

HIGH SPEED STEELS

Available Product Variants

Long Products*

Plates

*) Presented data refer exclusively to long products. Please observe the detailed explanations at the end of the data sheet (pdf).

Product Description

BÖHLER S390 MICROCLEAN – "The decathlete"

This grade is our PM steel with many positive usage properties. For twist drills, taps, mills, broaches, or cold-work applications, BÖHLER S390 MICROCLEAN is always a high performer.

Process Melting

Powder metallurgy

Properties

- > Toughness & Ductility : high
- > Wear Resistance : high
- > Compressive strength : very high
- > Edge Stability : very high
- > Grindability : high
- > Hot Hardness (red hardness) : very high

Applications

- > Motorsport industry
- > End Mills
- > Powder Pressing
- > Special Cutting Tools
- > Pill punching dies
- > Broaches and Reamers
- > Fine Blanking, Stamping, Blanking
- > Rolling
- > Twist Drills and Taps
- > Cold Forming / Coining
- > Gear Cutting, Shaving and Shaping Tools
- > Shearing / Machine Knives
- > Wear parts

Chemical composition (wt. %)

C	Cr	Mo	V	W	Co
1.64	4.80	2.00	4.80	10.40	8.00

Material characteristics

	Compressive strength	Grindability	Red hardness	Toughness	Wear resistance	Edge Stability
BÖHLER S390 MICROCLEAN	★★★★	★★★	★★★★	★★★★	★★★★	★★★★
BÖHLER S290 MICROCLEAN	★★★★★	★	★★★★	★★	★★★★★	★★★★
BÖHLER S393 MICROCLEAN	★★★★	★★★	★★★★	★★★★	★★★★	★★★★
BÖHLER S590 MICROCLEAN	★★★★	★★★	★★★★	★★★	★★★	★★★
BÖHLER S592 MICROCLEAN	★★★★	★★★	★★★★	★★★	★★★	★★★
BÖHLER S690 MICROCLEAN	★★★	★★★	★★	★★★★★	★★★	★★
BÖHLER S692 MICROCLEAN	★★★	★★★	★★	★★★★★	★★★	★★
BÖHLER S790 MICROCLEAN	★★★	★★★	★★	★★★★	★★	★★★
BÖHLER S792 MICROCLEAN	★★★	★★★	★★	★★★★	★★	★★★
BÖHLER S793 MICROCLEAN	★★★	★★★	★★★★	★★★	★★★	★★★

Delivery condition

Annealed

Hardness (HB)	max. 320 drawn execution max. 320 HB
Tensile Strength (MPa)	max. 1,080

Hardened and Tempered

Hardness (HRC)	64 to 68
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Heat treatment

Annealing

Temperature	770 to 840 °C	4 h controlled slow cooling in furnace (10 to 20°C/h / (50 to 68°F/h) to 740°C/2h (1364°F/2 h) cooling in furnace,
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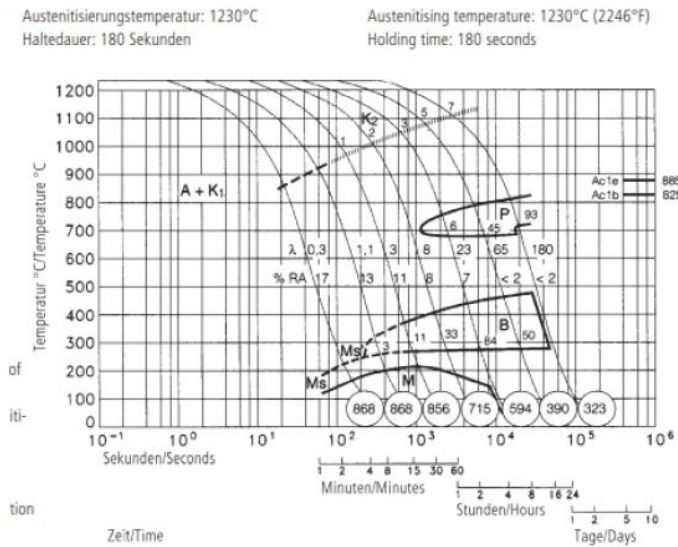
Stress relieving

Temperature	600 to 650 °C	Slow cooling in furnace. To relieve stresses set up by extensive machining or in tools of intricate shape. After through heating, hold in neutral atmosphere for 1 to 2 hours.
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Hardening and Tempering

Temperature	1,100 to 1,230 °C	Salt bath, vacuum Preheating: 1st stage ~ 500 °C (930 °F), 2nd stage ~ 850 °C (1560 °F), 3rd stage ~1050 °C (1920 °F) Austenitising: 1100 - 1230 °C (2012 °F - 2246 °F), holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating. Quenching: oil, warm bath (500 - 550 °C (930 °F - 1020 °F)), gas
Temperature	550 to 570 °C	Slow heating to tempering temperature immediately after austenitising. Holding time in the furnace 1 hour per 20 mm material thickness (at least 1 hour) Slow cooling to room temperature between each tempering step 3 tempering cycles recommended Hardness see tempering chart

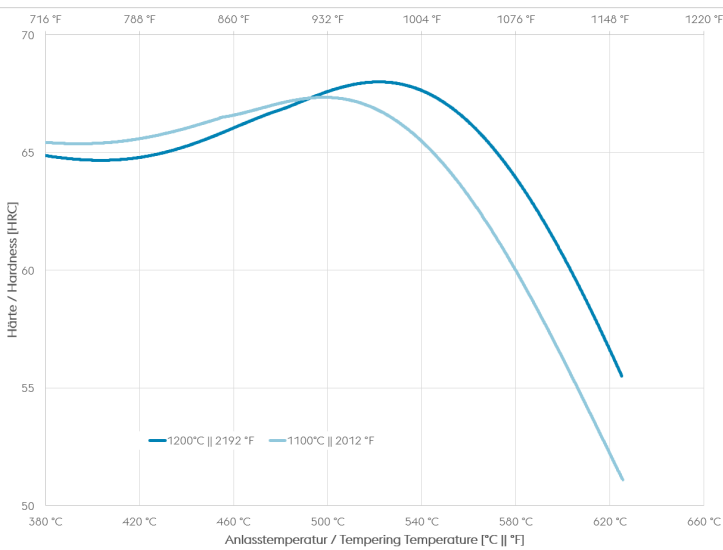
Continuous cooling CCT curves



Austenitising temperature: 1230°C (2246°F)
Holding time: 180 seconds

- A...Austenite
- B...Bainite
- K...Carbide
- P...Pearlite
- M...Martensite
- RA...Retained Austenite

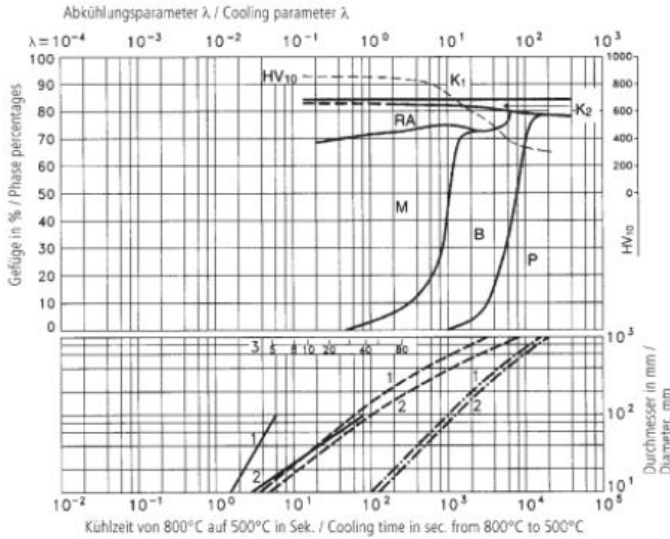
Tempering Chart



Quantitative phase diagram

Austenitising temperature: 1230°C
Haltedauer: 180 Sekunden

Austenitising temperature: 1230°C (2246°F)
Holding time: 180 seconds

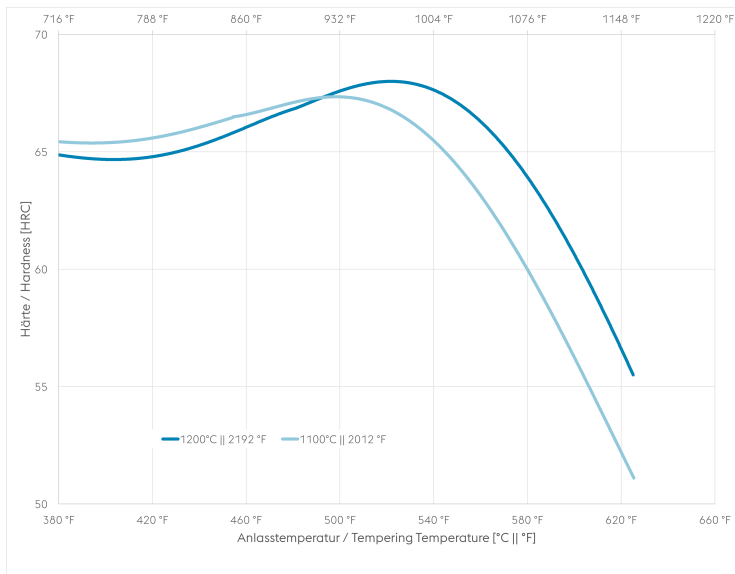


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1....Edge or Face
2....Core
3....Jominy test: distance from quenched end

— watercooling
- - oilcooling
- · - aircooling

Tempering Chart



Holdingtime 3x2 hours

Specimensize: square 25mm

Austenitising in vacuum

Physical Properties

Temperature (°C)	20
Density (kg/dm ³)	8.1
Thermal conductivity (W/(m.K))	17
Specific heat (kJ/kg K)	0.42
Spec. electrical resistance (Ohm.mm ² /m)	0.61
Modulus of elasticity (10 ³ N/mm ²)	231

Thermal Expansions between 20°C | 68°F and ...

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10 ⁻⁶ m/(m.K))	10	10.5	10.8	11.2	11.3	11.4	11.6

Long Products: For additional specifications and technical requirements, please contact our regional voestalpine BÖHLER sales companies.

Sheet & Plates: Product Variant may differ in terms of melting process, technical data, delivery, and surface condition as well as available product dimensions. Please contact voestalpine BÖHLER Bleche GmbH & Co KG.

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