#### Microbore continuous flow through-the-handle injector, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C1CFI

5,000 psi

Microbore

**Continuous flow** 

Through-handle

0.25 mm



Available only in manual version. Position feedback included. Includes nuts and ferrules.

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings. Includes one 5 µl loop of the stator material.

	N60 stainless stator Prod No	PAEK stator Prod No
6 port injector	C1CFI-1006	C1CFI-1346
Replacement rotor	C1-10R6	C1-13R6
Replacement stator	C1CF-1C06	C1CF-1C46

C-261

Replacement injector fitting for 22 gauge x 2" long needle

#### **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

■ 0.40 mm bore (.016") on page 165.

#### **MORE INFORMATION**

Syringes..... page 250

#### NOTE

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

### Microbore continuous flow injector, 1/16" Valco fittings, 0.25 mm ports (.010")

**Model C1CFI** 

1/16" ZDV fittings

Model C6

5,000 psi

**Microbore** 

**Continuous flow** 

1/16" 0.25 mm



**Model C6** 1/16" ZDV fittings

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Includes one 5 µl loop of the stator material.

	N60 stainless stator Prod No	PAEK stator Prod No
Manual	C6-1006	C6-1346
With pneumatic actuator	C6-1006A	C6-1346A
With standard electric actuator With microelectric actuator	C6-1006E C6-1006EH	C6-1346E C6-1346EH
Replacement valve	C6-1006D	C6-1346D
Replacement rotor	C2-10R6	C2-13R6
Replacement stator	C6-1C06	C6-1C46

### **SPECS**

5000 psi liq 75°C max

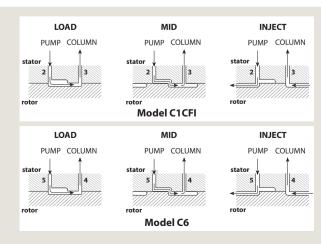
Metal stator Valcon H rotor

5000 psi liq 50°C max PAEK stator Valcon E rotor

Order loops from page 161.

#### **CONTINUOUS FLOWPATHS**

An engraving on the stator maintains pump flow between the pump connection port and the column connection port during most of the switching cycle, virtually eliminating pressure spikes.



#### Analytical valves, 1/16" Valco fittings, 0.40 mm ports (.016")

Model C2

0.40 mm

#### **SPECS** 5000 psi liq

75°C max Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

- Continuous flow version is available as Model C6. See page 162.
- Hastelloy C stators
- Semi-prep version with 0.75 mm ports (.030") available
- Loop fill port assembly for injection from front of the valve. See page 41.

#### **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.



Includes nuts and ferrules.

Valves with metal stators have stainless steel nuts and ferrules of the stator material. Valves with PAEK stators have PEEK nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

\* The 6 port valve includes a 20 µl loop of the stator material.







5,000 psi

**Analytical** 

		(8 00)		(8 <u></u> )
	4 Port Prod No	<b>6 Port*</b> Prod No	<b>8 Port</b> Prod No	<b>10 Port</b> Prod No
N60 stainless stator Manual With air actuator With microelectric actuator	C2-2004	C2-2006	C2H-2008	C2H-2000
	C2-2004A	C2-2006A	C2H-2008A	C2H-2000A
	C2-2004EH	C2-2006EH	C2H-2008EH	C2H-2000EH
Replacement valve Replacement rotor Replacement stator	C2-2004E11 C2-2004D C2-20R4 C-2C04	C2-2006D C2-20R6 C-2C06	C2H-2008D C2-20R8H C-2C08H	C2H-2000EN C2H-2000D C2-20R0H C-2C00H
PAEK stator  Manual  With air actuator  With microelectric actuator	C2-2344	C2-2346	C2H-2348	C2H-2340
	C2-2344A	C2-2346A	C2H-2348A	C2H-2340A
	C2-2344EH	C2-2346EH	C2H-2348EH	C2H-2340EH
Replacement valve	C2-2344D	C2-2346D	C2H-2348D	C2H-2340D
Replacement rotor	C2-23R4	C2-23R6	C2-23R8H	C2-23R0H
Replacement stator	C-2C44	C-2C46	C-2C48H	C-2C40H
<b>Titanium stator</b> Manual With air actuator With microelectric actuator	C2-2034	C2-2036	C2H-2038	C2H-2030
	C2-2034A	C2-2036A	C2H-2038A	C2H-2030A
	C2-2034EH	C2-2036EH	C2H-2038EH	C2H-2030EH
Replacement valve	C2-2034D	C2-2036D	C2H-2038D	C2H-2030D
Replacement rotor	C2-20R4	C2-20R6	C2-20R8H	C2-20R0H
Replacement stator	C-2C34	C-2C36	C-2C38H	C-2C30H



Model C2 1/16" ZDV fittings

### Model C2 6 port valves

can also be ordered with a dual 3-way rotor, as described in EPA Method

**OPTIONAL FLOWPATH** 

To specify this flowpath, substitute "6X" for "6" in the valve or rotor product number.



#### **AUTOSAMPLER REPLACEMENT VALVES**

The Cheminert Model C2 6 port valve is an excellent replacement for the valve originally supplied in many autosamplers, including autosamplers manufactured by Beckman, Gilson, Spark-Holland, CTC, Thermo Fisher, and Varian.

Call technical support to determine which replacement is best for your application.

#### Analytical internal sample injector, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C4

5,000 psi

**Analytical** 

1/16" 0.25 mm



Includes nuts and ferrules.

Valves with metal stators have stainless steel nuts and ferrules of the stator material. Valves with PAEK stators have PEEK nuts and ferrules.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

Sample volume	<b>0.1 μl</b>	<b>0.2 μl</b>	<b>0.5 μl</b>
	Prod No	Prod Noe	Prod No
N60 stainless stator Manual With air actuator With microelectric actuator	C4-10041 C4-10041A C4-10041EH	C4-10042 C4-10042A C4-10042EH	C4-10045 C4-10045A C4-10045EH
Replacement valve	C4-10041D	C4-10042D	C4-10045D
Replacement rotor	C4-10R1	C4-10R2	C4-10R5
Replacement stator	C4-1C0	C4-1C0	C4-1C0
PAEK stator  Manual  With air actuator  With microelectric actuator	C4-13441	C4-13442	C4-13445
	C4-13441A	C4-13442A	C4-13445A
	C4-13441EH	C4-13442EH	C4-13445EH
Replacement valve	C4-13441D	C4-13442D	C4-13445D
Replacement rotor	C4-13R1	C4-13R2	C4-13R5
Replacement stator	C4-1C4	C4-1C4	C4-1C4
<b>Titanium stator</b> Manual With air actuator With microelectric actuator	C4-10341	C4-10342	C4-10345
	C4-10341A	C4-10342A	C4-10345A
	C4-10341EH	C4-10342EH	C4-10345EH
Replacement valve	C4-10341D	C4-10342D	C4-10345D
Replacement rotor	C4-10R1	C4-10R2	C4-10R5
Replacement stator	C4-1C3	C4-1C3	C4-1C3

### **SPECS**

#### 5000 psi liq 75°C max

Metal stator Valcon H rotor

#### 5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

- .05 µl sample volumes are also available.
- Loop fill port assembly for injection from front of the valve. See page 41.



Model C4 1/16" ZDV fittings

#### **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

#### MORE INFORMATION

Actuators
Air page 197
Microelectric190
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Materials
Metals 254-255
Polymers256
Valve rotors257
Standoff
assemblies205

# Analytical continuous flow through-the-handle injector, 1/16" Valco fittings, 0.40 mm ports (.016")

Model C1CFI

#### **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

#### **OPTIONS**

■ 0.25 mm bore (.010") on page 162.

#### **MORE INFORMATION**

Syringes..... page 250

#### **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

Available only in manual version.

Position feedback included.

Includes nuts and ferrules.

Replacement stator

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Includes one 20 µl loop of the stator material.

	N60 stainless stator Prod No	PAEK stator Prod No
6 port injector	C1CFI-2006	C1CFI-2346
Replacement rotor	C1-20R6	C1-23R6

C-261

C1CF-2C06

C1CF-2C46

PAFK stator

Replacement injector fitting for 22 gauge x 2" long needle



5,000 psi

Analytical

**Continuous flow** 

Through-handle

1/16"

0.40 mm



# Analytical continuous flow injector, 1/16" Valco fittings, 0.40 mm ports (.016")

Model C6

5,000 psi

**Analytical** 

**Continuous flow** 

#### **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max PAEK stator

Valcon E rotor

Order loops from page 161.

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Includes a 20  $\mu$ I loop of the stator material.

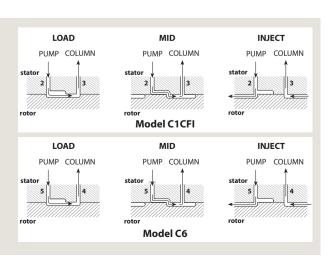
N60 stainless stator

	1400 Stailliess Statol	I ALK Stato
	Prod No	Price
Prod No	Price	
Manual	C6-2006	C6-2346
With pneumatic actuator	C6-2006A	C6-2346A
With microelectric actuator	C6-2006EH	C6-2346EH
Replacement valve	C6-2006D	C6-2346D
'		
Replacement rotor	C2-20R6	C2-23R6
Replacement stator	C6-2C06	C6-2C46

Model C6 1/16" ZDV fittings

#### **CONTINUOUS FLOWPATHS**

An engraving on the stator maintains pump flow between the pump connection port and the column connection port during most of the switching cycle, virtually eliminating pressure spikes.



#### Valves with 1/16" Valco ZDV fittings, 0.75 mm ports (.030")

Model C22Z

Low pressure

10-32 ZDV

0.75 mm

Includes Valco ZDV PEEK nuts and ferrules. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Sample loops are not included with valves. Order separately.

	4 Port	6 Port	8 Port	10 Port
	Prod No	Prod No	Prod No	Prod No
Manual	C22Z-3184	C22Z-3186	C22Z-3188	C22Z-3180
With air actuator	C22Z-3184A	C22Z-3186A	C22Z-3188A	C22Z-3180A
With microelectric actuator	C22Z-3184EH	C22Z-3186EH	C22Z-3188EH	C22Z-3180EH
Replacement valve	C22Z-3184D	C22Z-3186D	C22Z-3188D	C22Z-3180D
Replacement rotor	C12-314	C12-316	C12-318	C12-310
Replacement stator	C22Z-384	C22Z-386	C22Z-388	C22Z-380



**Model C22Z** 1/16" ZDV fittings

#### **SPECS**

100 psi gas/ 250 psi liq 75°C max

**PPS** stator Valcon E2 rotor

#### **OPTIONS**

- 12 and 14 port versions available.
- Purge option
- Other polymeric rotors and stators are available.

#### **PURGE OPTION**

The purge option permits a flow of liquid or gas to flush the valve interior of potentially toxic or corrosive components. We recommend this option for applications using materials (such as salt solutions) that could damage the metal parts of the valve.

Consult our technical staff for details.

### Sample loops

for Model C22Z



Loops include PEEK nuts and ferrules. Loops smaller than 500 µl are made from 1/16" OD tubing; loops 500  $\mu$ l or bigger are made from 1/8" OD tubing with polymeric unions and 1/16" ends.

	FEP	PTFE	PEEK
Volume	Prod No	Prod No	Prod No
5 μl	CZSL5FEP	CZSL5TF	CZSL5PK
10 μl	CZSL10FEP	CZSL10TF	CZSL10PK
20 μl	CZSL20FEP	CZSL20TF	CZSL20PK
50 μl	CZSL50FEP	CZSL50TF	CZSL50PK
100 μl	CZSL100FEP	CZSL100TF	CZSL100PK
250 μl	CZSL250FEP	CZSL250TF	CZSL250PK
500 μl	CZSL500FEP	CZSL500TF	CZSL500PK
1 ml	CZSL1KFEP	CZSL1KTF	CZSL1KPK
2 ml	CZSL2KFEP	CZSL2KTF	CZSL2KPK

#### **ABOUT LOOPS**

■ Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

#### MORE INFORMATION

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#### Valves with 1/4-28 fitting details for 1/16" tubing, 0.75 mm ports (.030")

Model C22

SPECS
100 psi gas/ 250 psi liq
75°C max
PPS stator

Valcon E2 rotor

Includes multicolored Cheminert 1/4-28 flangeless fittings for 1/16" tubing. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Sample loops are not included with valves. Order separately.

Low pressure

1/4-28 Internal

1/16"

6" 0.75 mm

	4 Port	6 Port	8 Port	10 Port
	Prod No	Prod No	Prod No	Prod No
Manual	C22-3184	C22-3186	C22-3188	C22-3180
With air actuator	C22-3184A	C22-3186A	C22-3188A	C22-3180A
With microelectric actuator	C22-3184EH	C22-3186EH	C22-3188EH	C22-3180EH
Replacement valve	C22-3184D	C22-3186D	C22-3188D	C22-3180D
Replacement rotor	C22-314	C22-316	C22-318	C22-310
Replacement stator	C22-384	C22-386	C22-388	C22-380

#### Valves with 1/4-28 fitting details for 1/8" tubing, 1.50 mm ports (.060")

Model C22

SPECS
100 psi gas/ 250 psi liq
75°C max
PPS stator
Valcon E2 rotor

Includes multicolored Cheminert 1/4-28 flangeless fittings for 1/8" tubing. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply. Sample loops are not included with valves. Order separately.

Low pressure

1/4-28 Internal
1/8" 1.50 mm

	4 Port	6 Port	8 Port	10 Port
	Prod No	Prod No	Prod No	Prod No
Manual	C22-6184	C22-6186	C22-6188	C22-6180
With air actuator	C22-6184A	C22-6186A	C22-6188A	C22-6180A
With microelectric actuator	C22-6184EH	C22-6186EH	C22-6188EH	C22-6180EH
Replacement valve	C22-6184D	C22-6186D	C22-6188D	C22-6180D
Replacement rotor	C22-614	C22-616	C22-618	C22-610
Replacement stator	C22-684	C22-686	C22-688	C22-680

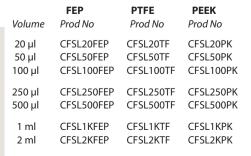
#### **Sample loops**

for Model C22

Loops include flangeless fittings with white color nuts. Loops smaller than 500  $\mu l$  are made from 1/16" OD tubing; loops 500  $\mu l$  or bigger are made from 1/8" OD tubing.

## **ABOUT LOOPS**■ Sample loop sh

Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.







Model C22 1/4-28 fittings

#### Internal sample injectors, 1/16" Valco ZDV fittings, 0.40 mm ports (.016")

Model C24Z

Low pressure

10-32 ZDV

0.40 mm

Includes Valco ZDV PEEK nuts and ferrules. Microelectric actuator:24 VDC, with 110/230 VAC to 24 VDC power supply.

**SPECS** 100 psi gas/ 250 psi liq 75°C max

#### **OPTIONS**

PPS stator

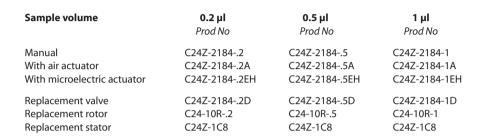
Valcon E2 rotor

- 2.0 µl sample volumes are also available.
- Purge option.
- Other polymeric rotors and stators are available.

#### **PURGE OPTION**

The purge option permits a flow of liquid or gas to flush the valve interior of potentially toxic or corrosive components. We recommend this option for applications using materials (such as salt solutions) that could damage the metal parts of the valve.

Consult our technical staff for details.





**Model C24Z** 1/16" ZDV fittings

#### MORE INFORMATION

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#### Internal sample injectors, 1/4-28 for 1/16" tubing, 0.50 mm ports (.020")

#### Model C24

#### **SPECS** 100 psi gas/ 250 psi liq 75°C max

**PPS** stator Valcon E2 rotor

#### **OPTIONS**

- 0.2 µl sample volumes are also available.
- Purge option
- Other polymeric rotors and stators are available. Consult the factory for prices and information.

Includes multicolored Cheminert 1/4-28 flangeless fittings for 1/16" tubing. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.



Low pressure

1/4-28 Internal

1/16" 0.50 mm

Sample volume	<b>0.5 μl</b>	1 μl	<b>2 μl</b>
	Prod No	Prod No	Prod No
Manual	C24-21845	C24-2184-1	C24-2184-2
With air actuator	C24-21845A	C24-2184-1A	C24-2184-2A
With microelectric actuator	C24-21845EH	C24-2184-1EH	C24-2184-2EH
Replacement valve	C24-21845D	C24-2184-1D	C24-2184-2D
Replacement rotor	C24-10R5	C24-10R-1	C24-10R-2
Replacement stator	C24-1C8	C24-1C8	C24-1C8



Model C24 1/4-28 fittings

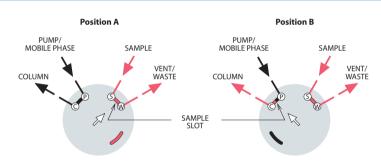
These illustrations show basic sample injection techniques using Cheminert two position valves. With rare exceptions, there is no difference between switching valves and external volume sampling valves, so the same valve can be used for either function.

The unique advantage of 8 and 10 port valves is that they reduce extra column volume by combining sampling and switching functions in a single valve. This minimizes expense, maintenance, service, and risk of leaks as compared to multiple 6 port valve systems.

#### MICROVOLUME SAMPLE INJECTION

The internal sample (fixed volume) flowpath is used when very small sample volumes are required. The sample size is determined by a passage engraved on the valve rotor, allowing precise, repeatable injections. In Position A, the sample flows through the sample passage while the mobile phase flows through to the column. The third passage is inactive. In Position B, the sample passage is in line with the column and the mobile phase injects the contents of the sample passage into the column. The passage which was inactive in Position A allows the sample to continue flowing without interruption.

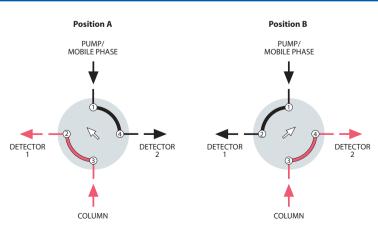
#### 4 port internal sample injector



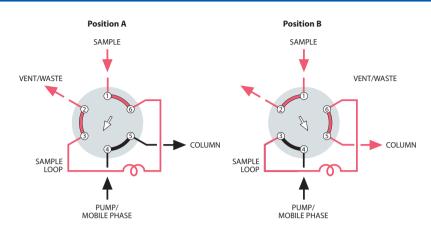
#### **DETECTOR SELECTION FROM TWO COLUMNS OR ONE COLUMN AND AUXILIARY CARRIER**

This unique configuration allows analyses of different parts of one analysis with two different detectors, without splitting or multiple injections.

#### 4 port switching valve



#### 6 port external sample injector



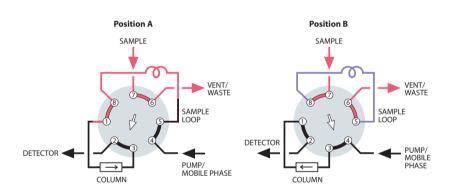
#### **SAMPLE INJECTION**

With the valve in Position A, sample flows through the external loop while the mobile phase flows directly through to the column. When the valve is switched to Position B, the sample contained in the sample loop and valve flow passage is displaced by the mobile phase and is carried into the column.

*Note:* Especially for partial-filled loops, the flow direction of the mobile phase through the loop should be opposite (backflush) to the flow direction during the loading of the loop.

More applications .....pages 120-121

#### 8 port sampling/switching

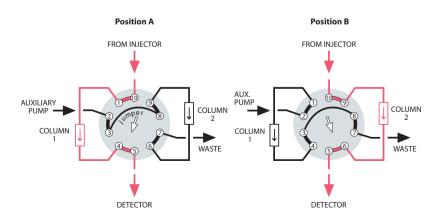


### LOOP SAMPLING WITH BACKFLUSH TO DETECTOR

One valve performs the functions of sampling and backflush valves, simplifying operation and reducing cost. When components of interest are detected, the strongly retained components are backflushed and removed from the column without temperature programming.

More applications ..... page 121

#### 10 port sampling/switching



#### **ALTERNATE COLUMN REGENERATION**

When columns must be regenerated following each analysis, this technique permits automation of the process. While one column performs the analysis, the second column undergoes regeneration through use of an auxiliary pump. Once the first analysis is complete, the valve is switched and the regenerated column is ready for analytical use.

More applications .....pages 122-123

#### 15,000 psi UHPLC Nanovolume® selectors, 1/32" Valco fittings, 150 micron ports (.006")

Model C75NX

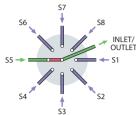
15,000 psi

Nanobore

1/32" 150 µm

Replacement stator

Includes Valco stainless steel fittings. Manual version not available. Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

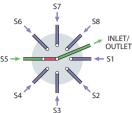


<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
C75NX-6676A	C75NX-6678A	C75NX-6670A
C75NX-6676EMH	C75NX-6678EMT	C75NX-6670EMT
C75NX-6676D	C75NX-6678D	C75NX-6670D C75N-66R0
	Prod No  C75NX-6676A  C75NX-6676EMH	Prod No         Prod No           C75NX-6676A         C75NX-6678A           C75NX-6676EMH         C75NX-6678EMT           C75NX-6676D         C75NX-6678D

C75N-6C78

C75N-6C70

C75N-6C76



with inert coating Valcon E3 rotor **OPTIONS** ■ 100 micron (.004") bore ■ 250 micron (.010") bore ■ 10,000 and 20,000 psi versions available

**SPECS** 

15,000 psi liq

Stainless stator

4 positions

50°C max



# 10,000 psi UHPLC microbore selectors, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C75H

#### SPECS 10,000 psi liq 50°C max

Stainless stator with inert coating Valcon E3 rotor

#### **OPTIONS**

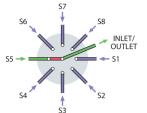
- 150 micron (.006") bore
- 15,000 psi version available
- 4 positions

Includes Valco stainless steel fittings.

Manual version not available.

Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



10,000 psi

Microbore

Stream selector

1/16" 0.25 mm

	<b>6 Position</b> Prod No	8 Position Prod No	10 Position  Prod No
Coated stainless stator With air actuator With microelectric actuator	C75H-1676A	C75H-1678A	C75H-1670A
	C75H-1676EMH	C75H-1678EMT	C75H-1670EMT
Replacement valve	C75H-1676D	C75H-1678D	C75H-1670D
Replacement rotor	C75-16R6	C75-16R8	C75-16R0
Replacement stator	C75-1C76	C75-1C78	C75-1C70



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assemblies 205

#### HPLC stream selector, 1/16" Valco ZDV fittings, 0.40 mm ports (.016")

Model C5

5,000 psi

10-32 ZDV

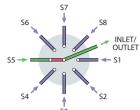
0.40 mm

Includes nuts and ferrules.

Valves with metal stators have stainless steel nuts and ferrules of the stator material.

Valves with PAEK stators have PEEK nuts and ferrules. Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
<b>N60 stainless stator</b> Manual With air actuator With microelectric actuator	C5-2004	C5-2006	C5H-2008	C5H-2000
	C5-2004A	C5-2006A	C5H-2008A	C5H-2000A
	C5-2004EMH	C5-2006EMH	C5H-2008EMT	C5H-2000EMT
Replacement valve	C5-2004D	C5-2006D	C5H-2008D	C5H-2000D
Replacement rotor	C5-20R4	C5-20R6	C5-20R8H	C5-20R0H
Replacement stator	C5-2C04	C5-2C06	C5-2C08H	C5-2C00H
PAEK stator Manual With air actuator With microelectric actuator	C5-2344 C5-2344A C5-2344EMH	C5-2346 C5-2346A C5-2346EMH	C5H-2348 C5H-2348A C5H-2348EMT	C5H-2340 C5H-2340A C5H-2340EMT
Replacement valve	C5-2344D	C5-2346D	C5H-2348D	C5H-2340D
Replacement rotor	C5-23R4	C5-23R6	C5-23R8H	C5-23R0H
Replacement stator	C5-2C44	C5-2C46	C5-2C48H	C5-2C40H
<b>Titanium stator</b> Manual With air actuator With microelectric actuator	C5-2034 C5-2034A C5-2034EMH	C5-2036 C5-2036A C5-2036EMH	C5H-2038 C5H-2038A C5H-2038EMT	C5H-2030 C5H-2030A C5H-2030EMT
Replacement valve	C5-2034D	C5-2036D	C5H-2038D	C5H-2030D
Replacement rotor	C5-20R4	C5-20R6	C5-20R8H	C5-20R0H
Replacement stator	C5-2C34	C5-2C36	C5-2C38H	C5-2C30H

#### **SPECS** 5000 psi liq 75°C max Metal stator

Valcon H rotor

5000 psi liq 50°C max PAEK stator Valcon E rotor

#### **OPTIONS**

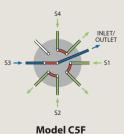
- 2", 3", 4", and 6" standoffs
- Hastelloy C stator
- Optional 0.15 mm (.006") and 0.25 mm (.010") bores available
- Optional 0.75 mm (.030") bore for Prep HPLC available



#### **OPTIONAL FLOWPATH**

Model C5F, the flowthrough version, is similar to the C5 but its non-selected streams continue flowing through individual outlets. 3, 4, and 5 positions are available.

Consult the factory for C5F prices and information.



schematic diagram

MORE INFORMATION Manifolds ..... page 33

#### HPLC column selector system with 1/16" Valco ZDV fittings, 0.40 mm ports (.016")

Model C5

0.40 mm

5,000 psi

10-32 ZDV

#### SPECS 5000 psi liq 75°C max

Metal stator Valcon H rotor

#### 5000 psi liq 50°C max PAEK stator

PAEK stator Valcon E rotor

#### **OPTIONS**

- 2", 3", 4", and 6" standoffs
- Hastelloy C stator
- Optional 0.25 mm (.010") and 0.15 mm (.006") bores available
- Optional 0.75 mm (.030") bore for Prep HPLC available

The system comprises two stream selection valves mounted on a single modular universal actuator, which can be controlled manually, via remote logic level signal, or by RS-232 interface (RS-485 optional). (See plumbing diagram below.)

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Includes microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

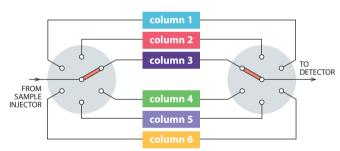
<b>6 Column</b> Prod No	<b>8 Column</b> Prod No	<b>10 Column</b> <i>Prod No</i>	
C5-2006EMTD	C5H-2008EMTD	C5H-2000EMTD	
C5-20R6	C5-20R8H	C5-20R0H	
C5-2346EMTD	C5H-2348EMTD	C5H-2340EMTD	
C5-23R6	C5-23R8H	C5-23R0H	
	Prod No  C5-2006EMTD C5-20R6  C5-2346EMTD	Prod No         Prod No           C5-2006EMTD         C5H-2008EMTD           C5-20R6         C5-20R8H           C5-2346EMTD         C5H-2348EMTD	

 $Contact \ factory \ for \ replacement \ valves \ and \ stators, as \ valves \ for \ dual \ drive \ assemblies \ have \ mirror \ image \ stators.$ 

#### **RS-232 interface cable**

Prod No

I-22697





Model C5 system

Columns not included

#### UHPLC COLUMN SELECTOR SYSTEMS

Consult the factory for more information on UHPLC systems.

#### **ORDERING STATORS**

Valves for dual drive assemblies have mirror image stators. Consult Technical Support for correct product number before ordering.

Both valves use the same rotor.

#### MORE INFORMATION

assemblies ......205

#### Stream selector, 1/16" Valco ZDV fittings, 0.75 mm ports (.030")

Model C25Z

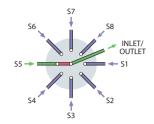
Low pressure

10-32 ZDV

1/16" 0.75 mm

Includes Valco ZDV PEEK nuts and ferrules. Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>	<b>14 Position</b> <i>Prod No</i>
Manual	C25Z-3186	C25Z-3188	C25Z-3180	C25Z-31814
With air actuator	C25Z-3186A	C25Z-3188A	C25Z-3180A	C25Z-31814A
With microelectric act.	C25Z-3186EMH	C25Z-3188EMH	C25Z-3180EMH	C25Z-31814EMH
Replacement valve	C25Z-3186D	C25Z-3188D	C25Z-3180D	C25Z-31814D
Replacement rotor	C15-310	C15-310	C15-310	C25Z-325
Replacement stator	C25Z-386	C25Z-388	C25Z-380	C25Z-38-14



#### **OPTIONS**

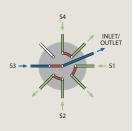
- 4 and 12 positions available
- 2",3",4",and 6" standoffs
- Other polymeric materials are available. Consult the factory.



#### **OPTIONAL FLOWPATH** Model C25ZF, the

flow-through version, is similar to the C25Z but its non-selected streams continue flowing through individual outlets, instead of being dead-ended. 3, 4, 5, 6, and 7 positions are available.

Consult the factory for C25ZF prices and information.



#### Stream selector, 1/4-28 fittings for 1/16" tubing, 0.75 mm ports (.030")

#### Model C25

#### **SPECS**

100 psi gas/ 250 psi liq 75°C max

**PPS** stator Valcon E2 rotor

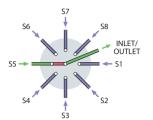
#### **OPTIONS**

- 2", 3", 4", and 6" standoffs
- CTFE stator

Includes multicolored Cheminert 1/4-28 flangeless fittings for 1/16" tubing.

Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



Low pressure

1/4-28 Internal

1/16" 0.75 mm

	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
Manual	C25-3184	C25-3186	C25-3188	C25-3180
With air actuator	C25-3184A	C25-3186A	C25-3188A0	C25-3180A
With microelectric act.	C25-3184EMH	C25-3186EMH	C25-3188EMH	C25-3180EMH
Replacement valve	C25-3184D	C25-3186D0	C25-3188D	C25-3180D
Replacement rotor	C25-314	C25-316	C15-310	C25-310
Replacement stator	C25-384	C25-386	C25-388	C25-380

#### Stream selector, 1/4-28 fittings for 1/8" tubing, 1.50 mm ports (.060")

#### Model C25

#### **SPECS**

100 psi gas/ 250 psi liq 75°C max

PPS stator Valcon E2 rotor

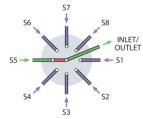
#### **OPTIONS**

- 2", 3", 4", and 6" standoffs
- CTFE stator

Includes multicolored Cheminert 1/4-28 flangeless fittings for 1/8" tubing.

Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



Low pressure

1/4-28 Internal

1.50 mm

	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
Manual	C25-6184	C25-6186	C25-6188	C25-6180
With air actuator	C25-6184A	C25-6186A	C25-6188A	C25-6180A
With microelectric act.	C25-6184EMH	C25-6186EMH	C25-6188EMH	C25-6180EMH
Replacement valve	C25-6184D	C25-6186D	C25-6188D	C25-6180D
Replacement rotor	C25-614	C25-616	C25-618	C25-610
Replacement stator	C25-684	C25-686	C25-688	C25-680

#### **OPTIONAL FLOWPATH**

Model C25F is the flow-through versionof C25. (See discussion on facing page.) 3,4,5,6, and 7 positions are available.

Consult the factory for C25F prices and information.

#### **MORE INFORMATION**

Actuators Air ..... page 196 Microelectric .....192 Materials Metals..... 254-255 Polymers . . . . . . . . . . . . . 256 Valve rotors......257 Standoff

assemblies ......205



#### Stream selector, 1/16" Cheminert fittings

Model C25G

Low pressure

6-40 flat bottom 1/16

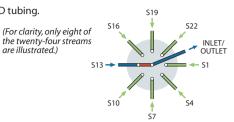
Includes 6-40 PEEK nut/bushings for 1/16" OD tubing.

Available only with

microelectric actuator:

24 VDC,

with 110/230 VAC power supply.



Bore:	20 Position	24 Position	28 Position
	0.67 mm (.026")	0.61 mm (.024")	0.56 mm (.022")
	Prod No	Prod No	Prod No
With microelectric actuator	C25G-24520EMT	C25G-24524EMT	C25G-24528EMT
Replacement valve	C25G-24520D	C25G-24524D	C25G-24528D
Replacement rotor	C25G-24R20	C25G-24R24	C25G-24R28
Replacement stator	C25G-2C520	C25G-2C524	C25G-2C528

#### **SPECS** 100 psi liq 50°C max **PEEK stator** Valcon M rotor

#### **OPTIONS**

- 2",3",4",and 6" standoffs
- Consult the factory for optional materials.



#### Fittings for C25G valves

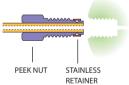
The C25G selector uses unique 6-40 fittings for flat-bottomed fitting details. As the fitting is tightened, the grooved area (supported by the stainless retainer) compresses enough to grip the tube for a low pressure connection.

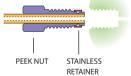
> Prod No CNNF1PK

natural PEEK, stainless retainer

6-40 one piece nut/bushing,

Tightening tool CGFT



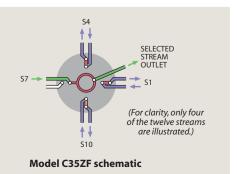


#### **OPTIONAL FLOWPATHS**

Model C25G valves select and isolate one of 20-28 streams, with the remainder dead-ended.

Model C25GF, the flow-through version, is similar to the C25G but its non-selected streams continue flowing through individual outlets. 10, 12, and 14 positions are available.

Call for pricing and information.



# **CHEMINERT VALVES**

# Stream selector, 1/2-20 fittings for 1/4" tubing, 4.6 mm ports (.180")

Model C45

# SPECS 100 psi liq 50°C max PPS stator

PPS stator Valcon TF rotor

# **OPTIONS**

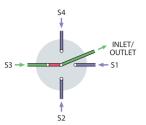
- 2", 3", 4", and 6" standoffs
- Consult the factory for optional materials.
- 8 position selectors are available with 3 mm (.120") ports

Manual version not available.

Includes Cheminert 1/2-20 flangeless fittings for 1/4" tubing, Delrin nuts, and CTFE ferrules.

Microelectric actuator:

24 VDC, with 110/230 VAC to 24 VDC power supply.



Low pressure

Stream selector

1/2-20 Internal

1/4"

4.6 mm

	<b>4 Position</b> Prod No	<b>6 Position</b> <i>Prod No</i>
With air actuator	C45-9784A	C45-9786A
With microelectric actuator	C45-9784EMT	C45-9786EMT
Replacement valve	C45-9784D	C45-9786D
Replacement rotor	C45-97R4	C45-97R6

Prod No

# **Fittings for C45 valves**

For additional 1/2-20 fittings and adapters, see page 72.



Nuts	CTFE Delrin PPS	CFL-4KF CFL-4D CFL-4PPS
Ferrules	CTFE	CFL-CB4KF-S
Plugs	CTFE Delrin	CP-4K CP-4D



# MORE INFORMATION

 Actuators
 page 196

 Microelectric
 192

 Universal
 193

 Materials
 254-255

 Polymers
 256

 Valve rotors
 257

 Standoff

assemblies ......205

# Integrated motor/valve, 1/16" Valco fittings, 0.25 mm ports (.010")

Model C52

5,000 psi

Microbore

Integrated

1/16"

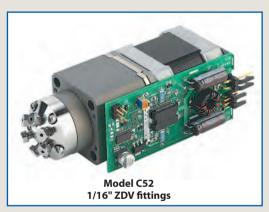
0.25 mm

See page 151 for more information on Model C52 valves. **Also available in vertical port version**. Contact the factory. Includes nuts and ferrules.

(2)

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings.

CE ready*				
	4 Port	6 Port*	8 Port	10 Port
N60 stainless stator	Prod No	Prod No	Prod No	Prod No
With integrated actuator	C52-1004I	C52-1006l	C52-1008I	C52-1000I
With motor/sensor only	C52-1004I-S	C52-1006I-S	C52-1008I-S	C52-1000I-S
With motor only	C52-1004IX	C52-1006IX	C52-1008IX	C52-1000IX
Replacement rotor	C2-10R4	C2-10R6	C2-10R8H	C2-10R0H
Replacement stator	C52-1C04	C52-1C06	C52-1C08	C52-1C00
PAEK stator				
With integrated actuator	C52-1344I	C52-1346l	C52-1348I	C52-1340I
With motor/sensor only	C52-1344I-S	C52-1346I-S	C52-1348I-S	C52-1340I-S
With motor only	C52-1344IX	C52-1346IX	C52-1348IX	C52-1340IX
Replacement rotor	C2-13R4	C2-13R6	C2-13R8H	C2-13R0H
Replacement stator	C52-1C44	C52-1C46	C52-1C48	C52-1C40





# Sample loops

for C52 injectors

Each metal loop includes two stainless steel nuts and ferrules. Each PEEK loop includes two PEEK nuts and ferrules.

	Stainless	PEEK
	Steel	(for PAEK stators)
Volume	Prod No	Prod No
2 µl	CSL2	CZSL2PK
5 µl	CSL5	CZSL5PK
10 µl	CSL10	CZSL10PK
20 µl	CSL20	CZSL20PK
50 µl	CSL50	CZSL50PK
100 µl	CSL100	CZSL100PK
250 µl	CSL250	CZSL250PK
500 µl	CSL500	CZSL500PK
1 ml	CSL1K	CZSL1KPK
2 ml	CSL2K	CZSL2KPK
5 ml	CSL5K	CZSL5KPK
10 ml	CSL10K	_



# **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, and PTFE (see pages 254-255).
- Metal loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

# **SPECS**

# 5,000 psi liq 40°C max

N60 stainless stator Valcon H rotor

# 5,000 psi liq 40°C max

000

PAEK stator Valcon E rotor

# **OPTIONS**

- Vertical port version.
   (Model C52V)
   Contact the factory for more information.
- Optional 0.40 mm (.016") and 0.75 mm ports (.030") available
- Titanium and Hastelloy stators available
- Serial communication via RS-232 is available.

# \* CE READY

Since these integrated VICI motor/valves are designed as components to be embedded into other systems, they do not include a power supply. They have been tested according to the following EMC Standards: EN61326-1:2006

Conducted emissions Radiated emissions However, these results do not substitute for, preclude, or guarantee passage of any or all relevant compliance testing as required for a final product that includes these components.

# **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

# **MORE INFORMATION**

Materials

Metals	page 254-5
Polymers	256
Valve rotors.	257

# Microbore centered port injector, 1/16" Valco fittings, 0.25 mm ports (.010")

# Model C3

# **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

### **OPTIONS**

Titanium and Hastelloy stators available



# NOTE

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Includes one 5 µl loop of the stator material.

Includes syringe fill port for 22 gauge 3/4" and 2" needle.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

ss stator PAEK stator No Prod No
06 C3-1346
06A C3-1346A
06EH C3-1346EH
06D C3-1346D
R6 C2-13R6
06 C3-1C46



5,000 psi Microbore

Centered port

1/16"

0.25 mm



# Microbore vertical port injector, 1/16" Valco fittings, 0.25 mm ports (.010")

# **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

**5000 psi liq 50°C max** PAEK stator

PAEK stator Valcon E rotor

# **OPTIONS**

Titanium and Hastelloy stators available



Includes nuts and ferrules.

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings.

Includes one 5 µl loop of the stator material.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

	N60 stainless stator Prod No	PAEK stator Prod No
Manual	C2V-1006	C2V-1346
With air actuator	C2V-1006A	C2V-1346A
With microelectric actuator	C2V-1006EH	C2V-1346EH
Replacement valve Replacement rotor	C2V-1006D C2-10R6	C2V-1346D C2-13R6
•		
Replacement stator	C2V-1C06	C2V-1C46



Model C2V

5,000 psi Microbore

Vertical port

1/16"

0.25 mm



# Integrated motor/valve, 1/16" Valco fittings, 0.40 mm ports (.016")

Includes nuts and ferrules.

Model C52

5,000 psi

**Analytical** 

**Integrated** 

1/16" 0.40 mm

CE ready*				
	<b>4 Port</b>	<b>6 Port*</b>	<b>8 Port</b>	<b>10 Port</b>
	Prod No	Prod No	Prod No	<i>Prod No</i>
<b>N60 stainless stator</b> With integrated actuator	C52-2004l	C52-2006l	C52-2008l	C52-2000l
With motor/sensor only	C52-2004I-S	C52-2006I-S	C52-2008I-S	C52-2000I-S
With motor only	C52-2004IX	C52-2006IX	C52-2008IX	C52-2000IX
Replacement rotor	C2-20R4	C2-20R6	C2-20R8H	C2-20R0H
Replacement stator	C52-2C04	C52-2C06	C52-2C08	C52-2C00
<b>PAEK stator</b> With integrated actuator	C52-2344I	C52-2346I	C52-2348I	C52-2340I
With motor/sensor only	C52-2344I-S	C52-2346I-S	C52-2348I-S	C52-2340I-S
With motor only	C52-2344IX	C52-2346IX	C52-2348IX	C52-2340IX
Replacement rotor	C2-23R4	C2-23R6	C2-23R8H	C2-23R0H
Replacement stator	C52-2C44	C52-2C46	C52-2C48	C52-2C40

See page 151 for more information on Model C52 valves.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.nuts and ferrules.





# Sample loops

for C52 injectors

Each metal loop includes two stainless steel nuts and ferrules. Each PEEK loop includes two PEEK nuts and ferrules.

	Stainless Steel	PEEK (for PAEK stators)
		•
Volume	Prod No	Prod No
2 µl	CSL2	CZSL2PK
5 µl	CSL5	CZSL5PK
10 µl	CSL10	CZSL10PK
20 µl	CSL20	CZSL20PK
50 µl	CSL50	CZSL50PK
100 µl	CSL100	CZSL100PK
250 µl	CSL250	CZSL250PK
500 µl	CSL500	CZSL500PK
1 ml	CSL1K	CZSL1KPK
2 ml	CSL2K	CZSL2KPK
5 ml	CSL5K	CZSL5KPK
10 ml	CSL10K	_



# **ABOUT LOOPS**

- Other materials available in many sizes: Electroformed Nickel, Hastelloy C, Nickel 200, and PTFE (see pages 254-255).
- Metal loops > 2 ml are made from 1/8" OD tubing with brazed or welded 1/16" tube ends or reducing unions.
- Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

# **SPECS**

# 5,000 psi liq 40°C max

N60 stainless stator Valcon H rotor

# 5,000 psi lia 40°C max

PAEK stator Valcon E rotor

### **OPTIONS**

- Vertical port version. (Model C52V) Contact the factory for more information.
- Optional 0.25 mm (.010") and 0.75 mm ports (.030") available
- Titanium and Hastelloy stators available
- Serial communication via RS-232 is available.

# \* CE READY

Since these integrated VICI motor/valves are designed as components to be embedded into other systems, they do not include a power supply. They have been tested according to the following EMC Standards: EN61326-1:2006

Conducted emissions Radiated emissions However, these results do not substitute for, preclude, or guarantee passage of any or all relevant compliance testing as required for a final product that includes these components.

# **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

# **MORE INFORMATION**

Materials

Metals	page 254-5
Polymers	256
Valve rotors	257

# Analytical centered port injector, 1/16" Valco fittings, 0.40 mm ports (.016")

Model C3

# **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

### **OPTIONS**

■ Titanium and Hastelloy stators available



# **NOTE**

Cheminert high pressure valves with polymeric stators have a longer pilot depth.

Includes nuts and ferrules.

Valves with stainless stators have stainless fittings.

Valves with PAEK stators have PEEK fittings.

Includes one 20 µl loop of the stator material.

Includes syringe fill port for 22 gauge 3/4" and 2" needle.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

	N60 stainless stator Prod No	PAEK stator Prod No
Manual	C3-2006	C3-2346
With air actuator	C3-2006A	C3-2346A
With microelectric actuator	C3-2006EH	C3-2346EH
Replacement valve Replacement rotor	C3-2006D C2-20R6	C3-2346D C2-23R6
Replacement stator	C3-2C06	C3-2C46



5,000 psi **Analytical** 

0.40 mm



# Analytical vertical port injector, 1/16" Valco fittings, 0.40 mm ports (.016")

# **SPECS**

5000 psi liq 75°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max PAEK stator

Valcon E rotor

# **OPTIONS**

■ Titanium and Hastelloy stators available



Includes nuts and ferrules.

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings.

Includes one 20 µl loop of the stator material.

Microelectric actuator: 24 VDC, with 110/230 VAC to 24 VDC power supply.

	N60 stainless stator Prod No	PAEK stator Prod No
Manual	C2V-2006	C2V-2346
With air actuator	C2V-2006A	C2V-2346A
With microelectric actuator	C2V-2006EH	C2V-2346EH
Replacement valve	C2V-2006D	C2V-2346D
Replacement rotor	C2-20R6	C2-23R6
Replacement stator	C2V-2C06	C2V-2C46



Model C2V

5,000 psi **Analytical** 

**Vertical** port

0.40 mm



# Integrated motor/valve, 1/16" Valco ZDV fittings, 0.75 mm ports (.030")

Sample loops are not included with valves. Order separately.

Includes Valco ZDV PEEK nuts and ferrules.

Model C62Z

Low pressure

ow pressure

Integrated

With motor, sensor, & controller

With motor and sensor only

10-32 ZDV

1/16" 0.75 mm

4 Port

*Prod No* C62Z-3184I

C62Z-3184I-S



**6 Port** Prod No

C62Z-3186l C62Z-3186l-S



8 Port

C62Z-3188I C62Z-3188I-S



10 Port

C62Z-3180I C62Z-3180I-S

# **SPECS**

100 psi gas/ 250 psi liq 50°C max

PPS stator Valcon E2 rotor

# **OPTIONS**

 Other polymeric rotors and stators are available

Consult the factory for prices and information.

■ Serial communication via RS-232 is available.

# \* CE READY

Since these integrated VICI motor/valves are designed as components to be embedded into other systems, they do not include a power supply. They have been tested according to the following EMC Standards: EN61326-1:2006

Conducted emissions Radiated emissions However, these results do not substitute for, preclude, or guarantee passage of any or all relevant compliance testing as required for a final product that includes these components.



# Sample loops

for Model C62Z

Loops include PEEK nuts and ferrules. Loops less than 500  $\mu$ l are made from 1/16" OD tubing; loops 500  $\mu$ l or greater are made from 1/8" OD tubing with polymeric unions and 1/16" ends.

Volume	<b>FEP</b>	PTFE	<b>PEEK</b>
	Prod No	Prod No	Prod No
5 μl	CZSL5FEP	CZSL5TF	CZSL5PK
10 μl	CZSL10FEP	CZSL10TF	CZSL10PK
20 μl	CZSL20FEP	CZSL20TF	CZSL20PK
50 μl	CZSL50FEP	CZSL50TF	CZSL50PK
100 μl	CZSL100FEP	CZSL100TF	CZSL100PK
250 μl	CZSL250FEP	CZSL250TF	CZSL250PK
500 μl	CZSL500FEP	CZSL500TF	CZSL500PK
1 ml	CZSL1KFEP	CZSL1KTF	CZSL1KPK
2 ml	CZSL2KFEP	CZSL2KTF	CZSL2KPK



# **ABOUT LOOPS**

Sample loop shape and dimensions may vary from batch to batch due to fluctuations in tubing ID. Loop volume is controlled as closely as possible, but is not calibrated.

# **MORE INFORMATION**

Materials

Metalspage 254-25	55
Polymers2	56
Valve rotors	57

# Integrated motor/valve, 1/4-28 fitting details for 1/16" tubing, 0.75 mm ports (.030")

Model C62

# **SPECS**

100 psi gas/ 250 psi liq 75°C max

PPS stator Valcon E2 rotor

# **OPTIONS**

■ Serial communication via RS-232 is available.

### \* CE READY

See note on facing page.

Includes multicolored Cheminert flangeless fittings for 1/16" tubing. Sample loops are not included with valves. Order separately.

Low pressure

Integrated

1/4-28 Internal

1/16" 0.75 mm

0.75 1111

CE ready\*



4 Port
Prod No

C62-3184l C62-3184l-S



**6 Port** Prod No

C62-3186I C62-3186I-S



**8 Port** Prod No

C62-3188I C62-3188I-S



Prod No
C62-3180I
C62-3180I-S

# Integrated motor/valve, 1/4-28 fitting details for 1/8" tubing, 1.50 mm ports (.060")

With motor, sensor, & controller

With motor and sensor only

Model C62

# **SPECS**

100 psi gas/ 250 psi liq 75°C max

PPS stator Valcon E2 rotor

### **OPTIONS**

 Serial communication via RS-232 is available.

\* CE READY

See note on facing page.

Includes multicolored Cheminert flangeless fittings for 1/8" tubing. Sample loops are not included with valves. Order separately.

Low pressure

Integrated

1/4-28 Internal.

1/8" 1.50 mm

CE readv\*

	4 Port	6 Port	8 Port	10 Port
	Prod No	Prod No	Prod No	Prod No
With motor, sensor, & controller	C62-6184I	C62-6186l	C62-6188I	C62-6180I
With motor and sensor only	C62-6184I-S	C62-6186I-S	C62-6188I-S	C62-6180I-S



for Model C62

Loops include flangeless fittings with natural color nuts. Loops less than 500  $\mu l$  are made from 1/16" OD tubing; loops 500  $\mu l$  or greater are made from 1/8" OD tubing.



	FEP	PTFE	PEEK
Volume	Prod No	Prod No	Prod No
20 µl	CFSL20FEP	CFSL20TF	CFSL20PK
50 µl	CFSL50FEP	CFSL50TF	CFSL50PK
100 µl	CFSL100FEP	CFSL100TF	CFSL100PK
250 µl	CFSL250FEP	CFSL250TF	CFSL250PK
500 μl	CFSL500FEP	CFSL500TF	CFSL500PK
1 ml	CFSL1KFEP	CFSL1KTF	CFSL1KPK
2 ml	CFSL2KFEP	CFSL2KTF	CFSL2KPK



# Integrated motor/stream selector, 1/16" Valco ZDV fittings, 0.40 mm ports (.016")

Model C55

5,000 psi

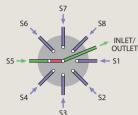
Includes nuts and ferrules.

**Integrated** Stream selector

10-32 ZDV

Valves with stainless stators have stainless fittings. Valves with PAEK stators have PEEK fittings.

See Tech Tip, below.



1/16"	0.40 mm
CE r	eady*
N60 stain	less stator
With integ	grated actuato
Includ	ing RS-232 int

CETEAUY	<b>4 Position</b> Prod No	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
N60 stainless stator With integrated actuator Including RS-232 interface	C55-2004I C55-2004IA	C55-2006I C55-2006IA	C55-2008I C55-2008IA	C55-2000I C55-2000IA
With motor/sensor only	C55-2004I-S	C55-2006I-S	C55-2008I-S	C55-2000I-S
With motor only	C55-2004IX	C55-2006IX	C55-2008IX	C55-2000IX
Replacement rotor	C5-20R4	C5-20R6	C5-20R8H	C5-20R0H
Replacement stator	C55-2C04	C55-2C06	C55-2C08	C55-2C00
PAEK stator With integrated actuator Including RS-232 interface	C55-2344I	C55-2346I	C55-2348I	C55-2340I
	C55-2344IA	C55-2346IA	C55-2348IA	C55-2340IA
With motor/sensor only	C55-2344I-S	C55-2346I-S	C55-2348I-S	C55-2340I-S
With motor only	C55-2344IX	C55-2346IX	C55-2348IX	C55-2340IX
Replacement rotor	C5-23R4	C5-23R6	C5-23R8H	C5-23R0H
Replacement stator	C55-2C44	C55-2C46	C55-2C48	C55-2C40



# **SPECS**

5000 psi liq 50°C max

Metal stator Valcon H rotor

5000 psi liq 50°C max

PAEK stator Valcon E rotor

### **OPTIONS**

- Optional bore: 0.25 mm (.010") 0.75 mm (.030")
- 4 and 8 positions available

# \* CE READY

Since these integrated VICI motor/valves are designed as components to be embedded into other systems, they do not include a power supply. They have been tested according to the following EMC Standards:

EN61326-1:2006 Conducted emissions Radiated emissions However, these results do not substitute for, preclude, or guarantee passage of any or all relevant compliance testing as required for a final product that includes these components.

# **TECH TIP**

For accurate port alignment, these integrated motor/stream selectors must be turned in one direction only. Factory setting is clockwise rotation, but it can be changed by a jumper setting. (See Technical Note TN-821 on vici.com)



# Integrated motor/stream selector, 1/16" Valco ZDV fittings, 0.75 mm ports (.030")

# Model C65Z

# **SPECS**

100 psi gas/ 250 psi liq 50°C max

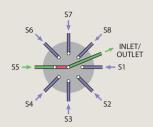
PPS stator Valcon E2 rotor

# \* CE READY

See note on facing page.

Includes Valco ZDV PEEK nuts and ferrules.

See Tech Tip on facing page.



Low pressure Integrated

Stream selector

10-32 ZDV

1/16" 0.75 mm
CE ready\*

	4 Position Prod No	<b>6 Position</b> Prod No	8 Position Prod No	10 Position Prod No
and the second				
Vith integrated actuator	C65Z-3184I	C65Z-3186l	C65Z-3188I	C65Z-3180I
Including RS-232 interface	C65Z-3184IA	C65Z-3186IA	C65Z-3188IA	C65Z-3180IA
Vith motor and sensor only	C65Z-3184I-S	C65Z-3186I-S	C65Z-3188I-S	C65Z-3180I-S

# Integrated motor/stream stream selector, 1/4-28 fittings for 1/16" tubing, 0.75 mm ports (.030")

W

# Model C65

# **SPECS**

100 psi gas/ 250 psi liq 50°C max

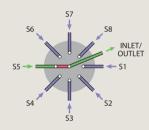
PPS stator Valcon E2 rotor

# \* CE READY

See note on facing page.

Includes multicolored Cheminert flangeless fittings for 1/16" tubing. See photo on facing page.

See Tech Tip on facing page.



Model Co3

Low pressure Integrated

**Stream selector** 

1/4-28 Internal

/16" 0.75 mm CE ready\*

	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod Noe</i>	<b>10 Position</b> <i>Prod No</i>
With integrated actuator	C65-3184I	C65-3186l	C65-3188I	C65-3180I
Including RS-232 interface	C65-3184IA	C65-3186IA	C65-3188IA	C65-3180IA
With motor and sensor only	C65-3184I-S	C65-3186I-S	C65-3188I-S	C65-3180I-S

# Integrated motor/stream stream selector, 1/4-28 fittings for 1/8" tubing, 1.50 mm ports (.060")

# Model C65

# **SPECS**

100 psi gas/ 250 psi liq 50°C max

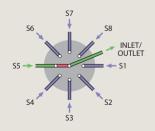
PPS stator Valcon E2 rotor

# \* CE READY

See note on facing page.

Includes multicolored Cheminert flangeless fittings for 1/8" tubing. See photo on facing page.

See Tech Tip on facing page.



Low pressure

Integrated
Stream selector

1/4-28 Internal

1.50 mm
CE ready\*

	<b>4 Position</b> <i>Prod No</i>	<b>6 Position</b> <i>Prod No</i>	<b>8 Position</b> <i>Prod No</i>	<b>10 Position</b> <i>Prod No</i>
With integrated actuator	C65-6184I	C65-6186l	C65-6188I	C65-6180I
Including RS-232 interface	C65-6184IA	C65-6186IA	C65-6188IA	C65-6180IA
With motor and sensor only	C65-6184I-S	C65-6186I-S	C65-6188I-S	C65-6180I-S

# Actuators

# **AND ACCESSORIES**

Two position valves switch back and forth between Load and Inject, or Position A and Position B. Selectors operate in continuous revolutions by incremental steps. There are several ways to actuate each type of valve, along with a number of supporting controllers and devices to interface the actuators with computer-controlled systems.

With the exception of low pressure Cheminert selectors, we recommend that selectors be purchased with air or electric actuators. While a manual detent assembly is available, the higher turning torque of our other selector designs makes them more difficult to position accurately by hand.

# **Manual Actuation**

Simplicity and low cost are the main advantages of manual actuation. Some models can be ordered with position feedback, an option which sends a signal to start a data system when the valve is switched.

# **Air Actuation**

Air actuators are useful in situations where any spark could be disastrous or where there is no electricity available. They are small, relatively inexpensive, very rugged and dependable, and field serviceable. Low gas consumption and lightweight, compact construction make the air actuator suitable for aerospace flight hardware applications as well as laboratory or process applications.

With the addition of a DVI (digital valve interface) to translate the timed event signals into the necessary air pulses, air actuators can be automatically switched by a data system, integrator, or controller.



Manual page 204



Two position, page 197 Selector, page 196

# MORE INFORMATION

# Actuators

Air ..... pages 196-197 Microelectric .. 190-192 Modular universal ..194 Universal electric ...193

# **Mounting Hardware**

Closemount assembly ......208
Standoff assembly .....205

# Controllers and Accessories





**Microelectric actuator** For two position valves, page 190

# **Electric Actuation**

The **microelectric actuator** features automatic valve alignment, high-speed switching, compact size, 24 VDC power input, and reversible direction (in the selector model).

Microelectric actuators can be operated manually with a controller assembly that features position-indicating LEDs and a toggle switch, or can be easily connected to an external data system for fully automated control. Built-in multidrop RS-232 (RS-485 optional) facilitates bidirectional communications.

The new **universal actuator** operates virtually any Valco or Cheminert rotary valve – two position and selector alike – greatly simplying the electronic aspect of instrument design. A manual controller is included; current interface options include RS232/485, USB, and BCD.

A modular universal actuator, also available, is fully backward-compatible with multiposition microelectric actuator models EMH and EMT. Like the universal actuator, it can also be used for two position valves.



**Microelectric actuator** For selectors, page 192



**Universal actuator** Two position and selectors, page 193



**Modular universal actuator**Two position and selectors, page 194



Standoff assemblies page 205

# **Standoff Assemblies**

All valves, no matter what their actuation mode, can be ordered with a standoff assembly. The standoff is an extension shaft mounted between the handle or actuator and the valve, allowing the valve to be installed within a heated zone while the actuator or handle remains outside at ambient temperature. The standoff extends through the oven wall, and is secured by a clamp ring supplied with the assembly. Standard standoff assembly lengths are 2", 3", 4", and 6". Other lengths can be special-ordered at additional cost.

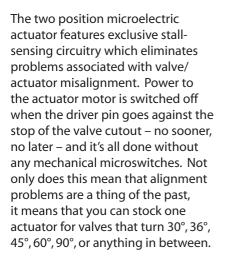
# **Right Angle Drive**

Some installations don't allow the valve and actuator to be installed in a typical in-line configuration. The RAD (right angle drive) is a 90° gearbox which permits the actuator or handle to be installed at a right angle to the valve. The RAD fits all VICI electric and air actuators.



# Microelectric actuators for two position valves

- C€ certified
- Automatic alignment via stall-sensing circuitry no mechanical microswitches
- Manual remote control with position indication
- High speed switching <100 ms in EQ model
- RS-232 bidirectional communication (switchable RS-485)
- Universal power supply, 110/230 VAC to 24 VDC



During initialization, the valve rotates at moderate speed while the actuator waits to sense the stall. Once the rotation angle has been measured and confirmed by repetition, the angle is memorized and actuation takes place at maximum speed. Valve position memory is maintained even in the event of a power failure. There is nothing more to do unless you wish to install a valve with a different angle of rotation. In that event, cycling the actuator with no valve mounted sets up reinitialization.

Since different valve models have varying actuation torque requirements, there are five microelectric actuator models – EQ, EH, EP, ED, and ET. Consult the chart on the facing page to determine which model meets your requirements. When a valve and actuator are ordered at the same time, the proper actuator is supplied automatically.

An actuator can be specified with closemount hardware, with a standoff, or with just the standoff mounting hardware, if your valve already has a standoff. The microelectric actuator is designed for room temperature use, so valves which will be mounted in ovens require a standoff assembly to locate the actuator out of the heated zone.

The microelectric actuator consists of a control module, a stepper motor/ gearbox assembly, a manual remote control, interconnecting cables, and a 110/230 VAC to 24 VDC power supply. The RS-232 interface cable, if required, must be ordered separately. (See facing page.)

for two position valves

# Microelectric actuators

Standard voltage 24 VDC. Includes autosensing 24 VDC power supply.
Standoff version includes a 2" standoff. 3", 4", and 6" standoffs are also available.
Consult the chart below left to determine which actuator model is best suited for your valve.

Description	With	With	For use with
	closemount	2" standoff	existing
	assembly	assembly	standoff
	Prod No	Prod No	Prod No
Highest speed actuator	EQ	EQ2	EQS
High speed actuator	EH	EH2	EHS
Medium torque actuato	r EP	EP2	EPS
High torque actuator	ED	ED2	EDS
Highest torque actuator	ET	ET2	ETS

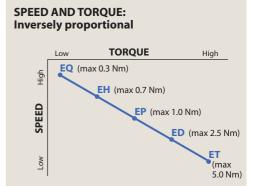


# WHICH MODEL FOR WHICH TWO POSITION VALVE?

Fitting size	Valve type	Actuator model	Valve A	Actuator model
	Valce	o GC	Valco	HPLC
1/32"	W	EH	W	EP
1/16"	W	EH	W	EP
1/16"	UW	ED	UW	ED
1/8"	UW	ED	UW	ED
1/4"	MW	ET	_	_

# **Cheminert HPLC & Low Pressure**

Model C72X 8 and 10 ports ED All other valves E H



# MORE INFORMATION

Closemount
hardware..page 208
Microelectric
actuators
for selectors . . . . 192
Pight angle drive 204

for selectors . . . . 192 Right angle drive . 204 Standoff assembly 205 Standoff mounting hardware . . . . . 205

# ORDER TIP

To purchase a two position valve with a microelectric actuator installed, see valve ordering information.

Valco injectors and valves... 98-117

Cheminert injectors and valves . 146-169, 181,183

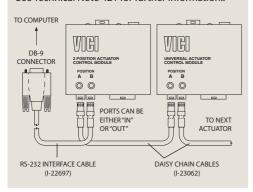
# **RS-232 interface cable**

Description Prod No
RS-232 interface cable I-22697

# **DAISY CHAIN CABLES**

Daisy chain cables permit a single serial port (RS-232) to control multiple actuators – newer two position microelectric and universal.

See Technical Note 421 for further information...



# NFW

for newer two position microelectric actuators and universal actuators

- More layout flexibility
- More economical than multi-drop configuration

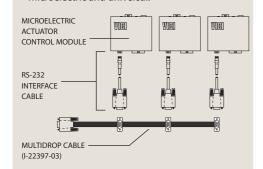
The newly redesigned two position microelectric actuator controller on the facing page (differentiated by a plastic housing instead of a metal one) allows multiple units to be daisy-chained for control from a single serial port. Universal actuators with the RS232/485 option (page 193) can be included in the series, if desired. A chain of actuators requires only one RS-232 interface cable, plus a 3-pin daisy chain cable for each actuator – a more flexible and economical solution than the multi-drop cable application described below.

For lengths other than the 55 cm cable listed, please contact our technical support department. Note that cable lengths should be shorter than one meter for reliable RS-232 communication; longer lengths can affect the signal integrity.

Length Prod No 55 cm I-23062

# **MULTI-DROP CABLES**

Multi-drop cables permit a single serial port (RS-232) to control multiple actuators – microelectric and universal.



# **Multi-drop cables**

for microelectric and universal actuators

■ Work with all VICI microelectric and universal actuators (RS232/485 option)

Multi-drop cables permit a single serial port (RS-232) to control any combination of microelectric actuators (two position and multiposition, any vintage) and universal actuators with the RS232/485 option (page 193). These ribbon cables have one female DB9 and 2 to 8 male DB9 connectors, spaced at approximately 6".

Note: An RS-232 interface cable (I-22697), above, is required for **each** actuator.

No. of actuators to be controlled	Prod No
2	I-22897-02
3	I-22897-03
4	I-22897-04
5	I-22897-05
6	I-22897-06
8	I-22897-08

### **TECH TIP**

Electric actuators can be directly controlled by signals from microprocessor-based instruments, data systems, or valve programmers, unlike air actuators, which require an interface to convert the signal to an air pulse.

### MORE INFORMATION

Universal actuators . . . 193

# **Plug-and-play cables**

for two position microelectric actuators

Plug-and-play cables will allow a direct connection and control between a specific instrument and the microeletric two position actuator. Contact technical support for other instruments.

Relay assembly	Prod No
Two position microelect	tric actuator to
Agilent 6890 GC	V-RA-24VDC-HP6890
Agilent 7890 GC	V-RA-24VDC-HP6890
Varian 3800 GC	V-RA-24VDC-VA3800
Agilent 1100 LC	V-RA-5VDC-HP1100
Waters Alliance LC	V-RA-5VDC-WA2690

# Microelectric actuators for selectors

- C € certified
- Direction reversal
- Position indication LED display RS-232 output BCD 5V negative true output
- Manual control Step and home functions Clockwise and counterclockwise functions
- Remote control Step and home functions with contact closure Direct position access with BCD 5V negative true input Direct position access with RS-232 input (RS-485 optional)
- Automatic self-alignment with keyed valves and standoffs
- Universal power supply, 110/230 VAC to 24 VDC

One actuator can be used on any selector, from 2 to 96 positions - you tell the actuator how many stops to make through its 360° of rotation. So you can stock only one type of actuator even if you have 4, 6, 8, 10, 12, and 16 position valves. Valve position memory is maintained even in the event of a power failure.

The direction reversal feature means that if a 6 position stream selection valve is on stream 1 and you select stream 6, you have the option of stepping "backwards" to stream 6 instead of passing through 2, 3, 4, and 5. The RS-232 input offers

various commands like position access, direction control, shortest route, etc. (The RS-232 cable must be ordered separately. See below.)

An actuator can be specified with closemount hardware, with a standoff, or with just the standoff mounting hardware, if your valve already has a standoff.

The microelectric actuator is designed for room temperature use. Valves which will be mounted in ovens require a standoff assembly, which locates the actuator out of the heated zone.

### Microelectric actuators

for selectors

Standard voltage 24 VDC. Includes autosensing 24 VDC power supply. Standoff version includes a 2" standoff. 3", 4", and 6" standoffs are also available. Consult the chart below to determine which actuator model is best suited for your valve.

	With keyed	With keyed	For use with
	closemount	2" standoff	existing
	assembly	assembly	standoff
Description	Prod No	Prod No	Prod No
High speed actuator	EMH	EMH2	EMHS
High torque actuator	EMT	EMT2	EMTS

# **RS-232 interface cable**

Description	Prod No
RS-232 interface cable	I-22697

### **TECH TIP**

Multi-drop cables permit a single serial port to control multiple actuators. In addition, we offer plug-and-play cables for direct connection of the actuator to a specific instrument.

Multi-drop cables...191 Plug-and-play cables ......195

### **ORDER TIP**

To purchase a **selector** (multiposition valve) with a microelectric actuator installed. see valve ordering information.

Valco selectors ... pp 124-135 Cheminert selectors ..... 172-179

# MORE INFORMATION

Closemount hardware.... page 208 Microelectric actuators for two position ....190 Right angle drive .....204 Standoff assembly....205 Standoff mounting hardware.....205

# WHICH MODEL FOR WHICH INJECTOR / TWO POSITION VALVE?

# Valco

Fitting	Valve	Actuator	Actuator
size	type	model	model
		GC	HPLC
1/32"	W	EUH	EUH
1/16"	W	EUH	EUH
1/16"	UW	EUD	EUD
1/8"	UW	EUD	EUD
1/4"	MW	EUT	_

# Cheminert

	Actuator model	Actuator model		
	HPLC	UHPLC		
4 and 6 ports *	EUH	EUH		
8 and 10 ports	EUH	EUD		
	Low			
pressure				
All valves	EUH			
*20,000 psi versio	ns use EUD.			

# WHICH MODEL FOR WHICH SELECTOR?

Valco		
	Actuator model	
All valves	EUT	
Cheminert		
	Actuator model <b>HPLC</b>	Actuator model <b>UHPLC</b>
4 and 6 position *	EUH	EUH
8 and 10 position	EUD	EUD
	Low	
M - d - L C25 L C257	pressure	
Model C25 and C25Z	EUH	
Model C25G	EUD	
Model C45	EUT	
* 20,000 psi versions	use EUD.	

## **ABOUT STANDOFFS**

Keyed standoff assemblies are used with selectors on universal actuators, to key the valve body to the actuator and standoff so that the actuators can self-align and operate valves with any number of positions.

Valco selectors are not keyed unless ordered with a universal actuator. To install a universal actuator on an existing Valco selector, the key (pin) must be removed from the actuator clamp ring assembly. This can be done easily with a pair of pliers.

See page 207, top and bottom illustrations, for drawings of keyed standoff assemblies with modular universal actuators.

# Universal actuators

- C € certified
- One actuator works with two position valves and selectors
- Simplified, universal communication protocol
- Variety of interfaces
- Three versions for various valve torque requirements

Our universal actuators are truly universal – a single actuator can be used to operate a selector and later to operate a two position valve and back again, simply by changing simple settings.

Three universal actuator models – high speed, medium speed/medium torque, and high torque – cover our entire line of Valco and Cheminert valves and selectors, with their wide range of turning torques.

Actuators include a universal 24 VDC power supply and a manual controller. An OEM version that excludes these items is also available. The standard interface allows simple positioning commands – Step and Home for selectors, A and B for two position – via direct input signals from switch closures, relay contacts, or TTL-compatible interfaces. A more extensive command set is available with the optional RS232/485, USB, or BCD interfaces.



Note: while the actuators listed below are universal, the valve mounting hardware is not. The product numbers shown do not include the hardware required for mounting a valve, since the necessary hardware depends on the valve type. If you are ordering the actuator for use with an existing valve, call our sales or technical staff to determine the correct hardware needed. If you want to order the universal actuator with a new valve, simply substitute the actuator product number in place of a different actuator and we'll provide the correct hardware.

# **Universal actuators**

Standard voltage 24 VDC. Includes autosensing 24 VDC power supply. Does not include mounting hardware. Order separately.

	High speed	Medium torque	High torque
	(EUH)	(EUD)	(EUT)
Interface	Prod no	Prod no	Prod no
Standard	EUH	EUD	EUT
RS-232/485	EUHA	EUDA	EUTA
USB	EUHB	EUDB	EUTB
BCD	EUHC	EUDC	EUTC

# **MORE INFORMATION**

Cablespages 191	, 195
Closemount	
hardware	.208
Right angle drive	.204
Standoff assembly	.205
Standoff mounting	
hardware	205

# **NOTE**

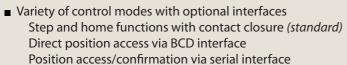
Modular universal actuators, with the motor separated from the controller, offer the same features and functionality as the universal actuator. The modular configuration is often easier to incorporate into an instrument design.

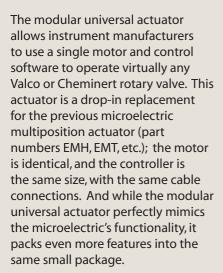
Modular universal actuators for OEMs .....194-5



# Modular universal actuators

- C € certified
- Bidirectional
- Optional position indication
   LCD display BCD
   RS-232/485 USB
- Compact stepper motor design
- Automatic self-alignment with keyed selector valves





This new version of the popular universal actuator makes it easier for the instrument manufacturer to work in the limited space frequently encountered in today's modern instruments. Plus, the modular design makes it possible to mount the more sensitive electronics module away from the liquid end of the valve.

Like the microelectric actuator, the modular universal actuator is bidirectional, and can be easily programmed to take the shortest path during actuation. Position feedback is available via RS232/485 (switchable) or USB interfaces.

All Valco and Cheminert valves and selectors can be actuated by one of the three available versions: high speed, medium speed/torque, or high torque. The actuator includes a universal input 24 volt DC power supply and a manual controller with LCD display. An OEM version that excludes these and the motor mounting bracket is available at additional savings.

While the actuators listed here are universal, the valve mounting hardware is not. The product numbers shown do *not* include the hardware required to mount a valve, since the parts required depend on the valve type. If you are ordering a universal actuator with a *new* valve, the proper hardware is, of course, included. If you are ordering an actuator for use with an *existing* valve, call our technical support staff for help in acquiring the correct mounting hardware.

# **NEW Modular universal actuators** for selectors and two position valves

Standard voltage 24 VDC. Includes autosensing 24 VDC power supply. Consult the charts at left to determine which actuator model is best suited for your valve.

High	Medium	High
speed	torque	torque
Prod no	Prod no	Prod no
UMH	UMD	UMT
UMHA	UMDA	UMTA
UMHB	UMDB	UMTB
UMHC	UMDC	UMTC
	speed Prod no UMH UMHA UMHB	speed torque Prod no Prod no UMH UMD UMHA UMDA UMHB UMDB

# WHICH MODEL FOR WHICH INJECTOR / TWO POSITION VALVE?

### Valco

Fitting size	Valve type	Actuator model	Actuator model	
		GC	HPLC	
1/32"	W	UMH	UMH	
1/16"	W	UMH	UMH	
1/16"	UW	UMD	UMD	
1/8"	UW	UMD	UMD	
1/4"	MW	UMT	_	

# Cheminert

	Actuator model	Actuator model	
	HPLC	UHPLC	
4 and 6 ports *	UMH	UMH	
8 and 10 ports	UMH	UMD	
	Low		
	pressure		
All valves	UMH		
*20,000 psi versio	ns use UMD.		

# WHICH MODEL FOR WHICH SELECTOR?

# Valco

Model C45

\* 20,000 psi versions use UMD.

Actuator model			
All valves	UMT		
Cheminert			
	Actuator model	Actuator model	
	HPLC	UHPLC	
4 and 6 position *	UMH	UMH	
8 and 10 position	UMD	UMD	
	Low pressure		
Model C25 and C25Z	UMH		
Model C25G	UMD		

UMT

# **MOUNTING HARDWARE**

MODITING HANDWAN
Closemount
hardware page 208
Right angle drive204
Standoff assembly205
Standoff mounting
hardware205

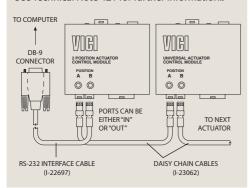
# **RS-232** interface cable

Description Prod No
RS-232 interface cable I-22697

# **DAISY CHAIN CABLES**

Daisy chain cables permit a single serial port (RS-232) to control multiple actuators – newer two position microelectric and universal.

See Technical Note 421 for further information..



# **NEW** for universal actuators **Daisy chain cables** and newer two position microelectric actuators

- More layout flexibility
- Economical

Universal actuators with the RS232/485 interface option can be daisy-chained for control from a single serial port. The series can also include the redesigned two position microelectric actuator (page 191) if desired. A chain of actuators requires only one RS-232 interface cable, plus a 3-pin daisy chain cable for each actuator – a more flexible and economical solution than the multi-drop cable application described in the shaded box below.

For lengths other than the 55 cm cable listed, please contact our technical support department. Note that cable lengths should be shorter than one meter for reliable RS-232 communication; longer lengths can affect the signal integrity.

Length Prod No
55 cm I-23062

# **Plug-and-play cables** for microelectric selector and universal actuators

Plug-and-play cables will allow a direct connection and control betweeen a specific instrument and a microelectic or universal actuator. Contact technical support for other instruments.

BCD cable Prod No

Modular universal actuator to

Agilent 6890 GC V-EMPMCR-HP6890 Agilent 6890 Network GC V-EMPMCR-HP6890N Agilent 7890 GC V-EMPMCR-HP6890N

# For 4 and 6 column selector \* (page 175)

Remote cable

Modular universal actuator to

Agilent 1100 LC V-EMPMCR-HP1100 Waters Alliance LC V-EMPMCR-WA2690

# For 8 and 10 column selector \* (page 175)

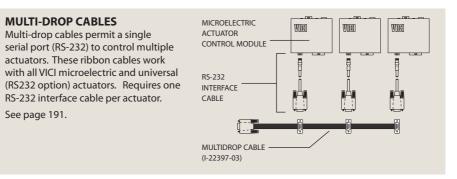
Remote cable

Modular universal actuator to

Agilent 1100 LC V-EMPMCR-HP1100-10 Waters Alliance LC V-EMPMCR-WA2690-10

# MORE INFORMATION

Microelectric actuators for two position ....190 for selectors .....192 Universal actuators ...193



<sup>\*</sup> Requires a specific software setting in the actuator control module

Air actuators offer reliable performance under the most stringent conditions. Low gas consumption and lightweight, compact construction make the air actuator suitable for aerospace flight hardware applications as well as laboratory or process applications.

The standard air actuator is rated for up to 80 psig at temperatures up to 70°C. Generally speaking, valves which will be heated require a standoff assembly, which locates the air actuator out of the heated zone and supports both the valve and actuator. A high temperature model permits both valve and actuator to be mounted within an oven (175°C maximum), but it is not recommended for use below 50°C.



# Air actuators for selectors

The recommended method for implementing a selector (multiposition) air actuator requires only a single 4-way solenoid. Up to 80 psig may be used without damaging the valve or actuator. Bottled instrument air or nitrogen is recommended.

If plant air from compressors must be used, an oil separator and water dryer are required.

Multiposition air actuators include a rotary switch which may be connected to a digital readout of your own design.



# **Standard air actuators**

for selectors

Temperature range 0-70°C

Standoff version includes a 2" standoff. 3", 4", and 6" standoffs are also available.

Description	With closemount assembly Prod No	With 2" standoff assembly Prod No	With standoff mounting hardware Prod No
4 position	A4	A42	A4S
6 position	A6	A62	A6S
8 position	A8	A82	A8S
10 position	A10	A102	A10S
12 position	A12	A122	A12S
16 position	A16	A162	A16S

# **High temperature air actuators**

for selectors

Temperature range 50-175°C

Standoff version includes a 4" standoff. 2", 3", and 6" standoffs are also available.

Description	With closemount assembly Prod No	With 4" standoff assembly Prod No	With standoff mounting hardware Prod No
4 position	AT4	AT44	AT4S
6 position	AT6	AT64	AT6S
8 position	AT8	AT84	AT8S
10 position	AT10	AT104	AT10S
12 position	AT12	AT124	AT12S
16 position	AT16	AT164	AT16S

# **Replacement O-rings**

Includes a complete set of O-rings for a multiposition air actuator.

Description Prod No
Standard ORMP
High temp ORTMP



# TECH TIP

The actuator's rotation must be properly matched to the valve's. If you are converting a manual valve to air actuation and have any doubts about which actuator and hardware you need, call our sales or technical staff for assistance.

# ORDER TIP

To purchase a *valve with an air actuator installed*, go directly to valve ordering information.

# MORE INFORMATION

PFAF ..... page 199
Position feedback

# **Mounting Hardware**

Closemount	
hardware	208
Right angle drive	.204
Standoff assembly	.205
Standoff mounting	
hardware	.205

# Air actuators for two position valves

The recommended method for implementing a two position air actuator is a manifold solenoid valve assembly (5-way three position solenoid air valve, page 198) that pulses air to the actuator to switch it from position to position. If air is applied continuously, the continuous rotational force applied to the valve can cause sideloading, leaking, and additional wear.

Typical actuation pressure is 40 to 50 psig, but up to 80 psig may be used. Ideally, only enough air

pressure should be used to switch the valve in 1/3 to 1/2 second. Bottled instrument air or nitrogen is recommended. If plant air from compressors must be used, an oil separator and water dryer are required.

A high speed switching accessory (HSSA) can upgrade valve switching times to less than 30 ms with air or 8 ms with helium. A position feedback (PFAF) with contact closures in both positions is also available as an option.

# **TECH TIP** Here's what you'll get when you order:



Air actuator with a **closemount assembly** 



Air actuator with a 4" standoff assembly



Air actuator for use with an existing standoff

# MORE INFORMATION

# **Standard air actuators**

for two position valves

Temperature range 0-70°C

Standoff version includes a 4" standoff. 2", 3", and 6" standoffs are also available.

No. of ports		With closemount assembly	With 4" standoff assembly	For use with existing standoff
in valve	Description	Prod No	Prod No	Prod No
3,4	90° rotation	A90	A904	A90S
6	60° rotation	A60	A604	A60S
8	45° rotation	A45	A454	A45S
10	36° rotation	A36	A364	A36S
12	30° rotation	A30	A304	A30S

# High temperature air actuators

for two position valves

Temperature range 50-175°C

Standoff version includes a 2" standoff. 3", 4", and 6" standoffs are also available.

		With closemount	With 2" standoff	For use with existing
No. of ports		assembly	assembly	standoff
in valve	Description	Prod No	Prod No	Prod No
3,4	90° rotation	AT90	AT902	AT90S
6	60° rotation	AT60	AT602	AT60S
8	45° rotation	AT45	AT452	AT45S
10	36° rotation	AT36	AT362	AT36S
12	30° rotation	AT30	AT302	AT30S

# **Replacement O-rings**

Includes a complete set of O-rings for a two position air actuator.

Description Prod No
Standard OR
High temp ORT



# **Actuator compression fittings**

Includes 1/8" compression to 10-32 male thread, plus 1/8" brass ferrule and hex nut.

Prod No

3 piece fitting assembly F-TCF



# **4-Way solenoid air valve CE** for selector air actuators

This 4-way solenoid air valve with 1/8" tube fittings is the simplest method of stepping a selector air actuator. Energizing the solenoid steps the valve to its next position, and de-energizing the solenoid resets the mechanical ratchet in the actuator. This implementation, not recommended for two position actuators, can be useful when only a limited number of external events is available on the data system.

ic on the date	i system.	
	Prod No	
110 VAC 240 VAC	V-SV-S52-110VAC V-SV-S52-220VAC	
24 VAC 24 VDC	V-SV-S52-24VAC V-SV-S52-24VDC	

# 3-Way solenoid air valve CE for diaphragm valves

This 3-way solenoid with 1/8" tube connections is perfect for switching spring-return valves such as our on/off or prime/purge valves (pages 212-213) or the DV22 diaphragm valves on pages 142-144. Energizing the solenoid provides air to the actuator, while removing power from the solenoid allows the valve to return to its original state. Use of this solenoid is not recommended for rotary valves.

	Prod No	
110 VAC 240 VAC	V-SV-S32-110VAC V-SV-S32-220VAC	
24 VAC 24 VDC	V-SV-S32-24VAC V-SV-S32-24VDC	

# 5-Way three position solenoid air valve C € for two position air actuators

This 5-way solenoid air valves with 1/8" tube connections is recommended to switch two position air actuators. It applies air to the actuator only during switching and alleviates problems associated with continuous air pressure.

	Prod No	
110 VAC 240 VAC	V-SV-S53-110VAC V-SV-S53-220VAC	
24 VAC 24 VDC	V-SV-S53-24VAC V-SV-S53-24VDC	



# MORE INFORMATION Actuators

Air ......pages 196-197 Microelectric .... 190-192 Universal electric .....193

# **Mounting Hardware**

Closemount
hardware..... page 208
Right angle drive ..... 204
Standoff assembly.... 205
Standoff mounting
hardware...... 205



# **DVI Digital valve interface** (Non-CE) for two position air actuators

We highly recommend the DVI for use with two position air actuators. It sends a two second pulse of air to switch the valve and then vents the air, simulating switching by hand and eliminating the potential for damaging the valve or actuator with continuously-applied pressure. It also features LED position indication, manual and remote operation, and a contact closure output on arrival to the INJECT position, a feature which can be used to start a run or integration. The DVI is available for 110 or 230 VAC.

Prod No

110 VAC DVI 230 VAC DVI-220



# **HSSA** High speed switching accessory for two position air actuators

The HSSA is an add-on for our standard air actuators, providing increased air or helium flow for the fast actuation required in microbore chromatography or partial loop injections. Normal switching time for a C6W with 100 psi air is 180 ms. With the HSSA that drops to 20 ms; substitute 100 psi helium and the valve switches in 8 ms. Usually the HSSA is used in conjunction with the DVI above.

Prod No

**HSSA** 



# **PFAF** Position feedback

for two position air actuators

The optional position feedback (PFAF) can be field installed on any two position standard air actuator. Each position provides a contact closure for TTL logic level signals.

Prod No

PFAF



# **Position feedback**

for manual valves

An optional position feedback is available for manual Valco W type and Cheminert C2 and C4 series valves (standard on Cheminert C1 valves). The continuous contact closure, provided only while the valve is in the inject position, can be used to start a chromatograph or data system.

Description Prod No
For Valco W type valves

4 port PFW90 6 port PFW60 8 and 10 port PFW36

For Cheminert valves

C2 series except 4 port PFC2 C2 series, 4 port PFC4 C4 series PFC4

Purge housings for Valco valves eliminate any possible diffusion from the atmosphere *into* the valve, or safely vent fugitive emissions *from* the valve. They are typically used in trace level analyses to isolate the valve from ambient air, but can also be used as a safety measure to isolate a valve against leaks into the atmosphere, such as when pyrophoric, toxic, or carcinogenic materials are present in the sample stream.

Two screws secure each half of the purge housing to the valve, so that the rear chamber of the housing (the preload assembly/spring side of the valve) can be removed for rotor inspection or replacement without affecting the actuator side of the housing.

Ideally, the purge housing should be ordered when a new valve is ordered, so that it can be factoryinstalled. Field installation of purge housings is generally not recommended. To order a new valve with a purge housing, add the suffix "PH" to the product number for the valve/actuator assembly. The purge housing requires a standoff assembly, which can be 2", 3", 4", or 6" long.

All Valco two position valves with two threaded mounting holes will accommodate a purge housing without modification. Some two position valves must be modified at the factory to accept the housing. The charge for modifying an existing valve includes the new purge housing. Call our service department to make arrangements for this service.

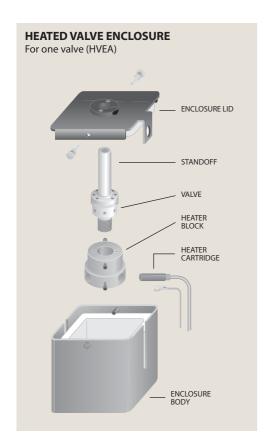


# **Purge housings**

# for two position valves and selectors

Description	Prod No	Notes	SPECS
On a new valve	Add suffix PH to valve prod no	Requires standoff assembly. Multiposition valve	Maximum temperature: 175°C
		requires an actuator.	Note: The purge
On existing valve,			housing limits the maximum
factory installation	Contact factory		temperature of the
On existing valve,			purged valve to
for field installation	Not recommended	d	175°C, regardless of the valve specifications.

# PURGE HOUSING WITH VALVE OR012V OR018V OR025V OR1NG O



These insulated enclosures allow valves to be operated at temperatures independent of other controlled zones of analytical instruments. The compact construction and minimum power dissipation enable mounting within larger, lower temperature zones without significantly raising the larger oven's minimum temperature or impairing its programmability.

An insulated enclosure and a standard heater block are included. The product number chart lists the heater cartridge size typically required to heat the valve(s) to the indicated temperature. Holes are provided in the heater block for Perkin Elmer, Agilent, and other temperature sensors, with an additional thermocouple hole permitting temperature readout.

Since 1/32" W type valves are smaller, they require a special heater block; enclosures for 1/32" valves are denoted by asterisk (\*) in the price chart below.

**Note:** Heated valve enclosures provide a way to heat valves. A GC's auxiliary temperature zone controller or a device such as our ITC (instrumentation temperature controller) is required to maintain the valves at a set temperature.

Standard voltage: 110 VAC. For a 230 VAC model, add -220 to the product number. Insulation is 1/2" thick, so internal dimensions are 1" smaller than the exterior size given below.

# **Heated valve enclosures** (Non-CE) for two position valves and selectors

Capacity	Exterior dimensions (Interior approx 1" smaller)	Rating	With heater cartridge Prod No	Without heater cartridge Prod No	
1 valve	4" x 4-1/4" x 3-5/8"d	65W/350°C * 65W/350°C	HVEA HVEAN	HVEAX HVEANX	
	4-1/4" x 5-1/8" x 3-5/8"d	65W/350°C * 65W/350°C	HVEB HVEBN	HVEBX HVEBNX	
	8" x 8" x 6"d	100W/350°C	HVEC	HVECX	
2 valves	8" x 5-1/4" x 4"d	125W/350°C	HVE2	HVE2X	
3 valves	13-1/2" x 5-3/4" x 4"d	150W/350°C	HVE3	HVE3X	
6 valves	13-3/4" x 8" x 6"d	300W/350°C	HVE6	HVE6X	

<sup>\*</sup> for use with 1/32" valves



# **MORE INFORMATION**

ITC ...... page 203 Instrumentation temperature controller

Heated column
enclosures .......203
Heater assemblies ....202
Heater blocks .....202

# **Heater assemblies**

(Non-CE)

A heater assembly includes a standard heater block, heater cartridge, and line cord. Heater cartridges are also available individually. Consult the factory for price and availability.

Standard voltage is 110 VAC. For a 230 VAC model, add -220 to the product

Description	Rating	Prod No
<b>Heater assembly</b> For use with HVEA		
or HVEB	65W/350°C	HA1
For use with HVEC	100W/350°C	HA1T
For use with HVE2	125W/350°C	HA2
For use with HVE3	150W/350°C	HA3
For use with HVE6	300W/350°C	HA6



# **Heater blocks**

for single valves

There are two single valve heater block designs: standard and low mass. The low mass heater block, which has a .075" diameter hole for sensor or thermocouple, works well for two position valves. The standard heater block is a high mass, multipurpose design which can be used with any Valco valve. It is designed so that sample loops or short columns can be wound directly on it.

Heater blocks do not include a heater cartridge.

Description	Prod No
Low mass heater block, 1 valve	HBS
Standard heater block, 1 valve	НВ
Standard heater block, 1 NW Type valve (1/32" fittings)	HB1N





# **Heater cartridges**

for single valve heater blocks

The cartridge size is 1.5" long by 3/8" diameter. Consult the factory to purchase cartridges for larger heater blocks.

Rating		Prod No
65W	110 VAC	I-21208-32
65W	220 VAC	I-21208-33
100W	110 VAC	I-21208-05
100W	220 VAC	I-21208-06



# **Heated column enclosures**

(Non-CE)

(Non-CE)

Heated column enclosures allow a column to be operated at temperatures independent of other controlled zones in the instrument. They are similar in construction to our heated valve enclosures (page 201), except instead of a valve heater block they contain a column mandrel which will accept 1/8" columns up to 10' long. The HCE2 can have a heated valve installed adjacent to the heated column, with a valve heater block ordered separately.

Includes a column mandrel, an insulated enclosure, and a standard heater block, with or without the heater cartridge and line cord. Standard voltage: 110 VAC. For a 230 VAC model, add -220 to the product number. Insulation is 1/2" thick, so internal dimensions are 1" smaller than the exterior size given below.

Capacity	Exterior dimensions (Interior approx 1" smaller)	Rating	With heater cartridge Prod No	Without heater cartridge Prod No
Heated colum	nn enclosure			
1 column	4" x 4-1/4" x 3-5/8"d 4-1/4" x 5-1/8" x 3-5/8"d 8" x 8" x 6"d	65W/350°C 65W/350°C 65W/350°C	HCE1 HCEB HCEC	HCE1X HCEBX HCECX
2 columns	8" x 5-1/4" x 4"d	65W/350°C	HCE2	HCE2X
	drel assembly not included umn mandrel)		Prod No CM	



# ITC Instrumentation temperature controller

The ITC is an isothermal proportional controller for use in the thermal systems common to analytical instrumentation, and is often used with heated valve enclosures. The desired temperature is set in 1°C increments on the front panel. A thermocouple sensor provides quick recognition of temperature changes. The power to the heater can be attenuated from 0-90% in 10% increments, an easy-to-use feature which improves temperature stability at the set point to 0.5°C. Maximum output current is 10 amps.

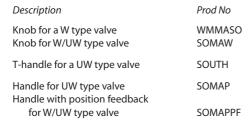
The ITC is available with a range of 0°C to 399°C, in 110 VAC or 230 VAC.

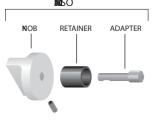
		Prod No
0°C to 399°C	110 VAC 230 VAC	ITC10399 ITC10399-220
Replacement	thermocouple	I-21014-01

# **Knobs and handles**

# for use with a standoff

Choose from theselection below if you already have a spare standoff assembly (see facing page) but lack the knob or retainer, or have an actuated valve on a standoff which you'd like to convert to manual use. Includes parts shown.





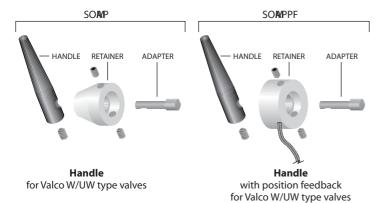
**SOMAW** KNOB RETAINER ADAPTER

**SOUTH** RETAINER ADAPTER HANDLE

Knob for Valco W type valves

Knob for Valco W/UW valves

T-handle for Valco UW type valves



### Right angle drive **RAD**

for two position actuators

Some installations don't allow the valve and actuator to be installed in a typical in-line configuration. The RAD is a 90° gearbox which permits the actuator or handle to be installed at a right angle to the valve. The RAD fits all VICI two position electric and air actuators. Not for use with 1/4" valves.

RAD with standoff includes a 2" standoff; 3", 4", and 6" standoffs are also available.

With closemount	With 2" standoff
hardware	assembly
Prod No	Prod No
RAD	2RAD

### **TECH TIP**

RADs add a slight amount of backlash and load. The backlash is not an issue with two position valves on microelectric or universal actuators, since the actuators locate and remember the stopping point. However, for two position valves on other actuators and for all selectors, we recommend that the valves have ports no smaller than .016".

The additional load may mean that a valve that ordinarily requires an ED actuator might require an ET when used with a right angle drive.

If you have any questions, please consult our technical support.



Valves which will be installed in ovens or heated zones require a standoff assembly, which locates the actuator out of the heated zone and supports both the valve and the handle or actuator. The 5/8" outside diameter standoff tube extends through the oven wall and is secured by means of a clamp ring supplied with the assembly.

If you are converting an actuated valve from a closemount to a standoff application, order the appropriate clamp ring and two screws in addition to the standoff assembly. Consult the factory for availability of non-standard lengths.

The microelectric actuator for selectors uses a special standoff assembly (SOMMP) which is keyed to both valve and actuator. The key guarantees proper alignment and positioning of the valve.

Product numbers show the most common length of standoffs: 4" for air actuators and manual knobs, 2" for microelectric and standard electric actuators. Standoff assemblies are available in lengths of 2", 3", and 6". To order a 6" standoff instead of a 4" one, change the 4 at the beginning of the product number to a 6.

# Standoff assemblies and mounting hardware

for actuators

	<b>3</b>			
	Standoff assembly	Clamp ring	Screws	
	Prod No	Prod No	Prod No	
Air actuators				
For Valco two position valves				
with 1 or 2 mounting holes	4SOA	CR3	HWSC-SC8-6	
with no mounting holes	4SOAMP	CR3	HWSC-SC8-6	
For Valco selectors	4SOAMP	CR3	HWSC-SC8-6	
For Cheminert valves	4SOAMP	CR3	HWSC-SC8-6	
Microelectric actuators				
For Valco two position valves				
with 1 or 2 mounting holes	2SOA	CR8	HWSC-SC8-8B	
with no mounting holes	2SOAMP	CR8	HWSC-SC8-8B	
For Valco multiposition valves				
(UW and MW Types only)	2SOAMMP	CR10	HWSC-SC8-8TDH	
For Cheminert two position valves	2SOAMP	CR8	HWSC-SC8-8B	
For Cheminert selectors	2SOAMMP	CR10	HWSC-SC8-8TDH	
Standard electric actuators				
For Valco two position valves				
with 1 or 2 mounting holes	2SOA	CR3	HWSC-SC8-8B	
with no mounting holes	2SOAMP	CR3	HWSC-SC8-8B	
For Valco selectors	2SOAMP	CR3	HWSC-SC8-8B	
For Cheminert valves	2SOAMP	CR3	HWSC-SC8-8B	

# installed. Actuators

**TECH TIP** 

Air pag	es 196-7
Microelectric	190-192
Universal alec	102

If you need the *actuator* as well as the hardware, you can order it complete with the appropriate hardware or with the required standoff already

# CONVERTING FROM CLOSEMOUNT TO A STANDOFF

If you are converting an actuated valve from a closemount to a standoff application, the clamp ring and screws which secure the standoff to the actuator are **not included** in the standoff assembly. Order clamp ring and screws in addition to the standoff assembly.

# **MORE INFORMATION**

For illustrations of standoffs on valves and actuators, see pages 206 and 207.

# Standoff assemblies

for manual valves

Includes knob, standoff assembly, retainer, and adapter. For illustration, see page 206, top.

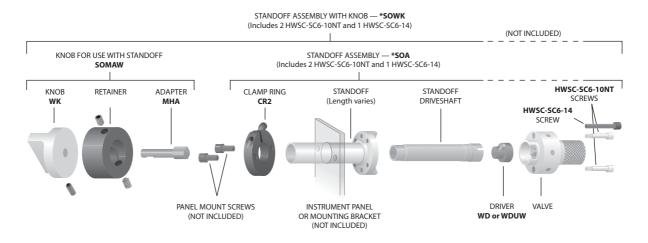
Prod No

For Valco W and UW Type two position valves
rated less than 5,000 psi
with 1 or 2 mounting holes
with no mounting holes
4SOWKMP
For Valco UW Type two position valves
rated 5,000 psi and higher
with 1 or 2 mounting holes
with no mounting holes
4SOUTH
with no mounting holes
4SOUTHMP
For Cheminert valves
4SOWKMP



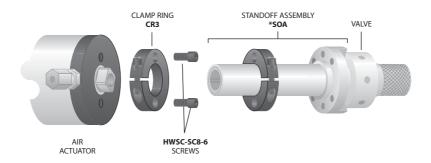
# Standoff with

# **VALCO TWO POSITION VALVE - MANUAL**



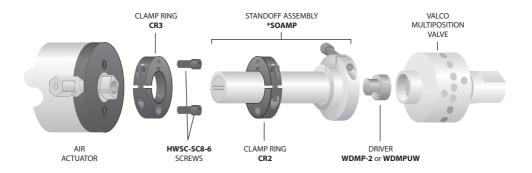
# Standoff with

# **VALCO TWO POSITION VALVE - AIR ACTUATOR**



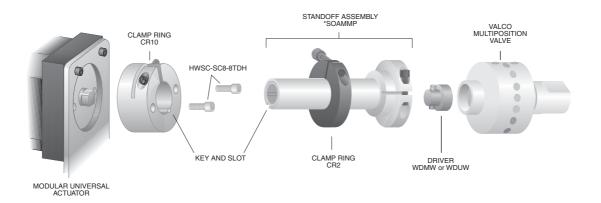
# Standoff with

# **VALCO SELECTOR – AIR ACTUATOR**



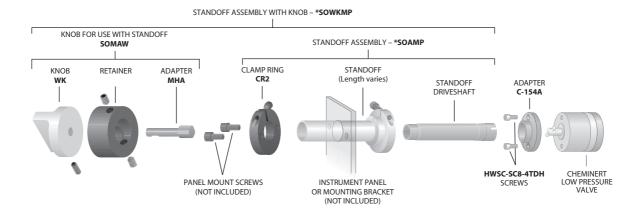
# **Keyed standoff with**

# VALCO SELECTOR - MICROELECTRIC, UNIVERSAL, OR MODULAR UNIVERSAL ACTUATOR



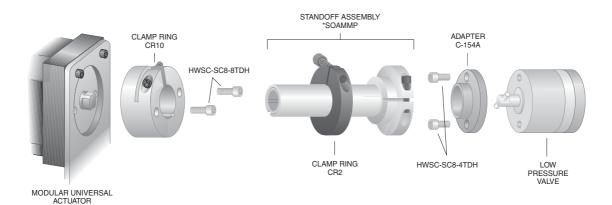
# Standoff with

# **CHEMINERT TWO POSITION VALVE - MANUAL**



# **Keyed standoff with**

# CHEMINERT SELECTOR-MICROELECTRIC, UNIVERSAL, OR MODULAR UNIVERSAL ACTUATOR



# Closemount hardware

# **ACTUATORS AND ACCESSORIES**

If a valve is not going to be heated beyond the temperature range of the actuator, closemount hardware often makes the cleanest installation.

# **Closemount hardware**

for manual valves

If you have a Valco W Type valve with no hardware and want a knob on it, or if you are converting an air or electrically actuated two position valve to manual use, this is what you need. There are two versions: one for valves with threaded mounting holes and one for valves with unthreaded mounting holes. (If your valve has no mounting holes, you will have to use it with a standoff.)

> Description Prod No

For valves with

threaded mounting holes WMMA unthreaded mounting holes WMMA10



# **Closemount hardware**

for actuators

Order the appropriate closemount hardware if you want to change your valve and actuator from a standoff to a closemount connection. Two mounting screws are included. If air and standard electric actuators require different mounting screws, two of each screw are included with the closemount hardware.

Doccription	Drad Na
Description	Prod No

# Air or standard electric actuators

For Valco two position valves with 1 or 2 mounting holes

CMH with no mounting holes **CMHMP** For Valco multiposition valves **CMHMP** 

For Cheminert valves

high pressure design CMH11H CMH11L low pressure design (low pressure design includes required adapter)



# Two position microelectric actuators

For Valco two position valves

with 1 or 2 mounting holes CMH12H with no mounting holes CMH12H

For Cheminert two position valves

high pressure design CMH12H low pressure design CMH12L (low pressure design includes required adapter)

# Universal and modular universal actuators

For Valco multiposition valves

(UW and MW Types only) CMH13 For Cheminert multiposition valves high pressure design CMH13H low pressure design CMH13L (low pressure design includes required adapter)

# **TECH TIP**

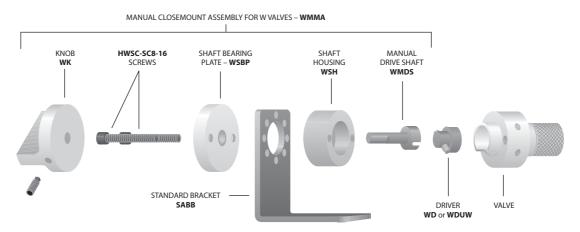
If you need the *actuator* as well as the hardware, you can order it complete with the appropriate hardware or with the required standoff already installed.

# Actuators

Airpages 196-1	97
Microelectric 190-1	92
Modular universal1	94
Universal 1	σs

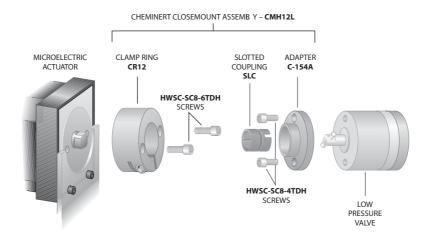
# **Closemount with**

# **VALCO VALVE - MANUAL**



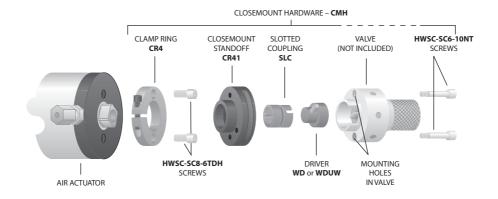
# **Closemount with**

# CHEMINERT VALVE (Low pressure two position) – MICROELECTRIC



# **Closemount with**

# VALCO VALVE (1 or 2 mounting holes) – AIR ACTUATOR



As a convenience to our customers, we stock several standard tools that are useful for working with valves, fittings, and other products from VICI. In addition, we offer custom tools which are designed and machined in our factory to facilitate use of specific VICI products.

# **Custom socket wrench**

These socket wrenches with a slot to slip over the tubing are the perfect tool for installing fittings when proximity of the ports makes it difficult to get a normal open end wrench in position. The SWH3 fits the 3/16" hex head on our 1/32" ZDV fittings; the SWH4 works with the 1/4" hex nuts for 1/16" fittings.

3/16" SWH 1/4" SWH	-



# Hex key set

The hex key set has a wrench to fit any socket head screw on any VICI valve or actuator. Includes .050", 1/16", 5/64", 3/32", 7/64", 1/8", 9/64", and 5/32" sizes.



# **Open end wrenches**

Size	For use with	Prod No	
3/16" x 1/4" 3/8" x 7/16" 1/2" x 9/16"	1/32" and 1/16" nuts 1/8" nuts 1/4" nuts	OEW-2 OEW-3	3 6

# **Pencil magnet**

A pencil-type magnet is useful for removing the rotor from Valco valves when the rotor must be replaced or rotated. The process of disassembly and assembly is described in Technical Note 201, which may be found in the support section at www.vici.com.



# Pin vise and drill index

The drill index has drills sized from 0.0135" to 0.039" (0.34 to 1 mm). These are useful tools when a fused silica tube breaks in a union, or for enlarging the inner diameter of fused silica adapters.



# **Template**

This tool is just what you need when you're working out plumbing and valve switching schematics. It features templates for two position valves with 4, 6, 8, and 10 ports with indications of both positions, as well as various flow symbols. For added convenience, the sides are edged with metric and inch rulers.

Prod No
TEMPLATE1



# Valve spanner handle

A special tool for gripping a multiposition valve body. It is especially useful during valve alignment procedures.



# Mirror

Helpful to get access to valve serial numbers and to check discharge on pulsed discharge detectors (PDD).



# Control devices

# FLOW, PRESSURE, AND ON/OFF

This section includes stainless needle valves, our combination on/off needle valves, high pressure prime/purge and on/off valves, and VICI pressure regulators and flow controllers.

Because cast parts can introduce porosity and contamination, every VICI control device is assembled from components which are precision-machined from bar stock. This assures that every item has the same high quality workmanship, with careful assembly and testing to rigid standards.

# On/off and prime/purge valves

Valco high pressure on/off or prime/purge valves feature quality engineering, precision machining, and extremely low internal volume (< 2 µl), making them the ideal choice in the most demanding liquid or supercritical fluid chromatography or extraction systems.\* The on/off function is self-explanatory; in prime/purge models, mobile phase flows around the needle when the valve is closed, relieving the back pressure from the column. When the valve opens, mobile phase vents to waste to prime the pump.

Standard models provide leak-tight operation up to 10,000 psi (690 bar) at 100°C, with high temperature versions rated up to 6,000 psi/300°C. A 1/16" fitting model with a larger bore and a 1/8" fitting model are available for high flow applications.

The valve needle is made from a special high strength alloy which is resistant even to the buffer salts which might accidentally precipitate inside the valve. Seals are fluorocarbon, with valve bodies machined from HPLC grade stainless steel, ensuring long lifetime in even the most demanding situations.

The on/off and prime/purge valves are available in manual or air/CO<sub>2</sub> actuated versions. The automated valves require a single three-way solenoid: application of 50 psi opens the valve; venting the air allows the spring to return the valve to the closed position.

\*Not suitable for use with gases.





# **CONTROL DEVICES**

On/off valves for liquids

# **SPECS**

Temp Pressure

# Standard temperature / high pressure

1/16" 100°C 10,000 psi liq

# High temperature / medium pressure

1/16" 300°C 6,000 psi liq 1/8" 300°C 2,000 psi liq

# Standard temperature/ high pressure

		Manual	Air actuated
		with 1" knob	with 1" standoff
Fitting size	Bore	Prod No	Prod No
1/16"	0.50 mm	SFVO	ASFVO
	0.75 mm	SFVOL	ASFVOL

# High temperature/ medium pressure

		Manual	Manual	Air actuated	Air actuated
		with 2" knob	with 4" knob	with 2" standoff	with 4" standoff
Fitting size	Bore	Prod No	Prod No	Prod No	Prod No
1/16"	0.50 mm	SFVOHT	SFVOHT4	ASFVOHT	ASFVOHT4
	0.75 mm	SFVOLHT	SFVOLHT4	ASFVOLHT	ASFVOLHT4
1/8"	1.50 mm	_	_	ASFVO2HT	ASFVO2HT4

# Prime/purge valves for liquids

# **SPECS**

Temp Pressure

# Standard temperature / high pressure

1/16" 100°C 10,000 psi liq

# High temperature / medium pressure

1/16" 300°C 6,000 psi liq 1/8" 300°C 2,000 psi liq

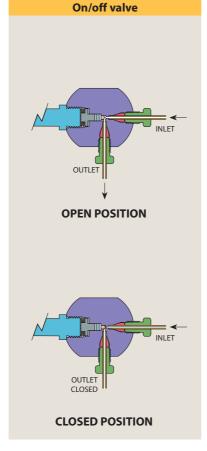
# Standard temperature/ high pressure

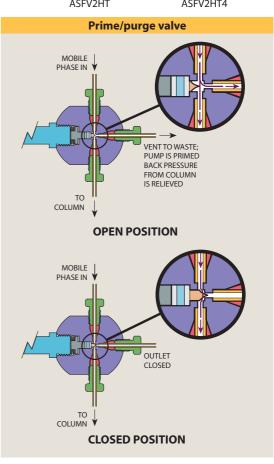
		Manuai	Air actuateu
		with 1" knob	with 1" standoff
Fitting size	Bore	Prod No	Prod No
1/16"	0.50 mm	SFV	ASFV
	0.75 mm	SFVL	ASFVL

# High temperature/ medium pressure

		Manual	Manual	Air actuated	Air actuated
		with 2" knob	with 4" knob	with 2" standoff	with 4" standoff
Fitting size	Bore	Prod No	Prod No	Prod No	Prod No
1/16"	0.50 mm	SFVHT	SFVHT4	ASFVHT	ASFVHT4
	0.75 mm	SFVLHT	SFVLHT4	ASFVLHT	ASFVLHT4
1/8"	1.50 mm	_	_	ASFV2HT	ASFV2HT4

# Air actuator option MOUNTING HOLES (1.00° CENTER) AIR INLET/OUTLET (50 PSI ACTUATION) AN EAOR21 FITTING FOR 1/8" AIR SUPPLY TUBING IS INCLUDED. (SEE PAGE 216)





# **CONTROL DEVICES**

A new generation needle and shutoff valve combines flow control and positive shut-off without damage to the needle. Since the flow setting is not changed by turning the valve on and off, the valve is ideal for providing hydrogen and air to an FID. It can also be used to supply makeup or combustion gas in a wide variety of applications.

Flow is set using the screwdriver adjustment in the center of the on/off knob.

The valve body materials are anodized aluminum or stainless steel, with Viton® O-ring seals. Maximum temperature is 100°C, and maximum inlet pressure is 100 psig. The valve can be panel-mounted in an 11/16" or 3/4" hole, using hardware supplied, and all are supplied with Valco 1/16" ZDV fittings. Other configurations are available in OEM quantity upon request.

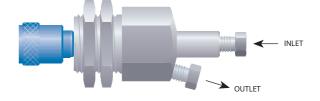
The standard knob is silver-colored and .62" long. Colored knobs for gas identification are available separately, in two lengths.

# **Combo valves**

Maximum flow @ 40 psi He or N <sub>2</sub>	Aluminum body Prod No	Stainless body Prod No
10 ml/min	CNV1A10S1	CNV1S10S1
50 ml/min	CNV1A50S1	CNV1S50S1
150 ml/min	CNV1A150S1	CNV1S150S1
250 ml/min 500 ml/min	CNV1A250S1 CNV1A500S1	CNV1S250S1 CNV1S500S1

# **SPECS** Inlet pressure: 100 psi Maximum temperature: 100°C

Optional colored knobs	Standard (.62") Prod No	Long (1.25") Prod No
Green	CNVEKG	CNVEKLG
Red	CNVEKR	CNVEKLR
Blue	CNVEKU	CNVEKLU
Silver	CNVEKS	CNVEKLS
Black	CNVEKB	CNVEKLB





Very similar in function to the more recent design on the opposite page, these are the original, hex-bodied combo valves made by the Condyne division of VICI Metronics for nearly 30 years. Condyne products have been transferred to the Valco Houston location, where a number of improvements have been made.

Standard construction features an anodized aluminum body with Viton® O-ring seals. Maximum inlet pressure is 100 psi, with a maximum temperature of 100°C. The valve can be panel mounted through an 11/16" or 3/4" diameter hole. Valco 1/16" fittings are standard, but 1/8" fittings are also available. Nuts and ferrules are included.

Typically, the knob color is used as an indicator of the rated flow, but the standard knob can be changed if desired. A longer version of the knob is also available, as is a nickel-plated all brass valve (in OEM quantities). Consult the factory regarding these options.

#### **Condyne combo valves**

SPECS Maximum inlet pressure: 100 psi	Maximu m fl @ 40psi He o	• • • •	1/16" Valco fittings Prod No	1/8" Valco fittings Prod No
Maximum tem-	10 ml/min	Green	CVA10GS1	CVA10GS2
perature:	50 ml/min	Red	CVA50RS1	CVA50RS2
100°C	150 ml/min	Blue	CVA150US1	CVA150US2
	500 ml/min	Black	CVA500BS1	CVA500BS2
	1 liter/min	Yellow	CVA1KYS1	CVA1KYS2



Flow controllers provide a stable flow rate under varying pressure. VICI flow controllers are precision machined from aluminum or stainless bar stock to eliminate the contamination often found in die cast parts. Positive flow

shut-off is provided by an integral Viton-sealed adjustment valve.

With all our flow controllers, the inlet pressure must exceed the outlet pressure by a minimum of 10 psi.

#### WHICH KIND OF CONTROLLER?

An **upstream-referenced** controller maintains the flow rate as long as the upstream (inlet) pressure is held constant.

A **downstream-referenced** controller maintains a constant flow under constant downstream (outlet) pressure.

Fixed span upstream-referenced flow controller

#### Model 100 gas flow controller

The Model 100 is available in a variety of preset maximum flow rates, from 150 mL/min to 10 liters/min ( $N_2$  at 40 psi). Any flow controller in this series can be ordered with a 10-turn Spectrol digital dial (3 or 4 digits), to permit a visual indication of the flow setting.

All flow rates listed below are based on N<sub>2</sub> at 40 psi inlet pressure. Maximum inlet pressure is 200 psi.



#### **SPECS**

#### Preset max flow rates:

150 mL/min to 10 liters/min (N<sub>2</sub> at 40 psi).

## Maximum inlet pressure:

200 psi

**Maximum temperature:** 100°C

#### Standard fittings:

■ 1/8" external tube fittings (EAOR22)

Other fittings are available. (See below.)
Contact the factory for further information.

		Aluminum body Viton diaphragm	Aluminum body SS diaphragm	SS body Viton diaphragm	SS body SS diaphragm
	Flow rate /min	Prod No	Prod No	Prod No	Prod No
			7700710	7700710	7704710
With st	andard conti				
	0 - 150 mL	FC10AV1K	FC10AS1K	FC10SV1K	FC10SS1K
	0 - 250 mL	FC10AV2K	FC10AS2K	FC10SV2K	FC10SS2K
	0 - 850 mL	FC10AV3K	FC10AS3K	FC10SV3K	FC10SS3K
	0 - 1.2 L	FC10AV4K	FC10AS4K	FC10SV4K	FC10SS4K
	0 - 4.5 L	FC10AV5K	FC10AS5K	FC10SV5K	FC10SS5K
	0 - 10.0 L	FC10AV6K	FC10AS6K	FC10SV6K	FC10SS6K
With S	pectrol 3-digi	it dial			
	0 - 150 mL	FC10AV1S3	FC10AS1S3	FC10SV1S3	FC10SS1S3
	0 - 250 mL	FC10AV2S3	FC10AS2S3	FC10SV2S3	FC10SS2S3
	0 - 850 mL	FC10AV3S3	FC10AS3S3	FC10SV3S3	FC10SS3S3
	0 - 1.2 L	FC10AV4S3	FC10AS4S3	FC10SV4S3	FC10SS4S3
	0 - 4.5 L	FC10AV5S3	FC10AS5S3	FC10SV5S3	FC10SS5S3
	0 - 10.0 L	FC10AV6S3	FC10AS6S3	FC10SV6S3	FC10SS6S3
With S	pectrol 4-digi	it dial			
	0 - 150 mL	FC10AV1S4	FC10AS1S4	FC10SV1S4	FC10SS1S4
	0 - 250 mL	FC10AV2S4	FC10AS2S4	FC10SV2S4	FC10SS2S4
	0 - 850 mL	FC10AV3S4	FC10AS3S4	FC10SV3S4	FC10SS3S4
	0 - 1.2 L	FC10AV4S4	FC10AS4S4	FC10SV4S4	FC10SS4S4
	0 - 4.5 L	FC10AV5S4	FC10AS5S4	FC10SV5S4	FC10SS5S4
	0 - 10.0 L	FC10AV6S4	FC10AS6S4	FC10SV6S4	FC10SS6S4

#### ADAPTERS USED FOR VALCO AND CONDYNE CONTROL DEVICES

Description			Prod No	Used for
Valco 1/16 internal to	10-32 O-ring seal		ZAOR11	Diaphragm valve On/off valves (optional)
	5/16-24 O-ring seal		ZAOR12	Model 100 controller (optional) Model 300 controller (optional)
Valco 1/8" internal to	5/16-24 O-ring seal		ZAOR22	Model 100 controller (optional) Model 300 controller (optional)
External 1/8" to	10-32 O-ring seal		EAOR21	Air actuated prime/purge and on/off valves
	5/16-24 O-ring seal		EAOR22	Model 100 controller (standard) Model 300 controller (standard)

#### ALTERNATE FITTING TYPES

#### Models 100 and 300

The standard is the EAOR22 1/8" external tube fitting. Alternative fitting types are ZAOR22 and ZAOR12, listed at left. Order separately.

#### Model 202

The standard 1/8" NPT female pipe thread with pipe adapters to 1/16" OD tubing included. To use 1/8" OD tubing, order PZA22 on page 35.

#### Model 202 gas flow controller

#### Adjustable span upstream-referenced flow controller

#### **SPECS**

#### Flow range:

infinitely adjustable Min: 5 mL/min Max: 1.6 L/min (N<sub>2</sub> at 40 psi)

#### Maximum inlet pressure:

200 psi

#### **Maximum temperature:** 100°C

#### **Standard fittings:**

- 1/8" NPT female pipe threads
- Pipe adapters to 1/16" OD tubing are included.

Other fittings are available. (See facing page.)

The Model 202 provides a user-variable span adjustment permitting it to be used for a variety of flow ranges. After the span is adjusted, the flow controller has a full 10 turns of resolution between the minimum and maximum flow rates. When equipped with a Spectrol digital dial, settings are reproducible to better than 1%.



	Aluminum body Viton diaphragm Prod No	Aluminum body SS diaphragm Prod No	SS body Viton diaphragm Prod No	SS body SS diaphragm Prod No
With standard con	<b>trol knob</b> FC22AV1K	FC22AS1K	FC22SV1K	FC22SS1K
With Spectrol 3-dig	git dial FC22AV1S3	FC22AS1S3	FC22SV1S3	FC22SS1S3
With Spectrol 4-dig	git dial FC22AV1S4	FC22AS1S4	FC22SV1S4	FC22SS1S4

#### Model 300 gas flow controller

#### Fixed span downstream-referenced flow controller

#### **SPECS**

#### **Maximum flow rate:**

1.6 L/min with ambient downstream pressure

#### Maximum inlet pressure:

200 psi

#### **Maximum temperature:** 100°C

Standard fittings:

■ 1/8" external tube fittings (EAOR22)

Other fittings are available. (See facing page.) Contact the factory for further information.

The Model 300 flow controller provides a stable flow rate when upstream pressure conditions vary, providing the downstream pressure remains constant.

All flow rates listed below are based on  $N_2$  at 40 psi inlet pressure. Maximum inlet pressure is 200 psi.

With screwdriver adjustable operator

FC31AV1

0 - 750 mL



	Flow rate	Aluminum body Viton diaphragm	Aluminum body SS diaphragm	SS body Viton diaphragm	SS body SS diaphragm
	/min	Prod No	Prod No	Prod No	Prod No
With sta	ndard contr	ol knob			
	0 - 200 mL	FC30AV1K	FC30AS1K	FC30SV1K	FC30SS1K
	0 - 300 mL	FC30AV2K	FC30AS2K	FC30SV2K	FC30SS2K
	0 - 800 mL	FC30AV3K	FC30AS3K	FC30SV3K	FC30SS3K
	0 - 1.6 L	FC30AV4K	FC30AS4K	FC30SV4K	FC30SS4K
With Sp	ectrol 3-digi	t dial			
	0 - 200 mL	FC30AV1S3	FC30AS1S3	FC30SV1S3	FC30SS1S3
	0 - 300 mL	FC30AV2S3	FC30AS2S3	FC30SV2S3	FC30SS2S3
	0 - 800 mL	FC30AV3S3	FC30AS3S3	FC30SV3S3	FC30SS3S3
	0 - 1.6 L	FC30AV4S3	FC30AS4S3	FC30SV4S3	FC30SS4S3
With Sp	ectrol 4-digi	t dial			
	0 - 200 mL	FC30AV1S4	FC30AS1S4	FC30SV1S4	FC30SS1S4
	0 - 300 mL	FC30AV2S4	FC30AS2S4	FC30SV2S4	FC30SS2S4
	0 - 800 mL	FC30AV3S4	FC30AS3S4	FC30SV3S4	FC30SS3S4
	0 - 1.6 L	FC30AV4S4	FC30AS4S4	FC30SV4S4	FC30SS4S4

#### **MORE INFORMATION**

Male pipe adapters
Internal..... page 35
External......36

Micrometering (needle) valves combine the ease of connection associated with Valco zero dead volume fittings with convenient bulkhead mounting. Very low internal volume and precision design make this valve ideal for use as a gas control valve in chromatographic systems.

The Viton® model is rated at 225°C, while a version with Kalrez™ seals is capable of continuous operation at 315°C. This allows a needle valve to be mounted directly within a heated oven, facilitating control of

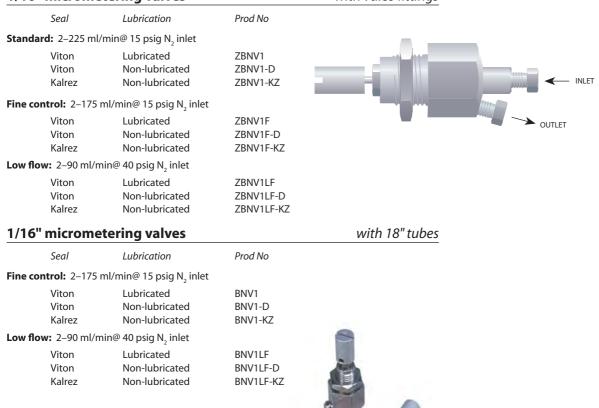
flow switching in multidimensional systems while keeping the gases at oven temperature.

Valves are rated for maximum of 1000 psi gas. They are individually tested on a mass spectrometer leak detector to a helium leak rate specification of  $< 1 \times 10^{-8}$  atm cc/sec.

An unlubricated version with a specially polished seat was designed to be used with our pulsed discharge detectors, and should be used upstream of any ultrapure gas system. There is also a 1/16" tube version.

#### 1/16" micrometering valves

#### with Valco fittings



VICI regulators are machined from aluminum bar stock and then hard-anodized to provide contamination-free service. They feature a stainless steel diaphragm and Viton\*-sealed stainless poppet. The compact size (1.125" diameter by 2" long for regulator, 3" long for combo version) saves panel space and permits installation anywhere that an 11/16" hole can be located. Mounting hardware is supplied.

While the outward appearance is unchanged, a recent redesign has enhanced thermal stability, linearity, and shock resistance.

The VICI combo regulator is a combination regulator and shut-off valve. The pressure is set using the screwdriver adjustment in the center

of the on/off knob. Turning the knob counterclockwise provides positive shutoff, while clockwise rotation restores gas pressure to within 0.05 psi of the setpoint.

Available with outlet pressure ranges of 0-15 psi, 0-30 psi, or 0-60 psi, VICI regulators can be ordered with 1/16" or 1/8" Valco internal fittings or 1/8" external fittings. Other configurations are available in OEM quantities.

Maximum operating temperature is 100°C, and maximum supply pressure is 250 psig. The influence of supply pressure on outlet pressure is less than 0.1 psi per 10 psi change in supply pressure.

#### **Pressure regulators**

#### NEW

#### No knob and shut-off feature



Pressure regulators		NEW	No knob and shut-off feature		
SPECS Maximum inlet pressure:		Valco internal fittings 1/16"	Valco internal fittings 1/8"	External fittings 1/8"	
250 psi Maximum	Pressure range:	Prod No	Prod No	Prod No	
temperature: 100°C  Wetted materials: Anodized aluminum Stainless steel Viton	0-15 psi 0-30 psi 0-60 psi	PR51A15Z1 PR51A30Z1 PR51A60Z1	PR51A15Z2 PR51A30Z2 PR51A60Z2	PR51A15E2 PR51A30E2 PR51A60E2	

#### Combo pressure regulators

aluminum
■ Stainless steel
■ Viton



ionibo pressure regulators					
SPECS Maximum inlet pressure: 250 psi	Pressure	Valco internal fittings 1/16" Prod No	Valco internal fittings 1/8" Prod No	External fittings 1/8" Prod No	
Maximum	range:				
temperature: 100°C	0-15 psi 0-30 psi	PR50A15Z1 PR50A30Z1	PR50A15Z2 PR50A30Z2	PR50A15E2 PR50A30E2	
Wetted materials: ■ Anodized	0-60 psi	PR50A60Z1	PR50A60Z2	PR50A60E2	

# Instrumentation

#### **DETECTORS, ANALYZERS, AND PURIFIERS**

Most of the components we supply to the instrumentation industry are from our valve and fitting lines. The rest, from our R&D 100 Award-winning pulsed discharge detectors to our application-dedicated trace gas analyzers, are primarily for gas detection and purification.

#### Pulsed discharge detectors

## Non-radioactive, multiple mode electron capture / helium photoionization

VICI PDDs (pulsed discharge detectors) utilize a stable, low powered, pulsed DC discharge in helium as an ionization source. Eluants from the column, flowing counter to the flow of helium from the discharge zone, are ionized by photons from the helium discharge. The bias electrode(s) focus the resulting electrons toward the collector electrode, where they cause changes in the standing current which are quantified as the detector output. Performance is equal to or better than detectors with conventional radioactive sources.

In the electron capture mode, the PDD is a selective detector for monitoring high electron affinity compounds such as freons, chlorinated pesticides, and other halogen compounds. For this type of compound, the minimum detectable quantity (MDQ) is at the femtogram (10<sup>-15</sup>) or picogram (10<sup>-12</sup>) level.

In the helium photoionization mode, the PDD is a universal, non-destructive, high sensitivity detector. The response to both inorganic and organic compounds is linear over a wide range. Response to fixed gases is positive (increase in standing current), with an MDQ in the low ppb range.

The PDD in helium photoionization mode is an ideal replacement for FIDs in petrochemical or refinery environments, where the hydrogen and flame can be problematic. In addition, when the discharge gas is doped with argon, krypton, or xenon (depending on the desired cutoff point), the PDD functions as a specific photoionization detector for selective determination of aliphatics, aromatics, amines, and other species.



R&D 100 AWARD WINNER

#### TRACE GAS ANALYZERS AT VICI.COM

For more information about trace gas analyers, go to:

www.vici.com/ instr/itga.php



#### MORE INFORMATION

Pulsed discharge detectors

detectors

Model D-2.... page 221

Model D2-IM ..... 222

Model D-3 ..... 223

Model D-4 ..... 223

Plug-and-play detectors

for Agilent 6890 ... 223

for Agilent 7890 ... 223

for other GCs .... 223



#### Model D-2

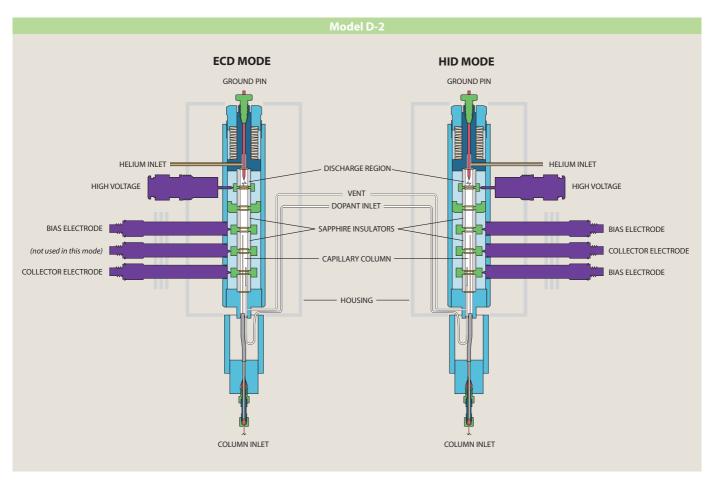
The D-2 is a dual mode, universal detector system which can be retro-fitted to your older GC. The D-2-I is optimized for trace level work in the helium photoionization mode. The stand-alone systems include detector, controller, electrometer, HP2 helium purifier (see page 226), and power supply.



#### 

Detector system includes detector cell, pulser, controller, electrometer, and helium purifier.

Description	110 VAC Prod No	<b>230 VAC</b> Prod No
Mode-selectable universal electron capture / photoionization detector system	D-2	D-2-220
Detectors optimized for trace level work in helium photoionization mode Optimized for packed column use	D-2-I	D-2-I-220



#### miniPDD helium ionization detectors

The newest member of the PDD family is also the smallest and thriftiest. The miniPDD uses about one fifth (20%) the amount of helium as the D-3 and D-4 versions, giving up only a bit of sensitivity and dynamic range in return. It is approximately one half the size of the D-4, but has nearly the same sensitivity – about 100 ppb for fixed gases. With its reduced size, weight, and helium consumption, it is particularly well suited to portable applications, or to any situation in which the high cost of helium becomes a consideration.

It can be paired with other Valco components (controller, pulse module, helium purifiers, etc.) or can be purchased alone for use with existing components. Call today to discuss the endless possibilities.



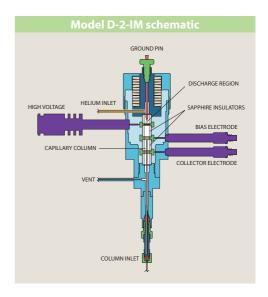
Detector cell only optimized for helium photoionization mode

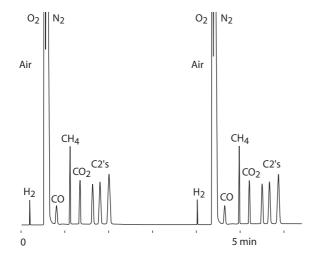
Prod No Description miniPDD cell only PD-D2-IM

miniPDD system

Includes controller and purifier D-2-IM







#### TWO CONSECUTIVE RUNS OF LIGHT HYDROCARBONS IN AIR

Detector: miniPDD Model PD-2-IM

Detector temp: 150°C

100/120 ShinCarbon Column:

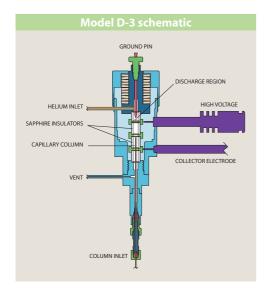
1.4 m x 0.53 mm Silcosteel Resistive heat: 30°C (0.9 min) to 230°C

at 100°C/min (hold 1 min)

Sample: 2000 ppm in air,  $2 \mu L$  size

Helium Carrier:

Discharge gas: Helium



#### Plug-and-play detectors for Agilent 7890 and 6890

Model D-3 is designed for plugand-play installation on the popular Agilent 6890 and 7890, and is optimized for trace level work in the helium photoionization mode.

Both versions utilize the electonics and power supply of the host GC.

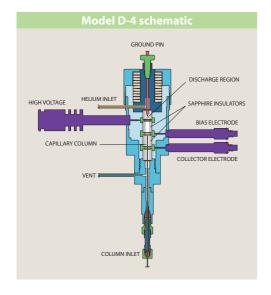
#### PDD Model D-3

Helium photoionization

Detector optimized for trace level work in helium photoionization mode

	110 VAC	230 VAC
Description	Prod No	Prod No
Plug-in system for Agilent 7890	D-3-I-7890	D-3-I-7890-220
Plug-in system for Agilent 6890	D-3-I-HP	D-3-I-HP-220





#### Plug-and-play detectors for other GCs

Pulsed Discharge Detector Model D-4 is available in versions for easy installation on most of the GCs in current use, including the Varian 3800; Shimadzu 14, 17, 2010, and 2014; ThermoFinnigan Trace, Mega, and Top; and Hewlett Packard 5890. The D-4 is single mode, optimized for trace level work in the helium photoionization mode.

#### PDD Model D-4

Helium photoionization

Detectors optimized for trace level work in helium photoionization mode

Description	110 VAC Prod No	230 VAC Prod No
Specialized detector for		
HP 5890 Shimadzu GC 14 *	D-4-I-HP58 D-4-I-SH14-R	D-4-I-HP58-220 D-4-I-SH14-R-220
Shimadzu GC 17, 2010, 2014 *  Thermo Trace GC *	D-4-I-SH17-R D-4-I-TO-R	D-4-I-SH17-R-220 D-4-I-TO-R-220
Varian 3800 *  * Uses existing GC FID electrometer.	D-4-I-VA38-R	D-4-I-VA38-R-220
For all other GCs	D-4-I	D-4-I-220 <b>( €</b>

#### NOTE

PDD Model D-4-I-220 has been designed to meet  $C \in \mathbb{C}$  regulations.



Mode: Electron capture Sample: Environmental soil (1 g)

Detector temp: 320°C

Column: ValcoBond VB-5

 $30 \text{ m} \times 0.25 \text{ mm} \times 0.25 \text{ } \mu\text{m}$ 

Column temp: 60°C (2 min),

20°C/min to 180°C, 4°C/min to 220°C,

40°C/min to 300°C (5 min)

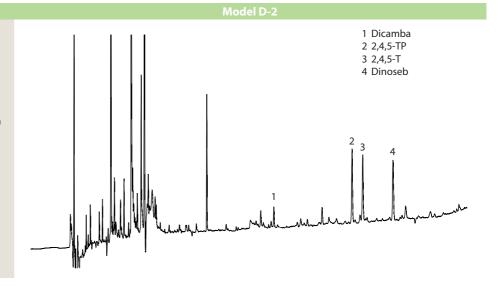
200°C Injector temp:

Sample volume: 2 μL (solvent microextrac-

> tion), 1:15 split Helium

Discharge gas: Dopant gas: Helium/argon

Attenuation:



#### **PAH RESIDUES IN AN ENVIRONMENTAL SOIL SAMPLE SPIKE**

Detector: PDD Model D-2 Mode: Helium photoionization Sample: Environmental soil (1 g)

300°C Detector temp:

Column: ValcoBond VB-35

 $30 \text{ m} \times 0.25 \text{ mm} \times 0.25 \text{ } \mu\text{m}$ 

Column temp: 120°C for 3 min, 15°C/min

to 310°C for 15 min

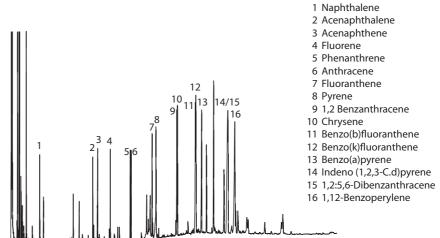
275°C Injector temp:

Sample volume: 2 µL (solvent microextrac-

tion), 1:15 split

Helium Discharge gas: Dopant gas: none Attenuation:

## PDD Model D-2



#### SIMULATED DISTILLATION **IN TWO MINUTES**

miniPDD Detector: Detector temp: 320°C

ValcoBond® VB-1 Column:  $5 \text{ m} \times 0.25 \text{ mm} \times 0.20 \text{ } \mu\text{m}$ 

40°C initial for 0.1 min Column temp:

to 320°C at 150°C/min Cold on-column injection

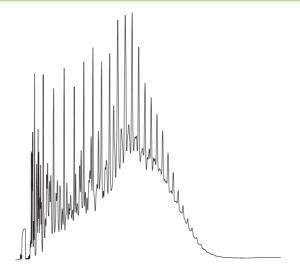
Carrier gas: Helium Helium Reference gas:

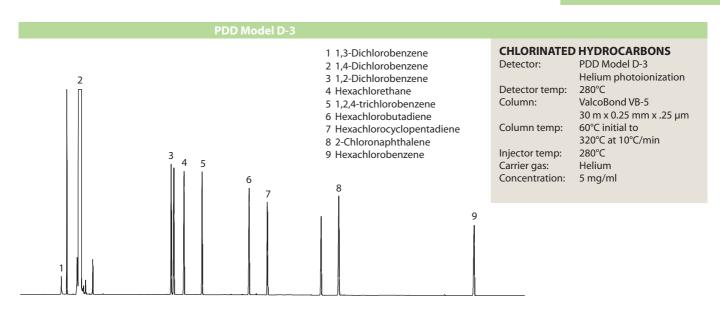
Injector temp:

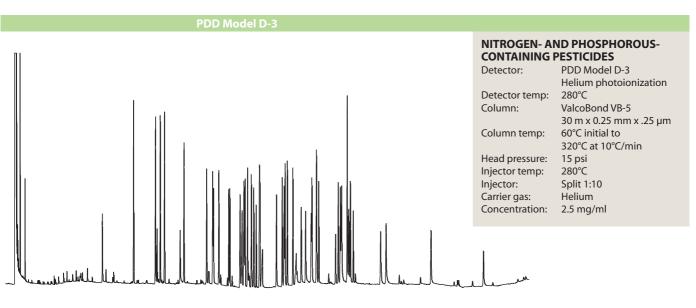
Sample: Reference Gas Oil (RGO)

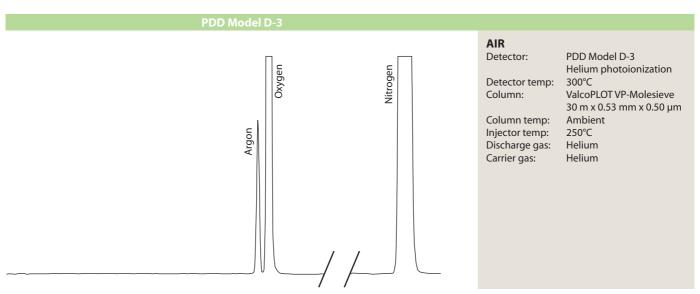
provided by

Separation Systems, Inc.









#### Helium and nitrogen purifiers

Carrier gas purity is essential in any application requiring extreme sensitivity. Impurities limit detector sensitivity and can even destroy capillary columns. The Valco HP2 provides "point-of-use" purification of helium or other noble gases, such as Ar, Ne, Kr, and Xe, to sub-ppm levels of reactive gaseous impurities. The NP2 is similar, purifying nitrogen to subppm levels of gaseous impurities.

The purification substrate in Valco gas purifiers is a non-evaporable gettering alloy. This stable alloy is contained in a welded assembly, so the purifiers can be used safely in industrial applications with minimal precautions. The getter is activated by heating, which eliminates the oxide film on the particle surface and allows helium to diffuse into the bulk of the getter particles. The HP2 and NP2 feature a self-regulating design which eliminates the possibility of thermal runaway and maintains the getter material at the optimum temperature.



#### Standard helium and nitrogen purifiers

 $\epsilon$ 

Includes universal power supply.

Helium	Nitrogen
purifier	purifier
Prod No	Prod No
HP2-110	NP2-110
HP2-220	NP2-220
	<b>purifier</b> <i>Prod No</i> HP2-110

#### Replacement getter assembly

I-23572HP2 Helium I-23572NP2 Nitrogen

#### **HELIUM PURIFIER**

■ CE certified

 Gases purified He, Ne, Ar, Kr, Xe, Rn

■ Maximum operating pressure 1000 psig

Outlet impurities less than 10ppb  $H_2O, H_2, O_2, N_2, NO, NH_3, CO, CO_2, and CH_4,$ based on 10ppm total inlet impurities. Other impurities removed include CF<sub>4</sub>, CCl<sub>4</sub>, SiH<sub>4</sub> and light hydrocarbons.

■ Impurities *not* removed He, Ne, Ar, Kr, Xe, Rn

#### **NITROGEN PURIFIER**

Impurities removed

■ CE certified

 Gases purified N<sub>2</sub> only

Impurities removed Outlet impurities less than 10ppb H<sub>2</sub>O, H<sub>2</sub>, O<sub>2</sub>, NO, NH<sub>3</sub>, CO, CO<sub>2</sub>, and CH<sub>4</sub>,

based on 10ppm total inlet impurities. Other impurities removed include CF<sub>4</sub>, CCl<sub>4</sub>, SiH<sub>4</sub> and light hydrocarbons.

He, Ne, Ar, Kr, Xe, Rn, N ■ Impurities *not* removed



#### Miniature gas purifiers

The Valco Miniature Helium Purifier (HPM) and Miniature Nitrogen Purifier (NPM) are designed to be installed in a gas chromatograph's flow path immediately upstream of the injector. The HPM/NPM will

remove any contaminants introduced by flow controllers, elastomeric tube seals, pressure regulators, crude traps, or other system components that are not completely clean and leak-tight.

#### Mini helium and nitrogen purifiers

 $\epsilon$ 

Includes universal pe	ower supply.	
	Helium	Nitrogen
	purifier	purifier
Description	Prod No	Prod No
110 VAC	HPM-110	NPM-110
230 VAC	HPM-220	NPM-220



#### Microvolume thermal conductivity detector

Our dual filament TCD is a stand-alone unit consisting of the detector housing and a controller with electrometer and temperature controls. The detector cell includes two separate nickel/iron filaments, capable of independent or referenced (differential) operation. Cell volume and geometry are optimized for capillary chromatography and

enhanced sensitivity at low flow rates. (Recommended total flow rate: 2-10 mL/min.) Thermal stability is maintained to ±0.02°C, resulting in a stable, noise-free signal. A single 0-1 millivolt attenuated output for a strip chart recorder is provided through the signal cable at the rear of the controller, with 0-1 volt and 0-10 volt unattenuated signals available through the remote signal cable.

#### **TCD** Thermal conductivity detectors

 $\epsilon$ 

	110 VAC	230 VAC
Description	Prod No	Prod No
Entire unit (cell and electronics)	TCD2-NIFE-110	TCD2-NIFE-220
Cell/oven assembly only, dual filament	TCD2-NIFED-110	TCD2-NIFED-220
TCD controller only	TCD2-C-110	TCD2-C-220

# Calibration gas standards

#### PERMEATION DEVICES AND CALIBRATION GAS GENERATORS

from VICI Metronics

VICI Metronics, Inc. in Poulsbo, Washington is the leading manufacturer of devices and instruments that are used in the generation of calibration gas standards, including Dynacal® and G-Cal permeation tubes and Dynacalibrator® and G-Cal calibration gas generators. In addition, Metronics is the leading provider of explosives, narcotics, and chemical warfare dopants for TSA airport security (ammonia, DCM, and BHT), law enforcement, border patrol, military, and other trace detection industry professionals. The product line also includes gas purifiers, contaminant traps, and GC Industries oxygen and toxic gas monitors.

#### Calibration gas standards

The purpose of a calibration gas standard is to establish a reference point for the verification of an analysis. Permeation tube rates can be certified using standards traceable to NIST by the most basic and accurate laboratory procedure – measuring the gravimetric weight loss over a known period of time at a known temperature. Permeation rate data is already established for hundreds of different compounds, and rates for new compounds can be easily certified using NIST-traceable standards.

#### **Advantages**

Calibration devices from VICI Metronics offer several advantages over cylinder-supplied gas calibration standards. Multi-component gas mixtures can be easily generated with NIST traceability employing established EPA and ASTM protocols by using the appropriate combination of permeation devices. This technique also allows the removal of a single component from a gas mixture by simply removing the appropriate permeation device. A wide range of concentrations can easily be generated by simply varying the dilution flow rate.

By contrast, bottled trace level (ppb and ppm) standards can be very expensive, and calibrations requiring multiple components over a wide range of concentrations require a large number of gas cylinders, consuming valuable lab space. Problems can also arise from degradation of the standard within the cylinder, from changes in cylinder pressure, and from interaction of calibration components and surfaces.

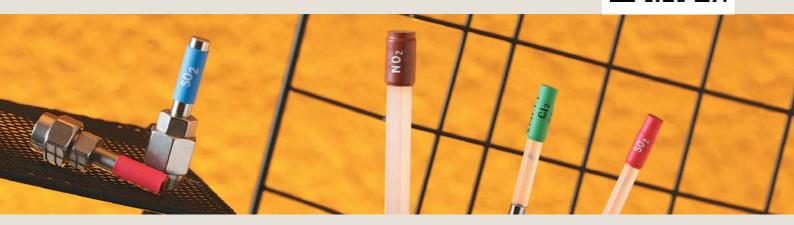
#### **TO ORDER**

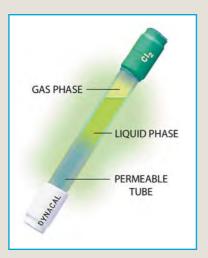
For prices or more information about specific compounds available in permeation devices, contact VICI Metronics:

Toll-free 877–737–1887 Tel .....360–697–9199 Fax.....360–697–6682

#### vicimetronics.com







- Ideal for lab environments
- Smaller than G-Cal devices
- More accurate than G-Cal devices
- Require a temperature-controlled environment
- Inexpensive calibration solution

Dynacal permeation devices are small, inert capsules containing a pure chemical compound in a two phase equilibrium between its gas phase and its liquid or solid phase. At a constant temperature, the device emits the compound through its permeable portion at a constant rate. Devices are typically inserted

into a carrier flow to generate test atmospheres for calibrating gas analyzer systems, testing hazardous gas alarms, or conducting long-term studies of effects on materials or biological systems – in short, any situation requiring a stable concentration of a specific trace chemical.

#### COMPOUNDS AVAILABLE IN DYNACAL PERM DEVICES

Literally hundreds of compounds are available in our permeation devices. This list is merely representative of the range we offer. Contact us if you don't see what you're looking for.

Ammonia Benzene Carbon disulfides Carbon tetrachloride Dichloromethane Dimethyl sulfide Ethanol Ethylene oxide Freon Formaldehyde Hydrogen cyanide Hydrogen fluoride Hydrogen sulfide lodine Isopropyl alcohol Mercury Methanol Methyl bromide **MTBE** Nitrogen dioxide Octane Sulfur dioxide Sulfur hexafluoride Thiophene Toluene Vinyl acetate Water **Xylenes** 

#### MORE INFORMATION

G-Cal perm tubes...p. 232

#### **Tubular device**

The tubular device, or "perm tube", is a sealed permeable cylinder containing the desired permeant reference material.



Release of the chemical occurs by permeation through the walls of the PTFE tube for the entire length between the impermeable plugs. A wide range of rates – typically from 5 ng/min to 50,000 ng/min – can be achieved by varying the length and thickness of the tube. These are the most widely used of the various permeation devices.

#### **Extended life tubular device**

Our unique extended life tubular (XLT) device is essentially a standard perm tube coupled to an impermeable



stainless steel reservoir. This design offers a range of permeation rates corresponding to a tubular device, but has a significantly enhanced lifetime – by a factor of 3 for a 5 cm (active length) device or a factor of 12 for a 1 cm device.

#### **Wafer device**

Wafer devices have only a small permeable window, or wafer, so permeation rates are typically lower than



rates for tubular devices. Since permeation occurs only through the polymeric wafer, the permeation rate is controlled by varying the wafer material, the thickness of the wafer, and the diameter of the permeation opening. Gases whose high vapor pressure at normal permeation temperatures prevent their containment in a tubular device can be contained in a wafer device. Wafer devices are available in different styles to allow use in calibrators made by various manufacturers.

- Deliver precise concentrations from ppb to high ppm
- Use Dynacal® permeation devices as the trace gas source, with front panel access to the permeation chamber
- Proprietary constant temperature system controls chamber temperature at a set point with ±0.01°C accuracy
- Choice of plumbing and flow configurations

VICI Metronics Dynacalibrators allow you to verify the accuracy of analytical data from air pollution monitoring, industrial hygiene surveys, odor surveys, and other instruments measuring gas concentration. All models enable calibrations traceable to NIST standards for almost any gas analyzer, in the lab or in the field.

The design takes full advantage of all the conveniences inherent in our Dynacal® permeation devices to generate and deliver precise concentrations ranging from ppb to high ppm for hundreds of different compounds. Standard features on all our models, from the most basic Model 150 to the most fully-equipped Model 500, facilitate accurate, reproducible, trouble-free calibrations time after time.

#### Model 120 (Non-CE) **Portable Dynacalibrators®**

- Completely portable
- Pump powered by rechargeable battery or a 12 VDC source (inverter with cigarette lighter plug provided)
- Available temperature control from 5°C above ambient to 100°C
- Utilizes permeation devices no bulky cylinders

Standard features on Model 120 include a glass or PTFE permeation chamber with screw cap access, solid state proportional temperature controller with digital readout of set point and chamber temperature, heater switch with LED indicator, flowmeter and flow control valve, span and overflow outlets, 12 VDC internal pump, activated charcoal scrubber, and molded fiberglass case.

Non-CE, use restricted within the EU.



#### Model 150 **Dynacalibrators®**

- Temperature control with an accuracy of ±0.01°C from 5°C above ambient to 110°C
- Ultra compact
- PPB to high PPM range

At only 6" wide x 15" deep x 7" high and 10.5 pounds, the Dynacalibrator Model 150 is a compact calibrator capable of delivering the precise concentrations you require. A passivated glass-coated stainless steel permeation chamber houses the permeation device(s). (Carrier and dilution flow rates must be supplied and measured externally.) The digital temperature controller maintains the chamber temperature at a set point with an accuracy of ±0.01°C, traceable to NIST standards. The wide range of temperature



settings (5°C above ambient to 110°C) means the end user can generate a wide range of volumetric concentrations for both low and high vapor pressure chemical compounds, establishing or changing the desired volumetric concentration by simply varying the carrier flow.

## Model 230 Dynacalibrators®

With a flexible flow metering system to maintain a constant carrier flow through the permeation chamber, the Model 230 allows the dilution flow to be varied over a wide range, generating the spectrum of concentrations required for checking analyzer linearity. Like all Dynacalibrators, its permeation chamber is big enough to accomodate several permeation devices for higher output concentrations or multi-component mixtures.



## Model 340 Dynacalibrators®

The Model 340 adds a front panel mode control switch to select between zero or span calibration modes. In the zero mode, scrubbed air is delivered to the span outlet, allowing the end user to establish zero before sampling.



#### Model 450 Dynacalibrators®

Ordinarily, the plumbing connections between the sample manifold, analyzer, and calibrator must be changed for each calibration. The Model 450's unique "through-port" feature eliminates this chore. The mode control switch selects among standby, zero, span 1 (low concentration), and span 2 (high concentration) modes.



#### Model 500 Dynacalibrators®

This innovative design features two separate permeation chambers with independent temperature control systems. The chambers can be used independently, or together to combine concentrations of trace components. Separate solenoid valves allow the carrier flows to be switched from the dilution stream to a vent port.



#### **TO ORDER**

For prices or more information about specific compounds available in permeation devices, contact VICI Metronics:

Toll-free 877–737–1887 Tel .....360–697–9199 Fax.....360–697–6682

#### vicimetronics.com

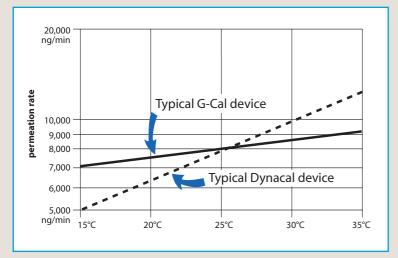
- Excellent for use in the field
- Can be operated at room temperature
- Can handle Arsine and Phosphine
- Longer lifetime than Dynacal® devices

G-Cal permeation tubes offer a proven and repeatable means of generating desired gas or vapor concentrations. The permeant gas escapes through the proprietary membrane system and mixes with a carrier gas (nitrogen is the most common) at a controlled flow rate to obtain a known mixture in ppm or ppb. Applications include calibration of gas monitoring systems and chromatographs, accuracy check of gas detectors, and generation of known test atmospheres for a specific application.

G-Cal devices exhibit the lowest temperature sensitivity among available similar products. The permeation rate through the polymeric membrane used in G-Cal devices changes only 1-3% per degree C, eliminating the need for a temperature-controlled chamber. Most G-Cal devices are guaranteed for 12 months operating life.



Over 100 different substances are available, including Arsine, Phosphine, and gas phase devices such as CO, NO, and Methane. Available permeation rates range from less than 100 ng/min to 50,000 ng/min. Each G-Cal device is individually calibrated and verified to generate a given mass output per unit time (ng/min) at a set point temperature. A graph which shows an estimated permeation rate vs. temperature from 0 to 50°C is included with each device.



Comparison of G-Cal permeation devices and Dynacal PTFE permeation devices

#### COMPOUNDS AVAILABLE IN G-CAL PERM TUBES

Literally hundreds of compounds are available in our permeation devices. This list is merely representative of the range we offer. Contact us if you don't see what you're looking for.

Ammonia Arsine \* Benzene Carbon Dioxide \* Carbon Monoxide \* Carbonyl Sulfide Chloroform **DMMP** Dichloromethane Dimethyl Sulfide Dimethyl Formamide Ethyl Chloride Ethyl Mercaptan Ethylene Oxide Freons Hydrogen Fluoride Hydrogen Sulfide Methane \* Methanol Methyl Mercaptan Nitric Oxide \* Nitrogen Dioxide Nitrous Oxide 3 Phosphine \* Propylene Oxide Sulfur Dioxide Sulfur Hexafluoride Thiophene Toluene Vinyl Chloride Water **Xvlenes** 

\* Available only in G-Cal permeation devices.

#### MORE INFORMATION

Dynacal perm tubes . . . . . p. 229



- Portable and rugged ideal for field use
- Ambient temperature from 15°C to 45°C
- Built-in pump
- Carrier gas flow rates from 100-1000 or 200-4000 cc/min
- Models with oven for constant temperature control at cold field sites

G-Calibrators are rugged portable units specifically designed to be used with our patented Series 23 G-Cal permeation devices to generate known concentrations (ppb to ppm) of various gases and liquid vapors. This combination offers the easiest method of calibrating toxic gas detection equipment, gas analyzers, and chromatographs commonly used in chemical, petrochemical, paper, power, and related industries.

Due to its unique permeation technology, the permeation rate of a G-Cal device remains fairly stable when exposed to changing temperatures. For most applications, this feature eliminates the need for the temperature-controlled oven.

Models with an oven have a single fixed temperature point (35° - 50°C). Models powered by a 12 VDC NiCad rechargeable battery also include a 110 VAC external charger. All G-Calibrators have stainless steel fittings and FEP tubing throughout.

#### **G-Calibrators**

Non CE. Use restricted in EU

Non-CE, use restricted within the EU.

Flow range	Oven	Battery	Prod No.
100-1000 cc/min	no	1.5 VDC	2301
	no	12 VDC NiCad	2310-10
	yes	12 VDC NiCad	2330-10
200-4000 cc/min	no	12 VDC NiCad	2310-20
	yes	12 VDC NiCad	2330-20

#### **TO ORDER**

For prices or more information about specific compounds available in permeation devices, contact VICI Metronics:

Toll-free 877–737–1887 Tel .....360–697–9199 Fax.....360–697–6682

vicimetronics.com

# GC capillary columns

from VICI Metronics

ValcoBond® and ValcoPLOT® capillary columns meet the highest quality standards for resolution, retention characteristics, inertness, bleed, and reproducibility.

# ValcoBond® capillary columns

- Individually tested
- High temperature range
- Competitive pricing

We use proprietary liquid phase processing to produce low bleed characteristics while maintaining retention characteristics identical to the phases you are used to.

# ValcoPLOT® capillary columns

- Widest polarity range
- Faster than micropacked
- Water tolerant

Reduce run time by replacing your packed columns with ValcoPLOT HayeSep capillary PLOT columns, with phases available only from VICI. Our proprietary phase processing produces the first capillary PLOT columns with characteristics identical to HayeSep packed columns.

#### **VALCOBOND PHASES**

**VALCOPLOT PHASES** 

pages 236-238

VB-FLUORO Bonded fluorosilicone phase
 VB-1 100% dimethylpolysiloxane
 VB-5 (5%-Phenyl)-methylpolysiloxane
 VB-35 (35%-Phenyl)-methylpolysiloxane
 VB-50/608 (50%-Phenyl)-methylpolysiloxane

VB-624 (6% Cyanopropyl-phenyl)-methylpolysiloxaneVB-1701 (14% Cyanopropyl-phenyl)-methylpolysiloxane

VB-Wax Polyethylene glycol (PEG)



#### pages 240-244

ValcoPLOT Molesieve 5Å ValcoPLOT A High purityDivinylbenzene/ethyleneglycoldimethacrylate

ValcoPLOT Metal Molesieve 5Å ValcoPLOT B Divinylbenzene/polyethyleneimine ValcoPLOT Alumina KCI ValcoPLOT C Divinylbenzene/acrylonitrile

ValcoPLOT Alumina Na<sub>2</sub>So<sub>4</sub> ValcoPLOT D High purity Divinylbenzene

**ValcoPLOT N** Divinylbenzene/ethyleneglycoldimethacrylate

ValcoPLOT P Divinylbenzene/styrene

ValcoPLOT Q Divinylbenzene

ValcoPLOT R Divinylbenzene/N-vinyl-2-pyrollidinone

ValcoPLOT S Divinylbenzene/4-vinyl-pyridine

#### PRODUCTS FOR GC

Other useful products for gas chromatography include:

1/32" ultra low mass external unions... p 19 FS adapter ferrules.16-17

Detectors 221-223,227 Injection

valves ......104-113

ream

selectors.....124-135 Gas purifiers.....246-247

Inlet discs

(injector nuts for HP 6890 and 5890 . . 18 Reduced breakdown

injection port liners.....245

#### TO ORDER

For prices or more information about your specific application, contact VICI Metronics:

Toll-free 877–737–1887 Tel ......360–697–9199 Fax.....360–697–6682

#### columns@vici.com





#### PRIMARY APPLICATIONS

Aldehydes CFCs Explosives Ketones PAHs Silanes Unsaturated compounds

#### **VB-Fluoro Capillary Columns**

- 100% bonded Fluorosilicone
- High thermal stability
- Unique selectivity

VB-Fluoro capillary columns feature unique selectivity created by high fluorine affinity to analyte lone pair electrons. This is coupled with thermal stability similar to low polarity phases such VB-1 and VB-5.

Low bleed characteristics make VB-Fluoro columns well suited for MS and ECD applications, and the high thermal stability allows their use as a complementary column for most high temperature applications which commonly utilize low polarity stationary phases.

Primary applications include ketones, aldehydes, explosives, PAHs, silanes, CFCs, and unsaturated compounds.

VB-Fluoro columns are a good replacement for Rtx-200, DB-200, DB-210, and VF-200 columns.

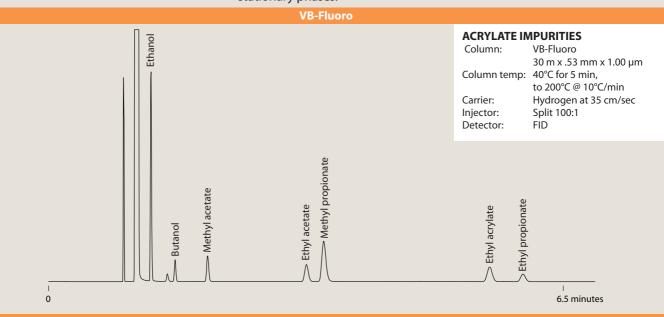
#### **VB-Fluoro**

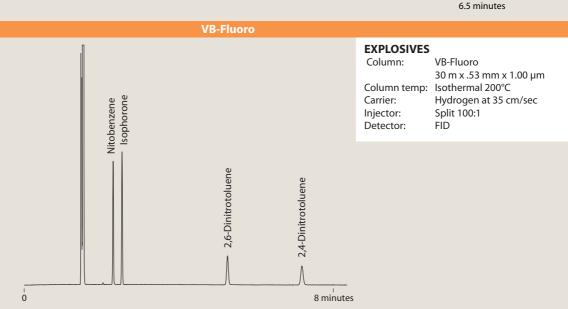
 0.25 mm ID
 df
 Prod No

 30 meters
 0.25
 CFS-N03025-025

 0.53 mm ID

 30 meters
 1.00
 CFS-N03053-100





#### VB-1

#### 100% dimethylpolysiloxane

REPLACES
DB-1, DB-1ms, HP-1,
HP-1MS, Ultra-1,
Rtx-1, Rtx-1MS,
SPB-1, MDN-1, BP-1,
CP-Sil 5 CB, GB-1,
007-1, OV-1, SE-30,
AT-1 and ZB-1

0.10 mm ID	df	Prod No	0.32 mm ID, c	ont'd	Prod No
10 meters	0.10	CFS-A01010-010B	15 meters	2.00	CFS-A01532-200B
10 meters	0.20	CFS-A01010-020B	15 meters	3.00	CFS-A01532-300B
10 meters	0.40	CFS-A01010-040B	15 meters	4.00	CFS-A01532-400B
20 meters	0.10	CFS-A02010-010B	15 meters	5.00	CFS-A01532-500B
20 meters	0.20	CFS-A02010-020B	30 meters	0.10	CFS-A03032-010B
20 meters	0.40	CFS-A02010-04 0B	30 meters	0.25	CFS-A03032-025B
0.18 mm ID	df	Prod No	30 meters	0.32	CFS-A03032-032B
10 meters	0.10	CFS-A01018-010B	30 meters	0.50	CFS-A03032-050B
10 meters	0.18	CFS-A01018-018B	30 meters	1.00	CFS-A03032-100B
10 meters	0.40	CFS-A01018-040B	30 meters	2.00	CFS-A03032-200B
			30 meters	3.00	CFS-A03032-300B
30 meters	0.10	CFS-A03018-010B	30 meters	4.00	CFS-A03032-400B
30 meters	0.18	CFS-A03018-018B	30 meters	5.00	CFS-A03032-500B
30 meters	0.40	CFS-A03018-040B	60 meters	0.10	CFS-A06032-010B
30 meters	1.00	CFS-A03018-100B	60 meters	0.25	CFS-A06032-025B
40 meters	0.18	CFS-A04018-018B	60 meters	0.32	CFS-A06032-032B
40 meters	0.40	CFS-A04018-040B	60 meters	0.50	CFS-A06032-050B
0.25 mm ID	df	Prod No	60 meters	1.00	CFS-A06032-100B
15 meters	0.10	CFS-A01525-010B	60 meters	2.00	CFS-A06032-200B
15 meters	0.25	CFS-A01525-025B	60 meters	3.00	CFS-A06032-300B
15 meters	0.50	CFS-A01525-050B	60 meters	4.00	CFS-A06032-400B
15 meters	1.00	CFS-A01525-100B	60 meters	5.00	CFS-A06032-500B
15 meters	1.50	CFS-A01525-150B	0.53 mm ID	df	Prod No
30 meters	0.10	CFS-A03025-010B	15 meters	0.15	CFS-A01553-015B
30 meters	0.25	CFS-A03025-025B	15 meters	0.50	CFS-A01553-050B
30 meters	0.50	CFS-A03025-050B	15 meters	1.00	CFS-A01553-100B
30 meters	1.00	CFS-A03025-100B	15 meters	1.50	CFS-A01553-150B
30 meters	1.50	CFS-A03025-150B	15 meters	3.00	CFS-A01553-300B
60 meters	0.10	CFS-A06025-010B	15 meters	5.00	CFS-A01553-500B
60 meters	0.25	CFS-A06025-025B	30 meters	0.15	CFS-A03053-015B
60 meters	0.50	CFS-A06025-050B	30 meters	0.50	CFS-A03053-050B
60 meters	1.00	CFS-A06025-100B	30 meters	1.00	CFS-A03053-100B
60 meters	1.50	CFS-A06025-150B	30 meters	1.50	CFS-A03053-150B
0.32 mm ID	df	Prod No	30 meters	3.00	CFS-A03053-300B
15 meters	0.10	CFS-A01532-010B	30 meters	5.00	CFS-A03053-500B
15 meters	0.25	CFS-A01532-025B	60 meters	1.00	CFS-A06053-100B
15 meters	0.32	CFS-A01532-032B	60 meters	1.50	CFS-A06053-150B
15 meters	0.50	CFS-A01532-050B	60 meters	3.00	CFS-A06053-300B
15 meters	1.00	CFS-A01532-100B	60 meters	5.00	CFS-A06053-500B

#### PRIMARY APPLICATIONS

Amines Flavors Fragrances Hydrocarbons Pesticides PCBs Phenols Sulfur compounds EPA Methods 504,551,1618 NIOSH Methods 1300-1301, 1400-1403, 1450,1501,2005

#### **VB-35**

#### (35%Phenyl)-methylpolysiloxane

REPLACES
DB-35, AT-35,
MDN-35, DB-35ms,
Rtx-35, BP-35,
HP-35, Rtx-35MS,
007-11, HP-35MS,
Sup-Herb, ZB-35

0.25 mm ID	df	Prod No
15 meters	0.25	CFS-C01525-025B
15 meters	0.50	CFS-C01525-050B
30 meters	0.25	CFS-C03025-025B
30 meters	0.50	CFS-C03025-050B
60 meters	0.25	CFS-C06025-025B
60 meters	0.50	CFS-C06025-050B
0.32 mm ID	df	Prod No
15 meters	0.25	CFS-C01532-025B
15 meters	0.50	CFS-C01532-050B
30 meters	0.25	CFS-C03032-025B
30 meters	0.50	CFS-C03032-050B

0.32 mm ID, cont'd		Prod No
60 meters	0.25	CFS-C06032-025B
60 meters	0.50	CFS-C06032-050B
0.53 mm ID	df	Prod No
15 meters	0.50	CFS-C01553-050B
15 meters	1.00	CFS-C01553-100B
30 meters	0.50	CFS-C03053-050B
30 meters	1.00	CFS-C03053-100B
60 meters	0.50	CFS-C06053-050B
60 meters	1.00	CFS-C06053-100B

## PRIMARY APPLICATIONS

Drugs
Pesticides
Herbicides
PAHs
Pharmaceuticals
PCBs
EPA Method 8081A
(organochlorine
pesticides)

#### **TO ORDER**

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#### VB-5

#### (5% Phenyl)-methylpolysiloxane

<b>APPLICATIONS</b>
Drugs
Herbicides
Hydrocarbons
PCBs
Pesticides
Phenols

Semi-volatiles

Sulfur compounds

**PRIMARY** 

0.10 mm ID	df	Prod No
10 meters	0.10	CFS-B01010-010B
10 meters	0.20	CFS-B01010-020B
20 meters	0.10	CFS-B02010-010B
20 meters	0.20	CFS-B02010-020B
0.18 mm ID	df	Prod No
10 meters	0.18	CFS-B01018-018B
10 meters	0.40	CFS-B01018-040B
20 meters	0.18	CFS-B02018-018B
20 meters	0.40	CFS-B02018-040B
30 meters	0.18	CFS-B03018-018B
30 meters	0.40	CFS-B03018-040B
40 meters	0.18	CFS-B04018-018B
40 meters	0.40	CFS-B04018-040B
0.25 mm ID	df	Prod No
15 meters	0.10	CFS-B01525-010B
15 meters	0.25	CFS-B01525-025B
15 meters	0.50	CFS-B01525-050B
15 meters	1.00	CFS-B01525-100B
30 meters	0.10	CFS-B03025-010B
30 meters	0.25	CFS-B03025-025B
30 meters	0.50	CFS-B03025-050B
30 meters	1.00	CFS-B03025-100B
60 meters	0.10	CFS-B06025-010B
60 meters	0.25	CFS-B06025-025B
60 meters	0.50	CFS-B06025-050B CFS-B06025-100B
60 meters	1.00	
0.32 mm ID	df	Prod No
15 meters	0.10	CFS-B01532-010B
15 meters	0.25	CFS-B01532-025B
15 meters 15 meters	0.50 1.00	CFS-B01532-050B CFS-B01532-100B
15 meters	2.00	CFS-B01532-100B
15 meters	3.00	CFS-B01532-200B
15 meters	5.00	CFS-B01532-500B

		1
0.32 mm II	), cont'd	Prod No
30 meters	0.10	CFS-B03032-010B
30 meters	0.25	CFS-B03032-025B
30 meters	0.50	CFS-B03032-050B
30 meters	1.00	CFS-B03032-100B
30 meters	2.00	CFS-B03032-200B
30 meters	3.00	CFS-B03032-300B
30 meters	5.00	CFS-B03032-500B
60 meters	0.10	CFS-B06032-010B
60 meters	0.25	CFS-B06032-025B
60 meters	0.50	CFS-B06032-050B
60 meters	1.00	CFS-B06032-100B
60 meters	2.00	CFS-B06032-200B
60 meters	3.00	CFS-B06032-300B
60 meters	5.00	CFS-B06032-500B
0.53 mm II	<b>)</b> df	Prod No
15 meters	0.50	CFS-B01553-050B
15 meters	1.00	CFS-B01553-100B
15 meters	1.50	CFS-B01553-150B
15 meters	2.00	CFS-B01553-200B
15 meters	2.65	CFS-B01553-265B
15 meters	3.00	CFS-B01553-300B
15 meters	5.00	CFS-B01553-500B
30 meters	0.50	CFS-B03053-050B
30 meters	1.00	CFS-B03053-100B
30 meters	1.50	CFS-B03053-150B
30 meters	2.65	CFS-B03053-265B
30 meters	3.00	CFS-B03053-300B
30 meters	5.00	CFS-B03053-500B
60 meters	1.00	CFS-B06053-100B
60 meters	1.50	CFS-B06053-150B
60 meters	2.00	CFS-B06053-200B
60 meters	2.65	CFS-B06053-265B
60 meters	3.00	CFS-B06053-300B
60 meters	5.00	CFS-B06053-500B

# REPLACES DB-5, DB-5ms, HP-5, HP-5MS, Ultra-5, Rtx-5, Rtx-5MS, Rtx-5sil MS, SPB-5, MDN-5, BP-5, CP-Sil 8 CB, GB-5, 007-5, OV-5, SE-54, AT-5, and ZB-5

#### **VB-50/608**

#### (50%Phenyl)-methylpolysiloxane

#### PRIMARY APPLICATIONS Drugs

Prings
Pharmaceuticals
Herbicides
Steroids
PAHs
Tocopherols
PCBs
EPA Methods
Pesticides
508,608 and 8080

0.25 mm ID	df	Prod No	0.32 mm ID, c	ont'd	Prod No
15 meters	0.25	CFS-D01525-025B	60 meters	0.25	CFS-D06032-025B
15 meters	0.50	CFS-D01525-050B	60 meters	0.50	CFS-D06032-050B
30 meters	0.15	CFS-D03025-015B	60 meters	1.00	CFS-D06032-100B
30 meters	0.25	CFS-D03025-025B	0.53 mm ID	df	Prod No
30 meters	0.50	CFS-D03025-050B	15 meters	0.50	CFS-D01553-050B
60 meters	0.25	CFS-D06025-025B	15 meters	0.83	CFS-D01553-083B
60 meters	0.50	CFS-D06025-050B	15 meters	1.00	CFS-D01553-100B
0.32 mm ID	df	Prod No	30 meters	0.50	CFS-D03053-050B
15 meters	0.25	CFS-D01532-025B	30 meters	0.83	CFS-D03053-083B
15 meters	0.50	CFS-D01532-050B	30 meters	1.00	CFS-D03053-100B
15 meters	1.00	CFS-D01532-100B	60 meters	0.50	CFS-D06053-050B
30 meters	0.25	CFS-D03032-025B	60 meters	0.83	CFS-D06053-083B
30 meters	0.50	CFS-D03032-050B	60 meters	1.00	CFS-D06053-100B
30 meters	1.00	CFS-D03032-100B			

REPLACES
DB-17, AT-50,
SP-2250, DB-17ms,
BPX-50, SP-17,
DB-608, 007-17,
SPB-608, HP-50+,
SPB-50, ZB-50,
Rtx-50

#### **VB-Wax**

#### **REPLACES** 0.10 mm ID df Prod No DB-WAX, DB-10 meters 0.10 CFS-G01010-010A WAXetr, HP-WAX, CFS-G02010-010A 20 meters 0.10 HP-InnoWAX, HP-20M, CB-WAX, 0.18 mm ID df Stabilwax, RtxWAX, 10 meters 0.18 CFS-G01018-018A SUPEROX II, 20 meters 0.18 CFS-G02018-018A SUPELCOWAX-10, 0.25 mm ID df Prod No BP-20, CP-WAX 52 CB, GB-WAX, 15 meters 0.25 CFS-G01525-025A 007-CW, OV-WAX, 0.25 CFS-G03025-025A 30 meters AT-WAX, and 60 meters 0.25 CFS-G06025-025A ZB-WAX

#### 100% bonded polyethylene glycol

0.32 mm ID	df	Prod No
15 meters	0.25	CFS-G01532-025A
15 meters	0.50	CFS-G01532-050A
15 meters	1.00	CFS-G01532-100A
30 meters	0.25	CFS-G03032-025A
30 meters	0.50	CFS-G03032-050A
30 meters	1.00	CFS-G03032-100A
60 meters	0.25	CFS-G06032-025A
60 meters	0.50	CFS-G06032-050A
0.53 mm ID	df	Prod No
15 meters	0.50	CFS-G01553-050A
15 meters	1.00	CFS-G01553-100A
30 meters	0.50	CFS-G03053-050A
30 meters	1.00	CFS-G03053-100A
60 meters	1.00	CFS-G06053-100A

#### PRIMARY APPLICATIONS

Alcohols Aldehydes Aromatics Flavors Fragrances Organic Acids Solvents

#### VB-624/1301

# REPLACES DB-624, HP-624, HP-VOC, Rtx-624, Rtx-Volatiles, BP624, Vocol, 007-624, 007-502, NONPAKD, 624, ZB-624

0.18 mm ID	df	Prod No
10 meters	1.00	CFS-E01018-100A
20 meters	1.00	CFS-E02018-100A
30 meters	1.00	CFS-E03018-100A
40 meters	1.00	CFS-E04018-100A
0.20 mm ID	df	Prod No
25 meters	1.12	CFS-E02520-112A
0.25 mm ID	df	Prod No
15 meters	1.40	CFS-E01525-140A
30 meters	1.40	CFS-E03025-140A
60 meters	1.40	CFS-E06025-140A

0.32 mm ID	df	Prod No	
15 meters 30 meters	1.80 1.80	CFS-E01532-180A CFS-E03032-180A	
60 meters	1.80 CFS-E06032-180A		
0.53 mm ID	df	Prod No	
0.53 mm ID 15 meters	<i>df</i> 3.00	Prod No CFS-E01553-300A	
15 meters	3.00	CFS-E01553-300A	

(6% Cyanopropyl-phenyl)-methylpolysiloxane

#### PRIMARY APPLICATIONS

APPLICATION
EPA Methods
501.3
502.2
503.1
524.2
601
602
8010
8015
8020
8240

#### **VB-1701**

# REPLACES DB-1701,007-1701, HP-1701, CP-Sil 19 CB, Rtx-1701, SPB-1701, BP-10, ZB-1701

0.25 mm ID	df	Prod No
15 meters	0.25	CFS-F01525-025A
15 meters	0.50	CFS-F01525-050A
30 meters	0.25	CFS-F03025-025A
30 meters	0.50	CFS-F03025-050A
60 meters	0.25	CFS-F06025-025A
60 meters	0.50	CFS-F06025-050A
0.32 mm ID	df	Prod No
0.32 mm ID 15 meters 15 meters 15 meters	<i>df</i> 0.25 0.50 1.00	Prod No CFS-F01532-025A CFS-F01532-050A CFS-F01532-100A
15 meters	0.25	CFS-F01532-025A
15 meters	0.50	CFS-F01532-050A

0.32 mm ID, cont'd		Prod No
60 meters	0.25	CFS-F06032-025A
60 meters	0.50	CFS-F06032-050A
60 meters 1.00		CFS-F06032-100A
<b>0.53 mm ID</b> <i>df</i>		Prod No
15 meters	0.50	CFS-F01553-050A
15 meters	1.00	CFS-F01553-100A
30 meters	0.50	CFS-F03053-050A
30 meters	1.00	CFS-F03053-100A
60 meters	0.50	CFS-F06053-050A
60 meters	1.00	CFS-F06053-100A

(14% Cyanopropyl-phenyl)-methylpolysiloxane

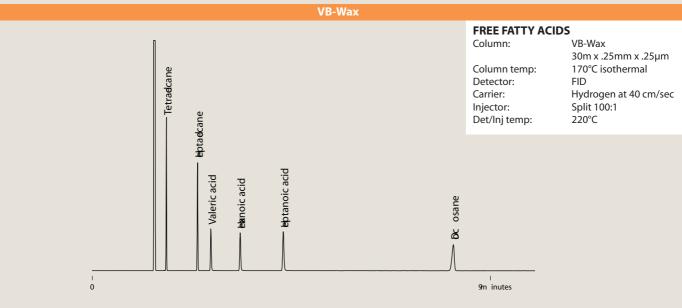
#### PRIMARY APPLICATIONS

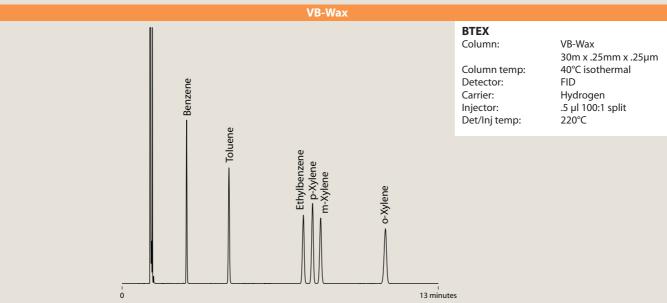
Drugs
PAHs
PCBs
Pesticides
Phenols
Solvents
Tranquilizers

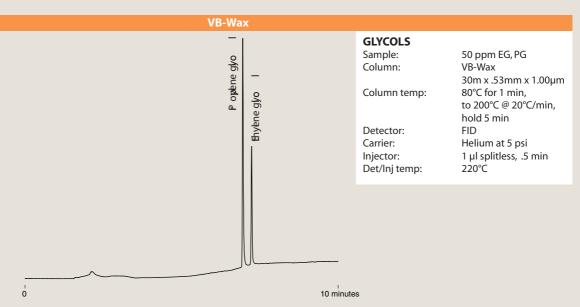
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Molesieve 5Å

Molesieve 5Å

#### **REPLACES**

GS-Molesieve 5A HP-PLOT Molesieve CP-Molesieve 5A Rt-Msieve-5A MXT-Msieve-51 PLT-5A ValcoPLOT Molesieve 5Å PLOT columns offer greatly enhanced analytical efficiency at economical prices. Our proprietary bonding technology ensures that the particles stay put even when columns are used with valves. Our thick film columns separate Ar/O<sub>2</sub> without the need for cryogenic equipment. The thin film columns offer fast elution of carbon monoxide with near perfect peak symmetry.

#### Fused silica

#### Stainless steel

0.53 mm ID	df	Prod No	0.53 mm ID	df (µm)	Prod No
15 meters	20	CFS-X1553-200	15 meters	20	CSS-X1553-200
15 meters	50	CFS-X1553-500	30 meters	20	CSS-X3053-200
30 meters	20	CFS-X3053-200	30 meters	50	CSS-X3053-500
30 meters	50	CFS-X3053-500			

#### PRIMARY APPLICATIONS

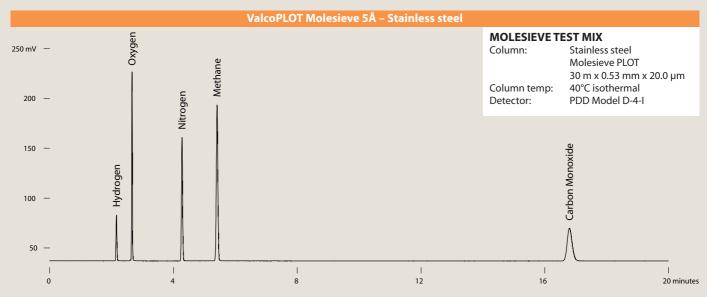
Gases

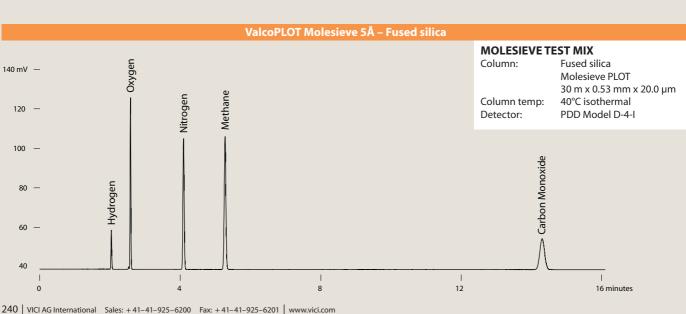
#### **TO ORDER**

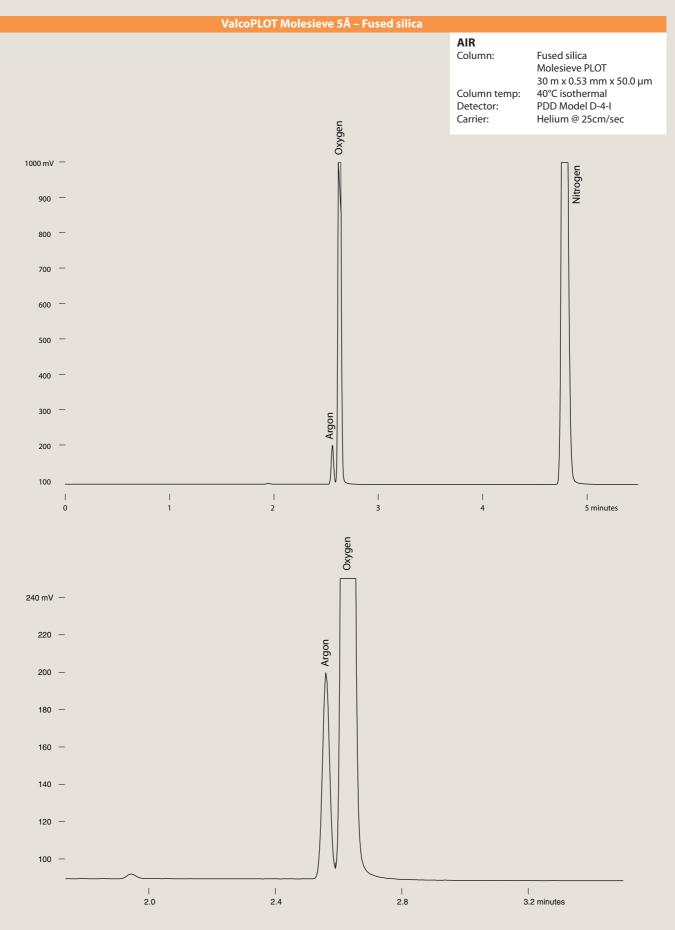
For prices or more information about your specific application, contact VICI Metronics:

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**Alumina** Aluminum oxide

#### REPLACES

GS-Alumina HP-PLOT Al203 CP-Al203/KCI CP-Al203/Na2SO4 Rt-alumina-PLOT Al203/KCI Al203/Na2SO4 With ValcoPLOT  $Al_2O_3$  PLOT columns there's no need for cryogenic equipment to analyze C1 - C5 hydrocarbons in a main stream of C1 - C5 hydrocarbons. ValcoPLOT  $Al_2O_3$  columns are deactivated with small salt crystals stable to 200°C. KCl deactivation produces a relatively apolar column while  $Na_2SO_4$  produces columns exhibiting increased retention of unsaturated hydrocarbons.

#### PRIMARY APPLICATIONS

C1 - C5 hydrocarbons

#### **VP-Alumina/KCI**

#### VP-Alumina/Na2SO4

Fused silica			Fused silic	Fused silica		
0.53 mm ID	df	Prod No	0.53 mm ID	df	Prod No	
15 meters	10	CFS-Y1553-100	15 meters	10	CFS-Z1553-100	
30 meters	10	CFS-Y3053-100	30 meters	10	CFS-Z3053-100	
50 meters	10	CFS-Y5053-100	50 meters	10	CFS-75053-100	

#### ValcoPLOT A

#### High purity Divinylbenzene/ethyleneglycoldimethacrylate

#### **Fused silica**

0.32 mm ID	df (μm	) Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PA1532-100	15 meters	20	CFS-PA1553-200
30 meters	10	CFS-PA3032-100	30 meters	30	CFS-PA3053-200

#### PRIMARY APPLICATIONS

Solvents Light gases Light hydrocarbons Residual solvents

#### ValcoPLOT D

#### High purity Divinylbenzene

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PD1532-100	15 meters	20	CFS-PD1553-200
30 meters	10	CFS-PD3032-100	30 meters	20	CFS-PD3053-200

#### PRIMARY APPLICATIONS

Solvents
Hydrocarbons
Alcohols
Sulfur compounds
Residual solvents
Halogenated
hydrocarbons

#### ValcoPLOT Q

#### Divinylbenzene

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PQ1532-100	15 meters	20	CFS-PQ1553-200
30 meters	10	CFS-PQ3032-100	30 meters	20	CFS-PQ3053-200

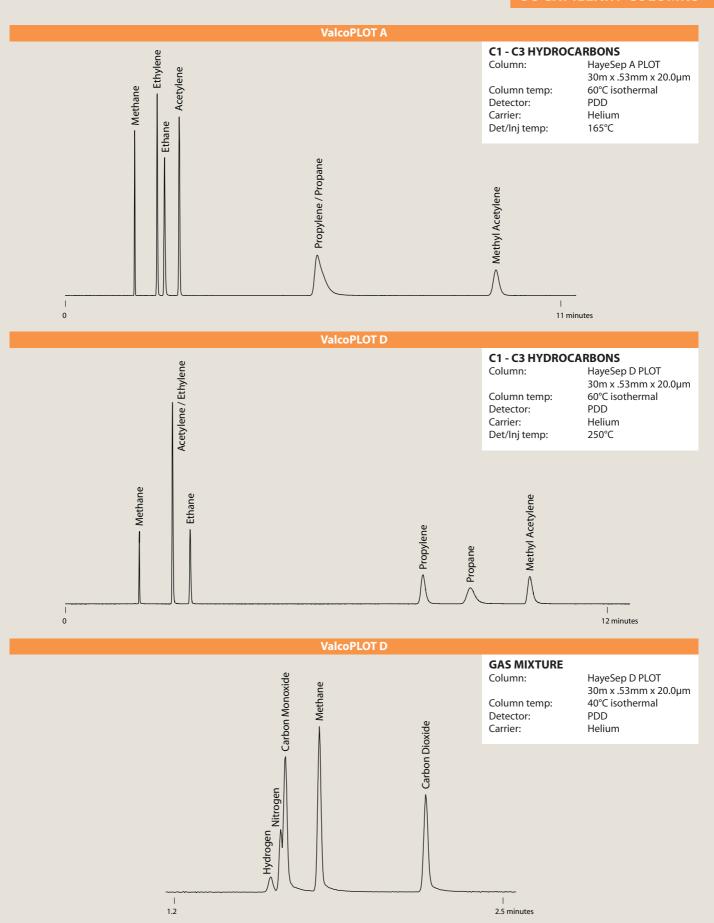
#### PRIMARY APPLICATIONS

Note: We highly recommend ValcoPLOT D, which has similar retention characteristics but is made from higher purity raw materials.

#### **TO ORDER**

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ValcoP	LOT	В
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#### Divinylbenzene/polyethyleneimine

			•	•
311	CA	а	CII	ica
ш	26	ч	311	ıva

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PB1532-100	15 meters	20	CFS-PB1553-200
30 meters	10	CFS-PB3032-100	30 meters	20	CFS-PB3053-200

#### ValcoPLOT C

#### Divinylbenzene/acrylonitrile

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PC1532-100	15 meters	20	CFS-PC1553-200
30 meters	10	CFS-PC3032-100	30 meters	20	CFS-PC3053-200

#### **ValcoPLOT N**

#### Divinylbenzene/ethyleneglycoldimethacrylate

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PN1532-100	15 meters	20	CFS-PN1553-200
30 meters	10	CFS-PN3032-100	30 meters	20	CFS-PN3053-200

#### ValcoPLOT P

#### Divinylbenzene/styrene

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PP1532-100	15 meters	20	CFS-PP1553-200
30 maters	10	CES-PP3032-100	30 maters	20	CES_PP3053_200

#### **ValcoPLOT R**

#### Divinylbenzene/N-vinyl-2-pyrollidinone

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PR1532-100	15 meters	20	CFS-PR1553-200
30 meters	10	CFS-PR3032-100	30 meters	20	CFS-PR3053-200

#### **ValcoPLOT S**

#### Divinylbenzene/4-vinyl-pyridine

#### **Fused silica**

0.32 mm ID	df	Prod No	0.53 mm ID	df	Prod No
15 meters	10	CFS-PS1532-100	15 meters	20	CFS-PS1553-200
30 meters	10	CFS-PS3032-100	30 meters	20	CFS-PS3053-200

#### **TO ORDER**

For prices or more information about your specific application, contact VICI Metronics:

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- Reduce breakdown of Endrin and DDT
- Increase the interval between liner changes

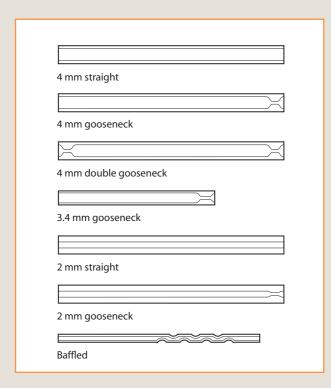
DDT and Endrin are easily degraded in the injection port; with non-deactivated liners and those filled with non-deactivated glass wool, Endrin breakdown can be as high as 98%. EPA method 8081A states, "If degradation of either DDT or Endrin exceeds 15%, take corrective action before proceeding with calibration."

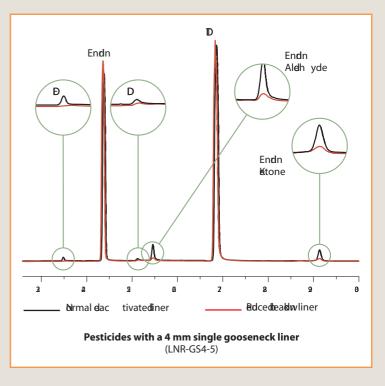
VICI reduced breakdown liners are produced by applying a highly-crosslinked siloxane over a conventionally deactivated liner. The resulting liner contributes less to breakdown than any other component of the injection system.

#### **Reduced breakdown injection port liners**

Package of 5 liners.

For injector	Description	Prod No
Agilent/Thermo	2 mm straight splitless	LNR-HP2-5
	4 mm straight splitless	LNR-HP4-5
	2 mm gooseneck	LNR-GS2-5
	4 mm gooseneck	LNR-GS4-5
	4 mm double gooseneck	LNR-DGS4-5
Gerstel CIS-4/PTV	Baffled	LNR-CIS4-B-5
Varian CP-1177	2 mm gooseneck	LNR-GS2-5
	4 mm gooseneck	LNR-GS4-5
Varian 1078/1079	2 mm gooseneck	LNR-VARGS2-5
	3.4 mm gooseneck	LNR-VAR3.4-5





# Gas purification

#### **GAS-SPECIFIC PURIFIERS AND CONTAMINANT TRAPS**

#### from VICI Metronics

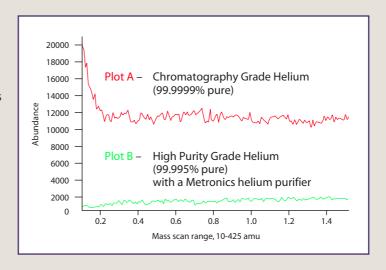
# Gas Specific Purifiers and Contaminant Traps

- Original equipment in Agilent® Mass Spec and LC Mass Spec
- Provide point-of-use gas purification of helium, hydrogen, methane, nitrogen, carbon dioxide, or air
- Reduce gas impurities from high PPM to low PPB levels
- Decrease baseline noise and increase GC/MS sensitivity
- Replace three traps with one purifier

Gas purity is critical to optimum GC performance. Several types of contaminants are detrimental – notably moisture, hydrocarbons, and oxygen. VICI Metronics gas purifier modules are designed to be placed in-line with the GC carrier or detector gas supply to remove these contaminants from the analytical gases prior to their entry into the GC.

Gas purification is optimized by a multiple bed format. Each bed functions at a lower contaminant concentration, resulting in a series of contaminant concentration gradients across the length of the gas purifier.

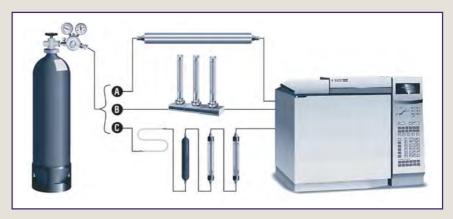
VICI Metronics gas purifiers dramatically reduce contaminant levels and absorb a greater variety of contaminants than other gas purification products. Advanced materials and design features quarantee that the modules will produce gases that are at least a factor of ten higher than a 99.9999% "chromatography grade" cylinder of gas when the purifier is supplied by a 99.995% cylinder. The cost difference between the two grades of gas will pay for the cost of the gas purifier several times over during its operating life.





#### **GAS PURIFICATION**

Every connection in your gas delivery system has the potential for leaks; the more fittings you have, the greater the potential. Using a VICI Metronics purifier or trap (A) minimizes the number of fittings as compared to a typical manifold system (B) or contaminant trap configuration with multiple components (C).



#### **SPECS**

22.5" long x 1.5" diameter (purifiers noted with \* in the charts are are 12" long) Max inlet pressure 1000 psi (6895 kPa) Recommended flow 500 mL/min

#### **Gas specific purifiers**

Description	1/8" fitting	1/4" fitting
Helium purifier	P100-1	P100-2
Hydrogen purifier	P200-1	P200-2
Nitrogen purifier	P300-1	P300-2
Nitrogen purifier for LC/MS apps	P310-1	P310-2
Purifier for nitrogen generators	P350-1	P350-2
Air purifier	P400-1	P400-2
Methane purifier*	P500-1	P500-2
Carbon dioxide (gas) purifier	P600-1	P600-2
Carbon dioxide (liquid) purifier	P700-1	P700-2

#### **Contaminant traps**

Description	1/8" fitting	1/4" fitting
Moisture trap	T100-1	T100-2
Hydrocarbon trap	T200-1	T200-2
Oxygen trap	T300-1	T300-2
Sulfur trap*	T400-1	T400-2
Sulfur trap	T401-1	T401-2
Mercury trap*	T700-1	T700-2



\*12" long

#### **TO ORDER**

For prices or more information about our gas purifiers, contact VICI Metronics:

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#### vicimetronics.com



#### **PPB at outlet** (based on 50 ppm nominal inlet concentration level)

PPB at outlet (	based o	n 50 ppi	m nomi	nal inlet co	oncentration	level)
Description	CO	CO <sub>2</sub>	02	H <sub>2</sub> O	Sulfur compounds	Non-methane hydrocarbons
Helium purifier Hydrogen purifier Air purifier Methane purifier	<1 <1	<1 <1 <1	<1 <1	<1 <1 <1 <1	<1 <1 <1	<3 <3 <3 <3
Nitrogen purifier Nitrogen purifier for LC/MS apps Purifier for nitrogen generators	<1	<1	<1	<1 <25 <25	<1 <25 <25	<3 <25 <25
Moisture trap Hydrocarbon trap Oxygen trap Sulfur trap			<1	<1 <1 <1	<1	<3

# Analytical syringes PLUS MININERT VALVES AND MICRO VALVES

from VICI Precision Sampling

#### Micro Valves for GC and LC

- 200 psi, .060" bore
- Compact 1" design
- Convenient panel mount
- Variety of configurations

Simplify your liquid or gas handling application with a VICI Precision Sampling Micro valve. The unique design of the fitting detail allows a leak-free seal with no potential for rotor damage from overtightening. Internal parts are PEEK and PTFE.



#### Micro valves for GC and LC

Prod No

1/4-28

SPECS

"T" flow path 3 ports 4 ports	PS-660100 PS-660110	3 PORT	4 PORT	200 psi gas <sup>1</sup> 500 psi liquid <sup>2</sup> .060" bore 1/4-28 fitting detail All polymer-based materials
180° flow path 2 ports 4 ports	PS-660200 PS-660210	2 PORT	4 PORT	30°
90° flow path 2 ports 3 ports 4 ports	PS-660300 PS-660310 PS-660320	2 PORT	3 PORT	4 PORT 90°

- Tested with Helium using 1/16" OD x 0.84 mm ID PTFE tubing with PEEK collapsible ferrules
- Tested with Isopropanol using 1/8" OD x 0.75 mm ID PTFE tubing with CTFE collapsible ferrules

#### **MORE INFORMATION**

1/4-28 fittings . . . . p. 68-9

#### **TO ORDER**

Toll-free 800–828–1653 Tel .....225–927–1128 Fax.....225–923–1331

#### FOR OUR COMPLETE LINE OF PRODUCTS

Visit our website at viciprecisionsampling.com or call us for a catalog:





#### **ANALYTICAL SYRINGES**

VICI Precision Sampling's patented Pressure-Lok® syringes feature a PTFE plunger tip, stress-formed by a special process to ensure a leak-tight seal. The self-lubricating plunger tip stays smooth for the life of the syringe, with none of the seizing or residue buildup associated with conventional all-metal plungers.

The needle is sealed by a PTFE sleeve, or packing, which effectively isolates the sample from the needle cement and prevents any possible dissolution of the adhesive or contamination of the sample. All Pressure-Lok syringes feature ultra smooth bores, easily replaceable parts, low dead volume, crisp clean graduations, and precision calibration.

**SPECS** 

Removable needles

Bevel, open end

(25, 50, and

.029" x .012" x 2" (all other

sample sizes) 250 psi max, gases and liquids

100 µl)

Needle size: .028" x .005" x 2"

Series A-2 for GC

The A-2 features a push-button valve for 250 psi sample storage in syringes as small as 25  $\mu$ l. Small liquid samples with low-boiling components are not lost through evaporation, as often occurs with ordinary syringes.

The positive rear stop (in 250  $\mu$ l and larger sizes) prevents plunger blowout at elevated pressures. The Series A-2 syringe has all the standard Pressure-Lok features such as a PTFE plunger tip, PTFE-sealed needle, and ultrasmooth bore. Replacement components are available for easy repairs.

	Standard	Luer
Sample size	Prod No	Prod No
25 μl	PS-050023	PS-050043
50 μl	PS-050024	PS-050044
100 μl	PS-050025	PS-050045
250 μl	PS-050031	PS-050051
500 μl	PS-050032	PS-050052
1 ml	PS-050033	PS-050053
2 ml	PS-050034	PS-050054
5 ml	PS-050035	PS-050055
10 ml	PS-050036	PS-050056

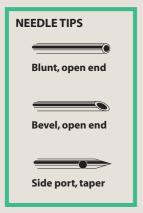
Replacement needles	Bevel,	Side port,
(Pkg/3)	open end	taper
Size	Prod No	Prod No
Pressure-Lok .028" x .005" x 2" .029" x .012" x 2"	PS-943050 PS-943051	— PS-943052
.028" x .006" x 2"	PS-943060	—
.028" x .016" x 2"	PS-943061	PS-943062

# Luer 500 µl sample (PS-050052) Standard 25 µl sample (PS-050023)

#### **SAFETY NOTE**

To prevent possible injury, proper safety precautions should always be observed when pressurizing glass cylinders such as syringes.

Not for medical use.



#### **ANALYTICAL SYRINGES**

Series C-160 for GC

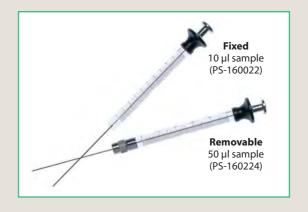
The C-160 offers day-in, day-out dependability at an economical price. A plunger tip of stress-formed virgin PTFE is self-lubricating and durable, and the PTFE needle seat at the rear of the needle prevents possible dissolution of the needle cement or contamination of the sample.

Choose between a fixed or removable needle version. Replacement needles are open end bevel type, .019" x .005" x 2.25", and come complete with an integral PTFE seal for a low dead volume connection and a leak-tight fit.

	Fixed needle	Removable needle
Sample		
size	Prod No	Prod No
5 µl	PS-160021	PS-160221
10 μl	PS-160022	PS-160222
25 μΙ	PS-160023	PS-160223
50 μl	PS-160024	PS-160224
100 µl	PS-160025	PS-160225
Replacement needles	Bevel,	
(Pkg/3)	open end	
Size	Prod No	
.019" x .005" x 2.25"	PS-123050	

# Fixed and removable needles Bevel, open end Fixed needle size: .019" x .005" x 2" Removable needle size: .019" x .005" x 2.25" 250 psi max, gases and liquids

**SPECS** 



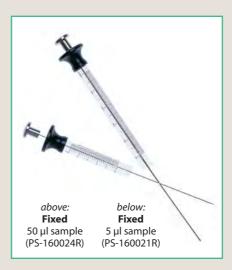
#### Syringes for Valco, Cheminert, and Rheodyne HPLC injectors

Syringes used to fill a loop on a sample injection valve have needles with blunt, smooth ends. For a sample to be delivered with any repeatability, the end of the needle must contact the bottom of the valve's fitting detail uniformly and seal on the outside of the tip. All Precision Sampling syringes for valve injections have smooth, burr-free ends that fit the valve fitting details perfectly. The standard HPLC syringe is our basic C-160 with a 2" long 22 gauge blunt tip needle.

	Fixed needle	Removable needle
Sample size	Prod No	Prod No
5 μl 10 μl 25 μl	PS-160021R PS-160022R PS-160023R	PS-160221R PS-160222R PS-160223R
50 μl 100 μl	PS-160024R PS-160025R	PS-160224R PS-160225R
eplacement needles		
Pkg/3)	Prod No	
	PS-123050R	

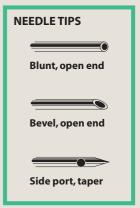
#### **SPECS**

Removable needles Blunt tip, open end Needle size: 22 gauge x 2" 250 psi max



#### MORE INFORMATION

Fill ports..... page 40 Luer adapters ......41



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### **ANALYTICAL SYRINGES**

Mininert™ push-button valves are highly dependable, leak-tight closures for screw-cap vials and other laboratory containers. When used with a glass vial, only PTFE and glass are in contact with the contents. Their unique features make Mininert valves the ideal closure for calibration standards, air- or

moisture-sensitive fluids, derivatizing reagents, or volatile chemicals.

Operation is extremely simple – push the green button to open the valve, insert the needle through the septum and take a sample, withdraw the needle, and push the red button to close the valve.



### **Valves for vials**

The screw-cap Mininert is available in a variety of sizes. The crimp-top valve for 13 mm ID glassware slides into the neck of the vial and features a threaded flange which is turned to provide a leak-tight fit.

Pkg/12:	Cap / thread size	Prod No
	13 mm-425	PS-614158
	15 mm-425	PS-614160
	18 mm-400	PS-614161
	20 mm-400	PS-614170
	24 mm-400	PS-614163
	Crimp top	PS-614250

#### **SPECS**

#### **TEMPERATURES**

Mininert valves can be used at temperature up to 40°C. However, after use at high temperatures, the valve may leak slightly when cooled to room temperature.

#### **MATERIALS**

PTFE is highly inert and may be used with most common materials. It is particularly useful for working with most acids and organic solvents. However, problems may be encountered when used with organometallics and some strong bases. We recommend actual exposure tests before use with any material.

#### **PRESSURE**

The sealing ability of Mininert valves is more than adequate for containing most volatile liquids and gases at low pressures. Mininert valves have been used as high as 120 psi without leakage, but this is **not** a recommendation for pressurizing glass containers to these levels. Such pressurization of glass containers can be extremely dangerous.



### Valves with threaded fittings

Our threaded designs offer positive on/off fluid control as an in-line valve or syringe access as a termination valve at a sample point. In-line valves are 1/4-28 male to male or 1/4-28 female to female. Termination valves are offered in 1/4-28 male or female and 1/8" NPT male or female.

In-line valv	ves	Prod No
	1/4-28 male to male 1/4-28 female to female	PS-631205 PS-631206
Terminatio	on valves	
	1/4-28 male	PS-631201
	1/4-28 female	PS-631203
	1/8" NPT male	PS-631202
	1/8" NPT female	PS-631204



### Replacement septa and septum installation tool

These silicone septa fit all Mininert valves. The installation tool is a handy device for quickly removing and replacing needle seal septa.

Septa, pkg/50	PS-644350
Installation tool	PS-644850



### Mininert syringe valves

These convenient add-on valves allow our Series C and D syringes to store samples at up to 250 psi. The valve body is all PTFE, with a stainless steel stem. Also available to fit luer-tip syringes from any manufacturer. All accept traditional luer needles.

For C or D syringe	PS-654050
For Luer-tip syringe	PS-654051

# General reference

## **HELPFUL PRODUCT INFORMATION**

This section contains background information to supplement the product discussions on the preceding pages. You will find a glossary of terms, safety and trademark information, and discussions of the mechanical and chemical properties of the materials used in the manufacturing of our products. Additional information, including a complete library of technical notes and manuals, can be found in the support section of our website at **www.vici.com**.

## Safety

- Never tighten or loosen a fitting or valve connection while it is pressurized. Provisions should be made within the system to release pressure via suitable valve components.
- Do not exceed pressure or temperature specifications. Note that in many cases, the system pressure is limited by the tubing used, not the fittings.
- 3. The use of toxic or hazardous fluids requires extra caution during operation or maintenance. The user is responsible for ensuring safe operation and for understanding the nature of the fluids and chemistry involved.
- 4. The use of thread lubricants or sealants is required only on tapered pipe threads. These sealants and lubricants may have different temperature limits or chemical compatibility than the valves or fittings.

#### **CAUTION**

The improper selection or use of components or systems described herein can cause personal injury or property damage.

The system designer and user are solely responsible for the selection of products suitable for the specific requirements of the application, as well as proper installation, operation, and maintenance of these products.

Compatibility with hazardous fluid streams, environmental conditions, and mechanical requirements are the responsibility of the user.



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## Warranty

This Limited Warranty gives the Buyer specific legal rights, and a Buyer may also have other rights that vary from state to state.

For a period of 365 calendar days from the date of shipment, Valco Instruments Company, Inc. (herein-after Seller) warrants the goods to be free from defect in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor OR at Seller's option demand return of the goods and tender repayment of the price. Buyer's exclusive remedy is repair or replacement of defective and nonconforming goods OR at Seller's option return of the goods and repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or for consequential incidental or special damages arising out of, resulting from, or relating in any manner to these goods.

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items, such as but not limited to valve seals or ferrules. This warranty is VOID when repairs are performed by a non-authorized service center or representative.

If you have any problem locating an authorized service center or representative, please call, fax, or write the Service Department, listed at left.

At Seller's option, repairs or replacements will be made on site or at the factory. If repairs or replacements are to be made at the factory, Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed in accordance with the laws of the State of Texas.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supersedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by the Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.

## SPECIFIC TERMS AND CONDITIONS OF SALE

Download specific terms and conditions of sales of VICI AG, Switzerland, from www.vici.ch.

#### Stainless steel, Type 316

This is the standard tubing material for chromatography, suitable for a wide variety of applications. It is cold drawn seamless, not welded, with close tolerances held on both ID and OD. We neither recommend nor offer Type 304 stainless steel for analytical applications.

Austenitic stainless steels may be used for most chromatographic applications. Type 316 is most commonly used for HPLC because of its superior chloride ion resistance.

### Stainless steel, Type 303

Recommended for GC use and general purpose connections, combining excellent machining characteristics with good resistance to corrosion and high temperature oxidation. Susceptible to attach by chlorides, iodides, and bromides.

#### Stainless steel, gold-plated

Improved inertness and high-integrity sealing for applications such as ultra pure gas analysis.

#### **Electroformed nickel (EFNI)**

We electroplate pure nickel over a diamond drawn mandrel in a continuous process, then carefully separate and remove the mandrel from the tubing. The result is an extremely inert and smooth interior surface (1-2 microinch finish). It is widely used for transfer lines, since it minimizes the potential for carryover or cross contamination often found with mill-drawn Nickel 200, due to its rough interior surface. Unlike glass- or silica-lined stainless, EFNI can easily accept tight bends and cutting without heating, and does not release damaging glass fragments or silica particles. Electroformed nickel has more in common with fused silica than drawn nickel tubing in terms of surface inertness and smoothness.

#### Hastelloy C° series

This is the material most often recommended for corrosion resistance – it works when nothing else will. This versatile nickel-chromium molybdenum alloy has excellent resistance to most acids, including strong oxidizers such as ferric and cupric chlorides; nitric, formic and acetic acids; wet chlorine; sea water and brine solutions; and mixtures containing nitric acid or oxidizing acids with chloride ions. VICI uses only HC-22 for fittings and valve stators, rather than the older and less corrosion resistant HC-276.

The best choice for most special applications where HPLC grade stainless cannot be used, Hastelloy C has excellent resistance to pitting, stress corrosion cracking, and oxidizing atmospheres up to temperatures well beyond any other standard components of the chromatographic system.

#### Inconel 600

One of the few metals which can be used with hot, strong solutions of magnesium chloride. Good for most severely corrosive environments at elevated temperatures. Resistant to sulfuric and hydrofluoric acid, and to all concentrations of phosphoric acid at room temperature. Poor resistance to nitric acid.

#### Monel 400

High resistance to hydrochloric, hydrofluoric, and sulfuric acid under reducing conditions. Attacked by oxidizing acid salts and hypochlorites. High resistance to chlorinated solvents and nearly all alkalis.

#### Nickel 200

Excellent resistance to caustics, high temperature halogens and hydrogen halides, and salts other than oxidizing halides. Good resistance to caustic soda and other alkalis except ammonium hydroxide.

The industry standard nickel alloy tubing, containing trace amounts of copper, carbon, silicon, and other elements which impart certain mechanical characteristics. Like our 316 stainless, this tubing is cold drawn to close ID and OD specifications, and is suitable for many applications where a relatively inert and low cost nickel is required. While more inert than 316 SS in most applications, it is still absorptive and has a relatively rough interior. Use electroformed nickel tubing for applications requiring a high level of inertness or finish.

#### Nitronic 50

Good resistance to chlorides, sulfuric acid, and sea water. Resistant to sulfur gases such as hydrogen sulfide and sulfur dioxide.

#### Nitronic 60

Chemical resistance is similar to Type 316 stainless, but its resistance to galling and oxidation make it superior to Type 316 or 303 in the majority of applications. This is the standard material in Valco and Cheminert metal valve lines.

#### **Titanium**

Although it is more difficult to machine than common alloys containing aluminum and vanadium, Valco uses Grade 2 pure titanium in order to avoid possible contamination of the sample stream with these metals.

Good for organic and inorganic salts except aluminum and calcium chlorides, and all alkalis except boiling concentrated potassium hydroxide. Good with dilute, low temperature formic, lactic, sulfuric, hydrochloric, and phosphoric acids, but rapidly attacked by hydrofluoric acid. Good with dilute nitric acid at low temperatures; corrodes at high concentrations and temperatures. Can ignite with fuming nitric acid. Attacked by oxalic acid, concentrated phosphoric acid, hot trichloroacetic acid, and zinc chloride.

Due to the nature of this metal, valves made of titanium typically have a shorter lifetime than HPLC grade stainless steel or Hastelloy C-22.

#### **Zirconium**

Excellent resistance to hydrochloric acid, good with hot sulfuric acid at concentrations up to 70% and boiling nitric acid at up to 90%. Attacked by hydrofluoric acid.

#### **Brass**

Used where a soft metal ferrule is desirable but no corrosive materials are present. Although Valco brass ferrules work as replacements in inexpensive commercial brass fittings, they are generally not recommended for chromatography applications.

## MATERIAL AVAILABILITY BY PRODUCT LINE

Note: This list represents materials available in at least some of the products in the lines listed. Not all products in a line are available in all the materials mentioned.

### **Fittings**

#### Cheminert

CTFE PEEK PFA

Polypropylene Stainless steel, Type 316

#### Valco

300 series stainless steel PEEK

#### **Ferrules**

#### Valco

CTFE FEP Hastelloy C Nickel PFA

PFA
Polyimide, graphite
Polyimide, Valcon
Polyimide, virgin
PTFE, virgin
PTFE, glass-filled
Stainless, Type 303
Stainless, Type 316
Stainless, gold-plated
Titanium

### Cheminert

PEEK

Brass

### **Tubing**

Titanium

Electroformed nickel (EFNI) ETFE FEP Hastelloy C Nickel 200 PEEK PTFE Stainless steel, Type 316

## Valve rotors

### Cheminert

Valcon E Valcon E2 Valcon E3 Valcon H Valcon M Valcon P Valcon T Valcon TF

#### Diaphragm

A specialized polyimide

#### Valco

Valcon E Valcon E2 Valcon H Valcon M Valcon P Valcon R Valcon T Valcon TF

## Valve stators/bodies

#### Cheminert

CTFE
Hastelloy C
Nitronic 60 stainless
PAEK
PPS
PVDF
Stainless steel, Type 316
Titanium

#### Diaphragm

Hastelloy C Nitronic 60 Stainless steel, Type 316

#### Valco

Hastelloy C Inconel 600 Monel 400 Nickel 200 Nitronic 50 Nitronic 60

Stainless steel, Type 316

Titanium Zirconium

#### **CTFE**

Chlorotrifluoroethylene, is the generic name for the material produced as Kel-F° and as Aclar°. It is very resistant to all chemicals except THF and some halogenated solvents, and is resistant to all inorganic corrosive liquids, including oxidizing acids. CTFE can be used at temperatures up to 100°C. Swells in ketones.

#### **ETFE**

Ethyltrifluoroethylene is the generic name for the material such as Tefzel®. A fluoropolymer used for sealing surfaces, it is resistant to most chemical attack; however, some chlorinated chemicals will cause a physical swelling of ETFE tubing.

#### **FEP**

Fluorinated ethylene propylene is another member of the fluorocarbon family with similar chemical properties. It is generally more rigid than PTFE, with somewhat increased tensile strength. It is typically more transparent than PTFE, slightly less porous, and less permeable to oxygen. FEP is not as subject to compressive creep at room temperature as PTFE, and because of its slightly higher coefficient of friction is easier to retain in a compression fitting.

#### **PAEK**

Polyaryletherketone is the generic name for the family of polyketone compounds. (See PEEK.) PAEK includes PEK, PEEK, PEKK, and PEKEKK, which differ in physical properties and, to a lesser degree, in inertness.

VICI utilizes a range of proprietary PAEK-based composites (PEEK and others) for valve and fitting components. These composites resist all common HPLC solvents and dilute acids and bases. However, concentrated or prolonged use of halogenated solvents may cause the polymer to swell. Avoid concentrated sulfuric or nitric acids (over 10%).

#### PEEK

Considered relatively inert and biocompatible, polyetheretherketone tubing can withstand temperatures up to 100°C. Under the right circumstances, .005" - .020" ID tubing can be used up to 5000 psi for a limited time, and 0.030" to 3000 psi. Larger IDs are typically good to 500 psi. These limits are substantially reduced at elevated temperatures and in contact with some solvents or acids.

Its mechanical properties allow PEEK to replace stainless in many situations and in some environments where stainless would be too reactive. However, PEEK can be somewhat absorptive of solvents and analytes, notably methylene chloride, DMSO, THF, and high concentrations of sulfuric and nitric acid.

#### PEEK, glass-filled

This form of PEEK has better mechanical properties than natural PEEK, and performs extremely well in products such as ferrules.

#### **PFA**

Perfluoroalkoxy is a fluorocarbon with chemical and mechanical properties similar to FEP. More rigid than either PTFE or FEP. Commonly used for injection molded parts.

#### **PPS**

Polyphenylene sulphide is the generic name for the material produced as Fortron®, Ryton®, and others. It is very resistant to all solvents, acids, and bases.

#### **PTFE**

Polytetrafluoroethylene is the generic name for the class of materials such as Teflon®. It offers superior chemical resistance but is limited in pressure and temperature capabilities. Because it's so easy to handle, it is often used in low pressure situations where stainless steel might cause adsorption. PTFE tubing is relatively porous, and compounds of low molecular weight can diffuse through the tubing wall.

#### PTFE, glass-filled

This form of PTFE is nearly as inert as the virgin but is much more mechanically stable.

#### Polyimide, graphite

A graphite-filled polyimide. Due to its brittle nature, it is usually used only for reducing ferrules.

#### Polyimide, virgin

Not recommended for general use due to its tendency to be sticky and brittle at high temperatures. Often used as a high temperature electrical insulator.

#### Polyimide, Valcon

A high temperature (350°) graphite-reinforced polyimide composite used for all FS and FSR ferrules (fused silica adapters) and many standard ferrules. Valcon polyimide is specially prepared by a process know as Hot Isostatic Pressing (HIP) prior to being machined into individual adapters. This two step process yields a fused silica adapter with high temperature stability far exceeding that of parts produced by molding. It cannot be used with steam or with bases such as strong alkali and aqueous ammonia solutions.

#### Polypropylene

Widely used polymer for non-wetted parts. Attacked by strong oxidizers, aromatic and chlorinated hydrocarbons.

#### **PVDF**

PVDF, polyvinylidene fluoride, has excellent resistance to most mineral and organic acids, aliphatic and aromatic hydrocarbons, and halogenated solvents. Poor resistance to acetone, MEK, THF, and potassium and sodium hydroxide. Often supplied as Kynar®.

A variety of polymeric composites have been developed to meet a variety of customer requirements for rotors, since no single material will perform satisfactorily in all situations. This brief summary of each polymer's particular features and potential drawbacks is provided to allow the user to make a more informed valve selection. Consult our technical specialists for any additional questions. VICI polymer composites are proprietary formulations: only the generic compound class can be discussed.

#### Valcon E

A polyaryletherketone/PTFE composite, the E material receives wide GC use in what had previously been a problematic gap between the optimum temperature ranges of P and T, and in HPLC applications where the temperature requirement is higher than what can be handled by the H material and where a lower pressure limit can be tolerated. (Standard specs are 400 psi at 225°C, but higher pressure ratings are possible at reduced temperatures.) However, this polymer cannot be used in prolonged contact with high concentrations of sulfuric and nitric acids, DMSO, THF, or liquid methylene chloride.

#### Valcon F2

A proprietary reinforced TFE composite, Valcon E2 works well at lower pressures and is suitable for temperatures up to 75°C. This material is resistant to most chemicals but should not be used in prolonged contact with high concentrations of sulfuric and nitric acids, DMSO, or liquid methylene chloride.

#### Valcon E3

An engineered polyaryletherketone, this highstrength composite resists all common HPLC solvents and dilute acids and bases. However, concentrated or prolonged use of halogenated solvents may cause the polymer to swell. Avoid concentrated sulfuric or nitric acids (over 10%).

#### Valcon H

This composite, a carbon fiber reinforced, PTFE-lubricated inert engineering polymer, has long been the standard for typical HPLC applications in which pressures are around 5000 psi and temperatures are not more than 75°C. It is not unusual for these valves to be ordered for use at 7000 psi, and less frequently for use at 10,000 psi. However, at that point the lifetime may be shortened by as much as 50%.

Valcon H is the rotor material used in the W and UW series, where no rotor material letter is added (as: C10W or AC6UW).

#### Valcon M

This material, basically a hydrocarbon in structure, is the most impermeable to light gases of all the rotor materials currently available, with wide acceptance in low-temperature (50°C maximum) trace gas applications. Avoid use with aromatic hydrocarbons.

#### Valcon P

This composite, the majority of which is PTFE and carbon, was the standard choice for most GC applications before the development of Valcon E. (Standard specs are 400 psi at 175°C.) Routinely used at 1000 psi, 75°C, it can also be used at temperatures approaching 200°C with decreased sealing tension; however, at that point Valcon E is probably a better choice from a lifetime standpoint. Valcon E can replace P in most applications.

#### Valcon R

While rarely used today, Valcon R (a PTFE composite) still finds use in low temperature/ pressure situations which require its nearly universal chemical inertness. Of the chemicals encountered in commercial practice, only molten sodium and fluorine at elevated temperatures and pressures produce any detrimental effects. Its most severe limitation is that it cannot go over 75°C, even at only 400 psi.

#### Valcon T

This polyimide/PTFE/carbon composite has been used successfully for many years and still cannot be surpassed when applications demand operating temperatures in the 250°C - 350°C range. (Standard specs for most series are 300 psi at 330°C.) However, at temperatures below 150°C there is a tendency for the seal material to stick to the valve body, making the valve difficult to turn and causing the rotor to crack in extreme cases. Literature provided at the time of purchase contains instructions for reconditioning the material if this condition should arise. The T material is susceptible to attack from steam, ammonia, hydrazines (anhydrous liquids or vapor), primary and secondary amines, and solutions having a pH of 10 or more. Chemical reagents which act as powerful oxidizing agents (nitric acid, nitrogen tetroxide, etc.) must also be avoided. Valcon T can be used in "hot" GPC/SEC applications with O-dichlorobenzene as a solvent.

#### **Valcon TF**

This is the series designation for a valve with a virgin PTFE seal. Its mechanical characteristics are poor compared to the other choices, but occasionally its use is dictated by the presence of oxidizing agents too strong even for the R material.

### Valcon X

This designation indicates a proprietary polyimide blend with chemical properties similar to Valcon T, but with higher compressive strength.

### NOTES

The specifications in the discussions on this page are for two position valves.

Multiposition selectors generally have lower pressure and temperature limits due to the more complex seal design.

Actual specifications for each valve series are shown on the appropriate pages throughout the valve sections of the catalog. If a valve is to be used at a pressure higher than the given standard, please contact the factory for ordering information.

Adapter: a type of fitting which provides a method of joining two components of differing thread types or systems.

Analytical column: a long narrow tube packed or coated with one of many available chemically diverse compounds that can separate the components in a sample according to their boiling point, polarity, molecular size, or combination thereof. A column of some kind is used with most chromatographic techniques.

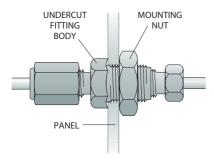
#### В

Backflush: the use of valving to reverse the flow through a column in order to "backflush" or purge heavier components from the column.

**Biocompatibility:** defines the materials used in a system (i.e. fittings, tubing, and valves) that do not change the bioactivity of the biological substances that come into contact with the surface of these materials. Note that in chromatographic systems, the tubing and column contribute over 99% of the surface area and the valves and fittings are insignificant.

**Bore:** the diameter of the minimum orifice through the fitting; see capillary bore, through-type bore, and large bore.

**Bulkhead fitting:** a type of fitting in which the fitting body is inserted through an instrument panel or mounting bracket, to which it is affixed with a mounting nut. The Valco fitting body is uniquely undercut so that it "bites" into the panel when the mounting nut is tightened, eliminating the need for a lock washer.



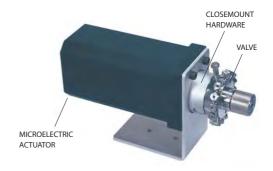
**Butt connection:** a type of connection in which the two tube ends are directly and squarely in contact, usually effected with a through-type union. Typically used with fused silica connections, or small bore metal tubing.

### C

Cap: a cap is used to dead-end a piece of tubing which has a nut and ferrule installed.

Capillary bore: the smallest available standard orifice in a given fitting design (usually 0.25 mm). Typically denoted by suffix "C" in the product number.

Closemount hardware: the mounting components providing the most direct, shortest attachment of valve to actuator.



**Compression fitting:** a style of fitting in which a threaded nut compresses a tapered ferrule onto tubing as the nut is tightened. Valco metal ferrules cut a ring into the tubing wall while polymer types rely on surface compression to form a seal.

Connecting volume: the volume between two or more connections. This may be cleanly swept, thus not contributing to peak distortion, or may be "dead volume" such as that found in fittings with larger bores than the connecting tubing.

Cross: a type of distribution fitting which connects four pieces of tubing, arranging them in the pattern of a cross.

#### D

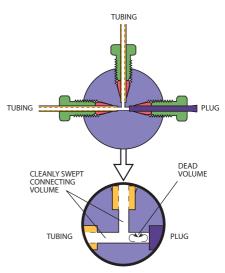
#### **Dead volume:**

(drawing at right) any volume which a component introduces to a system that is not cleanly swept and relies on diffusion to clear the space. See Connecting volume.

**Detail:** see Fitting detail.

### **Distribution fitting:**

a generic term for tees, crosses, and manifolds, which provide multiple



access points to "distribute" a gas or liquid through a system. CAUTION! Using a distribution fitting in reverse to coalesce multiple streams may create dead volume. Special manifolds are available for this application.

Ε

**External fitting:** a type of compression fitting in which the fitting body has male threads; an external *nut* has female threads.



EXTERNAL UNION



EXTERNAL REDUCING UNION

F

**FIA:** Flow Injection Analysis. A simple and versatile analytical technique for automating wet chemical analyses based on the manipulation of a sample zone formed from the injection of the sample into a continuous stream of fluid used as a carrier.

**Ferrule:** one of the components of a compression fitting; the conical piece of metal or plastic that compresses onto the tube as it is forced into a tapered seat. Valco metal ferrules are unique in that they attach to and seal at the tube by cutting a shallow ring into it, instead of by actually swaging it. This is preferable since it introduces no flow restriction.

**Filter:** a type of union or reducing union which traps the particulates in a stream. The filtering element is typically a mesh screen or sintered frit.

**Fitting detail:** one of the components of a compression fitting; if the tube, nut, and ferrule comprise the male part of the fitting, the fitting detail is the female part. It includes the threads for the nut, the tapered ferrule seat, and the pilot.

**Flanged fitting:** a type of fitting used with fluoropolymer tubing (PTFE, FEP) in which a flange is made at the tube end. Connections are made at the flange either by compressing the flange into a flat detail (typically 1/4-28 threaded) or by butting two flanges together. A special flanging tool forms the flanges.

**Flangeless fitting:** similar in application to the flanged fitting, but the flange is not required. A ferrule system is used which grips/compresses the tube. This fitting type can be used with virtually any polymeric tubing since the tube end does not have to be formed, but simply square cut. Typically used in 1/4-28 threaded fittings, it is usually interchangeable with flanged fittings.

**Frit:** a filter element typically made of stainless, Hastelloy, Titanium, or polymers, usually 0.75 mm or 1 mm thick. Frits may provide better filtration than screens, but because they are thicker there is greater mixing potential, and they typically result in increased pressure drop.

G

**GC:** Gas Chromatography. An analytical method incorporating an injection system, analytical column, controlled temperature zone, and detector. An inert carrier gas moves the sample through the column, which separates the sample components into discrete bands which are measured as they pass through the detector.

**Guard column:** a column used in series between the injector and analytical column to prevent certain types of components from entering the analytical column.

Н

**HPLC:** High Performance Liquid Chromatography. An analytical system consisting of an injector, pump, analytical column, and detector. Using a liquid mobile phase, the sample is pumped through the column, where it is separated into discrete sample component bands which are detected and measured as the bands elute from the column.

ID: internal diameter.

**Inert:** technically, unreactive with other substances; however, in the instrumentation field, "inert" is a relative term. Often polymers are termed inert but are soluble in some fluids and can react with some compounds.

**Internal fitting:** a type of compression fitting in which the fitting body has female threads; an internal *nut* has male threads.

L



**LC:** Liquid Chromatography. Any of a variety of low to medium pressure techniques which use a liquid mobile phase as the carrier to move sample. Similar to HPLC.

**Large bore:** a bore that is larger than the standard for a given fitting; a fitting ordered with a large bore will have a larger flow orifice than the standard or capillary bore fitting of the same design. Denoted by suffix "L" in the product number.

**Luer adapter:** an adapter that connects a tapered luer fitting (square nib) of a syringe to a tube or tube fitting.

#### M

Make up: the point at which a ferrule, nut, and tube are assembled in the fashion which will effect a leak-free seal. In most compression fittings, that is accomplished by compressing the tube with the small end of the ferrule. With Valco metal ferrules, the ferrule usually makes up on the tube by cutting a shallow ring in it.

Manifold: a type of distribution fitting in which a single source is directed to multiple outlets, or vice versa. CAUTION! Using a common distribution fitting in reverse to merge multiple streams may create dead volume. Special manifolds are available for this application.

Microbore column: a liquid chromatography column of narrow bore (typically 2 mm or less) for improved resolution.

#### Ν

**Nanovolume®:** a trademark registered to Valco Instruments Co. Inc, applied to our nanobore components with bore sizes less than 250 µm (0.010").

NPT: National Pipe Thread; a standardized tapered pipe fitting. See pipe thread.

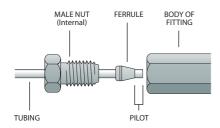
Nut: the tensioning component of a compression fitting. As the threaded nut is tightened into the fitting detail, it pushes the ferrule forward into the tapered ferrule seat, causing it to make up on the tube.

#### 0

**OD:** outside diameter.

#### P

**Pilot:** the tubing which extends beyond the ferrule in a made-up fitting, or the integral portion of a ZRF internal reducing ferrule which extends beyond the ferrule. See also **Pilot depth**.



Pilot depth: the length of the tubing diameter cavity beyond the tapered ferrule seat within a fitting detail. Valco fitting pilot depths are tightly controlled to facilitate the interchangeability of components without the risk of leaks or dead volume. The one exception is Cheminert high pressure valves with polymeric stators which have a longer pilot depth.

Pipe thread: the external or internal threads of a fitting designed to effect a metal-to-metal seal on the conical thread faces. This type of fitting does not "bottom out" in the detail. Typically used with PTFE tape or other compound to lubricate the threads; however, since the diffusion rate of air components through the PTFE tape is considerable, pipe fittings should not be used in systems where leakage rates are critical.

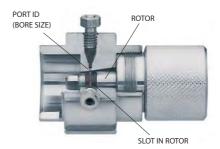
**Port:** the connection, orifice, seal, or septum, etc., through which sample may be added (injected) or withdrawn.

#### R

**Reducing ferrule:** a ferrule which allows a smaller tube to be used in a fitting detail designed for a larger tube. Caution should be taken if standard reducing ferrules (RF) without integral pilots are used, since dead volume may be created in the fitting pilot depth.

**Reducing union:** a fitting which joins two tubes of different ODs. The bore of the fitting should typically match the ID of the smaller tube.

**Rotor:** the internal rotating part of a Valco valve. It contains the engraved slots which connect the ports on the stator or cap.



Rotor visible in cutaway valve

**SFE:** Supercritical Fluid Extraction. An extraction technique using a fluid in its supercritical state as the extraction medium. Some liquids and mixtures maintained above a critical temperature and pressure exhibit properties of both the liquid and gas phases of the element. These are defined as supercritical. CO. is a common supercritical fluid. Extreme caution must be used with supercritical CO<sub>2</sub>, since uncontrolled expansion (leaks) can be very hazardous due to the substantial stored energy.

SFC: Supercritical Fluid Chromatography. An analytical technique using a supercritical fluid (see SFE) as the mobile phase/carrier.

**Screen:** a replaceable filter element generally made of Type 316 stainless steel, usually 0.003" thick. Screens clog less frequently than frits, and because they are thinner there is less mixing; however, they are less effective filters.

Sideloading: any force on the valve rotor other than the proper rotational force along the axis of the rotor, often resulting in leakage or increased wear. It is typically caused by actuation misalignment, over-rotation, or improper mounting of the valve.

Standard bore: a bore which was chosen as the standard for a particular fitting, typically based on the most common tubing ID used with that fitting.



**Standoff:** an extension between a valve and actuator which allows the valve to be installed in a different temperature zone than the actuator. Standoffs come in several different lengths.

**Stator:** the stationary component of a valve. Typically, it contains the fittings as well as one of the fluid sealing surfaces. In Valco valves, the stator is called the valve body.

#### Т

**Tee:** a type of distribution fitting which connects three pieces of tubing, arranging them in the pattern of a "T".

**Through-type bore:** a bore which is slightly larger than the OD of the tubing which is used with the given fitting. A union with a through-type bore allows the tube ends to butt directly together, or for one tube to run completely through the fitting. Denoted by suffix "T" in the product number. In order to assure correct pilot lengths, we recommend that ferrules be made up on the tubing in a standard union.

### U

**Union:** a fitting for connecting two pieces of tubing of the same OD.

**Unswept volume:** the volume of any portion of a fitting which is in the flowpath but which is a different diameter than the primary flow orifice through the tubing/fitting assembly, or any area not directly swept by the fluid flow. This can also be known as "dead volume" if it is very poorly swept.

#### W

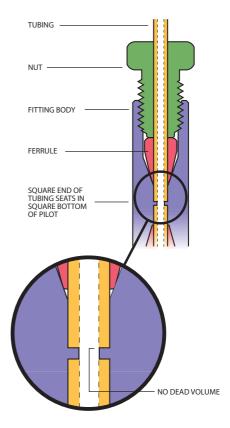
**Wetted surfaces:** the surfaces which are contacted by the sample stream.

### Υ

Y: a type of distribution fitting which connects three pieces of tubing, arranging them in the pattern of a "Y". Occasionally referred to as a "wye".

#### Z

**Zero dead volume (ZDV):** describes a connection which does not add volume to the system beyond what an extension of tubing would in its place.



**Zero volume:** while often used interchangeably with zero dead volume, it ideally describes a fitting design in which there is no internal volume, such as a through-type union designed to butt-fit two pieces of tubing.

	PRESS	URE CONV	ERSIONS					
	psi	KPa	BAR	Atm	psi	KPa	BAR	Atm
	1 10 20	68.948 137.896	0.06895 0.6895 1.379	0.06805 0.6805 1.361	800 825 850	5515.84 5688.21 5860.58	56.8837	
	30 40 50	206.844 275.792 344.74	2.0685 2.758 3.4475	2.0415 2.722 3.4025	875 900 925	6032.95 6205.32 6377.69	62.055	5 59.54375 61.245 5 62.94625
	60 70 80	413.688 482.636 551.584	4.137 4.8265 5.516	4.083 4.7635 5.444	950 975 1000	6550.06 6722.43 6894.8		64.6475 5 66.34875 68.05
LENGTH CONVERSIONS mm inches	90 100 125	620.532 689.48 861.85	6.2055 6.895 8.61875	6.1245 6.805 8.50625	1100 1200 1300	7584.28 8273.76 8963.24	75.845 82.74	74.855 81.66 88.465
0.12 .005" 0.15 .006"	150 175 200	1034.22 1206.59 1378.96	10.3425 12.06625 13.79	10.2075 11.90875 13.61	1400 1500 1600	9652.72 10342.2 11031.68	96.53 103.425	95.27 102.075 108.88
0.25 .010" 0.40 .016" 0.50 .020"	225 250 275	1551.33 1723.7 1896.07	17.2375 18.96125	15.31125 17.0125 18.71375	1700 1800 1900	11721.16 12410.64 13100.12	117.215 124.11	115.685 122.49 129.295
0.75 .030" 1.0 .040" 1.5 .060"	300 325 350	2068.44 2240.81 2413.18	24.1325	20.415 22.11625 23.8175	2000 2500 3000	13789.6 17237 20684.4	137.9 172.375 206.85	136.1 170.125 204.15
2.0 .080" 4.6 .180"	375 400 425	2585.55 2757.92 2930.29	25.85625 27.58 29.30375	27.22 28.92125	3500 4000 4500	24131.8 27579.2 31026.6	241.325 275.8 310.275	238.175 272.2 306.225
6.0 .236" 6.4 .253" 7.0 .276"	450 475 500	3102.66 3275.03 3447.4	31.0275 32.75125 34.475	30.6225 32.32375 34.025	5000 5500 6000	34474 37921.4 41368.8	344.75 379.225 413.7	340.25 374.275 408.3
10.0 .400" inches mm	525 550 575	3619.77 3792.14 3964.51	37.9225	35.72625 37.4275 39.12875	6500 7000 7500	44816.2 48263.6 51711	448.175 482.65 517.125	442.325 476.35 510.375
1/32" 0.8 1/16" 1.6 1/8" 3.2	600 625 650	4136.88 4309.25 4481.62	44.8175	40.83 42.53125 44.2325	8000 8500 9000	55158.4 58605.8 62053.2	551.6 586.075 620.55	544.4 578.425 612.45
1/4" 6.4 3/8" 9.5 1/2" 12.7 1" 25.4	675 700 725 750 775	4653.99 4826.36 4998.73 5171.1 5343.47	48.265 49.98875 51.7125	45.93375 47.635 49.33625 51.0375 52.73875	9500 10,000 15,000 20,000 40,000	65500.6 68947.6 103,421.4 137,895.1 275,790.3	1,378.95	646.475 680.46 1,020.69 1,360.9 2,721.84
					40,000	210,190.3	2,131.3	2,721.04

TEMPER	ATURE	CONV	ERSION	IS									
°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-40	-40	35	95	110	230	185	365	260	500	335	635	650	1202
-35	-31	40	104	115	239	190	374	265	509	340	644	675	1247
-30	-22	45	113	120	248	195	383	270	518	345	653	700	1292
-25	-13	50	122	125	257	200	392	275	527	350	662	725	1337
-20	-4	55	131	130	266	205	401	280	536	375	707	750	1382
-15	5	60	140	135	275	210	410	285	545	400	752	775	1427
-10	14	65	149	140	284	215	419	290	554	425	797	800	1472
-5	23	70	158	145	293	220	428	295	563	450	842	825	1517
0	32	75	167	150	302	225	437	300	572	475	887	850	1562
5	41	80	176	155	311	230	446	305	581	500	932	875	1607
10	50	85	185	160	320	235	455	310	590	525	977	900	1652
15	59	90	194	165	329	240	464	315	599	550	1022	925	1697
20	68	95	203	170	338	245	473	320	608	575	1067	950	1742
25	77	100	212	175	347	250	482	325	617	600	1112	975	1787
30	86	105	221	180	356	255	491	330	626	625	1157	1000	1832

### **REGULATIONS**





## REACH



As a worldwide supplier of products for the analytical instrument market, we work hard to make sure those products comply with regulatory requirements around the world. All machined products (valves, fittings, etc.) are fully RoHS/REACH/WEEE\* compliant. Most of the electrical products we manufacture are also CE tested and certified. Only a few legacy products are not CE certified.

Following is a list of items in this catalog which are *not* CE and/or RoHS compliant:

Cheminert® flanging toolspage	70
Cheminert starter kits	70
Digital valve interface	
DVI1	99
DVI-2201	99
Diluter/dispenser, M series	82
Dynacalibrator® Model 1202	30
G-calibrators (all)2	33
Heated valve enclosures (all)2	01
Heated column enclosures (all)2	03
Heater assemblies and cartridges (all)2	02
Instrumentation temperature controller	
ITC103992	03
ITC10399-2002	.03

\* CE Conformité Européene (European Conformity)

REACH Registration, Evaluation, Authorization, and Restriction of Chemical Substances

ROHS Restriction of Hazardous Substances
Directive

WEEE Waste Electrical and Electronic
Equipment Directive

#### **PATENTS**

Among important US patents held by VICI are the following. Others are pending and may have been granted by the time of publication.

publication.	
6,575,501	Tube sealing bushing (collapsible bushing
6,247,731	Nut w/ controlled radius
6,511,528 6,099,619 5,858,068	Purification of CO <sub>2</sub>
6,074,459	Ultra pure gas process
6,193,213	XL valves
6,030,436	Permeation tube
6,202,698	Diaphragm valve
5,153,519 5,317,271 5,394,090 5,394,091 5,394,092 5,541,519 5,532,599 5,528,150 5,594,346 5,767,683 5,858,068 6,133,740 6,842,008 6,933,771 7,091,044 7,507,586 7,601,543	Pulsed discharge detectors
5,329,966	Calibrated flow controllers
4,064,908	Combo valves
7,316,777	No-twist one-piece fitting
7,442,902	Adaptive temperature controller

### **TRADEMARKS**

INAULIMANN	•
Cheminert	Valco Instruments Co. Inc. and VICI AG International
Conduna	VICI Metronics Inc.
Condyne Delrin	E.I. duPont de Nemours
Dynacal	VICI Metronics Inc.
Dynacalibrator	VICI Metronics Inc.
Fortron	Fortron Industries Corp.
Hamilton	Hamilton Company
Hastelloy C	Haynes International Inc.
HayeSep	Hayes Separations, Inc.
IBM	International Business
IDIVI	Machines
Inconel 600	Huntington Alloys, Inc.
Kalrez	DuPont Dow Elastomers
Kel-F	3M Company
Kynar	Elf Atochem North America
Tyriai	Inc.
Metronics	VICI Metronics Inc.
Micro-Flo	Valco Instruments Co. Inc.
Mininert	Valco Instruments Co. Inc.
Monel	Inco Alloys Intl Inc.
Nanovolume	Valco Instruments Co. Inc.
Nickel 200	Inco Alloys Intl Inc
Nitronic	AK Steel Corporation
Parker	Parker Hannifin Co.
PEEK	Victrex Manufacturing Ltd.
Perifit	Valco Instruments Co. Inc.
Pressure-Flo	Valco Instruments Co. Inc.
Pressure-Lok	Valco Instruments Co. Inc.
Ryton	Phillips Petroleum Co.
Swagelok	Crawford Fitting Company
Teflon	E.I. duPont de Nemours
Tefzel	E.I. duPont de Nemours
Tygon	Saint-Gobain Performance
	Plastics
Valco	Valco Instruments Co. Inc.
	and VICI AG International
ValcoBond	Valco Instruments Co. Inc.
ValcoPLOT	Valco Instruments Co. Inc.
Vespel	E.I. duPont de Nemours
Viton	DuPont Performance
	Elastomers
VICI	Valco Instruments Co. Inc.
VICLI	and VICI AG International
VICI Jour	Valco Instruments Co. Inc.
Mataus	and VICI AG International Waters Associates
Waters	vvaters Associates



**Cheminert valve** product numbers all begin with the valve model (C1, C22, C25Z, C72MU, etc.) and a hyphen. Following the valve model are four numbers - as shown at right, the position of each number determines the category of the specification; the number indicates the actual spec. The final letters

indicate actuation. Internal sample injectors also include the sample size. (Keep in mind that some combinations are not possible, so check with sales for your actual requirements.)

#### NOTE!

This chart is for decoding existing product numbers, not for inventing new ones. Some options can not work with certain valve types and designs!

#### **VALVE TYPE** 1. Required. **UHPLC** injectors Low pressure injectors C72MH 10k psi Nanovolume® injector, 360 µm fittings C22Z Injector with Valco ZDV fittings C72MX 15k psi Nanovolume® injector, 360 µm fittings C22 Injector with 1/4-28 fittings C72MU 20k psi Nanovolume® injector, 360 µm fittings Internal sample injector, Valco ZDV fittings C24Z Internal sample injector, 1/4-28 fittings C72NH 10k psi Nanovolume® injector, 1/32" fittings C24 C72NX 15k psi Nanovolume® injector, 1/32" fittings **UHPLC** selectors C72NU 20k psi Nanovolume® injector, 1/32" fittings C75NH 10k psi Nanovolume® selector, 1/32" fittings C74NX 15 psi Nanovolume® internal sample C75NX 15k psi Nanovolume® selector, 1/32" fittings injector, 1/32" fittings C75NU 20k psi Nanovolume® selector, 1/32" fittings C72H 10k psi Microbore injector C75H 10k psi Microbore selector C72X 15k psi Microbore injector C75X 15k psi Microbore selector C72U 20k psi Microbore injector C75U 20k psi Microbore selector C74H 10k psi Internal sample injector **HPLC** selectors C74X 15k psi Internal sample injector C5 5k psi Stream selector **HPLC** injectors Low pressure selectors C2N 5k psi Nanovolume® injector, 1/32" fittings C25Z Stream selector, Valco ZDV fittings C4N 5k psi Nanovolume® internal sample injector, 1/32" fittings C25 Stream selector, 1/4-28 fittings Through-the-handle injector C1 5k psi C25G Stream selector, Cheminert fittings C1CF 5k psi Continuous flow through-the-C45 Stream selector, 1/2-20 fittings handle injector C25k psi Microbore/analytical valve C4 5k psi Internal sample injector Note: All valves have 1/16" Valco ZDV fittings C6 Continuous flow injector unless otherwise noted. 5k psi **OEM** injectors **OEM selectors** C2V 5k psi Vertical port injector C55 5k psi HPLC integrated motor/valve selector C3 5k psi Centered port injector C65Z Low pressure integrated motor/valve selector, Valco ZDV fittings C52 5k psi HPLC integrated motor/valve C65 Low pressure integrated motor/valve selector, C52V 5k psi HPLC integrated motor/valve 1/4-28 fittings with vertical port injector C62Z Low pressure integrated motor/valve, Valco ZDV fittings Low pressure integrated motor/valve, 1/4-28 fittings

### (HYPHEN)

#### 2. Required.

Place a hyphen after the Cheminert valve type.

C62

### **Examples:**

C1 - 1346

C1 through-the-handle injector, 0.25 mm ports, Valcon E rotor, PAEK stator, 6 ports, manual (blank = manual)

C5 - 2006 EMH

#### C5-2006EMH:

C5 stream selector, 0.40 mm ports, Valcon H rotor, Nitronic 60 stator, 6 positions, microelectric actuator

C22Z - 3 1 8 0 EUHA

#### C22Z-3180EUHA:

C22Z low pressure injector with ZDV fittings, 0.75 mm ports, Valcon E2 rotor, PPS stator, 10 ports, universal actuator with RS-232 interface

C74NX - 6 6 7 4 -.01 EH

#### C74NX-6674-.01EH:

C74NX UHPLC nanovolume internal sample injector rated at 15,000 psi, 150 micron ports (.006"), Valcon E3 rotor, coated stainless stator, 4 ports, 10 nl internal sample size, microelectric actuator

## SIZE 3. Required. 0 0.15 mm (.006") 1 0.25 mm (.010") 2 50 μm (.002")\* 0.40 mm (.016") 3 0.75 mm (.030") 4 100 µm (.004")\* 1.00 mm (.040") 5 1.25 mm (.050") 150 μm (.006")\* 1.50 mm (.060") 7 2.00 mm (.080") 3.18 mm (.125") 4.60 mm (.180")

\* for nanovolume

valves

#### **STATOR ROTOR MATERIAL MATERIAL** 4. Required. 5. Required. 0 Nitronic 60 0 Valcon H Valcon E2 CTFE Valcon T Hastelloy C\*\* 3 Titanium \*\* Valcon E Valcon M PAEK 5 Valcon E4 [not used] Valcon F3 [not used] Valcon TF (low pressure) Valcon P Coated stainless \*\*\* Valcon X 8 PPS Coated stainless \*\* These stator materials are coated when in a C72 / C74 / C75 series valve \*\*\* Stator code "7" indicates coated stainless for C72 / C74 / C75 series valves

## PORTS / **POSITIONS** 6. Required. **Ports** (Two position) **Positions** (Selectors) 14 20 24 26 28

4 4

6 6

8 8

0 10

4

6 6

0 10

8 8

14

20

24

26

28

	ITERNAL SAMPLE SIZE
	otional. ernal sample inj.
.004	0.004 µl (4 nl)
.01	0.01 µl (10 nl)
.02	0.02 µl (20 nl)
.05	0.05 µl (50 nl)
.1	0.1 μΙ
.2	0.2 μΙ
.5	0.5 μΙ
1	1.0 μΙ
2	2.0 μΙ
befo	a hyphen (-) re the sample in the product ber.

	ACTUATOR				
inj.	8. Required.				
(4 nl) I0 nl)	<b>Air</b> A 0-70°C				
20 nl)	Microelectric, two position EQ • highest speed				
50 nl)	EH • high speed EP • medium torque				
	ED • high torque ET • highest torque				
( )	Microelectric, for selectors EMH • high speed EMT • high torque				
(-) nple duct	<b>Universal</b> See chart below.				
	Manual [blank] (no code letter; shipped with knob)				
	<b>Driver only</b> D (for use with existing actuator)				

#### NOTE!

This chart is for decoding existing product numbers, **not** for inventing new ones. Some options can not work with certain valve types and designs!

UNIVERSAL ACTUATORS									
	High speed	Medium speed/ medium torque	High torque						
Without interface	EUH	EUD	EUT						
With RS-232/485	EUHA	EUDA	EUTA						
With USB	EUHB	EUDB	EUTB						
With BCD	EUHC	EUDC	EUTC						



The simplest way to determine a **Valco two position valve** product number is to call our sales department and discuss the features you require. But if you want to decipher an existing product number, refer to this chart and the examples on the facing page for guidelines. (Keep in mind that some combinations are not possible, so check with sales for your actual requirements.)

Every letter and number has a meaning in its proper order and sequence. The shaded columns indicate codes that are required in every product number, and the non-shaded columns offer possibilities of optional features.

#### NOTE!

This chart is for decoding existing product numbers, **not** for inventing new ones. Some options can not work with certain valve types and designs!

#### **ACTUATOR**

#### 1. Required.

Valve is shipped with manual knob unless specified otherwise.

#### Air

A 0-70°C AT 50-150°C

#### Microelectric

EH • high speed EP • medium

torque

• high torqueET• highest torque

#### Universal

See chart below.

#### Manual

[blank] (no code letter; wshipped with knob)

#### **Driver only**

(for use with existing actuator)

#### STANDOFF ASSEMBLY LENGTH

2. Optional. Specify if required.

2 2" standoff

3 3" standoff

4 4" standoff

6 6" standoff

BORE SIZE

3. Optional.

For standard bore, leave blank.

[blank] Standard bore

L Large bore

#### FITTINGS SIZE

## 4. **Required**.

For 1/8" fittings, leave blank.

N 1/32" C 1/16"

[blank] 1/8" VL 1/4"

### INTERNAL SAMPLE

5. Optional.

Requires 4 ports. Also specify sample size (9).

I

#### **UNIVERSAL ACTUATORS High torque High speed** Medium speed/ medium torque Without interface EUH EUD EUT **EUDA** With RS-232/485 FUHA FUTA With USB **EUHB EUDB EUTB** With BCD **EUHC EUDC EUTC**

*Note:* Valco valve product numbers require "-" (hyphen) after the universal actuator code.

### **Examples:**

## 4 N 8 W T

#### 4N8WT

 $Manual \ (blank = manual), 4" \ standoff, standard \ bore, 1/32" \ valve, 8 \ ports, \\ W \ type, Valcon T \ rotor, standard \ Nitronic 60 \ body$ 

## EH C | 4 W E .1

#### EHCI4WE.1:

Microelectric actuator, no standoff assembly, standard bore, 1/16" valve, internal sample, 4 ports, W type, Valcon E rotor, standard N60 body, 0.1  $\mu$ l sample

## A 3 6 UW E HC

#### A36UWEHC:

Air actuator, 3" standoff, standard bore, 1/8" (blank = 1/8"), 6 ports, UW type, Valcon E rotor, Hastelloy C body material

## **EUDC-2L6UWE**

#### **EUDC-2L6UWE:**

Universal actuator with BCD interface, 2" standoff, large bore (.067" instead of .030"), 1/8" (blank = 1/8"), 6 ports, UW type, Valcon E rotor, standard Nitronic 60 body

NUMBER OF PORTS			
6. <b>Required</b> .			
3			
4			
6			
8			
10			
12			
14			

VALVE TYPE
7. Required.
W
UW
MW

8. Required.			
[blank]	Valcon H		
Е	Valcon E		
E2	Valcon E2		
Μ	Valcon M		
Р	Valcon P		
R	Valcon R		
Т	Valcon T		
TF	Valcon TF		

MATERIAL

SPECIAL BODY MATERIAL			
9. C	ptional.		
Body material is Nitronic 60 SS unles specified otherwise.			
S6	Type 316 SS		
HC	Hastelloy C		
IN	Inconel 600		
M4	Monel 400		
NI	Nickel 200		
N5	Nitronic 50		
TI	Titanium		

INTERNAL SAMPLE SIZE		
10. Optional. Also specify "I" at Item 5.		
.06	0.06 µl	
.1	0.1 µl	
.2	0.2 μΙ	
.5	0.5 µl	
1	1.0 µl	
2	2.0 µl	
Put a hyphen (-) before the sample size in the product number.		

#### **TECH TIP**

The letter "C" after number of ports specifies smaller bore than standard. Example:

DC6**C**W,

bore size 0.25 mm

#### NOTE:

This chart is for decoding existing product numbers, **not** for inventing new ones. Some options can not work with certain valve types and designs!



Product numbers for Valco selectors, like those for two position valves, are composed of letters and numbers which have their meaning based on the position in the product number. The simplest way to determine a Valco valve product number is to call our sales department and discuss the features you require. The chart below and the examples opposite may help decode the product number you have, or direct you toward all the features you must specify for a selector. (Keep in mind that some combinations are not possible, so check with sales for your actual requirements.)

The shaded columns indicate codes that are required in every product number, and the non-shaded columns offer possibilities of optional features.

#### NOTE!

This chart is for decoding existing product numbers, *not* for inventing new ones. Some options can not work with certain valve types and designs!

## **ACTUATOR** 1. Required. Valve is shipped with manual knob unless specified otherwise.

Air 0-70°C AΗ high torque 50-150°C ΑT

Microelectric EMH • high speed

EMT • high torque Universal

See chart below.

Manual [blank] (not recommended)

**Driver only** (for use with existing actuator)

### **STANDOFF** ASSEMBLY LENGTH

2. Optional. Specify if required.

2 2" standoff 3 3" standoff

4" standoff

6 6" standoff

### **BORE** SIZE

3. Optional. For standard bore, leave blank.

[blank] Standard bore

Large bore

### **FITTINGS** SIZE

4. Required. For 1/8" fittings, leave blank.

1/16"  $\mathcal{C}$ [blank] 1/8" VL 1/4"

5. Required. SD SC SF ST STF

UNIVERSAL ACTUATORS			
	High speed	Medium speed/ medium torque	High torque
Without interface	EUH	EUD	EUT
With RS-232/485	EUHA	EUDA	EUTA
With USB	EUHB	EUDB	EUTB
With BCD	EUHC	EUDC	EUTC

Note: Valco valve product numbers require "-" (hyphen) after the universal actuator code.

**Examples:** 

## A 2 VL SC 6 MW E2

#### A2VLSC6MWE2:

Air actuated, 2" standoff, 1/4" valve, SC flowpath, 6 positions, MW type, Valcon E2 rotor, standard Nitronic 60 body

## UMT 4 C SD 4 UW

#### UMT4CSD4UW:

Modular universal actuator, 4" standoff, 1/16" valve, SD flowpath, 4 positions, UW type, Valcon H (blank = H) rotor, standard N60 body

## EUT- 3 ST 10 MW T HC

#### **EUT3ST10MWTHC:**

Universal actuator with no interface, 3" standoff, 1/8" (blank = 1/8") valve, ST flowpath, 10 positions, MW type, Valcon T rotor, Hastelloy C body

NUMBER OF POSITIONS			
6. <b>Required</b> .			
4			
6			
8			
10			
12			
16			

VALVE TYPE			
7. Required.			
MW Low pressure			
UW high pressure			

8. Required.				
[blank]	Valcon H			
Е	Valcon E			
E2	Valcon E2			
М	Valcon M			
Р	Valcon P			
R	Valcon R			
Т	Valcon T			
TF	Valcon TF			

ROTOR MATERIAL

SPECIAL BODY MATERIAL			
9. Optional.  Body material is  Nitronic 60 SS unless specified otherwise.			
S6	Type 316 SS		
НС	Hastelloy C		
IN	Inconel 600		
M4	Monel 400		
NI	Nickel 200		
N5	Nitronic 50		
TI Titanium			

#### **TECH TIP**

The letter "C" after number of ports specifies smaller bore than standard. Example: DCSD6**C**MWE,

bore size 0.25 mm

#### NOTE

This chart is for decoding existing product numbers, **not** for inventing new ones. Some options can not work with certain valve types and designs!

.2FR.5-5 53,60	2FR4HC-1045,53	4C6WT 110	A2NI4WE.1104
.5FR.5-5 53,60	2FR4TI-1045,53	4C8UWE109	A2NI4WE.2 104
.5FR1-1053	2FR645	4C8UWT111	A2NI4WE.5 104
.5FR1HC-10	2FR6HC45	4C8WE108	A2SC10MWE127
.5FR2-10	2FR6TI	4C8WT	A2SC12MWE
.5FR2HC-10	2FR845	4N10WE	A2SC16MWE 127
.5FR4-10 45,53	2I4UWE.2	4N10WT107	A2SD10MWE125
.5SR.5-1053	2I4UWE.5	4N4WE	A2SD12MWE125
.5SR1-1053	2l4UWE1105	4N4WT 107	A2SD16MWE125
.5SR2-1053	2I4UWE2	4N6WE	A2SD6MWE
.5SR4-10			A2SF10MWE
	2L10UW	4N6WT	
10FR1-10 45,53	2NI4WE.06104	4N8WE	A2SF12MWE129
10FR2-10 45,53	2NI4WE.1	4N8WT	A2SF16MWE129
10FR4-10 45,53	2NI4WE.2	4SOA 205	A2ST10MWE131
10FR4HC-10	2NI4WE.5	4SOAMP205	A2ST12MWE131
10SR.5-1053	2RAD	4SOAMPCP83	A2ST16MWE
10SR1-1053	2SC10MWE 127	4SOUTH	A2STF10MWE
10SR2-1053	2SC12MWE 127	4SOUTHMP205	A2STF12MWE133
10SR4-10	2SC16MWE 127	4SOWK 205	A2STF16MWE133
1FR2-1053	2SC6MWE 127	4SOWKMP205	A30 197
1FR2HC-1053	2SD10MWE125	4SOWKMP205	A304 197
1SR.5-1053	2SD12MWE	4UW117	A30S 197
1SR1-1053	2SD16MWE125	4UWE112	A36 197
1SR2-1053	2SD6MWE 125	4VL4MWE2	A364 197
1SR4-1053	2SF10MWE 129	4VL6MWE2	A36S 197
210UW 117	2SF12MWE 129	4VL8MWE2	A4 196
2301233	2SF16MWE	6SOAMPCP83	A410UWE
2310-10		6UW117	A410UWT
	2SF6MWE		
2310-20 233	2SOA 205	6UWE 112	A42 196
2330-10 233	2SOA 205	8UW 117	A44UWE112
2330-20 233	2SOAMMP	8UWE 112	A44UWT113
2CI4UWE.2105	2SOAMMP	A10196	A45197
2CI4UWE.5	2SOAMP	A102	A454
2CI4UWE1 105	2SOAMP205	A10S 196	A45S 197
2CI4UWE2 105	2SOAMP205	A10UW	A46UWE112
2CI4WE.06	2SOAMP	A12 196	A46UWT113
2CI4WE.1	2SOAMP	A122	A48UWE112
2CI4WE.2	2SOAMPCP83	A12S	A48UWT113
2CI4WE.5			A4C10UWE
	2SR.5-1053	A16196	
2CSC10MWE	2SR1-1053	A162 196	A4C10UWT
2CSC12MWE	2SR2-1053	A16S 196	A4C10WE108
2CSC16MWE	2SR4-10	A2CI4UWE.2 105	A4C10WT110
2CSC6MWE 126	2ST10MWE 131	A2CI4UWE.5 105	A4C4UWE 109
2CSD10MWE124	2ST12MWE	A2CI4UWE1	A4C4UWT 111
2CSD12MWE124	2ST16MWE 131	A2CI4UWE2105	A4C4WE108
2CSD16MWE124	2ST6MWE 131	A2CI4WE.06104	A4C4WT110
2CSD6MWE124	2STF10MWE 133	A2CI4WE.1104	A4C6UWE 109
2CSF10MWE128	2STF12MWE 133	A2CI4WE.2104	A4C6UWT
2CSF12MWE128	2STF16MWE	A2CI4WE.5	A4C6WE108
			A4C6WT
2CSF16MWE	2STF6MWE	A2CSC10MWE	
2CSF6MWE	3SOAMPCP83	A2CSC12MWE	A4C8UWE
2CST10MWE130	410UWE	A2CSC16MWE 126	A4C8UWT
2CST12MWE130	410UWT	A2CSD10MWE 124	A4C8WE108
2CST16MWE130	44UWE	A2CSD12MWE 124	A4C8WT110
2CST6MWE	44UWT	A2CSD16MWE 124	A4N10WE106
2CSTF10MWE132	46UWE		A4N10WT
		A2CSD6MWE	
2CSTF12MWE	46UWT	A2CSF10MWE128	A4N4WE106
2CSTF16MWE132	48UWE	A2CSF12MWE128	A4N4WT 107
2CSTF6MWE	48UWT	A2CSF16MWE128	A4N6WE106
2FR.5-5 53,60	4C10UWE109	A2CST10MWE130	A4N6WT107
2FR1-10	4C10UWT111	A2CST12MWE130	A4N8WE
2FR1HC-10	4C10WE	A2CST16MWE	A4N8WT
2FR1K45	4C10WT	A2CSTF10MWE 132	A4S
2FR1KHC45	4C4UWE109	A2CSTF12MWE 132	A4UW 117
2FR1KTI45	4C4UWT111	A2CSTF16MWE 132	A4VL4MWE2112
2FR1TI-1045,53	4C4WE108	A2I4UWE.2105	A4VL6MWE2112
2FR2-10	4C4WT	A2I4UWE.5	A4VL8MWE2112
2FR2HC-10	4C6UWE	A2I4UWE1	A6196
2FR2TI-1045,53	4C6UWT111	A2I4UWE2 105	A60197
2FR4-10 45,53	4C6WE108	A2NI4WE.06 104	A604
	•		•

A60S 197	ASFVO2HT4 213	C-2C38H163	C1-13R6
A62 196	ASFVO40K.5	C-2C40H163	C1-20R6
A6S 196	ASFVO40K185	C-2C44	C1-23R6
A6UW 117	ASFVO40K36085	C-2C46	C10UW
A8196	ASFVOD40K.585	C-2C48H	C10UWE
A82196	ASFVOD40K1	C-BOT16	C10W115
A8S 196	ASFVOD40K36085	C-BOT3281	C10WE 108
A8UW 117	ASFVOHT213	C-EN.5FPKB59	C12-310
A90 197	ASFVOHT4 213	C-F1.5Tl78	C12-314
A904 197	ASFVOL213	C-LFP41	C12-316 166
A90S	ASFVOLHT	C-LZP1PK64	C12-318
AC10UW	ASFVOLHT4	C-MPFTI10	C15-310
AC10W	AT10196	C-MPFTI2	C1CF-1C06
AC4UW116	AT104 196	C-MPR281	C1CF-1C46162
AC4W 115	AT10S 196	C-MPR381	C1CF-2C06165
AC6UW116	AT12 196	C-MZP1PK	C1CF-2C46165
AC6W 115	AT124 196	C-NEF.5FPK.15S161	C1CFI-1006 162
AC8UW116	AT12S 196	C-NEF.5FPK.20S1	C1CFI-1346 162
AC8W 115	AT16	C-NEF.5FPK.25S161	C1CFI-2006
ACI4UW.2114	AT164 196	C-NEF.5FPK.30S1 61	C1CFI-2346 165
ACI4UW.5114	AT16S 196	C-NEF.5FPK.35S1	C2-1004
ACI4UW1	AT30 197	C-NEF.5XFPK.15S161	C2-1004A160
ACI4UW2	AT302 197	C-NEF.5XFPK.20S161	C2-1004D160
ACI4W.06	AT30S	C-NEF.5XFPK.25S161	C2-1004EH160
ACI4W.1	AT36197	C-NEF.5XFPK.30S161	C2-1006 160
ACI4W.2	AT362 197	C-NEF.5XFPK.35S161	C2-1006A
ACI4W.5	AT36S 197	C-NERU1FPK59	C2-1006D160
ACSD10UW	AT4196	C-NEU.5FPK59	C2-1006EH160
ACSD4UW 134	AT44 196	C-NEU.5FPK.1560	C2-1034 160
ACSD6UW 134	AT45 197	C-NEU.5FPK.2060	C2-1034A160
ACST4UW135	AT452 197	C-NEU.5FPK.2560	C2-1034D160
ACST6UW	AT45S 197	C-NEU.5FPK.3060	C2-1034EH
AH2CSC6MWE	AT4S196	C-NEU.5FPK.3560	C2-1036
AH2CSF6MWE 128	AT6196	C-NEU.5XFPK59	C2-1036A160
AH2CST6MWE 130	AT60 197	C-NEU.5XFPK.15	C2-1036D160
AH2CSTF6MWE132	AT602 197	C-NEU.5XFPK.20	C2-1036EH160
AH2SC6MWE 127	AT60S 197	C-NEU.5XFPK.25	C2-10R0H160, 180
AH2SF6MWE	AT64196	C-NEU.5XFPK.3060	C2-10R4
AH2ST6MWE	AT6S196	C-NEU.5XFPK.3560	C2-10R6 160, 180, 181
AH2STF6MWE 133	AT8196	C-NL S1.1561	C2-10R8H160, 180
AH2VLSC4MWE2 127	AT84 196	C-NL.15L-560	C2-1344 160
AH2VLSC6MWE2127	AT8S 196	C-NL.15S-560	C2-1344A160
AH2VLSC8MWE2 127	AT90 197	C-NL.20L-560	C2-1344D160
AH2VLSD10MWE2 125	AT902 197	C-NL.20S-560	C2-1344EH160
AH2VLSD4MWE2125	AT90S 197	C-NL.25L-560	C2-1346 160
AH2VLSD6MWE2	BNV1	C-NL.25S-5	C2-1346A
	DNV1 D		
AH2VLSD8MWE2	BNV1-D	C-NL.30L-560	C2-1346D
AH2VLSF4MWE2	BNV1-KZ	C-NL.30S-560	C2-1346EH160
AH2VLSF6MWE2129	BNV1LF 218	C-NL.35L-560	C2-13R0H160, 180
AH2VLSF8MWE2129	BNV1LF-D 218	C-NL.35S-560	C2-13R4
AL10UW118	BNV1LF-KZ 218	C-NLS1.2061	C2-13R6 160, 162, 180, 181
AL4UW	C-1C00H160	C-NLS1.2561	C2-13R8H160,180
AL6UW 118	C-1C04	C-NLS1.3061	C2-2004
AL8UW 118	C-1C06	C-NLS1.35	C2-2004A
ASD4UW	C-1C08H	C-NNFFPK	C2-2004A
ASD6UW	C-1C30H	C-NPFPK59	C2-2004EH163
ASD8UW134	C-1C34 160	C-NTFPK59	C2-2006 163
ASFV 213	C-1C36 160	C-NTXFPK59	C2-2006A163
ASFV2HT 213	C-1C38H160	C-NXFPK59	C2-2006D163
ASFV2HT4 213	C-1C40H160	C-NXXFPK59	C2-2006EH
ASFV40K.585	C-1C44	C-NYFPK59	C2-2034
ASFV40K185	C-1C46	C-NYXFPK59	C2-2034
ASFV40K36085	C-1C48H	C-PF	C2-2034D
ASFVHT 213	C-2C00H163	C-PFL78	C2-2034EH163
ASFVHT4 213	C-2C04	C-PFM	C2-2036
ASFVL 213	C-2C06	C-PFS78	C2-2036A163
ASFVLHT 213	C-2C08H163	C-VISF-1	C2-2036D163
ASFVLHT4	C-2C30H	C-VISF-1H40	C2-2036EH
ASFVO	C-2C34	C-ZP1FPK	C2-20R0H163
ASFVO	C-2C34 163	C1-10R6	C2-20R0H163, 182
AJI VOZIII	C 2C30 103	C1-10N0	CZ ZUNT103, 102

C2-20R6 163, 165, 182, 183	C22Z-3184EH166	C25-6184EMH 177	C2H-2000163
C2-20R8H163, 182	C22Z-3186166	C25-6186 177	C2H-2000A 163
C2-23R0H163,182	C22Z-3186A 166	C25-6186A177	C2H-2000D
C2-23R4	C22Z-3186D 166	C25-6186D 177	C2H-2000EH
C2-23R6	C22Z-3186EH	C25-6186EMH 177	C2H-2008
C2-23R6 165, 182, 183	C22Z-3188166	C25-6188 177	C2H-2008A 163
C2-23R8H163, 182	C22Z-3188A 166	C25-6188A 177	C2H-2008D 163
C2-2344	C22Z-3188D 166	C25-6188D 177	C2H-2008EH 163
C2-2344A163	C22Z-3188EH 166	C25-6188EMH 177	C2H-2030163
C2-2344D	C22Z-380	C25-680 177	C2H-2030A
C2-2344EH163	C22Z-384166	C25-684 177	C2H-2030D 163
C2-2346 163	C22Z-386166	C25-686 177	C2H-2030EH 163
C2-2346A	C22Z-388166	C25-688 177	C2H-2038 163
C2-2346D	C24-10R2168	C25G-24520D	C2H-2038A 163
C2-2346EH	C24-10R5	C25G-24520EMT	C2H-2038D
	· ·		
C22-310 167	C24-10R-1168,169	C25G-24524D178	C2H-2038EH 163
C22-314 167	C24-10R-2	C25G-24524EMT178	C2H-2340163
C22-316 167	C24-1C8 169	C25G-24528D178	C2H-2340A 163
C22-318	C24-21845	C25G-24528EMT	C2H-2340D
C22-3180			C2H-2340EH
	C24-21845A	C25G-24R20	
C22-3180A167	C24-21845D 169	C25G-24R24 178	C2H-2348163
C22-3180D 167	C24-21845EH 169	C25G-24R28 178	C2H-2348A 163
C22-3180EH 167	C24-2184-1 169	C25G-2C520 178	C2H-2348D 163
C22-3184 167	C24-2184-1A169	C25G-2C524 178	C2H-2348EH 163
C22-3184A	C24-2184-1D 169	C25G-2C528	C2N-4000
C22-3184D 167	C24-2184-1EH 169	C25Z-3180176	C2N-4000D
C22-3184EH 167	C24-2184-2 169	C25Z-3180A 176	C2N-4000EH
C22-3186 167	C24-2184-2A169	C25Z-3180D 176	C2N-4006 158
C22-3186A	C24-2184-2D169	C25Z-3180EMH 176	C2N-4006D
C22-3186D 167	C24-2184-2EH	C25Z-31814	C2N-4006EH
C22-3186EH 167	C24Z-1C8168	C25Z-31814A 176	C2N-40R0158
C22-3188 167	C24Z-21 21845D 168	C25Z-31814D176	C2N-40R6 158
C22-3188A167	C24Z-21842	C25Z-31814EMH 176	C2N-4340158
C22-3188D 167	C24Z-21842D	C25Z-3186	C2N-4340D
C22-3188EH 167	C24Z-21845D	C25Z-3186A 176	C2N-4340EH
C22-380 167	C24Z-2184-1D 168	C25Z-3186D 176	C2N-4346158
C22-384 167	C24Z-2184-1D 168	C25Z-3186EMH 176	C2N-4346D 158
C22-386 167	C25-310 177	C25Z-3188176	C2N-4346EH 158
C22-388	C25-314 177	C25Z-3188A 176	C2N-43R0158
C22-610	C25-316	C25Z-3188D 176	C2N-43R6
C22-614 167	C25-3180 177	C25Z-3188EMH 176	C2N-4C00158
C22-616	C25-3180A 177	C25Z-325176	C2N-4C06158
C22-618 167	C25-3180D 177	C25Z-380176	C2N-4C40158
C22-6180 167	C25-3180EMH 177	C25Z-38-14	C2N-4C46158
C22-6180A	C25-3184A	C25Z-386	C2V-1006
C22-6180D 167	C25-3184D 177	C25Z-388176	C2V-1006A 181
C22-6180EH 167	C25-3184EMH 177	C2H-1008A 160	C2V-1006D 181
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	CRUMIKE 73	CEL 100	CEC 402010 010D 226
C74NX-667401A 155	CBUMKF73	CFL-1BR68	CFS-A03018-010B 236
C74NX-667401D	CBUMPK73	CFL-1DG68	CFS-A03018-018B
C74NX-667401EH 155	CBUMS673	CFL-1E68	CFS-A03018-040B
C74NX-667402 155	CBUPK73	CFL-1G	CFS-A03018-100B
C74NX-667402A 155	CBUS673	CFL-1L	CFS-A03025-010B
C74NX-667402D 155	CCKF-571	CFL-1N68	CFS-A03025-025B
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C74NX-667403A 155	CD50-8182-M2A	CFL-1R68	CFS-A03025-150B 236
C74NX-667403D	CEF1	CFL-1W	CFS-A03032-010B
C74NX-667403EH 155	CEF1.543	CFL-1Y68	CFS-A03032-025B
C74X-167402 157	CEF1.5F43	CFL-2A68	CFS-A03032-032B
C74X-167402A 157	CEF1F43	CFL-2A-PK	CFS-A03032-050B
C74X-167402D 157	CEF2.51.0	CFL-2BE68	CFS-A03032-100B
C74X-167402EH 157	CEF2.51.0F	CFL-2BK	CFS-A03032-200B
C74X-167405 157	CEF211.043	CFL-2BR68	CFS-A03032-300B
C74X-167405A 157	CEF211.0F	CFL-2DG68	CFS-A03032-400B
C74X-167405D 157	CEF212.0	CFL-2E68	CFS-A03032-500B
C74X-167405EH 157	CEF212.0F	CFL-2G	CFS-A03053-015B 236
C74X-16741	CEF412.1	CFL-2L	CFS-A03053-050B
C74X-16741A 157	CEF412.1F44	CFL-2N68	CFS-A03053-100B
C74X-16741D 157	CEF413.044	CFL-2P68	CFS-A03053-150B
C74X-16741EH	CEF413.0F	CFL-2PK	CFS-A03053-300B
C75-16R0 173	CEF414.0	CFL-2R68	CFS-A03053-500B 236
C75-16R6	CEF414.0F	CFL-2W	CFS-A04018-018B
C75-16R8 173	CEF414.644	CFL-2Y68	CFS-A04018-040B
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C75N-66R8 172	CF-1E69	CFPA4PK77	CFS-A06053-100B
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C75N-6C76 172			CFS-A06053-150B
	CF-1L69	CFS-A01010-020B 236	CFS-A06053-150B
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C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172	CF-1N .69 CF-1P .69 CF-1R .69 CF-1W .69 CF-1Y .69 CF-2A .69 CF-2BE .69	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172         C75NX-6678A       172	CF-1N	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236         CFS-A01525-100B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172	CF-1N .69 CF-1P .69 CF-1R .69 CF-1W .69 CF-1Y .69 CF-2A .69 CF-2BE .69	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172         C75NX-6678A       172	CF-1N	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236         CFS-A01525-100B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172         C75NX-6678A       172         C75NX-6678D       172         C75NX-6678EMT       172	CF-1N	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236         CFS-A01525-100B.       236         CFS-A01525-150B.       236         CFS-A01532-010B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172         C75NX-6678A       172         C75NX-6678D       172         C75NX-6678EMT       172         C8UW       116	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237
C75N-6C78       172         C75NX-6670A       172         C75NX-6670D       172         C75NX-6670EMT       172         C75NX-6676A       172         C75NX-6676D       172         C75NX-6676EMH       172         C75NX-6678A       172         C75NX-6678D       172         C75NX-6678EMT       172         C8UW       116         C8UWE       109	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237
C75N-6C78	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-050B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-050B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237
C75N-6C78	CF-1N	CFS-A01010-040B.       236         CFS-A01018-010B.       236         CFS-A01018-018B.       236         CFS-A01018-040B.       236         CFS-A01525-010B.       236         CFS-A01525-025B.       236         CFS-A01525-050B.       236         CFS-A01525-100B.       236         CFS-A01525-150B.       236         CFS-A01532-010B.       236         CFS-A01532-025B.       236         CFS-A01532-032B.       236         CFS-A01532-050B.       236         CFS-A01532-050B.       236         CFS-A01532-100B.       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-010B.       237         CFS-B01532-010B.       237         CFS-B01532-05B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237
C75N-6C78	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-050B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-050B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237
C75N-6C78	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-000B       236         CFS-A01532-100B       236         CFS-A01532-100B       236         CFS-A01532-200B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B0118-040B.       237         CFS-B01525-010B.       237         CFS-B01525-05B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-300B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676BM 172 C75NX-6676EMH 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 108 C9M1KF 74	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-150B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-200B       236         CFS-A01532-300B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-010B.       237         CFS-B01525-010B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676D 172 C75NX-6676EMH 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 115 C8WE 108 C9M1KF 74 C9M1PK 74 C9M2KF 74	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BK       .69         CF-2BG       .69         CF-2C       .69         CF-2E       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2R       .69         CF-2W       .69	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-150B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-100B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676D 172 C75NX-6676EMH 172 C75NX-6678EMT 172 C75NX-6678D 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-050B.       237         CFS-B01525-00B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01533-500B.       237         CFS-B01553-100B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676EMH 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 115 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2PK 74 CBUCKF 73	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BR       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2G       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2R       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-205B       236         CFS-A01532-308B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676D 172 C75NX-6676EMH 172 C75NX-6678EMT 172 C75NX-6678D 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-050B.       237         CFS-B01525-00B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01533-500B.       237         CFS-B01553-100B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676EMH 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 115 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2PK 74 CBUCKF 73	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BR       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2G       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2R       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-205B       236         CFS-A01532-308B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676EMH 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 175 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74 CBUCKF 73 CBUCKF 73 CBUCKS 73 CBUCKS 73 CBUCKS 73	CF-1N	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-015B       236         CFS-A01553-050B       236         CFS-A01553-100B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01533-500B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237         CFS-B01553-200B.       237         CFS-B01553-150B.       237         CFS-B01553-200B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676EMH 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 155 C8WE 108 C9M1KF 74 C9M2PK 74 C9M2PK 74 CBUCKF 73	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BE       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2C       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S2       .78	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-050B.       237         CFS-B01525-050B.       237         CFS-B01525-010B.       237         CFS-B01532-010B.       237         CFS-B01532-05B.       237         CFS-B01532-050B.       237         CFS-B01532-00B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-100B.       237         CFS-B01553-100B.       237         CFS-B01553-100B.       237         CFS-B01553-200B.       237 <t< td=""></t<>
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676EMT 172 C75NX-6676EMT 172 C75NX-6676EMH 172 C75NX-6676EMH 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 175 C8WE 74 C9M1KF 74 C9M1KF 74 C9M2KF 74 C9M2FK 74 C9M2PK 74 CBUCKF 73 CBUCKF 75	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BE       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2C       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S75       .78	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-3-300B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01152-010B.       237         CFS-B01525-010B.       237         CFS-B01525-05B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-100B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-300B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676B 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 15 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 76 CBUFLEFK 76 CBUKF 76 CBUKF 76 CBUKF 76 CBUKF 76 CBUKF 76	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BR       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S2.       .78         CFE-S75       .78         CFL-1A       .68	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-300B       236         CFS-A01553-500B       236         CFS-A01553-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-010B.       237         CFS-B01525-050B.       237         CFS-B01525-010B.       237         CFS-B01525-010B.       237         CFS-B01532-010B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237         CFS-B01553-200B.       237         CFS-B01553-265B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676EMT 172 C75NX-6676EMT 172 C75NX-6676EMH 172 C75NX-6676EMH 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678EMT 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 175 C8WE 74 C9M1KF 74 C9M1KF 74 C9M2KF 74 C9M2FK 74 C9M2PK 74 CBUCKF 73 CBUCKF 75	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BE       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2C       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S75       .78	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-3-300B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-050B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-050B.       237         CFS-B01532-100B.       237         CFS-B01532-200B.       237         CFS-B01532-500B.       237         CFS-B01533-100B.       237         CFS-B01553-100B.       237         CFS-B01553-150B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237 </td
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676B 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 15 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 76 CBUFLEFK 76 CBUKF 76 CBUKF 76 CBUKF 76 CBUKF 76 CBUKF 76	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BR       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S2.       .78         CFE-S75       .78         CFL-1A       .68	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-040B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-400B       236         CFS-A01532-500B       236         CFS-A01553-500B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-300B       236         CFS-A01553-500B       236         CFS-A01553-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01525-010B.       237         CFS-B01525-025B.       237         CFS-B01525-050B.       237         CFS-B01525-010B.       237         CFS-B01525-100B.       237         CFS-B01525-100B.       237         CFS-B01532-025B.       237         CFS-B01532-00B.       237         CFS-B01532-00B.       237         CFS-B01532-200B.       237         CFS-B01532-500B.       237         CFS-B01532-500B.       237         CFS-B01533-150B.       237         CFS-B01553-150B.       237         CFS-B01553-200B.       237         CFS-B01553-200B.       237         CFS-B01553-200B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237 <t< td=""></t<>
C75N-6C78 172 C75NX-6670A 172 C75NX-6670D 172 C75NX-6670EMT 172 C75NX-6676A 172 C75NX-6676B 172 C75NX-6676B 172 C75NX-6678A 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678B 172 C75NX-6678EMT 172 C8UW 116 C8UWE 109 C8W 115 C8WE 109 C8W 15 C8WE 108 C9M1KF 74 C9M2FK 74 C9M2FK 74 C9M2FK 74 CBUCKF 73 CBUCKF 73 CBUCKF 73 CBUCKF 76 CBUFLKF 76 CBUKF 76 CBUKF 76 CBUKF 773 CBULKF 76 CBUKF 773 CBULKF 773 CBULKF 773 CBULKF 773	CF-1N       .69         CF-1P       .69         CF-1R       .69         CF-1W       .69         CF-1Y       .69         CF-2A       .69         CF-2BE       .69         CF-2BR       .69         CF-2BR       .69         CF-2DG       .69         CF-2E       .69         CF-2L       .69         CF-2L       .69         CF-2N       .69         CF-2P       .69         CF-2W       .69         CF-2Y       .69         CF-W1       .69         CF-W2       .69         CF-S10       .78         CFE-S2.       .78         CFE-S75       .78         CFL-1A-PK       .68	CFS-A01010-040B       236         CFS-A01018-010B       236         CFS-A01018-018B       236         CFS-A01525-010B       236         CFS-A01525-025B       236         CFS-A01525-050B       236         CFS-A01525-100B       236         CFS-A01525-100B       236         CFS-A01525-150B       236         CFS-A01532-010B       236         CFS-A01532-025B       236         CFS-A01532-032B       236         CFS-A01532-050B       236         CFS-A01532-100B       236         CFS-A01532-200B       236         CFS-A01532-300B       236         CFS-A01532-500B       236         CFS-A01533-500B       236         CFS-A01553-100B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-150B       236         CFS-A01553-500B       236         CFS-A01553-500B       236         CFS-A01553-500B       236         CFS-A01553-500B       236         CFS-A01553-500B       236	CFS-A06053-300B.       236         CFS-A06053-500B.       236         CFS-B01010-010B.       237         CFS-B01010-020B.       237         CFS-B01018-018B.       237         CFS-B01018-040B.       237         CFS-B01525-010B.       237         CFS-B01525-05B.       237         CFS-B01525-050B.       237         CFS-B01525-100B.       237         CFS-B01525-050B.       237         CFS-B01532-010B.       237         CFS-B01532-025B.       237         CFS-B01532-00B.       237         CFS-B01532-00B.       237         CFS-B01532-300B.       237         CFS-B01532-500B.       237         CFS-B01533-150B.       237         CFS-B01553-150B.       237         CFS-B01553-265B.       237         CFS-B01553-265B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-300B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237         CFS-B01553-500B.       237 <tr< td=""></tr<>

CEC D00040 040D	. CEC DODGE 050D	CEC Disease and	CET T14
CFS-B03018-018B237	CFS-D03053-050B237	CFS-PA3053-200 242	CFT-TM70
CFS-B03018-040B	CFS-D03053-083B	CFS-PB1532-100 244	CFT-TXC70
CFS-B03025-010B	CFS-D03053-100B 237	CFS-PB1553-200 244	CFT-TXL70
CFS-B03025-025B237	CFS-D06025-025B	CFS-PB3032-100 244	CFT1K-11070
CFS-B03025-050B	CFS-D06025-050B	CFS-PB3053-200 244	CFT1K-22070
CFS-B03025-100B	CFS-D06032-025B237	CFS-PC1532-100 244	CFT2K-11070
CFS-B03032-010B	CFS-D06032-050B 237	CFS-PC1553-200 244	CFT2K-22070
CFS-B03032-025B	CFS-D06032-100B 237	CFS-PC3032-100 244	CGC4175
CFS-B03032-050B237	CFS-D06053-050B 237	CFS-PC3053-200 244	CGC41KF75
CFS-B03032-100B	CFS-E01018-100A	CFS-PD1532-100242	CGC4275
CFS-B03032-200B	CFS-E01525-140A 238	CFS-PD1553-200242	CGC42KF75
CFS-B03032-300B	CFS-E01532-180A 238	CFS-PD3032-100242	CGCB75
CFS-B03032-500B	CFS-E01553-300A 238	CFS-PD3053-200242	CGCBKF75
CFS-B03053-050B	CFS-E02018-100A	CFS-PN1532-100	
			CGCG41
CFS-B03053-100B	CFS-E02520-112A	CFS-PN1553-200244	CGCG4275
CFS-B03053-150B	CFS-E03018-100A	CFS-PN3032-100244	CGCN
CFS-B03053-265B237	CFS-E03025-140A	CFS-PN3053-200244	CGCNKF75
CFS-B03053-300B	CFS-E03032-180A	CFS-PP1532-100 244	CGCR
CFS-B03053-500B	CFS-E03053-300A238	CFS-PP1553-200 244	CGCRKF75
CFS-B04018-018B	CFS-E04018-100A 238	CFS-PP3032-100 244	CGFT67
CFS-B04018-040B	CFS-E06025-140A 238	CFS-PP3053-200 244	CGFT
CFS-B06025-010B237	CFS-E06032-180A	CFS-PQ1532-100242	CI4UW.2
		-	
CFS-B06025-025B	CFS-E06053-300A	CFS-PQ1553-200242	CI4UW.5
CFS-B06025-050B	CFS-E07553-300A	CFS-PQ3032-100242	CI4UW1114
CFS-B06025-100B	CFS-F01525-025A 238	CFS-PQ3053-200242	CI4UW2 114
CFS-B06032-010B237	CFS-F01525-050A	CFS-PR1532-100 244	CI4UWE.2105
CFS-B06032-025B	CFS-F01532-025A	CFS-PR1553-200 244	CI4UWE.5
CFS-B06032-050B	CFS-F01532-050A	CFS-PR3032-100 244	CI4UWE1 105
CFS-B06032-100B	CFS-F01532-100A 238	CFS-PR3053-200 244	CI4UWE2 105
CFS-B06032-200B	CFS-F01553-050A238	CFS-PS1532-100 244	CI4W.06114
CFS-B06032-300B	CFS-F01553-100A	CFS-PS1553-200 244	CI4W.1114
CFS-B06032-500B	CFS-F03025-025A238	CFS-PS3032-100 244	CI4W.2114
CFS-B06053-100B	CFS-F03025-050A	CFS-PS3053-200 244	CI4W.5114
CFS-B06053-150B	CFS-F03032-025A	CFS-X1553-200 240	CI4WE.06
CFS-B06053-200B	CFS-F03032-050A	CFS-X1553-500 240	CI4WE.1
CFS-B06053-265B237	CFS-F03032-100A238	CFS-X3053-200 240	CI4WE.2 104
CFS-B06053-300B	CFS-F03053-050A	CFS-X3053-500 240	CI4WE.5 104
CFS-B06053-500B	CFS-F03053-100A	CFS-Y1553-100 242	CM 203
CFS-C01525-025B	CFS-F06025-025A	CFS-Y3053-100 242	CM1XKF75
CFS-C01525-050B	CFS-F06025-050A	CFS-Y5053-100 242	CM1XPK
CFS-C01532-025B	CFS-F06032-025A	CFS-Z1553-100 242	CM2XKF
CFS-C01532-050B	CFS-F06032-050A238	CFS-Z3053-100 242	CM2XPK
CFS-C01553-050B 236	CFS-F06032-100A	CFS-Z5053-100 242	CMH208
CFS-C01553-100B	CFS-F06053-050A	CFSL100FEP167, 185	CMH11H208
CFS-C03025-025B	CFS-F06053-100A	CFSL100PK167,185	CMH11L 208
CFS-C03025-050B	CFS-G01010-010A 238	CFSL100TF167, 185	CMH12H 208
CFS-C03032-025B	CFS-G01018-018A 238	CFSL1KFEP167,185	CMH12L 208
CFS-C03032-050B 236	CFS-G01525-025A 238	CFSL1KPK167, 185	CMH13 208
CFS-C03053-050B		CFSL1KTF167, 185	CMH13H
	CFS-G01532-025A238		
CFS-C03053-100B	CFS-G01532-050A 238	CFSL20FEP167, 185	CMH13L 208
CFS-C06025-025B			CAALIAAD
	CFS-G01532-100A 238	CFSL20PK167, 185	CMHMP 208
CFS-C06025-050B			CMLAKF
	CFS-G01553-050A238	CFSL20TF167, 185	CMLAKF76
CFS-C06032-025B	CFS-G01553-050A	CFSL20TF	CMLAKF
CFS-C06032-025B	CFS-G01553-050A	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76
CFS-C06032-025B	CFS-G01553-050A	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236	CFS-G01553-050A	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178         CNV1A10S1       214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178         CNV1A10S1       214         CNV1A150S1       214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03032-100A.       238	CFSL20TF. 167,185 CFSL250FEP 167,185 CFSL250PK 167,185 CFSL250TF. 167,185 CFSL2KFEP 167,185 CFSL2KPK 167,185 CFSL2KPK 167,185 CFSL2KTF 167,185 CFSL2KTF 167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178         CNV1A10S1       214         CNV1A150S1       214         CNV1A250S1       214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238	CFSL20TF	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178         CNV1A10S1       214         CNV1A150S1       214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03032-100A.       238	CFSL20TF.       167,185         CFSL250FEP       167,185         CFSL250PK       167,185         CFSL250TF.       167,185         CFSL2KFEP.       167,185         CFSL2KPK.       167,185         CFSL2KTF.       167,185         CFSL500FEP       167,185         CFSL500PK       167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       178         CNV1A10S1       214         CNV1A150S1       214         CNV1A250S1       214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03032-100A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238	CFSL20TF       167,185         CFSL250FEP       167,185         CFSL250PK       167,185         CFSL250TF       167,185         CFSL2KFEP       167,185         CFSL2KPK       167,185         CFSL2KTF       167,185         CFSL500FEP       167,185         CFSL500PK       167,185         CFSL500TF       167,185         CFSL500TF       167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1A50S1       .214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237         CFS-D01553-050B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238	CFSL20TF. 167,185 CFSL250FEP 167,185 CFSL250PK 167,185 CFSL250TF. 167,185 CFSL2KFEP 167,185 CFSL2KPK. 167,185 CFSL2KTF. 167,185 CFSL500FEP 167,185 CFSL500PK 167,185 CFSL500TF. 167,185 CFSL500TF. 167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-083B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03053-050A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238	CFSL20TF. 167,185 CFSL250FEP 167,185 CFSL250PK 167,185 CFSL250TF. 167,185 CFSL2KFEP 167,185 CFSL2KPK. 167,185 CFSL2KTF. 167,185 CFSL500FEP 167,185 CFSL500PK 167,185 CFSL500TF. 167,185 CFSL500TF. 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S150S1       .214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-100B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-100A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238         CFS-G06032-050A.       238         CFS-G06032-050A.       238	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP 167, 185 CFSL2KFEP 167, 185 CFSL2KFF. 167, 185 CFSL2KFF. 167, 185 CFSL500FEP 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL50FEP 167, 185 CFSL50FF 167, 185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S250S1       .214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-083B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03053-050A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238	CFSL20TF. 167,185 CFSL250FEP 167,185 CFSL250PK 167,185 CFSL250TF. 167,185 CFSL2KFEP 167,185 CFSL2KPK. 167,185 CFSL2KTF. 167,185 CFSL500FEP 167,185 CFSL500PK 167,185 CFSL500TF. 167,185 CFSL500TF. 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185 CFSL500FEP 167,185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S150S1       .214
CFS-C06032-025B.       236         CFS-C06032-050B.       236         CFS-C06053-050B.       236         CFS-C06053-100B.       236         CFS-D01525-025B.       237         CFS-D01525-050B.       237         CFS-D01532-025B.       237         CFS-D01532-050B.       237         CFS-D01532-100B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-050B.       237         CFS-D01553-100B.       237         CFS-D03025-015B.       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-100A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238         CFS-G06032-050A.       238         CFS-G06032-050A.       238         CFS-G06032-050A.       238         CFS-G06053-100A.       238	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP 167, 185 CFSL2KFEP 167, 185 CFSL2KFK. 167, 185 CFSL2KTF. 167, 185 CFSL500FEP 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL500FF 167, 185 CFSL50FEP 167, 185 CFSL50FEP 167, 185 CFSL50FEP 167, 185 CFSL50FEP 167, 185 CFSL50FF 167, 185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S250S1       .214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237         CFS-D01532-050B       237         CFS-D01532-100B       237         CFS-D01553-050B       237         CFS-D01553-100B       237         CFS-D03025-015B       237         CFS-D03025-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-050A.       238         CFS-G03032-100A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238         CFS-G06032-050A.       238         CFS-G06053-100A.       238         CFS-G06053-100A.       238         CFS-G06053-100A.       238         CFS-N03025-025.       235	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP 167, 185 CFSL2KFEP 167, 185 CFSL2KFF. 167, 185 CFSL2KTF. 167, 185 CFSL500FEP 167, 185 CFSL500FF 167, 185 CFSL500TF. 167, 185 CFSL500TF. 167, 185 CFSL50TF. 167, 185 CFT-110 70 CFT-220 70	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNV1A10S1       .214         CNV1A150S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237         CFS-D01532-100B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-100B       237         CFS-D01553-100B       237         CFS-D03025-015B       237         CFS-D03025-025B       237         CFS-D03025-050B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-050A.       238         CFS-G03032-100A.       238         CFS-G03053-050A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06032-050A.       238         CFS-G06053-100A.       238         CFS-G06053-100A.       238         CFS-G06053-100A.       238         CFS-N03025-025.       235         CFS-N03053-100.       235	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP 167, 185 CFSL2KFEP 167, 185 CFSL2KTF. 167, 185 CFSL2KTF. 167, 185 CFSL500FEP 167, 185 CFSL500FEP 167, 185 CFSL500TF. 167, 185 CFSL500TF. 167, 185 CFSL50TF. 167, 185 CFSL50TF. 167, 185 CFSL50FEP 167, 185 CFSL50TF. 167, 185 CFSL50T	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S250S1       .214         CNV1S50OS1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNVEKB       .214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237         CFS-D01532-100B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D03025-015B       237         CFS-D03025-025B       237         CFS-D03025-050B       237         CFS-D03025-050B       237         CFS-D03025-050B       237         CFS-D03025-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-100A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238         CFS-G06032-025A.       238         CFS-G06053-100A.       238         CFS-N03025-025.       235         CFS-N03053-100.       235         CFS-PA1532-100.       242	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFF. 167, 185 CFSL2KTF. 167, 185 CFSL500FEP 167, 185 CFSL500PK 167, 185 CFSL500PK 167, 185 CFSL500FEP. 167, 185 CFSL500FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50TF. 167, 185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S50OS1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNVEKB       .214         CNVEKG       .214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237         CFS-D01532-100B       237         CFS-D01532-100B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-100B       237         CFS-D01553-100B       237         CFS-D03025-015B       237         CFS-D03025-025B       237         CFS-D03025-050B       237         CFS-D03032-025B       237         CFS-D03032-050B       237         CFS-D03032-050B       237	CFS-G01553-050A. 238 CFS-G01553-100A. 238 CFS-G02010-010A. 238 CFS-G02018-018A. 238 CFS-G03025-025A. 238 CFS-G03032-050A. 238 CFS-G03032-050A. 238 CFS-G03032-100A. 238 CFS-G03053-050A. 238 CFS-G03053-050A. 238 CFS-G03053-100A. 238 CFS-G06025-025A. 238 CFS-G06025-025A. 238 CFS-G06032-050A. 238 CFS-G06032-050A. 238 CFS-G06032-050A. 238 CFS-G06032-050A. 238 CFS-G06032-050A. 238 CFS-G06032-050A. 238 CFS-F06032-050A. 238 CFS-F06032-050A. 238 CFS-F06032-050A. 238 CFS-F06053-100A. 238 CFS-F06053-100A. 238 CFS-F06053-100A. 238 CFS-N03025-025 235 CFS-N03053-100 235 CFS-PA1532-100 242 CFS-PA1553-200 242	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFF. 167, 185 CFSL2KFF. 167, 185 CFSL500FEP 167, 185 CFSL500PK 167, 185 CFSL500FF. 167, 185 CFSL500FF. 167, 185 CFSL500FF. 167, 185 CFSL50TF. 167 CFSL50TF. 167 CFSL50TF. 167 CFSL50TF. 167 CFSL50	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S10S1       .214         CNV1S250S1       .214         CNV1S50OS1       .214         CNV1S50OS1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNVEKB       .214         CNVEKB       .214         CNVEKG       .214         CNVEKLB       .214
CFS-C06032-025B       236         CFS-C06032-050B       236         CFS-C06053-050B       236         CFS-C06053-100B       236         CFS-D01525-025B       237         CFS-D01525-050B       237         CFS-D01532-025B       237         CFS-D01532-100B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D01553-050B       237         CFS-D03025-015B       237         CFS-D03025-025B       237         CFS-D03025-050B       237         CFS-D03025-050B       237         CFS-D03025-050B       237         CFS-D03025-025B       237	CFS-G01553-050A.       238         CFS-G01553-100A.       238         CFS-G02010-010A.       238         CFS-G02018-018A.       238         CFS-G03025-025A.       238         CFS-G03032-025A.       238         CFS-G03032-100A.       238         CFS-G03053-100A.       238         CFS-G03053-100A.       238         CFS-G06025-025A.       238         CFS-G06025-025A.       238         CFS-G06032-025A.       238         CFS-G06032-025A.       238         CFS-G06053-100A.       238         CFS-N03025-025.       235         CFS-N03053-100.       235         CFS-PA1532-100.       242	CFSL20TF. 167, 185 CFSL250FEP 167, 185 CFSL250PK 167, 185 CFSL250TF. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFEP. 167, 185 CFSL2KFF. 167, 185 CFSL2KTF. 167, 185 CFSL500FEP 167, 185 CFSL500PK 167, 185 CFSL500PK 167, 185 CFSL500FEP. 167, 185 CFSL500FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50FEP. 167, 185 CFSL50TF. 167, 185	CMLAKF       .76         CMLAPFA       .76         CMLAPK       .76         CNFT       .67         CNNF1PK       .178         CNV1A10S1       .214         CNV1A250S1       .214         CNV1A500S1       .214         CNV1A50S1       .214         CNV1S10S1       .214         CNV1S150S1       .214         CNV1S250S1       .214         CNV1S50OS1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNV1S50S1       .214         CNVEKB       .214         CNVEKG       .214

CNVEKLR 214	CTA2KF76	CZSL2PK 161, 180, 182	DC6WT110
CNVEKLS 214	CTA2PK76	CZSL500FEP 166, 184	DC8UW116
CNVEKLU	CTA2S6	CZSL500PK 161,166,180,182,184	DC8UWE
CNVEKR 214	CTA4KF76	CZSL500TF166, 184	DC8UWT111
CNVEKS	CTA4PK76	CZSL50FEP166, 184	DC8W 115
CNVEKU 214	CTA4S6	CZSL50PK 161, 166, 180, 182, 184	DC8WE
CP-4D71	CTCKF74	CZSL50TF166, 184	DC8WT110
CP-4D 179	CTCPK74	CZSL5FEP166, 184	DCI4UW.2114
CP-4K71	CTKF74	CZSL5KPK 161, 180, 182	DCI4UW.5114
CP-4K	CTLKF	CZSL5PK161,166	DCI4UW1
CP-CM1-P83	CTLPK74	CZSL5PK 180, 182, 184	DCI4UW2114
CP-DSM83	CTMKF74	CZSL5TF166, 184	DCI4UWE.2 105
CP-DSM283	CTMPK74	CZUCKF72	DCI4UWE.5 105
CP2-4841-100D	CTPK74	CZUCPK72	DCI4UWE1105
CP2-4841-100M1	CU4LKF72	CZUCS672	DCI4UWE2105
CP2-4841-100SM83	CU4LPK	CZUKF	DCI4W.06
CP3-8182-625D83	CUCKF72	CZUMKF72	DCI4W.1
CP3-8182-625M283	CUCPK72	CZUMPK72	DCI4W.2
CP3-8182-625SM283	CUKF72	CZUMS672	DCI4W.5
CPA2KF77	CULKF72	CZUPK72	DCI4WE.06 104
CPA2PK77	CULPK72	CZUS672	DCI4WE.1104
CPA4KF77	CUMKF72	D-2221	DCI4WE.2104
CPA4PK	CUMPK	D-2-220	DCI4WE.5
CPKF	CUPK72	D-2-I	DCSC10MWE
CPPK	CUTPP72	D-2-l-220 221	DCSC12MWE 126
CR10 205	CVA10GS1 215	D-3-I-7890	DCSC16MWE 126
CR10 205	CVA10GS2 215	D-3-I-7890-220223	DCSC6MWE126
CR3 205	CVA150US1215	D-3-I-HP	DCSD10MWE 124
CR3	CVA150US2	D-3-I-HP-220223	DCSD10UW
CR3	CVA1KYS1	D-4-I	DCSD12MWE
CR3	CVA1KYS2 215	D-4-I-220 223	DCSD16MWE
CR3 205	CVA500BS1 215	D-4-I-HP58223	DCSD4UW 134
CR8 205	CVA500BS2 215	D-4-I-HP58-220 223	DCSD6MWE 124
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FS1R.4PK-517	l-21208-06202	JR-79892	MT.5XCKF23
FS1R.5-517	I-21208-33	JR-9000-0520	MT.5XCPK23
FS1R.5PK-517	I-22697 175, 191, 192, 195	JR-9000-053079	MT.5XCS623
FS1R.8-517	l-22897-02191,195	JR-9000-0602	MT.5XCTI23
FS1R.8PK-517	I-22897-03191,195	JR-9000-0640	MT1CHC23
FS1R1.0-517	I-22897-04191,195	JR-9001-592	MT1CKF23
FS1R1.0PK-5	I-22897-05191,195	JR-S-11001	MT1CPK23
FSL.25-517	l-22897-06191,195	JR-S-1100281	MT1CS623
FSL.4-517	I-22897-08191,195	JR-S-1100381	MT1CTI
FSL.5-517	I-23572HP2 226	JR-T-580491	MT1XCHC23
FSMUA1.520	I-23572NP2	JR-T-599991	MT1XCKF23
FSMUAS1.5	I4UWE.2	JR-T-6000	MT1XCPK23
FSMUAS1.5L20	I4UWE.5	JR-T-600191	MT1XCS623
FSMUAS1.5M20	I4UWE1 105	JR-T-600291	MT1XCTI23
FSR.25-5	I4UWE2 105	JR-T-600391	MU.5CHC
FSR.3-5	ITC10399 203	JR-T-6003191	MU.5CKF23
FSR.4-5	ITC10399-220	JR-T-9801391	MU.5CPK
FSR.5-517	IZERA1.521	JR-T-9801791	MU.5CS623
FSZA-HP18			
F3ZA-ПР10	IZERA1.5C21	JR-T-9802591	MU.5CTI23
FSZNA-HP	IZERA1.5C	JR-T-9802591 JR-T-9805091	MU.5CTI
FSZNA-HP18	IZERA1.5M21	JR-T-9805091	MU.5XCHC23
FSZNA-HP	IZERA1.5M21 IZN1-1010	JR-T-9805091 JR-T-9807591	MU.5XCHC23 MU.5XCKF23
FSZNA-HP18 HA1	IZERA1.5M	JR-T-98050	MU.5XCHC
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23
FSZNA-HP18 HA1	IZERA1.5M	JR-T-98050	MU.5XCHC
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38	JR-T-9805091 JR-T-9807591 JR-T-9820091 JR-TD-5804 .91 JR-TD-6007 .91 JR-TD-6008 .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB       .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38	JR-T-9805091 JR-T-9807591 JR-T-9820091 JR-TD-5804 .91 JR-TD-6007 .91 JR-TD-6008 .91 JR-TD-6009 .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HB1N       .202	IZERA1.5M     .21       IZN1-10     .10       IZR1.5     .38       IZR1.5F     .38       IZR1.5L     .38       IZR1.5LF     .38       IZR1.5T     .38       IZR21     .38	JR-T-98050.       .91         JR-T-98075.       .91         JR-T-98200.       .91         JR-TD-5804       .91         JR-TD-6007       .91         JR-TD-6008       .91         JR-TD-6009       .91         JR-TD-6010       .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBIN       .202         HBS.       .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38	JR-T-98050.       .91         JR-T-98075.       .91         JR-T-98200.       .91         JR-TD-5804       .91         JR-TD-6007       .91         JR-TD-6008       .91         JR-TD-6009       .91         JR-TD-6010       .91         JR-TD-6011       .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HB1N       .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38         IZR21CF       .38	JR-T-98050.       .91         JR-T-98075.       .91         JR-T-98200.       .91         JR-TD-5804       .91         JR-TD-6007       .91         JR-TD-6008       .91         JR-TD-6009       .91         JR-TD-6010       .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23         MU1CTI.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBIN       .202         HBS.       .202	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38	JR-T-98050.       .91         JR-T-98075.       .91         JR-T-98200.       .91         JR-TD-5804       .91         JR-TD-6007       .91         JR-TD-6008       .91         JR-TD-6009       .91         JR-TD-6010       .91         JR-TD-6011       .91	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBIN       .202         HBS.       .202         HCE1       .203	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38         IZR21CF       .38         IZR21F       .38	JR-T-9805091 JR-T-9807591 JR-T-9820091 JR-TD-5804 .91 JR-TD-6007 .91 JR-TD-6008 .91 JR-TD-6009 .91 JR-TD-6010 .91 JR-TD-6011 .91 L4UW .118 L6UW .118	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC.       23
FSZNA-HP       .18         HA1       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HBS.       .202         HCE1       .203         HCE2       .203	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38         IZR21CF       .38         IZR21F       .38         IZR21L       .38	JR-T-98050.       .91         JR-T-98075.       .91         JR-T-98200.       .91         JR-TD-5804       .91         JR-TD-6007       .91         JR-TD-6008       .91         JR-TD-6009       .91         JR-TD-6010       .91         JR-TD-6011       .91         L4UW.       .118         L6UW.       .118         L8UW.       .118	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC.       23         MU1XCKF.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCE2X       .203	IZERA1.5M       .21         IZN1-10       .10         IZR1.5       .38         IZR1.5F       .38         IZR1.5L       .38         IZR1.5LF       .38         IZR1.5T       .38         IZR21       .38         IZR21C       .38         IZR21CF       .38         IZR21F       .38         IZR21L       .38         IZR21L       .38         IZR21L       .38          IZR21LF       .38	JR-T-9805091 JR-T-9807591 JR-T-9820091 JR-TD-5804 .91 JR-TD-6007 .91 JR-TD-6008 .91 JR-TD-6009 .91 JR-TD-6010 .91 JR-TD-6011 .91 L4UW .118 L6UW .118 L8UW .118 LNR-CIS4-B-5 .245	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC.       23         MU1XCKF.       23         MU1XCPK.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HB       .202         HBIN       .202         HBS       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCEB       .203         HCEB       .203	IZERA1.5M     21       IZN1-10     10       IZR1.5     38       IZR1.5F     38       IZR1.5L     38       IZR1.5LF     38       IZR1.5T     38       IZR21     38       IZR21C     38       IZR21F     38       IZR21F     38       IZR21L     38       IZR21L     38       IZR21L     38       IZR21LF     38       IZR21LF     38       IZR21T     38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCS6.       23
FSZNA-HP       18         HA1       202         HA1T       202         HA2       202         HA3       202         HA6       202         HB       202         HBIN       202         HBS       202         HCE1       203         HCE1X       203         HCE2       203         HCE2X       203         HCEB       203         HCEBX       203	IZERA1.5M     21       IZN1-10     10       IZR1.5     38       IZR1.5F     38       IZR1.5L     38       IZR1.5LF     38       IZR1.5T     38       IZR21     38       IZR21C     38       IZR21CF     38       IZR21F     38       IZR21L     38       IZR21L     38       IZR21L     38       IZR21LF     38       IZR21LF     38       IZR21T     38       IZR21T     38       IZR41     38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CFK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCS6.       23         MU1XCTI.       23
FSZNA-HP       .18         HA1       .202         HA1T       .202         HA2       .202         HA3       .202         HB       .202         HBIN       .202         HBS       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCEB       .203         HCEB       .203	IZERA1.5M     21       IZN1-10     10       IZR1.5     38       IZR1.5F     38       IZR1.5L     38       IZR1.5LF     38       IZR1.5T     38       IZR21     38       IZR21C     38       IZR21F     38       IZR21F     38       IZR21L     38       IZR21L     38       IZR21L     38       IZR21LF     38       IZR21LF     38       IZR21T     38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCS6.       23
FSZNA-HP       18         HA1       202         HA1T       202         HA2       202         HA3       202         HA6       202         HB       202         HBS       202         HBS       202         HCE1       203         HCE1X       203         HCE2       203         HCE2X       203         HCEB       203         HCEBX       203         HCEC       203	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21LF       38         IZR21T       38         IZR41       38         IZR41F       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CFK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCS6.       23         MU1XCTI.       23
FSZNA-HP       18         HA1       202         HA1T       202         HA2       202         HA3       202         HA6       202         HB       202         HBS       202         HCE1       203         HCE1X       203         HCE2       203         HCE2X       203         HCEB       203         HCEBX       203         HCEC       203         HCECX       203         HCECX       203	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21T       38         IZR21T       38         IZR41       38         IZR41       38         IZR42       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCS6.       23         MU1XCTI.       23         MX.5CHC       23         MX.5CKF.       23
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202 HA3 .202 HA6 .202 HB .202 HB .202 HBIN .202 HCE1 .203 HCE1X .203 HCE2X .203 HCEBX .203 HCECX .203	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR21.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21T       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CFK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCTI       23         MU1XCTI       23         MX.5CHC       23         MX.5CKF.       23         MX.5CPK.       23
FSZNA-HP       .18         HA1       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCEBX       .203         HCEBX       .203         HCEBX       .203         HCEC       .203         HCECX       .203         HCECX       .203         HCECX       .203         HKS       .54         HKS       .210	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21LF       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCTI       23         MX.5CHC       23         MX.5CKF.       23         MX.5CPK.       23         MX.5CPK.       23         MX.5CS6.       23
FSZNA-HP       .18         HA1       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCE2X       .203         HCEBX       .203         HCEBX       .203         HCEC       .203         HCECX       .203         HCECX       .203         HCECX       .203         HKS       .54         HKS       .210         HP2-110       .226	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR21       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21LF       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCTI       23         MU1XCTI       23         MX.5CHC       23         MX.5CKF.       23         MX.5CPK.       23         MX.5CS6.       23         MX.5CS6.       23         MX.5CS7I       23
FSZNA-HP       .18         HA1       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCEBX       .203         HCEBX       .203         HCEBX       .203         HCEC       .203         HCECX       .203         HCECX       .203         HCECX       .203         HKS       .54         HKS       .210	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21LF       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCTI       23         MX.5CHC       23         MX.5CKF.       23         MX.5CPK.       23         MX.5CPK.       23         MX.5CS6.       23
FSZNA-HP       .18         HA1       .202         HA2       .202         HA3       .202         HA6       .202         HB.       .202         HBS.       .202         HCE1       .203         HCE1X       .203         HCE2       .203         HCE2X       .203         HCEBX       .203         HCEBX       .203         HCEC       .203         HCECX       .203         HCECX       .203         HCECX       .203         HKS       .54         HKS       .210         HP2-110       .226	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR21       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21LF       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC       23         MU1XCKF.       23         MU1XCPK.       23         MU1XCTI       23         MU1XCTI       23         MX.5CHC       23         MX.5CKF.       23         MX.5CPK.       23         MX.5CS6.       23         MX.5CS6.       23         MX.5CS7I       23
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202 HA3 .202 HA6 .202 HB202 HB202 HB202 HBIN .202 HCE1 .203 HCE1X .203 HCE2X .203 HCE2X .203 HCEBX .203 HCEBX .203 HCECC .203 HCECC .203 HCECX .203 HCEX	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR21       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42C       38         IZR42C       38         IZR42C       38         IZR42C       38         IZR42	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CS6.       23         MU1CTI.       23         MU1XCHC.       23         MU1XCKF.       23         MU1XCS6.       23         MU1XCTI.       23         MX.5CHC.       23         MX.5CKF.       23         MX.5CS6.       23         MX.5CYF.       23         MX.5CYF.       23         MX.5CYTI.       23         MX.5XCHC.       23         MX.5XCKF.       23         MX.5XCKF.       23
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202 HA3 .202 HA6 .202 HB202 HB202 HB202 HBS202 HCE1 .203 HCE1X .203 HCE2X .203 HCE2 .203 HCEEX .203 HCEBX .203 HCEBX .203 HCECX	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR21       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42C       38         IZR42C       38         IZR42C       38         IZR42C       38         IZR42	JR-T-98050	MU.5XCHC.       23         MU.5XCKF.       23         MU.5XCPK.       23         MU.5XCS6.       23         MU.5XCTI.       23         MU1CHC.       23         MU1CKF.       23         MU1CPK.       23         MU1CTI.       23         MU1XCHC       23         MU1XCFE.       23         MU1XCFE.       23         MU1XCFE.       23         MU1XCTI.       23         MX.5CHC       23         MX.5CFE.       23         MX.5CS6.       23         MX.5CYF.       23         MX.5CYF.       23         MX.5CYF.       23         MX.5CYCH.       23         MX.5CYCH.       23         MX.5XCYCH.       23         MX.5XCYCH.       23
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202 HA3 .202 HA6 .202 HB202 HB202 HB202 HB203 HCE1 .203 HCE1 .203 HCE2 .203 HCE2 .203 HCEE .203 HCEB .203 HCEB .203 HCEB .203 HCEC .203 HCEC .203 HCEC .203 HKS54 HKS .210 HP2-110 .226 HP2-220 .226 HPM-110 .227 HPM-220 .227 HSSA .199	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR5050       71         JR-26501       77         JR-26503       77	JR-T-98050	MU.5XCHC       23         MU.5XCKF       23         MU.5XCPK       23         MU.5XCS6       23         MU.5XCTI       23         MU1CHC       23         MU1CKF       23         MU1CPK       23         MU1CS6       23         MU1CTI       23         MU1XCHC       23         MU1XCKF       23         MU1XCFI       23         MU1XCTI       23         MX.5CHC       23         MX.5CYF       23         MX.5CYF       23         MX.5CYF       23         MX.5CYCH       23         MX.5CYCH       23         MX.5XCYCH       23
FSZNA-HP 18 HA1 202 HA1T 202 HA2 202 HA3 202 HA6 202 HB 202 HB 202 HBIN 202 HBS. 202 HCE1 203 HCE2 203 HCE2 203 HCE2 203 HCEEX 203 HCEB 203 HCEB 203 HCEC 203 HCEC 203 HCEC 203 HCECX 203 HCEC 203 HCECX 203 HCEC 203 HCECX 203 HCED 203 HCEC 203 HCECX 203 HCEC 203 HCECX	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR5050       71         JR-26501       77         JR-26503       77         JR-26504       77          JR-26504       77	JR-T-98050	MU.5XCHC       23         MU.5XCKF       23         MU.5XCPK       23         MU.5XCS6       23         MU.5XCTI       23         MU1CHC       23         MU1CKF       23         MU1CS6       23         MU1CTI       23         MU1XCHC       23         MU1XCFK       23         MU1XCFK       23         MU1XCFK       23         MU1XCFK       23         MU1XCF       23         MX.5CHC       23         MX.5CFF       23         MX.5CSC       23         MX.5CTI       23         MX.5XCPK       23         MX.5XCPK       23         MX.5XCPK       23         MX.5XCSC       23         MX.5XCTI       23         MX.5XCTI       23
FSZNA-HP .18 HA1 .202 HA1T .202 HA2 .202 HA3 .202 HA6 .202 HB202 HB202 HB202 HB203 HCE1 .203 HCE1 .203 HCE2 .203 HCE2 .203 HCEE .203 HCEB .203 HCEB .203 HCEB .203 HCEC .203 HCEC .203 HCEC .203 HKS54 HKS .210 HP2-110 .226 HP2-220 .226 HPM-110 .227 HPM-220 .227 HSSA .199	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR5050       71         JR-26501       77         JR-26503       77	JR-T-98050	MU.5XCHC       23         MU.5XCKF       23         MU.5XCPK       23         MU.5XCS6       23         MU.5XCTI       23         MU1CHC       23         MU1CKF       23         MU1CPK       23         MU1CS6       23         MU1CTI       23         MU1XCHC       23         MU1XCKF       23         MU1XCFI       23         MU1XCTI       23         MX.5CHC       23         MX.5CYF       23         MX.5CYF       23         MX.5CYF       23         MX.5CYCH       23         MX.5CYCH       23         MX.5XCYCH       23
FSZNA-HP 18 HA1 202 HA1T 202 HA2 202 HA3 202 HA6 202 HB 202 HB 202 HBIN 202 HBS. 202 HCE1 203 HCE2 203 HCE2 203 HCE2 203 HCEEX 203 HCEB 203 HCEB 203 HCEC 203 HCEC 203 HCEC 203 HCECX 203 HCEC 203 HCECX 203 HCEC 203 HCECX 203 HCED 203 HCEC 203 HCECX 203 HCEC 203 HCECX	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21F       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR41       38         IZR41       38         IZR42       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR5050       71         JR-26501       77         JR-26503       77         JR-26504       77          JR-26504       77	JR-T-98050	MU.5XCHC       23         MU.5XCKF       23         MU.5XCPK       23         MU.5XCS6       23         MU.5XCTI       23         MU1CHC       23         MU1CKF       23         MU1CS6       23         MU1CTI       23         MU1XCHC       23         MU1XCFK       23         MU1XCFK       23         MU1XCFK       23         MU1XCFK       23         MU1XCF       23         MX.5CHC       23         MX.5CFF       23         MX.5CSC       23         MX.5CTI       23         MX.5XCPK       23         MX.5XCPK       23         MX.5XCPK       23         MX.5XCSC       23         MX.5XCTI       23         MX.5XCTI       23
FSZNA-HP 18 HA1 202 HA1T 202 HA2 202 HA3 202 HA6 202 HB 202 HB 202 HBIN 202 HCE1 203 HCE2 203 HCE2 203 HCE2 203 HCEEX 203 HCES 203 HCEB 203 HCEC 20	IZERA1.5M       21         IZN1-10       10         IZR1.5       38         IZR1.5F       38         IZR1.5L       38         IZR1.5LF       38         IZR1.5T       38         IZR21       38         IZR21C       38         IZR21CF       38         IZR21F       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR21L       38         IZR41       38         IZR42       38         IZR42F       38         IZR42F       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR42L       38         IZR500       77         JR-26501       77         JR-26503       77         JR-26504       77         JR-32178       80	JR-T-98050	MU.5XCHC       23         MU.5XCKF       23         MU.5XCPK       23         MU.5XCS6       23         MU.5XCTI       23         MU1CHC       23         MU1CKF       23         MU1CS6       23         MU1CTI       23         MU1XCHC       23         MU1XCPK       23         MU1XCF       23         MU1XCF       23         MU1XCF       23         MU1XCF       23         MX.5CHC       23         MX.5CF       23         MX.5CF       23         MX.5CTI       23         MX.5XCPK       23         MX.5XCPK       23         MX.5XCF       23         MX.5XCPK       23         MX.5XCS6       23         MX.5XCS6       23         MX.5XCTI       23         MX.5XCTI       23         MX.5CCTI       23         MX.5CCTI       23         MX.5CCTI       23         MX.5CCTI       23         MX.5CCTI       23

MX1CS623	PEA4436	PS-61416181	SFVLHT213
MX1CTI23	PEA82	PS-61416381,251	SFVLHT4213
MX1XCHC	PEA84	PS-61417081,251	SFVO 213
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MX1XCKF23	PFAF199	PS-614250 81,251	SFVOHT 213
MX1XCPK23	PFC2 199	PS-631201 251	SFVOHT4 213
MX1XCS623	PFC4 199	PS-631202 251	SFVOL
MX1XCTI23	PFC4 199	PS-631203 251	SFVOLHT 213
MY.5CHC23	PFW36199	PS-631204251	SFVOLHT4 213
MY.5CKF	PFW60199	PS-631205	SI4G41
MY.5CPK	PFW90199		SL100CSTP
		PS-631206	
MY.5CS623	PM 210	PS-644350 251	SL100CSTUW 135
MY.5CTI23	PR50A15E2 219	PS-644850 251	SL100CUW109,111,116
MY.5XCHC23	PR50A15Z1219	PS-654050 251	SL100CW 108, 110, 115
MY.5XCKF23	PR50A15Z2219	PS-654051 251	SL100NW
MY.5XCPK23	PR50A30E2 219	PS-660100	SL100STP131
MY.5XCS623	PR50A30Z1 219	PS-660110	SL100UW113,117,118
MY.5XCTI23	PR50A30Z2219	PS-660200	SL10CSTUW
MY1CHC23	PR50A60E2 219	PS-660210 248	SL10CUW109,111,116
MY1CKF23	PR50A60Z1 219	PS-660300 248	SL10CW 108, 110, 115
MY1CPK	PR50A60Z2219	PS-660310 248	SL10KCSTP130
MY1CS623	PR51A15E2 219	PS-660320 248	SL10KCSTUW 135
MY1CTI23	PR51A15Z1219	PS-943050 249	SL10KCUW109,111,116
MY1XCHC	PR51A15Z2	PS-943051	SL10KCW 108, 110, 115
MY1XCKF	PR51A30E2	PS-943052	SL10KSTP
MY1XCPK23	PR51A30Z1219	PS-943060 249	SL10KUW113,117,118
MY1XCS623	PR51A30Z2219	PS-943061 249	SL10NW
MY1XCTI23	PR51A60E2 219	PS-943062249	SL10UW
MZN1-1010	PR51A60Z1219	PV55,211	SL15CSTUW 135
MZN1PK-1063	PR51A60Z2219	PZA2135	SL15CUW 109,111,116
MZNF1KF-562	PS-050023249	PZA21T35	SL15CW 108, 110, 115
			SL15NW
MZNF1PK-562	PS-050024	PZA2235	•
MZNF1PKG-562	PS-050025 249	PZA4135	SL15UW 117
MZP1PK 64,71	PS-050031 249	PZA42	SL1KCSTP130
NP2-110	PS-050032 249	PZA42L35	SL1KCSTUW 135
NP2-220	PS-050033 249	PZA44L35	SL1KCUW 109,111,116
NPM-110 227	PS-050034 249	PZA8135	SL1KCW 108, 110, 115
NPM-220 227	PS-050035249	PZA8235	SL1KSTP
OEW55,210	PS-050036	PZA82L35	SL1KUW
OEW-255, 210	PS-050043	PZA84L35	SL20CSTUW 135
OEW-355, 210	PS-050044 249	RAD 204	SL20CUW109,111,116
OR 197	PS-050045 249	RF1.5KF-515	SL20CW 108, 110, 115
ORMP 196	PS-050051 249	RF1.5PK-515	SL20KUW 113, 117, 118
ORT 197	PS-050052 249	RF1.5TFG-5	SL20NW 107
ORTMP	PS-050053	RF1.5V-515	SL20UW
P100-1247	PS-050054	RF2.5KF-515	SL250CSTP
P100-2247			SL250CSTV
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P200-1 247	PS-050056 249	RF2.5TFG-515	SL250CUW 109,111,116
P200-2 247	PS-123050R250	RF2.5V-515	SL250CW 108, 110, 115
P300-1247	PS-160021 250	RF21KF-515	SL250NW
P300-2247	PS-160021R	RF21PK-5	SL250STP131
P310-1247	PS-160022250	RF21TFG-515	SL250UW 113,117,118
P310-2247	PS-160022R	RF21V-5	SL25CSTUW
P350-1	PS-160023	RF41KF-5	SL25CUW 109, 111, 116
P350-2		RF41PK-515	SL25CW 109,111,110
	PS-160023R		
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P400-2247	PS-160024R	RF41V-515	SL25UW
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P500-2247	PS-160025R250	RF42PK-5	SL2KCSTP130
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P600-2	PS-160221R	RF42V-5	SL2KCUW109,111,116
P700-1	PS-160222	SD4UW	SL2KCW 109,111,110
P700-2247	PS-160222R	SD6UW134	SL2KSTP
PCL412	PS-160223	SD8UW134	SL2KUW 113, 117, 118
PCL415	PS-160223R	SEAL1-HP18	SL3CUW
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PD-D2-IM	PS-160225 250	SFV	SL500CUW109
PEA22	PS-160225R	SFVHT	SL500CUW111,116
PEA24	PS-61415881,251	SFVHT4	SL500CW 108,110,115
PEA42	PS-614160	SFVL	SL500NW
1 LATZ	1.5 01410001,251	51 VE 213	3L300INVV100, 107

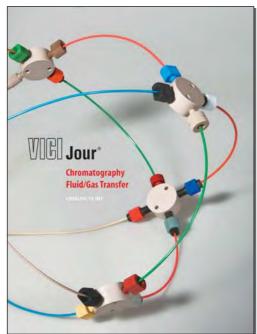
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SISOCTUW   133   SACHWE   104   SASTERWE   133   T10NS-10.	SL500UW 113, 117, 118		SSASTF12MWE133	T10N20-5094
SISOCTUW   133   SACHWE   104   SASTERWE   133   T10NS-10.	SL50CSTP130	SSACI4WE.06 104	SSASTF16MWE133	T10N20D
SISCUW   108,111,116   SACAMEZ   104   SANLAMWEZ   112   T10M5-50   94	SI 50CSTUW		SSASTE6MWE	T10N5-10
SLOCK   108, 10, 101   SACCYDMVE   126   SAMLSMWEZ   112   T10MSD   94   SLOUW   113, 117   SACCSCIAWWE   126   SAMLSAWEZ   127   T200-1   247   SLSCUW   109, 111   SACCSCIAWWE   126   SAMLSAWEZ   127   T200-1   247   SLSCUW   108, 110, 118   SACCSCIAWWE   126   SAMLSCIAWWEZ   127   T200-1   9.35   SLSCW   108, 110, 118   SACCSCIAWWE   126   SAMLSCIAWWEZ   127   T20C1-1 0   9.35   SLSCW   108, 110, 118   SACCSCIAWWE   126   SAMLSCIAWWEZ   127   T20C1-1 0   9.35   SLSCW   109   SACCSDIAWWE   124   SAMLSDIAWWEZ   125   T20C1-1 0   9.35   SLSCW   109   SACCSDIAWWE   124   SAMLSDIAWWEZ   125   T20C1-1 0   9.35   SLSCW   109   SACCSDIAWWE   124   SAMLSDIAWWEZ   125   T20C1-1 0   9.35   SLSCW   111, 116   SACCSDIAWWE   124   SAMLSDIAWWEZ   125   T20C1-1 0   9.35   SLSCW   111, 116   SACCSDIAWWE   124   SAMLSDIAWWEZ   125   T20C2-1 0   9.35   SLSCW   113, 117, 118   SACCSDIAWWE   124   SSAMLSDIAWWEZ   125   T20C2-1 0   9.35   SLSCW   113, 117, 118   SACCSDIAWWE   128   SAMLSDIAWWEZ   129   T20C2-1 0   9.35   SLSCW   113, 117, 118   SACCSDIAWWE   128   SMH3   45, 210   T20C2-1 0   9.35   SLSCW   130, 113, 117, 118   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SMH3   SACCSDIAWWE   128   SACCSDIAWWE   128   SWH3   45, 210   T20C3-1 0   9.35   SMMP3   SACCSDIAWWE   128   SAC				
SEONIW   106,107   SASCSCIONIWE   126   SANUSHMINEZ   112   T10NSD   9.4				
SASULW				
SLSCUW   109   11   SSACSCIGNWE   126   SSAUSCIGNWE2   127   T20C10-10   95   SLSCUW   108   110   115   SSACSCIDIOWE   124   SSAUSDIDMWE2   125   T20C10-10   95   SLSKCSTT   130   SSACSDIDWWE   124   SSAUSDIDMWE2   125   T20C10-10   95   SLSKCSTW   135   SSACSDIDWE   124   SSAUSDIDMWE2   125   T20C10-10   95   SLSKCSTW   135   SSACSDIDWE   124   SSAUSDIDMWE2   125   T20C10-10   95   SLSKCSW   111   116   SSACSDIDWE   124   SSAUSDIDMWE2   125   T20C10-10   95   SLSKCW   111   116   SSACSDIDWE   124   SSAUSDIDMWE2   125   T20C20-10   95   SLSKCW   111   116   SSACSDIDWE   124   SSAUSDIDWE2   125   T20C20-10   95   SLSKCW   113   117   118   SSACSDIDWE   128   SSAUSDIDWE2   129   T20C20-10   95   SLSKCW   113   SSACSDIDWE   128   SSAUSDIDWE2   129   T20C20-10   95   SLSKCW   128   SSAUSDIDWE   128   SSAUSDIDWE2   129   T20C20-10   95   SLSKCW   128   SSAUSDIDWE   128   SSAUSDIDWE2   129   T20C20-10   95   SLSKCW   128   SSAUSDIDWE2   128   SSAUSDIDWE2				
SISCUW   108, 110, 115   SSACSCEMWE   126   SSANSCEMWE2   127   T20C10-10   95   SISCSTP   130   SSACSD10UW   124   SSANSD4MWE2   125   T20C10-10   95   SISCSTP   130   SSACSD10WW   124   SSANSD4MWE2   125   T20C10-10   95   SISCSUW   109   SSACSD14WWE   124   SSANSD4MWE2   125   T20C10-10   95   SISCSUW   109   SSACSD16WWE   124   SSANSD4MWE2   125   T20C20-10   95   SISCSUW   110, 161   SSACSD4WWE   124   SSANSD4MWE2   125   T20C20-10   95   SISCSW   108, 161   SSACSD4WWE   124   SSANSD4WWE2   127   T20C20-10   95   SISCSW   108, 161   SSACSD4WWE   124   SSANSD4WWE2   129   T20C20-10   95   SISCSW   131, 171   131   SSACSD4WWE   128   SSANSD4WWE2   129   T20C20-10   95   SISCSW   131, 171   171   SSACSD4WWE   128   SSAWSD4WE2   129   T20C20-10   95   SSACSD4WWE   128   SSAWSD4WE2   129   T20C20-10   95   SSASCSD4WWE   128   SSAWSD4WE2   129   T20C20-10   95   SSASCSD4WWE   128   SSAWSD4WE2   129   T20C20-10   95   SSACSD4WWE   128   SSAWSD4WWE2   128   T100-1   247   T20C30-10   95   SSAWSD4WE2   SSAWSD4WWE   128   T100-1   247   T20C30-10   95   SSAWSD4WE2   T20C30-10   95   SSAWSD4WE2   T20C30-10   95   SSAWSD4WE2   T20C30-10   95   SSAWSD4WE2   T20C30-10   95   T20C40-10   95   T20C50-10   95   T20C50-10				
SLECKY   108, 110, 115   SACSDTOMWE   124   SAMUSDTOMWE2   125   T20C10-10   9.5   SLEKCTIW   135   SACSDTOMWE   124   SAMUSDEMWE2   125   T20C10-10   9.5   SLEKCLW   119   SSACSDTOMWE   124   SAMUSDEMWE2   125   T20C10-10   9.5   SLEKCLW   111, 116   SSACSDEMW   124   SSAMUSDEMWE2   125   T20C20-10   9.5   SLEKCLW   111, 116   SSACSDEMW   124   SSAMUSDEMWE2   129   T20C20-10   9.5   SLEKCW   108, 110   SSACSDEMW   124   SSAMUSFAMWE2   129   T20C20-10   9.5   SLEKCW   108, 110   SSACSDEMW   124   SSAMUSFAMWE2   129   T20C20-10   9.5   SLEKCW   13, 117, 118   SSACSDEMW   128   SWH3   SSAWUSFAMWE2   129   T20C20-10   9.5   SLEKCW   108, 110   SSACSDEMW   128   SWH3   SWH3	SL5CUW 109, 111	SSACSC16MWE 126	SSAVLSC6MWE2 127	T200-2 247
SISKICST	SL5CUW	SSACSC6MWE 126	SSAVLSC8MWE2 127	T20C10-1095
SISKICST	SL5CW 108,110,115	SSACSD10MWE124	SSAVLSD10MWE2 125	T20C10-10095
SISKCUW   199   SSACSTIGNWE   124   SANLSDEMWEZ   125   T20C201   9.95   SISKCUW   111   116   SSACSDEMW   124   SSANLSTEMWEZ   129   T20C20-100   9.95   SISKCW   111   116   SSACSDEMW   124   SSANLSTEMWEZ   129   T20C20-100   9.95   SISKCW   113   117   118   SSACSDEMW   124   SSANLSTEMWEZ   129   T20C20-100   9.95   SISKCW   134   SSANLSTEMWEZ   129   T20C20-100   9.95   SISKCW   134   SSANLSTEMWEZ   129   T20C20-10   9.95   SISKW   107   SSACSDEMW   128   SWH3.   SWH3.				
SLINECIUM				
SLISECUM				
SISKCW   108, 110				
SLISTEP   31   SACSFIONME   128   SWH3   54,210   TOCGOD   95   SLISTUW   113,117,118   SACSFIONME   128   SWH3   54,210   TOCGO-10-10   95   SLISTUW   107   SACSFIONME   128   TOO-1   247   TOCGO-10-10   95   SLISTUW   107   SACSFIONME   128   TOO-1   247   TOCGO-10-10   95   SOMAPPE   204   SACSFIONME   128   TOO-1   247   TOCGO-10-10   95   SOMAWRPE   264   SACSTIONME   130   TOOCO-10-10   95   TOCGO-10-10   95   SOMAWR   204   SACSTIONME   130   TOOCO-10-10   95   TOCGO-10-10   95   SOMAWR   204   SACSTIONME   130   TOOCO-10-10   95   TOCGO-10-10   95   SOMAWR   204   SACSTIONME   130   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONME   130   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   130   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   130   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   132   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   132   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   132   TOOCO-10-10   95   TOCGO-10-10   95   SACOWR   204   SACSTIONWE   212   TOOCO-10-10   95   TOOWR   204   SACOWR   204   SAC				
SLSNW	SL5KCW108, 110	SSACSD6MWE 124	SSAVLSF6MWE2129	T20C20-5095
SLSNW   107   SSACSF12MWE   128   SWH4   5.4210   T2C3-0-100   95   SOMAPP   204   SSACSF6MWE   128   T100-1   247   T2C3-05-05   95   SOMAPP   204   SSACSF6MWE   128   T100-1   247   T2C3-05-05   95   SOMAW   204   SSACSF6MWE   130   T100C10-10   95   T2C3-01-10   95   SOMAW   204   SSACST12MWE   130   T100C10-10   95   T2C3-01-10   95   SOMAW   204   SSACST12MWE   130   T100C10-10   95   T2C3-01-00   95   SOMAW   204   SSACST12MWE   130   T100C10-10   95   T2C3-01-00   95   SSA10UW   117   SSACST4UW   135   T100C10-10   95   T2C3-01-00   95   SSA10UW   117   SSACST8MWE   130   T100C20-10   95   T2C3-01-00   95   SSA10UW   117   SSACST8MWE   130   T100C20-10   95   T2C3-01-0   95   SSA10UW   117   SSACST8T0MWE   132   T100C20-10   95   T2C3-01-0   95   SSA10UW   117   SSACST8T0MWE   132   T100C20-10   95   T2C3-01-0   95   SSA4UW   117   SSACST8T0MWE   132   T100C20-10   95   T2C3-01-0   95   SSA4UW   117   SSACST8T6MWE   132   T100C30-10   95   T2C3-01-0   95   SSA4UW   117   SSACST8T6MWE   132   T100C30-10   95   T2C3-01-0   95   T2C3-01-0	SL5KSTP	SSACSD6UW134	SSAVLSF8MWE2 129	T20C20D95
SLSNW	SL5KUW	SSACSF10MWE 128	SWH354,210	T20C30-1095
SOMAPP   204   SSACSFIGMWE   128   T100-1   247   T20C3D-5   95   SOMAPP   204   SSACSFIGMWE   130   T100C10-10   95   T20C40-10   95   95   SOMAW   204   SSACSTIAWME   130   T100C10-10   95   T20C40-10   95   95   SOMAW   204   SSACSTIAWME   130   T100C10-10   95   T20C40-10   95   SPSSA   84   SSACSTIAWME   130   T100C10-10   95   T20C40-10   95   SPSSA   84   SSACSTIAWME   130   T100C10-10   95   T20C40-10   95   SPSSA   84   SSACSTIAWME   130   T100C10   95   T20C40-10   95   SSA10UWE   112   SSACSTIAWWE   132   T100C20-10   95   T20C5-10   95   SSA10UWT   113   SSACSTICHWE   132   T100C20-10   95   T20C5-10   95   SSA10UWT   113   SSACSTICHWE   132   T100C20-10   95   T20C5-10   95   SSA4UWE   112   SSACSTICHWE   132   T100C20-10   95   T20C5-10   95   SSAGUWE   112   SSACSTICHWE   132   T100C30-10   95   T20C5-10   95   T20C			•	
SOMAPPE         204         SSACSFEMWE         128         T1002         247         T20C40-10         95           SOUTH         204         SSACSTIOMWE         130         T100C10-10         95         T20C40-10         95           SOUTH         204         SSACSTIOWWE         130         T100C10-10         95         T20C40-10         95           SSA10UW         117         SSACSTHOW         135         T100C10-0         95         T20C40-0         95           SSA10UW         117         SSACSTHOW         135         T100C20-10         95         T20C5-10         95           SSA10UW         117         SSACSTERIOWE         130         T100C20-10         95         T20C5-10         95           SSA4UW         117         SSACSTERIOWE         132         T100C20-0         95         T20C5-50         95           SSA4UW         117         SSACSTERIOWE         132         T100C20-0         95         T20C5-50         95           SSA6UW         117         SSACSTERIOWE         132         T100C20-0         95         T20N10-10         94           SSA6UW         117         SSACSTERIOWE         132         T100C30-0         95         T20N10-10 </td <td></td> <td></td> <td>, ,</td> <td></td>			, ,	
SOMAW         204         SASCSTIAWE         130         T100C10-10         95         T20C40-10         95           SOUTH         204         SASCSTIAWE         130         T100C10-10         95         T20C40-10         95           SPSA10UW         117         SSASCTSTAUW         135         T100C10-10         95         T20C40-00         95           SANIOUWE         112         SSACSTEMWE         130         T100C20-10         95         T20C5-10         95           SSAIUW         117         SSACSTEIDWWE         132         T100C20-10         95         T20C5-10         95           SSAIUW         117         SSACSTFIOWWE         132         T100C20-10         95         T20C5-10         95           SSAIUWE         112         SSACSTFIOWWE         132         T100C30-10         95         T20K10-10         95           SSAIUWE         112         SSACSTFIOWWE         132         T100C30-10         95         T20K10-10         94           SSAGUWE         112         SSACSTFIOWWE         132         T100C30-10         95         T20K10-10         94           SSAGUWE         117         SSAALUWE         132         T100C30-10         95         <				
SOUTH   204   SACSTIAWE   130   T100C10-100   95   T20C40-100   95   SPS540   8.4   SACSTIGNWE   130   T100C10-50   95   T20C40-50   95   SSA10UW   117   SSACSTAUW   135   T100C10-10   95   T20C40-0   95   T20C5-10   95   SSA10UWT   113   SSACSTEUW   135   T100C20-100   95   T20C5-100   95   SSA10UWT   113   SSACSTEUW   135   T100C20-100   95   T20C5-100   95   SSA4UW   117   SSACSTF12MWE   132   T100C20-100   95   T20C5-100   95   SSA4UW   117   SSACSTF12MWE   132   T100C20-100   95   T20C5-100   95   SSA4UWT   113   SSACSTF12MWE   132   T100C20-100   95   T20C5-100   95   SSA4UWT   113   SSACSTF12MWE   132   T100C30-100   95   T20N10-10   94   SSA6UWT   113   SSAGVENEWE   132   T100C30-100   95   T20N10-100   94   SSA6UWT   113   SSA4UWE2   105   T100C30-100   95   T20N10-100   94   SSA6UWT   113   SSA4UWE5   105   T100C30-100   95   T20N10-100   94   SSA8UWT   117   SSAGVENEWE   112   SSA4UWE2   105   T100C40-100   95   T20N10-100   94   SSA8UWT   113   SSA4UWE2   105   T100C40-100   95   T20N20-100   94   SSACTIOUW   116   SSA4UWE   117   SSAGVENEWE   112   SSA4UWE2   105   T100C40-100   95   T20N20-100   94   SSACTIOUW   116   SSALUW   118   T100N10-10   94   T20N20-100   94   SSACTIOUW   116   SSALUW   118   T100N10-10   94   T20N20-100   94   SSACTIOUW   116   SSALUW   118   T100N10-10   94   T20N5-10   94   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T20N5-10   94   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T20N5-10   94   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T20N5-10   95   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T20N5-10   95   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T300-1   95   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T300-1   95   SSACTIOUW   116   SSANUWT   107   T100N10-10   94   T300-1   95   SSACTIOUW   107   SSANUWT   107   T100N10-10   95   T30CC10-10   95   SSACTIOUW   107   SSANUWT   107   T100N10-10   95   T30CC10-10   95   SSACTIOUW   107   SSANUWT   107   T10C10-10   95   T30CC10-10   95   SSACTIOUW   107   SSANUWT				
SPSSAO   84   SACSTIGNWE   130   T100C10-D   9.5   T20C40-D   9.5   SA10UW   117   SSACTSTUW   135   T100C10-D   9.5   T20C5-D   9.5   SSA10UW   117   SSACSTGWE   130   T100C20-D   9.5   T20C5-D   9.5   SSA10W   117   SSACSTGWE   132   T100C20-D   9.5   T20C5-D   9.5   SSA4UW   117   SSACSTFIOWWE   132   T100C30-D   9.5   T20ND-D   9.4   SSAGUW   117   SSACSTFIOWWE   132   T100C30-D   9.5   T20ND-D   9.4   SSAGUW   117   SSAGUWE   112   SSA4UWE   105   T100C30-D   9.5   T20ND-D   9.4   SSAGUW   117   SSAGUWE   105   T100C30-D   9.5   T20ND-D   9.4   SSAGUW   117   SSAGUWE   105   T100C40-D   9.5   T20ND-D   9.4   SSAGUW   117   SSAGUWE   105   T100C40-D   9.5   T20ND-D   9.4   SSAGUWE   112   SSAGUWE   105   T100C40-D   9.5   T20ND-D   9.4   SSAGUWE   112   SSAGUWE   113   SSALUWE   105   T100C40-D   9.5   T20ND-D   9.4   SSACUDW   116   SSALUW   118   T100C40-D   9.5   T20ND-D   9.4   SSACUDW   116   SSALUW   118   T100C40-D   9.5   T20ND-D   9.4   SSACUDW   116   SSALUW   118   T100ND-D   9.4   T20ND-D   9.4   SSACUDW   116   SSALUW   118   T100ND-D   9.4   T20ND-D   9.4   SSACUDW   116   SSANUW   118   T100ND-D   9.4   T20ND-D   9.4   SSACUDW   116   SSANUW   118   T100ND-D   9.4   T20ND-D   9.5   T20ND-				
SSAIOUW         117         SSACSTAIW         135         T100C1DD         95         T20C4DD         95           SSAIOUWT         113         SSACST6MWE         130         T100C2D-100         95         T20C5-100         95           SSAIUW         117         SSACSTFIOWE         132         T100C2D-100         95         T20C5-50         95           SSAHUWE         112         SSACSTFIOWE         132         T100C2D-100         95         T20C5D.         95           SSAHUWE         112         SSACSTFIOWE         132         T100C2D-10         95         T20NID-10         94           SSAGUW         117         SSASTFIGHWE         132         T100C3D-10         95         T20NID-10         94           SSAGUW         117         SSAGUWES         112         SSAHUWES         105         T100C3D-0         95         T20NID-0         94           SSABUW         117         SSAGUWES         112         SSAHUWES         105         T100C4D-10         95         T20NID-10         94           SSACIOW         118         SSACIOW         118         T100C4D-10         95         T20NID-10         94           SSACIOWE         109         SSALOWE			T100C10-10095	
SSACIOUNE	SPSS4084	SSACST16MWE 130	T100C10-5095	T20C40-5095
SSACIDUWT	SSA10UW117	SSACST4UW 135	T100C10D	T20C40D95
SSACIDUWT	SSA10UWF	SSACST6MWF	T100C20-1095	T20C5-1095
SSAALW         117         SSACSTF10MWE         132         T100C20D-0.         95         T20C5-50         95           SSAAUWT         112         SSACSTF16MWE         132         T100C20D-0.         95         T20N10-10         .94           SSAGUW         117         SSACSTF6MWE         132         T100C30-10         .95         T20N10-10         .94           SSAGUWE         112         SSAGUWE.         112         SSAGUWE.         100C30-10         .95         T20N10-10         .94           SSAGUWE         113         SSAGUWE.         100C30-10         .95         T20N10-10         .94           SSAGUWE         112         SSAHUWE.         105         T100C40-10         .95         T20N120-10         .94           SSAGUWE         112         SSAHUWE.         105         T100C40-10         .95         T20N20-10         .94           SSAC10UW         116         SSALGUW.         118         T100C40-10         .95         T20N20-10         .94           SSAC10W         118         SSALGUW.         118         T100C40-10         .95         T20N20-10         .94           SSAC10W         116         SSANIOWE.         106         T100N10-10         .94				
SSALUWE         112         SSACSTFIAWE         132         T100C3D0         95         T20C5D         95           SSAGUW         117         SSACSTF6MWE         132         T100C3O-100         .95         T20N10-10         .94           SSAGUW         117         SSAGUWE         112         SSAHUWE2         105         T100C3O-50         .95         T20N10-10         .94           SSABUW         117         SSAHUWE5         105         T100C3O-10         .95         T20N10-10         .94           SSABUW         117         SSAHUWE2         105         T100C40-10         .95         T20N20-10         .94           SSABUWT         113         SSALIOUW         118         T100C40-10         .95         T20N20-10         .94           SSAC10UW         116         SSALIOUW         118         T100C40-10         .95         T20N20-50         .94           SSAC10UWE         109         SSALGUW         118         T100N10-10         .94         T20N5-10         .94           SSAC10WE         109         SSAN10WE         106         T100N10-50         .94         T20N5-10         .94           SSAC10WE         108         SSAN10WE         106         T100N		SCACSTE10MM/E 122		
SSAALUWT.         113         SSACSTFEMWE         132         T100C30-10.         .95         T20N10-10.         .94           SSAGUW.         117         SSACSTFEMWE         132         T100C30-100.         .95         T20N10-10.         .94           SSAGUWE.         112         SSAHUWE.5.         105         T100C30-50.         .95         T20N10-10.         .94           SSABUWE.         113         SSAHUWE.1.         105         T100C40-10.         .95         T20N20-10.         .94           SSABUWE.         112         SSAHUWE.2.         105         T100C40-100.         .95         T20N20-10.         .94           SSACIOUW.         116         SSALIOUW.         118         T100C40-100.         .95         T20N20-10.         .94           SSACIOUW.         116         SSALIOW.         118         T100N10-10.         .94         T20N20-0.         .94           SSACIOWT.         111         SSALIOW.         118         T100N10-10.         .94         T20N5-10.         .94           SSACIOWT.         110         SSANIOWT.         106         T10N10-50.         .94         T20N5-10.         .94           SSACHUW.         116         SSANIOWT.         107         T10				
SSAGUW    117				
SSAGUWE         112         SSAI4UWE.2         105         T100C30-50         .95         T20N10-50         .94           SSA6UWT         113         SSAI4UWE5         105         T100C30D         .95         T20N10D         .94           SSABUW         117         SSAI4UWE1         105         T100C40-100         .95         T20N20-10.         .94           SSABUWE         112         SSAI4UWE2         105         T100C40-100         .95         T20N20-10.         .94           SSACIOUW         116         SSAILOUW         118         T100C40-100         .95         T20N20-50         .94           SSACIOUW         116         SSAILOUW         118         T100C40-10         .95         T20N20-50         .94           SSACIOUW         109         SSAILOUW         118         T100N10-10         .94         T20N5-10         .94           SSACIOUWT         111         SSAINOWE         106         T100N10-50         .94         T20N5-50         .94           SSACIOWT         110         SSANOWE         106         T100N20-10         .94         T20N5-50         .94           SSACHUW         116         SSANOWE         106         T100N20-10         .94				
SSABUWT         113         SSAI4UWE1         105         T100C30D         .95         T20N10D         .94           SSABUW         117         SSAI4UWE2         105         T100C40-10.         .95         T20N20-10.         .94           SSABUWT         113         SSAI-10UW.         118         T100C40-50.         .95         T20N20-50.         .94           SSAC10UW         116         SSAI-UW.         118         T100C40-50.         .95         T20N20-50.         .94           SSAC10UWE         109         SSAI-GUW.         118         T100C40-50.         .95         T20N20-50.         .94           SSAC10UWE         109         SSAI-GUW.         118         T100C40-50.         .95         T20N20-0.         .94           SSAC10WE         109         SSAI-GUW.         118         T100N10-10         .94         T20N5-10.         .94           SSAC10WE         108         SSAN10WE         106         T100N10-50         .94         T20N5-10.         .94           SSAC10WE         108         SSANWE         106         T100N10-50         .94         T300-1.         .247           SSAC4UWE         109         SSANWE         106         T100N20-10         .94 <td></td> <td></td> <td>T100C30-10095</td> <td></td>			T100C30-10095	
SSABUW	SSA6UWE112	SSAI4UWE.2 105	T100C30-5095	T20N10-5094
SSABUWE         .112         SSALUWE2         .105         T100C40-100         .95         T20N20-100         .94           SSARDUWT         .113         SSAL10UW         .118         T100C40-50         .95         T20N20-50         .94           SSAC10UWE         .109         SSAL6UW         .118         T100N10-10         .94         T20N5-10         .94           SSAC10UWT         .111         SSALBUW         .118         T100N10-10         .94         T20N5-10         .94           SSAC10WT         .115         SSAN10WE         .106         T100N10-50         .94         T20N5-50         .94           SSAC10WE         .108         SSAN10WT         .107         T100N10-50         .94         T20N5-50         .94           SSAC1WE         .108         SSAN1WT         .107         T100N100-10         .94         T20N5-50         .94           SSAC4UW         .116         SSAN4WT         .107         T100N20-10         .94         T300-1         .247           SSAC4UWT         .111         SSAN6WT         .107         T100N20-50         .94         T30C10-10         .95           SSAC4W         .115         SSANBWT         .107         T10C10-10         .95 </td <td>SSA6UWT113</td> <td>SSAI4UWE.5 105</td> <td>T100C30D</td> <td>T20N10D</td>	SSA6UWT113	SSAI4UWE.5 105	T100C30D	T20N10D
SSABUWE         .112         SSALUWE2         .105         T100C40-100         .95         T20N20-100         .94           SSARDUWT         .113         SSAL10UW         .118         T100C40-50         .95         T20N20-50         .94           SSAC10UWE         .109         SSAL6UW         .118         T100N10-10         .94         T20N5-10         .94           SSAC10UWT         .111         SSALBUW         .118         T100N10-10         .94         T20N5-10         .94           SSAC10WT         .115         SSAN10WE         .106         T100N10-50         .94         T20N5-50         .94           SSAC10WE         .108         SSAN10WT         .107         T100N10-50         .94         T20N5-50         .94           SSAC1WE         .108         SSAN1WT         .107         T100N100-10         .94         T20N5-50         .94           SSAC4UW         .116         SSAN4WT         .107         T100N20-10         .94         T300-1         .247           SSAC4UWT         .111         SSAN6WT         .107         T100N20-50         .94         T30C10-10         .95           SSAC4W         .115         SSANBWT         .107         T10C10-10         .95 </td <td>SSA8UW117</td> <td>SSAI4UWE1</td> <td>T100C40-1095</td> <td>T20N20-1094</td>	SSA8UW117	SSAI4UWE1	T100C40-1095	T20N20-1094
SSABUWT         113         SSALOUW         118         T100C40-50         .95         T20N20-50         .94           SSAC10UWE         109         SSAL6UW         .118         T100N10-10         .95         T20N20D         .94           SSAC10UWT         .111         SSAL6UW         .118         T100N10-10         .94         T20N5-10         .94           SSAC10WE         .111         SSASAL0W         .118         T100N10-10         .94         T20N5-10         .94           SSAC10WE         .108         SSAN10WT         .107         T100N10D         .94         T20N5-50         .94           SSAC10WE         .108         SSAN10WT         .107         T100N10D         .94         T20N5-50         .94           SSAC4UW         .116         SSAN4WT         .107         T100N20-10         .94         T300-1         .247           SSAC4UWE         .109         SSAN6WE         .106         T100N20-10         .94         T30C10-10         .95           SSAC4W         .115         SSAN6WE         .106         T10C10-10         .95         T30C10-10         .95           SSAC6WE         .108         SSANIAWE         .107         T10C10-10         .95				
SSAC10UW				
SSAC10UWE         109         SSAL6UW         118         T100N10-10         94         T20N5-10         94           SSAC10WT         111         SSALBUW         118         T100N10-100         94         T20N5-10         94           SSAC10WE         108         SSAN10WT         107         T100N10D         94         T20N5-50         94           SSAC10WT         110         SSAN10WT         107         T100N10D         94         T20N5-50         94           SSAC10WT         110         SSAN14WT         107         T100N10D         94         T300-1         247           SSAC4UW         116         SSAN6WE         106         T100N20-10         94         T300-1         247           SSAC4UWE         109         SSAN6WE         106         T100N20-10         94         T30C1-10         95           SSAC4WW         115         SSANBWE         106         T10C10-10         95         T30C10-10         95           SSAC6WE         108         SSANBWE         106         T10C10-10         95         T30C10-50         95           SSAC6WE         108         SSANIAWE         104         T10C10-50         95         T30C20-10         95				
SSAC10WT         111         SSALBUW.         118         T100N10-100         94         T20N5-100         .94           SSAC10WE         115         SSAN10WE         106         T100N10-50         .94         T20N5-50         .94           SSAC10WE         108         SSAN10WT         107         T100N10-50         .94         T20N5-50         .94           SSAC10WT         110         SSAN4WE         106         T100N20-10         .94         T300-1         .247           SSAC4UWE         109         SSAN6WE         106         T100N20-100         .94         T30C1-10         .95           SSAC4UWT         111         SSANBWT         107         T100N20-10         .94         T30C10-10         .95           SSAC4WE         108         SSANBWT         107         T10C10-10         .95         T30C10-10         .95           SSAC6WE         108         SSANIAWE.06         104         T10C10-10         .95         T30C20-10         .95           SSAC6UWE         109         SSANIAWE.2         104         T10C20-10         .95         T30C20-10         .95           SSAC6WE         108         SSASC10MWE         127         T10C20-50         .95 <t< td=""><td></td><td></td><td></td><td></td></t<>				
SSAC10W.         115         SSAN10WE.         106         T100N10-50         .94         T20N5-50         .94           SSAC10WE.         108         SSAN10WT         107         T100N10D         .94         T20N5D         .94           SSAC10WT.         110         SSAN4WE.         106         T100N2D-100         .94         T300-1         .247           SSAC4UW.         116         SSAN4WT.         107         T100N2D-100         .94         T300-2         .247           SSAC4UWT.         111         SSAN6WE.         106         T100N2D-50         .94         T30C10-100         .95           SSAC4WW.         115         SSAN8WE.         106         T10C10-10         .95         T30C10-100         .95           SSAC4WE.         108         SSAN8WE.         106         T10C10-10         .95         T30C10-100         .95           SSAC6WT.         110         SSAN14WE.06         104         T10C10-10         .95         T30C20-10         .95           SSAC6UW.         116         SSAN14WE.1         104         T10C20-10         .95         T30C20-10         .95           SSAC6WW.         111         SSASC16WW.E.2         104         T10C20-10         .95 <td></td> <td></td> <td></td> <td></td>				
SSAC10WE         108         SSAN10WT         107         T100N10D         .94         T20N5D         .94           SSAC10WT         110         SSAN4WE         106         T100N20-10         .94         T300-1         .247           SSAC4UW         116         SSAN6WT         107         T100N20-100         .94         T300-2         .247           SSAC4WE         109         SSAN6WE         106         T100N20-50         .94         T30C10-10         .95           SSAC4WT         111         SSANSWT         107         T100N20D         .94         T30C10-10         .95           SSAC4WE         108         SSANSWT         107         T10C10-10         .95         T30C10-50         .95           SSAC4WE         108         SSANSWT         107         T10C10-100         .95         T30C10D         .95           SSAC6WE         108         SSANI4WE.66         104         T10C10-50         .95         T30C20-10         .95           SSAC6UWE         109         SSANI4WE.2         104         T10C20-10         .95         T30C20-50         .95           SSAC6WE         135         SSASC1MWE         127         T10C20-10         .95         T30C20-50 <td>SSAC10UWT</td> <td>SSAL8UW 118</td> <td>T100N10-10094</td> <td>T20N5-10094</td>	SSAC10UWT	SSAL8UW 118	T100N10-10094	T20N5-10094
SSAC10WT.         110         SSAN4WE.         106         T100N20-10         94         T300-1         247           SSAC4UW.         116         SSANWE.         107         T100N20-100         .94         T300-2         .247           SSAC4UWE         109         SSANGWE.         106         T100N20-10         .94         T30C10-10         .95           SSAC4WT.         111         SSANSWE.         106         T10C10-10         .95         T30C10-50         .95           SSAC4WE.         108         SSANSWE.         106         T10C10-10         .95         T30C10-50         .95           SSAC4WT.         110         SSANIAWE.         106         T10C10-10         .95         T30C10-50         .95           SSAC6WW.         116         SSANIAWE.1         104         T10C10-50         .95         T30C20-10         .95           SSAC6WW.         109         SSANIAWE.2         104         T10C20-10         .95         T30C20-10         .95           SSAC6WT.         111         SSASC10MWE.         127         T10C20-50         .95         T30C20-10         .95           SSAC6WT.         110         SSASC16WWE.         127         T10C30-10         .95	SSAC10W115	SSAN10WE106	T100N10-5094	T20N5-5094
SSAC10WT.         110         SSAN4WE.         106         T100N20-10         94         T300-1.         247           SSAC4UW.         116         SSANWE.         107         T100N20-100         94         T300-2.         247           SSAC4UWE         109         SSANGWE.         106         T100N20-10         94         T30C10-10         95           SSAC4WT.         111         SSANSWE.         106         T10C10-10         95         T30C10-50         .95           SSAC4WE.         108         SSANSWT.         107         T10C10-10         .95         T30C10-50         .95           SSAC4WE.         108         SSANSWT.         107         T10C10-10         .95         T30C10-50         .95           SSAC6WE.         108         SSANSWT.         107         T10C10-10         .95         T30C10-10         .95           SSAC6UW.         116         SSANIAWE.2         104         T10C10-10         .95         T30C20-10         .95           SSAC6UW.         109         SSANCHWE.         127         T10C20-10         .95         T30C20-10         .95           SSAC6W.         115         SSASC10MWE.         127         T10C20-50         .95	SSAC10WE108	SSAN10WT 107	T100N10D94	T20N5D94
SSAC4UW.         116         SSAN4WT.         107         T100N20-100         .94         T300-2.         .247           SSAC4UWE         109         SSAN6WE.         106         T100N20-50         .94         T30C10-10.         .95           SSAC4W         111         SSAN6WT.         107         T100N20-0         .94         T30C10-10.         .95           SSAC4W.         115         SSAN8WT.         107         T10C10-10.         .95         T30C10-50.         .95           SSAC4WE.         108         SSAN8WT.         107         T10C10-100.         .95         T30C20-10.         .95           SSAC6WE.         116         SSANI4WE.06         104         T10C10-10.         .95         T30C20-10.         .95           SSAC6UW.         116         SSANI4WE.1         104         T10C20-10.         .95         T30C20-10.         .95           SSAC6UW.         115         SSASC10MWE.         127         T10C20-10.         .95         T30C20-10.         .95           SSAC6W.         115         SSASC10MWE.         127         T10C20-0.         .95         T30C30-10.         .95           SSAC8W.         116         SSASC16MWE.         127         T10C30-10.				
SSAC4UWE         109         SSAN6WE         106         T100N20-50         .94         T30C10-10         .95           SSAC4UWT         111         SSAN6WT         107         T100N20D         .94         T30C10-100         .95           SSAC4W         115         SSAN8WE         106         T10C10-10         .95         T30C10-50         .95           SSAC4WE         108         SSAN8WE         107         T10C10-100         .95         T30C10-50         .95           SSAC6WE         108         SSANHWE.06         104         T10C10-50         .95         T30C20-10         .95           SSAC6UWT         116         SSANHWE.1         104         T10C10-50         .95         T30C20-10         .95           SSAC6UWE         109         SSANHWE.2         104         T10C20-10         .95         T30C20-10         .95           SSAC6UWT         111         SSANHWE.5         104         T10C20-10         .95         T30C20D         .95           SSAC6W         115         SSASC10MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC8WT         110         SSASC12MWE         127         T10C20-50         .95         T3				
SSAC4UWT         111         SSANGWT         107         T100N20D         .94         T30C10-100         .95           SSAC4W         115         SSANSWE         106         T10C10-10         .95         T30C10-50         .95           SSAC4WE         108         SSANSWT         107         T10C10-100         .95         T30C10-D         .95           SSAC4WT         110         SSANI4WE.06         104         T10C10-50         .95         T30C20-10         .95           SSAC6UW         116         SSANI4WE.1         104         T10C10-D         .95         T30C20-10         .95           SSAC6UW         116         SSANI4WE.2         104         T10C20-10         .95         T30C20-10         .95           SSAC6UWT         111         SSANI4WE.5         104         T10C20-10         .95         T30C20-D         .95           SSAC6W         115         SSASC12MWE         127         T10C20-10         .95         T30C30-10         .95           SSAC6WT         10         SSASC12MWE         127         T10C30-10         .95         T30C30-10         .95           SSAC8UW         116         SSASC12MWE         127         T10C30-10         .95         T				
SSAC4W         115         SSANBWE         106         T10C10-10         .95         T30C10-50         .95           SSAC4WE         108         SSANBWT         107         T10C10-100         .95         T30C10D         .95           SSAC4WT         110         SSANI4WE.06         104         T10C10-50         .95         T30C20-10         .95           SSAC6UW         116         SSANI4WE.1         104         T10C10-D         .95         T30C20-100         .95           SSAC6UWE         109         SSANI4WE.2         104         T10C20-10         .95         T30C20-100         .95           SSAC6WT         111         SSANI4WE.5         104         T10C20-10         .95         T30C20-50         .95           SSAC6W         115         SSASC12MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC6WE         108         SSASC12MWE         127         T10C30-10         .95         T30C30-10         .95           SSAC8BW         116         SSASC6MWE         127         T10C30-10         .95         T30C30-10         .95           SSAC8BWT         111         SSASD12MWE         125         T10C30-10         .95				
SSAC4WE         108         SSANBWT         107         T10C10-100         .95         T30C10D         .95           SSAC4WT         110         SSANI4WE.06         104         T10C10-50         .95         T30C20-10         .95           SSAC6UW         116         SSANI4WE.1         104         T10C10-10         .95         T30C20-100         .95           SSACGUWE         109         SSANI4WE.2         104         T10C20-10         .95         T30C20-50         .95           SSACGUWT         111         SSANI4WE.5         104         T10C20-100         .95         T30C20D         .95           SSACGW         115         SSASC10MWE         127         T10C20-50         .95         T30C30-10         .95           SSACGWE         108         SSASC12MWE         127         T10C30-10         .95         T30C30-10         .95           SSACBUW         116         SSASC6MWE         127         T10C30-10         .95         T30C30-50         .95           SSACBUWE         109         SSASD10MWE         125         T10C30-10         .95         T30C40-10         .95           SSACBWE         109         SSASD14WWE         125         T10C30-10         .95				
SSAC4WT         110         SSANI4WE.06         104         T10C10-50         .95         T30C20-10         .95           SSAC6UW         116         SSANI4WE.1         104         T10C10D         .95         T30C20-100         .95           SSAC6UWE         109         SSANI4WE.2         104         T10C20-10         .95         T30C20-50         .95           SSAC6WT         111         SSANI4WE.5         104         T10C20-100         .95         T30C20D         .95           SSAC6WE         108         SSASC10MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC6WE         108         SSASC12MWE         127         T10C20D         .95         T30C30-10         .95           SSAC6WE         108         SSASC16MWE         127         T10C30-10         .95         T30C30-50         .95           SSAC8UW         116         SSASC6MWE         127         T10C30-100         .95         T30C40-10         .95           SSAC8UWT         111         SSASD16MWE         125         T10C30-50         .95         T30C40-10         .95           SSAC8W         115         SSASD16MWE         125         T10C40-10         .95				
SSAC6UW.         116         SSANI4WE.1         104         T10C10D         95         T30C20-100         .95           SSAC6UWE         109         SSANI4WE.2         104         T10C20-10         .95         T30C20-50         .95           SSAC6UWT         111         SSANI4WE.5         104         T10C20-100         .95         T30C20D         .95           SSAC6W         115         SSASC12MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC6WE         108         SSASC12MWE         127         T10C20D         .95         T30C30-100         .95           SSAC6WT         110         SSASC16MWE         127         T10C30-10         .95         T30C30-50         .95           SSAC8UW         116         SSASC6MWE         127         T10C30-10         .95         T30C30-50         .95           SSAC8UWE         109         SSASD10MWE         .125         T10C30-0         .95         T30C40-10         .95           SSAC8WW         115         SSASD16MWE         .125         T10C30-0         .95         T30C40-10         .95           SSAC8WE         .108         SSASD40WW         .134         T10C40-10         .95	SSAC4WE108	SSAN8WT 107	T10C10-10095	T30C10D95
SSAC6UWE         109         SSANIAWE.2         104         T10C20-10         .95         T30C20-50         .95           SSAC6UWT         111         SSANIAWE.5         104         T10C20-100         .95         T30C20D         .95           SSAC6W         115         SSASC10MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC6WE         108         SSASC12MWE         127         T10C20D         .95         T30C30-100         .95           SSAC6WT         110         SSASC16MWE         127         T10C30-10         .95         T30C30-50         .95           SSAC8UW         116         SSASC6MWE         127         T10C30-100         .95         T30C30-50         .95           SSAC8UWT         110         SSASD10MWE         125         T10C30-50         .95         T30C40-10         .95           SSAC8WWT         111         SSASD16MWE         125         T10C30-50         .95         T30C40-10         .95           SSAC8WWT         115         SSASD16MWE         125         T10C40-10         .95         T30C40-50         .95           SSAC14UW.2         114         SSASD66WW         134         T10C40-10         .95 <td>SSAC4WT110</td> <td>SSANI4WE.06 104</td> <td>T10C10-5095</td> <td>T30C20-1095</td>	SSAC4WT110	SSANI4WE.06 104	T10C10-5095	T30C20-1095
SSAC6UWT         111         SSANIAWE.5         104         T10C20-100.         95         T30C20D         .95           SSAC6W         115         SSASC10MWE         127         T10C20-50.         .95         T30C30-10.         .95           SSAC6WE         108         SSASC12MWE         127         T10C20D         .95         T30C30-100.         .95           SSAC6WE         110         SSASC6MWE         127         T10C30-10.         .95         T30C30-50.         .95           SSAC8UW.         116         SSASC6MWE         127         T10C30-100.         .95         T30C30-50.         .95           SSAC8UWE         109         SSASD10MWE         125         T10C30-50.         .95         T30C40-10.         .95           SSAC8UWT         111         SSASD12MWE         125         T10C30D         .95         T30C40-10.         .95           SSAC8W         115         SSASD16MWE         125         T10C40-10.         .95         T30C40-100.         .95           SSAC8WE         108         SSASD4WW         134         T10C40-10.         .95         T30C40-50.         .95           SSAC8WT         110         SSASD6MWE         .125         T10C40-50.	SSAC6UW116	SSANI4WE.1	T10C10D95	T30C20-10095
SSAC6UWT         111         SSANIAWE.5         104         T10C20-100.         95         T30C20D         .95           SSAC6W         115         SSASC10MWE         127         T10C20-50.         .95         T30C30-10.         .95           SSAC6WE         108         SSASC12MWE         127         T10C20D         .95         T30C30-100.         .95           SSAC6WE         110         SSASC6MWE         127         T10C30-10.         .95         T30C30-50.         .95           SSAC8UW.         116         SSASC6MWE         127         T10C30-100.         .95         T30C30-50.         .95           SSAC8UWE         109         SSASD10MWE         125         T10C30-50.         .95         T30C40-10.         .95           SSAC8UWT         111         SSASD12MWE         125         T10C30D         .95         T30C40-10.         .95           SSAC8W         115         SSASD16MWE         125         T10C40-10.         .95         T30C40-100.         .95           SSAC8WE         108         SSASD4WW         134         T10C40-10.         .95         T30C40-50.         .95           SSAC8WT         110         SSASD6MWE         .125         T10C40-50.	SSAC6UWE 109	SSANI4WE.2 104	T10C20-1095	T30C20-5095
SSAC6W         115         SSASC10MWE         127         T10C20-50         .95         T30C30-10         .95           SSAC6WE         108         SSASC12MWE         .127         T10C20D         .95         T30C30-100         .95           SSAC6WT         110         SSASC16MWE         .127         T10C30-10         .95         T30C30-50         .95           SSAC8UW         .116         SSASC66MWE         .127         T10C30-100         .95         T30C30D         .95           SSAC8UWE         .109         SSASD10MWE         .125         T10C30-50         .95         T30C40-10         .95           SSAC8UWT         .111         SSASD12MWE         .125         T10C30-50         .95         T30C40-10         .95           SSAC8W         .115         SSASD16MWE         .125         T10C40-10         .95         T30C40-100         .95           SSAC8WT         .110         SSASD40HW         .134         T10C40-10         .95         T30C40-50         .95           SSAC14UW.2         .114         SSASD60HW         .125         T10C40-50         .95         T30C5-10         .95           SSAC14UW.5         .114         SSASD80HW         .134         T10C40-50				
SSAC6WE       108       SSASC12MWE       127       T10C20D       .95       T30C30-100       .95         SSAC6WT       110       SSASC16MWE       127       T10C30-10       .95       T30C30-50       .95         SSAC8UW       116       SSASC6MWE       127       T10C30-100       .95       T30C30D       .95         SSAC8UWE       109       SSASD10MWE       125       T10C30-50       .95       T30C40-10       .95         SSAC8WWT       111       SSASD12MWE       125       T10C30D       .95       T30C40-100       .95         SSAC8W       115       SSASD16MWE       125       T10C40-10       .95       T30C40-50       .95         SSAC8WE       108       SSASD4WW       134       T10C40-10       .95       T30C40D       .95         SSAC8WT       110       SSASD6MWE       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD6UW       134       T10C40-0       .95       T30C5-10       .95         SSACI4UW.5       114       SSASD8UW       134       T10C40-10       .95       T30C5-10       .95         SSACI4UWE.2       114       SSASF10MWE       129				
SSAC6WT         110         SSASC16MWE         127         T10C30-10         .95         T30C30-50         .95           SSAC8UW         116         SSASC6MWE         127         T10C30-100         .95         T30C30D         .95           SSAC8UWE         109         SSASD10MWE         125         T10C30-50         .95         T30C40-10         .95           SSAC8UWT         111         SSASD12MWE         125         T10C30D         .95         T30C40-100         .95           SSAC8W         115         SSASD16MWE         125         T10C40-10         .95         T30C40-50         .95           SSAC8WE         108         SSASD4UW         134         T10C40-10         .95         T30C40D         .95           SSAC8WT         110         SSASD6MWE         125         T10C40-50         .95         T30C40D         .95           SSAC14UW.2         114         SSASD6WW         134         T10C40D         .95         T30C5-10         .95           SSAC14UW.5         114         SSASD8UW         134         T10C5-10         .95         T30C5-10         .95           SSAC14UW.2         114         SSASF12MWE         129         T10C5-10         .95				
SSAC8UW.       116       SSASC6MWE.       127       T10C30-100.       .95       T30C30D.       .95         SSAC8UWE.       109       SSASD10MWE.       125       T10C30-50.       .95       T30C40-10.       .95         SSAC8UWT.       111       SSASD12MWE.       125       T10C30D.       .95       T30C40-100.       .95         SSAC8W.       115       SSASD16MWE.       125       T10C40-10.       .95       T30C40-50.       .95         SSAC8WE.       108       SSASD4UW.       134       T10C40-100.       .95       T30C40-50.       .95         SSACBWT.       110       SSASD6MWE.       125       T10C40-50.       .95       T30C5-10.       .95         SSACI4UW.2.       114       SSASD80W.       134       T10C40D.       .95       T30C5-100.       .95         SSACI4UW1.       114       SSASD80W.       134       T10C5-10.       .95       T30C5-50.       .95         SSACI4UW2.       114       SSASF10MWE.       129       T10C5-100.       .95       T30C5D.       .95         SSACI4UWE.2.       105       SSASF16MWE.       129       T10C5-50.       .95       T30N10-10.       .94         SSACI4UWE.5.       105				
SSAC8UWE       109       SSASD10MWE       125       T10C30-50       .95       T30C40-10       .95         SSAC8UWT       111       SSASD12MWE       125       T10C30D       .95       T30C40-100       .95         SSAC8W       115       SSASD16MWE       125       T10C40-10       .95       T30C40-50       .95         SSAC8WE       108       SSASD4UW       134       T10C40-100       .95       T30C40D       .95         SSAC8WT       110       SSASD6MWE       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD80WW       134       T10C40D       .95       T30C5-10       .95         SSACI4UW.5       114       SSASD80WW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW.1       114       SSASF10MWE       129       T10C5-10       .95       T30C5D       .95         SSACI4UW.2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5-50       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129 </td <td></td> <td></td> <td></td> <td></td>				
SSAC8UWT       111       SSASD12MWE       125       T10C30D       .95       T30C40-100       .95         SSAC8W       115       SSASD16MWE       125       T10C40-10       .95       T30C40-50       .95         SSAC8WE       108       SSASD4UW       134       T10C40-100       .95       T30C40D       .95         SSAC8WT       110       SSASD6MWE       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD6UW       134       T10C40D       .95       T30C5-10       .95         SSACI4UW.5       114       SSASD8BUW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-10       .95       T30C5-50       .95         SSACI4UW2.       114       SSASF10MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.5       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-10       .94       T30N10D       .94         SSACI4UW62       105       SSAST12MWE       131 <td></td> <td></td> <td></td> <td></td>				
SSAC8W         115         SSASD16MWE         125         T10C40-10         .95         T30C40-50         .95           SSAC8WE         108         SSASD4UW         134         T10C40-100         .95         T30C40D         .95           SSAC8WT         110         SSASD6MWE         125         T10C40-50         .95         T30C5-10         .95           SSACI4UW.2         114         SSASD6UW         134         T10C40D         .95         T30C5-100         .95           SSACI4UW.5         114         SSASD8UW         134         T10C5-10         .95         T30C5-50         .95           SSACI4UW1         114         SSASF10MWE         129         T10C5-100         .95         T30C5D         .95           SSACI4UW2         114         SSASF12MWE         129         T10C5-50         .95         T30N10-10         .94           SSACI4UWE.2         105         SSASF16MWE         129         T10C5D         .95         T30N10-100         .94           SSACI4UWE1         105         SSAST10MWE         131         T10N10-100         .94         T30N10D         .94           SSACI4UW62         105         SSAST12MWE         131         T10N10-50         .94	SSAC8UWE 109	SSASD10MWE 125	T10C30-5095	T30C40-1095
SSAC8WE       108       SSASD4UW       134       T10C40-100       .95       T30C40D       .95         SSAC8WT       110       SSASD6MWE       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD6UW       134       T10C40D       .95       T30C5-100       .95         SSACI4UW.5       114       SSASD8UW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE2       105       SSAST10MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94	SSAC8UWT 111	SSASD12MWE 125	T10C30D95	T30C40-10095
SSAC8WE       108       SSASD4UW       134       T10C40-100       .95       T30C40D       .95         SSAC8WT       110       SSASD6MWE       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD6UW       134       T10C40D       .95       T30C5-100       .95         SSACI4UW.5       114       SSASD8UW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE2       105       SSAST10MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94	SSAC8W	SSASD16MWE 125	T10C40-1095	T30C40-5095
SSAC8WT.       110       SSASD6MWE.       125       T10C40-50       .95       T30C5-10       .95         SSACI4UW.2       114       SSASD6UW       134       T10C40D       .95       T30C5-100       .95         SSACI4UW.5       114       SSASD8UW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-100       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94				
SSACI4UW.2       114       SSASD6UW       134       T10C40D       .95       T30C5-100       .95         SSACI4UW.5       114       SSASD8UW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-100       .94       T30N10D       .94         SSACI4UW62       105       SSAST12MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94				
SSACI4UW.5       114       SSASD8UW       134       T10C5-10       .95       T30C5-50       .95         SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-100       .94       T30N10D       .94         SSACI4UW62       105       SSAST12MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94				
SSACI4UW1       114       SSASF10MWE       129       T10C5-100       .95       T30C5D       .95         SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-100       .94       T30N10D       .94         SSACI4UWE2       105       SSAST12MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94				
SSACI4UW2       114       SSASF12MWE       129       T10C5-50       .95       T30N10-10       .94         SSACI4UWE.2       105       SSASF16MWE       129       T10C5D       .95       T30N10-100       .94         SSACI4UWE.5       105       SSASF6MWE       129       T10N10-10       .94       T30N10-50       .94         SSACI4UWE1       105       SSAST10MWE       131       T10N10-100       .94       T30N10D       .94         SSACI4UWE2       105       SSAST12MWE       131       T10N10-50       .94       T30N20-10       .94         SSACI4W.06       114       SSAST16MWE       131       T10N10D       .94       T30N20-100       .94				
SSACI4UWE.2     105     SSASF16MWE     129     T10C5D     .95     T30N10-100     .94       SSACI4UWE.5     105     SSASF6MWE     129     T10N10-10     .94     T30N10-50     .94       SSACI4UWE1     105     SSAST10MWE     131     T10N10-100     .94     T30N10D     .94       SSACI4UWE2     105     SSAST12MWE     131     T10N10-50     .94     T30N20-10     .94       SSACI4W.06     114     SSAST16MWE     131     T10N10D     .94     T30N20-100     .94				
SSACI4UWE.5     105     SSASF6MWE     129     T10N10-10     .94     T30N10-50     .94       SSACI4UWE1     105     SSAST10MWE     131     T10N10-100     .94     T30N10D     .94       SSACI4UWE2     105     SSAST12MWE     131     T10N10-50     .94     T30N20-10     .94       SSACI4W.06     114     SSAST16MWE     131     T10N10D     .94     T30N20-100     .94	SSACI4UW2114	SSASF12MWE129		T30N10-1094
SSACI4UWE.5     105     SSASF6MWE     129     T10N10-10     .94     T30N10-50     .94       SSACI4UWE1     105     SSAST10MWE     131     T10N10-100     .94     T30N10D     .94       SSACI4UWE2     105     SSAST12MWE     131     T10N10-50     .94     T30N20-10     .94       SSACI4W.06     114     SSAST16MWE     131     T10N10D     .94     T30N20-100     .94	SSACI4UWE.2 105	SSASF16MWE129	T10C5D95	T30N10-10094
SSACI4UWE1.     105     SSAST10MWE.     131     T10N10-100     .94     T30N10D     .94       SSACI4UWE2.     105     SSAST12MWE.     131     T10N10-50     .94     T30N20-10     .94       SSACI4W.06.     114     SSAST16MWE.     131     T10N10D     .94     T30N20-100     .94				
SSACI4UWE2.       105       SSAST12MWE.       131       T10N10-50.       .94       T30N20-10.       .94         SSACI4W.06.       114       SSAST16MWE.       131       T10N10D.       .94       T30N20-100.       .94				
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T50C5-10	TEFNI.10287	TNPK800660510	TTF285-25M
T50C5-10095	TEFNI.104	TPK.10290	TTF285-5M92
T50C5-5095	TEFNI.105	TPK.10490	TTZ110-10M92
T50C5D95	TEFNI.1103	TPK.10490	TTZ110-10M92
T50N10-1094	TEFNI.50287	TPK.10690	TTZ110-5M92
T50N10-10094	TEFNI.50487	TPK.502-10M90	TTZ120-10M92
T50N10-5094	TEFNI.50587	TPK.502-25M90	TTZ120-25M
T50N10D94	TEFNI.50787	TPK.502-5M90	TTZ120-5M92
T50N20-1094	TEFNI.51087	TPK.505-10M90	TTZ130-10M92
T50N20-10094	TEFNI.51287	TPK.505-25M90	TTZ130-25M92
T50N20-5094	TEFNI.51587	TPK.505-5M90	TTZ130-5M
T50N20D	TEFNI.52087	TPK.510-10M90	TTZ260-10M92
T50N5-1094	TEFNI120	TPK.510-25M	TTZ260-25M
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			UMD 194
T50N5-50	TEFNI140	TPK.515-10M90	
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T5C10-10	TFEP110-10M92	TPK.515-5M90	UMDB 194
T5C10-10095	TFEP110-25M92	TPK106-10M	UMDC
T5C10-50	TFEP110-5M	TPK106-25M	UMH 194
T5C10D95	TFEP120-10M92	TPK106-5M90	UMHA
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T5C30-10	TFEP130-23M	TPK120-10M	UMTB194
T5C30-100	TFEP260-10M	TPK120-25M	UMTC194
T5C30-5095	TFEP260-25M92	TPK130-10M	V-EMPMCR-HP1100 195
T5C30D95	TFEP260-5M92	TPK130-25M	V-EMPMCR-HP1100-10 195
T5C40-1095	THC11093	TPK130-5M90	V-EMPMCR-HP6890 195
T5C40-10095	THC12093	TPK260-10M	V-EMPMCR-HP6890N 195
T5C40-5095	THC13093	TPK260-25M	V-EMPMCR-HP6890N 195
T5C40D95	THC14093	TPK260-5M90	V-EMPMCR-WA2690 195
T5C5-10	THC27093	TSS.50593	V-EMPMCR-WA2690-10 195
T5C5-100	THC28593	TSS.50793	V-RA-24VDC-HP6890191
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ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5LFPK       65         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65	ZBU4L       .26         ZBU4T       .26         ZBUF1       .50         ZBUF2       .50         ZBUF4       .50         ZBUFLKF       .76         ZBUFLKF       .76         ZBUFRS       .52         ZBUFR.SF       .51         ZBUFR1C       .52         ZBUFR1CF       .51         ZBUFR1F       .51         ZBUFR2       .52	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6-10       12         ZF2SI       41         ZF2TF-10       13         ZF2TFG-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V-5       13         ZF4B-10       12         ZF4FEP-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZPS-5       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .64         ZP1FPK       .71
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5FPK       65         ZBRU2.5FPK       65         ZBRU2.5L       29	ZBU4L       .26         ZBU4T       .26         ZBUF1       .50         ZBUF2       .50         ZBUF4       .50         ZBUFLKF       .76         ZBUFLKF       .76         ZBUFRS       .52         ZBUFR.5F       .51         ZBUFR1       .52         ZBUFR1C       .52         ZBUFR1CF       .51         ZBUFR1F       .51         ZBUFR2       .52         ZBUFR2F       .51	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6-10       12         ZF2SI       41         ZF2TF-10       13         ZF2TF-1       12         ZF2V1-       12         ZF2V1-5       13         ZF4B-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GP-10       12         ZF4GV-5       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZPS-       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5L       29         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5LFPK       65         ZBRU2.5LFPK       65         ZBRU2.5T       29	ZBU4L       .26         ZBU4T       .26         ZBUF1       .50         ZBUF2       .50         ZBUF4       .50         ZBUFLKF       .76         ZBUFLPK       .76         ZBUFR.5       .52         ZBUFR.5       .51         ZBUFR1       .52         ZBUFR1C       .52         ZBUFR1C       .51         ZBUFR1F       .51         ZBUFR1F       .51         ZBUFR2       .52         ZBUFR2F       .51         ZBUMLKF       .76         ZBUMLKF       .76	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2SI       41         ZF2TF-10       13         ZF2TF-1       13         ZF2TI       12         ZF2V1-5       13         ZF2V-5       13         ZF4B-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZP.5       .11         ZP.5FPK       .64         ZP.5H       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2       .11         ZP2H       .11
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5LFPK       65         ZBRU1.5T       29         ZBRU2.5       29         ZBRU2.5       29         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5LFPK       65         ZBRU2.5T       29         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65	ZBU4L       .26         ZBU4T       .26         ZBUF1       .50         ZBUF2       .50         ZBUF4       .50         ZBUFLKF       .76         ZBUFLPK       .76         ZBUFR.5       .52         ZBUFR.5       .51         ZBUFR1       .52         ZBUFR1C       .52         ZBUFR1CF       .51         ZBUFR1F       .51         ZBUFR2       .52         ZBUFR2F       .51         ZBUMLKF       .76         ZBUMLPK       .76         ZC.5       .11	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2SI       41         ZF2TF-10       13         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V-5       13         ZF4B-10       12         ZF4GP-10       12         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1 PKG-5       .62         ZNFT       .67         ZPS-       .11         ZPSFPK       .64         ZPSH       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2-       .11         ZP2-       .11         ZP2H       .11         ZP2H       .11         ZP2H       .11         ZP2H       .64
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5T       29         ZBRU2.5TFPK       65	ZBU4L	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6       41         ZF2TF-10       13         ZF2TFG-10       13         ZF2TI       12         ZF2V1-5       13         ZF4V5-5       13         ZF4FEP-10       13         ZF4FEP-10       13         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNFT       .67         ZP.5       .11         ZPSFPK       .64         ZPSH       .11         ZP1EPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2       .11         ZP2H       .11         ZP2H       .11         ZP2K       .64         ZP4       .11
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5T       29         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65 <td>ZBU4L</td> <td>ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4FB-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4FFA-10       13         ZF4FFA-10       13</td> <td>ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1 PKG-5       .62         ZNFT       .67         ZP.5       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP2H       .11         ZP2PK       .64         ZP4       .11         ZRF1.5KF-5       .14</td>	ZBU4L	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4FB-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4FFA-10       13         ZF4FFA-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1 PKG-5       .62         ZNFT       .67         ZP.5       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP2H       .11         ZP2PK       .64         ZP4       .11         ZRF1.5KF-5       .14
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       .65         ZBRU1.5L       29         ZBRU1.5LFPK       .65         ZBRU1.5T       29         ZBRU2.5       .29         ZBRU2.5FPK       .65         ZBRU2.5L       .29         ZBRU2.5LFPK       .65         ZBRU2.5T       .29         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.1       .29         ZBRU21       .29         ZBRU21C       .29         ZBRU21CFPK       .65	ZBU4L	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6-10       12         ZF2SI       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4B-10       12         ZF4FEP-10       13         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FFK-5       .62         ZNF1FPKG-5       .62         ZNF1FPKG-5       .62         ZNF1PK-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZP.5       .11         ZP.5PFK       .64         ZP.5H       .11         ZP1EPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP3H       .11         ZP4H       .11         ZP5H       .14          ZP5H       .14
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5T       29         ZBRU1.5TFPK       65         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5T       29         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65 <td>ZBU4L</td> <td>ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4FB-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4FFA-10       13         ZF4FFA-10       13</td> <td>ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1 PKG-5       .62         ZNFT       .67         ZP.5       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP2H       .11         ZP2PK       .64         ZP4       .11         ZRF1.5KF-5       .14</td>	ZBU4L	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4FB-10       12         ZF4FEP-10       13         ZF4GP-10       12         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4FFA-10       13         ZF4FFA-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PK-5       .62         ZNF1 PKG-5       .62         ZNFT       .67         ZP.5       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP2H       .11         ZP2PK       .64         ZP4       .11         ZRF1.5KF-5       .14
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       .65         ZBRU1.5L       29         ZBRU1.5LFPK       .65         ZBRU1.5T       29         ZBRU2.5       .29         ZBRU2.5FPK       .65         ZBRU2.5L       .29         ZBRU2.5LFPK       .65         ZBRU2.5T       .29         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.5TFPK       .65         ZBRU2.1       .29         ZBRU21       .29         ZBRU21C       .29         ZBRU21CFPK       .65	ZBU4L	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2S6-10       12         ZF2SI       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V5-5       13         ZF4B-10       12         ZF4FEP-10       13         ZF4GV-5       13         ZF4HC       12         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13         ZF4PFA-10       13	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FFK-5       .62         ZNF1FPKG-5       .62         ZNF1FPKG-5       .62         ZNF1PK-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZP.5       .11         ZP.5PFK       .64         ZP.5H       .11         ZP1EPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2       .11         ZP2H       .11         ZP3H       .11         ZP4H       .11         ZP5H       .14          ZP5H       .14
ZBNV1F-D       218         ZBNV1F-KZ       218         ZBNV1-KZ       218         ZBNV1LF       218         ZBNV1LF-D       218         ZBNV1LF-KZ       218         ZBRU1.5       29         ZBRU1.5FPK       65         ZBRU1.5L       29         ZBRU1.5LFPK       65         ZBRU1.5T       29         ZBRU2.5       29         ZBRU2.5FPK       65         ZBRU2.5L       29         ZBRU2.5LFPK       65         ZBRU2.5TFPK       65         ZBRU2.5TFPK       65         ZBRU2.1       29         ZBRU2.1       29         ZBRU2.1C       29         ZBRU2.1CFPK       65         ZBRU2.1FPK       65         ZBRU2.1FPK       65         ZBRU2.1FPK       65         ZBRU2.1FPK       65         ZBRU2.1FPK       65         ZBRU2.1FPK       65	ZBU4L       .26         ZBU4T       .26         ZBUF1       .50         ZBUF2       .50         ZBUF4       .50         ZBUFLKF       .76         ZBUFLPK       .76         ZBUFR.5       .52         ZBUFR.5       .51         ZBUFR1       .52         ZBUFR1C       .52         ZBUFR1F       .51         ZBUFR1F       .51         ZBUFR2F       .51         ZBUMR2F       .51         ZBUMLKF       .76         ZBUMLPK       .76         ZC.5       .11         ZC.5FPK       .64         ZC1       .11         ZC1FPK       .64         ZC1PK       .64	ZF2HC.       12         ZF2KF-10       13         ZF2NI.       12         ZF2PFA-10       13         ZF2PK-10       13, 63         ZF2PKG-10       63         ZF2SI       41         ZF2TF-10       13         ZF2TI       12         ZF2V1-5       13         ZF2V-5       13         ZF4B-10       12         ZF4FEP-10       13         ZF4HC       12         ZF4KF-10       13         ZF4NI       12         ZF4FFA-10       13         ZF4PFA-10       13         ZF4NI       12         ZF4PFA-10       13         ZF4PK-10       13         ZF4PK-10       63	ZNF.5PK-5       .62         ZNF.5PKG-5       .62         ZNF1FKF-5       .62         ZNF1FPK-5       .62         ZNF1FPKG-5       .62         ZNF1KF-5       .62         ZNF1PKG-5       .62         ZNFT       .67         ZPS-       .11         ZPSFPK       .64         ZPSH       .11         ZP1       .11         ZP1FPK       .64         ZP1FPK       .71         ZP1H       .11         ZP2-       .11         ZP2-       .11         ZP2H       .11         ZP2H       .11         ZP2H       .11         ZP2FK       .64         ZP4       .11         ZRF1.5KF-5       .14         ZRF1.5PK-5       .14         ZRF1.5FG-5       .14         ZRF1.5V1-5       .14
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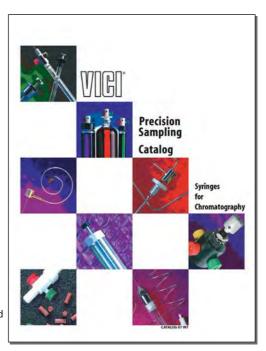


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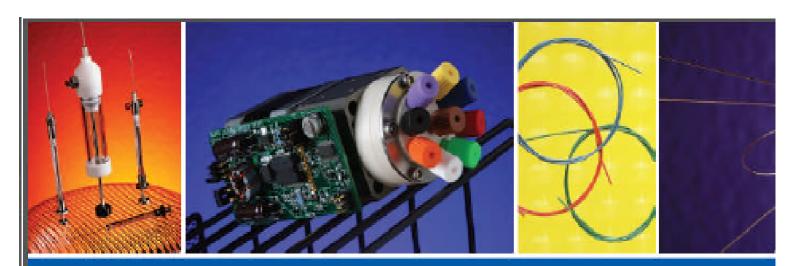
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