

# Graphite Ferrules

the "PERFECT" Connection for GC and Glass Tubes

also Graphite/Polyimide for GC/MS ( Vacuum Application )

**500degC** in air  
**"unlimited"** in inert gas  
**Soft and Malleable**  
**No phase transitions**  
**like plastics**

## Graphite Ferrules - ALL sizes from 2mmOD to 2.0 in ID

- have been proven in over 25 years production by **Chromalytic Technology** with "millions" being sold "world-wide" mainly through some of the leading chromatography distributors and OEMs.

Full range of sizes from 0.3mm ID for capillary columns right up to 2.0-in for preparative columns and industrial applications;

Industrial Applications : **glass/ceramic tube** reactor/catalyst tubes, pump glands.  
**there is a size to fit ALL applications !**

**If we haven't got it already we will guarantee to make it for you !**

- Maximum temperature use to 500 deg-C or much higher in a "capture fitting" or if protected in an inert atmosphere.
- They are soft and malleable and extrude into shape to fill minor imperfections in tubing and "distorted fittings".
- They have an ideal "feel" for use with glass and fused silica capillary tube to help avoid crushing on over-tightening.
- They will not stick or bind to tubing and the nut/ferrule can simply be slid off the tubing for re-use.

**Specifically for GC . . . ALL types of GCs** are catered for including OEM specific ferrules; for example HP/Agilent inlet seals, injector liner O-rings; 8mm, 1/4, 5mmOD for Carlo Erba / Fisons /Thermo / Shimadzu;  
 capture type cup GC column seals. etc

**OEM Enquiries Welcome**

### 3 basic Profiles are available . . .

- **SF** - Single (Piece) Ferrule for **Swagelok** and similar fittings eg **Parker**.
- **GF** - Front ferrule design for use with a "backing ferrule" or in Chromalytic "butt-type" connection fittings, injection systems.
- **Short profile** - "short" specially designed for HP/Agilent GC capillary GC column inlet seals.

Also . . .

**Graphite O-rings** (6.35mm and 6,5mm ID) for HP/Agilent GC injector liners.

**Cup Graphite Seals** for CE/Fisons/ThermoQuest , Shimadzu

and the NEW **CT** graphite capture fittings - **Enquire !**

**Capture Ring** graphite seal for 8mm OD Fisons/CE/TQ liners.

## Graphite/Polyimide Ferrules - 1/8"ID max

: material tends to be cost prohibitive - Other Sizes to special Order

These are precision machined ( and NOT moulded ) to give a perfect fit in all Swagelok and Parker 1/16-in fittings.

**Temperature use** is limited to about 320 deg-C.( phase transition )

They are made from **15% graphite/polyimide** selected by . . .

**Chromalytic Technology** as being the best compromise in "softness", non-stickability and crack resistance. They are preferred over **Graphite Ferrules** for vacuum operation or use in GC/MS for reduced air diffusion.

For long term use - they may tend to "dry out" and may crack on re-tightening after use at high temperature.



### Single Piece

Ferrule Size / Cat.#

1/16" to :  
 0.3mm SF100/0.3G  
 0.4mm SF100/0.4G  
 0.5mm SF100/0.5G  
 0.8mm SF100/0.8G  
 1.0mm SF100/1.0G  
 1.2mm SF100/1.2G  
 1/16" SF100G

1/8" to :  
 0.4mm SF200/0.4G  
 0.5mm SF200/0.5G  
 0.8mm SF200/0.8G  
 1.0mm SF200/1.0G  
 1.2mm SF200/1.2G  
 1/16" SF200/100G  
 1/8" SF200G

3/16" SF300G

1/4" to :  
 0.5mm SF400/0.5G  
 0.8mm SF400/0.8G  
 1/16" SF400/100G  
 1/8" SF400/200G  
 6mm SF400/M6G  
 1/4" SF400G

3/8" SF600G  
 1/2" SF800G  
 5/8" SF1000G  
 3/4" SF1200G  
 7/8" SF1400G  
 1.0-in SF1600G  
 1-1/4-in SF2000G  
 1-1/2-in SF2400G  
 1-3/4-in SF2800G  
 2.0-in SF3200G

**Metric**  
 5mm SFM5G  
 10mm SFM10G  
 12mm SFM12G  
 14mm SFM14G  
 16mm SFM16G  
 18mm SFM18G

### Front Ferrule Type

Ferrule Size / Cat.#

1/16" to :  
 0.4mm GF100/0.4  
 0.5mm GF100/0.5  
 0.8mm GF100/0.8  
 1.0mm GF100/1.0  
 1/16" GF100

1/8" GF200  
 1/4" to 3/16" GF400/300  
 1/4 to 6mm GF400/M6  
 1/4" GF400

### "Specials"

Agilent  
 O-rings GFO-6.35HP  
 6.35mm GFO-6.5HP  
 6.5mm  
 Inlet Seals  
 (Short)  
 0.3mm GF0.3HP  
 0.4mm GF0.4HP  
 0.5mm GF0.5HP  
 0.8mm GF0.8HP  
 0.8mm GF1.0HP  
 1.0mm GF1.2HP  
 1.2mm

(standard)  
 0.3mm GF100/0.3HP  
 0.4mm GF100/0.4HP  
 0.5mm GF100/0.5HP  
 0.8mm GF100/0.8HP  
 1.0mm GF100/1.0HP  
 1.2mm GF100/1.2HP

Fisons/CE/  
 0.3mm CF0.3Fis  
 0.4mm CF0.4Fis  
 0.5mm CF0.5Fis  
 0.8mm CF0.8Fis  
 1.0mm CF1.0Fis  
 8mm CF8.0Fis

### Graphite/Polyimide 1/16"OD . . . Tube Fitting

0.3mm SF100/0.3VG1  
 0.4mm SF100/0.4VG1  
 0.5mm SF100/0.5VG1  
 0.7mm SF100/0.7VG1  
 0.8mm SF100/0.8VG1  
 1.0mm SF100/1.0VG1  
 1.2mm SF100/1.2VG1  
 1/16" SF100VG1

1/8" SF200VG1  
 3/16" SF300VG1  
 1/4" SF400VG1

**ANY size**  
 to your  
 specifications  
**Generous Discounts**  
 apply to OEMs  
 and for  
**"bulk" orders**

**Other Specials** - for small "runs" a tooling cost may apply

### Double-Hole Ferrules

1/16" Double-hole  
 SF100/2x0.5G  
 GF2x0.5HP, GF100/2x0.5G  
 1/8" Double-hole  
 SF200/2xM0.5G  
 SF200/2xM0.8G

### No-Hole Ferrules (Blanks)

1/16" SF100/00G  
 1/8" SF200/00G  
 3/16" SF300/00G  
 1/4" SF400/00G  
 3/8" SF400/00G  
 1/2" SF800/00G

Note : **Teflon** and **PEEK** ferrules are also available for HPLC / LC / FIA applications . . . **Enquire !**

# Graphite Ferrules

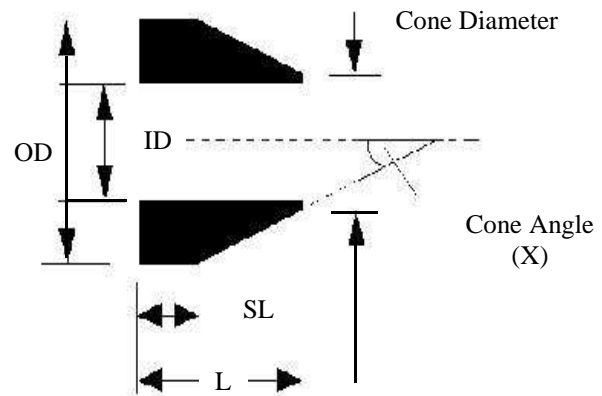
## CUSTOM Specifications

**"Not ALL Things  
are possible"**

### To Order Custom-made "Specials" ... Ferrule Specifications required

Size in . . . Inches ☐ or . . . mm ☐

Material	Required	Tolerance Required
- Graphite	<input type="checkbox"/>	
- Graphite/Polyimide 15%	<input type="checkbox"/>	
- Teflon (PTFE)	<input type="checkbox"/>	
- PEEK	<input type="checkbox"/>	
- Kel-F / Tefzel	<input type="checkbox"/>	
Other ( specify )		
ID		
OD		
Length		
Shoulder length (SL)		
Cone diameter (CD)		
Quantity Required		



The **Cone Angle** is generally incidental in production - but typically for the SF type ferrules (X)=17 degrees  $\pm 1$  deg  
The shape is actually determined by all other dimensions  
The **Overall Length** is the easiest parameter to vary in production simply by varying the **Shoulder Length (SL)** whilst retaining a constant **Cone Angle (X)**

**for Specials** - a tooling set-up cost of \$75 to \$150 may apply for small quantities depending on the actual size.

### Typical Ferrule Dimensions and Tolerances ( sizes in inches )

Catalog #	ID	L	SL	CD	OD	ID	Min	Max
SF100/...G	0.3mm-1/16"	0.170	0.100	0.075	0.125	0.3mm	0.0125	0.0135
GF...HP	0.3mm-1/16"	0.090	0.050	0.072	0.125	0.4mm	0.160	0.0175
GF100/...HP	0.3mm-1/16"	0.120	0.080	0.072	0.125	0.5mm	0.020	0.0215
GF100/...	0.3mm-1/16"	0.135	0.095	0.075	0.125	0.7mm	0.027	0.0285
SF200/...G	0.4mm-1/8"	0.250	0.120	0.135	0.250	0.8mm	0.310	0.320
SF400/...G	0.5mm-1/4"	0.255	0.120	0.260	0.375	1.0mm	0.040	0.042
HP O-ring	6.35mm, 6.5mm	0.100	-	-	0.375	1.2mm	0.047	0.049
SF600G	3/8"	0.320	0.160	0.390	0.500	1/16"	0.063	0.0645
SF800G	1/2"	0.375	0.160	0.520	0.675	1/8	0.125	0.1265
SF1000G	5/8"	0.400	0.160	0.660	0.815	1/4	0.250	0.252
SF1200G	3/4"	0.450	0.180	0.790	0.945	3/8	0.375	0.387
SF1400G	7/8"	0.525	0.200	0.780	1.125	Graphite Ferrules will squash into shape and actual sizes are far less critical than for metal ferrules.		
SF1600G	1.00"	0.575	0.250	1.040	1.25			
SF2400G	1-1/2"	0.875	0.340	1.560	1.75			
SF3200G	2.00"	1.100	0.275	2.090	2.60			

Graphite Ferrules will squash into shape and actual sizes are far less critical than for metal ferrules.

<b>Typical</b>	<b>L</b>	<b>+ 0.005</b>	<b>- 0.005</b>
<b>Manufacturing</b>	<b>SL</b>	<b>+ 0.005</b>	<b>- 0.005</b>
<b>Tolerances</b>	<b>ID</b>	<b>+ 0.002</b>	<b>- 0.000</b>
	<b>CD</b>	<b>+ 0.002</b>	<b>- 0.000</b>
	<b>OD</b>	<b>+ 0.000</b>	<b>- 0.002</b>
	<b>Cone Angle(X)</b>		

\* tighter tolerance is possible but generally at extra cost

**ANY Size - IF it is practical !**

**... THEN we can make it !**

Types include "capture type" and "cup seals" and "encapsulated" ferrules . . . **Enquire !**

**BUT !** We suggest YOU draw it exactly to scale first to PROVE it is feasible in principle in the first place !

### Custom Precision Machining

- Metal . . . in ANY material Stainless Steel - any grade 303 / 304/ 316/ Inconel, Brass
- ANY type of plastics . . . Vespel / **Graphite/polyimide** / Teflon / **PEEK** / Kel-F / Nylon / polypropylene etc etc
- "small" runs a specialty . . . **We do NOT try and compete with large auto-repetition shops**  
... If you can buy mass-produced / cast or moulded products we can't compete . . . we "specialise in specials"

### MXT™-Union Connector Kits for Fused Silica Columns

- Low-dead-volume, leak-tight connection.
- Reusable.
- Siltek® treatment ensures maximum inertness.
- Ideal for connecting a guard column or transfer line to an analytical column.
- Use to oven temperatures of 360°C.
- Available in union and “Y” configurations.
- Can also be used for fused silica to metal connections.

These MXT™ connectors can be used with fused silica tubing, because of a Valcon polyimide 1/32-inch one-piece fused silica adaptor. This unique graphite-reinforced composite allows a capillary column to slide into the adaptor and be locked in place simply by loosening and tightening the fitting.

#### MXT™-Union Connector Kits for Fused Silica Columns

Each kit contains the MXT™ union, two 1/32-inch nuts and two one-piece fused silica adaptors.



Description	qty.	cat.#	price
For 0.25mm ID Fused Silica Columns	kit	21386	
For 0.32mm ID Fused Silica Columns	kit	21385	
For 0.53mm ID Fused Silica Columns	kit	21384	

#### MXT™ “Y”-Union Connector Kits for Fused Silica Columns

Each kit contains the MXT™ union, three 1/32-inch nuts and three one-piece fused silica adaptors.



Description	qty.	cat.#	price
For 0.25mm ID Fused Silica Columns	kit	21389	
For 0.32mm ID Fused Silica Columns	kit	21388	
For 0.53mm ID Fused Silica Columns	kit	21387	



Adaptor Ferrules



20389

### Valco™ Connectors—One-Piece Valcon Polyimide Adaptor Ferrule for Fused Silica

Fused silica adaptor ferrules are Valcon polyimide, a unique graphite-reinforced composite, specially prepared to maximize mechanical stability at temperatures to 350°C. The determining factor for selecting adaptor ferrule size is the fused silica tubing OD.

#### 1/32-Inch Adaptor Ferrule (Valcon Polyimide)

Tubing OD	Tubing ID	Valco #	qty.	cat.#	price
0.25 ≤ 0.40mm	0.25mm	FS.4-5	5-pk.	20137	
0.40 ≤ 0.50mm	0.32mm	FS.5-5	5-pk.	20140	
0.50 ≤ 0.80mm	0.53mm	ZF.5V-5	5-pk.	20141	
1/32" Replacement Nut			5-pk.	20389	

### MXT™ Low-Dead-Volume Connector Kits for Metal Columns

These low-dead-volume connectors are Siltek® treated to make them inert to active compounds, just like our MXT® columns. They can be used at temperatures up to 430°C without degrading the deactivated layer. Purchase the appropriate ferrules for connecting 0.28, 0.32 or 0.53mm ID tubing.

#### MXT™ Low-Dead-Volume Connector Kits for Metal Columns

- Connect a guard column/transfer line to an MXT® stainless steel column.
- Low thermal mass tracks rapid oven temperature programming.
- Stainless steel ferrules and nuts.
- Available in “Y” and union configurations.
- Siltek® treatment ensures ultimate inertness.



Each kit contains the MXT™ union, two 1/32-inch ferrules and nuts.

Description	qty.	cat.#	price
For 0.28mm ID MXT Columns	kit	20397	
For 0.32mm ID MXT Columns	kit	20536	
For 0.53mm ID MXT Columns	kit	20394	

#### MXT™ Low-Dead-Volume “Y” Connector Kits for Metal Columns

- Connect two MXT® columns to one inlet or one MXT® column to two detectors.



Each kit contains the MXT™ union, three 1/32-inch ferrules and nuts.

Description	qty.	cat.#	price
For 0.28mm ID MXT Columns	kit	20396	
For 0.32mm ID MXT Columns	kit	20537	
For 0.53mm ID MXT Columns	kit	20395	

### 1/32-Inch Stainless Steel Replacement Ferrules for MXT™ Connectors

Ferrule ID	Fits Column ID	qty.	cat.#	price
0.59mm	0.28mm	10-pk.	20398	
0.53mm	0.32mm	10-pk.	20535	
0.79mm	0.53mm	10-pk.	20399	







### Zero-Dead-Volume Valco® Internal Union

Ends of tubing seat squarely at bottoms of fitting details. 300 series stainless steel. For 1/16" OD tubing. Stainless steel ferrules included.

Description	Union Bore	Valco #	qty.	cat.#	price
Internal Union	0.15mm	ZU1XC	ea.	20147	
Internal Union	0.25mm	ZU1C	ea.	20148	
Internal Union	0.75mm	ZU1	ea.	20149	
Internal Union	1/16"	ZU1T	ea.	20150	



### Zero-Dead-Volume Valco® Internal Reducing Union

Connect two sizes of tubing, using zero-dead-volume fittings on each end. For 1/8" to 1/16" OD tubing. Stainless steel ferrules included.

Description	Union Bore	Valco #	qty.	cat.#	price
Internal Reducing Union	0.25mm	ZRU21C	ea.	20151	
Internal Reducing Union	0.75mm	ZRU21	ea.	20152	
Internal Reducing Union	1/16"	ZRU21T	ea.	20153	



### Zero-Dead-Volume Valco® Internal Tee

Connect three lines. 300 series stainless steel; stainless steel ferrules included. For 1/16" OD tubing.

Description	Union Bore	Valco #	qty.	cat.#	price
Internal Tee	0.25mm	ZT1C	ea.	20154	
Internal Tee	0.75mm	ZT1	ea.	20155	



### Zero-Dead-Volume Valco® Internal Cross

Connect four lines. 300 series stainless steel; stainless steel ferrules included. For 1/16" OD tubing.

Description	Union Bore	Valco #	qty.	cat.#	price
Internal Cross	0.25mm	ZX1C	ea.	20156	
Internal Cross	0.75mm	ZX1	ea.	20157	



### Male Pipe to Valco® Internal Adapter

Makes a minimum volume connection from a female pipe fitting on a pressure gauge or regulator to a Valco® zero-dead-volume fitting. 300 series stainless steel; stainless steel ferrules included.

Description	Fitting Size	Bore	Valco #	qty.	cat.#	price
1/8" NPT Male Internal Adapter	1/16" ZDV	1.0mm	PZA21	ea.	20158	
1/4" NPT Male Internal Adapter	1/16" ZDV	1.0mm	PZA41	ea.	20159	



### Nuts & Ferrules for Valco® Connectors

Description	Valco #	qty.	cat.#	price
1/16" Stainless Steel Ferrules	ZF1-10	10-pk.	20286	
1/16" Stainless Steel Nuts	ZN1-10	10-pk.	20287	



### 1/16-Inch Valco® Adaptor Ferrules

Tubing OD	Tubing ID	Valco #	qty.	Valco Polyimide		qty.	Polyimide	
				cat.#	price		cat.#	price
0.25–0.4mm	0.1–0.25mm	FS1.4-5	5-pk.	20142		2-pk.	21015	
0.4–0.5mm	0.32mm	FS1.5-5	5-pk.	20143		2-pk.	21016	
0.5–0.8mm	0.53mm	FS1.8-5	5-pk.	20144		—	—	—
0.8mm (1/32")	—	FS1.9-5	5-pk.	20145		—	—	—

### also available

#### Treated Fittings!

See pages 237-241 for our Siltek®/Sulfinert® treated and Silcosteel®-CR treated fittings, as well as many more brass and stainless steel fittings from Swagelok® and Parker.





## tech tip

## Choosing the Right Ferrule

Although graphite and Vespel®/graphite ferrules each have advantages and disadvantages, the choice of ferrule composition is largely a personal preference. Graphite ferrules are soft, easy to seal, stable to 450°C, and contain no binders that might off-gas. Vespel®/graphite ferrules work better for vacuum and high-pressure applications (e.g., GC/MS) because they will not fragment or allow oxygen to permeate into the system, whereas graphite ferrules will. Because Vespel®/graphite ferrules are made from a harder material, they might require retightening after several temperature cycles. Alumaseal™ ferrules are ideal for GC/MS. They will not crack or fragment and require no retightening after temperature cycles.



graphite ferrules



Reusable!

graphite ferrules



graphite ferrules

## Vespel® Ferrules

- 100% high-temperature polyimide.
- Stable to 350°C.
- Durable, leak-tight.



Vespel® ferrules

## Graphite Ferrules

- Preconditioned to eliminate out-gassing.
- High-purity, high-density graphite.
- Smoother surface and cleaner edges than conventional graphite ferrules.
- Contain no binders that can off-gas or adsorb analytes.
- Stable to 450°C.

## Vespel®/Graphite Ferrules

- 60%/40% Vespel®/graphite blend, offering the best combination of sealing and ease of workability.
- Seal with minimal torque, reusable, and preferred for vacuum and high-pressure uses.
- Stable to 400°C.
- Recommended for mass spec transfer lines.

## Capillary Ferrules—For 1/16-Inch Compression-Type Fittings

Available in Vespel®, graphite, or Vespel®/graphite.

Ferrule ID	Fits Column ID	qty.	Vespel	Graphite	Vespel/Graphite
0.3mm	< 0.18mm	10-pk.	22213	20233	20275
0.4mm	0.18/0.25/0.28mm	10-pk.	22214	20200	20211
0.4mm	0.18/0.25/0.28mm	50-pk.	—	20227	20229
0.5mm	0.32mm	10-pk.	22215	20201	20212
0.5mm	0.32mm	50-pk.	—	20228	20231
0.6mm	0.28mm**	10-pk.	—	—	20232
0.8mm	0.45/0.53mm	10-pk.	22216	20202	20213
0.8mm	0.45/0.53mm	50-pk.	—	20224	20230
1.0mm	0.75mm*	10-pk.	22217	21058	24912
1.2mm	0.75mm	10-pk.	22218	—	—
1.6mm	1.00mm*	10-pk.	—	21060	—

## Encapsulated Ferrules—For 1/16-Inch Compression Fittings

- Reusable—will not deform and stick in fittings.
- Less torque needed to seal ferrule.
- Restek's unique blend of graphite minimizes fragmentation and outgassing.

Ferrule ID	Fits Column ID	qty.	cat.#	price
0.4mm	0.25mm	10-pk.	21036	
0.5mm	0.32mm	10-pk.	21037	
0.8mm	0.53mm	10-pk.	21038	

## Compact Ferrules—For Agilent 5890/6890/6850/7890 GCs

Available in graphite or Vespel®/graphite.

Ferrule ID	Fits Column ID	qty.	Graphite	Vespel/Graphite
0.4mm	0.25/0.28mm	10-pk.	20250	20238
0.4mm	0.25/0.28mm	50-pk.	20251	20239
0.5mm	0.32mm	10-pk.	21007	20248
0.5mm	0.32mm	50-pk.	21008	20249
0.8mm	0.45/0.53mm	10-pk.	20252	20263
0.8mm	0.45/0.53mm	50-pk.	20253	20264
1.0mm	0.75mm*	10-pk.	21059	21056
1.6mm	1.00mm*	10-pk.	21061	21057

\*For micropacked columns.

\*\*For 0.28mm MXT columns.

**Standard Ferrules—For 1/16-, 1/8-, and 1/4-Inch Fittings**

Available in Vespel®, graphite, or Vespel®/graphite.

Fitting Size	Ferrule ID	qty.	Vespel		Graphite		Vespel/Graphite
1/4"	3/16"	5-pk.	—	—	—	—	20258
1/16"	1/16"	10-pk.	22210	—	20207	—	20218
1/8"	1/8"	10-pk.	22211	—	20208	—	20219
1/8"	reduce to 1/16"	10-pk.	—	—	20209	—	20220
1/4"	1/4"	10-pk.	22212	—	20210	—	20221
1/4"	reduce to 1/8"	10-pk.	22219	—	20225	—	20222
1/4"	reduce to 1/16"	10-pk.	—	—	20226	—	20223

**Two-Hole Ferrules—For 1/8-Inch and 1/16-Inch Compression-Type Fittings**

Fitting Size	Ferrule ID	Fits Column ID	qty.	Vespel/Graphite
1/16"	0.4mm	0.25/0.28mm	5-pk.	24848
1/16"	0.5mm	0.32mm	5-pk.	24849
1/8"	0.8mm	0.45/0.53mm	5-pk.	20246

**Reducing Ferrules**

Available in graphite or Vespel®/graphite.

Fitting Size	Ferrule ID	Fits Column ID	qty.	Graphite	Vespel/Graphite
1/8"	0.4mm	0.25mm	5-pk.	20205	20254
1/8"	0.5mm	0.32mm	5-pk.	20205	20255
1/8"	0.8mm	0.53mm	5-pk.	20206	20215
1/4"	0.4mm	0.25mm	5-pk.	20203	—
1/4"	0.5mm	0.32mm	5-pk.	20203	20257
1/4"	0.8mm	0.45/0.53mm	5-pk.	20204	20217

**Blank Ferrules—For 1/16-Inch Fittings**

Fitting Size	Ferrule ID	qty.	Vespel/Graphite
1/16"	no hole	10-pk.	20240

**Alumaseal™ Ferrules\***

- Aluminum construction—will not crack or fragment.
- No retightening required after temperature cycles—excellent for GC/MS.
- Eliminate out-gassing, make leak-tight seals, for less detector noise.
- Unique two-piece design permanently locks on fused silica tubing without causing breakage.
- Will not stick in fittings, unlike Vespel® or graphite.
- Stable to 550°C.
- Use with any 1/16" compression-type fitting.

Ferrule ID	Fits Column ID	qty.	cat. #	price
0.4mm	0.25mm	10-pk.	21472	
0.5mm	0.32mm	10-pk.	21473	
0.8mm	0.53mm	10-pk.	21474	

\*Patent pending.



restek  
innovation!

**Alumaseal™  
Ferrules**

- Will not crack or fragment.
- Excellent for GC/MS.

## Ferrules

**Teflon® Ferrules**

- Upper temperature limit 250°C.
- 100% Teflon®; completely inert.
- One-piece design requires no back ferrule.

Fitting Size	Ferrule ID	qty.	cat.#	price
1/16"	1/16"	10-pk.	21122	
1/16"	0.4mm	10-pk.	21123	
1/16"	0.5mm	10-pk.	21124	
1/16"	0.8mm	10-pk.	21125	
1/8"	1/8"	10-pk.	21126	
3/16"	3/16"	10-pk.	21127	
1/4"	1/4"	10-pk.	21128	

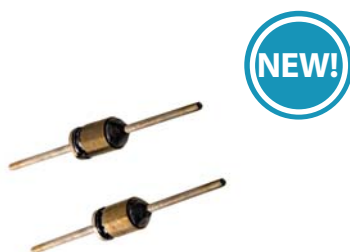
**Graphite Ferrules—M4 Fittings for Thermo Scientific TRACE, 8000, 8000 TOP & Focus GCs**

Ferrule ID	Fits Column ID	Similar to TS part #	Graphite 2-pk. price	Graphite 10-pk. price
0.3mm	0.10/0.15mm	—	22221	22222
0.4mm	0.18/0.28mm	29013488 (2-pk.) 29053488 (10-pk.)	20280	20281
0.5mm	0.32mm	29013487 (2-pk.) 29053487 (10-pk.)	20282	20283
0.8mm	0.45/0.53mm	29013486 (2-pk.) 29053486 (10-pk.)	20284	20285

**5mm Ferrules for Shimadzu 17A GCs**

- For use with **packed columns**.
- Graphite construction.

Description	qty.	cat.#	price
5mm Ferrules for Shimadzu 17A GCs	10-pk.	21121	

**Graphite Ferrules for Shimadzu 17A, 2010, & 2014 GCs**

- Graphite 2-piece construction.
- Available in 0.4, 0.5, and 0.8mm sizes.
- Packaged on mandrel for easy handling.

Ferrule ID	Fits Column ID	qty.	cat.#	price
0.4mm	0.25mm and less	10-pk.	24827	
0.5mm	0.32mm	10-pk.	24828	
0.8mm	0.53mm	10-pk.	24829	

also **available**

Restek now carries Swagelok fittings in brass &amp; stainless steel.

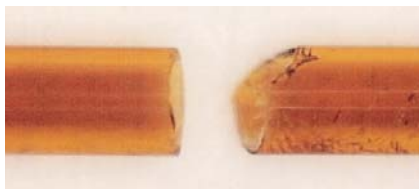
See **pages 237-239** or visit [www.restek.com](http://www.restek.com) and search on Swagelok.



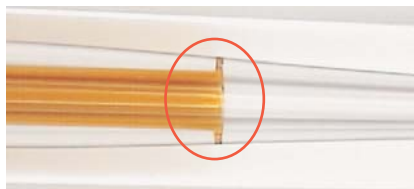
**Restek Press-Tight® Connectors**

Press-Tight® connectors are lightweight, quickly installed, and easy to use. They connect fused silica tubing having outside diameters ranging from 0.33 to 0.74mm (Restek 0.1 to 0.53mm ID). Press-Tight® connectors do not cause solvent tailing, or adsorb active compounds.

Press-Tight® connectors most often are used to connect a guard column to an analytical column. They also are used to connect columns differing in polarity, for unique separations, or to repair a broken column.



Make a clean, square cut for optimum connector performance. The cut on the right will produce a poor seal.



A brown ring indicates a proper seal.

**Obtaining a leak-tight seal:**

To achieve optimum performance from these connectors, begin with a properly cut fused silica column or retention gap end. Even if you use polyimide resin (cat.# 20445, page 214) for extra insurance, a poorly cut capillary column will make an inadequate seal.

Press the cut ends into the connector, then establish a flow, and leak-check the seal with a Restek Electronic Leak Detector (cat.# 22839, page 201) before heating the system. The seal is made permanent as the polyimide resin coating on the column bonds to the inner surface of the connector after several thermal cycles to 200°C.

**What is the maximum temperature for a Press-Tight® connector?**

Press-Tight® connectors are effective at oven temperatures to 325°C, the temperature at which the polyimide coating on the column decomposes and the connection will begin to leak. We strongly recommend using a Vu2 Union™ (page 215) or SeCure™ “Y” Connector (page 216) connector if oven temperatures will exceed 325°C for prolonged periods of time.

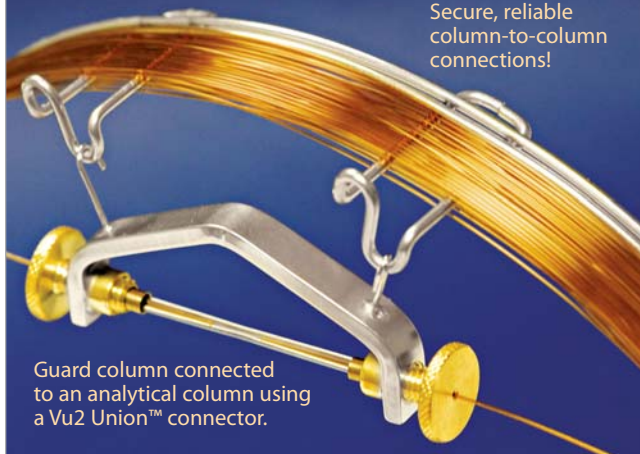
**Can Press-Tight® connectors be used with MXT® columns?**

No. To achieve a leak-tight fused silica to stainless steel connection, we recommend an MXT™ connector (see page 218).

Turn the page for a complete list of Restek Press-Tight® Connectors.

**Let Restek Make the Connection!**

Secure, reliable  
column-to-column  
connections!



Guard column connected  
to an analytical column using  
a Vu2 Union™ connector.

Restek will connect a guard column/transfer line to any analytical column, using a Vu2 Union™ connector. We will leak-check the connection and confirm analytical integrity by analyzing a test mixture. To order a preconnected guard column/transfer line, add the three-digit suffix from the chart below to any analytical column catalog number. Example: A 5m, 0.32mm ID guard column connected to a 30m, 0.32mm ID, 1.0µm Rtx®-5 column is cat.# 10254-163.

5m Guard Column	cat.#	suffix	Additional Cost*
0.15mm ID	-160	enquire	
0.18mm ID	-161	enquire	
0.25mm ID	-162	enquire	
0.32mm ID	-163	enquire	
0.53mm ID	-164	enquire	
10m Guard Column	cat.#	suffix	Additional Cost*
0.25mm ID	-165	enquire	
0.32mm ID	-166	enquire	
0.53mm ID	-167	enquire	

Guard columns listed are intermediate polarity (IP) deactivated.

For more information about guard columns and other deactivations, see pages 29–33.

\*Additional cost will be added to the price of the column.



## Nuts

### 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.

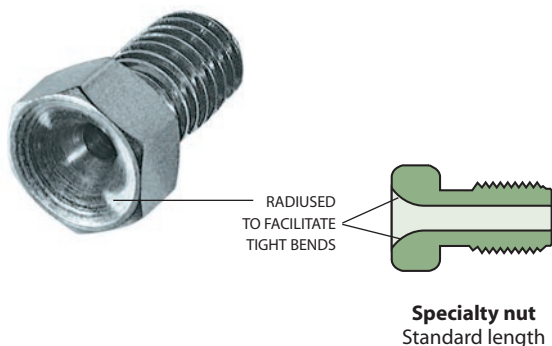
Stainless nuts			
Package of 10:	Length	Prod No	Price
1/32" nut	.30"	ZN.5-10	
1/32" nut	.45"	LZN.5-10	
1/16" nut	.43"	ZN1-10	
1/16" nut	.50"	MZN1-10	
1/16" nut	.75"	LZN1-10	
1/16" nut	1.00"	XLZN1-10	
1/8" nut	.57"	ZN2-10	
1/8" nut	.82"	LZN2-10	
1/8" nut	1.07"	XLZN2-10	
1/4" nut	.70"	ZN4-10	
1/4" nut	1.11"	LZN4-10	



### NEW Specialty nuts – stainless steel

These special purpose nuts facilitate a tight bend as the tube exits the fitting, and can also help prevent kinks in very thin wall tubing. Quick bend nuts are available in standard length (.43") and in a short version (.30") for certain custom applications. Note that the short version (ZSN1) can *only* be used in certain applications. Call for more information.

Stainless nuts			
Description	Length	Prod No	Price
1/16", standard	.43"	ZN1Q	
1/16", short	.30"	ZSN1	



#### MORE INFORMATION

PEEK nuts	page 63
HPLC column end fittings	43-46
Reducing unions	
Internal	29
External	30
External/internal	31
Internal/external	31
Unions	
Internal	26
External	27
External/internal	27

#### TECH TIP

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

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 (ECEP 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	Price
1/32" external 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.

Description	Length of nut*	Stainless plugs		High pressure Stainless plugs	
		Prod No	Price	Prod No	Price
1/32"	.30"	ZP.5		ZP.5H	
1/16"	.43"	ZP1		ZP1H	
1/16"	.75"	LZP1		LZP1H	
1/8"	.57"	ZP2		ZP2H	
1/8"	.82"	LZP2		LZP2H	
1/4"	.70"	ZP4		–	



### 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	Length of nut*	Stainless caps	
		Prod No	Price
1/32"	.30"	ZC.5	
1/16"	.43"	ZC1	
1/8"	.57"	ZC2	
1/4"	.70"	ZC4	

#### MORE INFORMATION

PEEK plugs . . . pages 64, 71  
 PEEK plugs for high  
 pressure Cheminert  
 valves . . . . . 64  
 PEEK caps . . . . . 57, 64

**CHROMalytic TECHNOlogy Pty Ltd AUSTRALIAN Distributors e-mail: [sales@chromtech.net.au](mailto:sales@chromtech.net.au) Tel: 03 9762 2034**

## Ferrules

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  $<10^{-9}$  cc/atm/sec leakage.



## MORE INFORMATION

For more detailed information on metals, refer to the discussion on pages 254-255.

## Metal ferrules

	Prod No	Price	Prod No	Price	Prod No	Price
<b>Package of 10:</b>	<b>Stainless, Type 303</b>		<b>Stainless, Type 316</b>		<b>Stainless, Gold-plated</b>	
1/32"	ZF.5-10		ZF.5S6-10	\$40	ZF.5GP-10	
1/16"	ZF1-10		ZF1S6-10	30	ZF1GP-10	
1/8"	ZF2-10		ZF2S6-10	22	ZF2GP-10	
1/4"	–		ZF4S6-10	19	ZF4GP-10	
<b>Sold individually:</b>	<b>Hastelloy C</b>		<b>Nickel</b>		<b>Titanium</b>	
1/32"	ZF.5HC		ZF.5NI	\$9	ZF.5TI	
1/16"	ZF1HC		ZF1NI	8	ZF1TI	
1/8"	ZF2HC		ZF2NI	8	ZF2TI	
1/4"	ZF4HC		ZF4NI	9	ZF4TI	
<b>Package of 10:</b>	<b>Brass</b>					
1/32"	ZF.5B-10					
1/16"	ZF1B-10					
1/8"	ZF2B-10					
1/4"	ZF4B-10					

– Not available

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

METALS  
AT A GLANCE

Hastelloy C® .....HC  
Resistant to pitting;  
Resists oxidizing atmospheres

Nickel ..... NI  
Resistant to caustics,  
high temp halogens,  
and hydrogen halides

Stainless steel,  
Gold-plated .....GP  
More inert than standard stainless

Stainless steel,  
Type 303  
GC, gas lines, general purpose

Stainless steel,  
Type 316 .....S6  
LC with high chloride ion in solutions

Titanium .....TI  
Outstanding resistance to most media except hydrofluoric acids

Brass ..... B  
Not recommended for most chromatographic applications

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



### Polymeric ferrules

#### MORE INFORMATION

PEEK ferrules .... page 63  
Grooved PEEK  
ferrules..... 63

For more detailed  
information on polymers,  
refer to the discussion  
on page 256.

#### POLYMERS AT A GLANCE

CTFE ..... KF

*Resists all inorganic  
corrosives.  
Produced as Kel-F®*

FEP ..... FEP

*Chemical resistance  
equals PTFE, but lower  
creep and higher  
friction*

PTFE, Glass-filled..... TFG

*Inert, mechanically  
stable*

PTFE, Virgin..... TF

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

Polyimide, Graphite.... GV

*Soft, easy to form fer-  
rules*

Polyimide, Valcon..... V

*High temp, graphite  
reinforced*

Polyimide, Virgin..... V1

*High temp, electrical  
insulator*

	Prod No	Price	Prod No	Price	Prod No	Price
Package of 10:	<b>PTFE, Virgin</b>		<b>PTFE, Glass-filled</b>		<b>FEP</b>	
1/32"	ZF5TF-10		ZF5TFG-10		ZF5FEP-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	

	Prod No	Price	Prod No	Price
Package of 10:	<b>PFA</b>		<b>CTFE</b>	
1/32"	ZF5PFA-10		ZF5KF-10	
1/16"	ZF1PFA-10		ZF1KF-10	
1/8"	ZF2PFA-10		ZF2KF-10	
1/4"	ZF4PFA-10		ZF4KF-10	
3/8"	ZF6PFA-10		ZF6KF-10	
1/2"	ZF8PFA-10		ZF8KF-10	

	Prod No	Price	Prod No	Price	Prod No	Price
Package of 5:	<b>Polyimide, Graphite</b>		<b>Polyimide, Valcon</b>		<b>Polyimide, Virgin</b>	
1/32"	ZF5GV-5		ZF5V-5		ZF5V1-5	
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	

#### FERRULE IDENTIFICATION

To differentiate among  
the most commonly  
ordered metal ferrules,  
ring(s) are engraved on  
the non-sealing surfaces.



316 STAINLESS



303 STAINLESS



HASTELLOY C



TITANIUM



## Reducing Ferrules

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.

**External ZDV** reducing ferrules are designed for use with all standard external style fittings – that is, those with a female nut and a male fitting detail. This ferrule has a slightly longer pilot than the internal version, to accommodate the longer external detail. The result is a zero dead volume fitting. A single groove indicates that the ferrule has the longer pilot and is for use in an external detail.

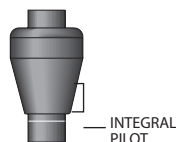
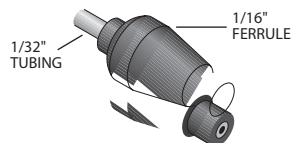
**Standard** reducing ferrules can be used where mixing is not a problem, such as with liquid or gas delivery. A 1/16" to 1/32" ferrule of this style is simply a 1/16" ferrule with a 1/32" hole.



### Internal reducing ferrules

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

	Prod No	Price	Prod No	Price	Prod No	Price
<b>Package of 5:</b>	<b>PTFE, Glass-filled</b>		<b>PEEK</b>		<b>Polyimide, Valcon</b>	
1/16" to 1/32"	ZRF1.5TFG-5		ZRF1.5PK-5		ZRF1.5V-5	
1/8" to 1/32"	ZRF2.5TFG-5		ZRF2.5PK-5		ZRF2.5V-5	
1/8" to 1/16"	ZRF21TFG-5		ZRF21PK-5		ZRF21V-5	
1/4" to 1/16"	ZRF41TFG-5		ZRF41PK-5		ZRF41V-5	
1/4" to 1/8"	ZRF42TFG-5		ZRF42PK-5		ZRF42V-5	
<b>Package of 5:</b>	<b>CTFE</b>		<b>Polyimide, Virgin</b>			
1/16" to 1/32"	ZRF1.5KF-5		ZRF1.5V1-5			
1/8" to 1/32"	ZRF2.5KF-5		ZRF2.5V1-5			
1/8" to 1/16"	ZRF21KF-5		ZRF21V1-5			
1/4" to 1/16"	ZRF41KF-5		ZRF41V1-5			
1/4" to 1/8"	ZRF42KF-5		ZRF42V1-5			



**Internal reducing ferrule (ZRF)**



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

### MORE INFORMATION

Internal reducers (IZR)..... page 34  
External reducers (EZR) ..... 35  
Ferrule removal kits. ... 16

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.

### 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®.

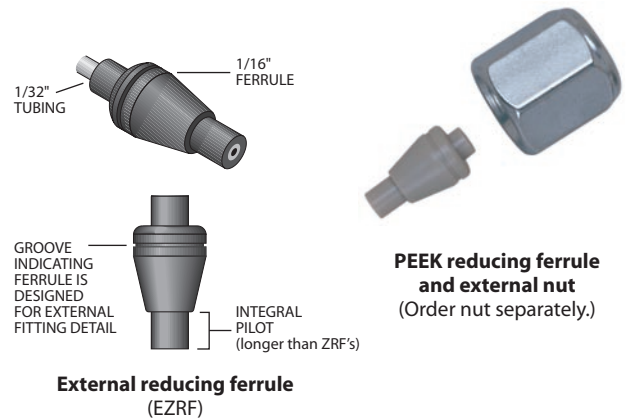
**OPTION**

Available in Virgin Polyimide.

**External reducing ferrules**

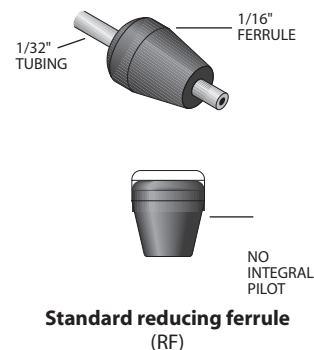
Use these ferrules in external type fitting details, with nuts that have internal threads.

	Prod No	Price	Prod No	Price	Prod No	Price
<i>Package of 5:</i>	<b>PTFE, Glass-filled</b>		<b>PEEK</b>		<b>Polyimide, Valcon</b>	
1/16" to 1/32"	EZRF1.5TFG-5		EZRF1.5PK-5		EZRF1.5V-5	
1/8" to 1/32"	EZRF2.5TFG-5		EZRF2.5PK-5		EZRF2.5V-5	
1/8" to 1/16"	EZRF21TFG-5		EZRF21PK-5		EZRF21V-5	
1/4" to 1/16"	EZRF41TFG-5		EZRF41PK-5		EZRF41V-5	
1/4" to 1/8"	EZRF42TFG-5		EZRF42PK-5		EZRF42V-5	
<i>Package of 5:</i>	<b>CTFE</b>					
1/16" to 1/32"	EZRF1.5KF-5					
1/8" to 1/32"	EZRF2.5KF-5					
1/8" to 1/16"	EZRF21KF-5					
1/4" to 1/16"	EZRF41KF-5					
1/4" to 1/8"	EZRF42KF-5					

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



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

## Fused Silica Adapters

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.



### 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	Price	Prod No	Price	Prod No	Price
<b>1/32" Adapters</b>	Tubing OD:						
	< 0.25 mm	FS.25-5		FS.25PK-5		FS.25V1-5	
	0.25 ≤ 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 ≤ 0.80 mm	ZF.5V-5		ZF.5PK-5		ZF.5V1-5	
<b>1/16" Adapters</b>	Tubing OD:						
	< 0.25 mm	FS1.2-5		FS1.2PK-5		FS1.2V1-5	
	0.25 ≤ 0.30 mm	FS1.25-5		FS1.25PK-5		FS1.25V1-5	
	0.30 ≤ 0.35 mm	FS1.3-5		FS1.3PK-5		FS1.3V1-5	
	0.35 ≤ 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 ≤ 0.80 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	

### 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 through-type 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.

### Ferrule removal kit

These tapered tools have teeth designed to grip and remove fused silica adapters if they get stuck in a fitting detail. Each kit has two sizes of tools, so they can retrieve 1/32" and 1/16" adapters.

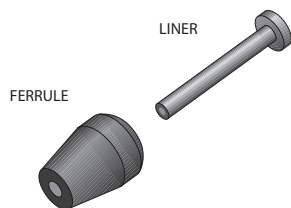
Prod No      Price  
FRK1          \$23



### WHICH ADAPTER FOR WHICH COLUMN?

Column ID	Typical column OD	1/32" adapter	1/16" adapter
< 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

## Fused Silica Adapters



## Removable fused silica adapters (FSR)

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 polyimide 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 counter-bored 1/16" nut. The 1/32" FSR adapter uses standard Valco 1/32" nuts.

## MORE INFORMATION

Fused silica

Unions . pp 18-19, 58, 61

Fittings . . . . . 18-21

A pin vise and drill index are useful for enlarging the inner diameters of the FS adapters.

Pin vise and

drill index . . . . . 55

## REPLACEMENT PARTS

## Ferrules

(package of 5)

1/32" Polyimide ZF.5V-5 \$30

1/16" Polyimide ZF1V-5 25

(package of 10)

1/16" PEEK ZF1PK-10 33

## Nuts

(package of 10)

1/32" SS ZN.5-10 29

Special nuts for FSRs:

1/16" SS ZCN1-10 30

1/16" SS long LZCN1-10 45

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 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

Package of 5:

**Polyimide, Valcon**

Prod No Price

**1/32"**

**Removable adapters**

Tubing OD:

< 0.25 mm

FSR.25-5

0.30  $\leq$  0.35 mm

FSR.3-5

0.35  $\leq$  0.40 mm

FSR.4-5

0.40  $\leq$  0.50 mm

FSR.5-5

**1/32"**

**Replacement liners**

Tubing OD:

< 0.25 mm

FSL.25-5

0.25  $\leq$  0.40 mm

FSL.4-5

0.40  $\leq$  0.50 mm

FSL.5-5

Package of 5:

**Polyimide, Valcon**

Prod No Price

**PEEK**

Prod No Price

**1/16"**

**Removable adapters**

Tubing OD:

< 0.15 mm

—

FS1R.15PK-5

< 0.20 mm

FS1R.2-5

FS1R.2PK-5

0.20  $\leq$  0.40 mm

FS1R.4-5

FS1R.4PK-5

0.40  $\leq$  0.50 mm

FS1R.5-5

FS1R.5PK-5

0.50  $\leq$  0.80 mm

FS1R.8-5

FS1R.8PK-5

0.90  $\leq$  1.0 mm

FS1R1.0-5

FS1R1.0PK-5

**1/16"**

**Replacement liners**

Tubing OD:

< 0.15 mm

—

FS1L.15PK-5

< 0.20 mm

FS1L.2-5

FS1L.2PK-5

0.20  $\leq$  0.40 mm

FS1L.4-5

FS1L.4PK-5

0.40  $\leq$  0.50 mm

FS1L.5-5

FS1L.5PK-5

0.50  $\leq$  0.80 mm

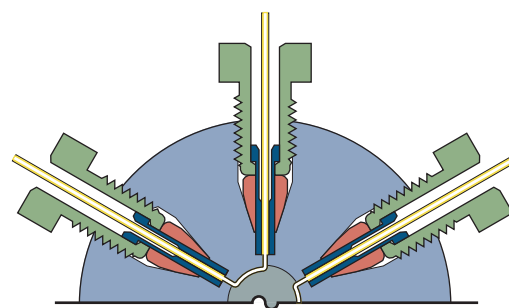
FS1L.8-5

FS1L.8PK-5

0.90  $\leq$  1.0 mm

FS1L1.0-5

FS1L1.0PK-5



Removable FSR adapters in a valve



## Fused Silica Fittings

The patented 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.

Self-compensating nuts are currently employed in two basic designs: a fused silica-lined union and an injector/detector nut for Agilent 6890 and 5890 GCs.

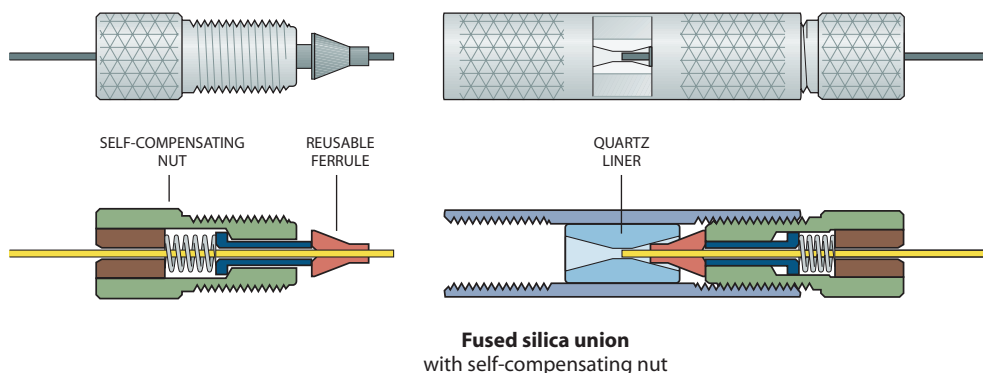
### Fused silica unions

The fused silica union\* has a quartz liner, providing an inert connection zone of minimal volume. Since the seal occurs only at the ferrule tip, the total sealing force is minimized, leaving the ferrule undistorted and reusable.

*Note:* The ferrules used in this union are unique, due to the seal at the tip. Standard ferrules will not work in this union.



Description	Prod No	Price
Fused silica union	FSKZU1	
Replacement liner	FSQ1	
Replacement nut	FSZN1	



### Replacement ferrules for fused silica unions and self-compensating nuts (Agilent injector nuts)

These reusable ferrules seal at the tip, and are different from standard ferrules. Order for use with FSKZU1 fused silica unions and FSZNA-HP nuts on these two pages.

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

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

\*U.S. patent numbers 5,234,235 and 4,991,883.