



Exotic Material Tubing

Bulletin XXX-TS



ENGINEERING YOUR SUCCESS.

Tubing Data

Exotic Tubing Selection Guide

Parker's instrument tube fittings have been designed to work in a wide variety of applications that demand the utmost in product performance.

Although Parker's instrument tube fittings have been engineered and manufactured to consistently provide this level of reliability, no systems integrity is complete without considering the critical link, tubing.

This bulletin is intended to assist the designer to properly select and order quality tubing.

Proper tube selection and installation, we believe, are key ingredients in building leak-free reliable tubing systems.

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Tubing Selection

Proper selection, handling, and installation of tubing, when combined with proper selection of Parker Instrument fittings, are essential to reliable tubing systems.

The following variables should be considered when ordering tubing for use with Parker Instrument fittings:

- Surface finish
- Material
- Hardness
- Wall thickness.

Tubing Handling & Preparation

After tubing has been properly selected and ordered, careful handling is important.

From the receiving dock to point of installation, special attention is necessary to prevent scratching, burring and other injurious damage occurring to the tube.

This is especially important for gas service. Low-density gases such as helium and argon cannot be sealed with damaged tubing.

Make certain not to drag tubing across any surfaces such as truck beds, shelves, or storage racks, the floor and (or) ground of any plant / construction site. This is important for tubing of all materials. Besides scratching, improper handling can create out-of-round tubing.

Out-of-round tubing will not fit the I.D. of the ferrule(s) or the fitting body bore properly and will cause leakage.

Tube end preparation is also essential in assuring trouble-free systems. Some important points to consider are:

- Always Handling the Tubing carefully
- Cutting Tube End with either a tube cutter or hacksaw
- Deburring the tube end
- Cleaning the tube end

Tubing Ordering Suggestions

Tubing for use with Parker instrument fittings must be carefully ordered to ensure adequate quality for good performance. Each purchase order must specify the material nominal outside diameter, and wall thickness.

Ordering to ASTM specifications ensures that the tubing will be dimensionally, physically, and chemically within strict limits. Also, more stringent requirements may be added by the user. All tubing should be ordered free of scratches and suitable for bending and flaring.

Example:

A purchase order meeting the above criteria would read as follows:

"1/2 x 0.049 tubing in 316 stainless steel, seamless, as per ASTM A-269. Fully annealed, with hardness of 90 HRB or less. Must be suitable for bending and flaring; surface scratches, and imperfections are not permissible."

System Pressure

The system operating pressure is another important factor in determining the type, and more importantly, the size of tubing to be used. In general, high pressure installations require stronger materials. Heavy walled softer tubing such may be used if chemical compatibility exists with the media. However, the higher strength of materials such as Alloy 625 permits the use of thinner tubes without reducing the ultimate rating of the system. In any event, tube fitting assemblies should never be pressurized beyond the recommended working pressure.

The following tables (1-11) list by material, the maximum suggested working pressure of various tubing sizes in combination with Parker A-LOK®/CPI™ fittings. Acceptable tubing diameters and wall thicknesses are those for which a rating is listed. Combinations, which do not have a pressure rating, are currently not recommended for use with instrument fittings. For higher pressures, see **the Parker Medium-Pressure Fittings or Phastite Fittings Range**.

Allowable Pressure Working Tables Table 12 lists the de-rating factors which should be applied to the working pressures listed in Tables 1-11 for elevated temperature conditions. Simply locate the correct factor in Table 12 and multiply this by the appropriate value in Tables 1-11 for elevated temperature working pressure.

Suggested Allowable Working Pressure

The figures and tables included are for reference purposes only. Applicable codes and industry practices should be always considered when designing pressure systems.

- All working pressures have been calculated following the recommendations contained within ASME B31.3, Chemical Plant and Petroleum Refinery Piping Code, and ASME B31.1, Power Piping, and have been proven as accurate by extensive product testing. The calculation utilizes an allowable stress figure that incorporates a 4:1 factor of safety.
- All calculations are based on maximum outside diameter and minimum wall thickness.
- All working pressures are applicable at ambient (72°F or 22°C) temperature.

Table 12 Temperature Tubing Material							
Temperature		Tubing Material					
°F	°C	Stainless 316/316L *	Stainless 317/317L	Alloy 400	Alloy 625	6Mo	Super Duplex 2507
100	38	1	1	1	1	1	1
200	93	1	1	0.88	0.93	1	0.90
300	149	1	1	0.81	0.88	0.95	0.86
400	204	0.97	0.97	0.79	0.85	0.9	0.82
500	260	0.90	0.90	0.79	0.82	0.87	0.81
600	315	0.85	0.85	0.79	0.79	0.86	--
700	371	0.82	0.82	0.78	0.77	0.84	--
800	426	0.80	0.80	0.76	0.75	--	--
900	482	0.78	0.78	0.43	0.74	--	--
1000	537	0.77	0.77	--	0.73	--	--
1100	593	0.62	0.62	--	0.73	--	--
1200	649	0.37	0.37	--	0.72	--	--

* Dual-certified grades such as 316/316L, meet the minimum chemistry and the mechanical properties of both alloy grades.

Example:

Tubing Type 316 stainless steel seamless, 1/2 in. x 0.049 in. wall at 100 °F

- The allowable working pressure at room temperature (up to 100 °F) is 3700 psi (Refer to Table 1)
- The elevated temperature factor for 316 stainless steel is 0.77 at 1000 °F (Refer to Table 12)
- The allowable working pressure for 316 stainless steel tubing 1/2 in. x 0.049 in. wall at 1000 °F is then: 3700 psi x 0.77 = 2849 psi

Stainless Steel

Suggested Allowable Working Pressure Tables applied for A-LOK® Tube Fitting

Tube Specification: High Quality, Fully Annealed, Stainless Steel Tubing to ASTM A269 Grade 316/316L UNS S31600/S31603. Recommended Tube Hardness 80 HRB. Maximum Permissible Hardness 90 HRB.

Table 1		316/316L Stainless Steel														Imperial
Tube O.D. Size	Wall Thickness, inches															
	0.010	0.012	0.014	0.016	0.020	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.188
Working pressure (psi)																
1/16	5600	6900	8200	9500	12100	16800										
1/8						8600	10900									
3/16						5500	7000	10300								
1/4						4000	5100	7500	10300							
5/16							4100	5900	8100							
3/8							3300	4800	6600							
1/2							2600	3700	5100	6700						
5/8								3000	4000	5200	6100					
3/4								2400	3300	4300	5000	5800				
7/8								2100	2800	3600	4200	4900				
1									2400	3200	3700	4200	4700			
1 1/4										2500	2900	3300	3700	4100	4900	
1 1/2											2400	2700	3000	3400	4000	4500
2												2000	2200	2500	2900	3200

Table 2		316/316L Stainless Steel											Metric
Tube O.D. Size	Wall Thickness, mm												
	0.8	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.8	3.0	3.5	4.0	
Working pressure (bar)													
3	720												
6	330	430	520	680									
8		310	380	490									
10		240	300	380	470								
12		200	240	310	380	430							
14		180	220	280	340	390	430						
15		170	200	260	320	360	400						
16			190	240	300	330	370	430					
18			170	210	260	290	330	380					
20			150	190	230	260	290	330	380				
22			140	170	210	230	260	300	340				
25					180	200	230	260	300	320			
28						180	200	230	260	280	330		
30						170	180	210	240	260	310		
32						160	170	200	220	240	290	330	

- Not recommended for gas service
- Recommended for all services - standard assembly
- Recommended for all services - Use pre-assembly tool
- Recommended for all services - Use 'Hyferset' pre-assembly tool
- No data/Not recommended/No solution

Note: For 317/317L Stainless Steel, pls refer to the above Suggested Allowable Working Pressure Tables

Alloy 400

Suggested Allowable Working Pressure Tables applied for A-LOK® Tube Fitting

Tube Specification: High Quality, Fully Annealed, Alloy 400 Tubing to ASTM B165 Grade UNS N04400. Recommended Tube Hardness 70 HRB. Maximum Permissible Hardness 75 HRB.

Table 3		Alloy 400							Imperial
Tube O.D. Size	Wall Thickness, inches								
	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.12	
Working pressure (psi)									
1/8	8000	10400							
1/4	3700	4800	7000	9800					
5/16		3700	5400	7500					
3/8		3100	4400	6100					
1/2		2400	3500	4700	6200				
3/4			2200	3000	4000	4600	5400		
1				2200	2900	3400	3900	4300	

Table 4		Alloy 400							Metric
Tube O.D. Size	Wall Thickness, mm								
	0.8	1	1.2	1.5	2	2.5	2.8	3	
Working pressure (bar)									
3	670	890							
6	310	400	490	640					
8		290	350	460					
10		230	280	360					
12		190	230	290	400				
18			160	200	270				
20			140	180	240	310	350		
25				140	190	240	280	300	

- Not recommended for gas service
- Recommended for all services - standard assembly
- No data/Not recommended/No solution

Alloy 625

Suggested Allowable Working Pressure Tables applied for A-LOK® Tube Fitting

Tube Specification: High Quality, Fully Annealed, Alloy 625 Tubing to ASTM B444 Grade 2 UNS N06625. Recommended Tube Hardness 85 HRB. Maximum Permissible Hardness 93 HRB.

Table 5		Alloy 625			Imperial
Tube O.D. Size	Wall Thickness, inches			Working pressure (psi)	
	0.035	0.049	0.065		
1/4	6800				
3/8	4400	6400		8700	
1/2		5000		6800	
3/4				4400	

Table 6		Alloy 625				Metric
Tube O.D. Size	Wall Thickness, mm					Working pressure (bar)
	0.8	1	1.2	1.5	1.8	
6	440	570				
10	260	330	400	510	630	
12			330	420		

- Recommended for all services - standard assembly
- Recommended for all services - Use pre-assembly tool
- Recommended for all services - Use 'Hyferset' pre-assembly tool
- No data/Not recommended/No solution

Super Austenitic 6Mo

Conforming to the stringent material standard of NORSOK M650 and NORSOK M630.
NACE MR0175/MR0103 approvals.

Suggested Allowable Working Pressure Tables applied for A-LOK® Tube Fitting

Tube Specification: High Quality, Fully Annealed, Super Stainless Steel Tubing to ASTM A269/A213 Grade UNS S31254. Recommended Tube Hardness 80 HRB. Maximum Permissible Hardness 90 HRB.

Table 7		6Mo					Imperial	
Tube O.D. Size	Wall Thickness, inches							
	0.02	0.028	0.035	0.049	0.065	0.083	0.095	
Working pressure (psi)								
1/16								
1/8	7100	10500						
3/16		6700	8600					
1/4		4900	6300	10000	11000			
5/16			4900	7100				
3/8			4000	5800	8000			
1/2			3200	4600	6200			
5/8				3600	4900			
3/4				3000	4000	5200		
7/8				2500	3400	4400		
1					2900	3800	4400	

Table 8		6Mo						Metric	
Tube O.D. Size	Wall Thickness, mm								
	0.8	1	1.2	1.5	1.8	2	2.2	2.5	
Working pressure (bar)									
3	550								
6	410	520	680						
8		380	470						
10		300	370	470					
12		250	300	380	470				
14			270	340	420				
15			250	320	390				
16			230	300	360				
18			210	260	320	360			
20			180	230	290	320			
22				210	260	290	320		
25					220	250	280	320	

- Not recommended for gas service
- Recommended for all services - standard assembly
- Recommended for all services - Use pre-assembly tool
- Recommended for all services - Use 'Hyferset' pre-assembly tool
- No data/Not recommended/No solution

Super Austenitic 6Mo

Conforming to the stringent material standard of NORSOK M650 and NORSOK M630.
NACE MR0175/MR0103 approvals.

Suggested Allowable Working Pressure Table applied for 316 SS MPI™ Fitting

In today's demanding offshore environment, many customers require both higher tubing corrosion resistant materials along with higher operating pressures.

Parker's MPI™ double ferrule system provides a strong mechanical hold and improved resistance to vibration.

The following Pressure Chart lists 254SMO tube size and wall thickness combinations currently rated for use with Parker 316SS MPI™ fittings.

316 MPI™ Fittings on Annealed 254SMO Seamless Tubing

Table 9	6MO									Imperial
Tube O.D. Size	Wall Thickness, inches									
	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.188	
	Working pressure (psi)									
1/4	10200	13900								
3/8	6500	8900	11700	13600						
1/2		6900	9100	10600	12300					
5/8			7100	8200	9600	10700	12100			
3/4			5800	6700	7800	8700	9900	11700		
1				4900	5700	6300	7200	8500	10500	

Notes:

- Customer must verify acceptable corrosion resistance for the combination of 316 fittings with 254SMO tubing and the specific application (media and environment).
- Tubing per ASTM A269 and with mechanical properties of seamless pipe per ASTM A312 for UNS S31254 material is recommended.
- Reduced makeup (1-1/4 turns from finger tight) and/or reduced preset pressure (min 80% of standard but no ferrule gap - see table below) may be used to control tube swell/stick on thinner tube walls and/or softer tube material. Gauging is not effective with reduced makeup.

Small Preset Assembly Tube Sz	Min Preset Pressure (psi)	Large Preset Assembly Tube Sz	Min Preset Pressure (psi)
1/4	2600	5/8	3300
3/8	3200	3/4	4100
1/2	5400	1	6400

For more fitting installation information, please contact your authorized Parker sales and service representative.

Super Duplex Stainless Steel

Parker 2507 tubing meets or exceeds the requirements of ASTM A789, NORSOK M630/M650. Fully annealed and rapidly cooled Alloy 2507 super duplex tubing, According to NACE MR0175/MR0103. Hardness not to exceed 32 HRC. Tubing to be free of scratches, suitable for bending.

Suggested Allowable Working Pressure Table applied for Parker MPA Tubing Fitting

Parker 2507 tubing is specified to provide maximum performance from MPA robust connection tube fittings.

Table 10		Super Duplex Stainless Steel Per ASTM A789					Imperial
MPA Size	Tube O.D. Size	Wall Thickness, inches					
		0.035	0.049	0.065	0.083	0.095	
Working pressure (psi)							
4S	1/4	9950	14550				
6S	3/8	14550	9300	12750			
8S	1/2		7200	9900	13000		
12S	3/4			6400	8300	9600	

Notes:

- 2507 tube working pressure ratings are calculated to ASME B31.3, Chapter 2.
- Proof test may be performed at pressures up to 1.5 X Working Pressure.

Suggested Allowable Working Pressure Table applied for Parker MPI™ Tubing Fitting

Parker's 2507 tubing is manufactured to a specialized and tightly controlled set of design specifications that work together with MPI™ fittings as a complete system.

Table 11		Super Duplex Stainless Steel 2507								Imperial
Tube O.D. Size	Wall Thickness, inches									
	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156 ⁴	
Working pressure (psi)										
1/4	10600	15000								
3/8	6800	9900	13600 ⁴	15000 ⁴						
1/2		7200	9900	13000 ⁴	15000 ⁴					
5/8			7700	10100 ⁴	11800 ⁴	13700 ⁴	15000 ⁴			
3/4			6400	8300	9600 ⁴	11200 ⁴	12500 ⁴	14100 ⁴		
1				6100	7000	8200 ⁴	9100 ⁴	10200 ⁴	12100 ⁴	

Notes:

1. Customer should verify acceptable corrosion resistance for the combination of 316 fittings with 2507 tubing for their specific application (media and environment). Parker recommends matching fitting material to tube material.
2. Tubing per ASTM A789 or UNS S32750 material is recommended. Hardness not to exceed 32 HRC.
3. ASME B31.3 allowable stress of 38,700 psi for UNS 32750 (A789) and tube wall thickness tolerance of ±10% used to calculate pressure ratings. Please contact factory for assistance in calculating pressure ratings for different parameters.
4. Heavier wall 2507 (high lighted fields) may require additional preset pressure. Refer to Catalog 4234-MA page 80 for recommended 2507 tube preset pressures.
5. Size 10 MPI is only available for 2507 tube applications.
6. 2507 Super Duplex size 12 & 16 MPI Fittings shall be ordered with the -XF high strength Ferrule Option.

How to Order

The correct part number is easily derived from the following number sequence. The seven product characteristics required are coded as shown below.

N	TUBE	1/4	X	035	-316L	-CD
Norsok	Seamless Tubing	OD		Wall Thickness	Material	Process
N = Norsok blank = no Norsok		1/8 = 1/8" 1/4 = 1/4" 3/8 = 3/8" 1/2 = 1/2" 3/4 = 3/4" 1 = 1" 1 1/4 = 1 1/4" 1 1/2 = 1 1/2" 2 = 2" 6MM = 6 mm 8MM = 8 mm 10MM = 10 mm 12MM = 12 mm 15MM = 15 mm 18MM = 18 mm 20MM = 20 mm 25MM = 25 mm		028 = 0.028" 035 = 0.035" 049 = 0.049" 065 = 0.065" 083 = 0.083" 095 = 0.095" 109 = 0.109" 134 = 0.134" 156 = 0.156" 188 = 0.188" 1.0 = 1 mm 1.5 = 1.5 mm 2.0 = 2 mm 2.2 = 2.2 mm 2.5 = 2.5 mm 3.0 = 3 mm 3.5 = 3.5 mm	316L = 316/316L SSM02.5 = 316/316L Moly 2.5% 317L = 317/317L S31254 = 6MO S32750 = Super Duplex 400 = UNS N04400 625 = UNS N06625	CD = cold drawn CR = cold rolling

Example:

Tubing 1/2" X Wall Thickness 0.065", Material Super Duplex Straight tube 6 meters, with Norsok certification, cold drawn.
PN: NTUBE 1/2 X 065-S32750-CD

Notes:

Norsok is available for 6Mo and Super Duplex Stainless Steel

For more material/size ordering information , please contact your authorized Parker sales and service representative.

Asset Integrity Formula

The Right Tube +
The Right Fitting +
A Parker Trained Fitter =
A High Integrity Solution



A-LOK® is a twin-ferrule compression fitting that dominates low pressure applications, aided by the unique anti corrosion performance of its Suparcase® treated ferrule.



CPI™ delivers a single-ferrule version (Suparcase® treated) of the industry standard twin-ferrule fitting, reducing potential leak paths.



MPI™ brings the two ferrule (Suparcase® treated) compression assembly principle to medium pressures, for applications up to 15,000 psi (1,034 bar).



MPA keeps two ferrules version (Suparcase® treated) to medium pressures rated to 15,000 psi (1040 bar) Maximum, 2507 MPA Gaugeable Tube Fitting is easily identified by a groove and sold completely assembled and ready for immediate use.

SBEx - Safety Training

The course has been developed as an upgrade and replacement to our industry leading Safety at Work Programme, providing material that is relevant to your on site engineers.

Some of the advantages over our existing programme are:

- Greater knowledge of small bore tubing systems
- Increased product familiarity
- Increased skills and confidence in dealing with small bore systems

The benefits that your trained engineer will get, include:

- Increased understanding of their own systems and installation practices
- Improvements in the safety and integrity of their small bore tubing system
- Overall asset integrity improvement

This will be the only licensed and certified training course that can be run with our support

