Valbruna Grade

V174

Steel type

Precipitation Hardening

Description of material

It is a martensitic precipitation hardening stainless steel with high strength and hardness. The mechanical properties are obtained by a solution treatment (Cond. A) that brings the Cu in solution in the Austenitic matrix followed by a rapid cooling obtaining a super-saturated Cu martensitic structure. A re-heating (ageing) at t° = 480°C gives a maximum Hardness and resistance Rm, with low Kv impact, due to a precipitation of Cu –rich phase. Ageing at t°= 620°C results in a higher Kv impact, with a reduction of Rp0,2 and Rm, due to a progressive softening of Martensite and the formation of both Cu-globules with loss of coherence within the matrix, and stable Austenite. It is important to know that the transformation of Austenite to Martensite is completed below 30°C and the formation of stable Austenite during aging can start to appear at 550°. This strongly depends on the (Cr/Ni) equivalent balance that, besides, influences the amount of Ferrite in the matrix.

Applications

It can be used in different kind of application as valves, chemical and power productions components, engine parts, fitting, fasteners, shafts and pumps shafts and parts of oil & gas plants.

Melting practices

Argon Oxygen Decarburization, AOD + ESR

Corrosion resistance

This grade has the same general resistance corrosion as 304 but better than the group of standard martensitic 400 series. However, solution treatment (cond. A) without aging should be avoided. For maximum resistance to Chloride stress corrosion cracking, it should be aged at a higher temperature, not less than 550-580°C. In Sulfide aggressive environments, age at 620° C or overage. The same choice should be done in the case of situations or environments prone to cause H-embrittlement. It should also be noted that for this grade, as for every kind of stainless steel, surfaces should be free of contaminants and scale, and passivated for optimum resistance corrosion.

Cold working

This grade has a limited cold deforming capacity in the annealed condition (cond.A) due to untempered Martensite. More severe cold working requires aging at the highest temperature or overaging. For restoring or increasing mechanical properties, such as Tensile Rm, a new solution treatment (cond.A) followed by a suitable aging temperature should be carried out.

Machinability

Machinability is good in both the solution-treated (cond.A) and precipitation hardening conditions, considering that this property improves when hardness decreases. A certain amount of dimensional changes, in terms of contraction, happens after the aging of parts: these dimensional variations should be evaluated.

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Weldability

This grade has a good weldability and doesn't normally need preheating, but welding design should be well evaluated in order to avoid situations prone to generate stress. In short, small sections could be welded in the solution treatment condition followed by an aging; large or heavy sections require a high temperature aging or overaging obviously followed by a new solution treatment (cond. A) and an aging.

Hot working

Ingots or large forgings require a suitable preheating in order to avoid thermal cracking. Avoid overheating and improper cooling. Large forging bars should be equalized at 1030 -1040°C in the heating furnace prior to cooling. Both small or large forgings, rolled rings or bars must be cooled under 30°C after solution treatment (cond. A) in order to complete the transformation of martensite, obtaining both a good structure and mechanical properties after aging. It is useful to point out that a certain amount of Ferrite could be in the V174 structure.

Designations

RCCM-M MATERIAL REF.	X6CrNiCu17-04
AISI	630
W.N.	1.4542
UNS	S17400
EN	X5CrNiCuNb16-4

Specifications

ASTM	A564
EN	10088-3

Chemical composition

Chemical element	C	Mn	Si	S	P	Ni	Cr	Mo	Cu	Ta+Nb	Nb
Minimum value %	-	-	-	-	-	3%	15%	-	3%	0,15%	5*C
Maximum value %	0,07%	1%	0,7%	0,03%	0,04%	5%	17%	0,5%	5%	0,45%	0,45%

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Heat treatment

Description of condition	Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Solution Annealed	AT	1025	1050	Air
Solution Annealed-Aged	H900	480	-	Air
Solution Annealed-Aged	H925	495	-	Air
Solution Annealed-Aged	H1025 (P1070)	550	-	Air
Solution Annealed-Aged	H1075	580	-	Air
Solution Annealed-Aged	H1100 (P960)	595	-	Air
Solution Annealed-Aged	H1150 (P930)	620	-	Air
Solution Annealed-Double Aged	H1150M (P800)	760 + 620	-	Air
Solution Annealed-Double Aged	H1150D	620 + 620	-	Air

Physical properties

Physical property	SI/metric units	US/BS Imperial units
Density	7,8 kg/dm³	0,282 lb/in³
Specific Thermal Capacity 20° C	500 J/(kg·K)	0,119 Btu/lb°F
Thermal conductivity 20° C	16 W/(m·K)	110,936 Btu in/ ft² h °F
Thermal expansion 20° - 100° C	10,9 (10^{-6}/K)	6,056 (10^{-6}/°F)
Electrical Resistivity 20° C	0,71 Ω·mm²/m	27,953 μΩin
Modulus of Elasticity 20° C	200 GPa	29007,548 ksi

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Mechanical properties

Condition	Subtype	Rm [N/mm²]	Rm [Ksi]	HBW	Rp0.2% [N/mm²]	Rp0.2% [Ksi]	E4d [%]
Solution Annealed	AT	1200 max.	174 max.	360 max.	-	-	-
Solution Annealed-Aged	H900	1310 min.	190 min.	388 min.	1170 min.	170 min.	10 min.
Solution Annealed-Aged	H925	1170 min.	170 min.	375 min.	1070 min.	155 min.	10 min.
Solution Annealed-Aged	H1025 (P1070)	1070 min.	155 min.	331 min.	1000 min.	145 min.	12 min.
Solution Annealed-Aged	H1075	1000 min.	145 min.	311 min.	860 min.	125 min.	13 min.
Solution Annealed-Aged	H1100 (P960)	965 min.	140 min.	302 min.	795 min.	115 min.	14 min.
Solution Annealed-Aged	H1150 (P930)	930 min.	135 min.	277 min.	725 min.	105 min.	16 min.
Solution Annealed-Double Aged	H1150M (P800)	795 min.	115 min.	255 min.	520 min.	75 min.	18 min.
Solution Annealed-Double Aged	H1150D	860 min.	125 min.	255 - 311	725 min.	105 min.	16 min.

Hot working

Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Forging / Hot Rolling	900	1150	Air

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