

# COLD WORK TOOL STEELS

## Application Segments

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Cold Work

## Available Product Variants

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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

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BÖHLER K110 is a 12% ledeburitic chromium steel and corresponds to material number 1.2379 (X153CrMoV12, D2). This tool steel combines the advantages of conventional 12% ledeburitic chromium steels with those of advanced tool steels. In the group of 12% ledeburitic chromium steels, BÖHLER K110 offers the best combination of wear resistance, compressive strength and toughness, for which reason it is used in virtually all cold work applications. Its advantageous tempering behavior with a pronounced secondary hardness maximum also enables the use of advanced coatings. This also makes BÖHLER K110 suitable for complex tools requiring a high degree of dimensional stability and shape stability.

## Process Melting

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Airmelted

## Properties

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- > Wear Resistance : good
- > Dimensional stability : good

## Applications

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- > Machine knife (for producers)
- > Coining
- > Standard Parts (Moulds, Plates, Pins, Punches)
- > Components for underground construction (drilling, shafts, etc.)
- > Thread rolling
- > Cutting
- > Clamping
- > Pumping
- > Cold Rolling incl. Sendzimir Rolls
- > Rolling
- > Fine Blanking, Stamping, Blanking
- > Screws and Barrels
- > Rolls
- > Industrial Knives
- > Packaging
- > Drilling
- > Wear Applications
- > Roll Forming
- > Cold Forming
- > Powder Pressing
- > Components for the recycling industry
- > Wear parts
- > Extrusion
- > Grinding
- > Mineral Processing
- > Mechanical Engineering
- > Packaging industry

Technical data

| Material designation |      | Standards |        |
|----------------------|------|-----------|--------|
| 1.2379               | SEL  | 4957      | EN ISO |
| X153CrMoV12          | EN   |           |        |
| ~T30402              | UNS  |           |        |
| D2                   | AISI |           |        |

Chemical composition (wt. %)

| C    | Si   | Mn   | Cr    | Mo   | V    |
|------|------|------|-------|------|------|
| 1.55 | 0.30 | 0.30 | 11.30 | 0.75 | 0.75 |

Material characteristics

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

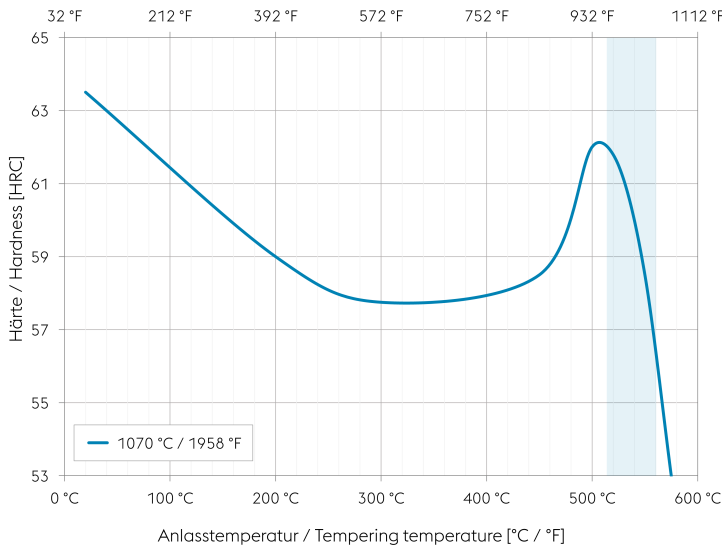
Delivery condition

|               |          |
|---------------|----------|
| Annealed      |          |
| Hardness (HB) | max. 250 |

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) 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             | 1,030 to 1,070 °C | Quenching: Oil, salt bath (220 to 250 °C or 500 to 550 °C   428 to 482 °F or 932 to 1022 °F), gas, compressed or still air. Tools of intricate shape or with sharp edges should preferably be hardened in air.    Holding time after temperature equalization: 15 to 30 minutes.    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.

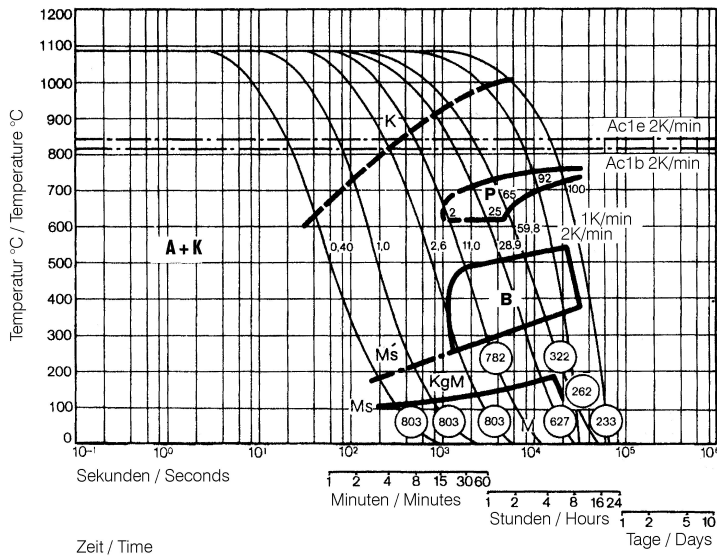
It is recommended to temper at least three times above the secondary hardness maximum.

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.

Recommended tempering temperature range is indicated by the blue area in the chart.

Continuous cooling CCT curves



Austenitising temperature: 1080 °C (1976 °F)  
Holding time: 30 minutes

○ Vickers hardness

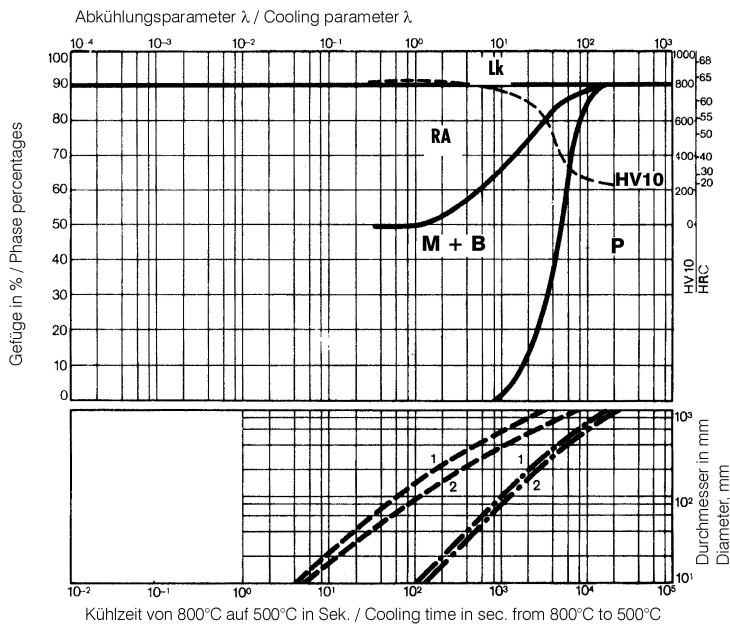
2...100 phase percentages

0.40...59.8 cooling parameter  $\lambda$ , i.e. duration of cooling from 800 to 500 °C (1472 to 932 °F) in  $s \times 10^{-2}$

1...2 K/min... cooling rate in the range of 800 to 500 °C (1472 to 932 °F)

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

Quantitative phase diagram

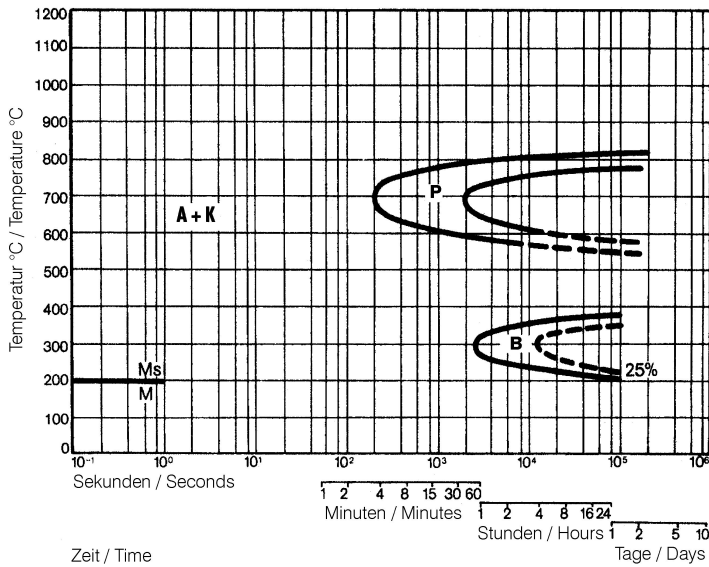


- HV10... Vickers Hardness
- Lk... Ledeburite carbide
- RA... Residual austenite
- M... Martensite
- B... Bainite
- P... Pearlite

- - - Oil cooling
- · - Air cooling

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

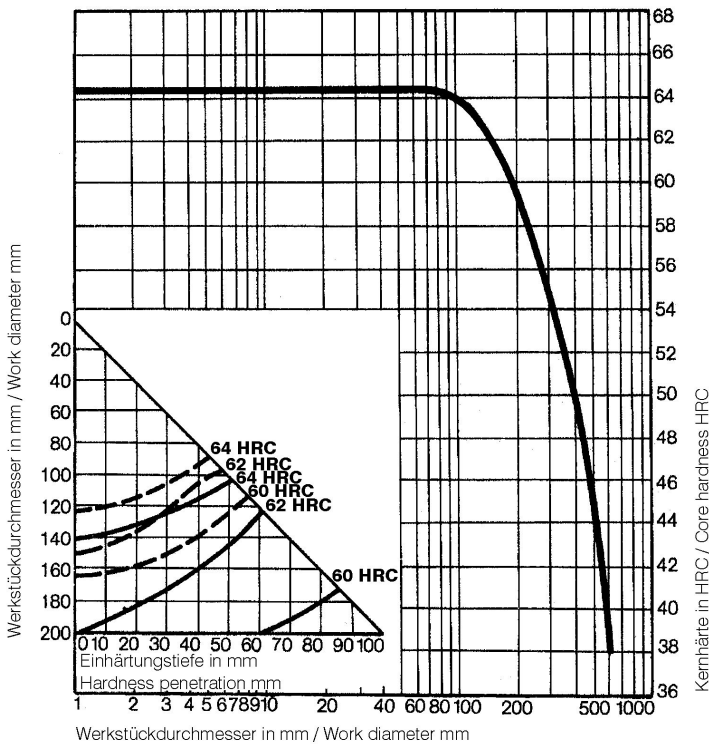
Isothermal TTT curves



Austenitising temperature: 1020 °C / 1868 °F  
Holding time: 30 minutes

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

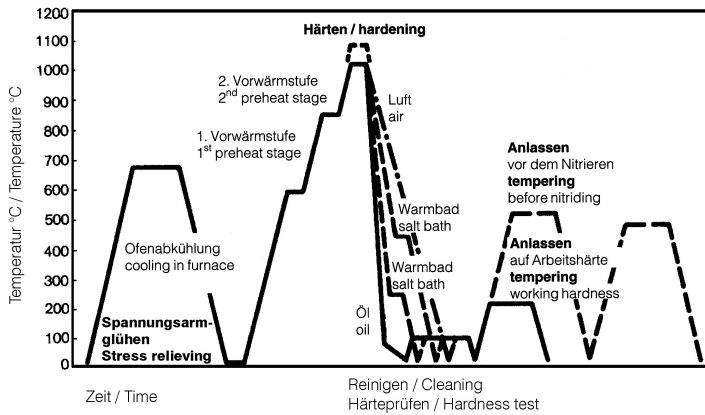
Influence of work diameter on core hardness and hardness penetration



Quenched from: 1030 °C / 1886 °F

Quenchant:  
— Oil  
- - - Air

Heat treatment sequence



Physical Properties

|  |      |
|--|------|
| Temperature (°C)   | 20   |
| Density (kg/dm <sup>3</sup> )                              | 7.67 |
| Thermal conductivity (W/(m.K))                             | 23.9 |
| Specific heat (kJ/kg K)                                    | 0.47 |
| Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)       | 0.65 |
| Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> ) | 200  |

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

| Temperature (°C)                             | 100 | 200  | 300  | 400  | 500  | 600  | 700  |
|--|-----|------|------|------|------|------|------|
| Thermal expansion (10 <sup>-6</sup> m/(m.K)) | 11  | 11.4 | 11.9 | 12.2 | 12.7 | 12.8 | 12.1 |

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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