

# HAYNES® 230® alloy for High Strength Furnace Components Tech Brief

## Hydrogen Embrittlement - Not susceptible

Nitrogen Absorption in 1200°F (1149°C) Flowing Ammonia After 168 Hours	
Alloy	Nitrogen Absorption (mg/cm <sup>2</sup> )
600	0.8
601	1.1
X	1.7
800H	4.3
316	6.9
310	7.4
304	9.7

## Nominal Composition

Nickel:	Balance
Cobalt:	5 max.
Chromium:	22
Molybdenum:	2
Tungsten:	14
Iron:	3 max.
Silicon:	0.4
Manganese:	0.5
Carbon:	0.10
Aluminum:	0.3
Boron:	0.015 max.
Lanthanum:	0.02

## Typical Tensile Properties, Plate

Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		Elongation 2 in. (51 mm)
°F	°C	ksi	MPa	ksi	MPa	%
RT	RT	57	395	125	860	50
1000	540	40	275	103	705	53
1200	650	40	275	98	675	55
1400	760	42	275	88	605	53
1600	870	37	255	63	435	65
1800	980	21	145	35	240	83
2000	1095	11	76	20	140	83
2100	1150	7	47	13	91	106
2200	1205	4	30	9	65	109

## Typical Rupture Properties, Plate

Test Temperature		Typical Rupture Properties: Stress Required to Produce Rupture in Hours Shown					
		100 h		1,000 h		10,000 h	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1200	650	56.0	385	42.5	295	29.0	200
1400	760	27.0	185	20.0	140	14.2	98
1600	870	13.7	95	9.5	66	6.2	43
1800	980	6.0	41	3.0	21	1.6	11
1900	1040	3.5	24	1.8	12	-	-
2000	1095	2.1	14	1.0	7	-	-
2100	1150	1.2	8	0.6	4	-	-

Physical Property	British Units	Metric Units
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<b>Density</b>	0.324 lb/in <sup>3</sup>	8.97 g/cm <sup>3</sup>
<b>Electrical Resistivity</b>	49.2 μohm-in	125 μohm-cm
<b>Modulus of Elasticity</b>	30.6 x 10 <sup>6</sup> psi	211 GPA
<b>Thermal Conductivity</b>	62 Btu-in/ft <sup>2</sup> -h-°F	8.9 W/m-°C
<b>Specific Heat</b>	0.095 Btu/lb-°F	397 J/Kg-°C

**Environmental Resistance: Flowing Ammonia After 168 Hours**

Oxidation in Air - Excellent at 2100°F (1150°C)

Sulfidation - Equal to alloy X

Carburization - Equal to alloy X

Nitriding - Best commercial alloy

Chlorination - Equal to alloy 625

**Product Description**

HAYNES<sup>®</sup> 230<sup>®</sup> alloy is a top-of-the-line high-performance, industrial heat-resistant alloy for applications demanding high strength as well as resistance to environment. It is a substantial upgrade in performance capabilities from common iron-nickel-chromium and nickel-chromium alloys, and displays the best combination of strength, stability, environmental resistance, and fabricability of any commercial nickel-base alloy. HAYNES<sup>®</sup> 230<sup>®</sup> alloy can be utilized at temperatures as high as 2100°F (1150°C) for continuous service. Its resistance to oxidation, combustion environments, and nitriding recommends it highly for applications such as nitric acid catalyst grids, high-temperature bellows, industrial furnace fixtures and hardware, strand annealing tubes, thermocouple protection tubes, and many more.