Haynes® 188 alloy, 40% cold reduction, 3.2 mm thick sheet

Subcategory: Cobalt Base; Metal; Superalloy

Key Words: UNS R30188, AMS 5608, AMS 5772, AMS 5801

Component	Wt. %	Component	Wt. %	Component	Wt. %
B	Max 0.015	Fe	Max 3	Ni	20 - 24
C	0.05 - 0.15	La	0.02 - 0.12	Si	0.2 - 0.5
Co	42	Mn	Max 1.25	W	13 - 15
Cr	21 - 23				

Material Notes:

Cobalt composition to balance. 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.

Physical Properties	Metric	English	Comments
Density	8.98 g/cc	0.324 lb/in³	at RT.
Mechanical Properties			
Hardness, Brinell	331	331	Converted from Rockwell C hardness.
Hardness, Knoop	443	443	Converted from Rockwell C hardness.
Hardness, Rockwell C	43.5	43.5	
Hardness, Vickers	428	428	Converted from Rockwell C hardness.
Tensile Strength, Ultimate	1480 MPa	215000 psi	
Tensile Strength, Yield	1220 MPa	177000 psi	at 0.2% offset
Elongation at Break	9.8 %	9.8 %	in 51 mm

Modulus of Elasticity	232 GPa	33600 ksi	RT
Modulus of Elasticity at Elevated Temperature	153 GPa	22200 ksi	1000°C (1830°F)
Modulus of Elasticity at Elevated Temperature	161 GPa	23400 ksi	900°C (1650°F)
Modulus of Elasticity at Elevated Temperature	169 GPa	24500 ksi	800°C (1470°F)
Modulus of Elasticity at Elevated Temperature	176 GPa	25500 ksi	700°C (1290°F)
Modulus of Elasticity at Elevated Temperature	184 GPa	26700 ksi	600°C (1110°F)
Modulus of Elasticity at Elevated Temperature	193 GPa	28000 ksi	500°C (930°F)
Modulus of Elasticity at Elevated Temperature	201 GPa	29200 ksi	400°C (750°F)
Modulus of Elasticity at Elevated Temperature	209 GPa	30300 ksi	300°C (570°F)
Modulus of Elasticity at Elevated Temperature	217 GPa	31500 ksi	200°C (390°F)
Modulus of Elasticity at Elevated Temperature	225 GPa	32600 ksi	100°C (212°F)
Charpy Impact	194 J	143 ft-lb	at 20°C, 158 J at -185°C, 162 J at -100°C, 159 J at 540°C, 145 J at 705°C, 194 J solution annealed, 31 J after 8000 hours at 650°C, 4 J after 8000 hours at 760°C, 12 J after 8000 hours at 870°C

Electrical Properties

Electrical Resistivity	0.000101 ohm-cm	0.000101 ohm-cm	RT
Electrical Resistivity at Elevated Temperature	0.000103 ohm-cm	0.000103 ohm-cm	100°C (212°F)
Electrical Resistivity at Elevated Temperature	0.000105 ohm-cm	0.000105 ohm-cm	200°C (390°F)
Electrical Resistivity at Elevated Temperature	0.0001077 ohm-cm	0.0001077 ohm-cm	300°C (570°F)
Electrical Resistivity at Elevated Temperature	0.0001105 ohm-cm	0.0001105 ohm-cm	400°C (750°F)
Electrical Resistivity at Elevated Temperature	0.0001127 ohm-cm	0.0001127 ohm-cm	500°C (930°F)
Electrical Resistivity at Elevated Temperature	0.0001148 ohm-cm	0.0001148 ohm-cm	600°C (1110°F)
Electrical Resistivity at Elevated Temperature	0.0001164 ohm-cm	0.0001164 ohm-cm	700°C (1290°F)
Electrical Resistivity at Elevated Temperature	0.0001175 ohm-cm	0.0001175 ohm-cm	800°C (1470°F)
Electrical Resistivity at Elevated Temperature	0.0001183 ohm-cm	0.0001183 ohm-cm	900°C (1650°F)
Electrical Resistivity at Elevated Temperature	0.0001191 ohm-cm	0.0001191 ohm-cm	1000°C (1830°F)

Thermal Properties

CTE, linear 20°C	11.9 µm/m-°C	6.61 µin/in-°F	25-100°C (77-212°F)
CTE, linear 250°C	12.6 µm/m-°C	7 µin/in-°F	25-200°C (77-390°F)
CTE, linear 500°C	13.2 µm/m-°C	7.33 µin/in-°F	25-300°C
CTE, linear 500°C	13.8 µm/m-°C	7.67 µin/in-°F	25-400°C
CTE, linear 500°C	14.5 µm/m-°C	8.06 µin/in-°F	25-500°C
CTE, linear 1000°C	15.2 µm/m-°C	8.44 µin/in-°F	25-600°C
CTE, linear 1000°C	15.8 µm/m-°C	8.78 µin/in-°F	25-700°C

CTE, linear 1000°C	16.5 µm/m-°C	9.17 µin/in-°F	25-800°C
CTE, linear 1000°C	17.1 µm/m-°C	9.5 µin/in-°F	25-800°C (77-1470°F)
CTE, linear 1000°C	17.9 µm/m-°C	9.94 µin/in-°F	25-1000°C
Specific Heat Capacity	0.403 J/g-°C	0.0963 BTU/lb-°F	RT
Specific Heat Capacity at Elevated Temperature	0.423 J/g-°C	0.101 BTU/lb-°F	100°C (212°F)
Specific Heat Capacity at Elevated Temperature	0.444 J/g-°C	0.106 BTU/lb-°F	200°C (390°F)
Specific Heat Capacity at Elevated Temperature	0.465 J/g-°C	0.111 BTU/lb-°F	300°C (570°F)
Specific Heat Capacity at Elevated Temperature	0.486 J/g-°C	0.116 BTU/lb-°F	400°C (750°F)
Specific Heat Capacity at Elevated Temperature	0.502 J/g-°C	0.12 BTU/lb-°F	500°C (930°F)
Specific Heat Capacity at Elevated Temperature	0.523 J/g-°C	0.125 BTU/lb-°F	600°C (1110°F)
Specific Heat Capacity at Elevated Temperature	0.54 J/g-°C	0.129 BTU/lb-°F	700°C (1290°F)
Specific Heat Capacity at Elevated Temperature	0.557 J/g-°C	0.133 BTU/lb-°F	800°C (1470°F)
Specific Heat Capacity at Elevated Temperature	0.573 J/g-°C	0.137 BTU/lb-°F	900°C (1650°F)
Specific Heat Capacity at Elevated Temperature	0.59 J/g-°C	0.141 BTU/lb-°F	1000°C (1830°F)
Thermal Conductivity	10.4 W/m-K	72.2 BTU-in/hr-ft²-°F	RT
Thermal Conductivity at Elevated Temperature	12.2 W/m-K	84.7 BTU-in/hr-ft²-°F	100°C (212°F)
Thermal Conductivity at Elevated Temperature	14.3 W/m-K	99.2 BTU-in/hr-ft²-°F	200°C (390°F)
Thermal Conductivity at Elevated Temperature	15.9 W/m-K	110 BTU-in/hr-ft²-°F	300°C (570°F)
Thermal Conductivity at Elevated Temperature	17.5 W/m-K	121 BTU-in/hr-ft²-°F	400°C (750°F)
Thermal Conductivity at Elevated Temperature	19.3 W/m-K	134 BTU-in/hr-ft²-°F	500°C (930°F)
Thermal Conductivity at Elevated Temperature	21.1 W/m-K	146 BTU-in/hr-ft²-°F	600°C (1110°F)
Thermal Conductivity at Elevated Temperature	23 W/m-K	160 BTU-in/hr-ft²-°F	700°C (1290°F)
Thermal Conductivity at Elevated Temperature	24.8 W/m-K	172 BTU-in/hr-ft²-°F	800°C (1470°F)
Thermal Conductivity at Elevated Temperature	25.5 W/m-K	177 BTU-in/hr-ft²-°F	900°C (1650°F)
Thermal Conductivity at Elevated Temperature	27.6 W/m-K	192 BTU-in/hr-ft²-°F	1000°C (1830°F)
Melting Point	1315 - 1410 °C	2400 - 2570 °F	
Solidus	1315 °C	2400 °F	
Liquidus	1410 °C	2570 °F	
Maximum Service Temperature, Air	1095 °C	2000 °F	