

# HIGH SPEED STEELS

## Application Segments

Cutting Tools

Automotive

## 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 S790 MICROCLEAN – "The 1<sup>st</sup> MICROCLEAN"

High-speed steel manufactured in a powder metallurgy process, with good hot hardness, compressive strength, and wear resistance. PM technology gives it good toughness and excellent workability, including the best machinability.

## Process Melting

Powder metallurgy

## Properties

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

## Applications

- > Motorsport industry
- > Powder Pressing
- > Special Cutting Tools
- > Broaches and Reamers
- > Rolling
- > Wear parts
- > Cold Forming / Coining
- > Shearing / Machine Knives

## Technical data

Material designation		Standards	
1.3345	SEL	4957	EN ISO
HS6-5-3C	EN		

## Chemical composition (wt. %)

C	Cr	Mo	V	W
1.3	4.2	5	3	6.3

## Material characteristics

	Compressive strength	Grindability	Red hardness	Toughness	Wear resistance	Edge Stability
<b>BÖHLER S790</b> MICROCLEAN	★★★	★★★	★★	★★★★★	★★	★★★
<b>BÖHLER S290</b> MICROCLEAN	★★★★★	★	★★★★★	★★	★★★★★	★★★★★
<b>BÖHLER S390</b> MICROCLEAN	★★★★★	★★★	★★★★★	★★★★★	★★★★★	★★★★★
<b>BÖHLER S393</b> MICROCLEAN	★★★★★	★★★	★★★★★	★★★★★	★★★★★	★★★★★
<b>BÖHLER S590</b> MICROCLEAN	★★★★★	★★★	★★★★★	★★★★	★★★★	★★★★
<b>BÖHLER S690</b> MICROCLEAN	★★★	★★★	★★	★★★★★	★★★★	★★
<b>BÖHLER S792</b> MICROCLEAN	★★★	★★★	★★	★★★★★	★★	★★★
<b>BÖHLER S793</b> MICROCLEAN	★★★	★★★	★★★★★	★★★★	★★★★	★★★★

## Delivery condition

### Annealed

Hardness (HB)	max. 280   drawn max. 300 HB
Tensile Strength (MPa)	max. 1,020
Yield Strength (N/mm <sup>2</sup> )	max. 1,020

## Heat treatment

### Annealing

Temperature	870 to 900 °C	870 to 900°C (1598 to 1652°F)    The steel needs to be protected against decarburization.    Through heating of the material is followed by controlled, slow furnace cooling at a maximum cooling rate of 10°C (50°F) per hour, down to approx. 700°C (1292°F).    Final cooling in air.
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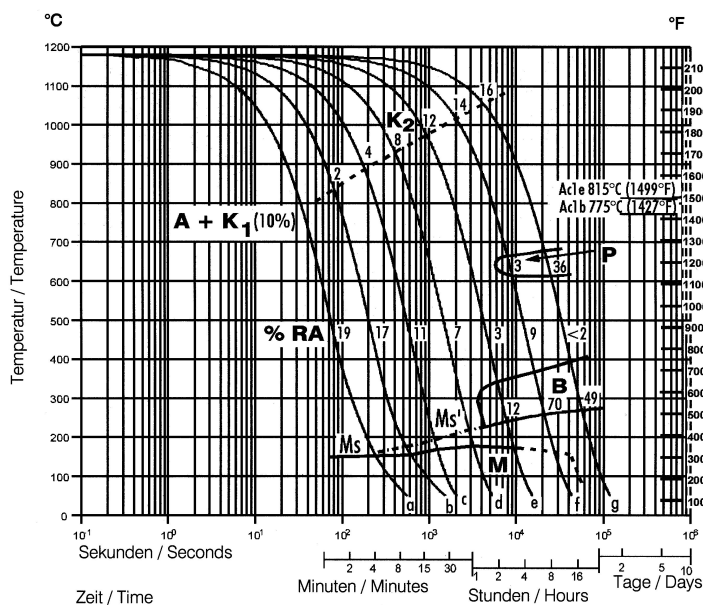
### Stress relieving

Temperature	600 to 650 °C	Slow cooling 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	1,050 to 1,200 °C	Salt bath, vacuum    Preheating: 1st stage ~ 500 °C, 2nd stage ~ 850 °C, 3rd stage ~1050 °C (for higher austenitising temperature)    Austenitising: for cutting applications at higher austenitising temperatures (> 1130 °C), holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overtime.    Austenitising: for cold work applications at lower austenitising temperatures (< 1100°C). Holding time after complete heating 15 to 30 min    Quenching: oil, warm bath (500 - 550 °C), gas.
Temperature	560 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 between each tempering step    3 tempering cycles recommended    Hardness see tempering chart

## Continuous cooling CCT curves

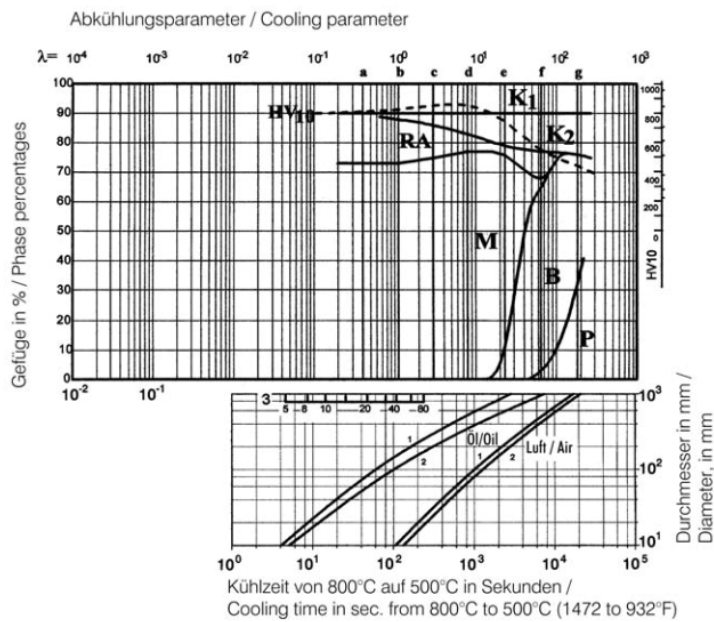


Austenitising temperature: 1180°C (2156°F)  
Holding time: 180 seconds

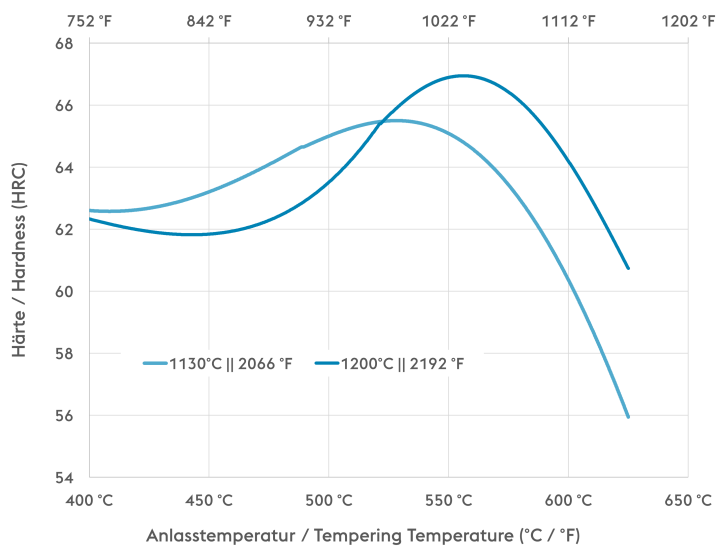
A....Austenite  
B....Bainite  
K....Carbide  
P....Pearlite  
M....Martensite  
RA...Retained Austenite

Sample	$\lambda$	HV10	Sample	$\lambda$	HV10
a	0,4	811	e	23,0	751
b	1,1	827	f	65,0	560
c	3,0	854	g	180,0	448
d	8,0	855			

## Quantitative phase diagram



## Tempering Chart



Holding time 3 x 2 hours  
Specimen size: square 25 mm

## Physical Properties

<b>Temperature (°C)</b>	<b>20</b>
Density (kg/dm <sup>3</sup> )	8
Thermal conductivity (W/(m.K))	24
Specific heat (kJ/kg K)	0.42
Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)	0.54
Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> )	230

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

<b>Temperature (°C)</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>	<b>700</b>
Thermal expansion (10 <sup>-6</sup> m/(m.K))	11.5	11.7	12.2	12.4	12.7	13	12.9

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.

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ONE STEP AHEAD.