

# ČELICI ZA TOPLI RAD

## Dostupne varijante proizvoda

Šipkasti proizvodi

## Opis proizvoda

Alatni čelik za obradu u toplom stanju, proizveden postupkom pretalijivanja u vakuumu, s dobrom otpornošću na temperiranje, ali s višom žilavošću od čelika W403.

## Put taljenja

Airmelted + VAR

## Karakteristike

- > Žilavost i duktilnost : vrlo visoka
- > Otpornost na habanje : dobar
- > Obradivost : dobar
- > Tvrdća pri visokim temperaturama : dobar
- > Mogućnost poliranja : vrlo visoka
- > Toplinska vodljivost : vrlo visoka
- > Mikro čistoća : vrlo visoka

## Korištenje

- > Visokotlačno lijevanje
- > Opći sklopovi za strojarstvo
- > Progresivno kovanje (Hatebur)
- > Tlačno otvrdnjavanje / vruće oblikovanje
- > Istiskivanje
- > Gravitacijsko / niskotlačno lijevanje
- > Mehanička Inženjerstvo / izrada strojeva Općenito
- > Kovanje (vruće / poluvruće)
- > Lijevanje ubrizgavanjem
- > Glasfibre reinforced plastics

## Tehnički podaci

Oznaka materijala	Standardi
1.2340 SEL	#207 NADCA
~T20811 UNS	
~X37CrMoV5-1 EN	
~H11 AISI	
E1810 NADCA	

## Kemijski sastav

C	Si	Mn	Cr	Mo	V
0,37	0,20	0,30	5,00	1,30	0,50

## Materijal

	Otpornost na toplinu	Vruća žilavost	Otpornost na vruće trošenje
<b>BÖHLER W400</b> <b>VMR®</b>	★★	★★★★★	★★
<b>BÖHLER W300</b> <b>ISOBLOC®</b>	★★	★★★★	★★
<b>BÖHLER W300</b> <b>ISODISC®</b>	★★	★★★	★★
<b>BÖHLER W302</b> <b>ISOBLOC®</b>	★★★	★★★★	★★★
<b>BÖHLER W302</b> <b>ISODISC®</b>	★★★	★★★	★★★
<b>BÖHLER W303</b> <b>ISODISC®</b>	★★★★	★★★	★★★★
<b>BÖHLER W350</b> <b>ISOBLOC®</b>	★★★	★★★★★	★★★
<b>BÖHLER W360</b> <b>ISOBLOC®</b>	★★★★★	★★★★	★★★★★
<b>BÖHLER W403</b> <b>VMR®</b>	★★★★	★★★★	★★★★

## Isporka

### Annealed

Tvrdoća (HB)	max. 205
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## Toplinska obrada

### Annealing

Temperatura	750 do 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.
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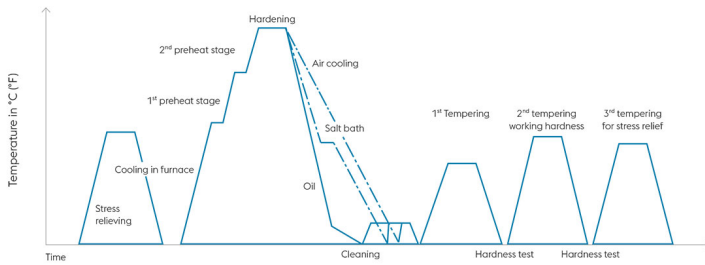
### Stress relieving

Temperatura	600 do 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.
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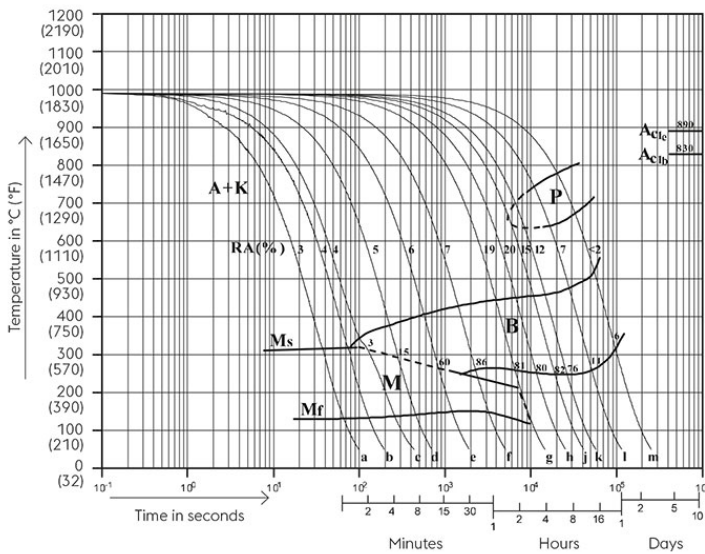
### Hardening and Tempering

Temperatura	980 do 990 °C	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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## Heat treatment sequence



## Continuous cooling CCT curves

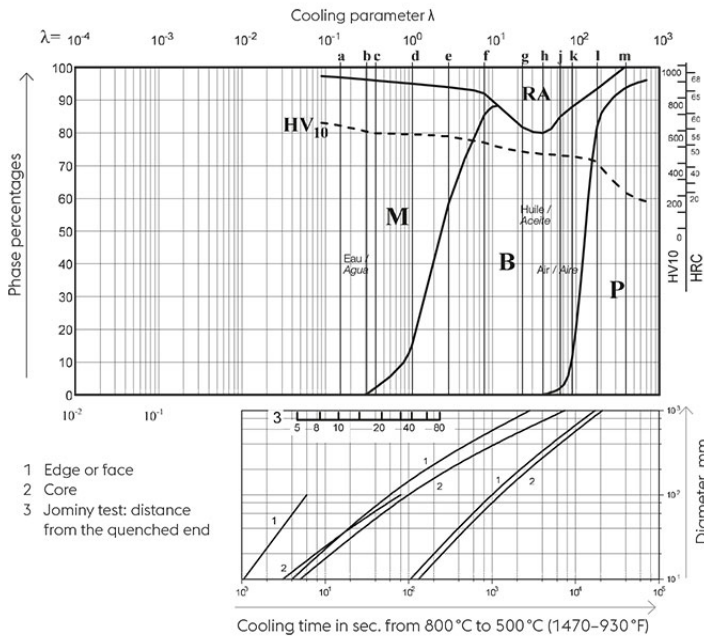


Austenitising temperature: 990°C (1814°F)  
 Holding time: 15 minutes  
 5...100 phase percentages  
 0.15...400 cooling parameter, i.e. duration of cooling from 800 - 500°C (1472-932°F) in  $s \times 10^{-2}$

Table:

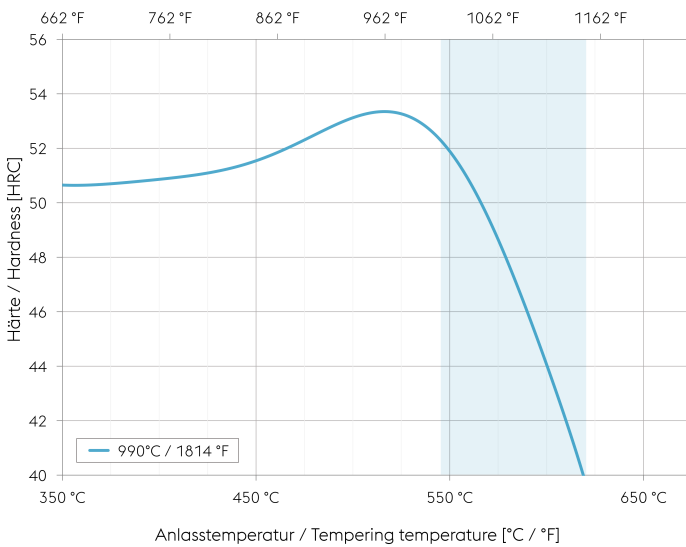
Sample	$\lambda$	HV10	Sample	$\lambda$	HV10
a	0,15	647	g	23	478
b	0,31	619	h	40	462
c	0,40	590	j	65	462
d	1,1	595	k	90	454
e	3	582	l	180	434
f	8	546	m	400	226

**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: 990°C (1814°F)  
Specimen size: square 20 mm

## Fizička svojstva

Temperatura (°C)	20
Gustoća (kg/dm <sup>3</sup> )	7,8
Toplinska vodljivost (W/(m.K))	31,5
Specifični toplinski kapacitet (kJ/kg K)	0,46
Spec. Otpornik (Ohm.mm <sup>2</sup> /m)	-
Modul elastičnosti (10 <sup>3</sup> N/mm <sup>2</sup> )	211

## Toplinska ekspanzija

Temperatura (°C)	100	200	300	400	500	600
Toplinska ekspanzija (10 <sup>-6</sup> m/(m.K))	11	11,2	11,9	12,7	14	14,3

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

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