440C Stainless Steel Bar

Steel Type - Martensitic

CMXC/1 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/1 is used in applications where this characteristic is the most important. Its Molybdenum content is lower than CMXC but properties and characteristics are substantially the same.

DESIGNATIONS

VALBRUNA	CMXC/1
AISI	440C
UNS	S44004

SPECIFICATIONS

ASTM	A276

CHEMICAL COMPOSITION

CHEMICAL ELEMENT	C	Mn	Si	P	S	Cr	Mo
MINIMUM VALUE %	0.95%	-	-	-	-	16%	-
MAXIMUM VALUE %	1.20%	1.00%	1.00%	0.04%	0.03%	18%	0.75%

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).

MACHINABILITY

In the annealed condition CMXC/1 has a good machinability but a little bit lower if compared to low-medium Carbon martensitic type 400 series steels. A significant improvement could be obtained by the micro-resulphurizing of CMXC/1 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 a 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.

CORROSION RESISTANCE

CMXC/1 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/1 has good corrosion resistance 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/1 is prone to surface decarburization: a protective atmosphere should be considered for the heat treatment of finished pieces.

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 cracking.

HEAT TREATMENT

CMXC/1 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.

MELTING PRACTICES

EAF+AOD

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