# **Specify Parker Grade Tube**

In any instrumentation application, one of the first steps to ensuring safety and reliability is to select the right tubing for your process.

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.** 

Whilst it is the responsibility of the system designer/user to ensure the correct specification of materials and tube to ensure system integrity, this brochure is intended as a guide to assist the designer in properly selecting and ordering quality tubing and details the compatibility of selected tubing with Parker fittings. Proper tube selection and installation, we believe, are key ingredients in building leak-free reliable tubing systems.

The following parameters should be considered when designing a leak-free system and ordering tubing for use with Parker tube fittings:

- Tubing Hardness
- Tubing Wall Thickness
- Tubing Surface Finish
- Material Compatibility

**Tubing Hardness**: Remember Parker Instrumentation Tube Fittings are designed to work within specific hardness ranges. Fittings are designed so the differential hardness between tube and fitting are optimum for a reliable and trouble-free operation. For specific values of our alloy portfolio and to understand the compatibility of a selected tubing with our ALOK/CPI fittings, refer to the allowable pressure working tables (1-14), on pages 22-31. As a general rule, tubing must be suitable for bending and flaring.

**Tube Wall Thickness**: Proper wall thickness is necessary to accommodate accepted safety factors relative to desired working pressures.

Tube Surface Finish: As best practice, it is fundamental to control the tubing finish and straightness.

Always select tubing free of visible draw marks or surface scratches. If possible, cut off any undesirable sections. These 'deep' scratches can cause leaks when attempting to seal low-density gases such as argon, nitrogen, or helium. In addition, tubing shall be reasonably straight and ends must be smooth and free of burrs or any other imperfections.

\* For materials not covered in this brochure, please contact us directly.





Picture of a low cost product. Corrosion damage created by a low quality hardening process applied to the back ferrule

## **Tube Part Numbers**

Listed below are some of our popular tubing requirements, we also can supply Super Duplex, 625, 825 and Titanium tube

Description	Unit of Measure	Material	Parker IPDE Part	Description	Unit of Measure	Material	Parker IPDE Part
1/4" OD x .028"	MT	316/316L	TUBE-316-1/4 OD X .028	6mm 0D x 1.0	MT	316/316L	TUBE-316-6MMOD X 1.0
1/4" OD x .035"	MT	316/316L	TUBE-316-1/4 OD X .035	6mm 0D x 1.5	MT	316/316L	TUBE-316-6MMOD X 1.5
1/4" OD x .049"	MT	316/316L	TUBE-316-1/4 OD X .049	8mm 0D x 1.0	MT	316/316L	TUBE-316-8MMOD X 1.0
1/4" OD x .065"	MT	316/316L	TUBE-316-1/4 OD X .065	8mm 0D x 1.5	MT	316/316L	TUBE-316-8MMOD X 1.5
5/16" OD x 0.035"	MT	316/316L	TUBE-316-5/16 OD X .035	10mm 0D x 1.0	MT	316/316L	TUBE-316-10MM0D X 1.0
5/16" OD x 0.049"	MT	316/316L	TUBE-316-5/16 OD X .049	10mm 0D x 1.5	MT	316/316L	TUBE-316-10MM0D X 1.5
5/16" OD x 0.065	MT	316/316L	TUBE-316-5/16 OD X .065	10mm 0D x 2.0	MT	316/316L	TUBE-316-10MM0D X 2.0
3/8" OD x .028"	MT	316/316L	TUBE-316-3/8 OD X .028	12mm 0D x 1.0	MT	316/316L	TUBE-316-12MMOD X 1.0
3/8" OD x .035"	MT	316/316L	TUBE-316-3/8 OD X .035	12mm 0D x 1.5	MT	316/316L	TUBE-316-12MMOD X 1.5
3/8" OD x .049"	MT	316/316L	TUBE-316-3/8 OD X .049	12mm 0D x 2.0	MT	316/316L	TUBE-316-12MMOD X 2.0
3/8" OD x .065"	MT	316/316L	TUBE-316-3/8 OD X .065	16mm 0D x 1.0	MT	316/316L	TUBE-316-16MM0D X 1.0
1/2" OD x .035"	MT	316/316L	TUBE-316-1/2 OD X .035	16mm 0D x 1.5	MT	316/316L	TUBE-316-16MM0D X 1.5
1/2" OD x .049"	MT	316/316L	TUBE-316-1/2 OD X .049	16mm 0D x 2.0	MT	316/316L	TUBE-316-16MM0D X 2.0
1/2" OD x .065"	MT	316/316L	TUBE-316-1/2 OD X .065	18mm OD x 1.0	MT	316/316L	TUBE-316-18MMOD X 1.0
1/2" OD x .083"	MT	316/316L	TUBE-316-1/2 OD X .083	18mm OD x 1.5	MT	316/316L	TUBE-316-18MMOD X 1.5
5/8" OD x 0.035"	MT	316/316L	TUBE-316-5/8 OD X .035	18mm 0D x 2.0	MT	316/316L	TUBE-316-18MM0D X 2.0
5/8" OD x .049"	MT	316/316L	TUBE-316-5/8 OD X .049	20mm 0D x 2.0	MT	316/316L	TUBE-316-20MM0D X 2.0
5/8" OD x .065"	MT	316/316L	TUBE-316-5/8 OD X .065	22mm 0D x 2.0	MT	316/316L	TUBE-316-22MM0D X 2.0
5/8" OD x .083	MT	316/316L	TUBE-316-5/8 OD X .083	25mm 0D x 2.0	MT	316/316L	TUBE-316-25MM0D X 2.0
5/8" OD x 0.095	MT	316/316L	TUBE-316-5/8 OD X .095	25mm OD x 2.5	MT	316/316L	TUBE-316-25MMOD X 2.5
5/8" OD x 0.120	MT	316/316L	TUBE-316-5/8 OD X .120	1/4" OD x 0.36"	MT	6Mo	TUBE-6MO-1/4 OD X 0.036
3/4" OD x 0.035	MT	316/316L	TUBE-316-3/4 OD X .035	1/2" OD x 0.49"	MT	6Mo	TUBE-6MO-1/2 OD X 0.049
3/4" OD x .049"	MT	316/316L	TUBE-316-3/4 OD X .049	1/2" OD x 0.65"	MT	6Mo	TUBE-6MO-1/2 OD X .065
3/4" OD x .065"	MT	316/316L	TUBE-316-3/4 OD X .065	3/8" OD x 0.49"	MT	6Mo	TUBE-6MO-3/8 OD X 0.049
3/4" OD x 0.083"	MT	316/316L	TUBE-316-3/4 OD X .083	3/8" OD x 0.65"	MT	6Mo	TUBE-6MO-3/8 OD X .065
3/4" OD x 0.095"	MT	316/316L	TUBE-316-3/4 OD X .095	1" OD x .125"	MT	6Mo	TUBE-6MO-1 OD X .125
3/4" OD x 0.109"	MT	316/316L	TUBE-316-3/4 OD X .109	6mm 0D x 1.0	MT	6Mo	TUBE-6MO-6MMOD X 1.0
3/4" OD x 0.120"	MT	316/316L	TUBE-316-3/4 OD X .120	8mm 0D x 1.0	MT	6Mo	TUBE-6MO-8MMOD X 1.0
7/8" OD x 0.049"	MT	316/316L	TUBE-316-7/8"0D X .049"	10mm 0D x 1.0	MT	6Mo	TUBE-6MO-10MMOD X 1.0
7/8" OD x 0.065"	MT	316/316L	TUBE-316-7/8"0D X .065"	10mm 0D x 1.5	MT	6Mo	TUBE-6MO-10MMOD X 1.5
7/8" OD x 0.083"	MT	316/316L	TUBE-316-7/8"0D X .083"	12mm 0D x 1.5	MT	6Mo	TUBE-6MO-12MMOD X 1.5
7/8" OD x 0.109"	MT	316/316L	TUBE-316-7/8"0D X .109"	20mm 0D x 2.0	MT	6Mo	TUBE-6MO-20MMOD X 2.0
1" OD x 0.035"	MT	316/316L	TUBE-316-1 OD X .035	25mm 0D x 2.0	MT	6Mo	TUBE-6M0-25MM0D X 2.0
1" OD x 0.049"	MT	316/316L	TUBE-316-1 OD X .049	1/4" OD x 0.65"	MT	Monel 400	TUBE-M400-1/4 X .065
1" OD x 0.065	MT	316/316L	TUBE-316-1 OD X .065	1/2" OD x 0.48"	MT	Monel 400	TUBE-M400-1/2 OD X .048
1" OD x .083"	MT	316/316L	TUBE-316-1 OD X .083	1/2" OD x 0.83	MT	Monel 400	TUBE-M400-1/2 OD X .083
1" OD X 0.095"	MT	316/316L	TUBE-316-1 OD X .095	12mm x 1.5	MT	Monel 400	TUBE-M400-12MM X 1.5
1" OD X 0.109"	MT	316/316L	TUBE-316-1 OD X .109	*Note: Non Std sizes	s are on an	inquiry by inq	uiry basis

# Training

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

IPDE is pleased to announce the arrival and running of its new Small Bore Expert (SBEx) courses.

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

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 nominated trainer can pass on to your engineers are:

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

What does the Trainer get?

- 5 days of training, including:
- A comprehensive kit including:
- Spanners
- Tube benders
- Tube cutter
- De-burrer
- Vice grips
- Fittings samples
- Promotional clothing
- License fee

This will be the only licensed and certified training course that we will allow to be run with our support. What else do you get?

Access to the only certified IPDE training course

Each individual fittings package incorporates summarized installation instructions which are adequate for most circumstances. However, it is strongly recommended that attention is given to the contents of the Parker Instrument Tube Fitting Installation Mini A-lok book and attendance to the Parker Certified Installer SBEx 'Small Bore Expert' Training is also highly beneficial and would be further recommended.









## **Our Materials Statement**

Our primary philosophy is to build reliable, efficient, cost-effective equipment for the intended service. We always strive for the best quality in the designs we produce, the materials we select and manufacturing processes we apply. All our materials come from the most prestigious mills in Europe and North America, and are fully traceable to the source of origin and mercury and radioactive free. We want to add value to every component we create and make all the applications we serve smarter, faster, cleaner and safer.

Due to their versatility, reliability and excellent corrosion resistance, the set of alloys and equipment that we offer usually meet all the demands in markets, including the oil and gas, chemical and petrochemical processing, pollution control, marine engineering, power generation, or pulp and paper among others.

However, the unique requirements of some of the projects often demand special approaches. Parker Instrumentation understand those needs and has the technical knowledge and experience to help our customers to find the better solutions for their applications and meet even the most challenging demands.



**Together, we can** create innovative solutions that ensure your success



## **Gas Service**

Special care must be taken when selecting tubing for gas service. In order to achieve a gas-tight seal, ferrules in instrument fittings must seal any surface imperfections.

This is accomplished by the ferrules penetrating the surface of the tubing. Penetration can only be achieved if the tubing provides radial resistance and if the tubing material is softer than the ferrules.

Thick walled tubing helps to provide resistance. Tables 1-14 (stainless to titanium pressure charts on pages 22 to 31) indicate the minimum acceptable wall thickness for various materials in gas service.

The ratings coloured in dark blue

indicate combinations of diameter and wall thickness which are not suitable for gas service.

Acceptable tubing hardness for general applications is listed in Tables 1-14. For most services, particularly in larger diameters and thicknesses, better results can be obtained by using tubing well below this maximum hardness.

For example, a desirable hardness of 80 HRB is suitable for stainless steel. The maximum allowed is 90 HRB.



### **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 80 HRB or less. Must be suitable for bending and flaring; surface scratches, and imperfections are not permissible."

## Allowable Pressure Working Tables

#### 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 (1-14) list by material, the maximum suggested working pressure of various tubing sizes in combination with Parker A-LOK®/CPI<sup>™</sup> 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**.

Table 15 lists the de-rating factors which should be applied to the working pressures listed in Tables 1-14 for elevated temperature conditions. Simply locate the correct factor in Table 15 and multiply this by the appropriate value in Tables 1-14 for elevated temperature working pressure.

Table 15 Elevated Temperature Rating Factors								
Temperature Tubing Material								
۴F	°C	Stainless 316/316L*	6Mo	Alloy 400	Alloy 625	Alloy 825	Alloy C276	Titanium Gr. 2
100	38	1	1	1	1	1	1	1
200	93	1	1	0.88	0.93	0.92	0.91	0.87
300	149	1	0.95	0.81	0.88	0.87	0.84	0.72
400	204	0.97	0.9	0.79	0.85	0.83	0.78	0.62
500	260	0.9	0.87	0.79	0.82	0.79	0.73	0.53
600	315	0.85	0.86	0.79	0.79	0.76	0.69	0.45
700	371	0.82	0.84	0.78	0.77	0.74	0.65	
800	426	0.8		0.76	0.75	0.73	0.63	
900	482	0.78		0.43	0.74		0.61	
1000	537	0.77			0.73		0.6	
1100	593	0.62			0.73			
1200	649	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 2800 psi (Refer to Table 1)
- The elevated temperature factor for 316 stainless steel is 0.77 at 1000 °F (Refer to Table 15)
- The allowable working pressure for 316 stainless steel tubing ½ in. x 0.049 in. wall at 1000 °F is then: 2800 psi x 0.77 = 2156 psi

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 utilises 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.

#### NB.

All Parker A-LOK®/CPI<sup>TM</sup> tube fittings are designed such that successful assembly is achieved under most circumstances with 1 ¼ turns of the nut being applied from finger tight. For high pressure gaseous services or other critically severe service, consideration should be given to the utilization of a high pressure make up being 1 ½ turns of the nut from finger tight.

Certain combinations of tube and fitting may also benefit from other techniques to aid assembly such as utilization of a pre setting tool. Guidelines are given within the following tables and again we recommend attention to the Parker Instrument Tube Fitting Installation Manual and to the SBEX 'Small Bore Expert' training. See page 15 for further details

## **Pipe Pressure Ratings**

NPT / BSPT Pipe Size	BRASS					
	Male		Female			
	Straight <sup>a</sup>	Shape⁵	Straight <sup>a</sup>	Shape⁵		
1/16	6000	5500	4500	3800		
1/8	5600	5000	4000	2900		
1/4	4100	4100	4300	3000		
3/8	4000	4000	3500	2700		
1/2	3900	3100	3600	2500		
3/4	3800	3400	3000	2000		
1	2700	2700	3100	2300		
1-1/4	2000	2000	2300	1900		
1-1/2	1800	1800	2100	1700		
2	1600	1600	2000	1500		

NPT / BSPT Pipe Size	CARBON STEEL					
	Male		Female			
	Straight <sup>a</sup>	Shape⁵	Straight <sup>a</sup>	Shape⁵		
1/16	10500	10100	8000	7500		
1/8	9700	9700	6800	5900		
1/4	8000	8000	7000	6000		
3/8	7600	7600	5600	5300		
1/2	7000	6200	5500	4800		
3/4	6800	6800	4600	3700		
1	4900	4900	4800	4200		
1-1/4	3700	3700	3700	3300		
1-1/2	3100	3100	3400	2600		
2	2800	2800	2800	2400		

NPT / BSPT Pipe Size	STAINLESS STEEL					
	Male		Female			
	Straight <sup>a</sup>	Shape⁵	Straight <sup>a</sup>	Shape <sup>b</sup>		
1/16	10000	9500	7500	7000		
1/8	9100	9100	6400	5500		
1/4	7500	7500	6600	5600		
3/8	7200	7200	5300	5000		
1/2	6600	5800	5200	4500		
3/4	6400	6400	4300	3500		
1	4600	4600	4500	3900		
1-1/4	3500	3500	3500	3100		
1-1/2	2900	2900	3200	2500		
2	2600	2600	2700	2300		

#### Notes:

- a. Fittings manufactured from bar stock.
- b. Fittings manufactured from forgings.
- c. Material of construction in accordance with Parker Catalog 4230/4233, Table 1.
- d. Pressure ratings for fittings with both tube and pipe ends are rated to the lower pressure.