

# 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 S290 MICROCLEAR – "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
<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 S790</b> MICROCLEAN	★★★	★★★★	★★	★★★★	★★	★★★
<b>BÖHLER S792</b> MICROCLEAN	★★★	★★★★	★★	★★★★	★★	★★★
<b>BÖHLER S793</b> MICROCLEAN	★★★	★★★★	★★★★	★★★	★★★	★★★

## Delivery condition

### Annealed

Hardness (HB)	max. 350
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## Heat treatment

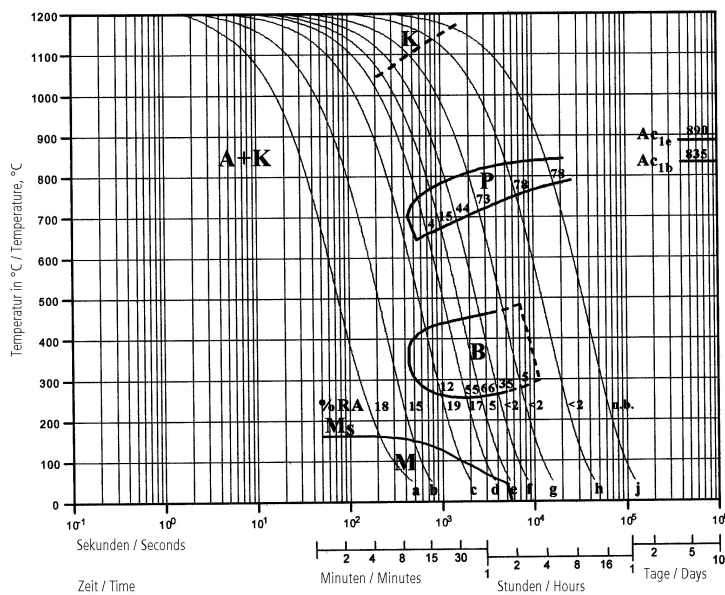
### Stress relieving

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	1,150 to 1,210 °C	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	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

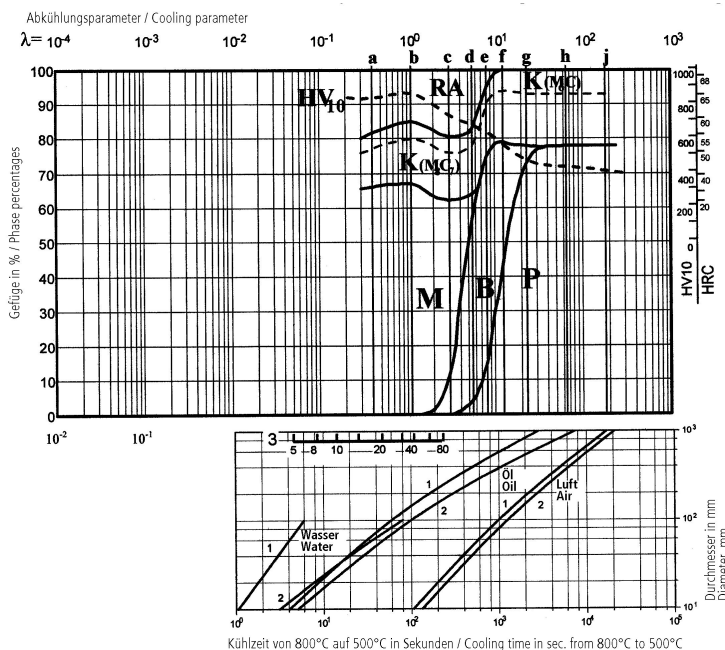


Austenitising temperature: 1210°C (2210°F)  
Holding time: 180 seconds

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

Sample	$\lambda$	HV10	Sample	$\lambda$	HV10
a	0,4	842	f	12,5	562
b	1,1	864	g	23,0	476
c	3,0	737	h	65,0	444
d	5,5	678	j	180,0	418
e	8,0	626			

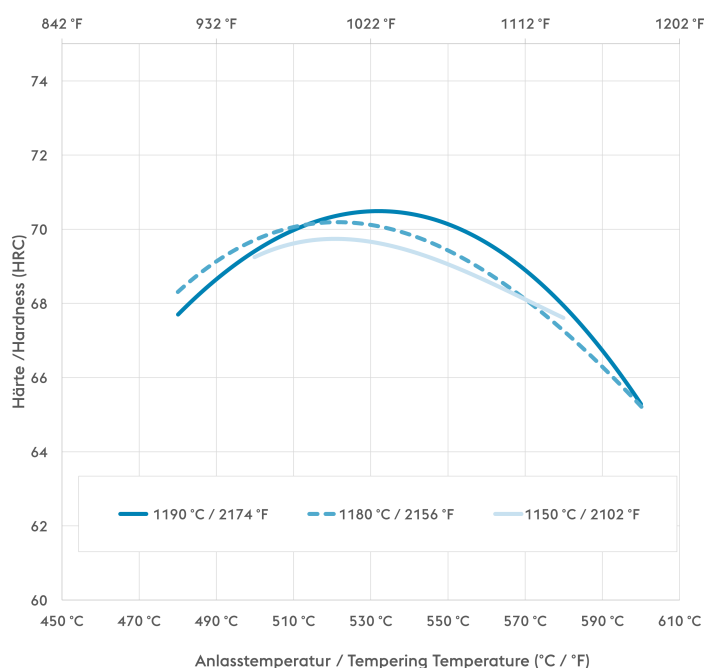
## Quantitative phase diagram



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



## Physical Properties

Temperature (°C)	20
Density (kg/dm <sup>3</sup> )	8.3
Thermal conductivity (W/(m.K))	19
Specific heat (kJ/kg K)	0.41
Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)	0.56
Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> )	242

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

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion ( $10^{-6}$ m/(m.K))	9.6	10	10.3	10.6	10.9	11.2	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.

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ONE STEP AHEAD.