

# 1.4037

X65Cr13

## Chromium martensitic stainless steel

C 0.58 – 0.70 Cr 12.50 – 14.50 S max. 0.015

<b>General comments</b>	1.4037 is characterised by its high hardenability in conjunction with good corrosion resistance in moderately corrosive environments. Due to its higher carbon content, 1.4037 is more hardenable than 1.4034. It is used in the quenched and tempered condition and due to its high hardness, it is ideally suited for the production of cutting tools of all sorts and surgical implements.		
<b>Relevant current and obsolete standards</b>	EN 10088-3 DIN 17440 SEW 400	1.4037 1.4037	X65Cr13  X65Cr13
<b>Special grades for particular applications</b>	wire drawing grade fine wire drawing grade		
<b>General properties</b>	corrosion resistance mechanical properties forgeability weldability machinability	average excellent good with care poor	
<b>Special properties</b>	ferromagnetic grade hardenable to 60 HRC		
<b>Physical properties</b>	density (kg/dm <sup>3</sup> ) electrical resistivity at 20 °C (Ω mm <sup>2</sup> /m) magnetizability thermal conductivity at 20 °C (W/m K) specific heat capacity at 20 °C (J/kg K) thermal expansion (K <sup>-1</sup> )	7.70 0.55 yes 30 460 20 – 100 °C: 10.5 x 10 <sup>-6</sup> 20 – 200 °C: 11.0 x 10 <sup>-6</sup> 20 – 300 °C: 11.5 x 10 <sup>-6</sup> 20 – 400 °C: 12.0 x 10 <sup>-6</sup>	
<b>Typical applications</b>	medical and pharmaceutical industry mechanical engineering cutlery, blade and tool industry bearings		
<b>Processing properties</b>	automated machining machinable hammer and die forging cold forming cold heading suited to polishing	seldom yes seldom yes not common yes	
<b>Conditions</b>	annealed, tempered		
<b>Demand tendency</b>	constant		
<b>Corrosion resistance (PRE = 12.5 – 14.5)</b>	Good corrosion resistance in moderately corrosive environments that are free of chlorides, such as soaps, detergents and organic acids. Good resistance to water and steam. 1.4037 is not resistant to intergranular corrosion in the as-delivered or as-welded conditions. Due to the precipitation of chromium carbides and the formation of chromium depleted regions adjacent to these precipitates, 1.4037 should not be used in the soft annealed or over tempered conditions if corrosion resistance is an issue. Optimal corrosion resistance is thus achieved in the hardened condition with a polished surface finish.		

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## Heat treatment and mechanical properties

1.4037 can be soft annealed by holding at a temperature in the range 750 to 850 °C followed by slow cooling in an oven or in air. In this condition, the following mechanical properties can be expected:

Property		Specification
tensile strength (N/mm <sup>2</sup> )	R <sub>m</sub>	≤ 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/mm<sup>2</sup> higher due to cold work during straightening of profiles ≤ 35 mm.

Due to the high hardenability of 1.4037, care must be taken to ensure that the tempering treatment is performed as soon as possible after the hardening treatment, whilst ensuring that the component has cooled to room temperature (to ensure that complete transformation to martensite has occurred).

After hardening and stress relieving at 200 °C, the hardness should not exceed 60 HRC.

## Welding

Although 1.4037 is generally not welded, it can be soldered in some instances.

## Forging

Gradual heating to a temperature of about 800 °C is recommended prior to more rapid heating to a temperature of between 1150 °C and 1180 °C. Forging then takes place between 1180 °C – 950 °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. 1.4037 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
<b>Annealed</b> <b>R<sub>m</sub> 700 – 850 N/mm<sup>2</sup></b>	Cutting speed (m/min)	115	140	160