1.4313

X3CrNiMo13-4

Chromium nickel martensitic stainless steel with molybdenum addition

C 0.05 – 0.15 **Cr** 12.00 – 14.00 **Ni** 3.50 – 4.50 **Mo** 0.30 – 0.70 **N** max. 0.02

General comments

In quenched and tempered condition, 1.4313 is used within a temperature range of -60 °C to 300 °C, showing good toughness properties. Due to its elevated molybdenum content, its corrosion resistance resembles that of 1.4057.

Relevant current and obsolete standards

EN 10088-3	1.4313	X3CrNiMo13-4
ASTM-A	182-F6NM430 F	
UNS	J91540	
BS	425C11	
SEL	G-X5CrNi13-4 / X4CrNi13-4	
JIS	SCS5	
AFNOR	Z6CN13-04	
DIN 17440	X4CrNi13-4	

General properties

corrosion resistance	average
mechanical properties	very good
forgeability	average
weldability	poor
machinability	average

Special properties

ferromagnetic grade

Physical properties

density (kg/dm³)	7.70
electrical resistivity at 20 °C (Ω mm²/m)	0.60
magnetizability	yes
thermal conductivity at 20 °C (W/m K)	25
specific heat capacity at 20 °C (J/kg K)	430
thermal expansion (K^{-1})	20 – 100 °C: 10.5 x 10^{-6}
	20 – 200 °C: 10.9 x 10^{-6}
	20 – 300 °C: 11.3 x 10^{-6}
	20 – 400 °C: 11.6 x 10^{-6}

Typical applications

petrochemical industry
pump and compressor components
tools and dies for pressure die casting
turbines for hydro-electric power generation

Processing properties

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

Conditions

annealed, tempered

Demand tendency

rising

Corrosion resistance (PRE = 13.31 – 16.63)

1.4313 displays good corrosion resistance in moderately corrosive environments that are free of chlorides. This grade of steel is slightly more resistant to corrosion than 1.4024. Surface condition plays an important role in the corrosion resistance of this steel with polished surfaces exhibiting far superior corrosion resistance compared with rougher surfaces on the same material.

Heat treatment and mechanical properties

1.4313 may be annealed to a fully soft structure by holding the steel or component at a temperature between 600 °C and 650 °C followed by furnace cooling or slow cooling in air. Care must however be taken to ensure that a temperature of 825 °C is not exceeded during annealing. In this condition, the following mechanical properties can be expected:

Property		Specification
tensile strength (N/mm²)	R_m	≤ 1100
hardness	HB	≤ 320

The mechanical properties may be improved by quenching and tempering, in which the steel is first hardened by holding the steel at a temperature between 950 °C and 1050 °C followed by quenching in air, oil or polymer. The tempering temperature is dependent on the desired strength. In most cases the QT650, QT780 and QT900 conditions are specified and may be obtained by tempering hardened material in the following temperature ranges:

1.4313

X10CrNi18-8 | **C** 0.05 – 0.15 **Cr** 12.00 – 14.00 **Ni** 3.50 – 4.50 **Mo** 0.30 – 0.70 **N** max. 0.02

	QT 650	QT 780	QT 900
Temperature	650 – 700 °C 600 – 620 °C	550 – 600 °C	520 – 580 °C
Quenching	Air/water	Air/water	Air/water

* Should heat treatment be performed in a continuos furnace, the upper temperature is usually aimed for, and in some instances is even exceeded. Typical mechanical properties that can be expected in these heat treated conditions are presented below:

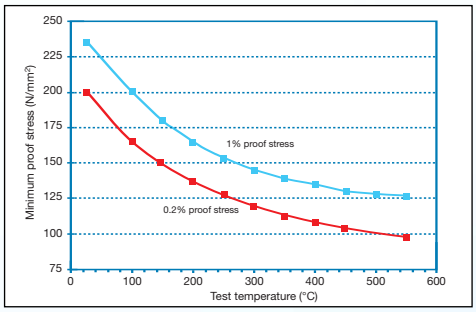
Property		Spec. QT650	Typical
yield strength (N/mm²)	$R_{p0.2}$	≥ 520	690
tensile strength (N/mm²)	R_m	650 – 830	760
tensile elongation (%)	A_5	≥ 15	20
impact energy (J) 25°C	ISO-V	≥ 70	

Property		Spec. QT780	Typical
yield strength (N/mm²)	$R_{p0.2}$	≥ 620	800
tensile strength (N/mm²)	R_m	780 – 980	875
tensile elongation (%)	A_5	≥ 15	19
impact energy (J) 25°C	ISO-V	≥ 70	

Property		Spec. QT900	Typical
yield strength (N/mm²)	$R_{p0.2}$	≥ 800	940
tensile strength (N/mm²)	R_m	900 – 1100	990
tensile elongation (%)	A_5	≥ 12	17
impact energy (J) 25°C	ISO-V	≥ 50	

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

1.4313 can be readily welded using all arc welding processes. Pre-heating of the work piece to a temperature of 150 °C is recommended, especially when larger sections (> 10 mm) are welded. After welding, the component needs to be tempered to restore some ductility to the weld zone. Any scale or heat tint that results from welding or high temperature processing must either be mechanically or chemically removed followed by a suitable passivating treatment to restore the corrosion resistance.

Forging

When forging 1.4313, the work piece should be gradually heated to a temperature of about 850 °C prior to more rapid heating to a temperature of between 1100 °C and 1150 °C. Forging then takes place at a temperature between 1150 °C – 950 °C.

Machining

The machinability of this grade of stainless steel is directly related to its hardness. The machinability of 1.4313 is 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 – 720 N/mm²**	Cutting speed (m/min)	110	140	175
Tempered **R_m 750 – 950 N/mm²**	Cutting speed (m/min)	95	100	135

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