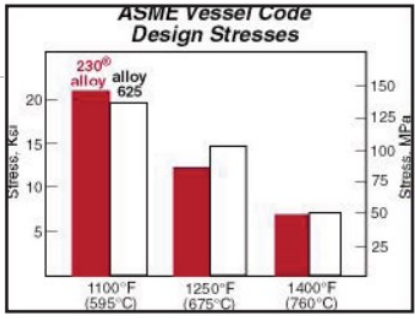
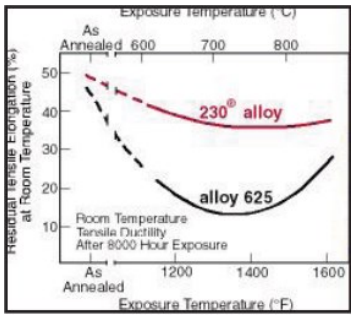
HAYNES® 230® alloy for Expansion Bellows Tech Brief



High Performance High-Temperature Expansion Bellows

High-temperature expansion bellows are key components in many different industrial operations. In the chemical and power industries; in metallurgical and mineral process facilities; and in waste incineration plants, selection of the materials of construction for expansion bellows can be of critical importance to long-term, cost effective performance.



HAYNES® 230® alloy combines the best in high-temperature strength, thermal stability, environment-resistance and fabricability of any commercial nickel-base alloy. With nearly the same design strength of HAYNES® 625 alloy and none of alloy 625's embrittlement problems, 230 alloy is a top choice for high-temperature bellows applications. Its lower thermal expansion characteristics can be a big plus as well.

Product Description

HAYNES® 230® 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, environment resistance, and fabricability of any commercial nickel-base alloy.

230® 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.

230® alloy is covered by ASME Section VIII, Division I, and ASME Section I, Code Case 2063, both up to 1650°F (900°C). 230 alloy is also covered by a number of ASTM and AMS specifications.

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 Solution Annealed, 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	-	-

Typical Room Temperature Physical Properties

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

Environmental Resistance

Oxidation in Air - Excellent at 2100°F (1095°C) Nitriding - Best Commercial alloy

Sulfidation - Equal to X alloy Chlorination - Equal to 625 alloy

Carburization - Equal to X alloy Hydrogen Embrittlement - Excellent