

High-Temperature Alloys TECH BRIEF

February 2005

HAYNES

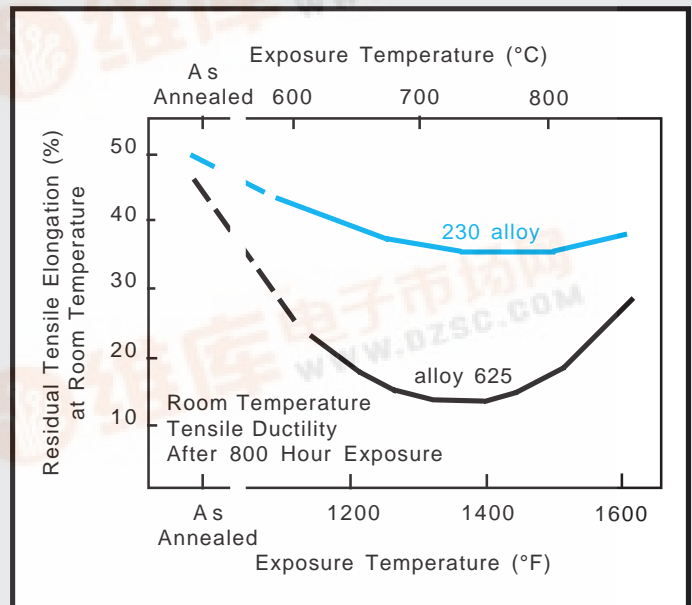
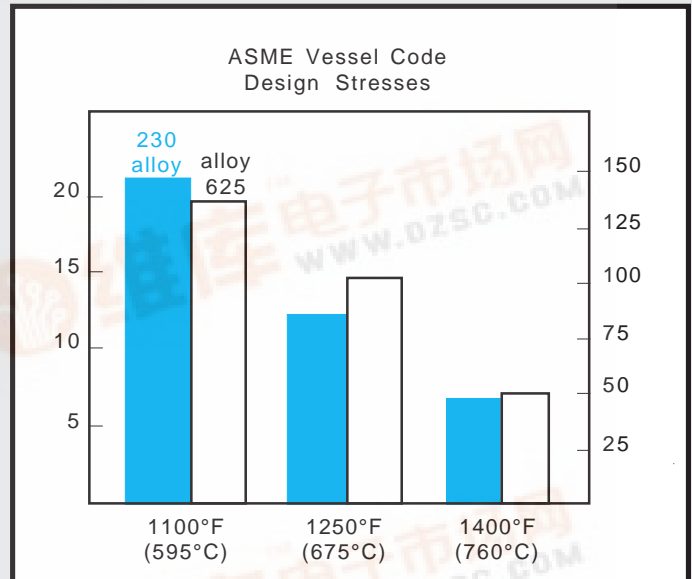
International

HAYNES® 230® alloy 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 alloy 230 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 alloy 625 and none of alloy 625's embrittlement problems, 230® alloy is a top choice for high-temperature bellows applications. It's lower thermal expansion characteristics can be a big plus as well.

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CHEMISTRY: Weight %

	Ni	Co	Cr	Mo	W	Fe	Si	Mn	C	Al	B	La
Balance	5*	22	2	14	3*	0.4	0.5	0.10	0.3	0.015*	0.02	



HAYNES® 230® alloy

TYPICAL TENSILE PROPERTIES SOLUTION ANNEALED (Plate):

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

TYPICAL RUPTURE PROPERTIES (Plate):

Solution Annealed (Plate):
Stress Required to Produce Rupture
in Hours Shown, Ksi (MPa)

Temperature °F (°C)	Stress Required to Produce Rupture in Hours Shown, Ksi (MPa)		
	100	1,000	10,000
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)	-

PRODUCT DESCRIPTION:

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.

PROPERTIES DATA:

The data and information in this publication are based upon work conducted principally by Haynes International, Inc. and occasionally supplemented by information from the open literature, and are believed to be reliable. However, Haynes International, Inc. does not make any warranty or assume any legal liability or responsibility for its accuracy, completeness, or usefulness. Haynes also makes no warranty of results to be obtained for any particular use of the information herein contained. Material safety data sheets are available from Haynes International, Inc.

TYPICAL ROOM TEMPERATURE PHYSICAL PROPERTIES:

	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 -hr-°F	8.9 W/m-K
Specific Heat	0.095 Btu/lb.-°F	397 J/Kg-K

AVAILABLE FORMS: (Routine Production)

Sheet & Strip	- 0.015 to 0.187" (0.38 to 4.75 mm)
Plate	- 0.1875 to 2.0" (4.76 to 50.8 mm)
Bar	- 0.250 to 6.0" (6.3 to 152 mm) dia.
Billet	- 4.0 to 12.0" (101.6 to 305 mm)
Wire	- 0.035 to 0.187" (0.89 to 4.75 mm) dia.
Pipe	- By inquiry only
Tube	- By inquiry only

For More Information Call:

1-800-354-0806

or Write

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ENVIRONMENTAL RESISTANCE:

Oxidation - Best commercial alloy
at 2100°F (1150°C)

Nitriding - Best commercial alloy
Carburization - Equal to alloy X

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