CHRONIFER® M-4028

1.4028/AISI 420B - Martensitic stainless steel

Attributes and particularities

The CHRONIFER® M-4028 steel is ESR remelted and has a low S content. It exhibits a good corrosion resistance in soap solutions as well as with products of the agro- and food industries. Its corrosion resistance in water and water steam is at its best in the quench-tempered, fine polished and passivized condition.

Use and applications

The CHRONIFER® M-4028 is well adapted for medical, surgical and dental instruments. It is also used in various industries for the production of gears, bolts and nuts, screws as well as for tableware's.

Applicable standards

Material number	1.4028
ISO	7153-1 (C)
EN	X30Cr13, EN 10088-3
DIN	X30Cr13
AISI/SAE/ASTM	AISI 420B, ASTM F899
AFNOR	X30Cr13 (former Z30C13)
NF	S 94-090
JIS	SUS 420J2

Chemical composition ($\%_{wt}$)

C	Si	Mn	P	S	Cr	Ni	Fe
0.26 0.35	max. 1.00	max. 1.00	max. 0.04	max. 0.03	12.00 14.00	max. 1.00	balance

Dimensions and tolerances

- Bars Ø < 2.00 mm: ISO h8 (h7)
- 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 tolerances on request

Executions and Delivery conditions

Standard: Bars 3 m (+50/0 mm)
Wires: coils for Escomatic

- Bars Ø ≥ 2.00 mm: cold drawn, ground polished, max Ra 0.4 µm (N5)
  Eddy-current checked according to EN10277-1, Table 1
  pointed and chamfered
- Bars < 2.00 mm: cold drawn execution
- Wires Ø <6.00 mm: cold drawn execution, coils for Escomatic

Other executions on request

Availability

Standard dimensions on stock, see: Sale program

Mechanical properties

Standard delivery conditions: UTS strength: 700 - 1000 MPa, function of the diameter

> 9.00 mm:	annealed
≤ 10.00 mm:	cold drawn, ground, polished

- Hardening capability: ≥ 47 HRc

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.

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Forming

Warm: forging: 950 – 1100°C, preferably > 1020°C, slow cooling
Slow heating up 850°C, then faster up to the forging temperature
Cold: Feasible after annealing at 750 – 825°C, slow cooling
- UTS strength after annealing: max 760 MPa

Welding

Difficult, not recommended

Annealing

Soft anneal: 745 – 825°C, holding time 2 – 4h, furnace cooling 30°C/h to 600°C
Intermediate anneal during cold working: 630 – 680°C
- Minimum reduction: ≥ 10 – 15%, to avoid an excessive grain growth

Quenching

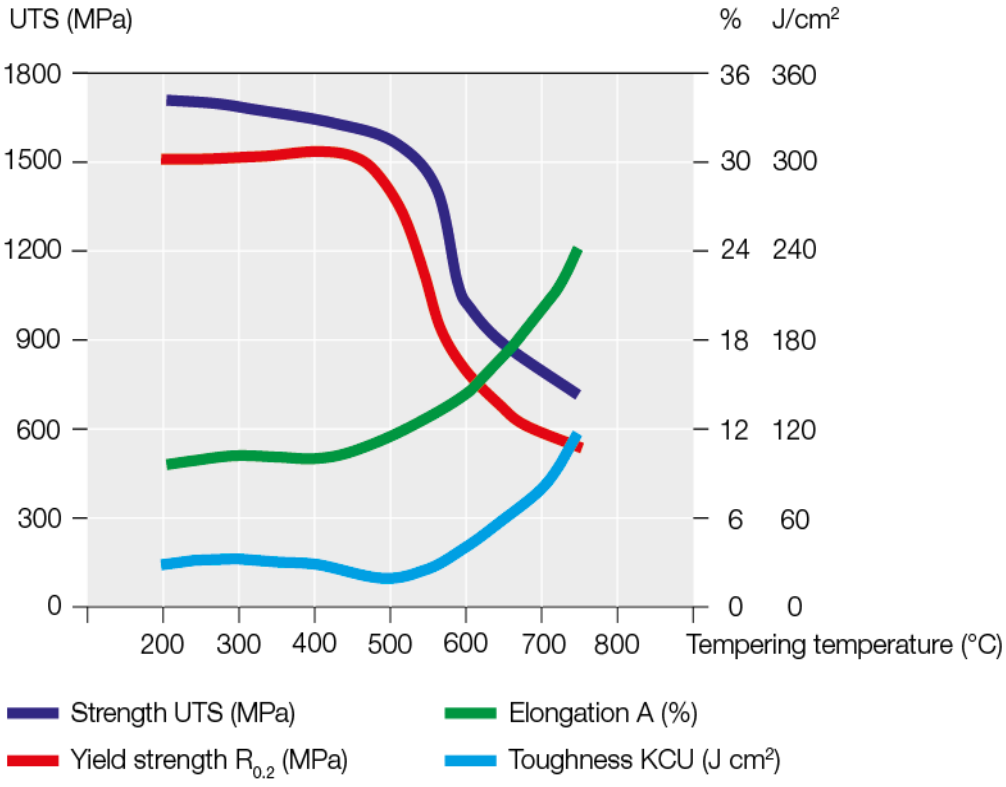
Primary quench oil, air or gas: 980 – 1030°C
Option: Secondary quench at sub-zero temperatures
-20 up to -80°C/12 – 48h, preferably -80°C/12 – 24h
or Cryo-treatment:
-196°C/6 – 12h, progressive step-by-step cooling to avoid a possible cracking
- The secondary quenching should be made as soon as possible after the primary one.

More info.

Tempering

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

Tempering diagram



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Microstructures

Delivery conditions: “annealed“ and “annealed + cold drawing“: Ferrite + carbides
- Machining microstructure: Ferrite + carbides

Condition quenched and tempered: Martensite + carbides
- Microstructure for hard machining: Martensite and carbide

Optimal hardness for fine polishing: Stress relieved martensite
- Microstructure for polishing: Stress relieved martensite or martensite + carbides

Polishing

Well indicated for mirror polish
- Optimal condition: quenched and tempered < 200°C

Laser Marking

- The Heat Affected Zone (HAZ) of the laser marking may modify the local micro-structure and affect negatively its corrosion resistance. More info.

Pickling and passivation

It is strongly recommended to use pickling and passivation procedures and solutions adapted to the treatment of martensitic stainless steels.
- To avoid any “flash back“ reactions, it is also strongly recommended to always pick-le the surfaces before the passivation procedure. More info.

Corrosion resistance

Optimum: Clean, quenched, tempered, fine polished, and passivized surfaces.
- Conditions of use to avoid: “annealed“ and “annealed and cold deformed“. These conditions should be avoided because of the increased risk of inter-graular-corrosion.
- The formation of oxides and scaling can strongly decrease the corrosion resistance. They must be eliminated either mechanically, or by pickling.

Elementary precautions

- The simplest and easiest precautions are to always 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}	20–100°C	20–200°C	20–300°C	20–400°C	20–500°C
	10^{-6}	10.5	11.0	11.5	12.0	12.0
Thermal conductivity	W m^{-1} K^{-1}	30				28.7
Specific heat	J kg^{-1} K^{-1}	460				
Melting range	1500 – 1430 °C					
Magnetisms	Ferromagnetic, can be magnetized. More info.					