AEROVAL V155

ACCIAIERIE VALBRUNA

AEROVAL®
Aerospace special grades

MATERIAL DESCRIPTION

GENERAL: V155 is a martensitic SS which could be strengthened by precipitation treatment leading a Cu-containing phase to precipitate in the alloy. It is typically used for parts requiring corrosion resistance and high mechanical properties up to 315°C. The proper chemical composition and the manufacturing process promote improved toughness in the transversal section and good ductility; these features are obtained by balanced chemistry capable to limit the content of δ - ferrite and by consumable electrode remelting practice capable to control the inclusion content tight.

APPLICATIONS

Aircraft components (structural parts, flap Tracks and engine pylons), fabricated parts in high pressure corrosive environments including valves, shafts, fasteners, fittings and gears.

CORROSION AND OXIDATION RESISTANCE

V155 exhibits good resistance to oxidation up to 600°C. Long-term exposure to elevated temperatures can result in reduced toughness in precipitation hardenable stainless steels. Decreased toughness caused by prolonged exposure to high temperatures can be reduced by high-temperature aging.
Corrosion resistance of V155 is pretty comparable to AISI 304 and similar to AISI 630. Stress-corrosion cracking resistance is achieved by precipitation treatment at temperatures equal or higher than 550°C in order to provide lowest hardness compatible with the specific use. V155 exhibits also good erosion-corrosion resistance thanks to its corrosion resistance combined with high hardness.
For better corrosion resistance surfaces should be clean, free of scale and residuals. Passivation is recommended for fabricated parts.
Annealed condition is not suitable for applications or services. Precipitation hardening after solution treatment is recommended in order to avoid delayed crackings.

DESIGNATIONS

UNS	AFNOR	ASTM	AECMA	EN
S15500	EZ5CNU15-04	XM-12	FE-PM64/FE-PM1802	1.4545/X5CrNiCuNb15-5

CHEMICAL COMPOSITION (chemistry shall conform to the following percentages by weight)

Element	Fe	C	Mn	Si	P	S	Cr	Ni	Cb	Cu	Mo
Min[%]	Bal.	-	-	-	-	-	14.00	3.50	5xC	2.50	-
Max[%]		0.07	1.00	1.00	0.030	0.015	15.50	5.50	0.45	4.50	0.50

HEAT TREATMENTS

Condition		Temperatures	Soaking times	Cooling
Solution Treatment	Cond. A	1040° ± 15°C	Commensurate to section, Min 30'	Air to below 30°C, alt.: $\phi \geq 75$mm → rapid air cooling $\phi < 75$mm → air
Precipitation hardening	H900	480° ± 5°C	1 hrs ± 5'	Air cooling
	H925	500° ± 5°C	4 hrs ± 15'	Air cooling
	H1025	550° ± 5°C	4 hrs ± 15'	Air cooling
	H1075	580° ± 5°C	4 hrs ± 15'	Air cooling
	H1100	590° ± 5°C	4 hrs ± 15'	Air cooling
	H1150	620° ± 5°C	4 hrs ± 15'	Air cooling
	H1150M (double PH)	760° ± 5°C	2 hrs ± 15'	Air cooling
		620° ± 5°C	4 hrs ± 15'	Air cooling

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PHYSICAL PROPERTIES

		Cond. A	Cond. H900	Cond. H1075	Cond. H1150
Density (gr/cm³ at 20°C)		7,75	7.81	7.83	7.86
Modulus of elasticity (GPa)		196			
Mean Coefficient of	-73 +21° C	-	10.4	10.8	11.0
Thermal Expansion (10^{-6}/°C)	+21 +427° C	11.3	11.7	12.2	13.0
Thermal Conductivity	+20° C	18.3	17.8	-	-
(W/mK at 20°C)	+500° C	22.7	22.7	-	-
Electrical resistivity ($\mu\Omega \times$m at 20°C)		-	0.770	0.800	-
Magnetic Permeability		Ferromagnetic			

MECHANICAL PROPERTIES

Condition		Charpy V-notch Impact Strength (J)	Hardness HRC	Hardness HB	Ultimate Tensile Strength (N/mm²), min	0.2% Yield Strength (N/mm²), min	Elongation [50mm or 4D] (%), min	Reduction of Area (%), min
Solution Treatment	Cond.A			363 max				
Precipitation treated	H900	20	40-44	388-444	1300	1170	10	35
	H925	34	38-42	375-429	1170	1070	10	38
	H1025	48	33-38	331-401	1070	1000	12	45
	H1075	54	29-36	311-375	1000	860	13	45
	H1100	61	29-34	302-363	965	795	14	45
	H1150	68	26-33	277-352	930	725	16	50
	H1150M	138	26-36	277	790	515		

HOT WORKING

V155 could be easily forged and hot-formed. Before forging, material should be heated at 1180-1200°C for 1 hour.
Forging below 1000°C is not recommended. In order to have material exhibiting best grain size and mechanical properties, forgings should be cooled in air to below 35°C before further processing.

COLD WORKING

The material could be moderately but not hardly formed in the overaged conditions. Best machinability or cold deformation can be achieved in the double-aged conditions (H1150M).

WELDABILITY

V155 can be satisfactorily welded by conventional inert gas, shielded fusion and resistance processes. Because of Carbon pickup. Preheating is generally not required to prevent cracking, while post-welding heat treatment is recommended to generate the precipitation-hardening properties.
Material could be welded in the solution annealed condition, and can be precipitation treated to the requested hardness after welding; nevertheless, in order to minimize the effect of several thermal cycles, to have more uniform properties and to have best corrosion resistance in the aged material, solution annealing is suggested before precipitation treatment. In case high welding stresses are expected, it could be better to weld in the overaged conditions (H1150); in this case, the component should be solution treated after welding and aged.
Should the weld not exhibit high strength an austenitic stainless filler as E/ER308L has to be used If welding has to provide properties similar to the ones of the base metal in the precipitation treated condition than E/ER630 filler metal is required in order to have the filler producing the precipitation hardening effect.

SPECIFICATIONS

ASTM	AMS
A 564	5659

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