

# COLD WORK TOOL STEELS

## Application Segments

Cold Work

## Available Product Variants

Long Products

## Product Description

BÖHLER K346 belongs to the group of conventionally produced 8% chromium steels. Its alloy composition features a high content of molybdenum, tungsten and vanadium, which makes BÖHLER K346 more wear resistant and tougher than conventional 12% chromium steels (1.2080, 1.2379). BÖHLER K346 is used in situations where materials like 1.2379 are insufficient in terms of toughness and where high requirements for abrasive wear resistance are set. This combination of high wear resistance and toughness offers advantages for industrial knives subject to high stress in the recycling industry. This grade is also used for stamping and cutting tools.

## Process Melting

Airmelted

## Properties

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

## Applications

- > Machine knife (for producers)
- > Thread rolling
- > Components for the recycling industry
- > Components for underground construction (drilling, shafts, etc.)

## Chemical composition (wt. %)

| C    | Si   | Mn   | Cr   | Mo   | V    |
|------|------|------|------|------|------|
| 1.13 | 1.20 | 0.35 | 7.80 | 1.60 | 2.40 |

## Material characteristics

|                        | Compressive strength | Dimensional stability during heat treatment | Toughness | Wear resistance abrasive | Wear resistance adhesive |
|------------------------|----------------------|---|-----------|--------------------------|--------------------------|
| BÖHLER K346            | ★★★                  | ★★★   | ★★★       | ★★★★★                    | ★★                       |
| BÖHLER K100            | ★★                   | ★★  | ★         | ★★★★                     | ★★                       |
| BÖHLER K105            | ★★                   | ★★  | ★         | ★★                       | ★★                       |
| BÖHLER K110            | ★★                   | ★★★   | ★         | ★★★★                     | ★★                       |
| BÖHLER K190 MICROCLEAN | ★★★★★                | ★★★★★                                       | ★★★★★     | ★★★★★                    | ★★★★★                    |
| BÖHLER K294 MICROCLEAN | ★★★★★                | ★★★★★                                       | ★★★★      | ★★★★★                    | ★★★★★                    |
| BÖHLER K340 ECOSTAR    | ★★★                  | ★★★   | ★★        | ★★                       | ★★                       |
| BÖHLER K340 ISODUR     | ★★★                  | ★★★★★                                       | ★★★★      | ★★★★                     | ★★★★★                    |
| 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. 250 |
|---------------|----------|

## Heat treatment

### Annealing

|             |               |   |
|-------------|---------------|---|
| Temperature | 840 to 870 °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. |
|-------------|---------------|---|

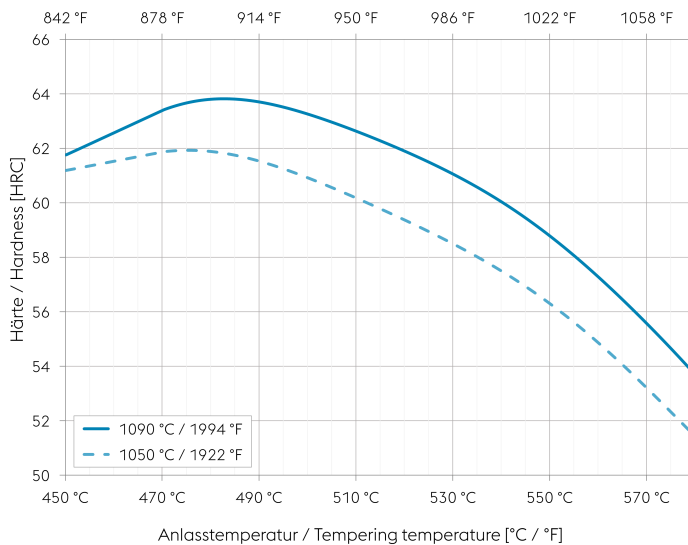
### Stress relieving

|             |        |   |
|-------------|--------|---|
| Temperature | 650 °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. |
|-------------|--------|---|

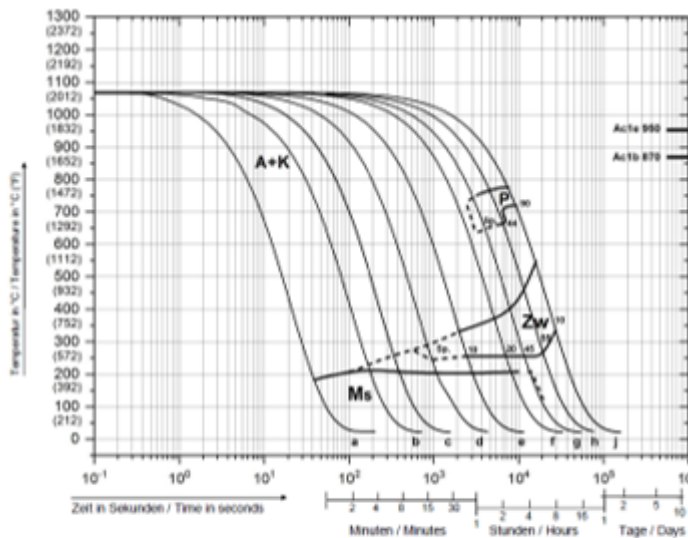
### Hardening and Tempering

|             |                   |   |
|-------------|-------------------|---|
| Temperature | 1,050 to 1,090 °C | Quenching: Oil, gas, 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



## Continuous cooling CCT curves



| Probe | (DIL805)<br>Vers.Nr. | $\lambda$ | HV <sub>0.05</sub> | RA% | Probe | (DIL805)<br>Vers.Nr. | $\lambda$ | HV <sub>0.05</sub> | RA% |
|-------|----------------------|-----------|--------------------|-----|-------|----------------------|-----------|--------------------|-----|
| a     | 2151                 | 0,1       | 812                | 14  | g     | 2154                 | 38        | 610                | 7   |
| b     | 2153                 | 0,5       | 810                | 13  | h     | 2180                 | 65        | 370                | 1   |
| e     | 2148                 | 1,1       | 810                | 12  | j     | 2183                 | 110       | 260                | <1  |
| d     | 2156                 | 3         | 790                | 16  |       |                      |           |                    |     |
| e     | 2182                 | 8         | 760                | 14  |       |                      |           |                    |     |
| f     | 2158                 | 23        | 680                | 13  |       |                      |           |                    |     |

## Physical Properties

| Temperature (°C)   | 20   |
|--|------|
| Density (kg/dm <sup>3</sup> )                              | 7.64 |
| Thermal conductivity (W/(m.K))                             | 22   |
| Specific heat (kJ/kg K)                                    | 0.47 |
| Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)       | 0.6  |
| Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> ) | 220  |

## 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  | 11.5 | 12  | 12.4 | 12.7 | 13  | 13.2 |

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.