Valbruna Grade

CMXC

Steel type

Martensitic Stainless Steel

Description of material

CMXC is a high carbon martensitic stainless steel designed to supply high hardness. Its corrosion resistance cannot be as good as Chromium 18% grades due to the high Carbon content. Because of its high hardness after heat treatment, CMXC is used in applications where this characteristic is the most important requirement.

Applications

All applications where high hardness is indispensable, such as bearing balls , fuel injection needles, valve seats , parts of pumps, wear resistant devices and professional cutlery (not table cutlery).

Melting practices

EAF + AOD

Corrosion resistance

CMXC has its maximum corrosion resistance when in the hardened + low temperature tempered condition and with its maximum hardness. Its use in the annealed condition or any other situation able to reduce the surface hardness and in environments containing Chloride, should be avoided. CMXC has good resistance corrosion in mild environments such as fresh water, industrial and rural atmospheres, petroleum products, gasoline fuel oil and alcohol. It should be noted that this grade, as for every kind of stainless steel, surfaces should be free of contaminant and scale, heat tint, and passivated for optimum resistance to corrosion.

Cold working

In the annealed condition, this grade is not suitable for cold forming operations such as cold heading or up-setting. Nevertheless, a moderate cold formability could be obtained after a long lasting annealing and very slow cooling in the furnace. It should be pointed out that CMXC is prone to surface decarburization: a protective atmosphere should be considered in the heat treatment of finished pieces.

Machinability

In the annealed condition CMXC has a good machinability but a little bit lower if compared to low-medium Carbon martensitic type 400 series steels. A significant improvement is obtained by the micro-resulphurizing of CMXC but is important to know that the productivity gain depends on the type of machines used, the kind of tools used and their geometry, cutting fluids and the kind of machine operations on the pieces produced. Grinding and polishing of hardened + tempered material at maximum values of hardness must be carried out with great care in order to avoid the overheating of the surface of the piece resulting in poor corrosion resistance and/or grinding cracks.

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Weldability

This process is very risky and shouldn't be a cycle of production to apply. Different and alternative choices should be evaluated to join parts. In any case, if welding process were required, a preheating is mandatory and the part must be maintained at temperature and followed by immediate annealing. Fillers of the same composition can be used to obtain mechanical properties close to that of the base metal. Alternatively, austenitic fillers may be used considering an inevitable reduction of these properties.

Hot working

Blooms and ingots require a suitable preheating to avoid cracks and a slow cooling in the furnace after forging. Overheating must always be avoided in order to reduce the risk of internal bursts. An improper cooling could result in stress cooling cracks. Large forgings and large cross – section shapes should be left to cool until their core reaches room temperature and, then, immediately heat treated. A right and suitable heat treatment of pieces after the forging process creates a structure with no or little retained austenite avoiding delayed cracks.

Heat treatment

CMXC should be double tempered after hardening in order to reduce or avoid retained austenite obtaining high values of hardness. Alternatively, a cryogenic treatment after hardening and tempering can be carried out but this must always be followed by another tempering.

Designations

AISI	440C
W.N.	1.4125
UNS	S44004
EN	X105CrMo17

Specifications

EN	10088-3
ASTM	A276

Chemical composition

Chemical element	C	Mn	Si	P	S	Cr	Mo	Ni
Minimum value %	0,95%	-	-	-	-	16%	0,4%	-
Maximum value %	1,2%	1%	1%	0,04%	0,03%	18%	0,65%	0,75%

Heat treatment

Description of condition	Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Annealed	A	740	880	Slow Furnace Cooling

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Physical properties

Physical property	SI/metric units	US/BS Imperial units
Density	7,7 kg/dm³	0,278 lb/in³
Specific Thermal Capacity 20° C	430 J/(kg·K)	0,103 Btu/lb°F
Thermal conductivity 20° C	15 W/(m·K)	104,002 Btu in/ ft² h °F
Thermal expansion 20° - 100° C	10,4 (10^{-6}/K)	5,778 (10^{-6}/°F)
Electrical Resistivity 20° C	0,8 Ω·mm²/m	31,496 μΩin
Modulus of Elasticity 20° C	200 GPa	29007,548 ksi

Mechanical properties

Condition	Subtype	Rm [N/mm²]	Rm [Ksi]	HBW
Annealed	A	931 max.	135 max.	255 max.

Hot working

Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Forging / Hot Rolling	930	1150	Air

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