

## Haynes HR-160® alloy, plate, aged 4000 hours at 760°C (1400°F)

Category : Metal , Nonferrous Metal , Nickel Alloy , Superalloy

### Material Notes:

Outstanding resistance to various forms of high-temperature corrosion attack, excellent resistance to sulfidation and chloride attack in both reducing and oxidizing atmospheres. Excellent forming and welding characteristics. Applications include a variety of fabricated components in municipal, industrial, hazardous, and nuclear waste heat recovery systems. Also suitable for utility boilers, sulfur plants, high-temperature furnaces, kilns, calciners, resource recovery units, cement kilns, pulp and paper recovery boilers, coal gasification systems, and fluidized-bed-combustion systems. Data provided by the manufacturer, Haynes International, Inc.

Order this product through the following link:

[http://www.lookpolymers.com/polymer\\_Haynes-HR-160-alloy-plate-aged-4000-hours-at-760C-1400F.php](http://www.lookpolymers.com/polymer_Haynes-HR-160-alloy-plate-aged-4000-hours-at-760C-1400F.php)

Physical Properties	Metric	English	Comments
Density	8.08 g/cc	0.292 lb/in <sup>3</sup>	at RT

Mechanical Properties	Metric	English	Comments
Tensile Strength, Ultimate	809 MPa	117000 psi	
Tensile Strength, Yield	321 MPa @Strain 0.200 %	46600 psi @Strain 0.200 %	
Elongation at Break	26 %	26 %	in 50.8 mm
Reduction of Area	23 %	23 %	
Modulus of Elasticity	211 GPa	30600 ksi	RT
	137 GPa @Temperature 980 °C	19900 ksi @Temperature 1800 °F	
	145 GPa @Temperature 925 °C	21000 ksi @Temperature 1700 °F	
	150 GPa @Temperature 870 °C	21800 ksi @Temperature 1600 °F	
	154 GPa @Temperature 815 °C	22300 ksi @Temperature 1500 °F	
	158 GPa @Temperature 760 °C	22900 ksi @Temperature 1400 °F	

Mechanical Properties	Metric	English	Comments
	163 GPa	23500 ksi	
	@Temperature 705 Å°C	@Temperature 1300 Å°F	
	168 GPa	24400 ksi	
	@Temperature 650 Å°C	@Temperature 1200 Å°F	
	173 GPa	25100 ksi	
	@Temperature 595 Å°C	@Temperature 1100 Å°F	
	177 GPa	25700 ksi	
	@Temperature 540 Å°C	@Temperature 1000 Å°F	
	180 GPa	26100 ksi	
	@Temperature 480 Å°C	@Temperature 896 Å°F	
	183 GPa	26500 ksi	
	@Temperature 425 Å°C	@Temperature 797 Å°F	
	187 GPa	27100 ksi	
	@Temperature 370 Å°C	@Temperature 698 Å°F	
	192 GPa	27800 ksi	
	@Temperature 315 Å°C	@Temperature 599 Å°F	
	197 GPa	28600 ksi	
	@Temperature 260 Å°C	@Temperature 500 Å°F	
	201 GPa	29200 ksi	
	@Temperature 205 Å°C	@Temperature 401 Å°F	
	204 GPa	29600 ksi	
	@Temperature 150 Å°C	@Temperature 302 Å°F	
	208 GPa	30200 ksi	
	@Temperature 90.0 Å°C	@Temperature 194 Å°F	
	210 GPa	30500 ksi	
	@Temperature 40.0 Å°C	@Temperature 104 Å°F	
Charpy Impact	24.0 J	17.7 ft-lb	aged 4000 hours at 760Å°C (1400Å°F)

Thermal Properties	Metric	English	Comments
CTE, linear	13.0 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	7.22 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 95.0 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 203 $\text{Å}^\circ\text{F}$	
	13.7 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	7.61 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 205 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 401 $\text{Å}^\circ\text{F}$	
	14.0 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	7.78 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 315 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 599 $\text{Å}^\circ\text{F}$	
	14.4 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	8.00 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 425 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 797 $\text{Å}^\circ\text{F}$	
14.9 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	8.28 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$		
@Temperature 25.0 - 540 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 1000 $\text{Å}^\circ\text{F}$		
15.5 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	8.61 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$		
@Temperature 25.0 - 600 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 1110 $\text{Å}^\circ\text{F}$		
15.7 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	8.72 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$		
@Temperature 25.0 - 700 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 1290 $\text{Å}^\circ\text{F}$		
16.6 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	9.22 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$		
@Temperature 25.0 - 800 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 1470 $\text{Å}^\circ\text{F}$		
17.1 $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	9.50 $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$		
@Temperature 25.0 - 900 $\text{Å}^\circ\text{C}$	@Temperature 77.0 - 1650 $\text{Å}^\circ\text{F}$		
Specific Heat Capacity	0.462 J/g- $\text{Å}^\circ\text{C}$	0.110 BTU/lb- $\text{Å}^\circ\text{F}$	RT
	0.653 J/g- $\text{Å}^\circ\text{C}$	0.156 BTU/lb- $\text{Å}^\circ\text{F}$	
	@Temperature 700 $\text{Å}^\circ\text{C}$	@Temperature 1290 $\text{Å}^\circ\text{F}$	
	0.672 J/g- $\text{Å}^\circ\text{C}$	0.161 BTU/lb- $\text{Å}^\circ\text{F}$	
@Temperature 800 $\text{Å}^\circ\text{C}$	@Temperature 1470 $\text{Å}^\circ\text{F}$		
0.689 J/g- $\text{Å}^\circ\text{C}$	0.165 BTU/lb- $\text{Å}^\circ\text{F}$		
	@Temperature 1650		

Thermal Properties	@Temperature 900 Å°C Metric	Å°F English	Comments
	0.719 J/g-Å°C	0.172 BTU/lb-Å°F	
	@Temperature 1100 Å°C	@Temperature 2010 Å°F	
	0.732 J/g-Å°C	0.175 BTU/lb-Å°F	
	@Temperature 1200 Å°C	@Temperature 2190 Å°F	
	0.784 J/g-Å°C	0.187 BTU/lb-Å°F	
	@Temperature 1000 Å°C	@Temperature 1830 Å°F	
Thermal Conductivity	10.9 W/m-K	75.6 BTU-in/hr-ftÅ²- Å°F	RT
	21.8 W/m-K	151 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 600 Å°C	@Temperature 1110 Å°F	
	24.7 W/m-K	171 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 700 Å°C	@Temperature 1290 Å°F	
	26.1 W/m-K	181 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 800 Å°C	@Temperature 1470 Å°F	
	26.9 W/m-K	187 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 900 Å°C	@Temperature 1650 Å°F	
	28.7 W/m-K	199 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 1000 Å°C	@Temperature 1830 Å°F	
	31.1 W/m-K	216 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 1100 Å°C	@Temperature 2010 Å°F	
	32.9 W/m-K	228 BTU-in/hr-ftÅ²-Å°F	
	@Temperature 1200 Å°C	@Temperature 2190 Å°F	
Melting Point	1293 - 1370 Å°C	2359 - 2500 Å°F	
Solidus	1293 Å°C	2359 Å°F	
Liquidus	1370 Å°C	2500 Å°F	

Component Elements Properties	Metric	English	Comments
Carbon, C	0.050 %	0.050 %	
Chromium, Cr	28 %	28 %	
Cobalt, Co	30 %	30 %	
Iron, Fe	<= 3.5 %	<= 3.5 %	
Manganese, Mn	0.50 %	0.50 %	
Molybdenum, Mo	<= 1.0 %	<= 1.0 %	
Nickel, Ni	37 %	37 %	
Niobium, Nb (Columbium, Cb)	<= 1.0 %	<= 1.0 %	
Silicon, Si	2.75 %	2.75 %	
Titanium, Ti	0.50 %	0.50 %	
Tungsten, W	<= 1.0 %	<= 1.0 %	

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.0001112 ohm-cm	0.0001112 ohm-cm	RT
	0.0001231 ohm-cm	0.0001231 ohm-cm	
	@Temperature 700 Â°C	@Temperature 1290 Â°F	
	0.0001238 ohm-cm	0.0001238 ohm-cm	
	@Temperature 800 Â°C	@Temperature 1470 Â°F	
	0.0001245 ohm-cm	0.0001245 ohm-cm	
	@Temperature 900 Â°C	@Temperature 1650 Â°F	
	0.0001252 ohm-cm	0.0001252 ohm-cm	
	@Temperature 1000 Â°C	@Temperature 1830 Â°F	
	0.0001259 ohm-cm	0.0001259 ohm-cm	
	@Temperature 1100 Â°C	@Temperature 2010 Â°F	
	0.0001267 ohm-cm	0.0001267 ohm-cm	
	@Temperature 1200 Â°C	@Temperature 2190 Â°F	

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