Alloy 800

NiWire Industries
www.niwire.com

UNS N08800

Alloy 800 (UNS N08800) is a Fe-Ni-Cr alloy with high strength and corrosion resistance used in chemical, petrochemical and food processing, in nuclear engineering, and for the sheathing of electric heating elements. Although resistant to many aqueous media, it is used primarily for its oxidation and carburization resistance and strength at elevated temperature.

Specification

NiWire's production follows:

ASTM B 163 (condenser and heat exchanger tube), B 366 (welding fittings, permissible raw materials), B 407 (seamless pipe and tube), B 408 (rod and bar), B 409 (plate, sheet, and strip), B 514 (welded pipe), B 515 (welded tube), B 564 (forgings), B 751 (welded tube, general requirements), B 775 (welded pipe, general requirements), B 829 (seamless pipe and tube, general requirements)

AMS 5766 (bar, forging)

Chemical Composition

Composition limits: 30.0 to 35.0 Ni; 19.0 to 23.0 Cr; 0.10 max C; 1.50 max Mn; 0.015 max S; 1.0 max Si; 0.75 max Cu; 0.15 to 0.60 Al; 0.15 to 0.60 Ti; 39.5 min Fe

Applications

Typical uses: Heat treating equipment, petrochemical pyrolysis tubing and piping systems, sheathing for electrical heating elements, food processing equipments

Physical Properties

Density: 7.94 g/cm3 (0.287 lb/in.3) at 20 °C (68 °F)
Liquidus temperature: 1385 °C (2525 °F)
Solidus temperature: 1355 °C (2475 °F)
Specific heat: 502 J/kg ·K (0.117 Btu/lb · °F) at 20 °C (68 °F)
Electrical conductivity: Volumetric, 1.7% IACS at 21 °C (70 °F)
Electrical resistivity: 989 nΩ· m at 21 °C (70 °F)
Magnetic permeability: Annealed material, 1.0092 at a field strength of 15.9 kA/m
Curie temperature: –115 °C (–175 °F)

Mechanical Properties

Poisson's ratio: Annealed material, 0.339 at 24 °C (75 °F)
Elastic modulus: Annealed material: tension, 195 GPa (28.35 × 106 psi) at 24 °C (75 °F); torsion, 73 GPa (10.64 × 106 psi) at 24 °C (75 °F)
Impact strength: Annealed plate, Charpy keyhole: 122 J at 21 °C (70 °F); 122 J at –79 °C (–110 °F); 106 J at –196 °C (–320 °F); 99 J at –253 °C (–423 °F)
Fatigue strength: Rotating beam: hot rolled, 352 MPa (51 ksi); cold drawn, 228 MPa (33 ksi); annealed, 214 MPa (31 ksi). All values at 108 cycles

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Tensile properties of Alloy 800:

Form and condition	Tensile strength		Yield Strength (0.2% offset)		Elongation
	MPa	ksi	Mpa	ksi	%
Rod and bar					
Annealed	517–690	75–100	207–414	30–60	60–30
Hot finished	552–827	80–120	241–621	35–90	50–25
Cold drawn	690–1034	100–150	517–862	75–125	30–10
Plate					
Hot rolled	552–758	80–110	207–448	30–65	50–25
Annealed	517–724	75–105	207–414	30–60	50–30
Sheet					
Annealed	517–724	75–105	207–379	30–55	50–30
Strip					
Annealed	517–690	75–100	207–379	30–55	50–30
Tubing					
Hot finished	517–724	75–105	172–414	25–60	50–30
Cold drawn, annealed	517–690	75–100	207–414	30–60	50–30
Wire					
Annealed	552–758	80–110	241–448	35–65	45–25
Spring temper	965–1207	140–175	896–1172	130–170	5–2

Typical tensile and compressive properties of Alloy 800:

Material condition	Tensile strength		Tension				Compression			
			0.02% offset		0.2% offset		0.02% offset		0.2% offset	
	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
Annealed bar	616	89.3	268	38.8	283	41.1	269	39.0	287	41.6
As extruded (tubing)	479	69.5	145	21.0	190	27.5	145	21.0	175	25.4

Typical stress-rupture strengths of Alloy 800:

Temperature		For stress rupture at:			
		100 h		1000 h	
°C	°F	MPa	ksi	MPa	ksi
650	1200	220	32	145	21
760	1400	115	17	69	10
870	1600	45	6.5	33	4.8

Chemical Properties

General corrosion behavior: a high chromium content gives Alloy 800 good resistance to oxidation. It also resists many aqueous media and is relatively free from stress-corrosion cracking.

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Resistance to specific corroding agents: Alloy 800 has excellent resistance to nitric acid at concentrations up to approximately 70% and at temperatures up to the boiling point. It also has good resistance to organic acids, such as formic, acetic, and propionic. It resists a variety of oxidizing and nonoxidizing salts, but not halide salts. Corrosion rates in various media are given in following table:

Environment	Test duration days	Corrosion rate		Pitting resistance
		mm/yr	mils/yr	
Acetic acid (10%)	7	0.0003	0.01	No pitting
Acetic acid (10%) + sulfuric acid (0.5%)	7	0.0006	0.02	No pitting
Acetic acid (10%) + sodium chloride (0.5%)	42	0.0008	0.03	Incipient pits visible at 30× after 42 days
Aluminum sulfate (5%)	7	0.0003	0.01	No pitting
Ammonium chloride (5%)	42	0.0006	0.02	Pitting after 42 days
Ammonium hydroxide (5%)	7	0.0003	0.01	No pitting
Ammonium hydroxide (10%)	7	0.0003	0.01	No pitting
Ammonium sulfate (5%)	7	0.00	0.00	No pitting
Barium chloride (10%)	42	0.0008	0.03	Pitting after 42 days
Bromine water (saturated)	42	0.19	7.6	Pitting after 7 days
Calcium chloride (5%)	42	0.0003	0.01	Pitting after 42 days
Chromic acid (5%)	7	0.041	1.6	No pitting
Citric acid (10%)	7	0.00	0.00	No pitting
Copper sulfate (10%)	7	0.00	0.00	No pitting
Ferric chloride (5%)	42	11	420	Pitting after 7 days
Ferrous ammonium sulfate (5%)	7	0.002	0.08	No pitting
Lactic acid (10%)	7	0.001	0.04	No pitting
Methanol (absolute)	7	0.00	0.00	No pitting
Oxalic acid (5%)	7	0.003	0.12	No pitting
Oxalic acid (10%)	7	0.28	11.0	No pitting
Potassium ferricyanide (5%)	7	0.001	0.04	No pitting
Sodium bisulfite (5%)	7	0.0008	0.03	No pitting
Sodium carbonate	7	0.00	0.00	No pitting
Sodium chloride (10%)	42	0.0003	0.01	Incipient pits visible at 30× after 42 days
Sodium chloride (20%)	42	0.0086	0.34	Pitting after 7 days
Sodium hypochlorite (1%)	42	0.127	5.0	Pitting after 7 days
Sodium hypochlorite (5%)	42	0.2	8.0	Pitting after 7 days
Sodium sulfate (5%)	7	0.00	0.00	No pitting
Sodium sulfate (10%)	7	0.0006	0.02	No pitting
Sulfurous acid (5%)	7	1.09	43.0	No pitting
Tartaric acid (10%)	7	0.0006	0.02	No pitting
Zinc chloride (10%)	42	0.0003	0.01	Pitting after 42 days