STAINLESS STEEL

ALLOY 6Mo

finetubes / AMETEK SPECIALTY METAL PRODUCTS

Alloy 6Mo (UNS S31254)

6Mo (UNS S31254) is a super austenitic stainless steel with a high level of molybdenum and nitrogen, providing high resistance to pitting and crevice corrosion as well as high strength compared with conventional austenitic stainless steels such as 316L.

The alloy can provide excellent resistance to stress corrosion cracking allowing tube cold forming and may be used without the necessity to re-anneal at testing up to 120°C.

	Alloy 625 (UNS N06625) with PREN value 50.
	↑
Fe Base Alloy	6Mo (UNS S31254) with PREN 43.
	↓
Lower cost, lower alloy	(316L) (UNS S31603) with PREN 25.

AVAILABLE TUBE PRODUCT FORMS
STRAIGHT
COILED
SEAMLESS
SEAM WELDED AND COLD REDRAWN
SEAM WELDED, COLD REDRAWN AND ANNEALED

TYPICAL MANUFACTURING SPECIFICATIONS	
ASTM A213	ASTM A312
ASTM A269	BS EN 10216 pt.5
Also individual customer specifications.	

TYPICAL APPLICATIONS
SEAWATER HANDLING SYSTEMS
DESALINATION PLANT EQUIPMENT
PAPER AND PULP
FLUE GAS DESULPHURISATION UNITS IN POWER PLANTS
CHEMICAL PROCESSING
CONTROL AND INSTRUMENTATION

INDUSTRIES PREDOMINANTLY USING THIS GRADE
CHEMICAL PROCESSES
OIL AND GAS

Technical Data

TYPICAL CHEMICAL COMPOSITION (% BY WEIGHT)

Title	UNS	Werkstof	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N
316L	S31603	1.4404	0.03	1	2	0.045	0.015	17.5	11.5	2.25	-	-
317L	S31703	1.4439	0.03	1	2	0.045	0.30	19	13	3.5	-	-
904L	N08904	1.4539	0.02	1	2	0.045	0.035	21	25.5	-	-	-
6Mo	**S31254**	**1.4547**	**<0.02**	**0.70**	**1**	**0.03**	**0.010**	**20**	**18**	**6.1**	**0.75**	**0.20**
625	N06625	2.4856	0.1	0.5	0.5	0.015	0.02	0.5	58	8.5	-	-
C276	N10276	2.4819	0.01	0.08	1	0.04	0.02	0.03	55	16	Co 2.5	W3.75

PHYSICAL PROPERTIES (Room Temperature)		
Specific Heat (0-100°C)	500	J.kg-1.°K-1
Thermal Conductivity	14	W.m -1.°K-1
Thermal Expansion	16.5	mm/m/°C
Modulus Elasticity	196	GPa
Electrical Resistivity	8.5	Ohm-cm
Density	8.00	g/cm^3

MECHANICAL PROPERTIES		
Temper	Annealed	
Tensile Rm	98	ksi (min)
Tensile Rm	675	MPa (min)
R.p. 0.2% Yield	45	ksi (min)
R.p. 0.2% Yield	310	MPa (min)
Elongation (2" or 4D gl)	35	% (min)

Properties

The steel grade was developed for use in halide containing environments such as seawater, hydrochloric acid and sulphuric acid. The increased levels of molybdenum combined with chromium and nitrogen provide levels of pitting and crevice corrosion resistance more typically associated with higher alloy nickel base alloys such as alloy 625 (UNS N06625).

Structure

Austenitic when annealed in the range 1120 - 1200C. In the hot working range between 600 - 1000C (Under certain process conditions traces of the chi and sigma intermetallic phases could form.) These could exist as grain boundary precipitates. Suitable procedures for heat treatment and welding will be required to ensure that there is no impact of precipitation on corrosion resistance. The typical microstructure of the 6Mo sheet is shown in Diagram 1 & 2.

ALLOY 6Mo

Pitting Corrosion

Some comparative test results for the different steel grades are shown in diagram 3. Fine Tubes investigated the pitting corrosion resistance of 6Mo grade by measuring pitting potentials using ASTM G5 test method.

The experiments conducted in an autoclave at 130°C in 3.5wt% NaCl has shown that 6Mo has the highest pitting potentials, compared to the super duplex stainless steels S32750 as shown is Diagram 3.

Diagram 1: Band contract map plus grain boundary maps of 6Mo

Diagram 2: IPF map showing microstructure of 6Mo stainless steel

Crevice Corrosion

6Mo grade steels show higher pitting and crevice corrosion resistance compared to the traditional duplex and austenitic grades as shown in Diagram 4. Tests conducted in 6% FeCl3 (ASTM G48 A & B) to determine the critical pitting temperature (CPT) and critical crevice corrosion temperature (CCT) has shown that 6Mo grade is superior to the other austenitic stainless steel grades.

Fabrication

Cold working - the alloy is fully cold workable and the increased level of nitrogen will lead to high work hardening rates such that will produce increased mechanical strength and toughness. Machining - the high work hardening rate attributable to increased nitrogen levels and low sulphur levels make this alloy tougher to machine and hence lower cutting speeds are required compared with conventional austenetic stainless steels.

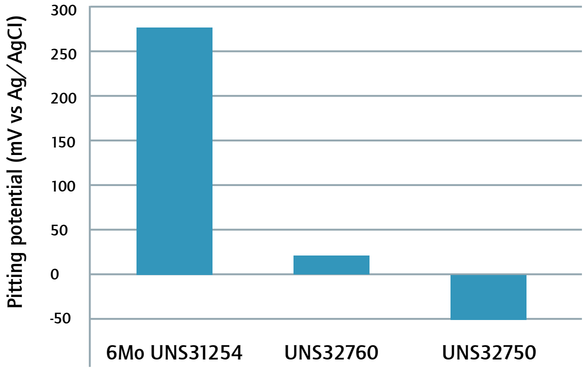

Diagram 3: pitting potentials in 3.5wt% NaCl at 130°C in 8ppm dissolved oxygen

Hardness Testing & Fittings Compatibility

The nature of our seamless tube production process control ensures a level of hardness is achieved which faciltates compatibility with compression settings where, typically a maximum hardness of Rockwell 'B' 90 is specified.

Hardness testing on small diameter tubes is typically not performed using the Rockwell test methodology as the level of loading required tends to distort surfaces or the ball impression can fall away due to the curvature of surface. The alloy has excellent forming characteristics permitting cold bending to very tight radii. Annealing is not normally necessary after forming.

Fine Tubes use the Vickers hardness testing as the most meaningful test methodology.

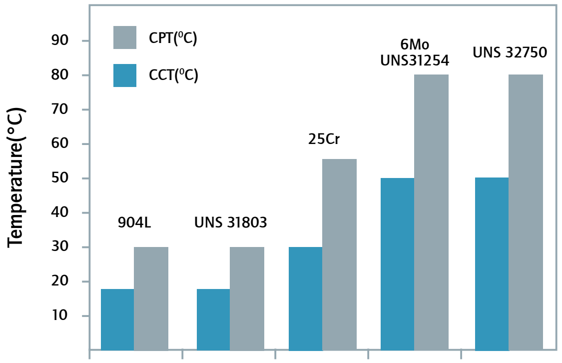

Diagram 4: Graph showing critical pitting and crevice temperatures in 6% FeCl3, 24 hours (ASTM G48 A & B)

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