# COLD WORK TOOL STEELS

## Application Segments

Cold Work

## 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 K190 MICROCLEAN is a 12% ledeburitic chromium steel manufactured using powder metallurgy. This material has the highest alloy content of the group of 12% ledeburitic chromium steels. Due to its high vanadium content, BÖHLER K190 MICROCLEAN has a significantly better resistance to abrasive wear than the tool steels 1.2080, 1.2601, 1.2436 and 1.2379. At the same time, the powder metallurgical manufacturing process creates a uniform matrix with finely distributed primary carbides, which among other things contributes to the good toughness of the material. BÖHLER K190 MICROCLEAN is used in situations where tool steels like 1.2379 are insufficient in terms of wear resistance.

## Process Melting

Powder metallurgy

## Properties

- Wear Resistance : high
- Compressive strength : high
- Toughness & Ductility : high
- Dimensional stability : very high

## Applications

- Rolling
- Screws and Barrels
- Wear parts
- Cold Forming
- Components for the 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 |
|---|---|---|---|---|---|
| 2.30 | 0.60 | 0.30 | 12.50 | 1.10 | 4.00 |

## Material characteristics

| | Compressive strength | Dimensional stability during heat treatment | Toughness | Wear resistance abrasive | Wear resistance adhesive |
|---|---|---|---|---|---|
| **BÖHLER K190** MICROCLEAN | ★★★★ | ★★★★★ | ★★★★ | ★★★★ | ★★★★ |
| **BÖHLER K100** | ★★ | ★★ | ★ | ★★★ | ★★ |
| **BÖHLER K105** | ★★ | ★★ | ★ | ★★ | ★★ |
| **BÖHLER K107** | ★★ | ★★ | ★ | ★★★ | ★★ |
| **BÖHLER K110** | ★★ | ★★★ | ★ | ★★★ | ★★ |
| **BÖHLER K294** MICROCLEAN | ★★★★★ | ★★★★★ | ★★★ | ★★★★★ | ★★★★★ |
| **BÖHLER K340** ECOSTAR | ★★★ | ★★★ | ★★ | ★★ | ★★ |
| **BÖHLER K340** ISODUR | ★★★ | ★★★★ | ★★★ | ★★★ | ★★★★ |
| **BÖHLER K346** | ★★★ | ★★★ | ★★★ | ★★★★ | ★★ |
| **BÖHLER K353** | ★★ | ★★★ | ★★ | ★★ | ★★ |
| **BÖHLER K360** ISODUR | ★★★ | ★★★★ | ★★★ | ★★★★ | ★★★★ |
| **BÖHLER K390** MICROCLEAN | ★★★★★ | ★★★★★ | ★★★★ | ★★★★★ | ★★★★★ |
| **BÖHLER K490** MICROCLEAN | ★★★★ | ★★★★★ | ★★★★ | ★★★★ | ★★★★ |
| **BÖHLER K497** MICROCLEAN | ★★★★★ | ★★★★★ | ★★★ | ★★★★★ | ★★★★★ |
| **BÖHLER K888** MATRIX | ★★★★ | ★★★★★ | ★★★★★ | ★★ | ★★ |
| **BÖHLER K890** MICROCLEAN | ★★★★ | ★★★★★ | ★★★★★ | ★★★ | ★★★ |

## Delivery condition

| **Annealed** | |
|---|---|
| Hardness (HB) | max. 260 |

## Heat treatment

### Annealing

| | | |
|---|---|---|
| Temperature | 800 to 850 °C | Slow controlled cooling in furnace at a rate of 10 to 20 °C/hr (18 to 36 °F/hr °F/hr) down to approximately 600 °C (1112 °F) \|\| Further cooling in air. |

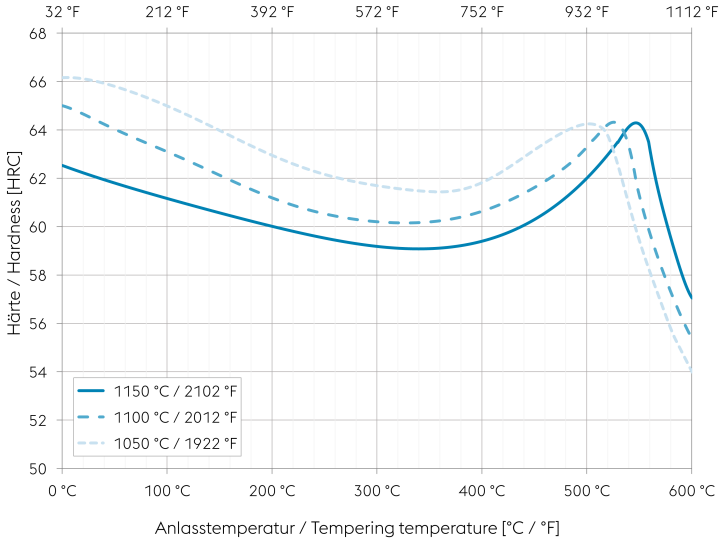
### Stress relieving

| | | |
|---|---|---|
| Temperature | 650 to 700 °C | After through heating, hold in neutral atmosphere for 1-2 hours. \|\| Slow cooling in furnace \|\| Intended to relieve stresses caused by extensive machining or in complex shapes. |

### Hardening and Tempering

| | | |
|---|---|---|
| Temperature | 1,050 to 1,150 °C | Vacuum hardening is recommended. Alternative: quenching from a neutral atmosphere in oil, salt bath (220 to 250 °C or 500 to 550 °C \| 428 to 482 °F or 932 to 1022 °F), gas, air. A sufficiently high cooling rate must be ensured. \|\| Holding time after temperature equalization: 20 to 30 minutes. Soaking time depends on the size of the workpiece and furnace parameters. \|\| We recommend hardening from the lower end of the hardening temperature range when high toughness is required and/or when the tool is of complex shape. If high wear resistance is of the utmost importance, we recommend hardening from the top end of the hardening temperature range. \|\| After hardening, tempering to the desired working hardness according to the tempering chart. |

## Tempering Chart




Specimen size: square 20 mm (0,787 inch)

Slow heating to tempering temperature immediately after hardening.

Time in furnace 1 hour for each 20 mm (0,787 inch) of workpiece thickness but at least 2 hours.

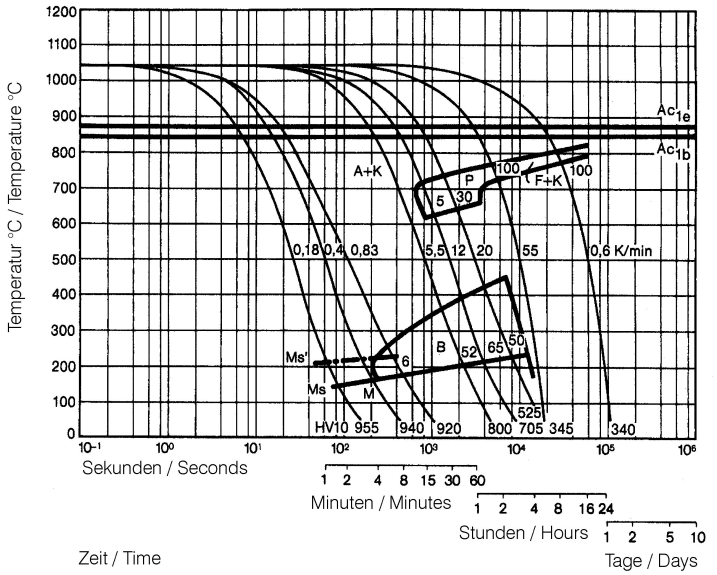
Please refer to the tempering chart for guide values for the achievable hardness after tempering.

It is recommended to temper at least three times above the secondary hardness maximum.

Cooling in air to room temperature after each tempering step is recommended.

Tempering for stress relieving 30 to 50 °C (86 to 122 °F) below the highest tempering temperature.

## Continuous cooling CCT curves




Austenitising temperature: 1050 °C (1922 °F)
Holding time: 10 minutes

O Vickers hardness

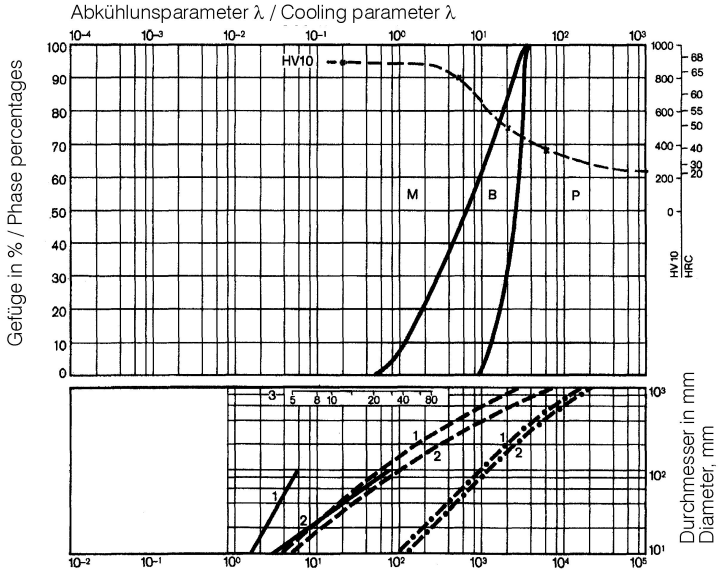
5...100 phase percentages

0.18...55 cooling parameter λ, i.e. duration of cooling from 800 to 500 °C (1472 to 932 °F) in s x $10^{-2}$

0.6 K/min... cooling rate in the range of 800 to 500 °C (1472 to 932 °F)

A... Austenite
K... Carbide
P... Perlite
B...Bainite
M... Martensite
Ms... Martensite starting temperature

## Quantitative phase diagram




HV10... Vickers Hardness
M... Martensite
P... Perlite
B... Bainite

—— Water cooling
- - - Oil cooling
- • - Air cooling

1... Edge or face
2... Core

## Physical Properties

| **Temperature (°C)** | **20** |
|---|---|
| Density (kg/dm$^3$) | 7.6 |
| Thermal conductivity (W/(m.K)) | 21.5 |
| Specific heat (kJ/kg K) | - |
| Spec. electrical resistance (Ohm.mm$^2$/m) | 0.59 |
| Modulus of elasticity (10$^3$N/mm$^2$) | - |

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

| **Temperature (°C)** | **100** | **200** | **300** | **400** | **500** | **600** | **700** |
|---|---|---|---|---|---|---|---|
| Thermal expansion (10$^{-6}$ m/(m.K)) | 12.2 | 12.5 | 13 | 13.2 | 13.7 | 14 | 13.7 |



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ONE STEP AHEAD.