

## HAYNES® NS-163® alloy

HAYNES® NS-163® alloy is a Co – 28Cr – 21Fe – 8Ni – 1.3Ti – 1Nb alloy produced as wrought sheet, strip and wire material with high creep strength and relatively low density. Its properties bridge the gap between the capabilities of current solid-solution strengthened alloys and the oxide-dispersion strengthened (ODS) mechanical alloys. HAYNES® NS-163® alloy exhibits good oxidation resistance up to 1800°F (982°C), but is capable of being coated for exceptional oxidation resistance at even higher temperatures.

The high level of creep strength in HAYNES® NS-163® alloy is achieved via a unique high-temperature Nitride Dispersion Strengthening (NDS) treatment performed after forming, welding and fabrication is complete. Unlike other materials of comparable performance, produced by powder metallurgy, HAYNES® NS-163® alloy is conventionally melted (VIM + ESR) and processed (via hot and cold rolling) in the same manner as the solid solution strengthened materials and can be conventionally formed, fabricated and welded into nearly any conceivable shape currently produced in other superalloys.

### Nominal Composition (wt%):

Co	Ni	Fe	Cr	Mn	Si	Cb	Al	Ti	C	B
Balance	8	21	28	0.5*	0.5*	1	0.5*	1.3	0.1	0.015*

\*Maximum

### Heat Treatment:

#### **Solution Heat Treatment:**

Typical Solution Annealing Temperature: 2100 to 2150°F (1150 to 1177°C) in dry hydrogen.

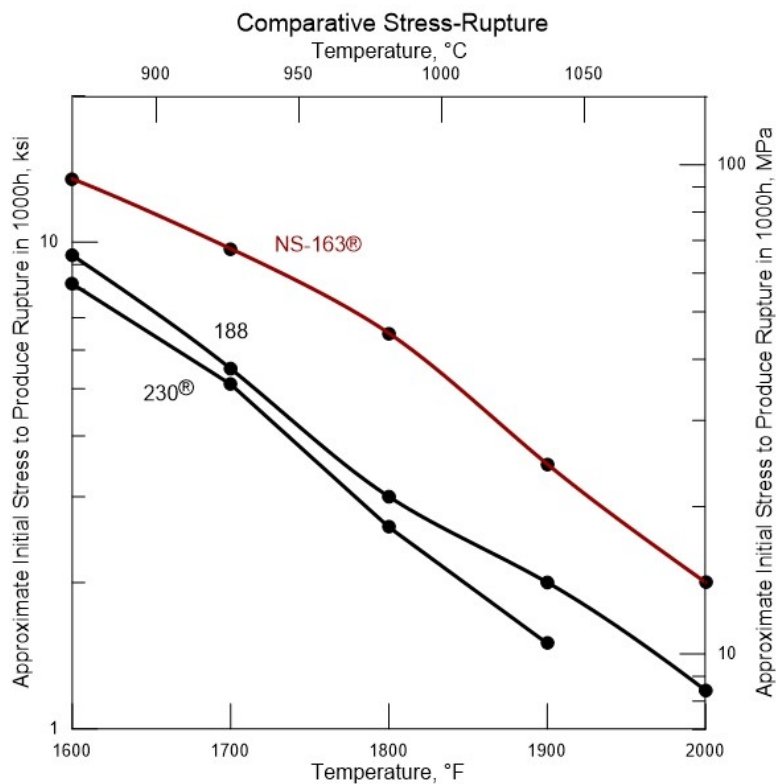
#### **NDS (Nitride Dispersion Strengthening) Treatment:**

NDS treatments have been developed for this alloy. Please contact Haynes International for more detailed information.

### Material Properties (Nitrided):

<b>Density</b>	0.287 lb/in <sup>3</sup>	7.95 g/cm <sup>3</sup>
<b>Melting Range</b>	2523 - 2586°F	1382 - 1419°C

## Stress-Rupture:



## Physical Properties (Nitrided):

Temperature	Specific Heat	Thermal Conductivity	Dynamic Modulus of Elasticity	Electrical Resistivity	Mean Coefficient of Thermal Expansion
(°F)	(BTU/lb-°F)	(BTU-in/ft <sup>2</sup> -hr-°F)	(10 <sup>6</sup> psi)	(μohm-in)	(μin/in-°F)
800	0.133	138	31.5	39.5	8.8
1000	0.137	156	27.5	40.9	9.0
1200	0.146	173	26.0	42.2	9.3
1400	0.155	190	24.5	43.2	9.6
1600	0.159	203	23.1	44.3	9.8
1800	0.162	212	21.5	45.3	10.1
Temperature	Specific Heat	Thermal Conductivity	Dynamic Modulus of Elasticity	Electrical Resistivity	Mean Coefficient of Thermal Expansion
(°C)	(J/kg-°C)	(W/m-°C)	(GPa)	(μohm-cm)	(μm/m-°C)
400	553	19.6	201	99	15.7
500	566	21.1	193	103	16.1
600	584	22.7	184	106	16.5
700	638	26.1	175	108	17.0
800	654	27.6	165	111	17.4
900	668	28.7	156	113	17.8
1000	681	29.5	146	115	18.1

**Disclaimer:** Haynes International makes all reasonable efforts to ensure the accuracy and correctness of the data in this document but makes no representations or warranties as to the data's accuracy, correctness or reliability. All data are for general information only and not for providing design advice. Alloy properties disclosed here are based on work conducted principally by Haynes International, Inc. and occasionally supplemented by information from the open literature and, as such, are indicative only of the results of such tests and should not be considered guaranteed maximums or minimums. It is the responsibility of the user to test specific alloys under actual service conditions to determine their suitability for a particular purpose. For specific concentrations of elements present in a particular product and a discussion of the potential health affects thereof, refer to the Safety Data Sheets supplied by Haynes International, Inc. All trademarks are owned by Haynes International, Inc., unless otherwise indicated.