

# HIGH SPEED STEELS

## Application Segments

Cutting Tools

## 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 S200 – "The old man"

This traditional tungsten high-speed steel shows its class as it always has in a tough working environment. High hot hardness and good wear resistance are characteristic of this class.

## Process Melting

Airmelted

## Properties

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

## Applications

- > Special Cutting Tools
- > Typical cutting instruments and knives
- > End Mills
- > Gear Cutting, Shaving and Shaping Tools
- > Machine knife (for producers)
- > Twist Drills and Taps

## Technical data

Material designation		Standards	
1.3355	SEL	4957	EN ISO
HS18-0-1	EN	A600	ASTM
T12001	UNS		
T1	AISI		

## Chemical composition (wt. %)

C	Si	Mn	Cr	V	W
0.75	0.25	0.30	4.10	1.10	18.00

## Material characteristics

	Compressive strength	Grindability	Red hardness	Toughness	Wear resistance	Edge Stability
BÖHLER S200	★★★	★★	★★★	★★	★★★	★★
BÖHLER S400	★★★	★★★	★★★	★★★	★★	★★
BÖHLER S401	★★	★★★	★★	★★★	★★	★★★
BÖHLER S404	★★	★★★	★★	★★★	★★	★★
BÖHLER S405	★★★	★★★	★★	★★★	★★	★★
BÖHLER S500	★★★★	★★★	★★★★	★★	★★★	★★★
BÖHLER S600	★★★	★★★	★★★	★★	★★	★★★
BÖHLER S607	★★★	★★★	★★★	★★	★★★	★★★
BÖHLER S630	★★★	★★★	★★★	★★	★★	★★★
BÖHLER S705	★★★	★★★	★★★★	★★	★★	★★★★
BÖHLER S730	★★★	★★★	★★★★	★★	★★	★★★★

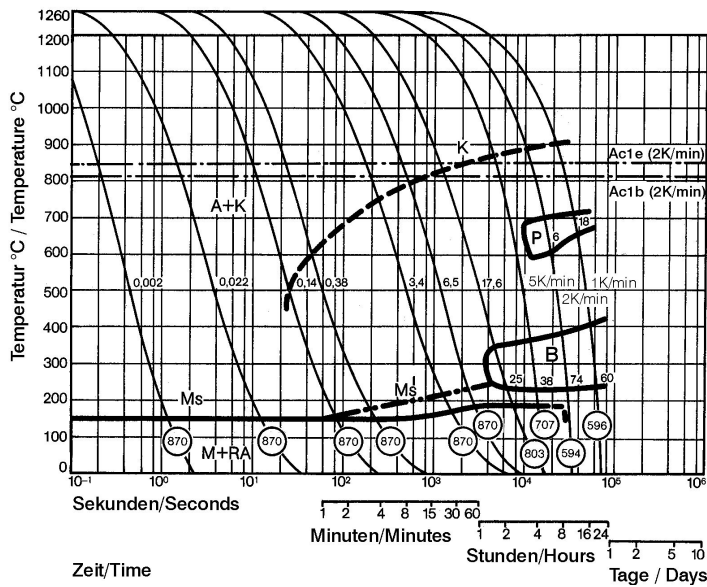
## Delivery condition

<b>Annealed</b>	
Hardness (HB)	max. 280
Tensile Strength (N/mm <sup>2</sup> )	max. 980

## Heat treatment

<b>Annealing</b>		
Temperature	770 to 840 °C	Controlled slow cooling in furnace (10 to 20°C/h / (50 to 68°F/h) to approx. 600°C (1112°F), air cooling.
<b>Stress relieving</b>		
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.
<b>Hardening and Tempering</b>		
Temperature	1,250 to 1,290 °C	Salt bath, vacuum Preheating: 1st stage ~ 500 °C (930 °F), 2nd stage ~ 850 °C (1560 °F), 3rd stage ~ 1050 °C (1920 °F) Austenitising: 1250 - 1290 °C (2280 - 2350 °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 - 1020 °F)), vacuum (nitrogen)
Temperature	550 to 580 °C	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 3 tempering cycles recommended Hardness see tempering chart

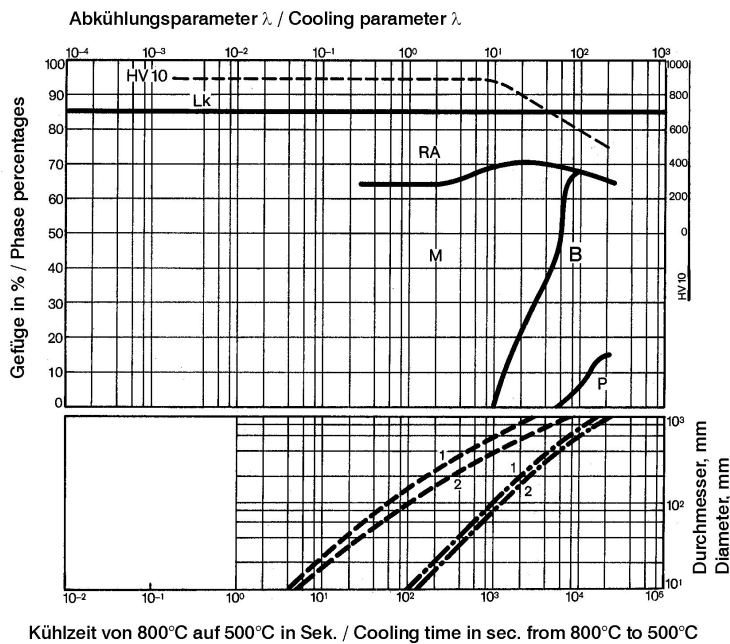
## Continuous cooling CCT curves



Austenitising temperature: 1260°C (2300°F)  
Holding time: 150 seconds

○ ... Vickers hardness  
6 ... 18 phase percentages  
0.002 ... 17.6 cooling parameter, i.e. duration of cooling from 800-500°C (1472-932°F) in  $s \times 10^{-2}$   
5 K/min ... 1 K/min cooling rate in K/min in the 800 - 500°C (1472 - 932°F) range  
Ms-Ms' ... range of grain boundary martensite formation

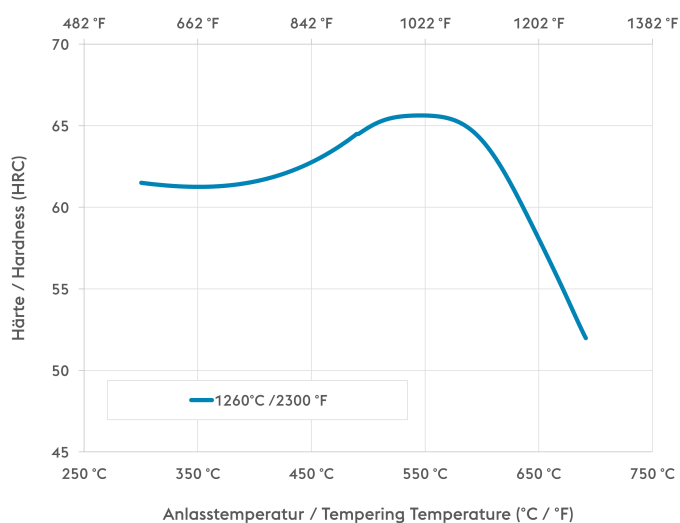
## Quantitative phase diagram



A ... Austenite  
B ... Bainite  
K ... Carbide  
M ... Martensite  
P ... Pearlite  
Lk ... Ledeburite carbide  
RA ... Retained austenite

--- Oil cooling  
-- Air cooling  
1 ... Edge or face  
2 ... Core

## Tempering Chart



## Physical Properties

Temperature (°C)	20
Density (kg/dm <sup>3</sup> )	8.7
Thermal conductivity (W/(m.K))	19
Specific heat (kJ/kg K)	0.46
Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)	0.5
Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> )	217

**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

If other available product variants are listed in addition to long products, please note that these may differ in terms of melting process, technical data, delivery and surface condition as well as available product dimensions. For mandatory technical specifications, other requirements and dimensions, please contact our regional voestalpine BÖHLER sales companies. The data contained in this brochure is merely for general information and therefore shall not be binding on the company. We may be bound only through a contract explicitly stipulating such data as binding. Measurement data are laboratory values and can deviate from practical analyses. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.