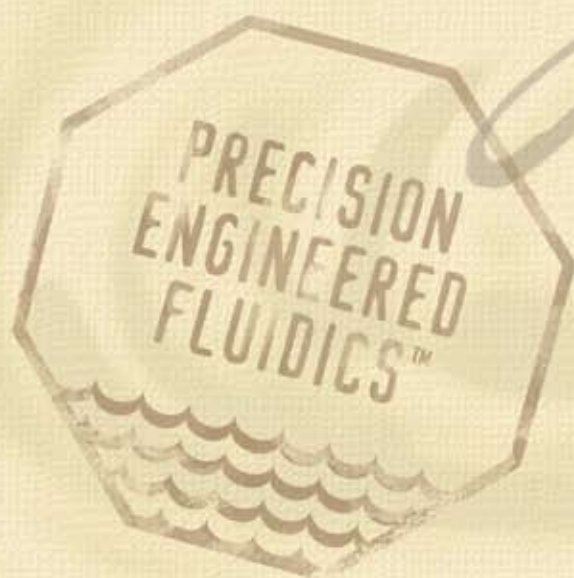




Tubing

Tubing





PEEK™ TUBING

- » 1/16", 1/8" and 1.8mm ODs Available
- » Biocompatible, Inert and Easily Cut
- » Great for High Pressure Applications

Upchurch Scientific® PEEK (polyetheretherketone) polymer tubing is biocompatible, chemically inert to most solvents, and can be used to replace stainless steel tubing in most liquid analytical systems. Unlike stainless steel and titanium tubing, PEEK tubing is flexible and can be easily cut to desired lengths. PEEK tubing can be used with stainless steel or polymer fittings. Our high pressure fittings are listed starting on page 8.

The benefits of PEEK polymer tubing include a high pressure rating (up to 7,000 psi in most cases) and a high temperature rating (maximum continuous use temperature of 100°C). Additionally, PEEK tubing has a very smooth internal surface, which causes less turbulence than similar sized metal tubing. Turbulence can cause remixing of separated sample bands and dilution of bands by the mobile phase. Of all our polymer tubing materials, PEEK is the least permeable to gas (see chart on page 73).

Upchurch Scientific PEEK polymer tubing is extruded to the following OD/ID tolerances: 1/16" OD tubing, ±.001" for both; 1/8" OD tubing, ±.003" for both; 1.8mm OD tubing, ±.002" and ±.001", respectively. The tubing also features excellent concentricity, with a Total Indicator Runout (TIR) of .003" or less on our 1/16" OD tubing. In addition, our 1/16" OD tubing is color-coded so different IDs are easily identified. Our proprietary extrusion process ensures color permanence in our tubing.

PEEK tubing offers outstanding chemical compatibility, with very few solvents interacting with the polymer. For information regarding specific solvents that may interact with the polymer, please visit www.upchurch.com or contact Upchurch Scientific or your local Distributor.

Our 5' length tubing is rough cut to approximately 5'1". A trim cut should be made before use, especially for smaller ID tubing. PEEK tubing can be cut easily with a razor blade. However for an improved cut, try our Tubing Cutters on page 77. See page 73 to determine the length of tubing required at a given ID for sample loop customization.

Upchurch Scientific Tubing OD Sizes:

Please use this table as a reference tool to help quickly locate within this chapter the appropriate OD size tubing for your application.

Size	Tubing OD	Page(s)
•	360µm	67, 68, 73
•	510µm	67, 75
•	1/32"	67, 68, 71, 75
•	1/16"	66, 68, 69, 70, 71, 75, 76
•	1/8"	66, 69, 70, 71, 72, 75
•	3/16"	71, 72
•	1/4"	70, 71, 72
•	5/16"	71
•	1mm	71
•	1.8mm	66
•	2mm	71
•	3mm	71
•	4mm	71



Application Note

WHAT SIZE PEEK TUBING SHOULD I USE?

- » It is usually safe to use .010" ID x 1/16" OD tubing throughout an analytical HPLC system. With a .010" ID, the pressure drop across most tubing lengths is negligible, and the ID is small enough to minimize band broadening.
- » High pressure semi-prep LC systems will most likely use 1/8" OD tubing.
- » Use 1.8mm OD tubing to replace fluoropolymer tubing used in some Pharmacia® systems.
- » Use our 1/32" OD tubing for the high pressure flow path of Agilent® 1100 capillary LC systems.
- » Choose 360µm OD tubing for most capillary systems.
- » PEEK tubing is available in additional sizes and in 50' and 100' lengths. Contact your local Distributor or Upchurch Scientific directly for pricing information.

PEEK TUBING, 1/16" OD X 5'

NEW

		Color	Max. Pressure
1559	.001" (25µm) ID	Natural	7,000 psi (483 bar)*
1560	.0025" (65µm) ID	Natural	7,000 psi (483 bar)*
1561	.004" (100µm) ID	Black	7,000 psi (483 bar)*
1535	.005" (125µm) ID	Red	7,000 psi (483 bar)*
1562	.006" (150µm) ID	Purple	7,000 psi (483 bar)*
1536	.007" (175µm) ID	Yellow	7,000 psi (483 bar)*
1531	.010" (.25mm) ID	Natural	7,000 psi (483 bar)*
1531B	.010" (.25mm) ID	Blue	7,000 psi (483 bar)*
1565	.015" (.40mm) ID	Gray	7,000 psi (483 bar)*
1532	.020" (.50mm) ID	Orange	7,000 psi (483 bar)*
1533	.030" (.75mm) ID	Green	7,000 psi (483 bar)*
1538	.040" (1.00mm) ID	Natural	5,000 psi (345 bar)*
1537	.055" (1.40mm) ID	Natural	500 psi (34 bar)*

PEEK TUBING, 1/8" OD X 5'

1534	.062" (1.60mm) ID	Natural	4,000 psi (276 bar)*
1544	.080" (2.00mm) ID	Natural	3,000 psi (207 bar)*

PEEK TUBING, 1.8MM OD X 5'

1545	.010" (.25mm) ID	Natural	7,000 psi (483 bar)*
1546	.020" (.50mm) ID	Natural	7,000 psi (483 bar)*
1547	.030" (.75mm) ID	Natural	7,000 psi (483 bar)*
1540	.042" (1.05mm) ID	Natural	5,000 psi (345 bar)*
1539	.055" (1.40mm) ID	Natural	500 psi (34 bar)*

* Testing conducted with water at room temperature. Use of some chemicals and higher temperatures may reduce the pressure limit. Please contact us for more information. Please Note: Using a heat gun or overheating can weaken your tubing.



CAPILLARY PEEK™ TUBING

- » 360µm, 510µm and 1/32" ODs Available
- » IDs as Small as 25µm (.001")

Capillary PEEK tubing offers all the benefits of larger sized PEEK tubing, while serving as an excellent alternative to more traditional fused silica and stainless steel capillary tubing (see Application Note below). This specialized tubing is manufactured in three sizes – 360µm (.0145"), 510µm (.020") and 1/32" (785µm) ODs. These sizes of tubing can be coupled to many of the products in our Micro Flow chapter (starting on page 24) and are recommended for the micro- and nano-scale valves in the High Pressure Valves Chapter (starting on page 78).

Tolerances of the Upchurch Scientific® capillary 360µm and 1/32" OD PEEK tubing are ±.0005" for both OD and ID. Tolerances for 510µm OD tubing is ±.001" for both OD and ID.

Please Note: Upchurch Scientific also manufactures 1/16" OD PEEK tubing with IDs in the microbore range (.0025" to .010"), presented on page 66. In addition, we offer the A-350 Tubing Cutter designed for polymer capillary tubing, found on page 77.



Application Note

- » An independent study conducted by a major pharmaceutical company indicated LC-MS chromatographic performance could be improved by switching the post-column transfer line from fused silica to PEEK polymer tubing. The switch dramatically reduced peak tailing and eliminated the degradation of peak symmetry as injection volume was reduced. For more information, please contact us or order the "Improved LC-MS Results Study" from the "Request Literature" section of our website at www.upchurch.com.
- » To straighten PEEK polymer tubing, first choose a piece of stainless steel tubing with an inner diameter slightly larger than the OD of your tubing and with an appropriate length for the PEEK tubing you wish to straighten. For instance, for 1/16" OD PEEK tubing with a length of 10", choose our U-825 tubing (stainless steel, 1/8" OD x .080" ID x 25cm long, page 75). Slip your PEEK tubing into the stainless steel tubing. Place this "sleeved" tubing into an oven and bake at 180°C for 20 minutes. Allow the sleeved tubing to return to room temperature naturally (i.e., do not quench it with water). Once cooled, remove the PEEK tubing from the stainless steel sleeve and inspect it for straightness. If needed, repeat the process until the desired straightness is achieved.

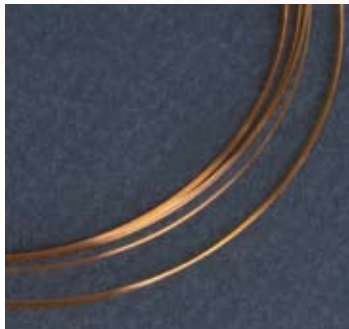
Please Note: Our 25µm ID PEEK Tubing is only compatible with certain fittings. Call us for more information on which fittings are appropriate for use with this product.

ORDER Tel: 800.426.0191 / 360.679.2528 · www.upchurch.com

FUSED SILICA TUBING

As a service to our customers, we offer cut fused silica tubing in convenient 2m lengths. Choose from 20, 50, 75, 100 and 150µm ID sizes, all with 360µm OD. These products are comprised of synthetic fused silica with a polyimide coating.

This tubing is manufactured by Polymicro Technologies. They rate this tubing to 350°C. The OD tolerance for all 360µm OD fused silica tubing is ±10µm. The ID tolerances are: ±2µm for the 20µm ID tubing; ±3µm for the 50µm and 75µm ID tubing; and ±4µm for the 100µm and 150µm ID tubing. For other sizes or lengths of fused silica tubing, please contact Polymicro Technologies directly (see page 167 for contact information).



To cut your fused silica tubing, try the FS-315 or FS-400 Cutters on page 76.

CAPILLARY PEEK TUBING, 360µm (.0145") OD*

		Color	Max. Pressure	Qty.
NEW	1574	25µm (.001") ID x 5'	Natural 5,000 psi (345 bar)**	ea.
NEW	1575-12x	25µm (.001") ID x 12"	Natural 5,000 psi (345 bar)**	10-pk
	1570	50µm (.002") ID x 5'	Natural 2,000 psi (138 bar)**	ea.
	1570-12x	50µm (.002") ID x 12"	Natural 2,000 psi (138 bar)**	10-pk
	1573	75µm (.003") ID x 5'	Black 2,000 psi (138 bar)**	ea.
	1573-12x	75µm (.003") ID x 12"	Black 2,000 psi (138 bar)**	10-pk
	1571	100µm (.004") ID x 5'	Red 2,000 psi (138 bar)**	ea.
	1571-12x	100µm (.004") ID x 12"	Red 2,000 psi (138 bar)**	10-pk
	1572	150µm (.006") ID x 5'	Yellow 2,000 psi (138 bar)**	ea.
	1572-12x	150µm (.006") ID x 12"	Yellow 2,000 psi (138 bar)**	10-pk
	360-KIT	360µm (.0145") OD x 12" Kit		40-pk
		Kit contains (1) each of the 360µm OD x 12" 10-packs listed above		

CAPILLARY PEEK TUBING, 510µm (.020") OD

1543	65µm (.0025") ID x 5'	Natural 2,000 psi (138 bar)**	ea.
1541	125µm (.005") ID x 5'	Natural 2,000 psi (138 bar)**	ea.
1542	255µm (.010") ID x 5'	Natural 2,000 psi (138 bar)**	ea.

CAPILLARY PEEK TUBING, 1/32" OD

NEW	1567	25µm (.001") ID x 5'	Natural 5,000 psi (345 bar)**	ea.
NEW	1567-12x	25µm (.001") ID x 12"	Natural 5,000 psi (345 bar)**	10-pk
	1579	65µm (.0025") ID x 5'	Natural 5,000 psi (345 bar)**	ea.
	1579-12x	65µm (.0025") ID x 12"	Natural 5,000 psi (345 bar)**	10-pk
	1578	90µm (.0035") ID x 5'	Black 5,000 psi (345 bar)**	ea.
	1578-12x	90µm (.0035") ID x 12"	Black 5,000 psi (345 bar)**	10-pk
	1576	125µm (.005") ID x 5'	Red 5,000 psi (345 bar)**	ea.
	1576-12x	125µm (.005") ID x 12"	Red 5,000 psi (345 bar)**	10-pk
	1577	175µm (.007") ID x 5'	Yellow 5,000 psi (345 bar)**	ea.
	1577-12x	175µm (.007") ID x 12"	Yellow 5,000 psi (345 bar)**	10-pk
	1575	200µm (.008") ID x 5'	Natural 5,000 psi (345 bar)**	ea.
	1575-12x	200µm (.008") ID x 12"	Natural 5,000 psi (345 bar)**	10-pk
	1580	230µm (.009") ID x 5'	Gray 5,000 psi (345 bar)**	ea.
	1580-12x	230µm (.009") ID x 12"	Gray 5,000 psi (345 bar)**	10-pk
	1581	.25mm (.010") ID x 5'	Blue 5,000 psi (345 bar)**	ea.
	1581-12x	.25mm (.010") ID x 12"	Blue 5,000 psi (345 bar)**	10-pk
	1568	.40mm (.015") ID x 5'	Natural 5,000 psi (345 bar)**	ea.
	1568-12x	.40mm (.015") ID x 12"	Natural 5,000 psi (345 bar)**	10-pk
	1569	.50mm (.020") ID x 5'	Orange 3,000 psi (207 bar)**	ea.
	1569-12x	.50mm (.020") ID x 12"	Orange 3,000 psi (207 bar)**	10-pk
	787-KIT	1/32" OD x 12" Kit		90-pk
		Kit contains (1) 10-pack of each 1/32" OD x 12" size listed above.		

FUSED SILICA TUBING, 360µm (.0145") OD*

FS-120	20µm (.0008") ID x 2m	ea.
FS-150	50µm (.002") ID x 2m	ea.
FS-175	75µm (.003") ID x 2m	ea.
FS-110	100µm (.004") ID x 2m	ea.
FS-115	150µm (.006") ID x 2m	ea.

* The OD size of the fused silica and 360µm PEEK tubing on this page is actually 363µm and 368µm, respectively. Industry convention refers to this tubing by a nominal size of 360µm.

** Testing conducted with water at room temperature. Use of some chemicals and higher temperatures may reduce the pressure limit. Please contact us for more information. Please Note: using a heat gun or overheating can weaken your tubing.

PEEKsil™ TUBING

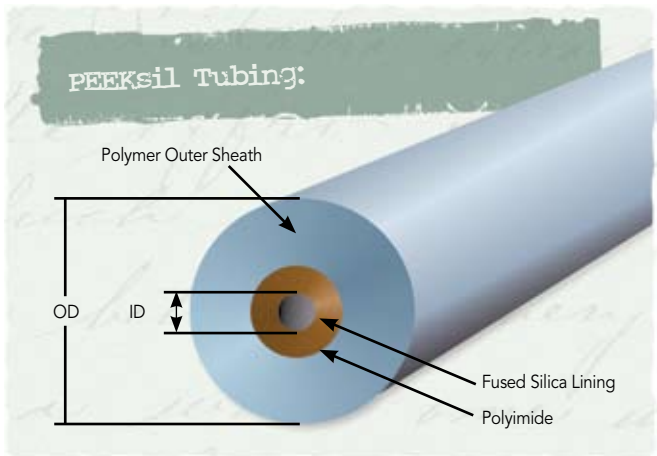
PEEKsil is fused silica tubing sheathed in PEEK™ polymer, with an effective outer diameter of 360µm, 1/32" or 1/16". The PEEK sheathing is mechanically strong and has ideal characteristics for sealing with metal or polymer fittings. PEEKsil can be used as a direct replacement for conventional stainless steel or PEEK tubing in many analytical systems. The 360µm OD PEEKsil tubing may also be used in place of standard fused silica tubing, and is ideal for capillary LC and LC-MS applications.



Like traditional fused silica tubing, PEEKsil has excellent chemical compatibility and extremely low absorption characteristics, especially when compared to stainless steel. The PEEK sheath/fused silica combination makes this tubing capable of withstanding up to 10,000 psi (690 bar).

PEEKsil is manufactured by SGE International Pty, Ltd. Their stated OD tolerance for 360µm, 1/32" and 1/16" OD tubing is ±10µm, ±20µm and ±30µm, respectively. The ID tolerances are: ±1µm for the 25µm; ±3µm for 50 -100µm; and ±5µm for the 150µm – 300µm IDs. Please contact us about the availability of additional ID sizes and lengths.

Please Note: **Do not cut this tubing.** It should be used at its precut lengths because of permanent damage caused by conventional cutters.



PEEKsil TUBING, 360µm (.0145") OD

		Color	Max. Pressure	Qty
360255	25µm (.001") ID x 5cm	Orange	10,000 psi (690 bar)	2-pk
3602510	25µm (.001") ID x 10cm	Orange	10,000 psi (690 bar)	2-pk
3602515	25µm (.001") ID x 15cm	Orange	10,000 psi (690 bar)	2-pk
3602525	25µm (.001") ID x 25cm	Orange	10,000 psi (690 bar)	2-pk
3602550	25µm (.001") ID x 50cm	Orange	10,000 psi (690 bar)	2-pk
360505	50µm (.001") ID x 5cm	Natural	10,000 psi (690 bar)	2-pk
3605010	50µm (.001") ID x 10cm	Natural	10,000 psi (690 bar)	2-pk
3605015	50µm (.001") ID x 15cm	Natural	10,000 psi (690 bar)	2-pk
3605025	50µm (.001") ID x 25cm	Natural	10,000 psi (690 bar)	2-pk
3605050	50µm (.001") ID x 50cm	Natural	10,000 psi (690 bar)	2-pk

PEEKsil TUBING, 1/32" OD

		Color	Max. Pressure	Qty.
3255	25µm (.001") ID x 5cm	Orange	10,000 psi (690 bar)*	2-pk
32510	25µm (.001") ID x 10cm	Orange	10,000 psi (690 bar)*	2-pk
32515	25µm (.001") ID x 15cm	Orange	10,000 psi (690 bar)*	2-pk
32520	25µm (.001") ID x 20cm	Orange	10,000 psi (690 bar)*	2-pk
32550	25µm (.001") ID x 50cm	Orange	10,000 psi (690 bar)*	2-pk
3505	50µm (.002") ID x 5cm	Natural	10,000 psi (690 bar)*	2-pk
35010	50µm (.002") ID x 10cm	Natural	10,000 psi (690 bar)*	2-pk
35015	50µm (.002") ID x 15cm	Natural	10,000 psi (690 bar)*	2-pk
35020	50µm (.002") ID x 20cm	Natural	10,000 psi (690 bar)*	2-pk
35050	50µm (.002") ID x 50cm	Natural	10,000 psi (690 bar)*	2-pk
3755	75µm (.003") ID x 5cm	Black	10,000 psi (690 bar)*	2-pk
37510	75µm (.003") ID x 10cm	Black	10,000 psi (690 bar)*	2-pk
37515	75µm (.003") ID x 15cm	Black	10,000 psi (690 bar)*	2-pk
37520	75µm (.003") ID x 20cm	Black	10,000 psi (690 bar)*	2-pk
37550	75µm (.003") ID x 50cm	Black	10,000 psi (690 bar)*	2-pk
31005	100µm (.004") ID x 5cm	Red	10,000 psi (690 bar)*	2-pk
310010	100µm (.004") ID x 10cm	Red	10,000 psi (690 bar)*	2-pk
310015	100µm (.004") ID x 15cm	Red	10,000 psi (690 bar)*	2-pk
310020	100µm (.004") ID x 20cm	Red	10,000 psi (690 bar)*	2-pk
310050	100µm (.004") ID x 50cm	Red	10,000 psi (690 bar)*	2-pk
31505	150µm (.006") ID x 5cm	Purple	10,000 psi (690 bar)*	2-pk
315010	150µm (.006") ID x 10cm	Purple	10,000 psi (690 bar)*	2-pk
315015	150µm (.006") ID x 15cm	Purple	10,000 psi (690 bar)*	2-pk
315020	150µm (.006") ID x 20cm	Purple	10,000 psi (690 bar)*	2-pk
315050	150µm (.006") ID x 50cm	Purple	10,000 psi (690 bar)*	2-pk

PEEKsil TUBING, 1/16" OD

6255	25µm (.001") ID x 5cm	Orange	10,000 psi (690 bar)*	5-pk
62510	25µm (.001") ID x 10cm	Orange	10,000 psi (690 bar)*	5-pk
62515	25µm (.001") ID x 15cm	Orange	10,000 psi (690 bar)*	5-pk
62520	25µm (.001") ID x 20cm	Orange	10,000 psi (690 bar)*	5-pk
62550	25µm (.001") ID x 50cm	Orange	10,000 psi (690 bar)*	2-pk
6505	50µm (.002") ID x 5cm	Natural	10,000 psi (690 bar)*	5-pk
65010	50µm (.002") ID x 10cm	Natural	10,000 psi (690 bar)*	5-pk
65015	50µm (.002") ID x 15cm	Natural	10,000 psi (690 bar)*	5-pk
65020	50µm (.002") ID x 20cm	Natural	10,000 psi (690 bar)*	5-pk
65050	50µm (.002") ID x 50cm	Natural	10,000 psi (690 bar)*	2-pk
6755	75µm (.003") ID x 5cm	Black	10,000 psi (690 bar)*	5-pk
67510	75µm (.003") ID x 10cm	Black	10,000 psi (690 bar)*	5-pk
67515	75µm (.003") ID x 15cm	Black	10,000 psi (690 bar)*	5-pk
67520	75µm (.003") ID x 20cm	Black	10,000 psi (690 bar)*	5-pk
67550	75µm (.003") ID x 50cm	Black	10,000 psi (690 bar)*	2-pk
61005	100µm (.004") ID x 5cm	Red	10,000 psi (690 bar)*	5-pk
610010	100µm (.004") ID x 10cm	Red	10,000 psi (690 bar)*	5-pk
610015	100µm (.004") ID x 15cm	Red	10,000 psi (690 bar)*	5-pk
610020	100µm (.004") ID x 20cm	Red	10,000 psi (690 bar)*	5-pk
610050	100µm (.004") ID x 50cm	Red	10,000 psi (690 bar)*	2-pk
61505	150µm (.006") ID x 5cm	Purple	10,000 psi (690 bar)*	5-pk
615010	150µm (.006") ID x 10cm	Purple	10,000 psi (690 bar)*	5-pk
615015	150µm (.006") ID x 15cm	Purple	10,000 psi (690 bar)*	5-pk
615020	150µm (.006") ID x 20cm	Purple	10,000 psi (690 bar)*	5-pk
615050	150µm (.006") ID x 50cm	Purple	10,000 psi (690 bar)*	2-pk
61755	175µm (.007") ID x 5cm	Yellow	10,000 psi (690 bar)*	5-pk
617510	175µm (.007") ID x 10cm	Yellow	10,000 psi (690 bar)*	5-pk
617515	175µm (.007") ID x 15cm	Yellow	10,000 psi (690 bar)*	5-pk
617520	175µm (.007") ID x 20cm	Yellow	10,000 psi (690 bar)*	5-pk
617550	175µm (.007") ID x 50cm	Yellow	10,000 psi (690 bar)*	2-pk
62005	200µm (.008") ID x 5cm	Blue	10,000 psi (690 bar)*	5-pk
620010	200µm (.008") ID x 10cm	Blue	10,000 psi (690 bar)*	5-pk
620015	200µm (.008") ID x 15cm	Blue	10,000 psi (690 bar)*	5-pk
620020	200µm (.008") ID x 20cm	Blue	10,000 psi (690 bar)*	5-pk
620050	200µm (.008") ID x 50cm	Blue	10,000 psi (690 bar)*	2-pk
63005	300µm (.012") ID x 5cm	Gray	10,000 psi (690 bar)*	5-pk
630010	300µm (.012") ID x 10cm	Gray	10,000 psi (690 bar)*	5-pk
630015	300µm (.012") ID x 15cm	Gray	10,000 psi (690 bar)*	5-pk
630020	300µm (.012") ID x 20cm	Gray	10,000 psi (690 bar)*	5-pk
630050	300µm (.012") ID x 50cm	Gray	10,000 psi (690 bar)*	2-pk

* Pressure rating determined by SGE International Pty, Ltd, the manufacturer of this tubing.



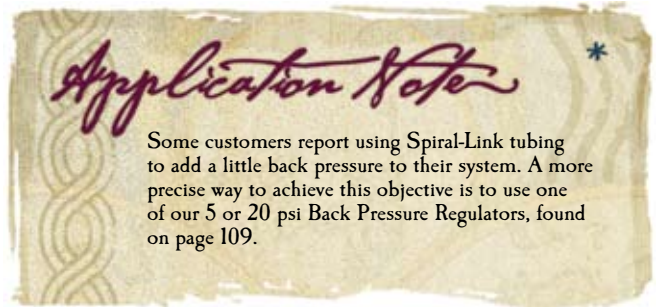
SPIRAL-LINK™ TUBING

The coils of our 1/16" OD x .010" ID Spiral-Link tubing expand and contract, allowing you to easily move your system components or even make equipment repairs whenever needed, without the hassle of breaking connections.

Upchurch Scientific® Spiral-Link tubing is made of PEEK™ polymer, a biocompatible, chemically inert material. Spiral-Links come in six different lengths. Our proprietary extrusion process ensures color permanence.

Each Spiral-Link ships with two F-287 SealTight™ Fittings.

Please Note: Spiral-Link tubing is also available with the following IDs: .005" (125µm), .020" (.50mm) and .030" (.75mm), all with 1/16" OD. Please contact us or an Upchurch Scientific Distributor for more information, or find these products at www.upchurch.com.



RADEL® R TUBING

» Withstands up to 12,500 psi (862 bar)

» Transparent and Autoclavable

» 1/16" and 1/8" ODs Available

Radel R (polyphenylsulfone) is a mechanically strong and chemically resistant material, much like PEEK. Radel R is frequently used in medical applications where repeated autoclave sterilization is performed (tests show product stability after 1,000 cycles). Radel R tubing is also transparent, allowing technicians to visually monitor flow through their instrument. Readily wetted surfaces help keep air bubbles from accumulating on inner surfaces.

This tubing is available in 1/16" and 1/8" ODs, with OD/ID tolerances of ±.001" and ±.003", respectively. This polymer's high heat deflection value allows it to be used at a maximum operating temperature of 100°C without losing mechanical strength. Please visit our website, www.upchurch.com, for more information regarding chemical compatibility of Radel R.



ORDER Tel: 800.426.0191 / 360.679.2528 · www.upchurch.com

ULTEM® TUBING

» Transparent

» Withstands Repeated Sterilization

» High Durability

Upchurch Scientific has the capability to extrude Ultem (polyetherimide) tubing. Ultem tubing offers high burst strength, high heat resistance and excellent chemical resistance against many solvents, lipids, detergents and disinfectants. In addition, tubing made from Ultem is transparent, allowing flow to be monitored.

This polymer withstands the degradation effects of various sterilization methods, such as repeated autoclaving, gamma radiation, EtO gas and dry heat. Ultem meets ISO10993, FDA and USP Class VI criteria. Please inquire about the availability of Ultem tubing.



Ultem PSI Ratings:	
Tubing Size	Max. Pressure
1/16" OD x .020 ID	6,000 psi (414 bar)
1/8" OD x .062 ID	4,000 psi (276 bar)

SPIRAL-LINK TUBING*, .010" (.25mm) ID X 1/16" OD • BLUE

Length of tubing prior to coiling	Max coil span	Volume
17201 10cm	N/A	5µL
17202 20cm	0.5" (1.3cm)	10µL
17204 40cm	2.4" (6.1cm)	20µL
17205 50cm	3.0" (7.6cm)	25µL
17210 100cm	7.0" (17.8cm)	51µL
17220 200cm	13.0" (33.0cm)	101µL

RADEL R TUBING, 1/16" OD

	Color	Max. Pressure
1210 .010" (.25mm) ID x 5'	Natural	12,500 psi (862 bar)**
1210L .010" (.25mm) ID x 50'	Natural	12,500 psi (862 bar)**
1210XL .010" (.25mm) ID x 100'	Natural	12,500 psi (862 bar)**
1220 .020" (.50mm) ID x 5'	Natural	7,500 psi (518 bar)**
1220L .020" (.50mm) ID x 50'	Natural	7,500 psi (518 bar)**
1220XL .020" (.50mm) ID x 100'	Natural	7,500 psi (518 bar)**
1230 .030" (.75mm) ID x 5'	Natural	5,500 psi (379 bar)**
1230L .030" (.75mm) ID x 50'	Natural	5,500 psi (379 bar)**
1230XL .030" (.75mm) ID x 100'	Natural	5,500 psi (379 bar)**

RADEL R TUBING, 1/8" OD

1235 .062" (1.55mm) ID x 5'	Natural	4,500 psi (310 bar)**
1235L .062" (1.55mm) ID x 50'	Natural	4,500 psi (310 bar)**
1235XL .062" (1.55mm) ID x 100'	Natural	4,500 psi (310 bar)**

* Each Spiral-Link includes (2) F-287 SealTight Fittings (see page 13).

** Testing conducted with water at room temperature. Use of some chemicals and at higher temperatures may reduce the pressure limit. Please contact us for more information.



TEFZEL® (ETFE) TUBING

- » Excellent Chemical Resistance
- » Holds Pressure up to 4,000 psi (276 bar)
- » 1/16", 1/8", and 1/4" ODs Available

Upchurch Scientific® ETFE (ethylene-tetrafluoroethylene) tubing is an excellent fluoropolymer product offering several benefits over DuPont Teflon® brand resin. For instance, the .010" ID x 1/16" OD ETFE tubing can withstand aqueous pressures to 4,000 psi (276 bar), and up to 1,200 psi (83 bar) with some amines and inorganic acids. ETFE tubing is also somewhat more rigid than Teflon tubing and thus exhibits a greater resistance to inner diameter collapse. The recommended maximum operating temperature for ETFE tubing is 80°C.

The OD/ID tolerances of our ETFE tubing are:

Tubing OD	Tubing ID	OD/ID Tolerances
1/16" OD	.010", .020", .030"	±.001"
1/16" OD	.040"	±.002"
1/8" OD	All	±.003"
1/4" OD	All	±.004"

HALAR® TUBING

- » Excellent Chemical Resistance
- » Good for Radiation Sterilization
- » 1/16" and 1/8" ODs Available

As another member of the fluoropolymer family, Halar ECTFE (ethylene-chlorotrifluoroethylene) offers excellent chemical resistance coupled with mechanical strength superior to Teflon. Tubing made of Halar also outperforms Teflon in ability to withstand radiation, making it attractive for in vitro medical applications. Please refer to page 152 for additional Halar properties. The OD/ID tolerances of Upchurch Scientific Halar tubing are both ±.001" for the 1/16" OD tubing and ±.003" for the 1/8" OD tubing. Pressure ratings are presented with the product listings on this page. The recommended maximum operating temperature for Halar tubing is 50°C.



TEFZEL (ETFE) TUBING, 1/16" OD

		Color	Max. Pressure
1529	.010" (.25mm) ID x 5'	Natural	4,000 psi (276 bar)*
1529L	.010" (.25mm) ID x 50'	Natural	4,000 psi (276 bar)*
1529XL	.010" (.25mm) ID x 100'	Natural	4,000 psi (276 bar)*
1516	.020" (.50mm) ID x 5'	Natural	3,000 psi (207 bar)*
1516L	.020" (.50mm) ID x 50'	Natural	3,000 psi (207 bar)*
1516XL	.020" (.50mm) ID x 100'	Natural	3,000 psi (207 bar)*
1528	.030" (.75mm) ID x 5'	Natural	2,000 psi (138 bar)*
1528L	.030" (.75mm) ID x 50'	Natural	2,000 psi (138 bar)*
1528XL	.030" (.75mm) ID x 100'	Natural	2,000 psi (138 bar)*
1517	.040" (1.00mm) ID x 5'	Natural	500 psi (34 bar)*
1517L	.040" (1.00mm) ID x 50'	Natural	500 psi (34 bar)*
1517XL	.040" (1.00mm) ID x 100'	Natural	500 psi (34 bar)*

TEFZEL (ETFE) TUBING, 1/8" OD

1515	.062" (1.55mm) ID x 5'	Black	1,000 psi (69 bar)*
1515L	.062" (1.55mm) ID x 50'	Black	1,000 psi (69 bar)*
1515XL	.062" (1.55mm) ID x 100'	Black	1,000 psi (69 bar)*
1530	.062" (1.55mm) ID x 5'	Natural	1,000 psi (69 bar)*
1530L	.062" (1.55mm) ID x 50'	Natural	1,000 psi (69 bar)*
1530XL	.062" (1.55mm) ID x 100'	Natural	1,000 psi (69 bar)*
1648	.093" (2.40mm) ID x 5'	Natural	500 psi (34 bar)*
1648L	.093" (2.40mm) ID x 50'	Natural	500 psi (34 bar)*
1648XL	.093" (2.40mm) ID x 100'	Natural	500 psi (34 bar)*

TEFZEL (ETFE) TUBING, 1/4" OD

1647	.188" (4.80mm) ID x 10'	Natural	250 psi (17 bar)*
1647L	.188" (4.80mm) ID x 50'	Natural	250 psi (17 bar)*
1647XL	.188" (4.80mm) ID x 100'	Natural	250 psi (17 bar)*

HALAR TUBING, 1/16" OD

4010	.010" (.25mm) ID x 5'	Natural	6,000 psi (414 bar)*
4010L	.010" (.25mm) ID x 50'	Natural	6,000 psi (414 bar)*
4010XL	.010" (.25mm) ID x 100'	Natural	6,000 psi (414 bar)*
4020	.020" (.50mm) ID x 5'	Natural	3,500 psi (241 bar)*
4020L	.020" (.50mm) ID x 50'	Natural	3,500 psi (241 bar)*
4020XL	.020" (.50mm) ID x 100'	Natural	3,500 psi (241 bar)*
4030	.030" (.75mm) ID x 5'	Natural	3,000 psi (207 bar)*
4030L	.030" (.75mm) ID x 50'	Natural	3,000 psi (207 bar)*
4030XL	.030" (.75mm) ID x 100'	Natural	3,000 psi (207 bar)*

HALAR TUBING, 1/8" OD

4000	.062" (1.55mm) ID x 5'	Natural	2,500 psi (172 bar)*
4000L	.062" (1.55mm) ID x 50'	Natural	2,500 psi (172 bar)*
4000XL	.062" (1.55mm) ID x 100'	Natural	2,500 psi (172 bar)*

* Testing conducted with water at room temperature. Use of some chemicals and at higher temperatures may reduce the pressure limit. Please contact us for more information.



DUPONT TEFLON® BRAND RESIN FEP TUBING

- » Great for Moderate-to-Low Pressure Applications
- » 1/32", 1/16", 1/8", 3/16", 1/4" and 5/16" ODs Available
- » 1mm, 2mm, 3mm and 4mm ODs Available

With virtually identical chemical resistance to PFA at a lower price, Teflon FEP tubing is great for general, low pressure applications. Compared to PTFE, Teflon FEP (fluorinated ethylene propylene) tubing is held to tighter tolerances and has lower gas permeability (see chart on page 73).

Much of our Teflon FEP Tubing is translucent, making it possible to watch fluid flow. Using different colored tubing can help identify transfer lines in multisolvent systems. Color coding also allows easy identification of the tubing thru-hole size. Black FEP tubing is available for light-sensitive applications (such as enzymatic and chemi-luminescent reactions) and entering/exiting flow cells.

FEP 1/16" OD tubing holds from 1,000 psi (69 bar) to 4,000 psi (276 bar) depending on the ID. Our 1/8" and 3/16" OD tubing hold to 500 psi (34 bar), while our 1/4" and 5/16" OD tubing hold to 250 psi (17 bar). All of our metric-sized tubing is rated to 500 psi (34 bar). The recommended maximum operating temperature for Teflon FEP is 50°C.



The OD/ID tolerances of our FEP tubing are:

Tubing Size	Tolerances	
	OD	ID
1/32" OD	±.0005"	±.0005"
1/16" OD	±.001"	±.001"
1/8" OD	±.003"	±.003"
3/16" OD	±.004"	±.004"
5/16" OD	±.004"	±.004"
1mm OD	±.025mm	±.025mm
2mm OD	±.075mm	±.075mm
3mm OD	±.075mm	±.075mm
4mm OD	±.1mm	±.10mm

These tolerances guarantee a good connection and ensure lot-to-lot dimensional consistency.

Please Note: Teflon® is a registered trademark of E.I. du Pont de Nemours and Company, used under license by Upchurch Scientific®. Only DuPont makes Teflon®.

TEFLON FEP TUBING, 1/32" OD

		Color	Max. Pressure
1683	75µm (.003") ID x 5'	Natural	4,000 psi (276 bar)*
1684	100µm (.004") ID x 5'	Black	3,000 psi (207 bar)*
1685	125µm (.005") ID x 5'	Red	3,000 psi (207 bar)*
1686	150µm (.006") ID x 5'	Violet	3,000 psi (207 bar)*
1687	175µm (.007") ID x 5'	Yellow	3,000 psi (207 bar)*
1688	200µm (.008") ID x 5'	Natural	2,500 psi (172 bar)*
1689	230µm (.009") ID x 5'	Blue	2,500 psi (172 bar)*
1692	405µm (.016") ID x 5'	Natural	1,500 psi (104 bar)*

* Testing conducted with water at room temperature. Use of some chemicals and at higher temperatures may reduce the pressure limit. Please contact us for more information.

TEFLON FEP TUBING, 1/16" OD

		Color	Max. Pressure
1474	.004" (100µm) ID x 10'	Black	4,000 psi (276 bar)*
1474-20	.004" (100µm) ID x 20'	Black	4,000 psi (276 bar)*
1475	.005" (125µm) ID x 10'	Red	4,000 psi (276 bar)*
1475-20	.005" (125µm) ID x 20'	Red	4,000 psi (276 bar)*
1476	.006" (150µm) ID x 10'	Violet	4,000 psi (276 bar)*
1476-20	.006" (150µm) ID x 20'	Violet	4,000 psi (276 bar)*
1477	.007" (175µm) ID x 10'	Yellow	4,000 psi (276 bar)*
1477-20	.007" (175µm) ID x 20'	Yellow	4,000 psi (276 bar)*
1478	.008" (200µm) ID x 10'	Natural	4,000 psi (276 bar)*
1478-20	.008" (200µm) ID x 20'	Natural	4,000 psi (276 bar)*
1479	.009" (230µm) ID x 10'	Blue	4,000 psi (276 bar)*
1479-20	.009" (230µm) ID x 20'	Blue	4,000 psi (276 bar)*
1526	.010" (.25mm) ID x 10'	Natural	3,000 psi (207 bar)*
1526B	.010" (.25mm) ID x 10'	Blue	3,000 psi (207 bar)*
1527	.010" (.25mm) ID x 20'	Natural	3,000 psi (207 bar)*
1527B	.010" (.25mm) ID x 20'	Blue	3,000 psi (207 bar)*
1549	.020" (.50mm) ID x 10'	Natural	2,000 psi (138 bar)*
1549OR	.020" (.50mm) ID x 10'	Orange	2,000 psi (138 bar)*
1548	.020" (.50mm) ID x 20'	Natural	2,000 psi (138 bar)*
1548OR	.020" (.50mm) ID x 20'	Orange	2,000 psi (138 bar)*
1518	.020" (.50mm) ID x 10'	Black	2,000 psi (138 bar)*
1519	.020" (.50mm) ID x 20'	Black	2,000 psi (138 bar)*
1522	.030" (.75mm) ID x 10'	Natural	1,000 psi (69 bar)*
1522G	.030" (.75mm) ID x 10'	Green	1,000 psi (69 bar)*
1520	.030" (.75mm) ID x 20'	Natural	1,000 psi (69 bar)*
1520G	.030" (.75mm) ID x 20'	Green	1,000 psi (69 bar)*

TEFLON FEP TUBING, 1/8" OD

1523	.062" (1.55mm) ID x 10'	Natural	500 psi (34 bar)*
1521	.062" (1.55mm) ID x 20'	Natural	500 psi (34 bar)*
1521BL	.062" (1.55mm) ID x 50'	Blue	500 psi (34 bar)*
1521GL	.062" (1.55mm) ID x 50'	Green	500 psi (34 bar)*
1521ORL	.062" (1.55mm) ID x 50'	Orange	500 psi (34 bar)*
1521RL	.062" (1.55mm) ID x 50'	Red	500 psi (34 bar)*
1521YL	.062" (1.55mm) ID x 50'	Yellow	500 psi (34 bar)*

TEFLON FEP TUBING, 3/16" OD

1525	.125" (3.20mm) ID x 10'	Natural	500 psi (34 bar)*
1524	.125" (3.20mm) ID x 20'	Natural	500 psi (34 bar)*
1524L	.125" (3.20mm) ID x 50'	Natural	500 psi (34 bar)*
1524XL	.125" (3.20mm) ID x 100'	Natural	500 psi (34 bar)*

TEFLON FEP TUBING, 1/4" OD

1651	.156" (4.0mm) ID x 10'	Natural	250 psi (17 bar)*
1651L	.156" (4.0mm) ID x 50'	Natural	250 psi (17 bar)*
1651XL	.156" (4.0mm) ID x 100'	Natural	250 psi (17 bar)*
1650	.188" (4.80mm) ID x 10'	Natural	250 psi (17 bar)*
1650L	.188" (4.80mm) ID x 50'	Natural	250 psi (17 bar)*
1650XL	.188" (4.80mm) ID x 100'	Natural	250 psi (17 bar)*

TEFLON FEP TUBING, 5/16" OD

1652	.250" (6.35mm) ID x 10'	Natural	250 psi (17 bar)*
1652L	.250" (6.35mm) ID x 50'	Natural	250 psi (17 bar)*
1652XL	.250" (6.35mm) ID x 100'	Natural	250 psi (17 bar)*

TEFLON FEP TUBING, 1mm OD

1671	.5mm (.020") ID x 3m	Natural	500 psi (34 bar)*
1671L	.5mm (.020") ID x 15m	Natural	500 psi (34 bar)*
1671XL	.5mm (.020") ID x 30m	Natural	500 psi (34 bar)*

TEFLON FEP TUBING, 2mm OD

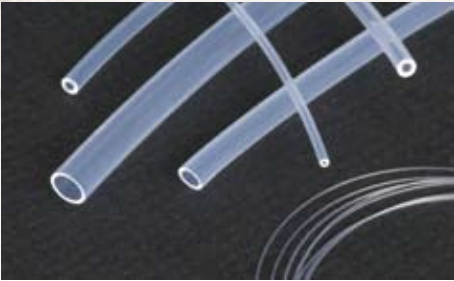
1673	1mm (.040") ID x 3m	Natural	500 psi (34 bar)*
1673L	1mm (.040") ID x 15m	Natural	500 psi (34 bar)*
1673XL	1mm (.040") ID x 30m	Natural	500 psi (34 bar)*

TEFLON FEP TUBING, 3mm OD

1675	1mm (.040") ID x 3m	Natural	500 psi (34 bar)*
1675L	1mm (.040") ID x 15m	Natural	500 psi (34 bar)*
1675XL	1mm (.040") ID x 30m	Natural	500 psi (34 bar)*
1677	2mm (.080") ID x 3m	Natural	500 psi (34 bar)*
1677L	2mm (.080") ID x 15m	Natural	500 psi (34 bar)*
1677XL	2mm (.080") ID x 30m	Natural	500 psi (34 bar)*

TEFLON FEP TUBING, 4mm OD

1679	3mm (.120") ID x 3m	Natural	500 psi (34 bar)*
1679L	3mm (.120") ID x 15m	Natural	500 psi (34 bar)*
1679XL	3mm (.120") ID x 30m	Natural	500 psi (34 bar)*



DuPont Teflon® Brand Resin PFA Tubing

- » 1/16” and 1/8” ODs Available
- » Excellent Solvent Resistance and Low Gas Permeability

Teflon PFA (perfluoroalkoxyalkane) tubing offers excellent solvent resistance (virtually identical to FEP and PTFE Teflon) while adding several advantages. These include smoother surface texture, higher continuous service temperature and superior polymer purity. The recommended maximum operating temperature for our Teflon PFA tubing is 80°C. The OD/ID tolerances of our 1/16” OD PFA tubing are ±.001” for both, while our 1/8” OD PFA tubing tolerances are ±.003” for both OD and ID.

DuPont Brand Resin High Purity Teflon® PFA Tubing

- » 1/16”, 1/8”, 3/16” and 1/4” ODs Available
- » PFA HP and PFA HP Plus Grades Available
- » Virtually Contaminant Free

PFA High Purity (HP) tubing offers all of the benefits of standard Teflon PFA tubing and more! This tubing is manufactured from a premium grade of PFA that is one of the most contaminant-free polymers available. Designed for chemical environments where purity in the parts-per-billion is needed, this tubing is perfect for fluid handling systems in the medical, diagnostics, pharmaceutical, biotechnology and semiconductor industries.

PFA HP Plus tubing is available in 1/16” and 1/8” OD sizes. This polymer grade has the same unsurpassed purity of Teflon PFA HP, with increased ability to withstand repeated flexing and improved resistance to stress cracking when exposed to aggressive fluorosurfactants. It also offers a more chemically-stable polymer chain end-capping functional group, minimizing interaction of this polymer with ionic species. Furthermore, tubing made from PFA HP Plus offers even smoother, clearer walls than the standard PFA HP.

The tolerances of our 1/16” OD PFA HP and PFA HP Plus are ±.001”, and ±.003” for the 1/8” OD tubing of both grades. Tolerances for 3/16” OD PFA HP tubing are ±.003” as well, with 1/4” OD PFA HP tubing tolerances at ±.004”. *Please Note: All tolerance values apply to both OD and ID.*

360µm OD TEFLON TUBING

Our capillary-sized tubing is manufactured from DuPont Teflon brand resin PFA HP Plus polymer. This tubing offers excellent chemical compatibility, transparency, very low contaminant levels and is available in the most commonly-used outer diameter for capillary tubing applications. Inner diameters range from 50µm to 150µm and tolerances are an incredible ±.0005” on both the ID and the OD.

To cut this tubing to the length you need, we highly recommend our A-350 Polymer Tubing Cutter (see page 77).

Connect this tubing using fittings on pages 28, 38 and 43, or the fittings on pages 32 – 33 for chip-based analyses. *Please Note: Once this tubing is held in place by connecting fittings, extra care must be taken not to stretch the tubing, as this will likely cause dimensional changes in both the OD and the ID of the tubing.*

For more information on this polymer, please refer to page 152. For PEEK™ 360µm OD tubing, see page 67.

TEFLON PFA TUBING, 1/16” OD				
		Color	Max. Pressure	
1500	.020” (.50mm) ID x 5’	Natural	2,000 psi	(138 bar)*
1511	.020” (.50mm) ID x 10’	Natural	2,000 psi	(138 bar)*
1512	.020” (.50mm) ID x 20’	Natural	2,000 psi	(138 bar)*
1512L	.020” (.50mm) ID x 50’	Natural	2,000 psi	(138 bar)*
1502	.030” (.75mm) ID x 5’	Natural	1,000 psi	(69 bar)*
1513	.030” (.75mm) ID x 10’	Natural	1,000 psi	(69 bar)*
1514	.030” (.75mm) ID x 20’	Natural	1,000 psi	(69 bar)*
1514L	.030” (.75mm) ID x 50’	Natural	1,000 psi	(69 bar)*
1503	.040” (1.00mm) ID x 5’	Natural	500 psi	(34 bar)*
1504	.040” (1.00mm) ID x 10’	Natural	500 psi	(34 bar)*
1507	.040” (1.00mm) ID x 20’	Natural	500 psi	(34 bar)*
1507L	.040” (1.00mm) ID x 50’	Natural	500 psi	(34 bar)*

TEFLON PFA TUBING, 1/8” OD				
1508	.062” (1.55mm) ID x 10’	Natural	500 psi	(34 bar)*
1509	.062” (1.55mm) ID x 20’	Natural	500 psi	(34 bar)*
1509L	.062” (1.55mm) ID x 50’	Natural	500 psi	(34 bar)*

TEFLON PFA HP TUBING, 1/16” OD				
		Color	Max. Pressure	
1620	.020” (.50mm) ID x 5’	Natural	2,000 psi	(138 bar)*
1621	.020” (.50mm) ID x 10’	Natural	2,000 psi	(138 bar)*
1622	.020” (.50mm) ID x 20’	Natural	2,000 psi	(138 bar)*
1622L	.020” (.50mm) ID x 50’	Natural	2,000 psi	(138 bar)*
1630	.030” (.75mm) ID x 5’	Natural	1,000 psi	(69 bar)*
1631	.030” (.75mm) ID x 10’	Natural	1,000 psi	(69 bar)*
1632	.030” (.75mm) ID x 20’	Natural	1,000 psi	(69 bar)*
1632L	.030” (.75mm) ID x 50’	Natural	1,000 psi	(69 bar)*

TEFLON PFA HP TUBING, 1/8” OD				
1640	.062” (1.55mm) ID x 10’	Natural	500 psi	(34 bar)*
1641	.062” (1.55mm) ID x 20’	Natural	500 psi	(34 bar)*
1641L	.062” (1.55mm) ID x 50’	Natural	500 psi	(34 bar)*

TEFLON PFA HP TUBING, 3/16” OD				
1642	.125” (3.20mm) ID x 10’	Natural	250 psi	(17 bar)*
1642L	.125” (3.20mm) ID x 50’	Natural	250 psi	(17 bar)*
1642XL	.125” (3.20mm) ID x 100’	Natural	250 psi	(17 bar)*

TEFLON PFA HP TUBING, 1/4” OD				
1645	.188” (4.80mm) ID x 10’	Natural	250 psi	(17 bar)*
1645L	.188” (4.80mm) ID x 50’	Natural	250 psi	(17 bar)*
1645XL	.188” (4.80mm) ID x 100’	Natural	250 psi	(17 bar)*

TEFLON PFA HP PLUS TUBING, 1/16” OD				
1900	.010” (.25mm) ID x 5’	Natural	3,000 psi	(207 bar)*
1901	.010” (.25mm) ID x 10’	Natural	3,000 psi	(207 bar)*
1902	.010” (.25mm) ID x 20’	Natural	3,000 psi	(207 bar)*
1902L	.010” (.25mm) ID x 50’	Natural	3,000 psi	(207 bar)*
1905	.020” (.50mm) ID x 5’	Natural	2,000 psi	(138 bar)*
1906	.020” (.50mm) ID x 10’	Natural	2,000 psi	(138 bar)*
1907	.020” (.50mm) ID x 20’	Natural	2,000 psi	(138 bar)*
1907L	.020” (.50mm) ID x 50’	Natural	2,000 psi	(138 bar)*
1910	.030” (.75mm) ID x 5’	Natural	1,000 psi	(69 bar)*
1911	.030” (.75mm) ID x 10’	Natural	1,000 psi	(69 bar)*
1912	.030” (.75mm) ID x 20’	Natural	1,000 psi	(69 bar)*
1912L	.030” (.75mm) ID x 50’	Natural	1,000 psi	(69 bar)*

TEFLON PFA HP PLUS TUBING, 1/8” OD				
1920	.062” (1.55mm) ID x 10’	Natural	500 psi	(34 bar)*
1921	.062” (1.55mm) ID x 20’	Natural	500 psi	(34 bar)*
1921L	.062” (1.55mm) ID x 50’	Natural	500 psi	(34 bar)*

TEFLON PFA HP PLUS TUBING, 360µm (.0145”) OD				
1930	50µm (.002”) ID x 5’	Natural	3,500 psi	(241 bar)*
1931	75µm (.003”) ID x 5’	Natural	3,000 psi	(207 bar)*
1932	100µm (.004”) ID x 5’	Natural	2,500 psi	(172 bar)*
1933	150µm (.006”) ID x 5’	Natural	1,750 psi	(121 bar)*

* Testing conducted with water at room temperature. Use of some chemicals and at higher temperatures may reduce the pressure limit. Please contact us for more information.

Differential Pressure Per 5-Foot Length:

Which ID is best for your application? Refer to flow rates (using water as the solvent) and tubing IDs below and the corresponding differential pressure per 5-foot length.

This theoretical data is presented in psi with the bar equivalent in parentheses, and was calculated using the formula presented to the right.

Flow Rate	Tubing ID						
	.0025”	.005”	.007”	.010”	.020”	.030”	.062”
0.1mL/min.	923 (64)	58 (4.0)	15 (1.0)	4 (0.3)	0 (0)	0 (0)	0 (0)
1.0mL/min	NR*	577 (40)	150 (10)	36 (2.5)	2 (0.1)	0 (0)	0 (0)
2.0mL/min	NR*	1,154 (80)	300 (21)	72 (5.0)	5 (0.3)	1 (0.1)	0 (0)
10.0mL/min	NR*	5,770 (398)	1,502 (103)	361 (25)	23 (1.6)	5 (0.3)	0 (0)
25.0mL/min	NR*	NR*	3,755 (259)	902 (62)	56 (3.9)	11 (0.8)	0 (0)

*Not Recommended - Exceeds the pressure rating of the tubing.

Refractive Index of Upchurch Scientific® Polymer Tubing:

	Refractive Index
DuPont Teflon® brand resin FEP	1.338
DuPont Teflon brand resin PFA	1.340
Tefzel®	1.400
Halar®	1.447
Ultem®	1.660
Radel® R	1.672
PEEK™	Opaque

Polymer Tubing Gas Permeability:

(Permeability is listed as cm³/100 in²•24 h•atm/mil @ 25°C)

Halar ECTFE polymer		Teflon PFA fluoropolymer	
Carbon Dioxide	330	Carbon Dioxide	2,260
Nitrogen	10	Nitrogen	291
Oxygen	25	Oxygen	881
PEEK polymer		Tefzel fluoropolymer	
Oxygen	14	Carbon Dioxide	250
Radel R polymer		Nitrogen	30
Carbon Dioxide	830	Oxygen	100
Nitrogen	36	Ultem PEI polymer	
Oxygen	195	Oxygen	37
Teflon FEP fluoropolymer			
Carbon Dioxide	1,670		
Hydrogen	2,200		
Nitrogen	323		
Oxygen	748		

Peristaltic Tygon® and PharMed® tubing are located in the Laboratory Pumps Chapter on pages 142 - 143.

Theoretical Pressure Drop Along a Length of Tubing:

$$\Delta P = \left(9.86 \times 10^8 \right) \left(\frac{F L V}{d^4} \right)$$

Where: ΔP = pressure drop in psi
F = flow rate in mL/min
L = tubing length in cm
V = viscosity in centipoise (cp)
d = tubing inside diameter in cm

(See table to the left for data calculated using this formula.)

Tubing Internal Diameters and Volumes:

Tubing Internal Diameter (d) in inches to Linear Volume (µL/inch):
12870.4 (d²)

Tubing Internal Diameter (d) in µm to Linear Volume (µL/cm):
7.85 x 10⁻⁴ (d²)

Internal Diameters				Linear Volumes	
Inches	Wire Gauge*	Millimeters	Microns	µL/in	µL/cm
0.0008	—	0.020	20	0.008	0.003
0.001	—	0.025	25	0.013	0.005
0.002	—	0.051	51	0.051	0.020
0.0025	—	0.064	64	0.081	0.032
0.003	—	0.076	76	0.116	0.046
0.004	36	0.102	102	0.206	0.081
0.005	35	0.127	127	0.322	0.127
0.006	—	0.152	152	0.463	0.182
0.007	34	0.178	178	0.631	0.248
0.008	33	0.203	203	0.824	0.324
0.009	32	0.229	229	1.042	0.410
0.010	31	0.254	254	1.287	0.507
0.012	30	0.305	305	1.853	0.730
0.014	28	0.356	356	2.523	0.993
0.015	—	0.381	381	2.896	1.140
0.018	26	0.457	457	4.170	1.642
0.020	25	0.508	508	5.148	2.027
0.028	22	0.711	711	10.090	3.973
0.030	—	0.762	762	11.583	4.560
0.032	21	0.813	813	13.179	5.189
0.040	—	1.016	1016	20.593	8.107
0.042	19	1.067	1067	22.703	8.938
0.046	—	1.168	1168	27.234	10.722
0.055	—	1.397	1397	38.933	15.328
0.062	—	1.575	1575	49.474	19.478
0.080	14	2.032	2032	82.370	32.429
0.093	—	2.362	2362	111.316	43.825
0.120	9	3.048	3048	185.333	72.966
0.125	—	3.175	3175	201.099	79.173

* Wire Gauge numbers are referencing Birmingham or Stub's Iron Wire Gauge values, which are commonly used by most stainless steel syringe manufacturers.

Application Note

Chromatography Applications For Teflon Tubing

Teflon tubing is well suited for all low pressure sections of standard liquid chromatography systems.

APPLICATION	APPLICABLE TUBING SIZE OD
HPLC helium sparging supply lines	1/8”
HPLC solvent delivery lines (prior to the pump)	1/8” and 3/16”
HPLC waste delivery tubing	1/16”
The entire low pressure LC solvent pathway	1/8” and 1/16”

STAINLESS STEEL TUBING

- » Precut 316 Stainless Steel*
- » The Cleanest, Best Finish Available
- » Color-Coded Banding for Easy Identification

Upchurch Scientific® provides seamless, precut stainless steel tubing to meet the exacting requirements of today's analyses. We machine cut and polish each end, deburr the inside and outside edges and passivate the tubing (please see the passivation information box on this page). Finally, we flush reagent-grade methanol through each piece.

Our thorough preparation and cleaning procedure guarantees tubing that is truly ready-to-use, with flat, burr-free ends and a clean finish. This care is important in achieving zero-dead-volume connections and good chromatographic results.

We offer a variety of precut lengths as well as longer lengths (5' and 25') of some sizes. Cutting the tubing disturbs and roughens the tubing's end surface, so we recommend using our precut tubing whenever possible. If you need to cut tubing to custom lengths, we suggest you then passivate the tubing. For a description of a cold passivation process, please contact Upchurch Scientific or visit our website at www.upchurch.com and search on "stainless steel tubing."

The tolerances of our .020" (510µm) OD tubing are ±.0005" for both OD and ID. Tolerances for our 1/32" OD tubing are +.002"/-.000" for the OD and +.000"/-.002" for the ID.** For 1/16" OD tubing, the tolerances are +.002"/-.000" for the OD and ±.001" for the ID. Our 1/8" OD tubing tolerances are ±.003 for both OD and ID.

Please refer to page 75 for our list of stainless steel tubing and to page 76 for our stainless steel tubing kits.

* Except our .020" OD Stainless Steel Tubing, which is manufactured from 304 series stainless steel.
** Except the .004" ID size, which has an ID tolerance of +.002"/-.000".



Stainless Steel Tubing Passivation:

Stainless steel is naturally self-passivating, forming an oxidation layer on newly created surfaces. Upchurch Scientific takes extra steps to ensure the chemical resistance of our stainless steel tubing by manually passivating before and after the tubing is cut into specified lengths (except in a few cases where size is prohibitive). In the precut stage, the internal wall is acid passivated and flushed. After the tubing is cut, deburred and polished, the length is completely submerged in an acid passivation bath and again flushed clean. The table below summarizes the manual passivation steps performed for each size of our stainless steel tubing:

Tubing	Precut Passivation	Postcut Passivation
.020" OD	All	All
1/32" OD	All	All
1/16" OD	All	All, ex. 25' lengths
1/8" OD	None	All, ex. 3 & 5m lengths

Application Note

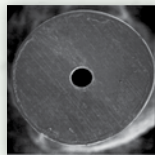
- » Our .020" OD tubing is the size of choice for the Rheodyne® Model 8125 Micro-Scale Injector Valve (page 85).
- » Our 1/32" OD tubing is designed for plumbing the Agilent® 1100 Capillary LC system.
- » Standard 1/16" and 1/8" OD stainless steel tubing is suited for most analytical applications.
- » PEEK polymer tubing is available in all of these sizes, listed on pages 66 – 67.

Miscellaneous Stainless Steel Tubing Specifications:

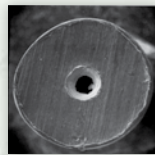
- » Maximum Recommended Operating Temperature: 750°F (399°C)
- » Rockwell Hardness (B): Maximum of 95
- » Meets ASTM A269 and A213



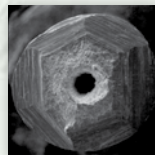
The Beauty of Precut Tubing:



Precut Tubing



Tubing cut by a commercially available tubing cutter



File Cut Tubing

STAINLESS STEEL*, .005" (125µm) ID X .020" (510µm) OD

Length	
U-119	5cm
U-120	10cm
U-121	20cm
U-122	30cm
U-123	50cm
U-124	1m**
U-125	5**

STAINLESS STEEL, .004" (100µm) ID X 1/32" (785µm) OD (Red Color Band)

U-1114	5cm
U-1115	10cm
U-1116	20cm
U-1117	30cm

STAINLESS STEEL, .006" (150µm) ID X 1/32" (785µm) OD (Yellow Color Band)

U-1120	5cm
U-1121	10cm
U-1122	20cm
U-1123	30cm

STAINLESS STEEL, .008" (200µm) ID X 1/32" (785µm) OD (Clear Color Band)

U-1125	5cm
U-1126	10cm
U-1127	20cm
U-1128	30cm

STAINLESS STEEL, .010" (.25mm) ID X 1/32" (785µm) OD (Blue Color Band)

U-1130	5cm
U-1131	10cm
U-1132	20cm
U-1133	30cm

STAINLESS STEEL, .015" (.40mm) ID X 1/32" (785µm) OD (Green Color Band)

U-1140	5cm
U-1141	10cm
U-1142	20cm
U-1143	30cm

STAINLESS STEEL, .018" (.45mm) ID X 1/32" (785µm) OD (Black Color Band)

U-1145	5cm
U-1146	10cm
U-1147	20cm
U-1148	30cm

STAINLESS STEEL, .005" (125µm) ID X 1/16" OD (Red Color Band)

	Length
U-152	5cm
U-153	10cm
U-154	20cm
U-155	30cm
U-156	0.5m
U-157	1m**
U-158	5**
U-160	25**

STAINLESS STEEL, .007" (175µm) ID X 1/16" OD (Black Color Band)

U-126	5cm
U-127	10cm
U-128	20cm
U-129	30cm
U-130	0.5m
U-131	1m**
U-108	5**
U-161	25**

STAINLESS STEEL, .010" (.25mm) ID X 1/16" OD (Blue Color Band)

U-111	5cm
U-112	10cm
U-113	20cm
U-114	30cm
U-132	0.5m
U-133	1m**
U-106	5**
U-162	25**

STAINLESS STEEL, .020" (.50mm) ID X 1/16" OD (Yellow Color Band)

U-101	5cm
U-102	10cm
U-103	20cm
U-104	30cm
U-134	0.5m
U-135	1m**
U-105	5**
U-163	25**

STAINLESS STEEL, .030" (.75mm) ID X 1/16" OD (White Color Band)

U-115	5cm
U-116	10cm
U-117	20cm
U-118	30cm
U-136	0.5m
U-137	1m**
U-107	5**
U-164	25**

STAINLESS STEEL, .040" (1.0mm) ID X 1/16" OD

U-138	5cm
U-139	10cm
U-140	20cm
U-141	30cm
U-142	0.5m
U-143	1m**
U-144	5**
U-165	25**

STAINLESS STEEL, .046" (1.15mm) ID X 1/16" OD

U-145	5cm
U-146	10cm
U-147	20cm
U-148	30cm
U-149	0.5m
U-150	1m**
U-151	5**

STAINLESS STEEL, .080" (2.0mm) ID X 1/8" OD

U-815	15cm
U-825	25cm
U-800	1m**
U-803	3m**
U-805	5m**

* Our .020" OD tubing is made of 304 series stainless steel. All other tubing on this page is made of 316 series stainless steel.
** All Stainless Steel tubing longer than 1m is coiled.



PRECUT STAINLESS STEEL TUBING KITS

Try Upchurch Scientific® precut Stainless Steel Tubing Kits, which contain some of the most popular 1/16" OD tubing sizes at a discount compared to purchasing the pieces individually. Each kit includes a handy storage container, great for keeping your tubing organized and close at hand.

Our 316 stainless steel tubing meets the highest quality standards in the industry. Each tubing piece features polished, burr-free ends and includes a color-coded band for easy ID identification. Please refer to pages 74 – 75 for more information on our stainless steel tubing.



FUSED SILICA TUBING CUTTERS

We offer a precision cutter for fused silica tubing – SGT's Shortix™ Cutter (FS-315). This cutter ensures clean, trouble-free cutting of fused silica tubing, providing better cuts than any other product on the market. It also includes a built-in magnifying glass to examine the cut tubing ends. Order the FS-315-02 Maintenance Kit, as needed, to replace a worn or damaged cutting wheel.

When using traditional fused silica tubing cutters, only a small part of the tubing wall is scratched, then the tubing is snapped in two, often resulting in a jagged, uneven cut. With a Shortix Cutter, a clean cut is made every time, regardless of skill or experience, as the cut is made by rotating a diamond blade around the entire circumference of the tubing.

We now also carry the Shortix Plus Cutter for fused silica tubing (FS-400). Built into the base of a genuine Swiss Army® knife, the Shortix Plus includes a Shortix fused silica tubing cutter with built-in magnifying glass, ferrule remover, septum hook and round file, plus standard Swiss Army knife features such as: a knife blade, screw drivers, multipurpose wrench, awl, scissors, tweezers, can opener, nail file and toothpick. This cutter also comes with a nylon belt loop carrying case.

Please Note: The FS-315 and FS-400 Fused Silica Tubing Cutters are designed to cut only tubing with ODs of 350µm – 780µm and IDs of 100µm – 350µm.



CAPILLARY POLYMER TUBING CUTTER

The Upchurch Scientific® A-350 Cutter is designed to cut capillary-sized polymer tubing. The cutter makes clean, perpendicular cuts without collapsing thin capillary walls. A set of ten tubing sleeves, required for cutting, are included with each cutter, along with five replacement blades. The included tubing sleeves are for cutting 360µm OD polymer capillary tubing. Alternative sleeves are available for cutting 510µm and 1/32" OD tubing. All tubing sleeves are 2" long and are made of DuPont brand Teflon® resin FEP.



POLYMER TUBING CUTTERS

» For 1/16", 1/8", 3/16", 1/4" and 5/16" OD tubing

A flat, 90°, burr-free cut is difficult to obtain with most commercial polymer tubing cutters. Upchurch Scientific has designed several tubing cutters specifically to cut polymer tubing. This line of tubing cutters includes a standard cutter for 1/16" and 1/8" OD tubing (A-327), and another for large bore tubing (A-329). Each has guide holes to ensure precise cutting. These cutters are durable, reliable and easy to operate. Five replacement blades are included with each cutter.



*Note **

» The A-350 Capillary Polymer Tubing Cutter can be used to cut tubing OD sizes other than 360µm, 510µm and 1/32". Simply use the proper NanoTight® Tubing Sleeve found on page 38. Please note, however, that these sleeves are shorter than those listed on this page, and therefore will last through fewer cuts.

» Our tubing cutters are material specific: the A-327, A-329 and A-350 should only be used to cut polymer tubing, where as the FS-315 and FS-400 should only be used to cut fused silica tubing.

Application Note

Stainless steel fittings are often used when making connections with stainless steel tubing. However, once these fittings have been swaged in place, the tubing and fittings combination should only be used in the ports in which they were originally swaged (see "Interchangeability" on page 154).

For added flexibility, try using our PEEK™ polymer tubing on pages 66 – 67, or our Fingertight fittings (with polymer ferrules) on pages 9 – 14 and 16.

1320 PRE-CUT STAINLESS STEEL TUBING KIT

1320	Stainless Steel Tubing Kit	
	Contains:	Qty.
U-101	.020" (.50mm) ID x 1/16" OD x 5cm	10
U-102	.020" (.50mm) ID x 1/16" OD x 10cm	10
U-103	.020" (.50mm) ID x 1/16" OD x 20cm	5
U-111	.010" (.25mm) ID x 1/16" OD x 5cm	10
U-112	.010" (.25mm) ID x 1/16" OD x 10cm	10
U-113	.010" (.25mm) ID x 1/16" OD x 20cm	5

PRE-CUT STAINLESS STEEL TUBING KITS

1321	(10) .010" ID x 1/16" OD 5cm & (10) .010" ID x 1/16" OD 10cm
1322	(10) .007" ID x 1/16" OD 5cm & (10) .007" ID x 1/16" OD 10cm
1323	(10) .005" ID x 1/16" OD 5cm & (10) .005" ID x 1/16" OD 10cm
1324	(10) .020" ID x 1/16" OD 5cm & (10) .020" ID x 1/16" OD 10cm

FUSED SILICA TUBING CUTTERS

FS-315	Shortix Precision Fused Silica Tubing Cutter
FS-315-02	Maintenance Kit for FS-315
FS-400	Shortix Plus Fused Silica Tubing Cutter
FS-400-02	Maintenance Kit for FS-400



✱ORDER✱ Tel: 800.426.0191 / 360.679.2528 · www.upchurch.com

CAPILLARY POLYMER TUBING CUTTER

A-350	Capillary Polymer Tubing Cutter* for 360µm – 1/32" OD tubing Includes (1) F-262x 10-pack of sleeves and (1) M-438-03 wrench	
A-328	Replacement Blades for A-350	5-pk
F-262x	Replacement Sleeves for A-350, .0155" ID, Green, for cutting 360µm OD tubing	10-pk
F-264x	Alternative Sleeves for A-350, .021" ID, Natural, for cutting 510µm OD tubing	10-pk
F-267Bx	Alternative Sleeves for A-350, .033" ID, Blue, for cutting 1/32" OD tubing	10-pk

POLYMER TUBING CUTTERS

A-327	Standard Polymer Tubing Cutter* for 1/16" and 1/8" OD tubing	
A-329	Large Bore Polymer Tubing Cutter* for 3/16" - 5/16" OD tubing	
A-328	Replacement Blades for A-327 and A-329	5-pk

* Includes (1) A-328 5-pack of replacement blades.