

Instrumentation Grade Tubing (Pressures up to 10,200 psi / 703 Bar)

Pascal Industries offers a complete line of annealed, seamless stainless steel tubing designed to meet the performance requirements of Pascal Industries Tube Fittings. Pascal Industries Instrumentation Grade tubing is provided in lengths of 20 feet (6 meters).

Pascal Industries offers various sizes of tubing and is available in a variety of lengths upon request.

Features

- Dual Certified Austenitic 316/316L Stainless Steel
- Annealed Instrumentation Grade Tubing
- Complies to PTS-138 / Exceeds ASTM A269 Standard
- Chemically Cleaned and Passivated
- Available in sizes from 1/4" to 1-1/2" OD
- Metric Sizes also Available
- Minimum 2.5% Molybdenum by Weight
- Great resistance to attacks in acidic environments
- Great resistance to pitting in neutral chloride-bearing solutions
- Great resistance to Stress Corrosion Cracking
- Great weldability
- Surface - Polished to 200 grit*
- Hardness of not more than Rb 90
- Tubing of wall thickness of less than 0.035" are not polished



Inspection and Testing

Pascal Industries Instrumentation Grade tubing is inspected for compliance to industry standards as well as carburization and intergranular carbide precipitation at the manufacturing stage. Pascal Industries tubing outside diameter and wall thickness is closely controlled to close tolerances set out on Pascal Industries proprietary standard to ensure proper fit and finish of each tubing. Quality testing is performed on sample pieces from each lot to provide assurance of quality and mechanical properties of the material. Tubing samples are also pressure tested for service assurance. Test certificates for individual tubing can be provided at additional cost.

Cleaning and Packaging

Pascal Industries Instrumentation Grade tubing complies with ASTM G93, for nonvolatile residue levels and also meets the requirements of CGA G4.1. Tubing ends are protected with durable silicone caps in a distinctive Pascal orange. The tubing is then packaged either singly or in bulk, in Polyvinyl Chloride (PVC) piping to ensure the tubing are not damaged during delivery.

Tubing Selection

When combining Pascal Industries Instrumentation Grade Tubing with Pascal Industries Double Ferrule Tube Fittings, proper selection, handling and installation of tubing are essential in order to ensure reliability, safety and durability of your tubing system.

The following should be considered when ordering tubing for use with Pascal Industries Double Ferrule Tube Fittings:

- Wall Thickness, which determines maximum working pressure
- Hardness
- Surface Finish
- Material

Tubing Wall Thickness

Pascal Industries Instrumentation Grade tubing have different working pressure ratings in a wide range of wall thicknesses. Allowable pressure ratings are calculated from S values as specified by ASME B31.3, Process Piping.

Pascal Industries Instrumentation Grade Tubing have been rigorously tested and inspected for only maximum wall thicknesses as the tolerance for Pascal Industries Instrumentation Grade tubing must be positive to allow for better fit in the double ferrule tube fittings.

Pascal Industries Double Ferrule Tube Fittings are not recommended for tube wall thicknesses outside that of the ranges shown in the accompanying tables for each size.

Tubing Hardness

The key to the selection of proper tubing for use with Pascal Industries Double Ferrule Tube Fittings is that the tubing must be softer than the fitting material. Pascal Industries Instrumentation Grade tubing are made from annealed austenitic 316 stainless steel which is softer than the fitting material. Pascal Industries Double Ferrule Tube Fittings have a hardness up to 200 HV or 90 HRB.

Tubing Handling

Proper handling of tubing can reduce the likelihood of scratches on the tubing and will protect the surface finish of Pascal Industries Instrumentation Grade tubing. The following are guidelines on general tubing handling:

- Tubing should not be dragged across a rough surface.
- Tube cutters or blades must be sharp.
- When cutting tubing, never force the blades as this might damage the Tubes Finish.
- Tube ends must be squared off and deburred.
- This is to ensure that the tubing is able to slide through the ferrules without damaging the sealing edge.

Tubing For Gas Service

Small molecule gases such as hydrogen, helium, nitrogen etc. can escape through the smallest of leak paths due to their size. Surface defects on the tubing can provide a leak path for these gases to escape. The probability of a leak path occurring increases as the tubing outer diameter increases.

For gas service, it is advised to use thicker walled tubing and to follow the installation instructions very carefully. Thicker walled tubing will resist the ferrule 'biting' action more than a thinner wall tubing due to the larger amount of material the ferrule has to negotiate. This allows the ferrules to 'remove' minor surface imperfections more than thin walled tubing.

Tubing Installation

The use of Pascal Industries Instrumentation Grade tubing and Pascal Industries Double Ferrule Tube Fittings, when properly selected, handled and installed will give a leak-free system and provides reliable service in a wide variety of applications.

To ensure reliable service:

- Properly select and handle high quality Pascal Industries Instrumentation Grade tubing and Pascal Industries Double Ferrule Tube Fittings.
- Properly assemble Pascal Industries Double Ferrule Tube Fittings together with Pascal Industries Instrumentation Grade tubing.
- Use appropriate tubing support to prevent extraneous stresses on the tubing and tube fittings.

Pressure De-rating due to High Temperature Service

Temperature (°C)	Temperature (°F)	De-Rating Factor
100	212	1.00
200	392	0.96
300	572	0.85
400	752	0.79
500	932	0.76

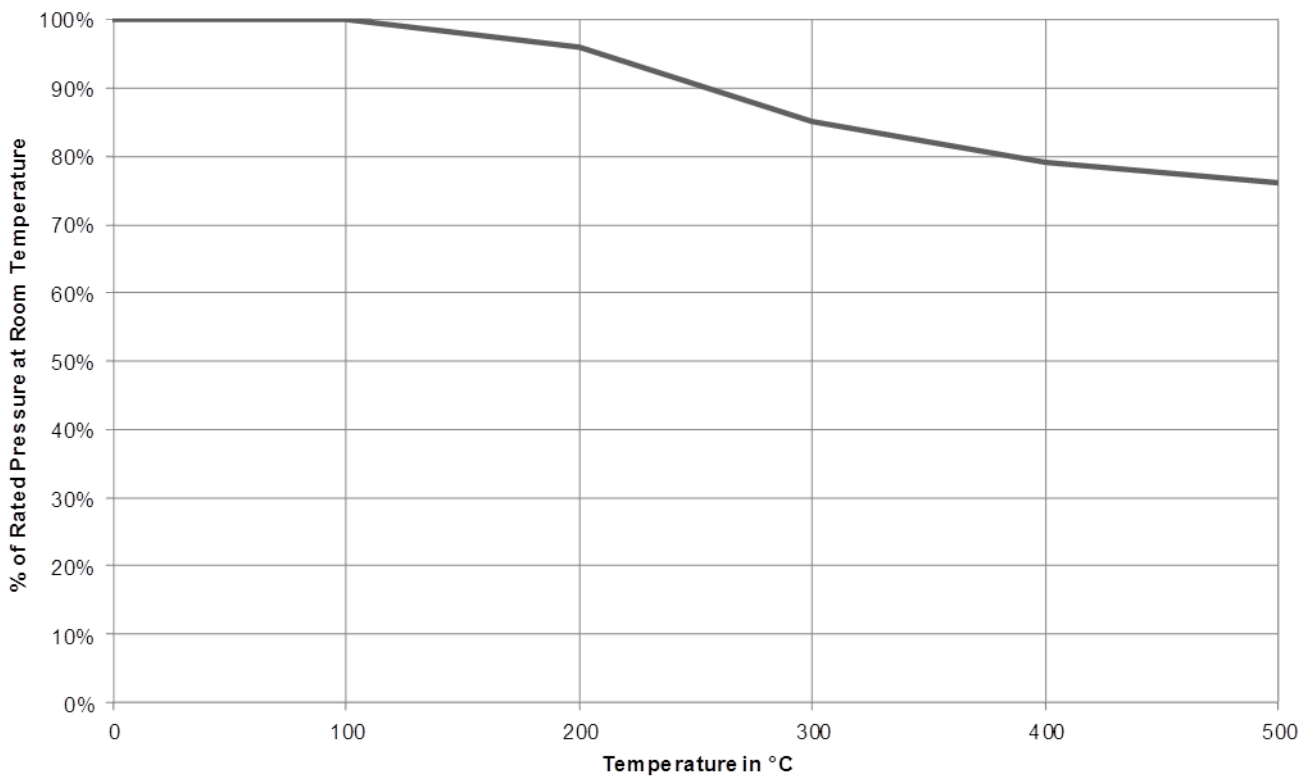
When using Pascal Industries Instrumentation Grade tubing at elevated temperatures, the pressure rating of the tubing will be decreased due to the changes in mechanical properties of the material. Use the table on the right and the plot below for the de-rating factor of the tubing at different temperatures.

To determine allowable working pressure at elevated temperatures, multiply allowable working pressure of the selected tubing by the de-rating factor at the elevated temperature.

Example

The tube to be used for high temperature service at 300°C is TBL08-083. (1/2" OD × 0.083" ID).

1. The maximum working pressure for TBL08-083 is 6700 psi.
2. The de-rating factor for the tubing used at 300°C is 0.85 or 85% of rated pressure at room temperature.
3. The maximum working pressure for TBL08-083 at 300°C is: $6700 \text{ psi} \times 0.85 = 5695 \text{ psi}$



The curve and rating presented above are based on average values for reference only. The pressure rating can be further affected by the pressure and temperature characteristics of the fluid. It is not recommended to use 316/316L tubing for temperatures higher than those stated above.

Ordering Information and Nominal Dimensions

Tube OD (inch)	Nominal Wall Thickness (inch)	Basic Ordering Number	Nominal Length (m)	Weight (kg/m)
1/4"	0.035	TBL04-035	6	0.50
	0.049	TBL04-049		0.64
	0.065	TBL04-065		0.78
3/8"	0.035	TBL06-035		0.77
	0.049	TBL06-049		1.03
	0.065	TBL06-065		1.31
	0.083	TBL06-083		1.57
1/2"	0.049	TBL08-049		1.43
	0.065	TBL08-065		1.83
	0.083	TBL08-083		2.24
3/4"	0.095	TBL12-095		4.03
1"	0.120	TBL16-120		6.84
1-1/2"	0.188	TBL24-188	15.17	

Note: For prompt service, Pascal Industries stocks a range of the above products. For other tubing sizes please consult your local Pascal representative.

Maximum Working Pressure for Seamless 316 Tubing - PSI (BAR)

Tube OD (inch)	Nominal Tube Wall Thickness (inch)						
	0.035	0.049	0.065	0.083	0.095	0.120	0.188
1/4"	5100 (352)	7500 (517)	10200 (703)	-	-	-	-
3/8"	3300 (228)	4800 (331)	6500 (448)	8200 (566)	-	-	-
1/2"	-	3700 (255)	5100 (352)	6700 (462)	7100 (490)	-	-
3/4"	-	-	-	-	4800 (331)	-	-
1"	-	-	-	-	-	4500 (310)	-
1-1/2"	-	-	-	-	-	-	4700 (324)

Note: Maximum pressure rating is based on the lowest rating of any component. Actual working pressure may be determined by tubing pressure rating, if lower.

Material Standards

Grade	SS316 / SS316L
UNS	S31600 / S31603
ASTM	A269 & A213
ASME	SA213 ¹
SS	2353
W. - NR	1.4435

¹ Nominal Wall Thickness, not minimum wall thickness

Product Standards

ASTM	A269 (Seamless Tube)
	A213
EN	10204 (2004)
PTS	138

Chemical Composition (% w.t.)

C	≤ 0.035
Si	≤ 0.750
Mn	≤ 2.00
P	≤ 0.045
S	≤ 0.030
Ni	10.00 – 14.00
Cr	16.00 – 18.00
Mo	2.50 – 3.00

Outer Diameter Tolerance

Pascal Industries Instrumentation Grade tubing have a outer diameter tolerance of +0.004" / -0" (+0.1mm / -0mm) to ensure tight and leak-free seal with Pascal Industries [Double Ferrule Tube Fittings](#).

Fittings

See Pascal [Double Ferrule Tube Fittings](#) catalog for more information.

Limited Lifetime Warranty

Pascal products are guaranteed a Limited Lifetime Warranty. For more information, contact your authorized Pascal representative.

Safety Information

When selecting a product, please ensure that the total design system is considered in order to guarantee a safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation and maintenance are the responsibilities of the user and the system designer. Pascal Industries is not liable for any injuries otherwise caused by any misjudgment.

Please Note: Pascal Industries does not recommend the mixing of components of other brands.

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