

TUBING	PEEK-LINED STAINLESS STEEL (PLS)	STAINLESS STEEL	PEEK	CAPILLARY PEEK	FUSED SILICA	PEEKsil™	SPIRAL-LINK™	RADEL®
Page	63	64	66	67	67	68	69	69
Description	<p>Biocompatible, chemically inert to most commonly-used solvents, PLS tubing offers a PEEK inner layer which serves as the fluid pathway, jacketed by stainless steel.</p> <ul style="list-style-type: none"> <li>Ideal for bio-inert UHPLC applications</li> <li>Can be bent into various shapes without affecting performance</li> </ul>	<p>Seamless, pre-cut 316 stainless steel tubing meets the exacting requirements of today's analyses. Thorough preparation guarantees that the tubing is truly ready-to-use, with flat-burr-free ends and a clean finish.</p> <ul style="list-style-type: none"> <li>Wide selection of outside and inside diameters and lengths</li> <li>Pre-cut to ensure burr-free, flat connections</li> <li>Many sizes feature a color-coded band for easy ID identification</li> </ul>	<p>Biocompatible, chemically inert to most commonly used solvents, PEEK tubing is flexible, offers a very smooth internal surface, and can be easily cut to desired lengths.</p> <ul style="list-style-type: none"> <li>Great alternative for stainless steel tubing in high pressure applications</li> <li>Many sizes available in color scheme to help identify ID</li> </ul>	<p>All the benefits of larger sized PEEK tubing, while serving as an excellent alternative to more traditional fused silica and stainless steel capillary tubing. Capillary PEEK tubing is available in a wide range of micro and nano-scale inner diameters.</p> <ul style="list-style-type: none"> <li>Available in common capillary tubing sizes with tight tolerances on OD and ID</li> <li>Tubing sleeves available for capillary tubing connections</li> </ul>	<p>Because of the tight tolerances of fused silica's inner diameters, this tubing is used for micro-scale analyses such as micro and nano-HPLC and capillary electrophoresis.</p> <ul style="list-style-type: none"> <li>Most commonly used OD and ID sizes available</li> <li>High quality, polyimide-clad fused silica</li> <li>Offered in convenient, two meter lengths</li> </ul>	<p>PEEKsil is mechanically strong and has ideal characteristics for sealing with metal or polymer fittings.</p> <ul style="list-style-type: none"> <li>Comprised of high quality fused silica sheathed by PEEK tubing</li> <li>Excellent chemical compatibility</li> <li>Very tight manufacturing tolerances</li> <li>Good replacement for stainless steel, PEEK, or standard fused silica</li> </ul>	<p>The PEEK Spiral Link coils expand and contract, allowing you to easily move your system components or even make equipment repairs whenever needed, without the hassle of breaking connections.</p> <ul style="list-style-type: none"> <li>Available in several specific volumes</li> <li>Includes two SealTight™ fittings</li> </ul>	<p>A mechanically strong and chemically resistant material, much like PEEK polymer, Radel is frequently used in medical applications where repeated autoclave sterilization is performed (tests show product stability after 1,000 cycles). Radel 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 as well.</p> <ul style="list-style-type: none"> <li>Withstands up to 12,500 psi (862 bar)</li> <li>Transparent and autoclavable</li> </ul>

Specifications								
OD (outside diameter)	1/16" (1.6 mm)	0.020" (510 µm), 1/32" (785 µm), 1/16" (1.55 mm), 1/8" (3.2 mm)	1/16" (1.55 mm), 0.071" (1.8 mm), 0.079" (2.0 mm), 1/8" (3.2 mm)	0.0145" (360 µm), 1/32" (785 µm), 0.020" (0.5 mm)	0.0145" (360 µm)	0.0145" (360 µm), 1/32" (785 µm), 1/16" (1.55 mm)	1/16" (1.55 mm)	1/16" (1.55 mm), 1/8" (3.2 mm)
ID (inside diameter)	0.001" (25 µm)–0.010" (254 µm)	0.004" (100 µm)–0.080" (2.0 mm)	0.001" (25 µm)–0.080" (2.0 mm)	0.001" (25 µm)–0.020" (0.50 mm)	0.0008" (20 µm)–0.006" (150 µm)	0.001" (25 µm)–0.012" (300 µm)	0.005" (125 µm)–0.030" (0.75 mm)	0.010" (0.25 mm)–0.062" (1.55 mm)
Operating Temp	-51 to 100 °C	-51 to 289 °C	-51 to 100 °C	-51 to 100 °C	-51 to 100 °C	-51 to 100 °C	-51 to 100 °C	-51 to 100 °C
Pressure Rating	17,400 psi (1,200 bar)	N/A*	500–10,000 psi (34–690 bar)	2,000–5,000 psi (138–345 bar)	N/A*	10,000 psi (690 bar)	7,000 psi (484 bar)	5,500–12,500 psi (379–862 bar)
Typical Tolerances	±5 to 15 µm	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing	±0.0005" (12.5 µm)	±0.0004" (10 µm)	±0.0004" (10 µm)	±0.001" (25 µm) for 1/16" OD tubing	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing
Refractive Index (Clarity)	Opaque	Opaque	Opaque	Opaque	1.78	Opaque	Opaque	1.672
pH Range	0–14	1–14	0–14	0–14	0–10	0–10	0–14	1–14
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Ethylene oxide; thermal	Ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Thermal, gamma irradiation
Autoclavable?	Y	Y	Y	Y	Y	Y	Y	Y

\*The manufacturer of this tubing or material does not publish this specification.

## 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)
•	360 µm	67, 68, 72
•	510 µm	65, 67
•	1/32"	65, 67, 68, 71
•	1/16"	63, 65, 66, 68, 69, 71, 72, 73, 77
•	1/8"	65, 66, 69, 71, 72, 73
•	3/16"	71, 72
•	1/4"	71, 72, 73

Size	Tubing OD	Page(s)
•	5/16"	71
•	1 mm	71
•	1.8 mm	66
•	2 mm	66, 71
•	3 mm	71
•	4 mm	71






TUBING	DuPONT® FEP	DuPONT PFA	DuPONT HIGH PURITY PFA	360 µm DuPONT HIGH PURITY PFA	ETFE
Page	71	72	72	72	73
<b>Description</b>	<p>FEP tubing is a great alternative to traditional PTFE tubing, desirable for use because it is chemically inert to most solvents, easy to cut, and translucent for easy monitoring of solutions passing through.</p> <ul style="list-style-type: none"> <li>Great for general, low pressure applications</li> <li>Many sizes available in multiple colors for easy identification</li> <li>Tight manufacturing tolerances to ensure product consistency</li> </ul>	<p>Offers excellent chemical compatibility, plus due to its inner surface smoothness, PFA tubing tends to be more translucent than PTFE tubing.</p> <ul style="list-style-type: none"> <li>Offers higher purity and enhanced translucence when compared with other fluoropolymer tubes</li> <li>Great for more critical, low pressure applications</li> </ul>	<p>This polymer tubing is manufactured from a premium grade of PFA — one of the most contaminant-free polymers on the market.</p> <ul style="list-style-type: none"> <li>Offers chemical stability, mechanical strength, and purity for applications such as medical, diagnostic, pharmaceutical, biotechnology, and semiconductor</li> <li>Excellent replacement for PTFE where gas permeability and surface texture are issues</li> <li>Clarity of tubing makes PFA an excellent choice for monitoring fluid movement</li> </ul>	<p>This tubing offers excellent chemical compatibility, transparency, very low contaminant levels and is available in the most commonly-used outside diameter for capillary tubing applications.</p> <ul style="list-style-type: none"> <li>Replacement for capillary tubing in low pressure applications where excellent chemical compatibility is required</li> <li>Tubing sleeves available for capillary tubing connections</li> </ul>	<p>ETFE is chemically inert and more suitable for higher pressure applications (when using aqueous mobile phases) than PTFE, FEP, and PFA. Additionally, because ETFE is more rigid than PTFE, FEP, and PFA, this tubing better resists inner diameter collapse.</p> <ul style="list-style-type: none"> <li>Excellent solvent resistance</li> <li>More durable and less gas permeable than PTFE, FEP, and PFA</li> <li>Operating temperatures up to 80 °C</li> </ul>
<b>Specifications</b>					
<b>OD (outside diameter)</b>	1/32" (785 µm), 0.040" (1.0 mm), 1/16" (1.55 mm), 0.080" (2.0 mm), 0.118" (3.0 mm), 1/8" (3.2 mm), 0.157" (4.0 mm), 3/16" (4.8 mm), 1/4" (6.35 mm), 5/16" (7.94 mm)	1/16" (1.55 mm), 1/8" (3.2 mm)	1/16" (1.55 mm), 1/8" (3.2 mm), 3/16" (4.8 mm), 1/4" (6.35 mm)	0.0145" (360 µm)	1/16" (1.6 mm), 1/8" (3.2 mm), 1/4" (6.35 mm)
<b>ID (inside diameter)</b>	0.003" (0.075 mm) – 0.250" (6.35 mm)	0.020" (0.50 mm)– 0.062" (1.55 mm)	0.020" (0.50 mm)– 0.188" (4.80 mm)	0.002" (50 µm)– 0.006" (150 µm)	0.010" (0.25 mm)– 0.188" (4.80 mm)
<b>Operating Temp</b>	-51 to 50 °C	-51 to 80 °C	-51 to 80 °C	-51 to 80 °C	-51 to 80 °C
<b>Pressure Rating</b>	2,500–4,000 psi (172–276 bar)	500–2,000 psi (34–138 bar)	250–2,000 psi (17–138 bar)	1,750–3,500 psi (121–241 bar)	250–4,000 psi (17–276 bar)
<b>Typical Tolerances</b>	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing	±0.001" (25 µm) for 1/16" OD tubing	±0.0005" (12.5 µm)	±0.001" (25 µm) for 1/16" OD tubing, ±0.003" (75 µm) for 1/8" OD tubing
<b>Refractive Index (Clarity)</b>	1.338	1.34	1.34	1.34	1.4
<b>pH Range</b>	0–14	0–14	0–14	0–14	0–14
<b>Sterilization Techniques</b>	Ethylene oxide; thermal	Ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Gamma irradiation; ethylene oxide; thermal	Ethylene oxide
<b>Autoclavable?</b>	Y	Y	Y	Y	Y

### 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)
•	360 µm	67, 68, 72
•	510 µm	65, 67
•	1/32"	65, 67, 68, 71
•	1/16"	63, 65, 66, 68, 69, 71, 72, 73, 77
•	1/8"	65, 66, 69, 71, 72, 73
•	3/16"	71, 72
•	1/4"	71, 72, 73

Size	Tubing OD	Page(s)
•	5/16"	71
•	1 mm	71
•	1.8 mm	66
•	2 mm	66, 71
•	3 mm	71
•	4 mm	71

	 <b>NEW!</b>	 <b>NEW!</b>			
<b>TUBING</b>	<b>TYGON® LMT-55</b>	<b>TYGON E-LFL</b>	<b>ISMARENE (PHARMED®)</b>	<b>TYGON 3350 SI</b>	<b>SILICONE PEROXIDE</b>
<b>Page</b>	<b>78</b>	<b>78</b>	<b>79</b>	<b>79</b>	<b>80</b>

<b>Description</b>	<p>The inexpensive all-round tubing for general laboratory applications.</p> <ul style="list-style-type: none"> <li>• Transparent</li> <li>• Resistant to almost all inorganic chemicals</li> <li>• Smooth polished inner wall</li> <li>• Low gas permeability</li> <li>• Non-aging and non-oxidizing</li> </ul>	<p>The tubing with the longest service-life of any clear Tygon tubing.</p> <ul style="list-style-type: none"> <li>• Transparent</li> <li>• Broad chemical resistance</li> <li>• Tasteless</li> <li>• Extremely low particulate spallation</li> <li>• Meets USP Class VI and FDA criteria</li> <li>• Non-aging</li> </ul>	<p>The ideal tubing for pharmaceutical and medical applications, and for foodstuffs.</p> <ul style="list-style-type: none"> <li>• Recommended for cell cultures and tissue</li> <li>• Ideal for production filtration, fermentation, and bioreactor process lines</li> <li>• Very long service-life</li> <li>• Non-toxic and non-hemolytic</li> <li>• Impermeable to normal light and UV-radiation</li> <li>• Appropriate for medical products and foodstuffs</li> <li>• Low particulate spallation</li> <li>• Can be autoclaved repeatedly</li> <li>• Withstands repeated CIP and SIP cleaning and sterilization</li> <li>• Meets USP class VI, FDA, and NSF criteria</li> </ul>	<p>The platinum-cured silicone tubing with an ultra-smooth inner surface for sanitary transfer of sensitive fluids.</p> <ul style="list-style-type: none"> <li>• Can be autoclaved with steam</li> <li>• Excellent biological compatibility</li> <li>• Ultra-smooth inner-bore reduces potential for particle entrapment</li> <li>• Lower level of protein binding</li> <li>• Entirely non-toxic, non-hemolytic and non-pyrogenic</li> <li>• Weather, ozone, sunlight, and radiation resistant</li> <li>• Resistant to fungus</li> <li>• Odorless</li> </ul>	<p>Silicone tubing blended with organic peroxide for biological applications.</p> <ul style="list-style-type: none"> <li>• Can be autoclaved with steam</li> <li>• Excellent biological compatibility</li> <li>• Greater physical compression capability</li> <li>• Not prone to mold</li> <li>• Non-toxic</li> <li>• Waterproof and resistant to ozone, radiation, and sunlight</li> <li>• Resistant to fungus</li> <li>• Odorless</li> </ul>
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<b>Specifications</b>					
<b>OD (outside diameter)</b>	0.16–0.88" (4.0–22.3 mm)	0.19–0.75" (4.8–19.1 mm)	0.16–1.3" (4.0–33.4 mm)	0.16–1.3" (4.0–33.4 mm)	0.16–1.3" (4.0–33.4 mm)
<b>ID (inside diameter)</b>	0.03–0.61" (0.8–15.9 mm)	0.06–0.5" (1.6–12.7 mm)	0.03–1" (0.8–25.4 mm)	0.03–1" (0.8–25.4 mm)	0.03–1" (0.8–25.4 mm)
<b>Operating Temp</b>	-50 to 74 °C	-50 to 74 °C	-60 to 135 °C	-60 to +200 °C	-51 to 238 °C
<b>Certification(s)</b>		FDA 21 CFR 175.300; US Pharmacopoeia Class VI	FDA 21 CFR 177.2600; US Pharmacopoeia Class VI, NSF listed (Standard 51)	FDA 21 CFR, 177.2600, Also exceeds 3A sanitary standards; US Pharmacopoeia XXIII Cl.VI;	FDA 21 CFR 177.2600; US Pharmacopoeia XXIII Cl.VI

<b>Chemical Resistance</b>					
<b>Acids</b>	Good	Fair	Good	Limited	Limited
<b>Alkaline Solutions</b>	Good	Fair	Good	Limited	Good
<b>Solvents</b>	Not Recommended	Not Recommended	Not Recommended	Limited	Not Recommended
<b>Pressure</b>	Fair	Good	Not Recommended	Not Recommended	Not Recommended
<b>Vacuum</b>	Good	Good	Excellent	Good	Good
<b>Viscous Media</b>	Excellent	Excellent	Good	Fair	Fair
<b>Sterile Media</b>	Limited	Limited	Excellent	Excellent	Excellent

<b>Gas Permeability (at 25 °C)*</b>					
<b>CO<sub>2</sub></b>	360	720	1200	25147	25147
<b>H<sub>2</sub></b>	—	—	—	—	—
<b>O<sub>2</sub></b>	80	160	200	4715	4715
<b>N<sub>2</sub></b>	40	80	80	2284	2284

\* Permeability Coefficient =  $\frac{\text{Amount of Gas (cm}^3\text{)} \times \text{tubing wall thickness (cm)}}{\text{Surface Area of tubing ID (cm}^2\text{)} \times \text{time (sec)} \times \text{pressure drop across tubing wall (cm Hg)}} \times 10^{-10}$



TUBING	TYGON 2001	TYGON MHLL	TYGON HC F-4040-A	NORPRENE® A-60-G	FLURAN® F-5500-A
Page	80	81	81	82	82

**Description**

The transparent, plasticizer-free tubing with superior pump-life. Especially designed for MEK and other aggressive solvents.

- Plasticizer and oil-free
- Smooth inner-bore
- Low sorption maintains fluid and tube integrity
- Does not impart anything into the pumping medium
- No release of hazardous materials when properly incinerated

Chemically resistant to Acetone, MEK and other aggressive solvents. Long life tubing.

- Plasticizer-free
- Smooth inner-bore
- Low sorption maintains fluid integrity
- Minimal adhesion and diffusion
- Suitable for MEK, Acetone and other corrosive solvents
- Long life tubing

The special tubing for hydrocarbons, petroleum products and distillates.

- Specially formulated to transport hydrocarbons, petroleum products and distillates
- Ideal for gasoline, kerosene, heating oils, cutting liquids and coolants based on glycols
- Low gas permeability

The high performance tubing for industrial use.

- Offers longest service-life with good flow consistency
- Good resistance to acids and alkaline chemicals
- Superior weathering
- Abrasion resistant
- Non-aging and non-oxidizing
- Outstanding flexural fatigue resistance
- Low gas permeability versus rubber tubing
- Ozone (300 ppm) and UV light resistant
- Ideal for use in vacuum system

The special tubing for concentrated acids and corrosive solvents.

- High chemical resistance
- Low gas permeability
- Wide temperature range

**Specifications**

<b>OD (outside diameter)</b>	0.19–0.88" (4.8–22.3 mm)	0.09–0.18" (2.22–4.63 mm)	0.19–0.75" (4.8–19.1 mm)	0.16–0.9" (4.0–22.3 mm)	0.16–0.6" (4.0–15.9 mm)
<b>ID (inside diameter)</b>	0.06–0.61" (1.6–15.9 mm)	0.01–0.1" (0.38–2.79 mm)	0.06–0.5" (1.6–12.7 mm)	0.03–0.6" (0.8–15.9 mm)	0.03–0.4" (0.8–9.5 mm)
<b>Operating Temp</b>	-73 to 57 °C	-70 to 74 °C	-37 to 74 °C	-60 to 135 °C	-32 to 204 °C
<b>Certification(s)</b>	FDA 21 CFR 177.2600; FDA Approved for contact with foods	FDA 21 CFR 177.2600; US Pharmacopoeia Class VI	None	None	GMP

**Chemical Resistance**

<b>Acids</b>	Excellent	Excellent	Limited	Excellent	Excellent
<b>Alkaline Solutions</b>	Excellent	Excellent	Not Recommended	Excellent	Excellent
<b>Solvents</b>	Good	Excellent	Not Recommended	Not Recommended	Limited
<b>Pressure</b>	Good	Not Recommended	Good	Not Recommended	Not Recommended
<b>Vacuum</b>	Good	Good	Good	Good	Good
<b>Viscous Media</b>	Excellent	Good	Excellent	Excellent	Good
<b>Sterile Media</b>	Good	Good	Limited	Not Recommended	Fair

**Permeability (at 25 °C)**

<b>CO<sub>2</sub></b>	1140	3800	100	1200	38
<b>H<sub>2</sub></b>	—	—	—	—	—
<b>O<sub>2</sub></b>	76	800	22	200	14
<b>N<sub>2</sub></b>	190	320	12	80	5