

# COLD WORK TOOL STEELS

## Application Segments

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Cold Work

## Available Product Variants

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Long Products

## Product Description

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BÖHLER K888 MATRIX - This MATRIX steel offers an excellent combination of high toughness and high compressive strength. MATRIX materials have high toughness, which is a critical factor in many applications. However, the hardness achievable with commonly used MATRIX steels often limits the potential applications. BÖHLER K888 MATRIX breaks through this barrier and offers the best of both worlds of matrix steels and high alloy tool steels. BÖHLER K888 MATRIX is a unique problem solver in situations where high compressive strength and toughness are required. Its advantageous tempering behavior with a pronounced secondary hardness maximum also enables the use of advanced coatings.

## Process Melting

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Powder metallurgy

## Properties

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- > Toughness & Ductility : very high
- > Hardness : very high
- > Compressive strength : very high
- > Machinability : very high
- > Dimensional stability : very high

## Applications

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- > Fine Blanking, Stamping, Blanking
- > Powder Pressing
- > Machine knife (for producers)
- > Industrial Knives
- > Mineral Processing
- > Camshafts
- > Packaging industry
- > Cold Forming
- > Pill punching dies
- > Components for the recycling industry
- > Grinding
- > Drilling
- > Mechanical Engineering
- > Coining
- > Rolling
- > Standard Parts (Moulds, Plates, Pins, Punches)
- > Wear Applications
- > Clamping
- > Roll Forming

## Technical data

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Material designation

|               |              |
|---------------|--------------|
| BÖHLER patent | Market grade |
|---------------|--------------|

Chemical composition (wt. %)

| C    | Si   | Cr   | Mo   | V    | W    | Co   |
|------|------|------|------|------|------|------|
| 0.60 | 0.85 | 4.40 | 2.80 | 1.10 | 2.45 | 3.80 |

Material characteristics

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

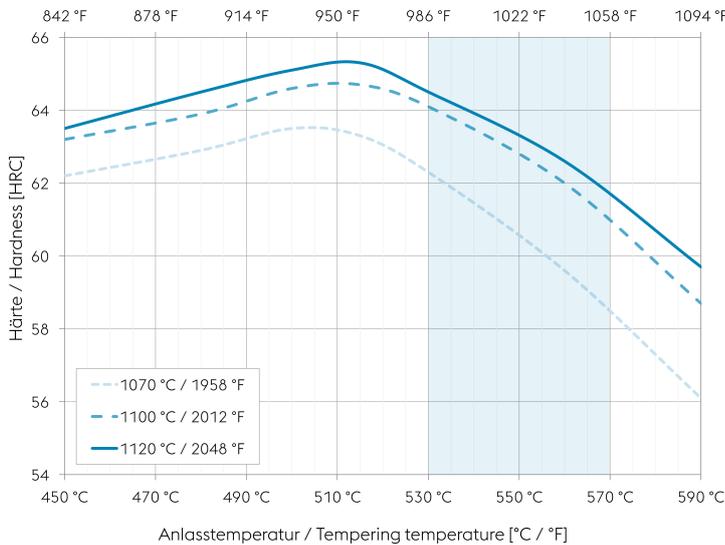
Delivery condition

| Annealed      |          |
|---------------|----------|
| Hardness (HB) | max. 280 |

Heat treatment

| 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             | 1,070 to 1,120 °C | Quenching: Oil, gas (N <sub>2</sub> )    Holding time after temperature equalization: 20-30 minutes (hardening temperature 1070 to 1100 °C   1958 to 2012 °F) or 10 minutes (hardening temperature 1120 °C (2048 °F)    After hardening, tempering to the desired working hardness according to the tempering chart. |

### Tempering Chart



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.

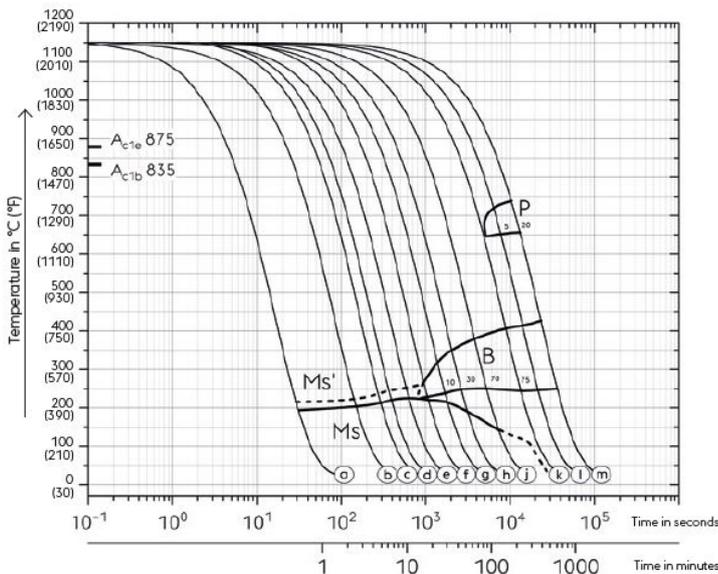
It is recommended to temper at least three times above the secondary hardness maximum.

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



Austenitizing temperature: 1150 °C / 2102 °F

Soak time: 180 sec

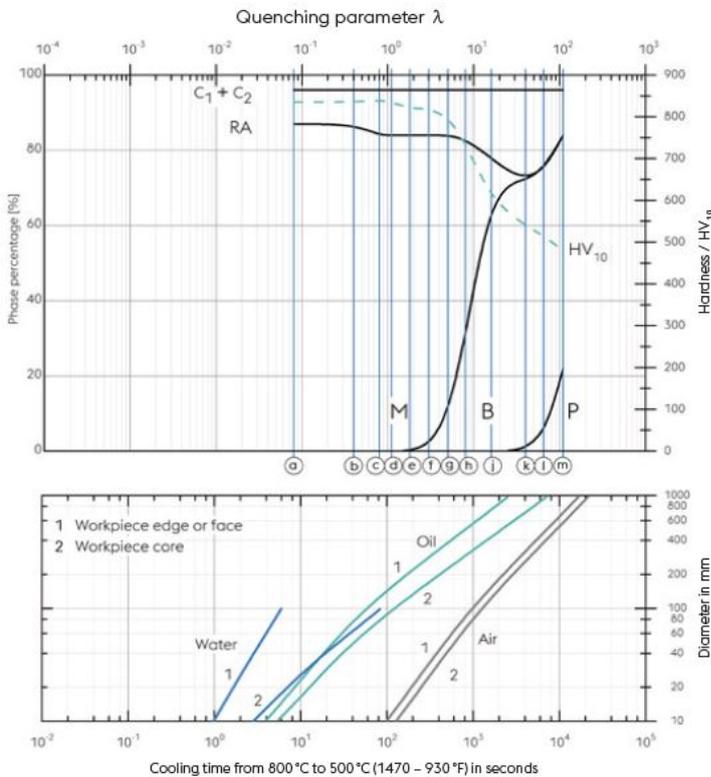
5...75 Phase proportion in %

0.08...110.00... Quenching parameter  $\lambda$ , i.e. quenching time from 800 to 500 °C (1470 – 930 °F) in  $s \times 10^{-2}$

P...Pearlite  
B...Bainite  
Ms... Martensite starting temperature  
M...Martensite

| Sample | $\lambda$ | HV <sub>10</sub> | Sample | $\lambda$ | HV <sub>10</sub> |
|--------|-----------|------------------|--------|-----------|------------------|
| a      | 0.08      | 835              | g      | 5.00      | 800              |
| b      | 0.40      | 835              | h      | 8.00      | 740              |
| c      | 0.80      | 840              | j      | 16.00     | 600              |
| d      | 1.10      | 835              | k      | 40.00     | 540              |
| e      | 1,80      | 820              | l      | 65.00     | 515              |
| f      | 3.00      | 820              | m      | 110.00    | 480              |

Quantitative phase diagram



- C1...Carbide content not dissolved during austenitization
- C2...Start of carbide precipitation during quenching from the austenitization temperature
- RA...Retained austenite
- A...Austenite
- M...Martensite
- P...Pearlite
- B...Bainite

Physical Properties

|  |           |
|--|-----------|
| <b>Temperature (°C)</b>                                    | <b>20</b> |
| Density (kg/dm <sup>3</sup> )                              | 7.86      |
| Thermal conductivity (W/(m.K))                             | 20.8      |
| Specific heat (kJ/kg K)                                    | 0.442     |
| Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)       | 0.5       |
| Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> ) | 218       |

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)) | 10.7 | 11.5 | 11.9 | 12.5 | 12.5 | 12.8 | 12.7 |

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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