1.4028

X30Cr13

Chromium martensitic stainless steel

C 0.26 – 0.35 **Cr** 12.00 – 14.00

General comments

1.4028 is used in the quenched and tempered condition in a host of constructional and fastener applications where moderate corrosion resistance is required. Due to its higher carbon content, 1.4028 is more hardenable than 1.4021. 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	1.4028	X30Cr13
AISI	420	
BS	420S45	
JIS	420J2	
AFNOR	Z33C13	
DIN 17440	1.4028	
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	average
machinability	average

Special properties

ferromagnetic grade
suitable for use up to 550 °C

Physical properties

density (kg/dm^3)	7.70
electrical resistivity at 20 °C (Ω mm^2/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

automotive industry
decorative applications and kitchen utensils
electronic equipment
mechanical engineering
pump and valve components
cutlery and blades

Processing properties

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

Conditions

annealed, tempered

Demand tendency

constant

Corrosion resistance (PRE = 12.0 – 14.0)

Good corrosion resistance in moderately corrosive environments that are free of chlorides, such as soaps, detergents and organic acids. Good resistance in oxidising atmospheres up to temperatures of about 600 °C. 1.4028 is not resistant to intergranular corrosion in the as-delivered or as-welded conditions. Optimal corrosion resistance is obtained in the hardened condition with a polished surface finish. From a corrosion point of view, 1.4028 displays the same or slightly reduced resistance to corrosion than 1.4021. This is due to the higher carbon content resulting in the removal of more chromium from solution and the development of a more highly stressed microstructure in 1.4028.

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X30Cr13 | **C** 0.16 – 0.25 **Cr** 12.00 – 14.00

Heat treatment and mechanical properties

1.4028 can be soft annealed by holding at a temperature in the range 745 °C to 825 °C followed by slow cooling in air. In this condition, the following mechanical properties can be expected:

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

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

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 ≤ 35 mm.

1.4021 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 48 HRC, (460 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. In most cases the QT850 condition is specified and may be obtained by tempering in the temperature range 625 °C to 675°C. In this condition, the following mechanical properties can be expected:

Property		Spec. QT850
yield strength (N/mm²)	$R_{p0.2}$	≥ 650
tensile strength (N/mm²)	R_m	850 – 1000
tensile elongation (%)	A_5	≥ 10

Welding

1.4028 is generally not welded, but if welding is unavoidable, then the following precautions should be taken: Pre-heating of the work piece to a temperature within the range 300 °C – 400 °C is required as well as a post weld tempering treatment to restore some of the ductility in the weld zone. Generally, Novonit® 4551 is recommended when a filler material is required. When using an inert or protective shielding gas during welding, care must be taken to avoid use of any hydrogen or nitrogen containing gases since contamination of the weld with nitrogen or hydrogen will adversely affect the mechanical properties. After welding the work piece must be cooled to below the martensite start (M_S), temperature of approximately 120 °C before being tempered.

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. 1.4028 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)	155	190	210
Tempered **R_m 850 – 950 N/mm²**	Cutting speed (m/min)	160	210	250

DEUTSCHE EDELSTAHLWERKE GMBH
Auestraße 4
58452 Witten
www.dew-stahl.com

Tel. +49 2302 29 0
Fax +49 2302 29 4000
stainless@dew-stahl.com

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