

# HOT WORK TOOL STEELS

## Application Segments

Hot Work

## Available Product Variants

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

BÖHLER W360 ISOBLOC is a material produced by the electroslag remelting process (ESR), which has been specially adapted for use at high tool hardnesses in the range of 51-57 HRC. Although the steel can be classified as a 5% chromium steel, the increased carbon and molybdenum content coupled with state-of-the-art manufacturing technology ensures that BÖHLER W360 ISOBLOC still shows a very good toughness and an exceptionally good thermal resistance, even at high hardness levels. These properties make the steel the perfect choice for smaller components in the die casting sector (e.g., mold inserts, cores, core pins, ejector pins, etc.). The material also is frequently the preferred choice for closed-die and open-die forging tools due to its high wear resistance. Because of this excellent wear resistance and the high toughness, BÖHLER W360 ISOBLOC is also frequently used for cold work applications and as a molding material for plastic injection molds. The Steel also is available as powder material for metal-3D-printing under the brand name BÖHLER W360 AMPO.

## Process Melting

Airmelted + Remelted

## Properties

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

## Applications

- |   |                                      |                                 |
|---|--------------------------------------|---------------------------------|
| > High Pressure Die-Casting                     | > Forging (Hot / Semi-hot)           | > Progressive Forging (Hatebur) |
| > Extrusion                                     | > Fine Blanking, Stamping, Blanking  | > Coining                       |
| > General Components for Mechanical Engineering | > Gravity / Low Pressure Die-Casting | > Injection Molding             |
| > Press Hardening / Hot Stamping                | > Rolling                            | > Industrial Knives             |
| > Mechanical Engineering                        | > Motorsport industry                | > Cold Forming                  |
| > Fasteners, Bolts, Nuts                        | > Forging Applications               | > Machine knife (for producers) |
| > Powder Pressing                               | > Rolls                              | > Screws and Barrels            |
| > Standard Parts (Molds, Plates, Pins, Punches) | > Pill punching dies                 | > Glasfibre reinforced plastics |

## Technical data

Material designation	
BÖHLER patent	Market grade

## Chemical composition (wt. %)

C	Si	Mn	Cr	Mo	V
0.50	0.20	0.25	4.50	3.00	0.60

## Material characteristics

	High temperature strength	High temperature toughness	High temperature wear resistance	Machinability in as supplied condition	Polishability
<b>BÖHLER W360</b> ISOBLOC	★★★★★	★★★★★	★★★★★	★★★	★★★
<b>BÖHLER W300</b> ISOBLOC	★★	★★★★★	★★	★★★	★★★
<b>BÖHLER W300</b> ISODISC	★★	★★★★	★★	★★★	★★★
<b>BÖHLER W302</b> ISOBLOC	★★★	★★★★★	★★★	★★★	★★★
<b>BÖHLER W302</b> ISODISC	★★★	★★★★	★★★	★★★	★★★
<b>BÖHLER W303</b> ISODISC	★★★★★	★★★★	★★★★★	★★★	★★★
<b>BÖHLER W320</b> ISODISC	★★★	★★	★★★	★★★	★★★
<b>BÖHLER W350</b> ISOBLOC	★★★	★★★★★	★★★	★★★	★★★
<b>BÖHLER W400</b> VMR	★★	★★★★★	★★	★★★	★★★
<b>BÖHLER W403</b> VMR	★★★★★	★★★★★	★★★★★	★★★	★★★

## Delivery condition

Annealed	
Hardness (HB)	max. 205

## Heat treatment

### Annealing

Temperature	750 to 800 °C   1,382 to 1,472 °F	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.
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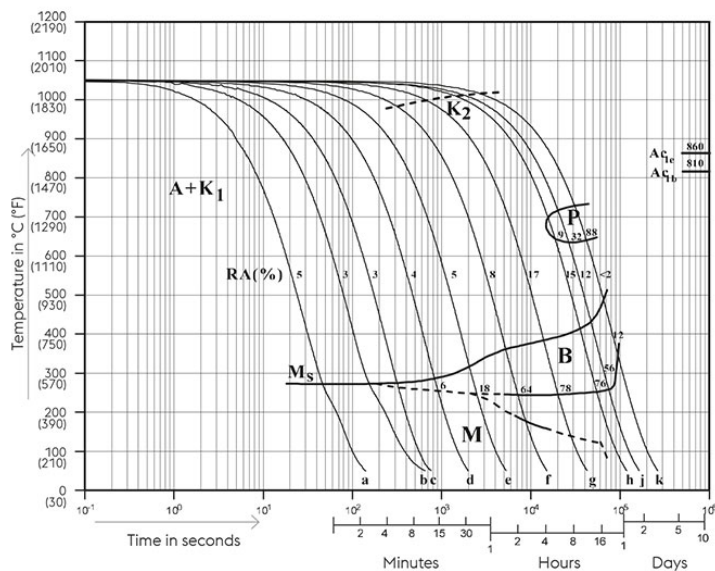
### Stress relieving

Temperature	650 to 700 °C   1,202 to 1,292 °F	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.
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### Hardening and Tempering

Temperature	1,050 °C   1,922 °F	Holding time after temperature equalization: 15 to 30 minutes; In order to prevent coarsening of the grain, hardening must be carried out at the recommended temperature; Quenching: oil, salt bath (500 - 550°C [930 to 1020 °F]), air, inert gas in vacuum; After hardening, required tempering treatment to achieve desired working hardness (see tempering chart).
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## Continuous cooling CCT curves

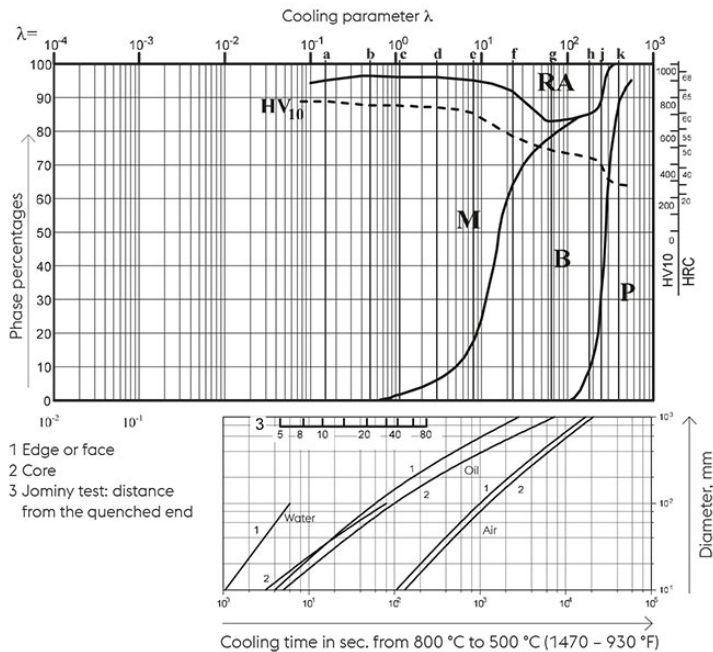


Austenitising temperature: 1050°C (1922°F)  
Holding time: 30 minutes  
5...100 phase percentages  
0.5...400 cooling parameter, i.e. duration of cooling from 800 - 500°C (1472-932°F) in s x 10<sup>-2</sup>

Table:

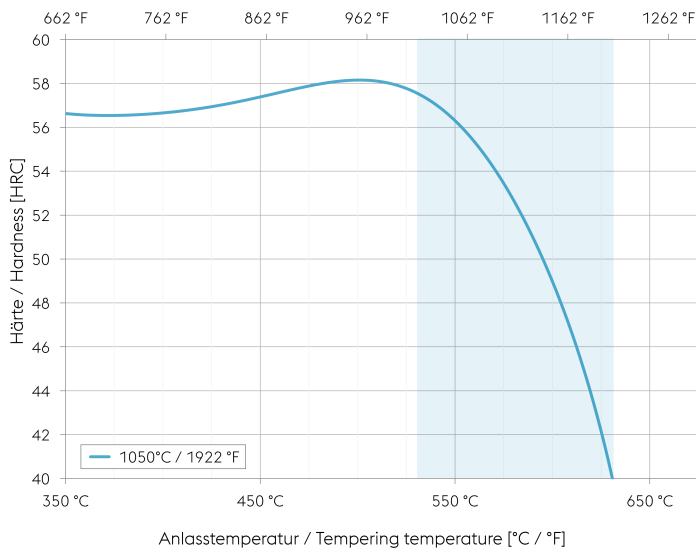
Sample	λ	HV10	Sample	λ	HV10
a	0,15	785	f	23	582
b	0,50	760	g	65	498
c	1,10	762	h	180	453
d	3	754	j	250	415
e	8	724	k	400	294

## Quantitative phase diagram



A... Austenite  
B... Bainite  
K... Carbide  
M... Martensite  
P... Pearlite  
RA... Retained austenite

## 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

## Physical Properties

Temperature (°C   °F)	20   68
Density (kg/dm³   lb/in³)	7.8   0.28
Thermal conductivity (W/(m.K)   BTU/ft h °F)	30.8   17.8
Specific heat (kJ/kg K   BTU/lb °F)	0.43   0.1027
Spec. electrical resistance (Ohm.mm²/m   10⁻⁴ Ohm.inch²/ft)	-
Modulus of elasticity (10³N/mm²   10³ksi)	212   30.8

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

Temperature (°C   °F)	100   212	200   392	300   572	400   752	500   932	600   1,112
Thermal expansion (10⁻⁶ m/(m.K)   10⁻⁶ inch/inch.°F)	10.8   6	11.6   6.4	12.1   6.7	12.5   6.9	12.8   7.1	13.3   7.4

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.