Hastelloy X alloy

Heanjia Super Metals Co., Ltd

The **Hastelloy X alloy** belongs to the family of resistance to corrosion nickel alloys and known as superalloy or high performance alloy. In the corrosion resistance applications the hastelloy may be treated as the off season alloy due to functionality, price, and technical problems like welding ease and more. Despite of the act that the hastelloy alloys are nominally preferred in acids rather than other alloys due to economy, it is implemented in the various industrial operations. The Hastelloy X is a Ni-Cr-Fe-Mo alloy that is manufactured for the elevated temperature applications. The alloy attains highly ductile character even after it is subjected into the extended exposure at temperature ranges of 1200oF, 1400oF, 1600oF for over 10,000 hours.

Hastelloy X is preferred for diverse furnace applications since it offers excellent resistance to oxidation, reduction and neutral conditions. It is utilized in the jet engines, afterburner parts, cabin heaters and other aircraft components. It is also utilized as a resistance alloy in the petrochemical operations.

Chemical composition of Hastelloy X alloy:

Molybdenum	8.00 - 10.0%
Chromium	20.5 – 23.0%
Iron	17.0 - 20.0%
Tungsten	0.20 – 1.00%
Cobalt	0.50- 2.50 %
Carbon	0.05- 0.015%
Silicon	1.00%
Manganese	1.00%
Boron	0.01%
Phosphorus	0.04%

Physical properties of Hastelloy X alloy:

Density	8.22 g/cubic cm.
Melting Range	2300oF – 2470oF
Electrical Resistivity	1.18 microhm-m
Mean Coefficient of Thermal expansion	13.8 X 10(-6)m/m-K
Thermal Conductivity	9.7* W/m-K
Poisson's Ratio at -78oF	0.328
Magnetic Permeability	<1.002 at 200 oersteds

Coefficient of thermal expansion of Hastelloy X alloy

°F	British Units	°C	Metric Units
79-200	7.7 microin./in.-°F	26-100	13.8 X 10(-6)m/m-K
79-1000	8.4 microin./in.-°F	26-500	14.9 X 10(-6)m/m-K
79-1200	8.6 microin./in.-°F	26-600	15.3 X 10(-6)m/m-K
79-1350	8.8 microin./in.-°F	26-700	15.7 X 10(-6)m/m-K
79-1500	8.9 microin./in.-°F	26-800	16.0 X 10(-6)m/m-K
76-1650	9.1 microin./in.-°F	26-900	16.3 X 10(-6)m/m-K
79-1800	9.2 microin./in.-°F	26-1000	16.6 X 10(-6)m/m-K

Thermal conductivity offered by Hastelloy X alloy

°F	British Units	°C	Metric Units

70	63 Btu-in/ft²-hr-°F	20	9.7* W/m-K
200	76 Btu-in/ft²-hr-°F	100	11.1 W/m-K
500	98 Btu-in/ft²-hr-°F	300	14.7 W/m-K
1100	144 Btu-in/ft²-hr-°F	600	20.6 W/m-K
1300	159 Btu-in/ft²-hr-°F	700	22.8 W/m-K
1500	174 Btu-in/ft²-hr-°F	800	25.0 W/m-K
1700	189 Btu-in/ft²-hr-°F	900	27.4* W/m-K

Dynamics modulus of elasticity of Hastelloy X alloy

Condition	Temperature, oF	Dynamic Modulus ofElasticity,10(6) psi
Heat-Processed at 2150 °F (1177°C), Rapid Cooled	76	28.5
	212	28.0
	392	26.9
	572	26.0
	752	25.0
	932	23.8
	1112	22.9
	1292	21.8
	1472	20.7
	1652	19.5
	1832	18.3

Tensile strength of Hastelloy X alloy

Alloy Form	Condition	Tensile strength, ksi	Yield Strength, ksi	Elongation
Sheet, 0.012 -0.090"thick	Heat treated at 2150°F (1177°C)QC	110.3 (760)	55.1 (380)	44
Sheet,0.091 -0.312" thick	Heat treated at 2150°F (1177°C)QC	109.5 (755)	55.9 (385)	45
Plate, 3/8 - 2" thick	Heat treated at 2150°F (1177°C)QC	107.7 (743)	49.1 (339)	51

Dynamic Modulus of elasticity

Temperature, oF	Temperature, oC	Modulus of elasticity, 10(6) psi	Modulus of elasticity, GPa
200	93	29.4	203
400	204	28.6	197
600	316	27.8	192
800	427	26.7	184
1000	538	25.8	178
1200	649	24.7	170
1400	760	23.3	161
1600	871	22.2	153

An easily fabricable hastelloy X offers superior forging and welding features. It can be easily forged and offers high ductility. It can be cold treated. The alloy X can be easily welded by following the manual and automatic techniques such as shielded metal arc and gas tungsten arc and gas metal arc. It can also resistance welded.

Heat Processing

The wrought forms of Hastelloy X alloy are provided in the solution heat processing condition. It is solution heat processed at temperature of 2150oF and then quenched quickly. The shining products are quenched through hydrogen.

Resistance features of Hastelloy X

The analysis is made on Hastelloy X in the carburization conditions with an inlet gas mixture that consists of 5% hydrogen gas, 5% carbon mono oxide and 5% methane and remaining argon. The oxygen strength and carbon performance at 1800oF are noticed 9 x 10-22 atm. And 1.0.

Welding Precautions

Welding of Hastelloy X is made safely. The people involved in the welding processes are familiar with the significant harms of the welding gases, heat, electric shocks and burns. The federal laws that are approved by OSHA in correspondence of welding and cutting methods are followed. The Nickel-Cobalt-Iron alloys contain different content of elements such as aluminum, cobalt, chromium, copper, iron, manganese, molybdenum, nickel and tungsten. Intake of metal dust produced through welding, crushing, grinding, melting or other processes put adverse effects on humans like lung cancer.

Extended contact in welding dust may cause eye irritation, skin problems and other problems. The application and maintenance of welding and cutting machines are performed by following the latest ANSI standards. The mechanical aeration is essential under the specific environments like in limited area during welding, cutting applications to avoid exposure to the toxic fumes and dust.

Applications of Hastelloy X

Hastelloy X is purposeful in aircrafts, furnace and chemical processing. It is used in gas turbine engines, transition ducts, combustor cans, spray bars and flame holders and cabin heating equipments.

Hastelloy X is purposeful in the commercial furnace operations due to its excellent resistance to oxidation, reduction and neutral conditions. The furnace parts that are made of Hastelloy X alloy show stabilized nature even after exposure at temperature of 2150oF for 8700 hours. It is also employed in the chemical processing for catalyst support grids, furnace baffles, tubing for pyrolysis and others.

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