

Haynes Hastelloy® Hybrid-BC1® Nickel Alloy Synergic Gas Metal Arc Welded (GMAW) Plate

Category : Metal , Nonferrous Metal , Nickel Alloy

Material Notes:

HASTELLOY® HYBRID-BC1® 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 427°C (800°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 1149°C (2100°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 954°C (1750°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. Tensile properties reported are for transverse Synergic Gas Metal Arc (GMAW MIG) welded samples. Other properties are typical of the alloy. 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/in ³	

Mechanical Properties	Metric	English	Comments
Tensile Strength, Ultimate	681 MPa	98800 psi	
	@Thickness 12.7 mm, Temperature 260 °C	@Thickness 0.500 in, Temperature 500 °F	
	684 MPa	99200 psi	
	@Thickness 12.7 mm, Temperature 427 °C	@Thickness 0.500 in, Temperature 801 °F	
	687 MPa	99600 psi	
	@Thickness 12.7 mm, Temperature 371 °C	@Thickness 0.500 in, Temperature 700 °F	
709 MPa	709 MPa	103000 psi	
	@Thickness 12.7 mm, Temperature 316 °C	@Thickness 0.500 in, Temperature 601 °F	
	719 MPa	104000 psi	

Mechanical Properties	Metric	English	Comments
	@Thickness 12.7 mm, Temperature 204 °C	@Thickness 0.500 in, Temperature 399 °F	
	756 MPa	110000 psi	
	@Thickness 12.7 mm, Temperature 149 °C	@Thickness 0.500 in, Temperature 300 °F	
	795 MPa	115000 psi	
	@Thickness 12.7 mm, Temperature 93.0 °C	@Thickness 0.500 in, Temperature 199 °F	
	835 MPa	121000 psi	
	@Thickness 12.7 mm, Temperature 25.0 °C	@Thickness 0.500 in, Temperature 77.0 °F	
Tensile Strength, Yield	402 MPa	58300 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 204 °C	@Thickness 0.500 in, Temperature 399 °F	
	405 MPa	58700 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 371 °C	@Thickness 0.500 in, Temperature 700 °F	
	408 MPa	59200 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 260 °C	@Thickness 0.500 in, Temperature 500 °F	
	413 MPa	59900 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 316 °C	@Thickness 0.500 in, Temperature 601 °F	
	416 MPa	60300 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 427 °C	@Thickness 0.500 in, Temperature 801 °F	
	438 MPa	63500 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 149 °C	@Thickness 0.500 in, Temperature 300 °F	
	458 MPa	66400 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 93.0 °C	@Thickness 0.500 in, Temperature 199 °F	
	501 MPa	72700 psi	0.2% Offset
	@Thickness 12.7 mm, Temperature 25.0 °C	@Thickness 0.500 in, Temperature 77.0 °F	
Elongation at Break	33.7 %	33.7 %	
	@Thickness 12.7 mm, Temperature 260 °C	@Thickness 0.500 in, Temperature 500 °F	

Mechanical Properties	Metric	English	Comments
	@Thickness 12.7 mm, Temperature 25.0 °C	@Thickness 0.500 in, Temperature 77.0 °F	
	37.2 %	37.2 %	
	@Thickness 12.7 mm, Temperature 371 °C	@Thickness 0.500 in, Temperature 700 °F	
	37.6 %	37.6 %	
	@Thickness 12.7 mm, Temperature 149 °C	@Thickness 0.500 in, Temperature 300 °F	
	38.8 %	38.8 %	
	@Thickness 12.7 mm, Temperature 427 °C	@Thickness 0.500 in, Temperature 801 °F	
	39.3 %	39.3 %	
	@Thickness 12.7 mm, Temperature 204 °C	@Thickness 0.500 in, Temperature 399 °F	
	39.7 %	39.7 %	
	@Thickness 12.7 mm, Temperature 93.0 °C	@Thickness 0.500 in, Temperature 199 °F	
	42.5 %	42.5 %	
	@Thickness 12.7 mm, Temperature 316 °C	@Thickness 0.500 in, Temperature 601 °F	
Modulus of Elasticity	188 GPa	27300 ksi	Dynamic
	@Temperature 600 °C	@Temperature 1110 °F	
	191 GPa	27700 ksi	Dynamic
	@Temperature 500 °C	@Temperature 932 °F	
	197 GPa	28600 ksi	Dynamic
	@Temperature 400 °C	@Temperature 752 °F	
	200 GPa	29000 ksi	Dynamic
	@Temperature 300 °C	@Temperature 572 °F	
	205 GPa	29700 ksi	Dynamic
	@Temperature 200 °C	@Temperature 392 °F	
	211 GPa	30600 ksi	Dynamic
	@Temperature 100 °C	@Temperature 212 °F	
	217 GPa	31500 ksi	Dynamic
	@Temperature 25.0 °C	@Temperature 77.0 °F	

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

Thermal Properties	Metric	English	Comments
	9.30 W/m-K @Temperature 25.0 °C	64.5 BTU-in/hr-ft ² -°F @Temperature 77.0 °F	
	10.5 W/m-K @Temperature 100 °C	72.9 BTU-in/hr-ft ² -°F @Temperature 212 °F	
	11.9 W/m-K @Temperature 200 °C	82.6 BTU-in/hr-ft ² -°F @Temperature 392 °F	
	13.5 W/m-K @Temperature 300 °C	93.7 BTU-in/hr-ft ² -°F @Temperature 572 °F	
	14.9 W/m-K @Temperature 400 °C	103 BTU-in/hr-ft ² -°F @Temperature 752 °F	
	16.4 W/m-K @Temperature 500 °C	114 BTU-in/hr-ft ² -°F @Temperature 932 °F	
	17.5 W/m-K @Temperature 600 °C	121 BTU-in/hr-ft ² -°F @Temperature 1110 °F	
Maximum Service Temperature, Air	427 °C	800 °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 Resistivity	0.000126 ohm-cm @Temperature 25.0 °C	0.000126 ohm-cm @Temperature 77.0 °F	
	0.000127 ohm-cm @Temperature 100 °C	0.000127 ohm-cm @Temperature 212 °F	

Electrical Properties	Metric	English	Comments
	0.000127 ohm-cm	0.000127 ohm-cm	
	@Temperature 200 °C	@Temperature 392 °F	
	0.000128 ohm-cm	0.000128 ohm-cm	
	@Temperature 300 °C	@Temperature 572 °F	
	0.000128 ohm-cm	0.000128 ohm-cm	
	@Temperature 400 °C	@Temperature 752 °F	
	0.000129 ohm-cm	0.000129 ohm-cm	
	@Temperature 500 °C	@Temperature 932 °F	
	0.000131 ohm-cm	0.000131 ohm-cm	
	@Temperature 600 °C	@Temperature 1110 °F	

Descriptive Properties	Value	Comments
Consumable Diameter	1.1	
Thermal Diffusivity	0.0264 cm ² /s	23°C
	0.0291 cm ² /s	at 100°C
	0.0319 cm ² /s	at 200°C
	0.0352 cm ² /s	at 300°C
	0.0382 cm ² /s	at 400°C
	0.0412 cm ² /s	at 500°C
	0.0435 cm ² /s	at 600°C

Contact Songhan Plastic Technology Co.,Ltd.

Website : www.lookpolymers.com

Email : sales@lookpolymers.com

Tel : +86 021-51131842

Mobile : +86 13061808058

Skype : lookpolymers

Address : United North Road 215,Fengxian District, Shanghai City,China