

Hastelloy C-276 (UNS N10276)



Hastelloy C-276 offers good resistance to pitting and crevice corrosion and stress corrosion cracking in reducing and oxidizing media. It is extremely resistant to wet chloride gas and chlorine dioxide environments. It retains good corrosion resistance even in the welded form. Alloy C-276 is used in chemical processing, pollution control, scrubbers, stack gas reheaters, pharmaceutical and food processing systems.

C-276 alloy is an enhanced version of corrosion resistance material. It doesn't need to be heat processed after welding and provides extremely improved fabricability. It resists the production of grain precipitation in the welded areas so it is very much fit for using in the chemical processing applications in the welded form. But in the conditions when there is a feasibility of corrosion of alloy C-276 welds, Hastelloy C-22 weld filler metal is recommended for use.

Alloy C-276 offers superior resistance to the localized corrosion and oxidizing and reducing environments. This versatile material can be set into upset conditions for use in the multifunctional units.

Chemical Composition

Molybdenum (Mo)	15 to 17 %
Chromium (Cr)	14.5 to 16.5 %
Iron (Fe)	4 to 7 %
Tungsten (W)	3 to 4.50 %
Cobalt (Co)	2.50 %
Carbon (C)	0.02 %
Silicon (Si)	0.08 %
Manganese (Mn)	1 %
Vanadium (V)	0.35 %
Phosphorous (P)	0.03 %

Sulfur (S) 0.03 %

Nickel (Ni) Rem %

Physical Properties

Density	0.321 lb./in.(3) at 72oF or 8.89 g/cm(3) at 22oC
Melting Point	2415 to 2500 or 1323 to 1371
Electrical Resistivity	51 microhm-in. at 75oF or 1.30 microhm-m at 24oC

Coefficient of thermal expansion

Temperature		microin./ in.-°F	10 (-6) m/m-K
oF	oC		
75 oF to 200 oF	24 oC to 93 oC	6.2	11.2
75 oF to 400 oF	24 oC to 204 oC	6.7	12
75 oF to 600 oF	24 oC to 316 oC	7.1	12.8
75 oF to 800 oF	24 oC to 427 oC	7.3	13.2
75 oF to 1000 oF	24 oC to 538 oC	7.4	13.4
75 oF to 1200 oF	24 oC to 649 oC	7.8	14.1
75 oF to 1400 oF	24 oC to 760 oC	8.3	14.9
75 oF to 1600 oF	24 oC to 871 oC	8.8	15.9
75 oF to 1700 oF	24 oC to 927 oC	8.9	16

Thermal Conductivity

Temperature		Btu-in/ft ² -hr-°F	W/m-K
of	oC		
-270 of	-168 oC	50	7.2
-100 of	-73 oC	60	8.6
0 of	32 oC	65	9.4
100 of	38 oC	71	10.2
200 of	93 oC	77	11.1
400 of	204 oC	90	13
600 of	316 oC	104	15
800 of	427 oC	117	16
1000 of	538 oC	132	19
1200 of	649 oC	145	20.9
1400 of	760 oC	159	22.9
1600 of	871 oC	173	24.9
1800 of	982 oC	185	26.7
2000 of	1093 oC	195	28.1

Modulus of Elasticity

Temperature		Psi	GPa
oF	oC		

Room temperature	Room temperature	29.8	205
400 oF	204 oF	28.3	195
600 oF	316 oF	27.3	188
800 oF	427 oF	26.4	182
1000 oF	538 oF	25.5	176

Mechanical Properties

Form	Processing	Temperature		Ultimate Tensile Strength		Yield Strength at 0.2% offset		Elongation % in 2 inch
		oF	oC	Ksi	Mpa	Ksi	Mpa	
Sheet	Heat processing at 2050oF, quick cooling	400 oF	204 oC	100.8	695	42.1	290	56
		600 oF	316 oC	97	669	37.7	260	64
		800 oF	427 oC	95	655	34.8	240	65
		1000 oF	538 oC	88.9	613	33.8	233	60
Plate	Heat processing at 2050oF, quick cooling	400 oF	204 oC	98.9	682	38.2	263	61
		600 oF	316 oC	94.3	650	34.1	235	66
		800 oF	427 oC	91.5	631	32.7	235	60
		1000 oF	538 oC	87.2	601	32.8	226	59
Plate	Heat processing at 2050oF, quick cooling	RT	RT	113.9	785	52.9	365	59
		600 oF	316 oC	96.3	664	36.2	250	63
		800 oF	427 oC	94.8	654	30.5	210	61

Corrosion Resistance

Hastelloy C-276 corrosion resistance alloy offers tremendous resistance to the various chemical processing conditions such as powerful oxidizer like chlorides of iron and copper, hot mixed organic and inorganic acids, formic and acetic acids, acetic anhydride, and seawater and brine solutions. It offers resistance to the carbide precipitation while welding retains corrosion resistance features in the heated zones of welding points.

Alloy C-276 is used in the desulfurization processes due its very high resistance to compounds containing sulfur and chloride ions found in the scrubs. The alloy offers superior resistance to the pitting and stress corrosion cracking and it is one of the popular metals that are capable to adhere under the impact of hydrated chlorine, hypochlorite, and chlorine dioxide and other media.

Aqueous corrosion data

Media	Content wt %	Temp		Mean Corrosion rate, mills per year			
		oF	oC	Alloy C276	Alloy C22	Alloy C4	Alloy 60
Acetic Acid	99 %	boiling	Boiling	Below 1	None	None	Below 1
Ferric Chloride	10 %	boiling	boiling	2	1	140	7689
Formic Acid	88 %	boiling	boiling	2	Below 1	3	9
Hydrochloric acid	1 %	boiling	boiling	10	3	36	1
Hydrochloric acid	1.5 %	boiling	boiling	29	11	64	353
Hydrochloric acid	2 %	194 oF	90 oC	1	None	31	None

Hydrochloric acid	2 %	Boiling	boiling	51	61	85	557
Hydrochloric acid	3 %	194 oF	90 oC	12	Below 1	34	72
Hydrochloric acid	3 %	Boiling	boiling	70	84	44	296
Hydrochloric acid	10 %	boiling	boiling	288	400	228	642
Hydrochloric acid + 42 g/l Fe ₂ (SO ₄) ₃	1 %	200 oF	93 oC	41	2	10	238
	5 %	150 oF	66 oC	5	2	3	2
HCl + 2 % HF	5 %	158 oF	70 oC	26	59	34	112
Hydrofluoric acid	2 %	158 oF	70 oC	9	9	17	20
	5 %	158 oF	70 oC	10	14	15	16
Industrial P ₂ O ₅	38 %	185 oF	85 oC	9	2	-	1
	44 %	240 oF	116 oC	100	21	-	23
	52 %	240 oF	116 oC	33	11	-	12
P ₂ O ₅ + 2000 ppm Cl	38 %	185 oF	85 oC	12	1	-	2
P ₂ O ₅ + 0.5 % HF	38 %	185 oF	85 oC	45	7	-	9
Nitric Acid	10 %	Boiling	Boiling	17	Below 1	14	1
	65 %	Boiling	Boiling	888	53	217	20
Nitric Acid + 6% HF	5 %	140 oF	60 oC	207	67	204	73
Nitric Acid + 25% H ₂ SO ₄ + 4% NaCl	5 %	boiling	Boiling	64	12	97	713
Nitric Acid + 1 % HCl	5 %	boiling	Boiling	8	Below 1	11	1
Nitric Acid + 2.5 % HCl	5 %	boiling	Boiling	21	2	26	Below 1
Nitric Acid + 15.8 % HCl	9 %	126 oF	52 oC	33	4	114	Above 10,0
Sulfuric Acid	10 %	boiling	boiling	23	11	31	46
Sulfuric Acid	20 %	150 oF	66 oC	Below 1	Below 1	Below 1	Below 1
Sulfuric Acid	20 %	174 oF	79 oC	3	1	2	Below 1
Sulfuric Acid	20 %	boiling	boiling	42	33	36	124
Sulfuric Acid	30 %	150 oF	66 oC	Below 1	1	Below 1	Below 1
Sulfuric Acid	30 %	174 oF	79 oC	4	3	3	Below 1
Sulfuric Acid	30 %	boiling	boiling	55	64	73	238
Sulfuric Acid	40 %	100 oF	38 oC	Below 1	Below 1	Below 1	Below 1
Sulfuric Acid	40 %	150 oF	66 oC	1	Below 1	10	17
Sulfuric Acid	40 %	174 oF	79 oC	10	6	15	35
Sulfuric Acid	50 %	100 oF	38 oC	None	Below 1	Below 1	1
Sulfuric Acid	50 %	150 oF	66 oC	4	1	13	25
Sulfuric Acid	50 %	174 oF	79 oC	12	16	25	52
Sulfuric Acid	60 %	100 oF	38 oC	Below 1	Below 1	Below 1	Below 1
Sulfuric Acid	70 %	100 oF	38 oC	None	None	2	Below 1
Sulfuric Acid	80 %	100 oF	38 oC	Below 1	None	Below 1	Below 1

Fabrication

Hastelloy C-276 alloy can be produced, hot set and impact extruded. Though it causes the work toughening, it can be vitally deep drawn, fabricated and stressed. It is welded by using

the common and traditional welding methods except oxyacetylene method are used. The serious provisions are followed to prevent the excessive heating of alloy.

The shaped C-276 alloy is prepared in the heat processed solution until it is recommended. The alloy is heat processed at the 2050oF temperature or 1121oC and quickly quenched.

The dehydrated chemical composition of hastelloy electrodes includes Carbon by 0.02 %, Silicon by 0.20 %, Phosphorous by 0.03 % and sulfur by 0.015 %. In the rigorous corrosive conditions **Hastelloy C-276** is utilized as the most trusted alloy. The excellent service in the tough conditions for several years has proven the quality performance of this alloy.

Alloy C-276 is purposeful in the chemical processing and other industrial operations and it has become the dominant choice of engineers. Before employing in the industry, Hastelloy C-276 alloy goes through the exacting process, chemical controls, heat mechanical treatments, analysis and criteria for the rigid norms. Moreover the welded alloy specimen offers the enhanced functionality.

Available Forms

Wire, Mesh, Strip, Foil, Plate, Sheet, Rod, Bar, Tubing, Pipe, Flanges