1.4031

X39Cr13

Chromium martensitic stainless steel

C 0.36 – 0.42 **Cr** 12.50 – 14.50

General comments

1.4031 is used in the quenched and tempered condition in a host of constructional applications where moderate corrosion and abrasion resistance is required. Due to its higher carbon content, 1.4031 is more hardenable than 1.4028 and as such is suitable for use as a blade material. As for other martensitic grades, optimal corrosion resistance is attained when the steel is in the hardened condition and the surface is finely ground or polished.

Relevant current and obsolete standards

EN 10088-3	1.4031	X39Cr13
AISI	420	
BS	420S45	
DIN 17440	1.4031	
SIS	2304	

Special grades for particular applications

wire drawing grade
fine wire drawing grade

General properties

corrosion resistance	average
mechanical properties	very good
forgeability	good
weldability	with care
machinability	average

Special properties

ferromagnetic grade

Physical properties

density (kg/dm³)	7.70
electrical resistivity at 20 °C (Ω mm²/m)	0.65
magnetizability	yes
thermal conductivity at 20 °C (W/m K)	30
specific heat capacity at 20 °C (J/kg K)	460
thermal expansion (K^{-1})	20 – 100 °C: 10.5 x 10^{-6}
	20 – 200 °C: 11.0 x 10^{-6}
	20 – 300 °C: 11.5 x 10^{-6}
	20 – 400 °C: 12.0 x 10^{-6}

Typical applications

decorative applications and kitchen utensils
medical and pharmaceutical industry
mechanical engineering
cutlery and blades

Processing properties

automated machining	yes
machinable	yes
hammer and die forging	yes
cold forming	no
cold heading	no
suited to polishing	yes

Conditions

annealed, tempered

Demand tendency

rising

Corrosion resistance (PRE = 12.5 – 14.5)

Good corrosion resistance in moderately corrosive environments that are free of chlorides, such as soaps, detergents and organic acids. Optimal corrosion resistance is obtained in the hardened condition with a polished surface finish. From a corrosion point of view, 1.4031 displays a slightly improved resistance to corrosion than 1.4028. This is due to the slightly higher chromium content which sufficiently compensates for the removal of more chromium from solution, due to the increased carbon content, and the development of a more highly stressed microstructure in 1.4031.

1.4031

X39Cr13 | **C** 0.16 – 0.25 **Cr** 12.00 – 14.00

Heat treatment and mechanical properties

1.4031 can be soft annealed by holding at a temperature in the range 750 °C to 850 °C followed by slow cooling in an oven or air. In this condition, the following mechanical properties can be expected:

Property		Specification
tensile strength (N/mm²)	R_m	≤ 800
hardness	HB	≤ 245

Note: the HB values could be 60 units higher and the tensile strengths 150 N/mm² higher due to cold work during straightening of profiles ≤ 35mm.

1.4031 can be hardened by holding at a temperature between 950 °C – 1050 °C followed by cooling in air or oil. Care must be taken to ensure that the time at the hardening temperature is sufficient to take any carbides that might be present into solution.

After hardening and stress relieving at 200 °C, the hardness should not exceed 52 HRC (520 HB).

The tempering temperature is dependent on the desired strength. Due to the precipitation of undesirable phases, the temperature range 400 °C to 600 °C should be avoided.

The mechanical properties (d ≥ 160 mm) have to be agreed on for thicker dimensions, or the delivered product is based on the values given.

Welding

In general, 1.4031 is not welded.

Forging

Gradual heating to a temperature of about 800 °C is recommended prior to more rapid heating to a temperature of between 1050 °C and 1100 °C. Forging then takes place between 1100 °C – 800 °C followed by slow cooling in an oven or in dry ash or similar material to promote slow cooling.

Machining

The machinability of this grade of stainless steel is directly related to its hardness. 1.4031 machines similar to carbon steels of the same hardness. Although it must be realised that the machining parameters will vary depending on the structure/hardness of the steel, the following parameters can be used as a guideline when machining with coated hardmetal tools:

	Depth of cut (mm)	6	3	1
	Feed rate (mm/r)	0.5	0.4	0.2
Annealed R_m **650 – 750 N/mm²**	Cutting speed (m/min)	140	170	190
Tempered R_m **850 – 950 N/mm²**	Cutting speed (m/min)	145	190	225

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