

## Haynes 188 alloy, 10% cold reduction, 3.2 mm thick sheet, 1065°C for 5 minutes

Category : Metal , Nonferrous Metal , Cobalt Alloy , Superalloy

### Material Notes:

Excellent high temperature strength and very good resistance to oxidizing environments up to 1095°C for prolonged exposure, and excellent resistance to sulfate deposit hot corrosion. Readily fabricated and formed, excellent resistance to molten chloride salts, and good resistance to gaseous sulfidation. Applications include a variety of fabricated component applications in the aerospace industry, commercial gas turbine engines for combustion cans, transition ducts and afterburner components. Data provided by the manufacturer, Haynes International, Inc.

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[http://www.lookpolymers.com/polymer\\_Haynes-188-alloy-10-cold-reduction-32-mm-thick-sheet-1065C-for-5-minutes.php](http://www.lookpolymers.com/polymer_Haynes-188-alloy-10-cold-reduction-32-mm-thick-sheet-1065C-for-5-minutes.php)

Physical Properties	Metric	English	Comments
Density	8.98 g/cc	0.324 lb/in <sup>3</sup>	at RT.

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	277	277	Converted from Rockwell C hardness.
Hardness, Knoop	313	313	Converted from Rockwell C hardness.
Hardness, Rockwell C	29.7	29.7	
Hardness, Vickers	299	299	Converted from Rockwell C hardness.
Tensile Strength, Ultimate	1025 MPa	148700 psi	
Tensile Strength, Yield	630 MPa @Strain 0.200 %	91400 psi @Strain 0.200 %	
Elongation at Break	41.4 %	41.4 %	in 51 mm
Modulus of Elasticity	232 GPa	33600 ksi	RT
	153 GPa @Temperature 1000 °C	22200 ksi @Temperature 1830 °F	
	161 GPa @Temperature 900 °C	23400 ksi @Temperature 1650 °F	
	169 GPa @Temperature 800 °C	24500 ksi @Temperature 1470 °F	

Mechanical Properties	Metric	English	Comments
	@Temperature 700 Â°C	@Temperature 1290 Â°F	
	176 GPa	25500 ksi	
	@Temperature 600 Â°C	@Temperature 1110 Â°F	
	193 GPa	28000 ksi	
	@Temperature 500 Â°C	@Temperature 932 Â°F	
	201 GPa	29200 ksi	
	@Temperature 400 Â°C	@Temperature 752 Â°F	
	209 GPa	30300 ksi	
	@Temperature 300 Â°C	@Temperature 572 Â°F	
	217 GPa	31500 ksi	
	@Temperature 200 Â°C	@Temperature 392 Â°F	
	225 GPa	32600 ksi	
	@Temperature 100 Â°C	@Temperature 212 Â°F	

Thermal Properties	Metric	English	Comments
CTE, linear	11.9 Âµm/m-Â°C	6.61 Âµin/in-Â°F	
	@Temperature 25.0 - 100 Â°C	@Temperature 77.0 - 212 Â°F	
	12.6 Âµm/m-Â°C	7.00 Âµin/in-Â°F	
	@Temperature 25.0 - 200 Â°C	@Temperature 77.0 - 392 Â°F	
	13.2 Âµm/m-Â°C	7.33 Âµin/in-Â°F	
	@Temperature 25.0 - 300 Â°C	@Temperature 77.0 - 572 Â°F	
	13.8 Âµm/m-Â°C	7.67 Âµin/in-Â°F	
	@Temperature 25.0 - 400 Â°C	@Temperature 77.0 - 752 Â°F	
	14.5 Âµm/m-Â°C	8.06 Âµin/in-Â°F	
	@Temperature 25.0 - 500 Â°C	@Temperature 77.0 - 932 Â°F	
	15.2 Âµm/m-Â°C	8.44 Âµin/in-Â°F	
	@Temperature 25.0 - 600 Â°C	@Temperature 77.0 - 1110 Â°F	

Thermal Properties	Metric $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	English $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	Comments
	@Temperature 25.0 - 700 Å°C	@Temperature 77.0 - 1290 Å°F	
	16.5 Å $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	9.17 Å $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 800 Å°C	@Temperature 77.0 - 1470 Å°F	
	17.1 Å $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	9.50 Å $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 800 Å°C	@Temperature 77.0 - 1470 Å°F	
	17.9 Å $\mu\text{m}/\text{m}\cdot\text{Å}^\circ\text{C}$	9.94 Å $\mu\text{in}/\text{in}\cdot\text{Å}^\circ\text{F}$	
	@Temperature 25.0 - 1000 Å°C	@Temperature 77.0 - 1830 Å°F	
Specific Heat Capacity	0.403 J/g-Å°C	0.0963 BTU/lb-Å°F	RT
	0.423 J/g-Å°C	0.101 BTU/lb-Å°F	
	@Temperature 100 Å°C	@Temperature 212 Å°F	
	0.444 J/g-Å°C	0.106 BTU/lb-Å°F	
	@Temperature 200 Å°C	@Temperature 392 Å°F	
	0.465 J/g-Å°C	0.111 BTU/lb-Å°F	
	@Temperature 300 Å°C	@Temperature 572 Å°F	
	0.486 J/g-Å°C	0.116 BTU/lb-Å°F	
	@Temperature 400 Å°C	@Temperature 752 Å°F	
	0.502 J/g-Å°C	0.120 BTU/lb-Å°F	
	@Temperature 500 Å°C	@Temperature 932 Å°F	
	0.523 J/g-Å°C	0.125 BTU/lb-Å°F	
	@Temperature 600 Å°C	@Temperature 1110 Å°F	
	0.540 J/g-Å°C	0.129 BTU/lb-Å°F	
	@Temperature 700 Å°C	@Temperature 1290 Å°F	
	0.557 J/g-Å°C	0.133 BTU/lb-Å°F	
	@Temperature 800 Å°C	@Temperature 1470 Å°F	
	0.573 J/g-Å°C	0.137 BTU/lb-Å°F	
	@Temperature 900 Å°C	@Temperature 1650 Å°F	

Thermal Properties	0.590 J/g-Â°C Metric	0.141 BTU/lb-Â°F English	Comments
	@Temperature 1000 Â°C	@Temperature 1830 Â°F	
Thermal Conductivity	10.4 W/m-K	72.2 BTU-in/hr-ftÂ²- Â°F	RT
	12.2 W/m-K @Temperature 100 Â°C	84.7 BTU-in/hr-ftÂ²- Â°F @Temperature 212 Â°F	
	14.3 W/m-K @Temperature 200 Â°C	99.2 BTU-in/hr-ftÂ²- Â°F @Temperature 392 Â°F	
	15.9 W/m-K @Temperature 300 Â°C	110 BTU-in/hr-ftÂ²-Â°F @Temperature 572 Â°F	
	17.5 W/m-K @Temperature 400 Â°C	121 BTU-in/hr-ftÂ²-Â°F @Temperature 752 Â°F	
	19.3 W/m-K @Temperature 500 Â°C	134 BTU-in/hr-ftÂ²-Â°F @Temperature 932 Â°F	
	21.1 W/m-K @Temperature 600 Â°C	146 BTU-in/hr-ftÂ²-Â°F @Temperature 1110 Â°F	
	23.0 W/m-K @Temperature 700 Â°C	160 BTU-in/hr-ftÂ²-Â°F @Temperature 1290 Â°F	
	24.8 W/m-K @Temperature 800 Â°C	172 BTU-in/hr-ftÂ²-Â°F @Temperature 1470 Â°F	
	25.5 W/m-K @Temperature 900 Â°C	177 BTU-in/hr-ftÂ²-Â°F @Temperature 1650 Â°F	
	27.6 W/m-K @Temperature 1000 Â°C	192 BTU-in/hr-ftÂ²-Â°F @Temperature 1830 Â°F	
Melting Point	1315 - 1410 Â°C	2399 - 2570 Â°F	
Solidus	1315 Â°C	2399 Â°F	
Liquidus	1410 Â°C	2570 Â°F	
	1095 Â°C	2003 Â°F	

Maximum Service Temperature, Air			
Thermal Properties	Metric	English	Comments
Component Elements Properties	Metric	English	Comments
Boron, B	<= 0.015 %	<= 0.015 %	
Carbon, C	0.050 - 0.15 %	0.050 - 0.15 %	

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.000101 ohm-cm	0.000101 ohm-cm	RT
	0.000103 ohm-cm	0.000103 ohm-cm	
	@Temperature 100 Â°C	@Temperature 212 Â°F	
	0.000105 ohm-cm	0.000105 ohm-cm	
	@Temperature 200 Â°C	@Temperature 392 Â°F	
	0.0001077 ohm-cm	0.0001077 ohm-cm	
	@Temperature 300 Â°C	@Temperature 572 Â°F	
	0.0001105 ohm-cm	0.0001105 ohm-cm	
	@Temperature 400 Â°C	@Temperature 752 Â°F	
	0.0001127 ohm-cm	0.0001127 ohm-cm	
	@Temperature 500 Â°C	@Temperature 932 Â°F	
	0.0001148 ohm-cm	0.0001148 ohm-cm	
	@Temperature 600 Â°C	@Temperature 1110 Â°F	
	0.0001164 ohm-cm	0.0001164 ohm-cm	
	@Temperature 700 Â°C	@Temperature 1290 Â°F	
	0.0001175 ohm-cm	0.0001175 ohm-cm	
	@Temperature 800 Â°C	@Temperature 1470 Â°F	
	0.0001183 ohm-cm	0.0001183 ohm-cm	
	@Temperature 900 Â°C	@Temperature 1650 Â°F	
	0.0001191 ohm-cm	0.0001191 ohm-cm	
	@Temperature 1000 Â°C	@Temperature 1830 Â°F	

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