Alloy 625

NiWire Industries
www.niwire.com

UNS N06625

Alloy 625 (UNS N06625), which contains 9% Mo, serves effectively as both a corrosion resistant and heat resistant material. The combination of high-temperature strength and resistance to halogen attack, oxidation, and carburization has made alloy 625 a popular choice for chemical and petrochemical process equipment exposed to hostile, high temperature environments.

Specification

NiWire's production follows: ASTM B 366 (welding fittings, permissible raw materials), B 443 (plate, sheet, and strip), B 444 (seamless pipe and tube), B 446 (rod and bar), B 564 (forgings), B 704 (welded tube), B 705 (welded pipe), B 751 (welded tube, general requirements), B 775 (welded pipe, general requirements), B 829 (seamless pipe and tube, general requirements)
AMS 5581 (seamless and welded tubing), 5599 (sheet, strip, and plate), 5666 (bars, forgings, and rings), 5837 (wire), 5869 (sheet, strip, and plate)
AWS A5.14 (welding wire ERNiCrMo-3)

Chemical Composition

Composition limits: 20.0 to 23.0 Cr; 5.0 max Fe; 8.0 to 10.0 Mo; 3.15 to 4.15 Cb + Ta; 0.10 max C; 0.50 max Mn; 0.50 max Si; 0.015 max P; 0.015 max S; 0.40 max Al; 0.40 max Ti; 1.0 max Co; 58.0 min Ni

Applications

Typical uses: exhaust ducts for Navy utility boats, sheathing for undersea communication cables, submarine transducer controls, and steam-line bellows, engine exhaust systems, thrust-reverser systems, resistance-welded honeycomb structures for housing engine controls, fuel and hydraulic line tubing, spray bars, bellows, turbine shroud rings, and heat-exchanger tubing in environmental control systems. It is also suitable for combustion system transition liners, turbine seals, compressor vanes, and thrust-chamber tubing for rocket motors

Physical Properties

Density: 8.44 g/cm3 (0.305 lb/in.3) at 20 °C (68 °F)
Liquidus temperature: 1350 °C (2460 °F)
Solidus temperature: 1290 °C (2350 °F)
Coefficient of thermal expansion: 14.0 µm/m · K (7.8 µin./in. · °F) at 538 °C (1000 °F); 15.8µm/m · K(8.8 µin./in. · °F) at 871 °C (1600 °F)
Specific heat: 410 J/kg · K (0.095 Btu/lb · °F) at 21 °C (70 °F)
Thermal conductivity: 9.8 W/m · K (68 Btu/ft2 · in. · h · °F) at 21 °C (70 °F); 17.5 W/m · K (121 Btu/ft2 · in. · h · °F) at 538 °C (1000 °F); 22.8 W/m · K(158 Btu/ft 2 · in. · h · °F) at 871°C(1600 °F)
Electrical conductivity: Volumetric, 1.3% IACS at 21 °C (70 °F)
Electrical resistivity: 1290 nΩ·m at 21 °C (70 °F)
Magnetic permeability: 1.006 at a field strength of 15.9 kA/m
Curie temperature: <–196 °C (<– 320 °F)

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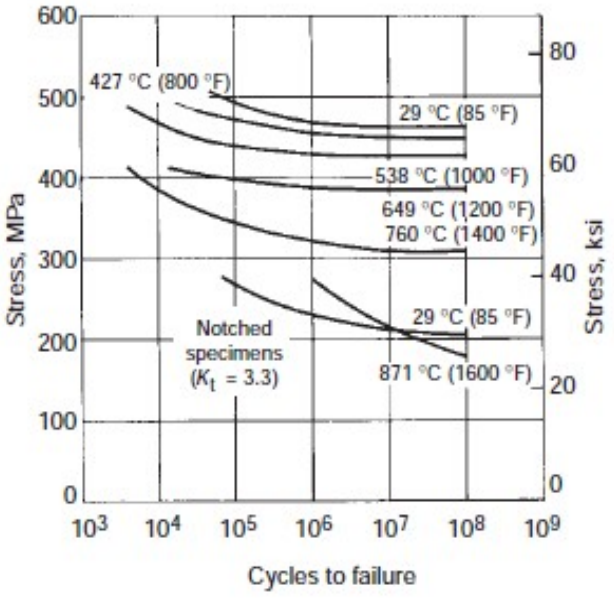
Mechanical Properties

Poisson's ratio: Annealed material, 0.278 at 21 °C (70 °F)
Elastic modulus: Annealed material: tension, 208 GPa (30 × 106 psi) at 21 °C (70 °F); torsion, 81 GPa (11.8 × 106 psi) at 21 °C (70 °F)
Impact strength: As-rolled plate, Charpy keyhole: 66 J (48.7 ft · lbf) at 29 °C (85 °F); 60 J (44.2 ft · lbf) at –79 °C (–110 °F); 47 J (34.7 ft · lbf) at –196 °C (–320 °F)

Room-Temperature Mechanical Properties:

Form and condition	Tensile strength		Yield strength (0.2% offset)		Elongation
	Mpa	ksi	MPa	ksi	%
Rod, bar, plate					
As rolled	827-1103	120-160	414-758	60-110	60-30
Annealed	827-1034	120-150	414-655	60-95	60-30
Solution treated	724-896	105-130	290-414	42-60	65-40
Sheet, strip					
Annealed	827-1034	120-150	414-621	60-90	55-30
Tube, pipe cold drawn					
Annealed	827-965	120-140	414-517	60-75	55-30
Solution treated	689-827	100-120	276-414	40-60	60-40

Rotating-beam fatigue strength of hot-rolled solution-treated Alloy 625 bar (15.9 mm, or 0.625 in., diam) at elevated temperature. Average grain size, 0.10mm (0.004 in.)



Typical stress-rupture strengths of solution treated (1150 °C, or 2100 °F) Alloy 625

Temperature		For stress rupture at:			
		100 h		1000 h	
°C	°F	MPa	ksi	MPa	ksi
650	1200	440	64	370	54
815	1500	130	19	93	13.5
870	1600	72	10.5	48	7

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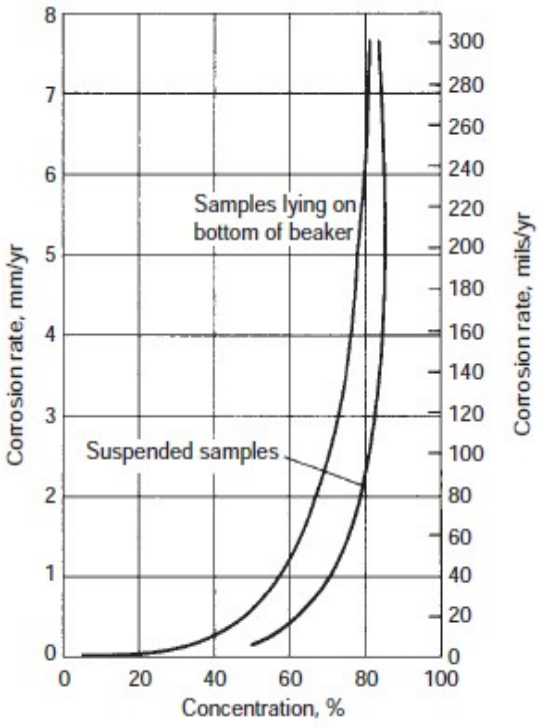
Chemical Properties

General corrosion behavior: The high alloy content of Alloy 625 enables it to withstand a wide variety of corrosive environments. The alloy is almost completely resistant to mild environments such as the atmosphere, fresh water and seawater, neutral salts, and alkaline media. In more severe environments, the combination of nickel and chromium provides resistance to oxidizing chemicals, and the combination of nickel and molybdenum provides resistance to reducing conditions. The molybdenum content also makes Alloy 625 highly resistant to pitting and crevice corrosion. The columbium stabilizes the alloy against sensitization and prevents intergranular corrosion. The high nickel content provides freedom from chloride stress-corrosion cracking.

Corrosion rates for Alloy 625 in sulfuric and hydrochloric acids at various concentrations:

Concentration,%	Corrosion rate	
	mm/yr	mils/yr
Sulfuric acid(a)		
15	0.188	7.40
50	0.432	17.0
60	0.711	28.0
70	1.626	64.0
80	2.286	90.0
Hydrochloric acid(b)		
5	1.803	71.0
10	2.057	81.0
15	1.651	65.0
20	1.270	50.0
25	0.965	38.0
30	0.864	34.0
Conc(c)	0.381	15.0

(a) At 80 °C (176 °F). (b) At 66 °C (151 °F). (c) Conc, concentrated, approximately 37.1%



Corrosion of Alloy 625 in boiling phosphoric acid solutions