

# HOT WORK TOOL STEELS

## Application Segments

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Hot Work

## Available Product Variants

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Long Products\*

Plates

Open Die Forgings

\* 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 W302 ISOBLOC is a 5% chromium steel and corresponds to material number 1.2344 (X40CrMoV5-1). Produced via the electroslag remelting process (ESR), this tool steel has very high hot toughness as well as very high hot hardness and a very good resistance against heat-checkings. The combination of these properties makes it a top performer in closed- and open-die forging as well as in high- and low-pressure die casting. In addition, this material has very good polishability and is therefore also often used as a molding material for plastic injection molds.

## Process Melting

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Airmelted + Remelted

## Properties

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- > Toughness & Ductility : high
- > Wear Resistance : high
- > Machinability : very high
- > Hot Hardness (red hardness) : high
- > Polishability : very high
- > Thermal conductivity : good
- > Micro-cleanliness : high

## Applications

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- |                                 |                                                      |                                                  |
|---------------------------------|------------------------------------------------------|--------------------------------------------------|
| > High Pressure Die-Casting     | > Forging (Hot / Semi-hot)                           | > Gravity / Low Pressure Die-Casting             |
| > Progressive Forging (Hatebur) | > Hot Extrusion                                      | > Fasteners, Bolts, Nuts                         |
| > Injection Moulding            | > Press Hardening / Hot Stamping                     | > Rolling                                        |
| > Industrial Knives             | > Tool Holders (milling, drilling, turning & chucks) | > Standard Parts (Moulds, Plates, Pins, Punches) |
| > Screws and Barrels            | > Blow Molding                                       | > Machine knife (for producers)                  |
| > Rolls                         | > Mechanical Engineering                             | > Hotrunner systems                              |
| > Glasfibre reinforced plastics | > Grinding                                           | > Drilling                                       |
| > Mineral Processing            | > Wear Applications                                  | > Injection Components                           |
| > Pumps                         | > Roll Forming                                       | > Cold Rolling incl. Sendzimir Rolls             |

## Technical data

| Material designation |       | Standards |        |
|----------------------|-------|-----------|--------|
| 1.2344               | SEL   | 4957      | EN ISO |
| X40CrMoV5-1          | EN    | #207      | NADCA  |
| T20813               | UNS   | G4404     | JIS    |
| H13                  | AISI  |           |        |
| B1885                | NADCA |           |        |
| SKD61                | JIS   |           |        |

## Chemical composition (wt. %)

| C    | Si   | Mn   | Cr   | Mo   | V    |
|------|------|------|------|------|------|
| 0.39 | 0.90 | 0.40 | 5.20 | 1.40 | 0.95 |

## Material characteristics

|                               | High temperature strength | High temperature toughness | High temperature wear resistance | Machinability in as supplied condition | Polishability |
|-------------------------------|---------------------------|----------------------------|----------------------------------|----------------------------------------|---------------|
| <b>BÖHLER W302</b><br>ISOBLOC | ★★★                       | ★★★★                       | ★★★                              | ★★★★★                                  | ★★★★          |
| <b>BÖHLER W300</b><br>ISODISC | ★★                        | ★★★                        | ★★                               | ★★★★★                                  | ★★★           |
| <b>BÖHLER W300</b><br>ISOBLOC | ★★                        | ★★★★                       | ★★                               | ★★★★★                                  | ★★★★          |
| <b>BÖHLER W302</b><br>ISODISC | ★★★                       | ★★★                        | ★★★                              | ★★★★★                                  | ★★★           |
| <b>BÖHLER W303</b><br>ISODISC | ★★★★                      | ★★★                        | ★★★★                             | ★★★★★                                  | ★★★           |
| <b>BÖHLER W350</b><br>ISOBLOC | ★★★                       | ★★★★★                      | ★★★                              | ★★★★★                                  | ★★★★          |
| <b>BÖHLER W360</b><br>ISOBLOC | ★★★★★                     | ★★★★                       | ★★★★★                            | ★★★★★                                  | ★★★★          |
| <b>BÖHLER W400</b><br>VMR     | ★★                        | ★★★★★                      | ★★                               | ★★★★                                   | ★★★★★         |
| <b>BÖHLER W403</b><br>VMR     | ★★★★                      | ★★★★                       | ★★★★                             | ★★★★                                   | ★★★★★         |

## Delivery condition

|                              |                                             |
|------------------------------|---------------------------------------------|
| <b>Annealed</b>              |                                             |
| Hardness (HB)                | max. 229                                    |
| <b>Hardened and Tempered</b> |                                             |
| Hardness (HRC)               | 40 to 55   bars hardened and tempered (BHT) |
| <b>Hardened and Tempered</b> |                                             |
| Hardness (HRC)               | 30 to 44                                    |

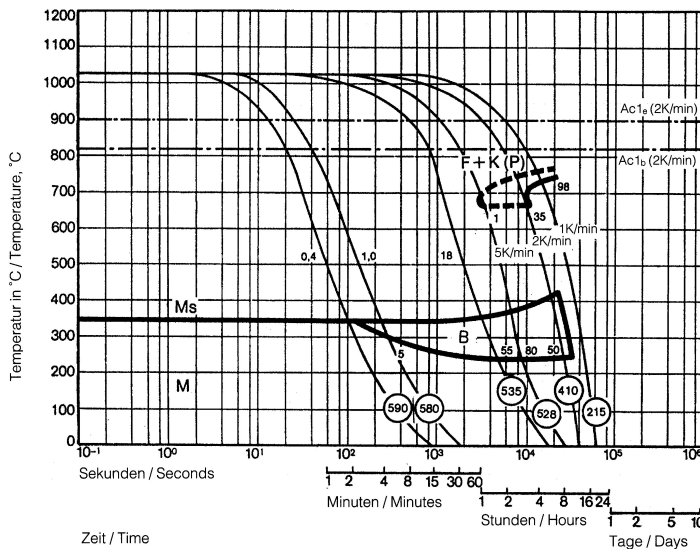
Heat treatment

| Annealing               |                   |                                                                                                                                                                                                                                                                             |
|-------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature             | 750 to 800 °C     | Holding time 6 to 8 hours. Slow, controlled furnace cooling at 10 to 20°C/h (50 to 68 °F/hr) to approx. 600°C (1112°F), further cooling in air.                                                                                                                             |
| Stress relieving        |                   |                                                                                                                                                                                                                                                                             |
| Temperature             | 600 to 670 °C     | For stress relief after extensive machining or for complicated tools. Holding time depending on tool size after complete heating 2 - 6 hours in neutral atmosphere. Slow furnace cooling.                                                                                   |
| Hardening and Tempering |                   |                                                                                                                                                                                                                                                                             |
| Temperature             | 1,020 to 1,080 °C | (Die casting equipment: 1020 - 1030 °C [1868 - 1886°F]) Holding time after temperature equalization: 15 to 30 minutes; Quenching: Oil, salt bath (500 - 550°C [932-1022°F]), air, vacuum; After hardening, tempering to the desired working hardness (see tempering chart). |

Heat treatment sequence



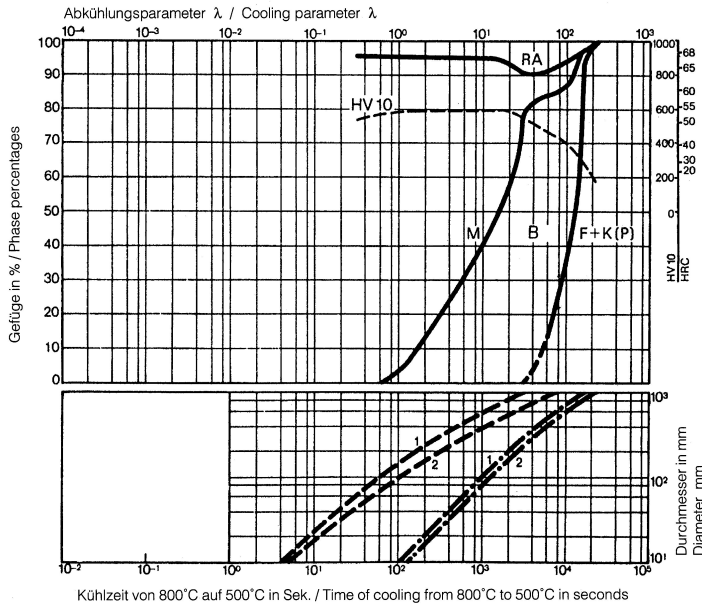
Continuous cooling CCT curves



Austenitising temperature: 1020°C (1868°F)  
Holding time: 15 minutes

- Vickers hardness
- 1...35 phase percentages
- 0.4...18 cooling parameter, i.e. duration of cooling from 800 - 500°C (1472-932°F) in  $s \times 10^{-2}$
- 5...1 K/min cooling rate in K/min in the 800 - 500°C (1472-932°F) range

Quantitative phase diagram

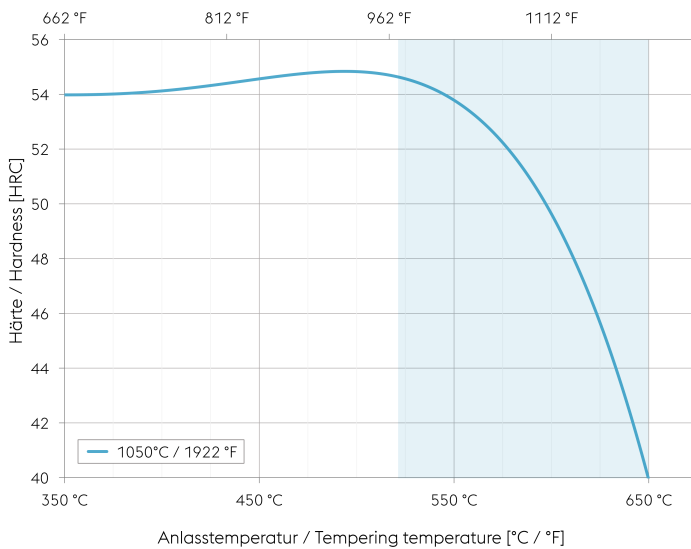


B... Bainite  
 F... Ferrite  
 K... Carbide  
 M... Martensite  
 P... Pearlite  
 RA... Retained austenite

----- Oil cooling  
 - · - Air cooling

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

Tempering chart



Tempering:

Slow heating to tempering temperature immediately after hardening / time in furnace 1 hour for each 0,787 inch (20 mm) of workpiece thickness but at least 2 hours / cooling in air. It is recommended to temper at least twice.

A third tempering cycle for the purpose of stress relieving may be advantageous.

1st tempering approx. 86°F (30°C) above maximum secondary hardness.

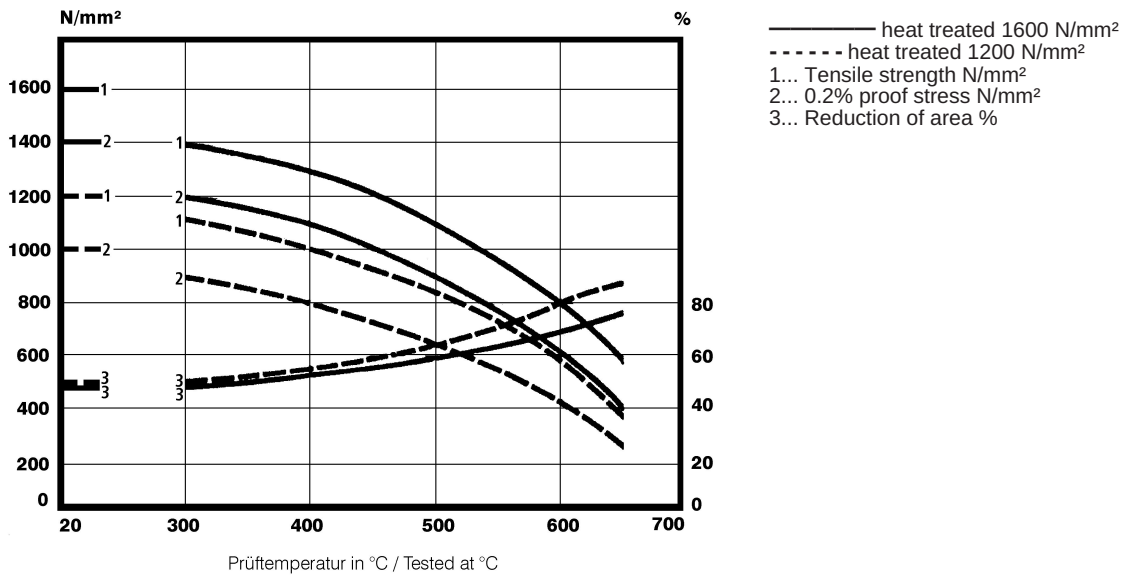
2nd tempering to desired working hardness. The tempering chart shows average tempered hardness values.

3rd for stress relieving at a temperature 86 to 122 °F (30 to 50°C) below highest tempering temperature.

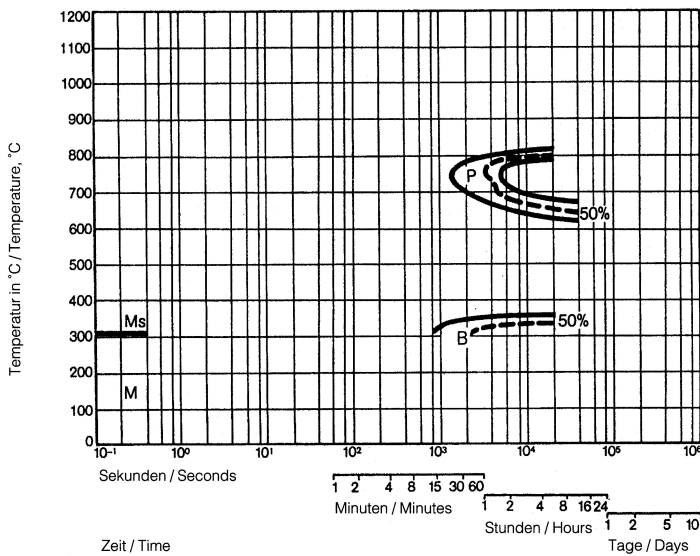
Recommended tempering temperature range is indicated by the blue area in the chart.

Hardening temperature: 1050°C (1922°F)  
 Specimen size: square 50 mm

Hot strength chart



Isothermal TTT curves



Austenitising temperature: 1020 °C (1868 °F)  
 Holding time: 15 minutes

## Physical Properties

| Temperature (°C)                                           | 20   |
|------------------------------------------------------------|------|
| Density (kg/dm <sup>3</sup> )                              | 7.8  |
| Thermal conductivity (W/(m.K))                             | 22.8 |
| Specific heat (kJ/kg K)                                    | 0.47 |
| Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)       | 0.52 |
| Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> ) | 213  |

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

| Temperature (°C)                             | 100  | 200 | 300  | 400  | 500  | 600  |
|----------------------------------------------|------|-----|------|------|------|------|
| Thermal expansion (10 <sup>-6</sup> m/(m.K)) | 10.8 | 11  | 12.1 | 12.7 | 14.2 | 14.3 |

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.