

Alloy C-4

Alloy C-4 (UNS N06455) is a nickel-chromium-molybdenum alloy with similar corrosion resistance to Alloy C-276, but has improved thermal stability. In strongly reducing media like hydrochloric acid, Alloy C-276 was better; but in highly oxidizing media, the opposite was true, that is, Alloy C-4 was better. Alloy C-4 offers good corrosion resistance to a wide variety of media including organic acids and acid chloride solutions. This alloy has found greater acceptance in European countries in contrast to Alloy C-276, which is more widely used and accepted in the United States.

Specification

NiWire's production follows:

ASTM B 366 (welding fittings), B 574 (rod), B 575 (plate, sheet, and strip), B 619 (welded pipe), B 622 (seamless pipe and tube), B 626 (welded tubes)

Chemical Composition

Composition limits: 14 to 18 Cr; 14 to 17 Mo; 3.00 max Fe; 2.00 max Co; 1.00 max Mn; 0.70 max Ti; 0.15 max C; 0.08 max Si; 0.04 max P; 0.03 max S; bal Ni

Applications

Typical uses: Outstanding high-temperature stability; exhibits good ductility and corrosion resistance after long-time aging at 650 to 1040 °C (1200–1900 °F). Resists formation of grain-boundary precipitates in weld heat-affected zones, and is suitable for most chemical process applications in the as-welded condition. Has excellent resistance to stress-corrosion cracking and to oxidizing atmospheres up to 1040 °C (1900 °F).

Physical Properties

Density: 8.64 g/cm³ (0.312 lb/in.³) at 20 °C (68 °F)

Coefficient of thermal expansion (linear):

Temperature		Coefficient	
°C	°F	μm/m · K	μin./in. · °F
20–93	68–200	10.8	6.0
20–205	68–400	11.9	6.6
20–315	68–600	12.6	7.0
20–425	68–800	13.0	7.2
20–540	68–1000	13.3	7.4
20–650	68–1200	13.5	7.5
20–760	68–1400	14.4	8.0
20–870	68–1600	14.9	8.3
20–980	68–1800	15.7	8.7

Specific heat

Temperature		Specific heat	
°C	°F	J/kg · K	Btu/lb · °F
0	32	406	0.097
100	212	426	0.102
200	390	448	0.107
300	570	465	0.111
400	750	477	0.114
500	930	490	0.117
600	1100	502	0.120

Electrical resistivity:

Temperature		Resistivity, μΩ · m
°C	°F	
23	74	1.25
100	212	1.25
200	390	1.26
300	570	1.27
400	750	1.28
500	930	1.29
600	1110	1.32

Alloy C-4

Thermal conductivity:

Temperature		Conductivity	
°C	°F	W/m · K	Btu/ft · h · °F
23	74	10.0	5.8
100	212	11.4	6.6
200	390	13.2	7.7
300	570	14.9	8.7
400	750	16.6	9.7
500	930	18.4	10.7
600	1100	20.4	11.8

Thermal diffusivity:

Temperature		Diffusion coefficient
°C	°F	$10^{-6} \text{m}^2/\text{s}$
23	74	2.8
100	212	3.1
200	390	3.3
300	570	3.7
400	750	4.0
500	930	4.3
600	1100	4.7

Mechanical Properties

Tensile properties: Average, at room temperature, for material solution treated at 1065 °C (1950 °F) and quenched. Sheet: tensile strength, 785 MPa (114 ksi); yield strength, 400 MPa (58 ksi); elongation in 50 mm or 2 in., 54%. Plate: tensile strength, 785 MPa (114 ksi); yield strength, 345 MPa (50 ksi); elongation in 50 mm or 2 in., 60%

Hardness: At room temperature, for sheet heat treated at 1065 °C (1950 °F) and quenched: 91 HRB

Elastic modulus: In tension, average of three tests at each temperature for 12.7 mm (1/2 in.) thick plate heat treated at 1065 °C (1950 °F) and quenched:

Temperature		Modulus	
°C	°F	GPa	10^6 psi
RT	RT	211	30.8
93	200	207	30.2
205	400	201	29.3
315	600	194	28.3
425	800	187	27.3
540	1000	179	26.2
650	1200	171	25.0
760	1400	162	23.7
870	1600	152	22.2
980	1800	141	20.6

RT, room temperature

Chemical Properties

General corrosion behavior: Exceptional resistance to a variety of chemical process environments, including hot contaminated mineral acids, solvents, chlorine, and chlorine-contaminated media (organic and inorganic, dry chlorine, formic and acetic acids, acetic anhydride, seawater, and brine)