Hastelloy G-30 Alloy

Introduction

The excellent Hastelloy G-30 alloy is a nickel- chromium alloy that offers outstanding resistance to corrosion to the commercial phosphoric acid and oxidizing acid solutions containing the concentrated nitric, hydrochloric acid and sulfur acid.

The resistance offered by G-30 alloy to the production of grain precipitates in the heated area enables it for using in the chemical operations in the welded conditions.

Chemical composition of Hastelloy G-30 Alloy alloy

Ni	Co	Cr	Mo	W	Fe	Si	Mn	C	Cb +Ta	Cu	P	S
43	5.0	28-31.5	4-6	1.5–4	13 –17	0.8	1.5	0.03	0.3–1.5	1-2.4	0.04	0.02

Physical properties of Hastelloy G30 Alloy

Density	8.22 gm/cm3
Electrical Resistivity	1.16 microhm-m
Thermal Conductivity	10.2 W/m.K
Mean Coefficient of thermal expansion	12.8 x 10-6m / m.K

Modulus of elasticity in different temperatures

Temp oC or oF	Dynamic modulus of elasticity, Gpa
75 or 24	202
400 or 204	196
600 or 316	194
800 or 427	192

Toughness

% cold work	Unaged, Rc	200 hr./392°F (200°C)	100 hr./932°F (500°C)
As Mill annealed	90	-	-
10	98	100	93
20	29	26	25
30	32	34	34
40	35	38	40
50	36	39	41

Hastelloy G-30 Alloy

Corrosion resistance

The Hastelloy G-30 alloy provides very high resistance to the hydrofluoric acid and nitric acid solutions that are utilized in the stainless steel pickling. This specific application includes dilute 15% nitric acid and 5% hydrofluoric acid at temperature of 140oF or 60oC. It also offers superior resistance to the industrial phosphoric acid. The use of alloy has been increasing in the fertilizer industry for acid evaporators.

The relative resistance offered by G-30 alloy and G alloy or 625 alloys to the industrial acids is described in the varied concentrations, temperatures and pollution levels. The significant difference in the rate of corrosion is possible in the acids of equal amount though from dissimilar sources. The corrosion evaluation in the acids obtained from the different sources and functionality of G-30 alloy as compare to 625 alloy is described. Normally the Hastelloy G-30 alloy provides improved performance in the corrosive conditions.

Environment	Temp. oF or oC	Corrosion rate per year		
		G-30 alloy	625 alloy	G-3 alloy
28% P2O5+ 2000 ppm C1	1 8 5 (8 5)	1 . 0	1 . 5	0 . 9
42% P2O5 + 2000 ppm C1 –	1 8 5 (8 5)	0 . 9	1 . 3	1 1
44% P2O5	2 4 1 (1 1 6)	7 . 0	2 3	22
44% P2O5+ 2000 ppm C1 –	2 4 1 (1 1 6)	7 . 7	25	22
44% P2O5+ 0.5% HF	2 4 1 (1 1 6)	16	60	49
52% P2O5	2 4 1 (1 1 6)	3 . 9	12	11

The relative corrosion rate of Hastelloy G-30 alloy in the different acid mediums is provided below:

M e d i a	Conc.%	Temp, oF or oC	Corrosion rate per year		
			G-30 alloy	G-3 alloy	625 alloy
Acetic Ac i d	99	Boiling	1	0.6	<1
Formic Ac i d	88	Boiling	2	5	9
Nitric Ac i d	10	Boiling	0.4	0.9	1
Nitric Acid + 1% HF	20	176 (80)	31	74	123
Nitric Acid + 6% HF	20	176 (80)	177	540	2400

Aging of Hastelloy G-30 alloy

The corrosion resistance of hastelloy G-30 alloy is influenced by aging is described below:

Aging temp.	Average Corrosion Rate in 20% HNO3 + 6% HF at 176°F (80°C) per year					
oF or oC	Aging Time, 1 hour			Aging Time, 10hours		
	G	G - 3	G - 30	G	G - 3	G - 30
1200 or 649	860	438	223	3890	575	272
1400 or 760	12000	860	230	19000	2660	1600
1600 or 871	19000	2145	177	20000	4375	454
1800 or 982	19000	577	338	19000	640	427

Pitting temperature in Oxidizing Chloride Media

The content of solution that is used to determine the immersion pitting temperature in the oxidizing and chloride media is 4% sodium chloride, 0.1% ferrous sulphate, and 0.1% hydrochloric acid. The mixture consists of 24,3000 ppm chlorides and it is acidic in nature. The variation in temperature occurs by 5oC to evaluate the minimum temperature to begin the pitting corrosion.

Hastelloy G-30 Alloy

Alloy	oC	oF
Hastelloy G - 30	70	158
Hastelloy G-3	70	158
Alloy 904L	45	113
317 LM stainless steel	35	95
317L stainless steel	25	77
Alloy 825	25	77
20 Cb-3 alloy	20	68

Room Temperature tensile properties

Alloy Form	Tensile strength, ksi	Yield strength, ksi	Elongation %	Reduction Area %
Sheet, 0.028 in. (0.71mm) thick	100	47	56	-
Sheet, 0.125 in. (3.2mm) thick	100	51	56	-
Plate, 0.250 in. (6.4mm) thick	98	46	55	-
Plate, 0.375 in. (9.5mm) thick	100	45	65	68
Plate, 0.500 in. (12.7mm) thick	100	46	64	77

High temperature tensile properties of hastelloy G-30 alloy

oF or oC	Tensile strength, ksi	Yield strength, ksi	Elongation %
Room temp.	103	49	53
200 or 93	95	42	54
400 or 204	88	36	59
600 or 316	83	33	59
800 or 427	80	31	60

Fabrication of Hastelloy G-30

The wrought forms of G-30 alloy are subjected to heat processing until the other condition is suggested. The standard mixture, heat processing comprises of heating of alloy up to 2150oF or 1177oC subsequent to quick air or water quenching. The portions that are not hot produced are subjected to heat treatment before fabrication accomplished.

Since Hastelloy G-30 alloy is comprised of superior forming features, cold formation is a recommended method for fabrication. Due to superior ductility of alloy, it can be conveniently cold processed. The alloy G-30 is normally more rigid as compare to austenitic stainless steel alloys. So more energy is needed while cold processing of alloy.

Tensile properties and cold processing of alloy at the room temperature are provided as following:

Condition	Tensile Strength, ksi	Yield Strength, ksi	Elongation,%
Mill Annealed	100	46	64
10% cold rolled	116	88	38
30% cold rolled	159	145	12
50% cold rolled	173	158	12
50% cold rolled + 1 hr. at 932oF (500oC), air cool	180	161	12

Hastelloy G-30 Alloy

Influence of cold working on impact strength

Condition	Impact Strength	
	ft - lb	J
Mill Annealed	260	353
50% cold rolled	31	42
50% cold rolled + 1 hr. at 932°F (500°C)	33	45
50% cold rolled + 500 hrs. at 932°F (500°C)	11	15

Hastelloy G-30 Strip has same nature as other alloys in formability. It is more rigid than austenitic steels. Due to its superior ductility, cold processing is easy and preferred for forging. It is easily weldable through Gas Tungsten Arc, Gas Metal Arc and shielded metal arc. The welding properties are similar to Hastelloy G-3. It prevents the production of grain boundary precipitate in the heated zone that makes it fit in the welded conditions.

Machining of Hastelloy G-30

Consisting of Nickel and Cobalt, temperature and wear resistance alloys are classified as moderate to hard during machining. However, it should be taken care that Hastelloy G-30 is machined through conventional fabrication methods at the affordable rates. While machining these alloys work hardened rapidly, produce large heat while cutting, weld to the cutting to surface and has superior resistance to metal eradication due to high shear strength. Following are basic factors that should be chosen while machining:

Capacity: Machine should be solid and overpowered.
Rigidity: Working material and apparatus should be solid. Reduce tool projection.
Apparatus Sharpness: Get the apparatus sharp regularly instead of unnecessarily. 0.015 inch wear land is called as dull equipment.
Apparatus: Utilize positive rake angles for the machining operations. Negative rake angle equipments can be chosen for irregular cuts and heavy stock removal. The carbide tipped equipments are preferred for various operations. The high speed equipments can be utilized, low formation rates and generally preferred for intermittent cuts.
Positive Cuts: Utilize massive, constant feeds to preserve positive cutting action. If the feed rate is slow and equipment dwell in the cuts, work toughening occurs, tool life deteriorates and approximate tolerances become unfeasible.
Lubrication: Lubricants are enviable, soluble oils are preferred especially while utilizing carbide equipments.

Welding of Hastelloy G-30

Hastelloy G-30 alloy is easily weldable through Gas Tungsten Arc welding, Gas Metal Arc welding and shielded metal arc welding methods. The welding features are similar to Hastelloy G-3 alloy. Submerged arc welding is not preferred because this procedure includes extensive heating of base metal and slows weld quenching.

Basic Metal: The joining surface and around space is cleaned properly for welding. Every kind of contaminant and foreign material like oil crayon marks, sulfur compounds and grease and other materials are removed.
Filter metals: Machining work filer metal is preferred for welding. Gas Tungsten Arc welding, Gas Metal Arc welding, Hastelloy G-30 filler wire is recommended. For shielded metal arc welding, G-30 alloy covered electrodes are preferred.

Hastelloy G-30 Alloy

Heanjia Super Metals Co., Ltd

ASTM standards Hastelloy G-30

ASME/ASTM	SB366/B 366	Fittings
ASME/ASTM	SB 581/B 581	Bar
ASME/ASTM	SB 582/B 582	Sheet, plate, strip
ASME/ASTM	SB 619/B 619	Welded pipe
ASME/ASTM	SB 622/SB 622	Seamless pipe and tubing
ASME/ASTM	SB 626/B 626	Welded tube
ASTM	B 462	Pipe, Flanges, Forged Fittings
ASTM	B 472	Billets and Bars and Reforging
ASME	Section III Class 2	Nuclear-All forms
ASME	Section III Class 3	Nuclear-All forms
ASME	Section VIII Division 1	All forms
ASME	B 16.5	Pipe, Flanges and Flanged, Fittings
ASME	B 16.34	Valves-Flanged, Threaded, and Welding Ends
ASME	SFA 5.14	Bare Welding Rods
ASME	SFA 5.11	Covered Welding Electrodes
AWS	A 5.14	Bare Welding Rods
AWS	A 5.11	Covered welding electrodes
DIN	No. 2.4603	All forms
DIN	NiCr30FeMo	All forms
Nace	MR-01-75	Metallic materials for oil field equipments

Applications of Hastelloy G-30 Alloy

1. Phosphoric Acid treatment
2. Sulfuric Acid treatment, Nitric Acid treatment
3. Nuclear Fuel Reprocessing, Nuclear Waste treatment
4. Fertilizer production, Pesticide production

Hastelloy G-30 Alloy Product Forms Available:

Wire, Wiremesh Screen, Strip, Sheet, Rod, Pipe, Bar, Tubing, Plate, Ribbon, Tape

Heanjia Super Metals Co., Ltd

Room 2108, 21/F, BLK128, Yinling International Zone, Wangjing West Rd, Chaoyang, Beijing, China (100102)