

Alloy B-3

UNS N10675

Alloy B-3 (UNS N10675) is a nickel-molybdenum alloy with excellent resistance to hydrochloric acid at all concentrations and temperatures. It also withstands sulfuric, acetic, formic and phosphoric acids, and other nonoxidizing media. Alloy B-3 has a special chemistry designed to achieve greater thermal stability than Alloy B-2, resulting in easier fabrication.

Specification

NiWire's production follows:

ASTM B 333 (plate, sheet, and strip), B 335 (rod), B 366 (welding fittings), B 564 (forgings), B 619 (welded pipe), B 622 (seamless pipe and tube), B 626 (welded tube)

Chemical Composition

Composition limits: 65 min Ni; 28.5 Mo; 1.5 Cr; 1.5 Fe; 3 max Co; 3 max Mn; 0.5 max Al; 0.2 max Ti; 0.1 max Si; 0.01 max C

Applications

Typical uses: Suitable for most chemical process applications in the as-welded condition. Well suited for equipment handling hydrochloric acid in all concentrations and temperatures. Resistant to hydrogen chloride gas and sulfuric, acetic, and phosphoric acids. Principal high-temperature uses are those in which a low coefficient of thermal expansion is required.

Precautions in use: Like Alloy B-2, Alloy B-3 is not recommended for use in the presence of ferric or cupric salts because these salts can cause premature failure.

Physical Properties

Density: 9.22 g/cm³ (0.333 lb/in.³)

Melting range: 1370 to 1418 °C (2500–2585 °F)

Coefficient of thermal expansion: 10.6 μm/m · K at 25 to 100 °C (5.7 μin./in. · °F at 78–200 °F)

Electrical resistivity: 1.37 μΩ · m (53.8 μΩ · in.) at room temperature

Thermal diffusivity: 3.0 × 10⁻⁶ m² / s (4.6 × 10⁻⁹ in.²/s)

Mechanical Properties

Tensile properties: See Table 1.

Elastic modulus: 216 GPa (31.4 × 10⁶ psi) at room temperature

Chemical Properties

General corrosion behavior: Excellent resistance to hydrochloric acid at all concentrations and temperatures. Alloy B-3 also withstands sulfuric, acetic, formic, and phosphoric acids, and other non-oxidizing media. The chemistry of Alloy B-3 has been designed to achieve a level of thermal stability superior to that of Alloy B-2. It also resists pitting corrosion, stress-corrosion cracking, and weldment corrosion.

Resistance to specific corroding agents: See Table 2 for data comparing alloys B-3, B-2, stainless steel 316L and nickel-copper Alloy 400 in various boiling acids.

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Table 1 - Typical tensile properties of Alloy B-3 sheet and plate

Test temperature		Ultimate tensile strength		Yield strength at 0.2% offset		Elongation 50 mm (2 in.),%
°C	°F	MPa	ksi	MPa	ksi	
Sheet (a)						
RT	RT	860	125.0	420	60.6	53.4
95	200	830	120.7	380	55.3	56.9
205	400	760	110.0	325	47.0	59.7
315	600	720	104.4	300	43.5	63.4
425	800	705	102.0	290	42.4	62.0
540	1000	675	97.8	270	39.0	59.0
650	1200	715	103.5	315	45.8	55.8
Plate (b)						
RT	RT	885	128.3	400	58.2	57.8
95	200	845	122.4	375	54.1	58.2
205	400	795	115.1	330	47.6	60.9
315	600	765	111.2	305	44.4	61.6
425	800	745	108.2	285	41.3	61.7
540	1000	730	105.6	275	39.6	61.7
650	1200	735	106.9	290	42.0	64.6

(a) Bright annealed 3.2mm (0.125 in.) thick sheet. (b) Solution treated 6.4mm (0.250 in.) thick plate

Table 2 - Corrosion rates of Alloy B-3 in various boiling acids compared with other corrosion resistant alloys

Acid medium	Average corrosion rates, mm/yr (mils/yr)			
	Alloy B-3	Alloy B-2	S.S 316L	Alloy 400
50% acetic acid	0.005 (0.2)	0.010 (0.4)	0.005 (0.2)	...
40% formic acid	0.013 (0.5)	0.018 (0.7)	1.041 (41)	0.053 (2.1)
50-55% phosphoric acid	0.076 (3.0)	0.152 (6)	0.457 (18)	0.114 (4.5)
50% sulfuric acid	0.043 (1.7)	0.030 (1.2)	>500 (>20,000)	4.699 (185)
20% hydrochloric acid	0.305 (12)	0.381 (15)	>500 (>20,000)	40.310 (1587)