

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 S290 MICROCLEAN – "The hard stuff"

The unusual alloy point of this bridge material between carbide and high-speed steel gives it a hardness of up to 70 HRC. In addition to its hot hardness and good wear resistance, its compressive strength is one of the most important properties of this powder-metallurgical high-speed steel class.

Process Melting

Powder metallurgy

Properties

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

Applications

- > Cold Forming / Coining
- > Fine Blanking, Stamping, Blanking
- > Gear Cutting, Shaving and Shaping Tools
- > Powder Pressing
- > Special Cutting Tools
- > Wear parts

Chemical composition (wt. %)

C	Cr	Mo	V	W	Co
2.0	3.8	2.5	5.1	14.3	11.0

Material characteristics

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

Delivery condition

Annealed

Hardness (HB)	max. 350
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Heat treatment

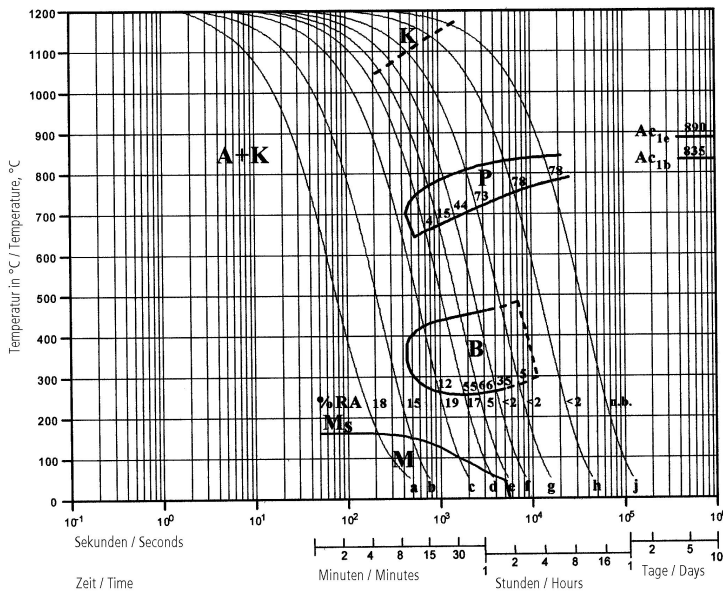
Stress relieving

Temperature	600 to 650 °C 1,112 to 1,202 °F	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	1,150 to 1,210 °C 2,102 to 2,210 °F	Salt bath, vacuum Preheating: 1st stage ~ 500 °C (930 °F), 2nd stage ~ 850 °C (1560 °F), 3rd stage ~ 1050 °C (1920 °F) Austenitising: 1150 - 1210 °C (2100 °F - 2210 °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 580 °C 1,022 to 1,076 °F	Slow heating to tempering temperature immediately after austenitising. Dwell 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

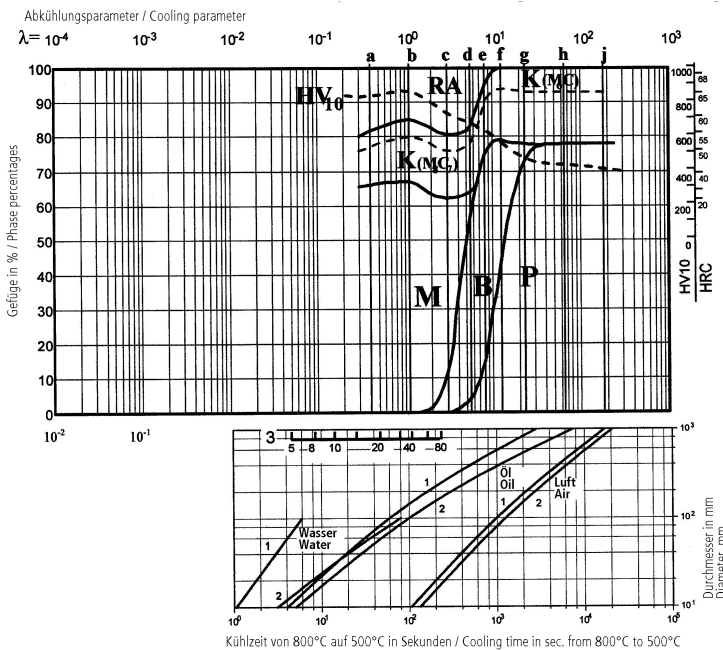
Continuous cooling CCT curves



Austenitising temperature: 1210°C (2210°F)
Holding time: 180 seconds

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

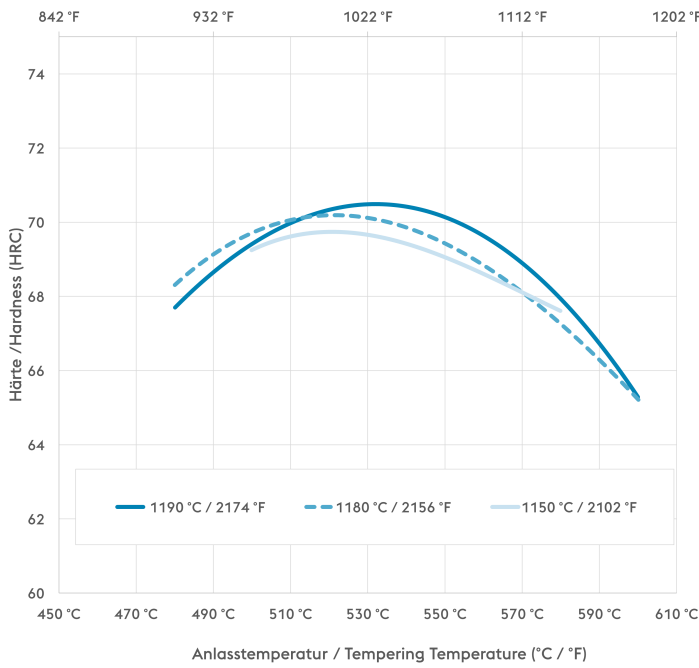
Quantitative phase diagram



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

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

Tempering Chart



Holdingtime 3x2 hours

Specimensize: square 25mm

Physical Properties

Temperature (°C °F)	20 68
Density (kg/dm ³ lb/in ³)	8.3 0.3
Thermal conductivity (W/(m.K) BTU/ft h °F)	19 10.98
Specific heat (kJ/kg K BTU/lb °F)	0.41 0.0979
Spec. electrical resistance (Ohm.mm ² /m 10 ⁻⁴ Ohm.inch ² /ft)	0.56 2.65
Modulus of elasticity (10 ³ N/mm ² 10 ³ ksi)	242 35.1

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

Temperature (°C °F)	100 212	200 392	300 572	400 752	500 932	600 1,112	700 1,292
Thermal expansion (10 ⁻⁶ m/(m.K) 10 ⁻⁶ inch/inch.°F)	9.6 5.3	10 5.6	10.3 5.7	10.6 5.9	10.9 6.1	11.2 6.2	11.6 6.4

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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