Draka

A brand of the Prysmian Group

Alloy 316L Seamless Pressure Tubing

HEAT TREATED / 30 KSI MINIMUM YIELD STRENGTH / UNS S31603

Application

Alloy 316L seamless pressure tubing in the heat treated condition is typically used in oil and natural gas wells for applications including hydraulically-actuated surface-controlled subsurface safety valves, chemical injection, and instrumentation. In such applications, it is commonly referred to as control line tubing. The tubing is generally deployed by strapping it to the outside of the production casing. It may be encapsulated and can be included along with other pressure or TEC and mechanical components, such as bumpers, within a flatpack. The tubing is frequently supplied as 5,000 to 35,000 ft. coils on a wooden or steel reel, depending on size.

Description

Alloy 316L is a chromium - nickel austenitic stainless steel with an addition of molybdenum and reduced carbon content. The addition of molybdenum provides improved resistance to pitting and crevice corrosion in environments containing halides such as chlorides when compared to so-called conventional 18 chromium 8 nickel austenitic stainless steels such as 304L. The reduced carbon content minimizes harmful chromium carbide precipitation during welding and thereby improves resistance to intergranular corrosion. Austenitic stainless steels such as 316L are susceptible to stress corrosion cracking (SCC) in environments containing chlorides and other halides. Alloy 316L is generally used in oil and gas production environments which do not contain oxygen and have limited amounts of chlorides and hydrogen sulfide. Consult ISO 15156-3, Table A.2 for the limits regarding alloy 316L in hydrogen sulfide containing environments for oil and gas production. Draka uses expert system software to assist customers in their selection of alloys for oil and gas environments.

Manufacturing Process and Resultant Properties

Seamless extruded tube hollows are drawn or drawn / sunk to final size to produce seamless tubing coils 500 to 2,000 ft. long, depending upon the size. The tubing is heat treated and joined by orbital welding to achieve the desired length. The final material condition of the tubing is heat treated. Mechanical properties, permissible variation in tubing dimensions and size dependant characteristics / properties are listed in Tables 3, 4, and 5 on reverse respectively.

Nondestructive Testing (NDT)

Eddy current testing (ECT) is performed at final size in the heat treated condition. Radiographic testing is performed on all orbital welds. Yield pressure hydrostatic testing is performed on the heat treated tubing at final size.

Standards and Specifications

Tubing Specification PTM-TS-022, Alloy 316L Seamless Tubing for Control Line Applications

ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

Meets the material limits for 316L austenitic stainless steel listed in ISO 15156-3, Table A.2.

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For sales and technical information, contact:
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022 316L S PT HT 1012

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Table 1 - Chemical Composition
UNS S31603 with further restrictions by Draka Strip Specifications PTM-TPS-001, (%)

C	Mn	P	S	Si	Cr	Ni	Mo	N	Cu	B	C+N	Fe
0.030 max	2.00 max	0.040 max	0.005-0.010	0.75 max	16.0-18.0	10.0-14.0	2.00-3.00	0.10 max	0.50 max	0.0010 max	0.060	Bal

Table 2 - Typical Physical Constants and Thermal Properties

Density (lbs/in3)	0.290
Modulus of tension elasticity (x 10^6 psi)	29.0 at 70°F
Mean coefficient of thermal expansion from 70°F to temperature shown (in/in/°F x 10^{-6})	9.2 to 200°F

Table 3 - Mechanical Properties

Property	Minimum	Maximum	Typical
Ultimate Tensile Strength UTS, (psi)	75,000	–	77,500
0.2% Offset Yield Strength, YS (psi)	30,000	–	33,500
Elongation in 2 inches, E (%)	35	–	55
Hardness, HRBW	–	90	66

Table 4 - Permissible Variation in Tubing Dimensions

Nominal Outside Diameter (in)	OD	t (± %)
Less than 0.625	±0.003	10
Equal to or greater than 0.625	+0.004, -0.003	10

Table 5 - Size Dependant Characteristics / Properties (based upon nominal tubing dimensions)

Nominal Outside Diameter in	Nominal Wall Thickness in	Minimum Burst Pressure psi	Minimum Collapse Pressure psi	Metal Cross Section in^2	Flow Cross Section in^2	Volume per unit Length gal/1000 ft	Weight per unit Length lbs/1000 ft	Load at Minimum 0.2% YS lbs	Load at Typical UTS lbs
0.250	0.035	18,676	6,540	0.0236	0.0254	1.3	82.3	709	1,832
0.250	0.049	26,146	8,635	0.0309	0.0181	0.9	107.7	928	2,398
0.250	0.065	34,684	10,666	0.0378	0.0113	0.6	131.5	1,133	2,928
0.375	0.035	12,500	4,583	0.0374	0.0731	3.8	130.1	1,122	2,897
0.375	0.049	17,500	6,183	0.0502	0.0603	3.1	174.6	1,506	3,889
0.375	0.065	23,214	7,849	0.0633	0.0471	2.4	220.3	1,899	4,906
0.500	0.035	9,394	3,522	0.0511	0.1452	7.5	177.9	1,534	3,963
0.500	0.049	13,151	4,799	0.0694	0.1269	6.6	241.6	2,083	5,381
0.500	0.065	17,445	6,167	0.0888	0.1075	5.6	309.1	2,665	6,884

Notes Regarding Burst and Collapse Pressure

Minimum internal burst pressure and external collapse pressure calculations were based upon:
- Minimum ultimate tensile strength, UTS_{min} and minimum 0.2% offset yield strength, YS_{min} per above table.
- Maximum outside diameter, OD_{max} per above table
- Minimum wall thickness, t_{min} per above table
- Minimum burst pressure = $(2 \times t_{min} \times UTS_{min}) / OD_{max}$; assumes no axial or other loading except internal pressure.
- Collapse pressure based on API 5C3; assumes no ovality, internal pressure or other loading except external pressure.

Notes Regarding Load at 0.2% YS & UTS

The load at minimum 0.2% YS represents the load at which 0.002 in/in of plastic (permanent) axial strain deformation has occurred.
The load at typical UTS represents the load to cause failure. Decisions regarding the pull out load to be applied to tubing should consider these two loads.

The data herein is approximate and subject to normal manufacturing tolerances. These specifications are subject to change without notice.

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