Draka

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Alloy 825 Seam Welded Sheathed Tubing

COLD WORKED / 95 KSI MINIMUM YIELD STRENGTH / UNS N08825

Application

Alloy 825 seam welded sheathed tubing, which is commonly referred to as TEC, is typically used in oil, natural gas and geothermal wells to provide power and communication to down-hole gauges. TEC contains a core consisting of insulated electrical conductor(s) and/or optical fiber(s). The tubing is generally deployed by strapping it to the outside of the production casing. However, it may also be free hanging (self-supporting) inside the production casing. It may be encapsulated and can be included along with pressure tubing 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 825 is a titanium-stabilized austenitic nickel - iron - chromium alloy with additions of molybdenum, and copper. The chemical composition of the alloy is listed in Table 1. The alloy is characterized by good resistance to stress-corrosion cracking due to its nickel content (38.0 to 46.0) and satisfactory resistance to pitting and crevice corrosion. Alloy 825 has shown good 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 4c 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, which are used to join lengths of cold rolled strip, enable long continuous lengths of

tubing to be manufactured. The strip is formed into a tubular cross section around the core and longitudinally seam welded using the gas tungsten arc welding (GTAW) process. The tubing is seam welded at a larger outside diameter to protect the core and then sunk to final size. The final material condition of the tubing is cold worked. 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)

In-process eddy current testing (ECT) is performed on the as-welded tubing and final ECT is performed on the as-sunk tubing. Visual examination is performed on all ECT indications. Performance of additional NDT is dependent upon both the type of core and specific customer requirements, and may include: electrical continuity, high voltage/bending; insulation resistance, optical time domain reflectometer, and high pressure nitrogen underwater.

Standards and Specifications

Tubing Specification PTM-TS-003, Alloy 825 Sheathed Insulated Electrical Conductors and Optical Fibers

ASTM B704, Standard Specification for Welded UNS N06625, UNS N06219, and UNS N08825 Alloy Tubes

Meets the material limits for material type 4c listed in ISO 15156-3, Table A.14, except no heat treatment after welding.

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For sales and technical information, contact:
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003 825 W ST 1012

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Table 1 - Chemical Composition
UNS N08825 with further restrictions by Draka Strip Specification, PTM-SS-003, (%)

Ni	Cr	Fe	Mn	C	Cu	Si	S	P	Al	Ti	Mo	B
38.0 - 46.0	21.5 - 23.5	22.0 min	1.0 max	0.020 max	1.5 - 3.0	0.5 max	0.005 max	0.020 max	0.2 max	0.6 - 1.2	2.5 - 3.5	0.006 max

Table 2 - Typical Physical Constants and Thermal Properties

Density (lbs/in^3)	0.293
Modulus of tension elasticity (x 10^6 psi)	28.3 at 70°F 26.8 at 400°F
Mean coefficient of thermal expansion from 70°F to temperature shown (in/in/°F x 10^{-6})	7.8 to 200°F 8.3 to 400°F

Table 3 - Mechanical Properties

Property	Minimum	Typical
Ultimate Tensile Strength UTS, (psi)	100,000	140,000 to 160,000
0.2% Offset Yield Strength, YS (psi)	95,000	120,000 to 140,000
Elongation in 2 inches, E (%)	–	5 to 10
Vickers Hardness, HV5 (5 kg load)	–	285 to 310

Note: Typical properties vary with the amount of cold work. Vickers Hardness testing was performed in weld metal and base metal regions on mounted cross sections

Table 4 - Permissible Variation in Tubing Dimensions

Dimension	Permissible Variation
Nominal Outside Diameter (in)	± 0.002
Nominal Wall Thickness 0.022-in.	0.0200 to 0.0225
Nominal Wall Thickness 0.028-in.	0.0255 to 0.0285
Nominal Wall Thickness 0.035-in.	0.0315 to 0.0355
Nominal Wall Thickness 0.049-in.	0.0445 to 0.0495

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	Weight per unit Length lbs/1000 ft	Load at Minimum 0.2% YS lbs	Load at Typical UTS lbs
0.125	0.022	34,646	25,209	0.0071	25.0	676	1,068
0.125	0.028	44,173	30,490	0.0085	30.0	811	1,280
0.1875	0.035	36,570	26,333	0.0168	59.0	1,593	2,515
0.250	0.028	22,262	17,281	0.0195	68.7	1,855	2,929
0.250	0.035	27,500	20,781	0.0236	83.1	2,246	3,546
0.250	0.049	38,849	27,627	0.0309	108.8	2,939	4,641
0.3125	0.049	31,129	23,080	0.0406	142.6	3,853	6,084
0.375	0.035	18,382	14,549	0.0374	131.4	3,552	5,608
0.375	0.049	25,968	19,780	0.0502	176.4	4,767	7,528

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. The UTS used in the calculation of the load at typical UTS was 150,000 psi.
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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