

# COLD WORK STEELS

## Available Product Shapes

[Long Products](#)[Open Die Forgings](#)

## Product Description

An increase in productivity in high-tech toolmaking can only be achieved by using the appropriate highly wear-resistant PM materials. The decisive factors are toughness, wear resistance, compressive strength and edge-holding ability. Factors which are combined to formidable advantage in BÖHLER K190 MICROCLEAN.

## Properties

- > Toughness & Ductility: high
- > Good toughness means safety against cracking of the molds in use: good
- > Uniformly high strength and toughness, even with large dimensions: good
- > Wear Resistance: high
- > Compressive strength: high
- > Dimensional stability: very high
- > Excellent homogeneity and isotropy: very high
- > Fine carbide structure: good
- > Homogeneous microstructure: good

## Applications

- > Rolling
- > Screws and Barrels
- > Wear parts
- > Cold Forming
- > Components for Recycling Industry
- > General Components for Mechanical Engineering
- > Fine Blanking, Stamping, Blanking
- > Rolls

## Technical data

Material designation	
~1.2380	SEL
~X230CrVMo13 4	EN

## Chemical composition (wt. %)

C	Si	Mn	Cr	Mo	V
2.3	0.6	0.3	12.5	1.1	4

### Material characteristics

	Compressive strength	Dimensional stability during heat treatment	Toughness	Wear resistance abrasive	Wear resistance adhesive
<b>BÖHLER K190</b> MICROCLEAN®	★★★★	★★★★★	★★★★	★★★★	★★★★
<b>BÖHLER K100</b>	★★	★★	★	★★★	★★
<b>BÖHLER K105</b>	★★	★★	★	★★	★★
<b>BÖHLER K107</b>	★★	★★	★	★★★	★★
<b>BÖHLER K110</b>	★★	★★★	★	★★★	★★
<b>BÖHLER K294</b> MICROCLEAN®	★★★★★	★★★★★	★★★	★★★★★	★★★★★
<b>BÖHLER K340</b> ISODUR®	★★★	★★★★	★★★	★★★	★★★★
<b>BÖHLER K340</b> ECOSTAR®	★★★	★★★	★★	★★	★★
<b>BÖHLER K360</b> ISODUR®	★★★	★★★★	★★★	★★★★	★★★★
<b>BÖHLER K346</b>	★★★	★★★	★★★	★★★★	★★
<b>BÖHLER K353</b>	★★	★★★	★★	★★	★★
<b>BÖHLER K390</b> MICROCLEAN®	★★★★★	★★★★★	★★★★	★★★★★	★★★★★
<b>BÖHLER K890</b> MICROCLEAN®	★★★★	★★★★★	★★★★★	★★★	★★★
<b>BÖHLER K490</b> MICROCLEAN®	★★★★	★★★★★	★★★★	★★★★	★★★★
<b>BÖHLER K497</b> MICROCLEAN®	★★★★★	★★★★★	★★★	★★★★★	★★★★★

### Delivery condition

Annealed	
Hardness	max. 260 HB

## Heat treatment

### Annealing

Temperature (°C   °F)	800   1472 to 850   1562	Slow, controlled cooling in furnace at a rate of 50 to 68°F/hr (10 to 20 °C/hr) down to approx. 1112°F (600 °C), further cooling in air.
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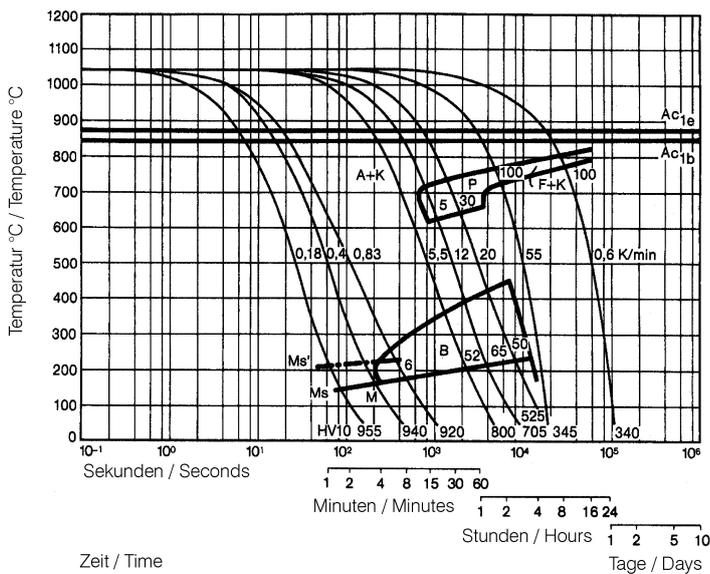
### Stress relieving

Temperature (°C   °F)	650   1202 to 700   1292	After through-heating, soak for 1 to 2 hours in neutral atmosphere. Slow cooling in furnace
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### Hardening and Tempering

Temperature (°C   °F)	to	From a neutral atmosphere at 1050 – 1150°C / quench in oil, salt-bath at 200 – 250 °C or at 500 – 550 °C, in air or in gas. A sufficiently high cooling rate must be ensured. Holding time after through-heating: 20 to 30 minutes, soaking time depends on the size of the work-piece and furnace parameters. Vacuum hardening is recommended. Average hardness after quenching prior to tempering see austenitising chart. We recommend hardening from the lower end of the hardening temperature range where high toughness is required and/or where the tool is of complicated geometry. Where high wear resistance is of the utmost importance we recommend hardening from the top end of the hardening temperature range given. After hardening, tempering to the desired working hardness, see tempering chart.
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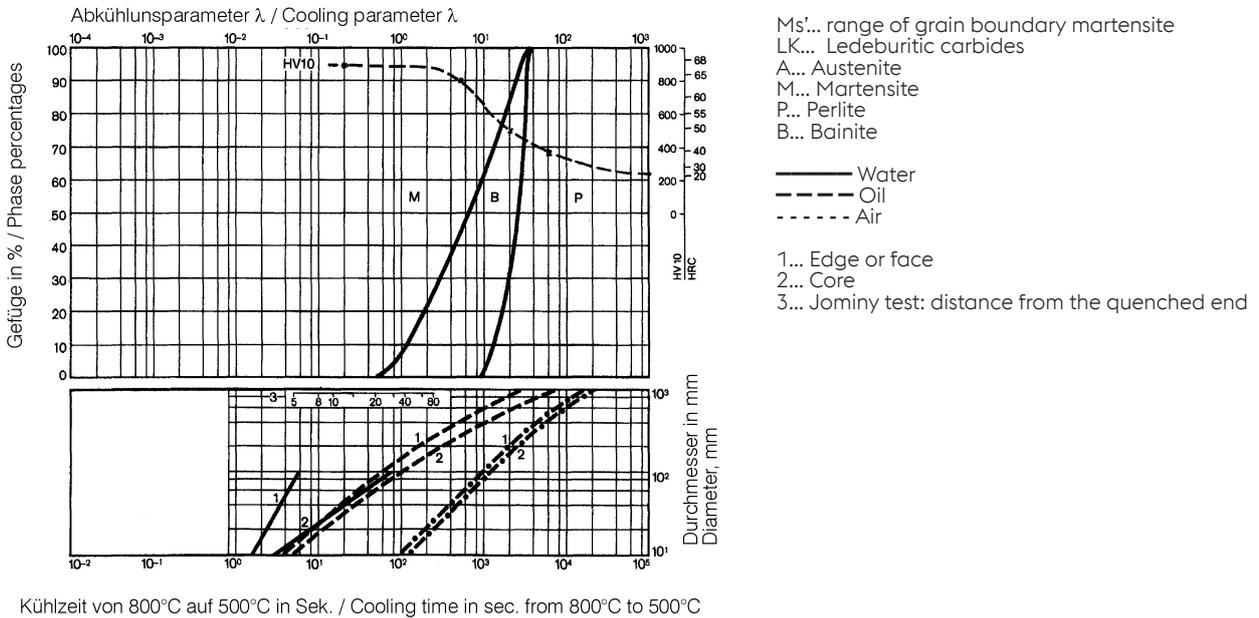
## Continuous cooling CCT curves



Austenitizing temperature: 1050°C / 1922°F  
Holding time: 10 minutes

5...100 phase percentages  
0,18...50 cooling parameter, i.e. duration of cooling from 800 – 500° C (1472°F - 932°F) in s x 10<sup>-2</sup>  
0,6 K/min. cooling rate in the 800 – 500 °C (1472°F - 932°F) range

**Quantitative phase diagram**



**Physical Properties**

Temperature (°C   °F)	20   68
Density (kg/dm <sup>3</sup>   lb/in <sup>3</sup> )	7.6   0.27
Thermal conductivity (W/(m.K)   BTU (IT) ft/hr/ft <sup>2</sup> /F)	21.5   12.42
Specific heat (J/(kg.K)   BTU (IT) lb/F)	-
Spec. electrical resistance (Ohm.mm <sup>2</sup> /m   10 <sup>-4</sup> Ohm.inch <sup>2</sup> /ft)	0.59   2.79
Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup>   10 <sup>3</sup> ksi)	-

**Thermal Expansions**

Temperature (°C   °F)	100   212	200   392	300   572	400   752	500   932	600   1112	700   1292
Thermal expansion (10 <sup>-6</sup> m/(m.K)   10 <sup>-6</sup> inch/(inch.F))	12.2   6.778	12.5   6.944	13   7.222	13.2   7.333	13.7   7.611	14   7.778	13.7   7.611

For more information see [www.voestalpine.com/boehler-edelstahl](http://www.voestalpine.com/boehler-edelstahl)

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ONE STEP AHEAD.