Alloy 625 Seam Welded Pressure Tubing

Heat treated and cold worked / 90 ksi minimum yield strength
UNS N06625

Applications

Alloy 625 seam welded pressure tubing in the heat treated and cold worked condition is typically used in oil and gas wells for chemical injection applications. In such applications, it is commonly referred to as capillary tubing and is free hanging (self-supporting) inside the production casing. The chemicals being injected are often used to enhance production flow rates, inhibit corrosion or scaling and/or de-water. The tubing is frequently supplied as 5,000 to 35,000 ft. coils on a wooden reel, depending on size.

Description

Alloy 625 is an austenitic nickel – chromium – molybdenum - niobium alloy (see Table 1 on reverse). The high alloy content enables alloy 625 to withstand severe aqueous corrosion environments. High molybdenum content (8.0 to 10.0%) makes the alloy very resistant to chloride pitting and crevice corrosion. High nickel content (58.0% min.) provides relative freedom from chloride ion induced stress-corrosion cracking. Alloy 625 has shown excellent corrosion resistance in oil and gas production environments containing hydrogen sulfide, carbon dioxide and chlorides. Consult ISO 15156-3, Table A.14 for the limits regarding material type 4d 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

Strip splice welds join lengths of cold rolled strip to enable long lengths between orbital welds (greater than 5,000 ft between orbital welds is achievable).

The strip is formed into a tubular cross section and longitudinally seam welded using either the gas tungsten arc (GTAW) or laser beam welding (LBW) process. The tubing is first sunk to an intermediate outside diameter, heat treated, and joined by orbital welding to achieve the desired length. The tubing is then sunk to the final outside diameter and provided in the as-cold worked condition. 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 on the longitudinally seam welded tubing and strip splice welds at intermediate size in the as-heat treated condition. Radiographic testing is performed on all orbital welds and those strip splice welds detected by ECT at intermediate size in the as-heat treated condition. Yield pressure hydro static testing is performed on the cold worked tubing at final size.

Standards and Specifications

Tubing Specification PTM-TS-010,
Alloy 625 Tubing with Enhanced Properties

ASTM B704, Standard Specification for
Welded UNS N06625, UNS N06219, and UNS N08825 Alloy Tubes, except in the as-cold worked condition

Meets the material limits for annealed and cold-worked, solid-solution, nickel-based alloys listed in ISO 15156-3 for material type 4d in Table A.14.

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Table 1 - Chemical Composition, UNS N06625 with further restrictions by Draka Strip Specification, PTM-SS-004, (%)

C	Mn	Si	P	S	Cr	Nb + Ta	Co	Mo	Fe	Al	Ti	Ni
0.05 max	0.50 max	0.50 max	0.015 max	0.015 max	20.0 - 23.0	3.15 - 4.15	1.0 max	8.0 - 10.0	5.0 max	0.40 max	0.40 max	58.0 min

Table 2 - Typical Physical Constants and Thermal Properties

Density (lbs/in^3)	0.305
Modulus of tension elasticity (x10^6 psi)	29.8 at 70º F
	28.4 at 400º F
Mean coefficient of thermal expansion (in/in/ºF x 10^{-6})	7.1 to 200º F
from 70º F to temperature shown	7.3 to 400º F

Table 3 - Mechanical Properties

Property	Minimum	Maximum	Typical
Ultimate Tensile Strength UTS, (psi)	–	165,000	138,000
0.2% Offset Yield Strength, YS (psi)	90,000	135,000	105,000
Ratio YS / UTS	–	0.90	0.70
Elongation in 2 inches, E (%)	25	–	32
Hardness, HR30TW	–	93	86

Table 4 - Permissible Variation in Tubing Dimensions

Nominal Outside Diameter (in)	OD (± in)	t (± %)
less than 0.625	0.003	10
greater than or equal to 0.625	0.005	10

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

Nominal Outside Diameter in (mm)	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	33,617	19,621	0.0236	0.0254	1.3	86.5	2,128	3,262
0.250	0.049	47,063	25,906	0.0309	0.0181	0.9	113.2	2,785	4,270
0.250	0.065	62,431	31,997	0.0378	0.0113	0.6	138.3	3,400	5,213
0.375	0.035	22,500	13,750	0.0374	0.0731	3.8	136.8	3,365	5,159
0.375	0.049	31,500	18,550	0.0502	0.0603	3.1	183.7	4,517	6,925
0.375	0.065	41,786	23,546	0.0633	0.0471	2.4	231.7	5,697	8,736
0.500	0.035	16,909	8,792	0.0511	0.1452	7.5	187.1	4,602	7,056
0.500	0.049	23,672	14,398	0.0694	0.1269	6.6	254.1	6,248	9,581
0.500	0.065	31,402	18,500	0.0888	0.1075	5.6	325.1	7,995	12,258

Notes Regarding Burst and Collapse Pressure

Minimum internal burst pressure and external collapse pressure calculations were based upon:
Minimum ultimate tensile strength, UTS_{min} = 135,000 psi
Minimum 0.2% offset yield strength, YS_{min} = 90,000 psi
Maximum outside diameter, OD_{max} per Table 4
Minimum wall thickness, t_{min} per Table 4
Minimum burst pressure = (2 x t_{min} x 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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