Draka

A brand of the Prysmian Group

Alloy 2205 Seam Welded Pressure Tubing

HEAT TREATED / 80 KSI MINIMUM YIELD STRENGTH / UNS S32205

Application

Alloy 2205 seam welded pressure tubing in the heat treated condition is typically used in oil and natural 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. However, the tubing can also be used for control line tubing applications including hydraulically actuated surface-controlled subsurface safety valves. For control line applications, the tubing is generally deployed by strapping it to the outside of the production casing. The tubing is frequently supplied as 5,000 to 35,000 ft. coils on a wooden or steel reel, depending on size.

Description

Alloy 2205 is a duplex stainless steel. When properly heat treated, the microstructure consists of a nearly equal mixture of the austenitic and ferrite phases. This two-phase microstructure produces a fine grain size which increases the yield strength. In the final heat treated condition, alloy 2205 can achieve a yield strength approximately twice that of austenitic alloys such as 316L, 825 and 625 which must be cold worked to achieve comparable yield strengths. Duplex stainless steels are often classified as lean, conventional, super or hyper based upon their pitting resistance equivalent (PRE or PREN). Various PRE formulas are used to rank an alloy's resistance to chloride pitting corrosion based upon its composition. Alloy 2205 typically has a PRE of 36 and is considered a conventional duplex stainless steel. Alloy 2205 is often selected for use in oil and gas production environments based upon its higher strength and resistance to pitting, crevice and stress corrosion cracking in chloride containing environments. Consult ISO 15156-3, Table A.24 for the limits regarding the use of alloy 2205 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 may be welded at a larger outside diameter, sunk to final size and subsequently heat treated. The heat treated tubing is 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 on the longitudinally seam welded tubing and strip splice welds in the as-heat treated condition. Radiographic testing is performed on all orbital welds and those strip splice welds detected by ECT. Yield pressure hydrostatic testing is performed on the heat treated tubing at final size.

Standards and Specifications

Tubing Specification PTM-TS-011, Alloy 2205 Tubing for Control Line Applications

ASTM A789, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service

Meets the material limits for duplex stainless steel with PREN 30 to 40 as listed in ISO 15156-3, Table A.24

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011 2205 W PT HT 1012

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Table 1 - Chemical Composition
UNS S32205 with further restrictions by Draka Strip Specification PTM-SS-005, (%)

C	Mn	P	S	Si	Cr	Ni	Mo	N	Fe
0.030 max	2.00 max	0.030 max	0.005 max	1.00 max	22.0 - 23.0	4.5 - 6.5	3.0 - 3.5	0.14 - 0.20	Bal

Table 2 - Typical Physical Constants and Thermal Properties

Density (lbs/in^3)	0.283
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})	7.2 to 200°F

Table 3 - Mechanical Properties

Property	Minimum	Maximum	Typical
Ultimate Tensile Strength UTS, (psi)	110,000	–	125,000
0.2% Offset Yield Strength, YS (psi)	80,000	–	90,000
Elongation in 2 inches, E (%)	25	–	30
Hardness, HR30TW	–	90	85

Table 4 - Permissible Variation in Tubing Dimensions

Nominal Outside Diameter (in)	OD (± in)	t (± %)
Less than 0.625	0.003	10
Equal to or greater than 0.625	0.005	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	27,391	17,441	0.0236	0.0254	1.3	80.3	1,891	2,955
0.250	0.049	38,348	23,028	0.0309	0.0181	0.9	105.1	2,475	3,868
0.250	0.065	50,870	28,442	0.0378	0.0113	0.6	128.3	3,022	4,722
0.375	0.035	18,333	12,222	0.0374	0.0731	3.8	127.0	2,991	4,673
0.375	0.049	25,667	16,489	0.0502	0.0603	3.1	170.4	4,015	6,273
0.375	0.065	34,048	20,930	0.0633	0.0471	2.4	215.0	5,064	7,913
0.375	0.083	43,476	25,371	0.0761	0.0343	1.8	258.6	6,091	9,517
0.500	0.035	13,777	8,091	0.0511	0.1452	7.5	173.6	4,090	6,391
0.500	0.049	19,288	12,798	0.0694	0.1269	6.6	235.8	5,554	8,678
0.500	0.065	25,586	16,444	0.0888	0.1075	5.6	301.7	7,106	11,104
0.500	0.083	32,672	20,233	0.1087	0.0876	4.6	369.3	8,699	13,592
0.625	0.035	11,035	4,990	0.0649	0.2419	12.6	220.3	5,190	8,109
0.625	0.049	15,449	9,903	0.0887	0.2181	11.3	301.1	7,093	11,084
0.625	0.065	20,494	13,478	0.1144	0.1924	10.0	388.3	9,148	14,294
0.625	0.083	26,169	16,722	0.1413	0.1655	8.6	479.9	11,306	17,666

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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