Valbruna Grade

V138

Steel type

Precipitation Hardening

Description of material

V138 is a precipitation hardening stainless steel fabricated by a special steel making processes and with an accurate chemical balance, able to warrant both higher mechanical properties and a resistance to general corrosion and stress corrosion cracking better than other typical PH martensitic grades. It can be solution treated, aged or overaged as the other PH martensitic grades, or solution treated and age - hardened by a cryogenic treatment; in both cases, the complete transformation of Martensite must be assured in order to obtain good metallurgical and mechanical properties.

Applications

V138 is used in a number of different kinds of applications, such as aircraft and nuclear, oil & gas components, fittings, bolting, valves, shafts and fasteners.

Melting practices

VIM + VAR

Corrosion resistance

The same as other PH martensitic grades, V138 shows same corrosion resistance of austenitic 304 and should be aged at temperature not less than 540°C to avoid stress corrosion and obtain a good level of toughness. The susceptibility to H-embrittlement decreases as the aging temperature is increased, but this is not dependent solely on strength, but also on both microstructure and environment. It's important to point out that this grade, as for every kind of stainless steel, the surface should be free of contaminant and scale, and passivated for optimum corrosion resistance.

Cold working

This grade has the same behavior of other PH grades, due to high yield strength that reduces the cold deforming capacity. Machining of V138 can be done in both the solution treated and age- hardened conditions, considering that this improves as the hardening temperature increases.

Machinability

It should be noted that V138 has lower machinability than V174, V174LC and V174/1. A certain amount of dimensional changes, in terms of contraction, happens after the ageing 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. Small sections could be welded in the solution treatment condition followed by an aging. Nevertheless, the best results, in terms of toughness, strength and corrosion resistance, are obtained by solution treatment of the welded pieces before aging. Large sections require a high temperature aging or over-aging obviously followed by a new solution treatment 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 and shapes should be equalized in the heating furnace prior to cooling. Both small or large forgings, rolled rings or bars must be cooled under 15°C and then solution treated, in order to complete the transformation of martensite, obtaining both good structure and mechanical properties after aging. Transverse toughness of heavy forgings or large section pieces of V138 are better than V174 and V155.

Designations

AISI	XM-13
W.N.	1.4534
UNS	S13800
EN	X3CrNiMoAl13-8-2

Specifications

ASTM	A564

Chemical composition

Chemical element	C	Mn	P	S	Si	Cr	Ni	Al	Mo	N
Minimum value %	-	-	-	-	-	12.25%	7.5%	0.9%	2%	-
Maximum value %	0.05%	0.2%	0.01%	0.008%	0.1%	13.25%	8.5%	1.35%	2.5%	0.01%

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Heat treatment

Description of condition	Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Solution Annealed	A	910	940	Air
Solution Annealed-Aged	H950	510	-	Air
Solution Annealed-Aged	H1000	540	-	Air
Solution Annealed-Aged	H1025	550	-	Air
Solution Annealed-Aged	H1050	565	-	Air
Solution Annealed-Aged	H1100	595	-	Air
Solution Annealed-Aged	H1150	620	-	Air
Solution Annealed-Double Aged	H1150M	760 + 620	-	Air

Physical properties

Physical property	SI/metric units	US/BS Imperial units
Density	7.76 kg/dm³	0.28 lb/in³
Specific Thermal Capacity 20° C	500 J/(kg·K)	0.119 Btu/lb°F
Thermal conductivity 20° C	14 W/(m·K)	97.069 Btu in/ ft² h °F
Thermal expansion 20° - 100° C	11.4 (10^{-6}/K)	6.333 (10^{-6}/°F)
Electrical Resistivity 20° C	0.85 Ω·mm²/m	33.465 μΩin
Modulus of Elasticity 20° C	196 GPa	28427.397 ksi

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Mechanical properties

Condition	Subtype	HBW	Rm [N/mm²]	Rm [Ksi]	Rp0.2% [N/mm²]	Rp0.2% [Ksi]	E4d [%]
Solution Annealed	A	363 max.	-	-	-	-	-
Solution Annealed-Aged	H950	430 min.	1520 min.	220 min.	1415 min.	205 min.	10 min.
Solution Annealed-Aged	H1000	400 min.	1415 min.	205 min.	1310 min.	190 min.	10 min.
Solution Annealed-Aged	H1025	380 min.	1280 min.	186 min.	1210 min.	175 min.	11 min.
Solution Annealed-Aged	H1050	372 min.	1210 min.	175 min.	1140 min.	165 min.	12 min.
Solution Annealed-Aged	H1100	313 min.	1035 min.	150 min.	930 min.	135 min.	14 min.
Solution Annealed-Aged	H1150	283 min.	930 min.	135 min.	620 min.	90 min.	14 min.
Solution Annealed-Double Aged	H1150M	259 min.	860 min.	125 min.	585 min.	85 min.	16 min.

Hot working

Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Forging / Hot Rolling	1000	1170	Air

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