L.KLEIN SA
PREMIUM STEEL & METALS
SINCE 1946

CHRONIFER® M-13

1.4034 / AISI 420 – Martensitic stainless steel

Distinctive feature and main attributes

The CHRONIFER® M-13 steel has a low S content. In order to obtain a satisfactory corrosion resistance in water and water steam, the machined parts must previously be heat treated, fine polished and passivized. In this condition, this grade has a similar wear resistance as its equivalent free machining grade CHRONIFER® Labor M-13 (1.4035 alias 1.4034+S) with a higher S content.

Use and application range

This steel grade is well adapted for the production of turned part such as bolts and nuts, screws, valves, nozzles, faucet and pump parts. It is also used for the manufacture of wear resistant parts such as bearings, medical, surgical and dental instruments as well as in the agro and food industries.

Norms

Material No.	1.4034
ISO	7153-1 (D)
DIN	X46Cr13
AISI / SAE / ASTM	AISI 420, AISI 420C, ASTM F899, A276, A959
AFNOR	X46Cr13 (former Z44C14)
EN	X46Cr13
NF	S 94-090
JIS	SUS420
UNS	S 42000

Chemical composition (% wt)

C	Si	Mn	P	S	Cr	Ni	Fe
0.43 – 0.50	max. 1.00	max. 1.00	max. 0.04	max. 0.03	12.5 – 14.5	max. 1.00	balance

Dimensions and tolerances

- **Bars Ø < 2.00 mm:** ISO h8
- **Bars Ø ≥ 2.00 mm:** ISO h6 (h7)
- **Wires Ø ≥ 0.80 mm:** ISO fg7, coils for Escomatic
- **Out of roundness:** max. ½ of tolerance

Other executions on request

Executions and delivery conditions

Standard: in bars 3 m (+ 50 / 0 mm), coils for Escomatic

- **Bars Ø ≥ 2.00 mm:** cold drawn, ground polished, rugosity Ra < 0.4 µm (N5), eddy-current check according to EN10277-1, Table 1, pointed and chamfered
- **Bars Ø < 2.00 mm: surface condition:** cold drawn
- **Wires Ø ≤ 6.00 mm: surface condition:** cold drawn, coils for Escomatic

Other executions on request

Availability

Standard dimensions on stock: see product range

Mechanical properties

Standard delivery condition: UTS Strength: depends on diameter

- **Ø 1.00 up to < 4.50 mm:** 775 – 925 MPa
- **Ø > 4.50 mm:** 725 – 925 MPa

Hardening capability: up to 55 HRc

Modifications will not be adjusted automatically. Last update 08 / 2024

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Cutting conditions

Machinability: good, build long chips
Cutting speed: $V_c \approx 25 – 40$ m / min
Lubricant-coolant: individual choice
The optimal cutting conditions depend on the machine tool, the cutting tools, the chip dimensions, the lubricant-cooling fluid, as well as the tolerances and surface the roughness to be achieved.

Forming

Warm: forging: 950 – 1'100°C, slow furnace cooling
Above 1'050°C: **danger of rapid grain growth**

Cold: relatively difficult, not recommended.

Welding

Difficult, not recommended.

Annealing

Soft anneal: 750 – 830°C / 2 – 4 h, slow furnace cooling 30°C / h down to 600°C

Quenching

Primary quenching: 1'000 – 1'050°C / oil, or fast air or gas cooling
Optional: secondary quenching by sub-zero cooling:
- - 20 down to - 80°C / 12 – 48 h, preferably - 80°C / 12 – 24 h

or cryo-treatment (deep cryo-cooling):
- - 196°C / 6 – 12 h, progressive cooling or step by step cooling, to avoid cracking.

To obtain the best efficiency, this secondary quench must be made without delay after the primary one. more info

Tempering

Tempering according to needs, see tempering diagram
Not recommended temperature range: 400 – 580°C (brittleness range) and increased risk of inter-granular corrosion.

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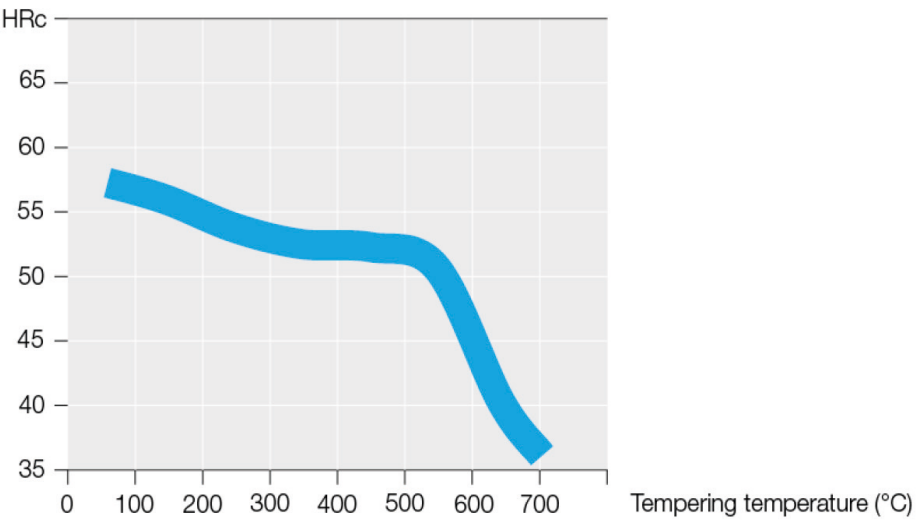
Figure 1
Tempering diagram



Microstructures

Delivery conditions: "annealed" and "annealed + cold drawn": Ferrite + carbides

- **Machining microstructure:** Ferrite + carbides
- **Conditions after heat treatment:** Martensite + carbides
- **Microstructure for hard machining:** Martensite or Martensite + carbides
- **Microstructure for optimal polishing:** Stress relieved martensite
- **Microstructure for polishing:** Martensite or Martensite + carbides

Polishing

Well indicated for polishing
Optimal condition: quenched and tempered < 200°C

Laser marking

The laser marking heat in the Heat Affected Zone (HAZ) may modify the local microstructure and affect negatively its corrosion resistance. more info

Pickling and passivation

It is strongly recommended to use passivation procedures adapted to the treatment of martensitic stainless steels.
To avoid a possible staining by a "flash back" reaction, it is strongly recommended to pickle the surfaces before the passivation procedure. more info

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Corrosion resistance

Optimum: Clean, quenched, tempered, fine polished, and passivized surfaces.

- **Conditions to avoid:** annealed and "annealed – cold deformed". These conditions should be avoided due to the increased inter-granular corrosion risk. These two conditions must be avoided for any permanent uses.
- The possible formation of oxides and scaling can strongly decrease the corrosion resistance. These oxides must be eliminated, either mechanically or chemically by pickling.

Elementary precautions

- The simplest and easiest precautions are always to keep the parts clean, free of working residues, polished, and correctly dried.
- Use only chloride free disinfection solutions, cleaning and washing solutions and products. more info

Physical properties

Properties	*Units*	*Temperature (°C)*				
		20	200	300	400	500
Density	g cm^{-3}	7.70				
Young Modulus E	GPa	215			190	
Electrical resistance	Ω mm^2 m^{-1}	0.70				
Thermal expansion	m m^{-1} K^{-1} 10^{-6}	20 – 100°C 10.5	20 – 200°C 11.0	20 – 300°C 11.5	20 – 400°C 12.0	20 – 500°C 12.0
Thermal conductivity	W m^{-1} K^{-1}	30				
Specific heat	J kg^{-1} K^{-1}	460				
Melting range	1'475 – 1'410°C					
Magnétisme	Ferromagnetic, can be magnetized. See Figure 2 page 5, more info					

Disclaimer: The information and data of this informative Data sheet are indicative only. They are not use instructions. The users must define and endorse them in each case.

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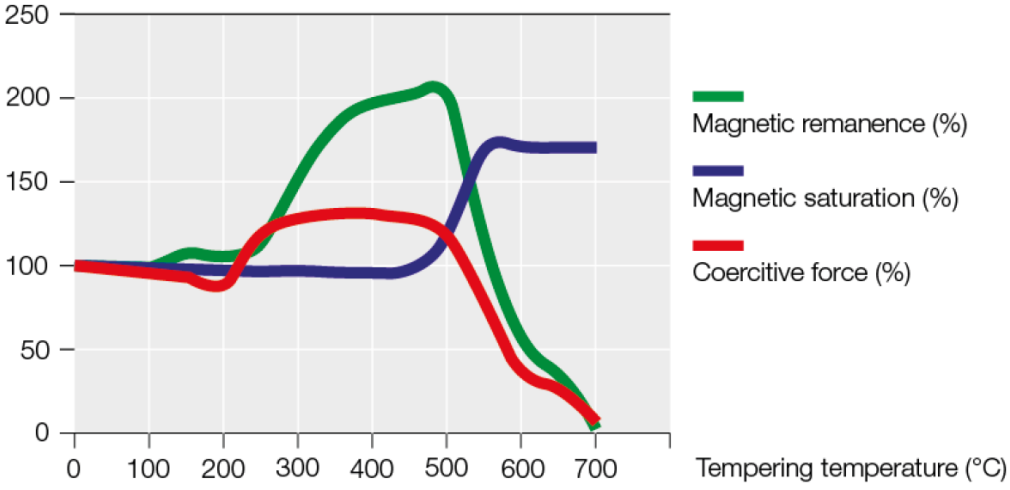
Magnetism

Figure 2 shows the dependence of the magnetic properties of martensitic stainless steels in function of the tempering and annealing temperatures. The values in the hardened quenched condition have been taken as 100, as normal reference. Between approximately 200°C and 500°C the magnetic properties become progressively hard. From 500°C and above they drops continuously to reach their minimum in the annealed condition at approximately >750°C.

Figure 2
Relative magnetic properties

Typical diagram



Selon S. S. M. Tavares and al: Magnetic properties of an AISI 320 martensitic steel
Journal of Alloys and Components 312 (2000) 307-314