HEAT-RESISTANT

ALLOY AT A GLANCE

HAYNES International

HAYNES® 230® alloy

HAYNES® 230® alloy is a solid-solution-strengthened superalloy that combines excellent high-temperature strength, outstanding resistance to oxidizing environments up to 2100˚F (1150˚C), excellent resistance to nitriding and hydrogen environments, and good carburization resistance. It is not embrittled by long-term thermal exposure. It is widely used for forged and fabricated parts in gas turbine engines, chemical and petrochemical plants, power plants, and industrial heating applications. Over the full industrial use temperature range, this alloy's strength and environment resistance are superior to most other heat-resistant alloys. 230® alloy may be cold-formed or hot-formed, and it is readily welded by standard techniques.

Nominal Composition (wt%):

Ni	Cr	W	Mo	Fe	Co	Mn	Si	Nb	Al	Ti	C	La	B
57[a]	22	14	2	3*	5*	0.5	0.4	0.5*	0.3	0.1*	0.1	0.02	0.015*

[a]As Balance *Maximum

Stress-Rupture:

Test Temperature		Approximate Initial Stress to Produce Rupture in:					
		100 Hours		1,000 Hours		10,000 Hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1200	649	56	386	41	283	29	200
1400	760	27	186	20	138	14.2	98
1600	871	13.7	94	9.5	66	6.2	43
1800	982	6.0	41	3.2	22	1.7	12
1900	1038	3.7	26	1.8	12	1.0	6.9
2000	1093	2.1	14	1.0	6.9	0.55	3.8
2100	1149	1.2	8.3	0.60	4.1	-	-

Heat Treatment:

2250°F (1230°C), air cool or faster.

Tensile Properties, Plate:

Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		Elongation
°F	°C	ksi	MPa	ksi	MPa	%
70	21	55.5	383	123.6	852	46.0
1000	538	38.1	263	102.5	706	53.2
1200	649	38.7	267	98.2	677	53.0
1400	760	37.7	260	77.2	533	68.0
1600	871	33.9	234	45.1	311	94.0
1800	982	16.8	116	24.3	168	91.2
2000	1093	9.1	63	13.2	91	92.1

Physical Properties – Standard Units:

Temperature (°F)	Specific Heat (BTU/lb-°F)	Thermal Conductivity (BTU-in./ft^2-hr.-°F)	Thermal Diffusivity (ft^2/h)	Electrical Resistivity (microhms-in.)	Mean Coefficient of Thermal Expansion (µmin/in-°F)
800	0.112	118	27.3	50.7	7.6
1000	0.112	133	26.4	51.5	7.9
1200	134	148	25.3	51.6	8.10
1400	140	164	24.1	51.1	8.3
1600	145	179	23.1	50.3	8.6
1800	147	195	21.9	49.3	8.9
Temperature (°C)	**Specific Heat (J/kg-°C)**	**Thermal Conductivity (W/m-°C)**	**Thermal Diffusivity (cm^2/s)**	**Electrical Resistivity (microhms-cm)**	**Mean Coefficient of Thermal Expansion (µm/m-°C)**
400	465	16.4	190	128.4	-
600	486	20.4	177	131.2	14.4
700	574	22.4	171	130.7	14.8
800	595	24.4	164	139.1	15.2
900	609	26.4	157	127.1	15.7
1000	617	28.4	150	125.0	16.1

Dynamic Modulus of Elasticity:

Temperature (˚F)	10^6 psi	Temperature (˚C)	Gpa
RT	30.3 x 10^6 psi	RT	209 GPa
400°F	29.0 x 10^6 psi	200°C	200 GPa
800°F	26.8 x 10^6 psi	400°C	186 GPa
1000°F	25.9 x 10^6 psi	500°C	181 GPa
1200°F	24.9 x 10^6 psi	600°C	175 GPa
1400°F	23.6 x 10^6 psi	700°C	168 GPa
1600°F	22.2 x 10^6 psi	800°C	159 GPa
1800°F	20.7 x 10^6 psi	900°C	150 GPa
2000ºF	19.1 x 10^6 psi	1000°C	141 GPa

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