

HASTELLOY C-276 TECHNICAL DATA

Type Analysis

Element	Min	Max
Molybdenum	15.0	17.0
Chromium	14.5	16.5
Iron	4.00	7.00
Tungsten	3.00	4.50
Cobalt	--	2.50
Carbon	--	0.02
Silicon	--	0.08
Manganese	--	1.00
Vanadium	--	0.35
Phosphorus	--	0.03
Sulfur	--	0.03
Nickel	Remainder	

Description

Hastelloy C-276 is a nickel-molybdenum-chromium-tungsten alloy with excellent general corrosion resistance and good fabricability. The alloy should be considered for use in environments where resistance to hot contaminated mineral acids, organic and inorganic chloride-contaminated media, chlorine, formic and acetic acids, acetic, acetic anhydride, sea water and brine solutions is desired. Hastelloy C-276 has resisted the formation of grain boundary precipitates in the weld heat-affected zone, making it a candidate for most chemical and petrochemical processing applications in the as-welded condition. The alloy has resisted both general and localized corrosion, including pitting, crevice corrosion, and stress corrosion cracking. Hastelloy C-276 is readily fabricated by welding, using methods similar to those utilized for nickel-based alloys.

Corrosion Resistance

Hastelloy C-276 is balanced to provide excellent corrosion resistance to a variety of chemical process environments. This alloy has provided resistance to hot contaminated mineral acids, organic and inorganic chloride contaminated media, hypochlorite, chlorine dioxide solutions, formic and acetic acids, acetic anhydride, sea water and brine solutions.

Typical General Corrosion Rates*

Environment	Concentration (% by weight)	Test Temperature		Penetration Rate (per year)					
		°F	°C	Unwelded**		As-welded***		Welded and heat-treated**	
				mils	mm	mils	mm	mils	mm
Formic Acid	20	Boiling	Boiling	4.8	0.12	3.5	0.09	3.60	0.09
Hydrochloric Acid	10	150	66	21.	0.53	20.	0.51	21.	0.53
Hydrochloric Acid	10	167	75	40.	1.02	50.	1.27	--	--
Hydrochloric Acid	10+0.5 NaOCl	167	75	46.	1.17	50.	1.27	--	--
Hydrochloric Acid	3.5+8 Fe Cl ₃	190	88	--	--	5.	0.13	--	--
Sulfuric Acid	10	Boiling	Boiling	15.	0.38	14.	0.36	18.	0.46
Sulfuric Acid	85	167	75	17.	0.43	17.	0.43	--	--

*Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.

**Solution heat-treated

***Gas tungsten-arc welded.

Workability

Hastelloy C-276 can be forged, hot-upset, and impact extruded. Although the alloy tends to work-harden, it can be successfully deep-drawn, spun, press formed or punched. All of the common methods of welding can be used to weld alloy C-276, although the oxy-acetylene and submerged arc processes are not recommended when the fabricated item is intended for use in corrosion service. Special precautions should be taken to avoid excessive heat in-put.

Welding

Gas tungsten-arc welding, gas metal-arc welding, shielded metal-arc (coated electrode) welding, or resistance welding may be used. Minimum heat input consistent with adequate penetration reduces the chance of hot-cracking. Oxyacetylene welding should be avoided due to possibility of carburization. Hastelloy C-276 can be used in the as-welded condition in most chemical and petrochemical process equipment.

Heat-Treatment

Wrought forms of Hastelloy C-276 are furnished in the solution heat-treated condition unless otherwise specified. Alloy C-276 is normally solution heat-treated at 2050 °F and rapid quenched. Parts which have been hot-formed should be solution heat-treated prior to final fabrication or installation, if possible.

Average Physical Properties

Physical Properties	°F	British Units	°C	Metric Units
Density	72	0.321 lb./in.(3)	22	8.89 g/cm(3)
Melting Range	2415-2500		1323-1371	
Electrical Resistivity	75	51 microhm-in.	24	1.30 microhm-m
Mean Coefficient of Thermal Expansion	75-200	6.2 microin./in.-°F	24-93	11.2 X 10(-6)m/m-K
	75-400	6.7 microin./in.-°F	24-204	12.0 X 10(-6)m/m-K
	75-600	7.1 microin./in.-°F	24-316	12.8 X 10(-6)m/m-K
	75-800	7.3 microin./in.-°F	24-427	13.2 X 10(-6)m/m-K
	75-1000	7.4 microin./in.-°F	24-538	13.4 X 10(-6)m/m-K
	75-1200	7.8 microin./in.-°F	24-649	14.1 X 10(-6)m/m-K
	75-1400	8.3 microin./in.-°F	24-760	14.9 X 10(-6)m/m-K
	75-1600	8.8 microin./in.-°F	24-871	15.9 X 10(-6)m/m-K
	75-1700	8.9 microin./in.-°F	24-927	16.0 X 10(-6)m/m-K

Thermal Conductivity	-270	50 Btu-in/ft ² -hr-°F	-168	7.2 W/m-K
	-100	60 Btu-in/ft ² -hr-°F	-73	8.6 W/m-K
	0	65 Btu-in/ft ² -hr-°F	32	9.4 W/m-K
	100	71 Btu-in/ft ² -hr-°F	38	10.2 W/m-K
	200	77 Btu-in/ft ² -hr-°F	93	11.1 W/m-K
	400	90 Btu-in/ft ² -hr-°F	204	13.0 W/m-K
	600	104 Btu-in/ft ² -hr-°F	316	15.0 W/m-K
	800	117 Btu-in/ft ² -hr-°F	427	16.9 W/m-K
	1000	132 Btu-in/ft ² -hr-°F	538	19.0 W/m-K
	1200	145 Btu-in/ft ² -hr-°F	649	20.9 W/m-K
	1400	159 Btu-in/ft ² -hr-°F	760	22.9 W/m-K
	1600	173 Btu-in/ft ² -hr-°F	871	24.9 W/m-K
	1800	185 Btu-in/ft ² -hr-°F	982	26.7 W/m-K
	2000	195 Btu-in/ft ² -hr-°F	1093	28.1 W/m-K

Average Dynamic Modulus of Elasticity

Form	Condition	Test Temp, °F(°C)	Average Dynamic Modulus of Elasticity,10(6) psi (GPa)
Plate	Heat-treated at 2050 °F (1121 °C), Rapid Quenched	Room	29.8 (205)
		400 (204)	28.3 (195)
		600 (316)	27.3 (188)
		800 (427)	26.4 (182)
		1000 (538)	25.5 (176)

Average Room Temperature Hardness

Form	Hardness, Rockwell
Sheet	Rb 90
Plate	Rb 87

Average Tensile Data

Form	Condition	Test Temp., °F(°C)	Ultimate Tensile Strength ksi (MPa)	Yield Strength at 0.2% offset ksi (MPa)	Elongation in 2" percent
Sheet, 0.063 to 0.187" Thick	Heat treated at 2050 °F Rapid Quenched	400 (204)	100.8 (695)	42.1 (290)	56
		600 (316)	97.0 (669)	37.7 (260)	64
		800 (427)	95.0 (655)	34.8 (240)	65
		1000 (538)	88.9 (613)	33.8 (233)	60
Plate, 3/16 to 1.000" Thick	Heat treated at 2050 °F Rapid Quenched	400 (204)	98.9 (682)	38.2 (263)	61
		600 (316)	94.3 (650)	34.1 (235)	66
		800 (427)	91.5 (631)	32.7 (235)	60
		1000 (538)	87.2 (601)	32.8 (226)	59
Plate, 1.000" Thick	Heat treated at 2050 °F Rapid Quenched	Room	113.9 (785)	52.9 (365)	59
		600 (316)	96.3 (664)	36.2 (250)	63
		800 (427)	94.8 (654)	30.5 (210)	61

Average Oxidation Data

Test Temperature, °F(°C)	Average Oxidation Rate per 100-hour test period			
	100 hours,continuous mils mm		100 hours,intermittent mils mm	
1800 (982)	0.11	0.003	0.11	0.003
1900 (1038)	0.22	0.006	0.18	0.005
2000 (1093)	1.62	0.041	2.88	0.073

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