Haynes HastelloyÂ® Hybrid-BC1Â® Nickel Alloy Sheet, Cold Rolled and Solution Annealed

Category : Metal , Nonferrous Metal , Nickel Alloy

Material Notes:

HASTELLOYÂ® HYBRID-BC1Â® alloy possesses much higher resistance to hydrochloric and sulfuric acids than the nickel-chromium-molybdenum (C-type) alloys, and can tolerate the presence of oxidizing species. The alloy also exhibits extremely high resistance to pitting and crevice corrosion. HYBRID-BC1 alloy is available in the form of plate, sheet, strip, billet, bar, wire, pipe, and tube. HYBRID-BC1 alloy is suitable for the following applications in the chemical processing, pharmaceutical, agricultural, food, petrochemical, and power industries: Reaction vessels Heat exchangers Valves Pumps Piping Storage tanks The alloy is suitable for use at temperatures up to approximately 427Â°C (800Â°F). HYBRID-BC1 alloy excels in reducing acids and acid mixtures (with or without halides) open to oxygen and other oxidizing residuals/contaminants. Heat Treatment: Wrought forms of HYBRID-BC1 alloy are furnished in the solution annealed condition, unless otherwise specified. The standard solution annealing treatment consists of heating to 1149Â°C (2100Â°F) followed by rapid air-cooling or (preferably) water quenching. Parts which have been hot formed should be solution annealed prior to final fabrication or installation. The minimum hot forming temperature of the alloy is 954Â°C (1750Â°F). Forming: HYBRID-BC1 alloy has excellent forming characteristics, and cold forming is the preferred method of shaping. The alloy can be easily cold worked due to its high ductility; however, the alloy is stronger than the austenitic stainless steels and therefore requires more energy during cold forming.Data provided by the manufacturer, Haynes International, Inc.

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Physical Properties	Metric	English	Comments
Density	8.83 g/cc	0.319 lb/inÂ³	

Mechanical Properties	Metric	English	Comments
Tensile Strength, Ultimate	745 MPa @Thickness 3.20 mm, Temperature 316 Â°C	108000 psi @Thickness 0.126 in, Temperature 601 Â°F	
	747 MPa @Thickness 3.20 mm, Temperature 371 Â°C	108000 psi @Thickness 0.126 in, Temperature 700 Â°F	
	754 MPa @Thickness 3.20 mm, Temperature 260 Â°C	109000 psi @Thickness 0.126 in, Temperature 500 Â°F	
	763 MPa @Thickness 3.20 mm, Temperature 204 Â°C	111000 psi @Thickness 0.126 in, Temperature 399 Â°F	
	778 MPa	113000 psi	

Mechanical Properties	Metric	English	Comments
	@Thickness 3.20 mm, Temperature 427 Â°C	@Thickness 0.126 in, Temperature 801 Â°F	
	789 MPa @Thickness 3.20 mm, Temperature 149 Â°C	114000 psi @Thickness 0.126 in, Temperature 300 Â°F	
	811 MPa @Thickness 3.20 mm, Temperature 93.0 Â°C	118000 psi @Thickness 0.126 in, Temperature 199 Â°F	
	841 MPa @Thickness 3.20 mm, Temperature 25.0 Â°C	122000 psi @Thickness 0.126 in, Temperature 77.0 Â°F	
Tensile Strength, Yield	276 MPa @Thickness 3.20 mm, Temperature 371 Â°C	40000 psi @Thickness 0.126 in, Temperature 700 Â°F	0.2% Offset
	280 MPa @Thickness 3.20 mm, Temperature 427 Â°C	40600 psi @Thickness 0.126 in, Temperature 801 Â°F	0.2% Offset
	283 MPa @Thickness 3.20 mm, Temperature 316 Â°C	41000 psi @Thickness 0.126 in, Temperature 601 Â°F	0.2% Offset
	292 MPa @Thickness 3.20 mm, Temperature 260 Â°C	42400 psi @Thickness 0.126 in, Temperature 500 Â°F	0.2% Offset
	310 MPa @Thickness 3.20 mm, Temperature 204 Â°C	45000 psi @Thickness 0.126 in, Temperature 399 Â°F	0.2% Offset
	333 MPa @Thickness 3.20 mm, Temperature 149 Â°C	48300 psi @Thickness 0.126 in, Temperature 300 Â°F	0.2% Offset
	360 MPa @Thickness 3.20 mm, Temperature 93.0 Â°C	52200 psi @Thickness 0.126 in, Temperature 199 Â°F	0.2% Offset
	405 MPa @Thickness 3.20 mm, Temperature 25.0 Â°C	58700 psi @Thickness 0.126 in, Temperature 77.0 Â°F	0.2% Offset
Elongation at Break	61.6 % @Thickness 3.20 mm, Temperature 25.0 Â°C	61.6 % @Thickness 0.126 in, Temperature 77.0 Â°F	

Mechanical Properties	Metric	English	Comments
	63.3 % @Thickness 3.20 mm, Temperature 204 Â°C	63.3 % @Thickness 0.126 in, Temperature 399 Â°F	
	64.5 % @Thickness 3.20 mm, Temperature 149 Â°C	64.5 % @Thickness 0.126 in, Temperature 300 Â°F	
	66.1 % @Thickness 3.20 mm, Temperature 93.0 Â°C	66.1 % @Thickness 0.126 in, Temperature 199 Â°F	
	67.9 % @Thickness 3.20 mm, Temperature 260 Â°C	67.9 % @Thickness 0.126 in, Temperature 500 Â°F	
	68.5 % @Thickness 3.20 mm, Temperature 316 Â°C	68.5 % @Thickness 0.126 in, Temperature 601 Â°F	
	75.3 % @Thickness 3.20 mm, Temperature 427 Â°C	75.3 % @Thickness 0.126 in, Temperature 801 Â°F	
	76.9 % @Thickness 3.20 mm, Temperature 371 Â°C	76.9 % @Thickness 0.126 in, Temperature 700 Â°F	
Modulus of Elasticity	188 GPa @Temperature 600 Â°C	27300 ksi @Temperature 1110 Â°F	Dynamic
	191 GPa @Temperature 500 Â°C	27700 ksi @Temperature 932 Â°F	Dynamic
	197 GPa @Temperature 400 Â°C	28600 ksi @Temperature 752 Â°F	Dynamic
	200 GPa @Temperature 300 Â°C	29000 ksi @Temperature 572 Â°F	Dynamic
	205 GPa @Temperature 200 Â°C	29700 ksi @Temperature 392 Â°F	Dynamic
	211 GPa @Temperature 100 Â°C	30600 ksi @Temperature 212 Â°F	Dynamic
	217 GPa @Temperature 25.0	31500 ksi	Dynamic

Mechanical Properties	Metric	English	Comments
	Â°C	@Temperature 77.0 Â°F	

Thermal Properties	Metric	English	Comments
CTE, linear	11.5 Âµm/m-Â°C @Temperature 25.0 - 100 Â°C	6.39 Âµin/in-Â°F @Temperature 77.0 - 212 Â°F	
	11.9 Âµm/m-Â°C @Temperature 25.0 - 200 Â°C	6.61 Âµin/in-Â°F @Temperature 77.0 - 392 Â°F	
	12.2 Âµm/m-Â°C @Temperature 25.0 - 300 Â°C	6.78 Âµin/in-Â°F @Temperature 77.0 - 572 Â°F	
	12.5 Âµm/m-Â°C @Temperature 25.0 - 400 Â°C	6.94 Âµin/in-Â°F @Temperature 77.0 - 752 Â°F	
	12.7 Âµm/m-Â°C @Temperature 25.0 - 500 Â°C	7.06 Âµin/in-Â°F @Temperature 77.0 - 932 Â°F	
	12.7 Âµm/m-Â°C @Temperature 25.0 - 600 Â°C	7.06 Âµin/in-Â°F @Temperature 77.0 - 1110 Â°F	
Specific Heat Capacity	0.403 J/g-Â°C @Temperature 25.0 Â°C	0.0963 BTU/lb-Â°F @Temperature 77.0 Â°F	
	0.416 J/g-Â°C @Temperature 100 Â°C	0.0994 BTU/lb-Â°F @Temperature 212 Â°F	
	0.429 J/g-Â°C @Temperature 200 Â°C	0.103 BTU/lb-Â°F @Temperature 392 Â°F	
	0.439 J/g-Â°C @Temperature 300 Â°C	0.105 BTU/lb-Â°F @Temperature 572 Â°F	
	0.449 J/g-Â°C @Temperature 400 Â°C	0.107 BTU/lb-Â°F @Temperature 752 Â°F	
	0.457 J/g-Â°C @Temperature 600 Â°C	0.109 BTU/lb-Â°F @Temperature 1110 Â°F	
	0.461 J/g-Â°C	0.110 BTU/lb-Â°F	

Thermal Properties	Metric	English	Comments
	@Temperature 500 Â°C	@Temperature 932 Â°F	
Thermal Conductivity	9.30 W/m-K @Temperature 25.0 Â°C	64.5 BTU-in/hr-ftÂ²-Â°F @Temperature 77.0 Â°F	
	10.5 W/m-K @Temperature 100 Â°C	72.9 BTU-in/hr-ftÂ²-Â°F @Temperature 212 Â°F	
	11.9 W/m-K @Temperature 200 Â°C	82.6 BTU-in/hr-ftÂ²-Â°F @Temperature 392 Â°F	
	13.5 W/m-K @Temperature 300 Â°C	93.7 BTU-in/hr-ftÂ²-Â°F @Temperature 572 Â°F	
	14.9 W/m-K @Temperature 400 Â°C	103 BTU-in/hr-ftÂ²-Â°F @Temperature 752 Â°F	
	16.4 W/m-K @Temperature 500 Â°C	114 BTU-in/hr-ftÂ²-Â°F @Temperature 932 Â°F	
	17.5 W/m-K @Temperature 600 Â°C	121 BTU-in/hr-ftÂ²-Â°F @Temperature 1110 Â°F	
Maximum Service Temperature, Air	427 Â°C	800 Â°F	

Component Elements Properties	Metric	English	Comments
Aluminum, Al	<= 0.50 %	<= 0.50 %	
Carbon, C	<= 0.010 %	<= 0.010 %	
Chromium, Cr	15 %	15 %	
Iron, Fe	<= 1.25 %	<= 1.25 %	
Manganese, Mn	0.25 %	0.25 %	
Molybdenum, Mo	22 %	22 %	
Nickel, Ni	60.91 %	60.91 %	as balance
Silicon, Si	<= 0.080 %	<= 0.080 %	

Electrical Properties	Metric	English	Comments

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.000126 ohm-cm @Temperature 25.0 Â°C	0.000126 ohm-cm @Temperature 77.0 Â°F	
	0.000127 ohm-cm @Temperature 100 Â°C	0.000127 ohm-cm @Temperature 212 Â°F	
	0.000127 ohm-cm @Temperature 200 Â°C	0.000127 ohm-cm @Temperature 392 Â°F	
	0.000128 ohm-cm @Temperature 300 Â°C	0.000128 ohm-cm @Temperature 572 Â°F	
	0.000128 ohm-cm @Temperature 400 Â°C	0.000128 ohm-cm @Temperature 752 Â°F	
	0.000129 ohm-cm @Temperature 500 Â°C	0.000129 ohm-cm @Temperature 932 Â°F	
	0.000131 ohm-cm @Temperature 600 Â°C	0.000131 ohm-cm @Temperature 1110 Â°F	

Descriptive Properties	Value	Comments
Thermal Diffusivity	0.0264 cm^2/s	23Â°C
	0.0291 cm^2/s	at 100Â°C
	0.0319 cm^2/s	at 200Â°C
	0.0352 cm^2/s	at 300Â°C
	0.0382 cm^2/s	at 400Â°C
	0.0412 cm^2/s	at 500Â°C

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