CHRONIFER® M-17B

1.4112/AISI ≈ 440B - Martensitic stainless steel

Main features and particularities

The CHRONIFER® M-17B steel has a low S content and is ESR remelted. It exhibits a good wear resistance and, because of its high C content, a good bluntness resistance as well. It is widely used in the cutlery industry as a substitute for the 1.4034 and 1.4035 grades. Its corrosion resistance in water and water steam is at best when the parts are previously hardened, tempered, fine ground and passivized. This steel can be mirror polished.

Uses and applications

This steel is well indicated for the production of medical, surgical and dental instruments. It is also used where good wear and bluntness resistances allied to a good corrosion resistance are required, i.e. as in the agro- and food industries.

Standards

Material Number	1.4112
ISO	7153-1 (R)
EN 10088-3	X90CrMoV18
DIN	X90CrMoV18
AFNOR	X90CrMoV18, X 89CrMoV 18-1 (former Z90 CDV 18)
AISI/SAE/ASTM	≈ AISI 440B, ASTM F899, QQS763 (chemical composition)
NF	S 94-090
JIS	≈ SUS 440B

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

C	Si	Mn	P	S	Cr	Mo	V	Fe
0.85 0.95	max. 1.00	max. 1.00	max. 0.04	max. 0.03	17.0 19.0	0.90 1.30	0.07 0.12	balance

Dimensions and tolerances

- Bars Ø < 2.00 mm: ISO h8
- Bars Ø ≥ 2.00 mm: ISO h6
- 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, Ra max 0.4 µm (N5)
  eddy-current check according to EN10277-1, Table 1
  pointed and chamfered
- Bars < 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: Sale program

Mechanical properties

Standard delivery condition: UTS max. 925 MPa

- Ø > 2.00 mm: depends on diameter
- Ø > 14.00 mm: annealed max. 265 HB, converted in Rm: max 865 MPa

Hardening capability: up to HRc 58, also after tempering at 150-175°C

Cutting conditions

Machinability: satisfactory
build long chips
Cutting speed: V_c ≈ 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 roughness to be achieved.

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Forming

Warm: forging: 800 – 1100°C, slow heating up to 800°C, then faster up to the forming/forging temperature, slow cooling
Cold: difficult, not recommended

Welding

Difficult, not recommended

Annealing

Soft anneal: 740 – 840°C / 2 – 4h / slow furnace cooling down to 600°C
- Hardness after annealing: ≈ 265 H_B or Hv (converted in Rm: ≈ 865 MPa)

Quenching

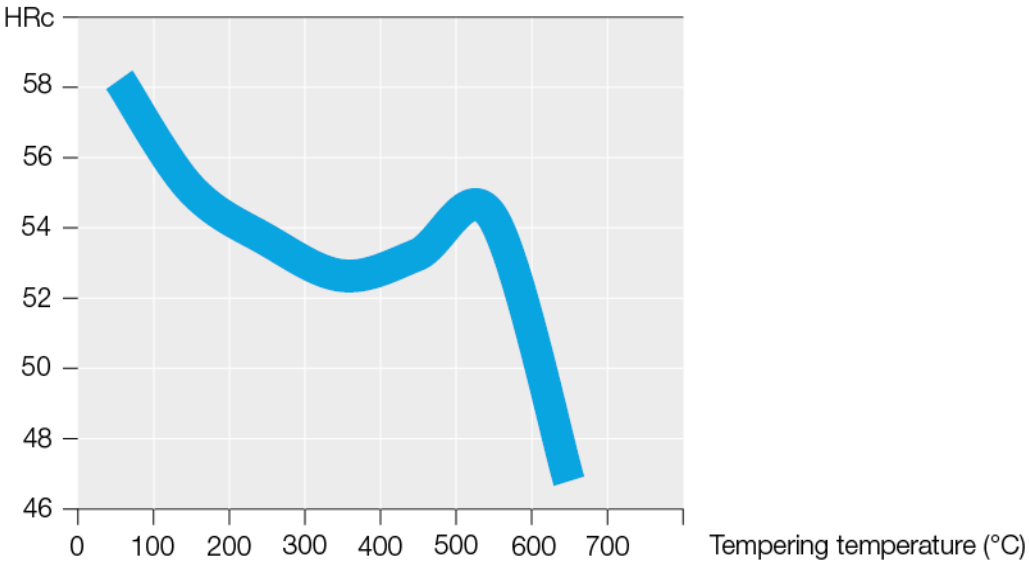
Primary quenching: 950-1050°C oil, or rapid air or gas cooling
Optional: Secondary quenching by sub-zero cooling
-20 down to -80°C/12 - 48h, preferably -80°C/12 – 24h
or cryo-treatment (deep cryo-cooling):
-196°C/6 - 12h: progressive, or step-by-step, cooling, to prevent a possible cracking.
- To achieve the best efficiency, this secondary quenching must be made without delay after the primary one.

More info.

Tempering

According to needs, see Tempering diagram
- The temperature range 400 – 580°C is not recommended, because of the risks of brittleness and increased inter-granular corrosion.

Tempering diagram



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Microstructures

Delivery conditions: “annealed“ or “annealed and cold drawn“: Ferrite + carbides
- Machining microstructure: Ferrite + carbides
- Hard machining microstructure: Martensite or martensite +carbides

Tempered condition: From stress relieved martensite to martensite + carbides
- Microstructure for an optimal polishing ability: Stress relieved martensite
- Polishing microstructure: Stress relieved martensite - Martensite + carbides

Polishing

The adequacy of the CRONIFER® M-17B steel for fine polishing is strongly dependent on the presence, size, number and distribution of primary carbides. They may strongly negatively influence the quality of the polishing, especially of the mirror polishing.
- Optimal condition for polishing: Quenched and tempered below 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 pickling and passivation procedures and products adapted to the treatment of martensitic stainless steels.
- To avoid staining by “flash back“ reactions, it is also strongly recommended to pickle the surfaces before the passivation procedure. More info.

Corrosion resistance

Optimum: Clean, quenched, tempered, fine polished, and passivized surfaces.
- Conditions to avoid: “annealed” and “annealed and cold formed“. These conditions should be avoided due to the increased inter-granular corrosion risk. These two conditions are definitively not recommended for the permanent use of parts.
- The possible formation of oxides and scaling during heat treatments can strongly decrease the corrosion resistance. These oxidations should always 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}	0.80				
Thermal expansion	m m^{-1} K^{-1}	20–100°C	20–200°C	20–300°C	20–400°C	20–500°C
	10^{-6}	10.4	10.8	11.2	11.6	
Thermal conductivity	W m^{-1} K^{-1}	30				
Specific heat	J kg^{-1} K^{-1}	460				
Melting range	1435 – 1315 °C					
Magnetism	Ferromagnetic, can be magnetized. More info					

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