

# TUBING & COILED TUBING



# Tubing Selection

Proper selection, handling, and installation of tubing, when combined with proper selection of FT-LOK® tube fittings, are essential for reliable tubing systems.

The following variables should be considered when ordering tubing for use with FT-LOK® tube fittings:

- Surface finish
- Material
- Hardness
- Wall thickness

## Tubing surface finish

Many ASTM specifications cover the above requirements, but they often are not very detailed on surface finish. For example, ASTM A450, a general tubing specification, it is specified as below:

### 12. Straightness and Finish

12.1 Finished tubes shall be reasonably straight and have smooth ends free of burrs. They shall have a workmanlike finish.

Surface imperfections (Note) may be removed by grinding, provided that a smooth curved surface is maintained, and the wall thickness is not decreased to less than that permitted by this or the product specification. The outside diameter at the point of grinding may be reduced by the amount so removed.

*Note: An imperfection is any discontinuity or irregularity found in the tube.*

## Material

Our suggested ordering instructions for each type of tubing are shown under the respective tables.

## Hardness

The key to selecting proper tubing for use with metal FT-LOK® tube fittings is that the tubing must be softer than the fitting material. FT-LOK® tube fittings are designed to work properly with the tubing that is suggested in the ordering instructions.

## Wall Thickness

The accompanying tables show working pressure of tubing in a wide range of wall thicknesses. Allowable working pressures are calculated from S values as specified by ASME B31.3, Process Piping. FT-LOK® tube fittings have been repeatedly tested in both the minimum and maximum wall thicknesses shown. FT-LOK® tube fittings are not recommended for tube wall thicknesses outside the ranges shown in the accompanying tables for each size.

## Tubing Handling

It is important to properly handle the tubing in order to reduce the scratches and protect the surface finish.

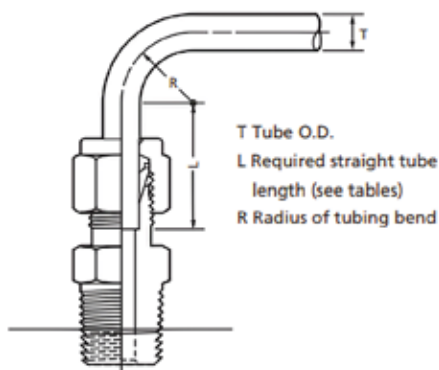
- Tubing should never be dragged out of a tubing rack or across a rough surface.
- Tube cutters or hacksaws should be sharp. Do not take deep cuts with each turn of the cutter or stroke of the saw.
- Remove burrs on the tube end which will be helpful for the tubing to go through the ferrules without damaging the ferrule sealing edge.

## Gas Service

Gasses (air, hydrogen, helium, nitrogen, etc.) have very small molecules that can escape through even the most minute leak path. Some surface defects on the tubing can provide such a leak path. As tube outside diameter (O.D.) increases, so does the likelihood of a scratch or other surface defect interfering with proper sealing. The most successful connection for gas service will occur if all installation instructions are carefully followed and the heavier wall thicknesses of tubing on the accompanying tables are selected.

A heavy-wall tube resists ferrule action more than a thin-wall tube, allowing the ferrules to coin out minor surface imperfections and grip the tube more firmly. Within the applicable suggested allowable working pressure table, select a tube wall thickness whose working pressure is outside of the shaded areas.

## Tubing Installation



Tubing properly selected and handled, combined with properly installed FT-LOK® tube fittings, will give you a leaktight system and provide reliable service in a wide variety of applications.

For maximum assurance of reliable performance, use:

- Properly selected and handled high-quality tubing such as provided by FT-LOK®.
- FT-LOK® tube fittings assembled in accordance with catalog instructions.

When installing fittings near tube bends, there must be sufficient straight length of tubing to allow the tube to be bottomed in the FT-LOK® fitting.

Fractional, in.	
T Tube O.D.	L <sup>Ⓢ</sup>
1/16	1/2
1/8	23/32
3/16	3/4
1/4	13/16
5/16	7/8
3/8	15/16
1/2	1 3/16
5/8	1 1/4
3/4	
7/8	1 5/16
1	1 1/2
1 1/4	2
1 1/2	2 13/32
2	3 1/4

Ⓢ Required straight tube length.

Metric, mm	
T Tube O.D.	L <sup>Ⓢ</sup>
3	19
6	21
8	23
10	25
12	31
14	32
15	
16	
18	34
20	
22	40
25	46
28	50
30	54
32	63
38	80
50	

# Suggested Allowable Working Pressure for Tubing

Figures and tables are for reference only. No implication is made that these values can be used for design work. Applicable codes and practices in industry should be considered. ASME Codes are the successor to and replacement of ASA Piping Codes.

- All pressures are calculated from equations in ASME B31.3, Process Piping. See factors for calculating working pressures in accordance with ASME B31.1, Power Piping.
- Calculations are based on maximum O.D. and minimum wall thickness, except as noted in individual tables. Example: 1/2 in. O.D.×0.035 in. wall thickness stainless steel tubing according to ASTM A269/213  
O.D. Tolerance  $\pm 0.005$  in. / Wall Thickness Tolerance  $\pm 10\%$  Calculations are based on 0.505 in.O.D.×0.0315 in. wall thickness tubing.
- No allowance is made for corrosion or erosion.

## Table 1 — Fractional Seamless Tubing

Allowable working pressures are calculated from an S value of 20 000 psig (137.8 MPa) for ASTM A269/213 tubing at -20 to 100°F (-28 to 37°C), as listed in ASME B31.3 and ASME B31.1.

## Table 2 — Metric Seamless Tubing

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

## Suggested Ordering Information

High-quality, fully annealed (Type 304/304L, 316/316L) stainless steel tubing, EN ISO 1127 or equivalent. Hardness not to exceed 90 HRB or 200 HV. Tubing to be free of scratches, suitable for bending and flaring. O.D. tolerances not to exceed  $\pm 0.076$  mm for 3 mm O.D. tubing. Note: Dual-certified grades such as 304/304L, 316/316L meet the minimum chemistry and the mechanical properties of both alloy grades.

## Table 1 — Stainless Steel Tubing (Fractional)

Nominal Diameter		Nominal Wall Thickness (in/mm)																	
		Tubing O.D.																	
Inch.	mm	WT (in)	0.01	0.012	0.014	0.016	0.02	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.188	
		WT (mm)	0.25	0.3	0.36	0.41	0.51	0.71	0.89	1.24	1.65	2.11	2.41	2.77	3.05	3.4	3.96	4.78	
		Cal./WT	31	30	28	27	25	22	20	18	16	14	13	12	11	10	9	3/16	
1/16"	1.59	WP (Psi)	5,600	6,800	8,100	9,400	12,000												
		Kg/Meter	0.008	0.009	0.010	0.011	0.013												
1/8"	3.18	WP (Psi)						8,500	10,900										
		Kg/Meter						0.042	0.049										
3/16"	4.77	WP (Psi)						5,400	7,000	10,200									
		Kg/Meter						0.070	0.083	0.106									
1/4"	6.35	WP (Psi)						4,000	5,100	7,500	10,200								
		Kg/Meter						0.096	0.118	0.154	0.188								
5/16"	7.95	WP (Psi)							4,000	5,800	8,000								
		Kg/Meter							0.152	0.201	0.252								
3/8"	9.53	WP (Psi)							3,300	4,800	6,500								
		Kg/Meter							0.186	0.249	0.314								
1/2"	12.7	WP (Psi)							2,600	3,700	5,100	6,700							
		Kg/Meter							0.254	0.345	0.442	0.541							
5/8"	15.88	WP (Psi)								2,900	4,000	5,200	6,000						
		Kg/Meter								0.441	0.568	0.703	0.788						
3/4"	19.05	WP (Psi)								2,400	3,300	4,200	4,900	5,800					
		Kg/Meter								0.537	0.696	0.865	0.973	1.093					
7/8"	22.23	WP (Psi)								2,000	2,800	3,600	4,200	4,800					
		Kg/Meter								0.632	0.823	1.027	1.159	1.306					
1"	25.4	WP (Psi)									2,400	3,100	3,600	4,200	4,700				
		Kg/Meter									0.950	1.190	1.345	1.519	1.652				
1-1/4"	31.75	WP (Psi)										2,400	2,800	3,300	3,600	4,100	4,900		
		Kg/Meter										1.352	1.531	1.732	1.886	2.077	2.365		
1-1/2"	38.1	WP (Psi)											2,300	2,700	3,000	3,400	4,000	4,900	
		Kg/Meter											2.088	2.372	2.590	2.864	3.280	3.859	
2"	50.8	WP (Psi)												2,000	2,200	2,500	2,900	3,600	
		Kg/Meter												3.224	3.529	3.911	4.500	5.329	

## Table 2 — Stainless Steel Tubing (Metric)

Nominal Diameter		Nominal Wall Thickness (mm/in)													
Tubing O.D.		WT (mm)	0.8	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.8	3.0	3.5	.0	4.5
mm	Inch.	WT (in)	0.031	0.039	0.047	0.059	0.071	0.079	0.087	0.098	0.110	0.118	0.138	0.157	0.177
3	0.118	WP (Psi)	9,717												
		Kg/Meter	0.043												
6	0.236	WP (Psi)	4,496	6,091	7,832	10,297									
		Kg/Meter	0.103	0.123	0.141	0.166									
8	0.315	WP (Psi)		4,496	5,656	7,541									
		Kg/Meter		0.173	0.201	0.240									
10	0.394	WP (Psi)		3,480	4,351	5,801	7,396	8,412							
		Kg/Meter		0.221	0.260	0.315	0.363	0.395							
12	0.472	WP (Psi)		2,900	3,625	4,786	5,946	6,816							
		Kg/Meter		0.271	0.320	0.388	0.453	0.493							
14	0.551	WP (Psi)		2,320	2,900	3,916	4,931	5,511	6,236	7,106					
		Kg/Meter		0.320	0.378	0.462	0.542	0.592	0.640	0.708					
15	0.591	WP (Psi)		2,174	2,755	3,625	4,496	5,221	5,801	6,526					
		Kg/Meter		0.345	0.408	0.500	0.587	0.642	0.695	0.770					
16	0.630	WP (Psi)			2,465	3,335	4,206	4,786	5,366	5,801					
		Kg/Meter			0.438	0.537	0.630	0.690	0.748	0.832					
18	0.709	WP (Psi)			2,175	2,900	3,770	4,206	4,641	5,366					
		Kg/Meter			0.497	0.610	0.718	0.790	0.857	0.955					
20	0.787	WP (Psi)			2,030	2,610	3,335	3,770	4,206	4,786	5,511				
		Kg/Meter			0.557	0.685	0.808	0.888	0.965	1.078	1.188				
22	0.866	WP (Psi)			2,030	2,320	2,900	3,335	3,770	4,351	4,931				
		Kg/Meter			0.615	0.758	0.897	0.987	1.150	1.202	1.325				
25	0.984	WP (Psi)					2,610	2,900	3,335	3,770	4,206	4,641			
		Kg/Meter					1.030	1.135	1.237	1.387	1.533	1.628			
28	1.102	WP (Psi)						2,610	2,900	3,335	3,770	4,061	4,786		
		Kg/Meter						1.282	1.400	1.572	1.740	1.850	2.115		
30	1.181	WP (Psi)						2,465	2,610	3,045	3,480	3,770	4,496		
		Kg/Meter						1.382	1.508	1.695	1.878	1.998	2.287		
32	1.260	WP (Psi)						2,320	2,465	2,900	3,190	3,480	4,206	4,786	
		Kg/Meter						1.480	1.617	1.818	2.017	2.145	2.460	2.762	
38	1.496	WP (Psi)							2,030	2,320	2,755	2,900	3,480	3,916	4,496
		Kg/Meter							1.942	2.188	2.430	2.590	2.978	2.353	3.718

### Table 3 — Stainless Steel Coiled Tubing (Fractional)

Nominal Diameter		Nominal Wall Thickness (in/mm)												
Tubing O.D.														
Inch.	mm	Coil Length (Ft)	WT (in)	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.188
			WT (mm)	0.71	0.89	1.24	1.65	2.11	2.41	2.77	3.05	3.4	3.96	4.78
			Cal./WT	22	20	18	16	14	13	12	11	10	9	3/16
1/4"	6.35	400	WP (Psi)	4,000	5,100	7,500	10,200							
			Kg/Coil	12.07	14.61	19.12	23.34							
		800	WP (Psi)	4,000	5,100	7,500	10,200							
			Kg/Coil	24.13	29.21	38.23	46.68							
		1200	WP (Psi)	4,000	5,100	7,500	10,200							
			Kg/Coil	36.2	43.82	57.35	70.02							
3/8"	9.53	400	WP (Psi)		3,300	4,800	6,500							
			Kg/Coil		23.11	31.02	39.14							
		800	WP (Psi)		3,300	4,800	6,500							
			Kg/Coil		46.22	62.05	78.27							
		1200	WP (Psi)		3,300	4,800	6,500							
			Kg/Coil		69.33	93.07	117.41							
1/2"	12.7	400	WP (Psi)		2,600	3,700	5,100	6,700						
			Kg/Coil		31.59	42.89	54.88	67.18						
		800	WP (Psi)		2,600	3,700	5,100	6,700						
			Kg/Coil		63.18	85.79	109.77	134.36						
		1200	WP (Psi)		2,600	3,700	5,100	6,700						
			Kg/Coil		94.77	128.68	164.65	201.54						

## Conversion Tables

Weight Conversion Table					
	Kilogram	Ton	Ounce	Pound	Slug
Kilogram	1	0.001	35.27	2.2	0.0685
Ton	1000	1	35274	2204.62	68.58
Ounce	0.028349	0.000028	1	0.0625	0.00194
Pound	0.45359	0.000454	16	1	0.03111
Slug	14.59	0.01459	514.82	32.136	1

Length Conversion Table					
	Meter	Kilometer	Inch	Foot	Mile
Meter	1	0.001	39.37	3.28084	0.000621
Kilometer	1000	1	39370.1	3280.84	0.62137
Inch	0.0254	0.0000254	1	0.08333	0.000015
Foot	0.3048	0.000348	12	1	0.000189
Mile	1609.34	1.609	63.346	5280	1

## Formulas

Linear weight formula for smooth end pipe	
<b>P</b>	$(D - e) * e * 0.02466$

Where:

<b>P</b>	Weight in Kg/m
<b>D</b>	Exterior Diameter in mm
<b>e</b>	Wall Thickness in mm

Hydrostatic Formula (Barlow's Formula)	
<b>P(Psi)</b>	$(2Se)/D$

Where:

<b>P</b>	Pressure in Psi
<b>D</b>	Exterior Diameter in inch
<b>e</b>	Wall Thickness in inch
<b>S</b>	Yield strength (Ys) in Psi

Hydrostatic Formula (Barlow's Formula)	
<b>P(MPa)</b>	$(2Se)/D$

Where:

<b>P</b>	Pressure in MPa
<b>D</b>	Exterior Diameter in mm
<b>e</b>	Wall Thickness in mm
<b>S</b>	Yield strength (Ys) in MPa

Conventional Terms	
<b>API</b>	American Petroleum Institute
<b>ANSI</b>	American National Standards Institute
<b>ASME</b>	American Society of Mechanical Engineers
<b>ASTM</b>	American Society of Testing Materials
<b>NACE</b>	National Association of Corrosion Engineers
<b>AWWA</b>	American Water Works Association
<b>SSAW</b>	Spiral / helical Seam Submerged Arc Welded pipe
<b>DSAW</b>	Double seam Submerged Arc Welded pipe
<b>LSAW</b>	Longitudinal seam Submerged Arc Welded pipe (one seam)
<b>ERW-HFI</b>	Electric Resistance Welded High Frequency Induced
<b>EFW</b>	Electric Fusion Welded Tube
<b>SRL</b>	Single Random Lengths: minimum average Lengths 17'6" - shortest length permissible is 9".
<b>DRL</b>	Double Random Lengths: minimum average Lengths 35" - shortest length permissible is 14".

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