1.4122

X39CrMo17-1

Chromium martensitic stainless steel with molybdenum addition

C max. 0.33 – 0.45 **Cr** 15.50 – 17.50 **Mo** 0.80 – 1.30 **Ni** max. 1.00

General comments

1.4122 is characterised by its combination of outstanding mechanical properties, (after heat treatment) and a corrosion resistance which is comparable with that of 1.4016. This steel can also be polished to high gloss finishes.

Relevant current and obsolete standards

EN 10088-3	1.4122	X39CrMo17-1
DIN 17440	1.4122	

General properties

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

Special properties

ferromagnetic grade: $\mu_r \geq 400$

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)	29
specific heat capacity at 20 °C (J/kg K)	430
thermal expansion (K^{-1})	20 – 100 °C: 10.4 x 10^{-6}
	20 – 200 °C: 10.8 x 10^{-6}
	20 – 300 °C: 11.2 x 10^{-6}
	20 – 400 °C: 11.6 x 10^{-6}

Typical applications

automotive industry
pump shafts
food and beverage industry
mechanical engineering
cutting tools
building industry

Note: available from stock

Processing properties

automated machining	seldom
machinable	moderate
hammer and die forging	seldom
cold forming	seldom
cold heading	not common
Suited to polishing	yes

Conditions

annealed, tempered

Demand tendency

rising

Corrosion resistance (PRE = 18.47 – 20.46)

As a result of its higher chromium content, 17 %, 1.4122 is more corrosion resistant than 1.4006 and other 13 % chromium stainless steels. Good corrosion resistance is displayed in moderately corrosive media/environments with low chloride ion concentrations. Although the addition of molybdenum increases the resistance of this steel to chloride containing environments, it is not suited for use in sea water applications unless it is provided with cathodic protection. Optimal corrosion resistance is attained when the surface is finely ground or polished.

Heat treatment and mechanical properties

1.4122 can be soft annealed by holding at a temperature in the range 750 °C to 850 °C followed by slow cooling in air or in a furnace. In this condition, the following mechanical properties can be expected:

Property		Specification
tensile strength (N/mm²)	R_m	≤ 900
hardness	HB	≤ 280

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.

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1.4122 can be hardened by holding at a temperature between 980 °C – 1060°C followed by cooling in oil or polymer.

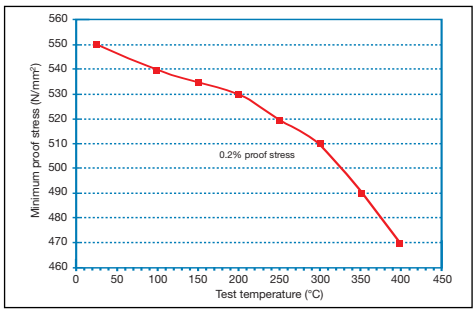
The tempering temperature is dependent on the desired strength. The heat treated condition usually specified is the QT750 condition and is obtained by tempering in the temperature range 650 °C to 750 °C. The number behind the designation QT relates to the minimum tensile strength. In this condition, the following mechanical properties can be expected:

Property		Spec. QT750	Typical
yield strength (N/mm²)	$R_{p0.2}$	≥ 550	570
tensile strength (N/mm²)	R_m	750 – 950	825
tensile elongation (%)	A_5	≥ 12	19
impact energy (J) 25 °C	ISO-V	Ø < 60: ≥ 20 Ø > 60: ≥ 14	

To reduce the possibility of cracking, care must be taken to ensure that tempering takes place as soon as possible after the hardening step.

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

Elevated temperature properties



Minimum tensile properties at various temperatures, shown in the diagramm, are specified in the EN 10088-3.

Welding

This grade of steel is not usually welded, but if absolutely no alternative exists, then the workpiece is to be pre-heated to a temperature within the range 300 °C – 400 °C prior to welding. Since a large amount of untempered martensite will form in the heat affected zone, a subsequent tempering treatment will be required. Since this tempering treatment will over temper the already tempered martensite in the rest of the work piece, it would be preferable if the entire component were hardened and tempered, as described above. Once again, the time lapse between welding and heat treatment must be as short as possible to reduce the possibility of cracking. When the application of a filler metal is required, then Novonit® 4576 can be used.

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 and as such the optimal machining parameters vary considerably. Once the hardness is known, the machining parameters can be estimated since 1.4122 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 1.4122 with coated hardmetal tools:

	Depth of cut (mm)	6	3	1
	Feed rate (mm/r)	0.5	0.4	0.2
Annealed R_m **700 – 850 N/mm²**	Cutting speed (m/min)	100	130	165

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