# HIGH SPEED STEELS

## Available Product Variants

Long Products* | Plates

* ) Presented data refer exclusivly 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
- Gear Cutting, Shaving and Shaping Tools
- Cutting-typical instruments and knives
- Machine knife (for producers)
- End Mills
- Twist Drills and Taps

## Technical data

| Material designation | |
|---|---|
| 1.3355 | SEL |
| T12001 | UNS |
| HS18-0-1 | EN |
| T1 | AISI |

| Standards | |
|---|---|
| 4957 | EN ISO |
| A600 | ASTM |

## 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

### Annealed

| | |
|---|---|
| Hardness (HB) | max. 280 |
| Tensile Strength (N/mm$^2$ \| ksi) | max. 980 \| 143 |

## Heat treatment

### Annealing

| | | |
|---|---|---|
| Temperature | 770 to 840 °C \| 1,418 to 1,544 °F | Controlled slow cooling in furnace (10 to 20°C/h / (50 to 68°F/h) to approx. 600°C (1112°F), air cooling. |

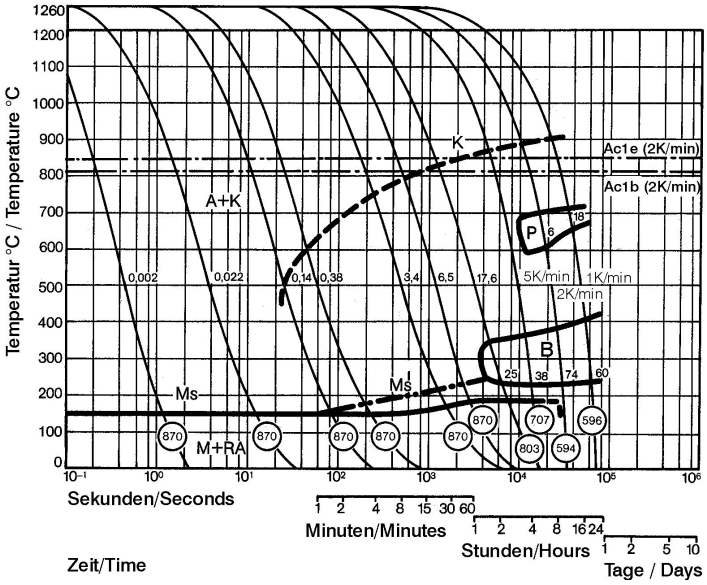
### Stress relieving

| | | |
|---|---|---|
| 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. |

### Hardening and Tempering

| | | |
|---|---|---|
| Temperature | 1,250 to 1,290 °C \| 2,282 to 2,354 °F | 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 \| 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 3 tempering cycles recommended Hardness see tempering chart |

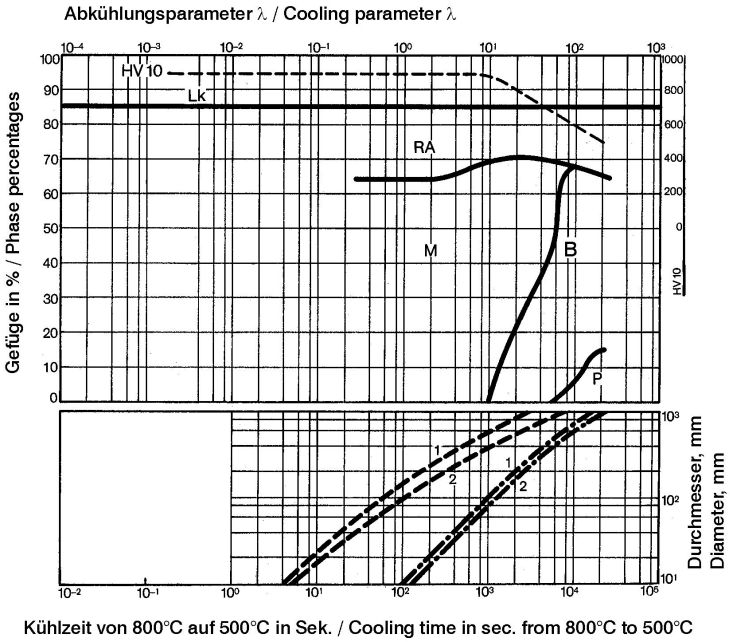
## Continuous cooling CCT curves




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 x $10^{-2}$
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. . . Perlite

Lk . . Ledeburite carbide

RA . Retained austenite

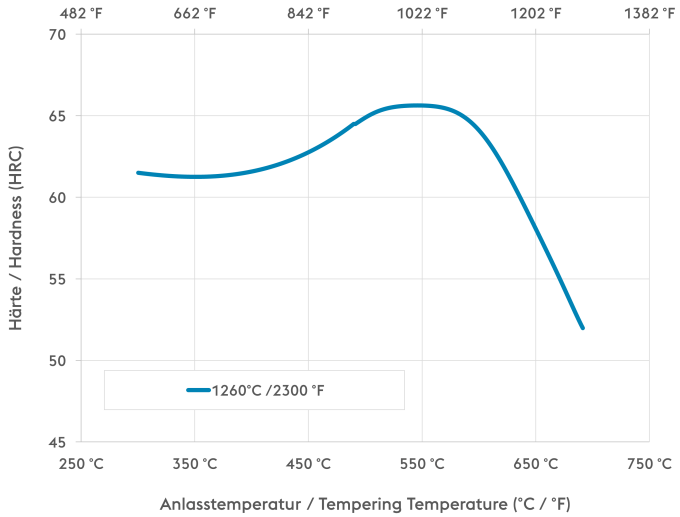
- - - - Oil cooling

-- • -- Air cooling

1. . . Edge or face

2. . . Core

## Tempering Chart




Hardening temperature: 1260°C (2300°F)

Specimen size: square 20 mm

## Physical Properties

| Temperature (°C \| °F) | 20 \| 68 |
|---|---|
| Density (kg/dm$^3$ \| lb/in$^3$) | 8.7 \| 0.31 |
| Thermal conductivity (W/(m.K) \| BTU/ft h °F) | 19 \| 10.98 |
| Specific heat (kJ/kg K \| BTU/lb °F) | 0.46 \| 0.1099 |
| Spec. electrical resistance (Ohm.mm$^2$/m \| $10^{-4}$ Ohm.inch$^2$/ft) | 0.5 \| 2.36 |
| Modulus of elasticity ($10^3$N/mm$^2$ \| $10^3$ksi) | 217 \| 31.47 |

## 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) | 10 \| 5.6 | 10.5 \| 5.8 | 10.8 \| 6 | 11.2 \| 6.2 | 11.3 \| 6.3 | 11.4 \| 6.3 | 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.

*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.*

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voestalpine
ONE STEP AHEAD.