

# ČELICI ZA HLADNI RAD

## Dostupne varijante proizvoda

 Šipkasti proizvodi\*

 Ploče

\* ) Presented data refer exclusively to long products. Please observe the detailed explanations at the end of the data sheet (pdf).

## Opis proizvoda

Rezni alati (matrice i probojci) za intenzivnu uporabu, alati za probijanje i prosijecanje, alati za obradu drveta, oštrice za odsijecanje materijala manje debljine, alati za valjanje navoja, alati za izvlačenje, duboko izvlačenje i hladno istiskivanje, alati za prešanje u industriji keramike i farmaceutskoj industriji, valjci za hladno valjanje (radni valjci) za valjačke stanove, mjerni instrumenti i uređaji, te kalupi manjih dimenzija u industriji plastike kad se zahtijeva izvrsna otpornost na trošenje.

## Put taljenja

 Airmelted

## Karakteristike

- > Otpornost na habanje : dobar
- > Dimenzionalna stabilnost : dobar
- > Kaljivi čelik s dobrom dimenzionalnom stabilnošću : dobar

## Korištenje

- > Strojni mjerni noževi (za proizvodnju)
- > Coining
- > Standardni dijelovi (kalupi, ploče, klinovi, probijači)
- > Sklopovi za opremu Podzemna oprema (bušenje, vratila itd.)
- > Opći sklopovi za strojarstvo
- > Valjanje
- > Precizno štancanje / štancanje / pečačenje
- > Vijci i cijevi
- > Valjci
- > Thread rolling (HR)
- > Cold Forming
- > Oblikovanje utiskivanjem praškastih materijala
- > Sklopovi za reciklažnu djelatnost
- > Potrošni dijelovi

## Tehnički podaci

Oznaka materijala		Standardi	
1.2379	SEL	4957	EN ISO
~T30402	UNS		
X153CrMoV12	EN		
D2	AISI		

**Kemijski sastav**

C	Si	Mn	Cr	Mo	V
1,55	0,30	0,30	11,30	0,75	0,75

**Materijal**

	Kapacitet tlaka	Dimenzionalna stabilnost u toplinskoj obradi	Žilavost	Abraziv otpora na habanje	Ljepilo za otpornost na habanje
<b>BÖHLER K110</b>	★★	★★★	★	★★★	★★
<b>BÖHLER K100</b>	★★	★★	★	★★★	★★
<b>BÖHLER K105</b>	★★	★★	★	★★	★★
<b>BÖHLER K107</b>	★★	★★	★	★★★	★★
<b>BÖHLER K190</b> <b>MICROCLEAN®</b>	★★★★	★★★★★	★★★★	★★★★	★★★★
<b>BÖHLER K294</b> <b>MICROCLEAN®</b>	★★★★★	★★★★★	★★★	★★★★★	★★★★★
<b>BÖHLER K340</b> <b>ECOSTAR®</b>	★★★	★★★	★★	★★	★★
<b>BÖHLER K340</b> <b>ISODUR®</b>	★★★	★★★★	★★★	★★★	★★★★
<b>BÖHLER K346</b>	★★★	★★★	★★★	★★★★	★★
<b>BÖHLER K353</b>	★★	★★★	★★	★★	★★
<b>BÖHLER K360</b> <b>ISODUR®</b>	★★★	★★★★	★★★	★★★★	★★★★
<b>BÖHLER K390</b> <b>MICROCLEAN®</b>	★★★★★	★★★★★	★★★★	★★★★★	★★★★★
<b>BÖHLER K490</b> <b>MICROCLEAN®</b>	★★★★	★★★★★	★★★★	★★★★	★★★★
<b>BÖHLER K497</b> <b>MICROCLEAN®</b>	★★★★★	★★★★★	★★★	★★★★★	★★★★★
<b>BÖHLER K888</b> <b>MATRIX</b>	★★★★	★★★★★	★★★★★	★★	★★
<b>BÖHLER K890</b> <b>MICROCLEAN®</b>	★★★★	★★★★★	★★★★★	★★★	★★★

**Isporuca**
**Annealed**

Tvrdoća (HB)	max. 250
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## Toplinska obrada

### Annealing

Temperatura	800 do 850 °C	Slow controlled cooling in furnace at a rate of 10 to 20°C/hr down to approx. 600°C, further cooling in air.
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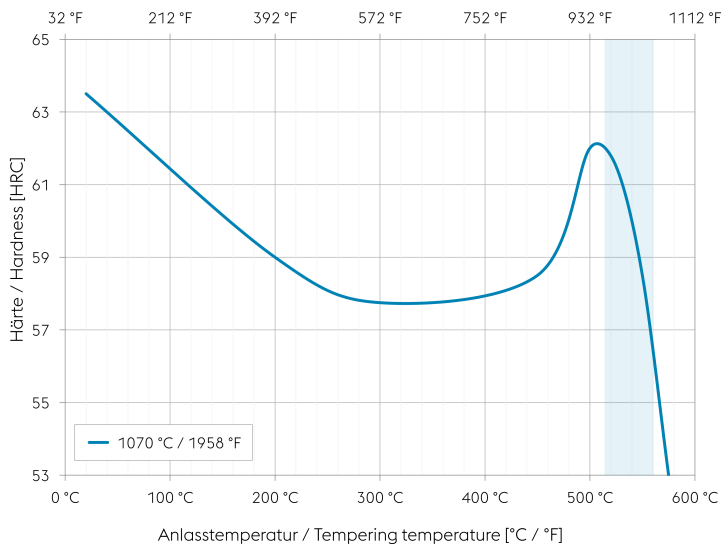
### Stress relieving

Temperatura	650 do 700 °C	Slow cooling in furnace. Intended to relieve stresses set up by extensive machining, or in complex shapes. After through heating, hold in neutral atmosphere for 1 to 2 hours.
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### Hardening and Tempering

Temperatura	1.030 do 1.070 °C	Complex shapes / air, simple shapes / air blast, oil, salt bath from (220 to 250°C or 500 to 550°C) or gas. Holding time after temperature equalization: 15 to 30 minutes. After hardening, tempering to the desired working hardness, see tempering chart.
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## Tempering chart



### Tempering:

Specimen size: square 0,787 inch (20 mm)

Slow heating to tempering temperature immediately after hardening. Recommended tempering temperature is indicated by the blue area in the chart.

Time in furnace 1 hour for each 0,787 inch (20 mm) of workpiece thickness but at least 2 hours/cooling in air.

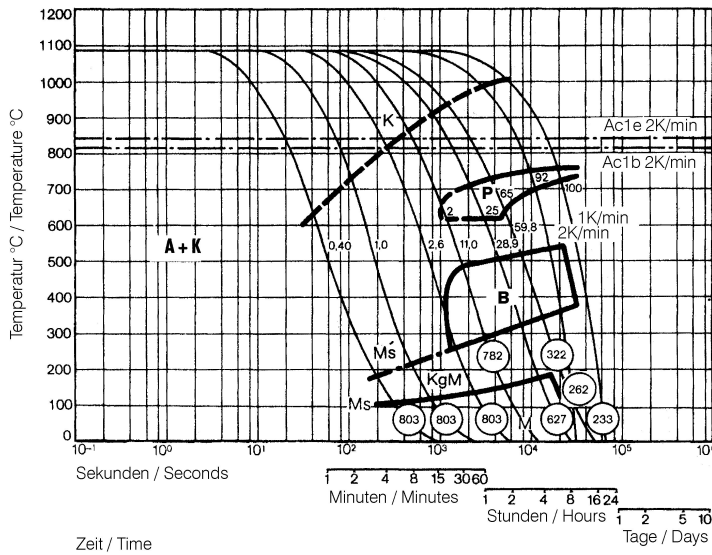
Slow cooling to room temperature after each tempering step is recommended.

Please refer to the tempering chart for guide values for the hardness achievable after tempering.

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

Tempering for stress relieving 86 to 122 °F (30 to 50 °C) below the highest tempering temperature.

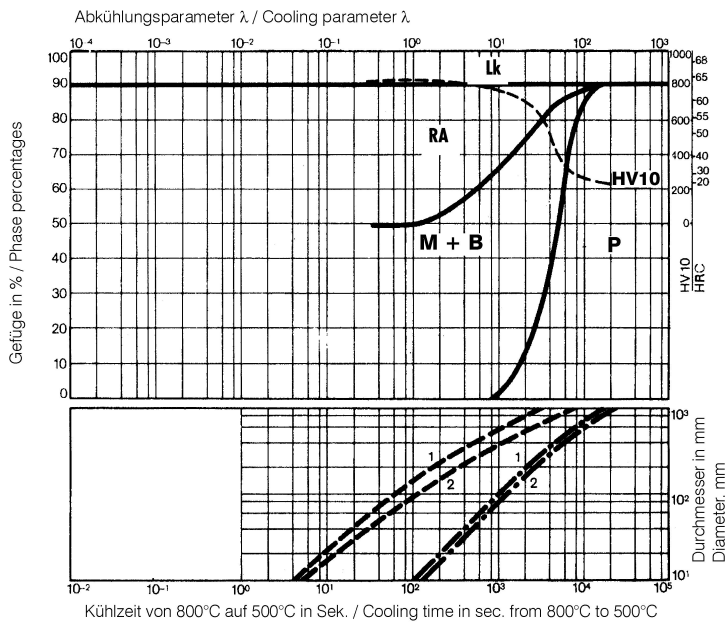
Continuous cooling CCT curves



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

O Hardness in HV  
2...100 phase percentages  
0,40...59,8 cooling parameters, i. e. Cooling from 800 - 500°C (1472 - 932°F) in  $s \times 10^{-2}$   
2...1 K/min cooling rate in K/min in the 800 - 500°C (1472 - 932°F) range  
Range of grain boundary martensite formation  
KgM... Grain boundary martensite

Quantitative phase diagram

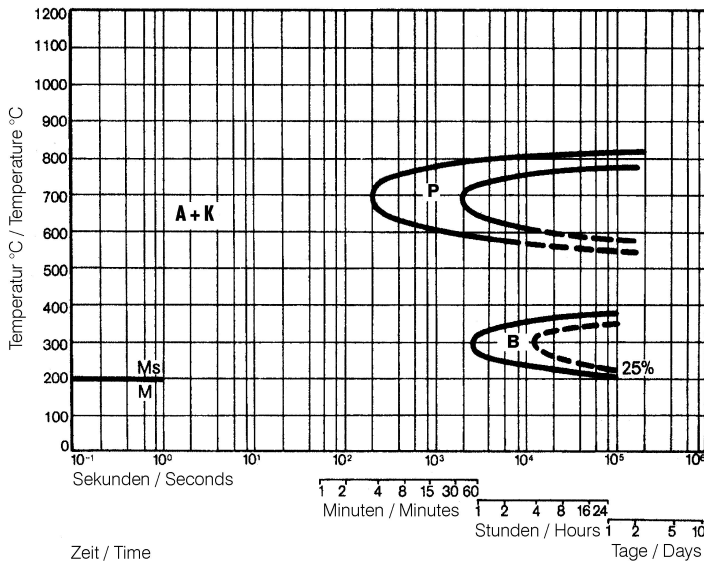


Lk... Ledeburite carbide  
RA... Residual austenite  
A... Austenite  
B... Bainite  
P... Pearlite  
K... Carbide  
M... Martensite

----- Oil cooling  
- · - Air cooling

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

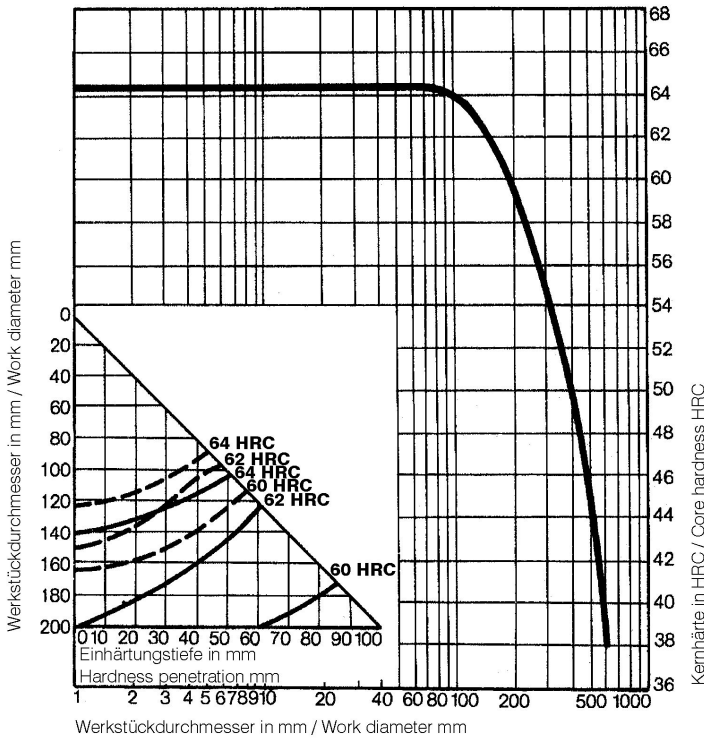
**Isothermal TTT curves**



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

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

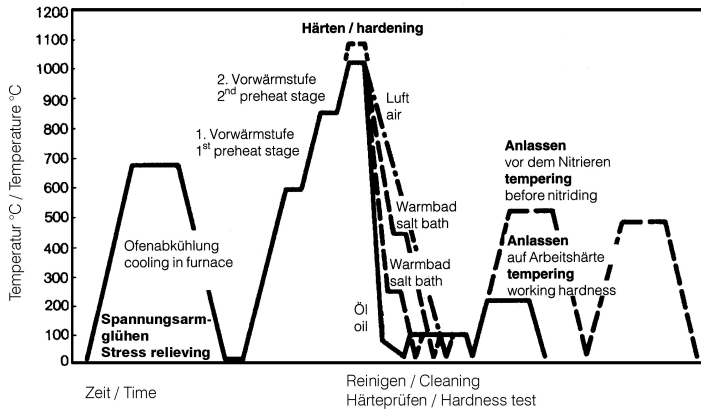
**Influence of work diameter on core hardness and hardness penetration**



Hardening temperature: 1030°C / 1886°F

- Quenchant:
- Oil
- - - Air

## Heat treatment sequence



## Fizička svojstva

Temperatura (°C)	20
Gustoća (kg/dm <sup>3</sup> )	7,67
Toplinska vodljivost (W/(m.K))	23,9
Specifični toplinski kapacitet (kJ/kg K)	0,47
Spec. Otpornik (Ohm.mm <sup>2</sup> /m)	0,65
Modul elastičnosti (10 <sup>3</sup> N/mm <sup>2</sup> )	200

## Toplinska ekspanzija

Temperatura (°C)	100	200	300	400	500	600	700
Toplinska ekspanzija (10 <sup>-6</sup> m/(m.K))	11	11,4	11,9	12,2	12,7	12,8	12,1

**Long Products:** For additional specifications and technical requirements, please contact our regional voestalpine BÖHLER sales companies.

**Sheet & Plates:** Product Variant may differ in terms of melting process, technical data, delivery, and surface condition as well as available product dimensions. Please contact voestalpine BÖHLER Bleche GmbH & Co KG.

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