

# Ultrahigh-Purity (UHP) and High-Purity Stainless Steel Tubing

Fractional, Metric, and Imperial Sizes



- 316L stainless steel
- Ultrahigh-purity, coaxial, chemically cleaned and passivated, and thermocouple-cleaned tubing
- Ends prepared for orbital welding
- 1/8 to 2 in. and 6 to 18 mm sizes
- Marked to indicate size, material specifications, and heat code

## Material Standards

Fractional Sizes	Metric and Imperial Sizes
UNS S31603 ASTM A269 ASME SA213	UNS S31603 ASTM A269 ASME SA213 EN 1.4404 <sup>①</sup>

① W.-NR 1.4435 material available upon request.

## Chemical Composition

Element	All Sizes Composition wt. %
Chromium	16.0 to 18.0
Nickel	10.0 to 15.0
Molybdenum	2.00 to 3.00
Manganese	2.00 max
Silicon	0.75 max
Carbon	0.035 max <sup>①</sup>
Sulfur	0.005 to 0.012 (seamless); 0.005 to 0.017 (welded); 0.030 max (thermocouple-cleaned)

① Tubing sizes smaller than 1/2 in. / 12 mm outside diameter contain up to 0.040 wt. % carbon.

## Ultrahigh-Purity Tubing

Swagelok® stainless steel UHP tubing has an electropolished internal surface finish of 10 µin. / 0.25 µm  $R_a$  max and is cleaned and packaged in accordance with the specifications listed in the table at right.

Cleaning	Packaging	Individual Certificates	Process Designator
Rinsed with 0.1 µm-filtered, 18 MΩ-cm DI water heated to 60°C; purged with heated and filtered nitrogen	Ends are capped; tubes are individually double bagged, then bulk bagged in an ISO Class 4 clean room	Mill Test Reports Certificate of Conformance <sup>①</sup>	E2
		Mill Test Reports Surface Roughness Dimensional Tolerances	E3

Process specifications are available upon request. Contact your authorized Swagelok sales and service representative.

① Certificate of Conformance for surface roughness, dimensional tolerances, purity test for moisture and particulates, SEM pits, inclusions, or other raw material defects, XPS minimum chromium-to-iron and chromium oxide-to-iron oxide ratios, and DI water cleaning for effluent resistivity.

## Ordering Information, Dimensions, and Pressure Ratings

Select a basic ordering number and add a process designator from the table above. Example: 6L-T4-S-035-20-E2

### Fractional Sizes

Allowable working pressures are calculated from an S value of 20 000 psi (137.8 MPa) for ASTM A269 tubing at -20 to 100°F (-28 to 37°C), as listed in ASME B31.3 and ASME B31.1.

Tubing nominal length is 20 ft.

Tube OD in.	Tube Wall in.	Basic Ordering Number	Weight lb/ft	Working Pressure psig
<b>316L Seamless</b>				
1/4	0.035	6L-T4-S-035-20-	0.080	5100
3/8	0.035	6L-T6-S-035-20-	0.127	3300
1/2	0.049	6L-T8-S-049-20-	0.236	3700
3/4	0.065	6L-T12-S-065-20-	0.476	3300
1	0.065	6L-T16-S-065-20-	0.813	2400
<b>316L Welded</b>				
1 1/2	0.065	6L-T24-W-065-20-	0.996	1250
2	0.065	6L-T32-W-065-20-	1.34	950

### Fractional Coaxial Sizes

Process tube is 316L seamless. Containment tube is 316L welded.

Tubing nominal length is 20 ft.

Process Tube		Containment Tube		Ordering Number	Weight lb/ft
OD in.	Wall in.	OD in.	Wall in.		
1/4	0.035	1/2	0.049	6L-CXT4-S-035-20-	0.320
3/8	0.035	5/8	0.049	6L-CXT6-S-035-20-	0.490
1/2	0.049	3/4	0.065	6L-CXT8-S-049-20-	0.720
3/4	0.065	1	0.065	6L-CXT12-S-065-20-	1.29
1	0.065	1 1/4	0.065	6L-CXT16-S-065-20-	1.52

## Ultrahigh-Purity Tubing

### Ordering Information, Dimensions, and Pressure Ratings

#### Metric Sizes

Allowable working pressures are based on equations from ASME B31.3 and ASME B31.1 for EN ISO 1127 tubing (D4, T4 tolerance for 6 to 12 mm; D4, T3 tolerance 14 to 50 mm), using a stress value of 137.8 MPa (20 000 psi) and tensile strength of 516.4 MPa (74 900 psi).

Tubing nominal length is 6 m.

Tube OD mm	Tube Wall mm	Ordering Number	Weight kg/m	Working Pressure bar
<b>316L Seamless</b>				
6	1.0	6L-T6M-S-1.0M-6M-	0.125	420
8	1.0	6L-T8M-S-1.0M-6M-	0.175	310
10	1.0	6L-T10M-S-1.0M-6M-	0.225	240
12	1.0	6L-T12M-S-1.0M-6M-	0.275	200
18	1.5	6L-T18M-S-1.5M-6M-	0.619	200

#### Imperial Sizes

Allowable working pressures are calculated from an S value of 20 000 psi (137.8 MPa) for ASTM A269 tubing at –20 to 100°F (–28 to 37°C), as listed in ASME B31.3 and ASME B31.1.

Tubing nominal length is 6 m.

Tube OD in.	Tube Wall in.	Basic Ordering Number	Weight kg/m	Working Pressure psig
<b>316L Seamless</b>				
1/4	0.035	6L-T4-S-035-6M-	0.12	5100
3/8	0.035	6L-T6-S-035-6M-	0.19	3300
1/2	0.049	6L-T8-S-049-6M-	0.35	3700
3/4	0.065	6L-T12-S-065-6M-	0.71	3300
1	0.065	6L-T16-S-065-6M-	1.2	2400
<b>316L Welded</b>				
1 1/2	0.065	6L-T24-W-065-6M-	1.5	1250
2	0.065	6L-T32-W-065-6M-	2.0	950

#### Imperial Coaxial Sizes

Process tube is 316L seamless. Containment tube is 316L welded.

Tubing nominal length is 6 m.

Process Tube		Containment Tube		Ordering Number	Weight kg/m
OD in.	Wall in.	OD in.	Wall in.		
1/4	0.035	1/2	0.049	6L-CXT4-S-035-6M-	0.48
3/8	0.035	5/8	0.049	6L-CXT6-S-035-6M-	0.73
1/2	0.049	3/4	0.065	6L-CXT8-S-049-6M-	1.1
3/4	0.065	1	0.065	6L-CXT12-S-065-6M-	1.9
1	0.065	1 1/4	0.065	6L-CXT16-S-065-6M-	2.3

## Pressure Ratings at Elevated Temperatures

To determine elevated-temperature pressure ratings in accordance with B31.3 and B31.1, multiply the pressure ratings provided in the tables above by the factors in the table at right.

Temperature		Factor
°F	°C	
200	93	1.00
400	204	0.96
600	315	0.85
800	426	0.79
1000	537	0.76

#### Example:

Type 316L stainless steel 1/2 in. OD × 0.049 in. wall at 1000°F

- The allowable working pressure at –20 to 100°F (–28 to 37°C) is 3700 psig (**Fractional Sizes**, page 2).
- The elevated temperature factor for 1000°F (537°C) is 0.76:

$$3700 \text{ psig} \times 0.76 = 2812 \text{ psig}$$

The allowable working pressure for 316L SS 1/2 in. OD × 0.049 in. wall tubing at 1000°F (537°C) is 2812 psig.

## Chemically Cleaned and Passivated and Thermocouple-Cleaned Tubing

**Chemically cleaned and passivated** tubing complies with ASTM G93, Level A requirement for nonvolatile residue levels and also meets requirements of CGA G4.1.

**Thermocouple-cleaned** tubing meets the cleanliness requirements of ASTM A632-S3.

Tubing	Inside Diameter Surface Finish	Packaging	External Finish	Process Designator
Seamless, chemically cleaned and passivated	20 $\mu\text{in.}$ / 0.51 $\mu\text{m}$ $R_a$ max	Ends are protected with polyamide nylon film and polyethylene caps; tubes are individually packed in heat-sealed polyethylene bags	Satin	G20
	32 $\mu\text{in.}$ / 0.76 $\mu\text{m}$ $R_a$ max			G30
Seamless, thermocouple-cleaned	Standard finish (see ASTM A269)	Ends are polyethylene capped; tubes are bulk packaged in heat-sealed polyethylene bags		G

### Ordering Information, Dimensions, and Pressure Ratings

Select a basic ordering number and add a process designator from the table above. Example: 6L-T6M-S-1.0M-6M-**G20**

#### Fractional Sizes

Tubing nominal length is 20 ft.

Tube OD in.	Tube Wall in.	Basic Ordering Number	Weight lb/ft	Working Pressure psig
1/8	0.020	6L-T2-S-020-20-	0.022	6000
	0.028	6L-T2-S-028-20-G <sup>①</sup>	0.029	8500
1/4	0.035	6L-T4-S-035-20-	0.080	5100
3/8	0.035	6L-T6-S-035-20-	0.127	3300
1/2	0.049	6L-T8-S-049-20-	0.236	3700
	0.065	6L-T8-S-065-20-	0.302	5100
3/4	0.065	6L-T12-S-065-20-	0.476	3300
1	0.065	6L-T16-S-065-20-G20 <sup>②</sup>	0.649	2400

<sup>①</sup> Available thermocouple-cleaned only. Use ordering number shown.

<sup>②</sup> Available with G20 process only. Use ordering number shown.

#### Metric Sizes

Tubing nominal length is 6 m.

Tube OD mm	Tube Wall mm	Ordering Number	Weight kg/m	Working Pressure bar
6	1.0	6L-T6M-S-1.0M-6M-	0.125	420
8	1.0	6L-T8M-S-1.0M-6M-	0.175	310
10	1.0	6L-T10M-S-1.0M-6M-	0.225	240
12	1.0	6L-T12M-S-1.0M-6M-	0.275	200
18	1.5	6L-T18M-S-1.5M-6M-	0.619	200

#### Imperial Sizes

Tubing nominal length is 6 m.

Tube OD in.	Tube Wall in.	Basic Ordering Number	Weight lb/ft	Working Pressure psig
1/8	0.020	6L-T2-S-020-6M-	0.03	6000
	0.028	6L-T2-S-028-6M-G <sup>①</sup>	0.04	8500
1/4	0.035	6L-T4-S-035-6M-	0.12	5100
3/8	0.035	6L-T6-S-035-6M-	0.19	3300
1/2	0.049	6L-T8-S-049-6M-	0.35	3700
	0.065	6L-T8-S-065-6M-	0.45	5100
3/4	0.065	6L-T12-S-065-6M-	0.71	3300
1	0.065	6L-T16-S-065-6M-G20 <sup>②</sup>	0.97	2400

<sup>①</sup> Available thermocouple-cleaned only. Use ordering number shown.

<sup>②</sup> Available with G20 process only. Use ordering number shown.

### Standard Instrumentation Tubing

See the Swagelok *Stainless Steel Seamless Tubing—Fractional, Metric, and Imperial Sizes* catalog, MS-01-181, for ordering numbers and complete information on 316 / 316L and 304 / 304L standard instrumentation tubing.

## About this document

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### Safe Product Selection

**When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.**

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