Haynes HastelloyÂ® C-2000Â® alloy, flat products

Category : Metal , Nonferrous Metal , Nickel Alloy , Superalloy

Material Notes:

Nickel-chromium-molybdenum (Ni-Cr-Mo) C-type alloys have a long history of use in the Chemical Process Industries and are known for their versatility. Not only do they resist all acids (especially hydrochloric, sulfuric, and hydrofluoric) over large temperature ranges, but they also resist the insidious types of attack induced by chlorides and other halide solutions, specifically pitting, crevice attack, and stress corrosion cracking. HASTELLOYÂ® C-2000Â® alloy has greater versatility than traditional Ni-Cr-Mo alloys. This was accomplished by use of a high chromium content, a high molybdenum content, and a small but effective addition of copper. The copper provides enhanced temperature capability in sulfuric acid, hydrofluoric acid, and dilute hydrochloric acid.C-2000 alloy is available in plate, sheet, strip, billet, bar, wire, covered electrodes, pipe, and tubing. Applications: Chemical process industry reactors, heat exchangers, columns, and piping.Pharmaceutical industry reactors and dryers.Flue gas desulfurization systems.C-2000 alloy is covered by ASME, ASTM, AWS, DIN, and TÃœV specifications.Welding: The weldability of C-2000 alloy is similar to that of C-276 alloy. To weld the C-type alloys, three processes are commonly used. For sheet welds and plate root passes, gas tungsten arc (GTAW) welding is favored. For plate welds, the gas metal arc (GMAW) process is preferred. For field welding, the shielded metal arc process, using coated electrodes, is favored. Submerged arc welding is not recommended as this process is characterized by high heat input to the base metal and slow cooling of the weld. To minimize the precipitation of second phases in regions affected by the heat of welding, a maximum interpass temperature of 93Â°C (200Â°F) is recommended for the C-type alloys. Welding of cold-worked materials is strongly discouraged, since they sensitize more quickly and induce residual stresses. A full solution anneal, followed by water quenching, is recommended for cold-worked structures prior to welding.Base Metal Preparation: The joint surface and adjacent area should be thoroughly cleaned before welding. All grease, oil, crayon marks, sulfur compounds, and other foreign matter should be removed. Filler Metal Selections: For gas tungsten arc and gas metal arc welding, C-2000 filler wire (ERNiCrMo-17) is suggested. For shielded metal arc welding,C-2000 covered electrodes (ENiCrMo-17) are suggested. Heat Treatment: The standard solution annealing treatment consists of heating to 1135Â°C (2075Â°F) followed by rapid air-cooling or water quenching. Parts which have been hot formed should be solution annealed prior to final fabrication or installation.Forming: C-2000 alloy has excellent forming characteristics, and cold forming is the preferred method of shaping. The alloy can be easily cold worked due to its good ductility. The alloy is generally stiffer than the austenitic stainless steels so more energy is required during cold forming.Data provided by the manufacturer, Haynes International, Inc.

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http://www.lookpolymers.com/polymer_Haynes-Hastelloy-C-2000-alloy-flat-products.php

Physical Properties	Metric	English	Comments
Density	8.50 g/cc	0.307 lb/inÂ³	at RT

Mechanical Properties	Metric	English	Comments
Tensile Strength, Ultimate	752 MPa @Thickness 25.4 mm	109000 psi @Thickness 1.00 in	
	752 MPa @Thickness 1.60 mm	109000 psi @Thickness 0.0630 in	

Mechanical Properties	Metric	English	Comments
	758 MPa @Thickness 12.7 mm	110000 psi @Thickness 0.500 in	
	765 MPa @Thickness 3.17 mm	111000 psi @Thickness 0.125 in	
	779 MPa @Thickness 6.35 mm	113000 psi @Thickness 0.250 in	
Tensile Strength, Yield	345 MPa @Thickness 12.7 mm, Temperature 20.0 Â°C	50000 psi @Thickness 0.500 in, Temperature 68.0 Â°F	0.2% offset
	358 MPa @Thickness 1.60 mm, Temperature 20.0 Â°C	51900 psi @Thickness 0.0630 in, Temperature 68.0 Â°F	0.2% offset
	372 MPa @Thickness 25.4 mm, Temperature 20.0 Â°C	54000 psi @Thickness 1.00 in, Temperature 68.0 Â°F	0.2% offset
	379 MPa @Thickness 6.35 mm, Temperature 20.0 Â°C	55000 psi @Thickness 0.250 in, Temperature 68.0 Â°F	0.2% offset
	393 MPa @Thickness 3.17 mm, Temperature 20.0 Â°C	57000 psi @Thickness 0.125 in, Temperature 68.0 Â°F	0.2% offset
Elongation at Break	62 % @Thickness 6.35 mm	62 % @Thickness 0.250 in	in 50.8 mm
	63 % @Thickness 25.4 mm	63 % @Thickness 1.00 in	in 50.8 mm
	63 % @Thickness 3.17 mm	63 % @Thickness 0.125 in	in 50.8 mm
	64 % @Thickness 1.60 mm	64 % @Thickness 0.0630 in	in 50.8 mm
	68 % @Thickness 12.7 mm	68 % @Thickness 0.500 in	in 50.8 mm
Modulus of Elasticity	162 GPa @Temperature 649 Â°C	23500 ksi @Temperature 1200 Â°F	

Mechanical Properties	Metric	English	Comments
	171 GPa @Temperature 538 Â°C	24800 ksi @Temperature 1000 Â°F	
	177 GPa @Temperature 427 Â°C	25700 ksi @Temperature 801 Â°F	
	190 GPa @Temperature 316 Â°C	27600 ksi @Temperature 601 Â°F	
	207 GPa @Temperature 25.0 Â°C	30000 ksi @Temperature 77.0 Â°F	

Thermal Properties	Metric	English	Comments
CTE, linear	12.4 Âµm/m-Â°C @Temperature 25.0 - 100 Â°C	6.89 Âµin/in-Â°F @Temperature 77.0 - 212 Â°F	
	12.6 Âµm/m-Â°C @Temperature 25.0 - 300 Â°C	7.00 Âµin/in-Â°F @Temperature 77.0 - 572 Â°F	
	13.2 Âµm/m-Â°C @Temperature 25.0 - 500 Â°C	7.33 Âµin/in-Â°F @Temperature 77.0 - 932 Â°F	
	14.0 Âµm/m-Â°C @Temperature 25.0 - 700 Â°C	7.78 Âµin/in-Â°F @Temperature 77.0 - 1290 Â°F	
	15.0 Âµm/m-Â°C @Temperature 25.0 - 900 Â°C	8.33 Âµin/in-Â°F @Temperature 77.0 - 1650 Â°F	
Specific Heat Capacity	0.428 J/g-Â°C @Temperature 25.0 Â°C	0.102 BTU/lb-Â°F @Temperature 77.0 Â°F	
	0.434 J/g-Â°C @Temperature 100 Â°C	0.104 BTU/lb-Â°F @Temperature 212 Â°F	
	0.443 J/g-Â°C @Temperature 200 Â°C	0.106 BTU/lb-Â°F @Temperature 392 Â°F	
	0.455 J/g-Â°C @Temperature 300 Â°C	0.109 BTU/lb-Â°F @Temperature 572 Â°F	

Thermal Properties	Metric	English	Comments
	0.468 J/g-Â°C @Temperature 400 Â°C	0.112 BTU/lb-Â°F @Temperature 752 Â°F	
	0.486 J/g-Â°C @Temperature 500 Â°C	0.116 BTU/lb-Â°F @Temperature 932 Â°F	
	0.536 J/g-Â°C @Temperature 600 Â°C	0.128 BTU/lb-Â°F @Temperature 1110 Â°F	
Thermal Conductivity	9.10 W/m-K	63.2 BTU-in/hr-ftÂ²-Â°F	RT
	10.8 W/m-K @Temperature 100 Â°C	75.0 BTU-in/hr-ftÂ²-Â°F @Temperature 212 Â°F	
	14.1 W/m-K @Temperature 300 Â°C	97.9 BTU-in/hr-ftÂ²-Â°F @Temperature 572 Â°F	
	18.0 W/m-K @Temperature 500 Â°C	125 BTU-in/hr-ftÂ²-Â°F @Temperature 932 Â°F	
	24.8 W/m-K @Temperature 700 Â°C	172 BTU-in/hr-ftÂ²-Â°F @Temperature 1290 Â°F	
	25.9 W/m-K @Temperature 900 Â°C	180 BTU-in/hr-ftÂ²-Â°F @Temperature 1650 Â°F	
Melting Point	1328 - 1358 Â°C	2422 - 2476 Â°F	
Solidus	1328 Â°C	2422 Â°F	
Liquidus	1358 Â°C	2476 Â°F	

Component Elements Properties	Metric	English	Comments
Aluminum, Al	<= 0.50 %	<= 0.50 %	
Carbon, C	<= 0.010 %	<= 0.010 %	
Chromium, Cr	23 %	23 %	
Copper, Cu	1.6 %	1.6 %	
Iron, Fe	<= 3.0 %	<= 3.0 %	
Manganese, Mn	<= 0.50 %	<= 0.50 %	

Component Elements Properties	Metric	English	Comments
Molybdenum, Mo	15 %	15 %	
Nickel, Ni	59 %	59 %	as balance
Silicon, Si	<= 0.080 %	<= 0.080 %	

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.000128 ohm-cm	0.000128 ohm-cm	RT
	0.000129 ohm-cm @Temperature 100 Â°C	0.000129 ohm-cm @Temperature 212 Â°F	
	0.000131 ohm-cm @Temperature 300 Â°C	0.000131 ohm-cm @Temperature 572 Â°F	
	0.000132 ohm-cm @Temperature 900 Â°C	0.000132 ohm-cm @Temperature 1650 Â°F	
	0.000134 ohm-cm @Temperature 500 Â°C	0.000134 ohm-cm @Temperature 932 Â°F	
	0.000134 ohm-cm @Temperature 700 Â°C	0.000134 ohm-cm @Temperature 1290 Â°F	

Descriptive Properties	Value	Comments
Thermal Diffusivity	0.025 cm^2/s	at 25Â°C
	0.029 cm^2/s	at 100Â°C
	0.033 cm^2/s	at 200Â°C
	0.036 cm^2/s	at 300Â°C
	0.04 cm^2/s	at 400Â°C
	0.043 cm^2/s	at 500Â°C
	0.047 cm^2/s	at 600Â°C

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