Haynes HastelloyÂ® C-4 alloy, plate, heat treated at 1066Â°C, rapid quenched

Category : Metal , Nonferrous Metal , Nickel Alloy , Superalloy

Material Notes:

Nickel-chromium-molybdenum alloy with outstanding high-temperature stability as evidenced by high ductility and corrosion resistance even after aging in the 1200 to 1900Â°F (649 to 1038Â°C) range. This alloy resists the formation of grain-boundary precipitates in the weld heat-affected zone, thus making it suitable for most chemical process applications in the as-welded condition. C-4 alloy also has excellent resistance to stress-corrosion cracking and to oxidizing atmospheres up to 1900Â°F (1038Â°C). HASTELLOY C-4 alloy has exceptional resistance to wide variety of chemical process environments. These include hot contaminated mineral acids, solvents, chlorine and chlorine contaminated media (organic and inorganic), dry chlorine, formic and acetic acids, acetic anhydride, and seawater and brine solutions. Laboratory precipitation studies on C-4 alloy indicate that the intermetallic precipitates (Mu phase) associated with other nickel alloys in the 1200 to 2000Â°F (649 to 1093Â°C) temperature range have not been detected. Fine intergranular M6C carbides can form but their damaging effect is minimal.HASTELLOY C-4 alloy can be forged, hot-upset, and impact extruded. Although the alloy tends to work-harden, it can be successfully deep-drawn, spun, press formed or punched. All of the common methods of welding can be used to weld HASTELLOY C-4 alloy, although the oxy-acetylene and submerged arc processes are not recommended when the fabricated item is intended for use in corrosion service. Special precautions should be taken to avoid excessive heat input.Wrought forms of HASTELLOY C-4 alloy are furnished in the solution heat-treated condition unless otherwise specified. C-4 alloy is solution heat-treated at 1950Â°F (1066Â°C) and rapid quenched.Data provided by the manufacturer, Haynes International, Inc.

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Physical Properties	Metric	English	Comments
Density	8.64 g/cc	0.312 lb/inÂ³	at RT

Mechanical Properties	Metric	English	Comments
Tensile Strength, Ultimate	483 MPa @Thickness 9.50 mm, Temperature 760 Â°C	70100 psi @Thickness 0.374 in, Temperature 1400 Â°F	
	584 MPa @Thickness 9.50 mm, Temperature 649 Â°C	84700 psi @Thickness 0.374 in, Temperature 1200 Â°F	
	635 MPa @Thickness 12.7 mm, Temperature 538 Â°C	92100 psi @Thickness 0.500 in, Temperature 1000 Â°F	
	643 MPa @Thickness 9.50 mm, Temperature 538 Â°C	93300 psi @Thickness 0.374 in, Temperature 1000 Â°F	
	657 MPa	95300 psi	

Mechanical Properties	Metric	English	Comments
	@Thickness 9.50 mm, Temperature 427 Â°C	@Thickness 0.374 in, Temperature 801 Â°F	
	683 MPa @Thickness 6.30 mm, Temperature 427 Â°C	99100 psi @Thickness 0.248 in, Temperature 801 Â°F	
	688 MPa @Thickness 12.7 mm, Temperature 427 Â°C	99800 psi @Thickness 0.500 in, Temperature 801 Â°F	
	704 MPa @Thickness 9.50 mm, Temperature 316 Â°C	102000 psi @Thickness 0.374 in, Temperature 601 Â°F	
	707 MPa @Thickness 12.7 mm, Temperature 316 Â°C	103000 psi @Thickness 0.500 in, Temperature 601 Â°F	
	712 MPa @Thickness 6.30 mm, Temperature 316 Â°C	103000 psi @Thickness 0.248 in, Temperature 601 Â°F	
	717 MPa @Thickness 6.30 mm, Temperature 204 Â°C	104000 psi @Thickness 0.248 in, Temperature 399 Â°F	
	725 MPa @Thickness 12.7 mm, Temperature 204 Â°C	105000 psi @Thickness 0.500 in, Temperature 399 Â°F	
	727 MPa @Thickness 9.50 mm, Temperature 204 Â°C	105000 psi @Thickness 0.374 in, Temperature 399 Â°F	
	765 MPa @Thickness 12.7 mm, Temperature 93.0 Â°C	111000 psi @Thickness 0.500 in, Temperature 199 Â°F	
	767 MPa @Thickness 6.30 mm, Temperature 20.0 Â°C	111000 psi @Thickness 0.248 in, Temperature 68.0 Â°F	
	791 MPa @Thickness 9.50 mm, Temperature 20.0 Â°C	115000 psi @Thickness 0.374 in, Temperature 68.0 Â°F	
	805 MPa @Thickness 12.7 mm, Temperature 20.0 Â°C	117000 psi @Thickness 0.500 in, Temperature 68.0 Â°F	

Mechanical Properties	Metric	English	Comments
Tensile Strength, Yield	205 MPa	29700 psi	0.2% offset
	@Thickness 12.7 mm, Temperature 538 Â°C	@Thickness 0.500 in, Temperature 1000 Â°F	
	211 MPa @Thickness 9.50 mm, Temperature 760 Â°C	30600 psi @Thickness 0.374 in, Temperature 1400 Â°F	0.2% offset
	217 MPa @Thickness 9.50 mm, Temperature 649 Â°C	31500 psi @Thickness 0.374 in, Temperature 1200 Â°F	0.2% offset
	228 MPa @Thickness 9.50 mm, Temperature 538 Â°C	33100 psi @Thickness 0.374 in, Temperature 1000 Â°F	0.2% offset
	236 MPa @Thickness 12.7 mm, Temperature 427 Â°C	34200 psi @Thickness 0.500 in, Temperature 801 Â°F	0.2% offset
	247 MPa @Thickness 12.7 mm, Temperature 316 Â°C	35800 psi @Thickness 0.500 in, Temperature 601 Â°F	0.2% offset
	255 MPa @Thickness 6.30 mm, Temperature 427 Â°C	37000 psi @Thickness 0.248 in, Temperature 801 Â°F	0.2% offset
	258 MPa @Thickness 9.50 mm, Temperature 427 Â°C	37400 psi @Thickness 0.374 in, Temperature 801 Â°F	0.2% offset
	264 MPa @Thickness 12.7 mm, Temperature 204 Â°C	38300 psi @Thickness 0.500 in, Temperature 399 Â°F	0.2% offset
	270 MPa @Thickness 9.50 mm, Temperature 316 Â°C	39200 psi @Thickness 0.374 in, Temperature 601 Â°F	0.2% offset
	281 MPa @Thickness 6.30 mm, Temperature 316 Â°C	40800 psi @Thickness 0.248 in, Temperature 601 Â°F	0.2% offset
	295 MPa @Thickness 6.30 mm, Temperature 204 Â°C	42800 psi @Thickness 0.248 in, Temperature 399 Â°F	0.2% offset
	301 MPa @Thickness 9.50 mm,	43700 psi @Thickness 0.374 in,	0.2% offset

Mechanical Properties	Metric	English	Comments
	Temperature 204 Â°C 301 MPa @Thickness 12.7 mm, Temperature 93.0 Â°C	Temperature 399 Â°F 43700 psi @Thickness 0.500 in, Temperature 199 Â°F	0.2% offset
	335 MPa @Thickness 12.7 mm, Temperature 20.0 Â°C	48600 psi @Thickness 0.500 in, Temperature 68.0 Â°F	0.2% offset
	336 MPa @Thickness 6.30 mm, Temperature 20.0 Â°C	48700 psi @Thickness 0.248 in, Temperature 68.0 Â°F	0.2% offset
	356 MPa @Thickness 9.50 mm, Temperature 20.0 Â°C	51600 psi @Thickness 0.374 in, Temperature 68.0 Â°F	0.2% offset
Elongation at Break	52 % @Thickness 9.50 mm, Temperature 538 Â°C	52 % @Thickness 0.374 in, Temperature 1000 Â°F	in 50.8 mm
	52 % @Thickness 9.50 mm, Temperature 649 Â°C	52 % @Thickness 0.374 in, Temperature 1200 Â°F	in 50.8 mm
	54 % @Thickness 6.30 mm, Temperature 204 Â°C	54 % @Thickness 0.248 in, Temperature 399 Â°F	in 50.8 mm
	55 % @Thickness 6.30 mm, Temperature 316 Â°C	55 % @Thickness 0.248 in, Temperature 601 Â°F	in 50.8 mm
	56 % @Thickness 9.50 mm, Temperature 204 Â°C	56 % @Thickness 0.374 in, Temperature 399 Â°F	in 50.8 mm
	58 % @Thickness 6.30 mm, Temperature 20.0 Â°C	58 % @Thickness 0.248 in, Temperature 68.0 Â°F	in 50.8 mm
	59 % @Thickness 9.50 mm, Temperature 20.0 Â°C	59 % @Thickness 0.374 in, Temperature 68.0 Â°F	in 50.8 mm
	59 % @Thickness 9.50 mm, Temperature 316 Â°C	59 % @Thickness 0.374 in, Temperature 601 Â°F	in 50.8 mm
	60 %	60 %	

Mechanical Properties	Metric	English	Comments
	@Thickness 6.30 mm, Temperature 427 Â°C	@Thickness 0.248 in, Temperature 801 Â°F	in 50.8 mm
	61 % @Thickness 12.7 mm, Temperature 204 Â°C	61 % @Thickness 0.500 in, Temperature 399 Â°F	in 50.8 mm
	62 % @Thickness 9.50 mm, Temperature 427 Â°C	62 % @Thickness 0.374 in, Temperature 801 Â°F	in 50.8 mm
	63 % @Thickness 12.7 mm, Temperature 20.0 Â°C	63 % @Thickness 0.500 in, Temperature 68.0 Â°F	in 50.8 mm
	63 % @Thickness 9.50 mm, Temperature 760 Â°C	63 % @Thickness 0.374 in, Temperature 1400 Â°F	in 50.8 mm
	65 % @Thickness 12.7 mm, Temperature 316 Â°C	65 % @Thickness 0.500 in, Temperature 601 Â°F	in 50.8 mm
	66 % @Thickness 12.7 mm, Temperature 427 Â°C	66 % @Thickness 0.500 in, Temperature 801 Â°F	in 50.8 mm
	70 % @Thickness 12.7 mm, Temperature 93.0 Â°C	70 % @Thickness 0.500 in, Temperature 199 Â°F	in 50.8 mm
	71 % @Thickness 12.7 mm, Temperature 538 Â°C	71 % @Thickness 0.500 in, Temperature 1000 Â°F	in 50.8 mm
Modulus of Elasticity	211 GPa	30600 ksi	RT
	141 GPa @Temperature 982 Â°C	20500 ksi @Temperature 1800 Â°F	
	152 GPa @Temperature 871 Â°C	22000 ksi @Temperature 1600 Â°F	
	162 GPa @Temperature 760 Â°C	23500 ksi @Temperature 1400 Â°F	
	171 GPa	24800 ksi	

Mechanical Properties	Metric	English	Comments
	@Temperature 649 Â°C	@Temperature 1200 Â°F	
	179 GPa @Temperature 538 Â°C	26000 ksi @Temperature 1000 Â°F	
	187 GPa @Temperature 427 Â°C	27100 ksi @Temperature 801 Â°F	
	194 GPa @Temperature 316 Â°C	28100 ksi @Temperature 601 Â°F	
	201 GPa @Temperature 204 Â°C	29200 ksi @Temperature 399 Â°F	
	207 GPa @Temperature 93.0 Â°C	30000 ksi @Temperature 199 Â°F	

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.000125 ohm-cm @Temperature 100 Â°C	0.000125 ohm-cm @Temperature 212 Â°F	
	0.000125 ohm-cm @Temperature 23.0 Â°C	0.000125 ohm-cm @Temperature 73.4 Â°F	
	0.000126 ohm-cm @Temperature 200 Â°C	0.000126 ohm-cm @Temperature 392 Â°F	
	0.000127 ohm-cm @Temperature 300 Â°C	0.000127 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	
	0.000132 ohm-cm @Temperature 600 Â°C	0.000132 ohm-cm @Temperature 1110 Â°F	

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