HEAT-RESISTANT

ALLOY AT A GLANCE

HAYNES International

HASTELLOY® X alloy

CHEMISTRY: Weight %

Ni	Co	Fe	Cr	Mo	W	Mn	Si	C	B
47[a]	1.5	18	22	9	0.6	1*	1*	0.10	0.008*

[a] As Balance *Maximum

ALLOY DESCRIPTION:

HASTELLOY alloy X is a solid-solution-strengthened superalloy that combines very good high-temperature strength with very good resistance to oxidizing environments up to about 2000°F (1095°C), and good carburization resistance. It is one of the most widely used materials for fabricated or forged parts in gas turbine engines, and is also used in chemical and petrochemical plant, power plant and industrial heating applications. Although it is a highly capable material, alloy X is being replaced in many demanding new applications by more modern materials, such as HAYNES 230® alloy (ask for document H-3135). Alloy X may be cold-formed or hot-formed by various techniques, and is readily weldable by most standard methods.

PHYSICAL PROPERTIES:

	Temp., °F	British Units	Temp., °C	Metric Units
Density	Room	0.297 lb/in³	Room	8.22g/cm³
Melting Range	2300-2470		1260-1355	
Thermal Conductivity	800	121 BTU-in/ft²-hr-°F	400	16.9 W/m-K
	1000	136 BTU-in/ft²-hr-°F	600	20.9 W/m-K
	1200	152 BTU-in/ft²-hr-°F	700	22.8 W/m-K
	1400	167 BTU-in/ft²-hr-°F	800	24.8 W/m-K
	1600	182 BTU-in/ft²-hr-°F	900	26.7 W/m-K
	1800	197 BTU-in/ft²-hr-°F	1000	28.7 W/m-K
Mean Coefficient of Thermal Expansion	70-800	8.2 µin/in-°F	20-500	15.0 µm/m-°C
	70-1000	8.4 µin/in-°F	20-600	15.3 µm/m-°C
	70-1200	8.6 µin/in-°F	20-700	15.6 µm/m-°C
	70-1400	8.8 µin/in-°F	20-800	16.0 µm/m-°C
	70-1600	9.0 µin/in-°F	20-900	16.3 µm/m-°C
	70-1800	9.2 µin/in-°F	20-1000	16.6 µm/m-°C
Electrical Resistivity	400	46.9 µohm-in	200	119.0 µohm-cm
	800	48.4 µohm-in	400	122.7 µohm-cm
	1000	49.0 µohm-in	600	125.0 µohm-cm
	1200	49.5 µohm-in	700	126.0 µohm-cm
	1400	49.7 µohm-in	800	126.3 µohm-cm
	1600	49.8 µohm-in	900	126.6 µohm-cm
	1800	49.9 µohm-in	1000	126.6 µohm-cm

HEAT TREATMENT, SHEET AND STRIP (AMS 5536):

2150°F (1175°C)/Bright Anneal

HASTELLOY® X alloy

DYNAMIC MODULUS OF ELASTICITY:

Temp.,°F	10^6 psi	Temp.,°C	GPa	Temp.,°F	10^6 psi	Temp.,°C	GPa
70	29.8	20	205	1200	24.7	700	166
400	28.6	200	197	1400	23.3	800	158
800	26.7	400	186	1600	22.2	900	151
1000	25.8	600	174	1800	20.4	1000	139

TYPICAL TENSILE PROPERTIES, SHEET (AMS 5536):

Test Temperature		Ultimate Tensile Strength		0.2% Yield Strength		Elongation in 2 in (51mm)
°F	°C	Ksi	MPa	Ksi	MPa	%
ROOM	ROOM	110.6	765	54.9	380	44.2
1000	540	89.0	615	35.6	245	49.5
1200	650	82.9	570	35.4	245	54.0
1400	760	67.1	465	34.4	235	53.4
1600	870	45.0	310	28.2	195	58.3
1800	980	25.6	175	13.2	91	65.1
2000	1095	14.0	97	6.4	44	59.8

TYPICAL STRESS-RUPTURE STRENGTH, SHEET (AMS 5536):

Test Temperature		Approximate Initial Stress, Ksi (MPa) to Produce Rupture in:					
°F	°C	10 Hours		100 Hours		1000 Hours	
1400	760	28.0	(195)	20.5	(140)	14.6	(100)
1500	815	19.5	(135)	13.9	(96)	9.5	(66)
1600	870	13.5	(93)	9.1	(63)	5.6	(39)
1700	925	9.1	(63)	5.5	(38)	3.2	(22)
1800	980	5.5	(38)	3.2	(22)	1.9	(13)

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