

# ACEROS PARA HERRAMIENTAS DE TRABAJO EN CALIENTE

## Formatos disponibles

Productos largos\*

Forja de matriz abierta

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

## Descripción

Acero para herramientas de trabajo en caliente que requieran elevada resistencia, principalmente para el procesamiento de aleaciones no ferrosas livianas, como mandriles, troqueles y elemento y matrices de extrusión en caliente, matrices de forja de piezas huecas, bulones, tornillos, tuercas, remaches y pernos. Para moldes de fundición a presión, moldes de inyección, insertos de moldes, cuchillas de corte en caliente, moldes de plástico.

## Método de obtención

Convencional

## Propiedades

- > Dureza y Ductilidad : buena
- > Resistencia al desgaste : alto
- > Maquinabilidad : muy alta
- > Dureza en caliente (dureza roja) : alto
- > Pulibilidad : buena
- > Conductividad térmica : buena
- > Micro-limpieza : buena

## Aplicaciones

- > Extrusión
- > Fundición por gravedad / a baja presión
- > Forja progresiva (Hatebur)
- > Forja (caliente / semicaliente)
- > Fundición inyectada
- > Ingeniería mecánica / construcción de maquinaria en general
- > Componentes generales de ingeniería mecánica
- > Forja fría/ conformación en caliente

## Datos técnicos

Designación		Estándares	
1.2367	SEL	4957	EN ISO
X38CrMoV5-3	EN		

## Composición Química

C	Si	Mn	Cr	Mo	V
0,38	0,40	0,40	5,00	2,80	0,55

## Características

	Resistencia a altas temperaturas	Tenacidad a altas temperaturas	Resistencia al desgaste a altas temperaturas
	★★★★	★★★	★★★★
	★★	★★★	★★
	★★	★★★★	★★
	★★★	★★★	★★★
	★★★	★★★★	★★★
	★★★	★★	★★★
	★★★	★★★★★	★★★
	★★★★★	★★★★★	★★★★★
	★★	★★★★★	★★
	★★★★	★★★★	★★★★

## Estado de suministro

### recocido

Dureza (HB)	máx. 229
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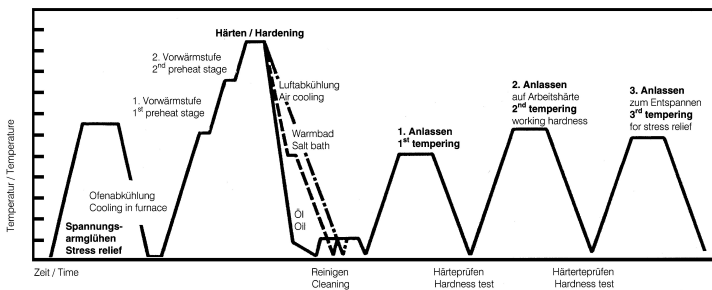
### Endurecido y templado

Dureza (HRC)	30 a 44
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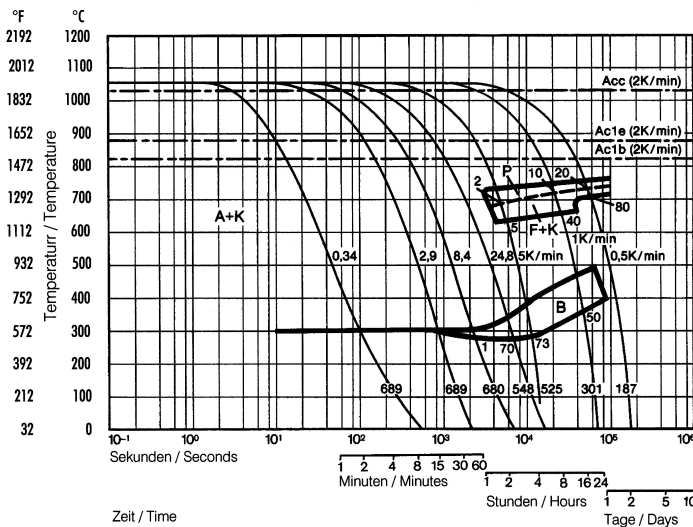
## Tratamiento térmico

Recocido		
Temperatura	750 a 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.
Alivio de tensiones		
Temperatura	600 a 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.
Temple y revenido		
Temperatura	1.030 a 1.080 °C	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



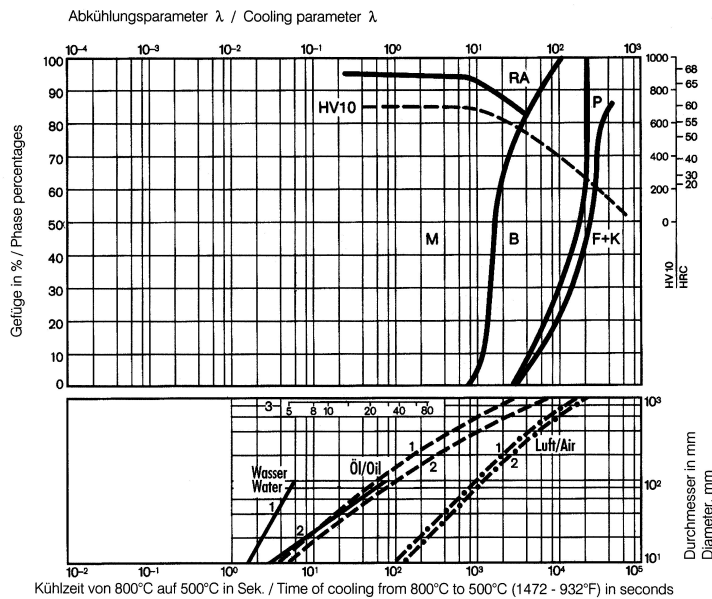
## Continuous cooling CCT curves



Austenitising temperature: 1922°F (1050°C)  
Holding time: 15 minutes

689 - 187 Vickers hardness  
1...80 phase percentages  
0.34...24.8 cooling parameter, i.e. duration of cooling from 1472 - 932°F (800-500°C) in  $s \times 10^{-2}$   
41...32,9°F/min (5...0.5 K/min) cooling rate in °F/min (K/min) in the 1472 - 932°F (800-500°C) range

## Quantitative phase diagram

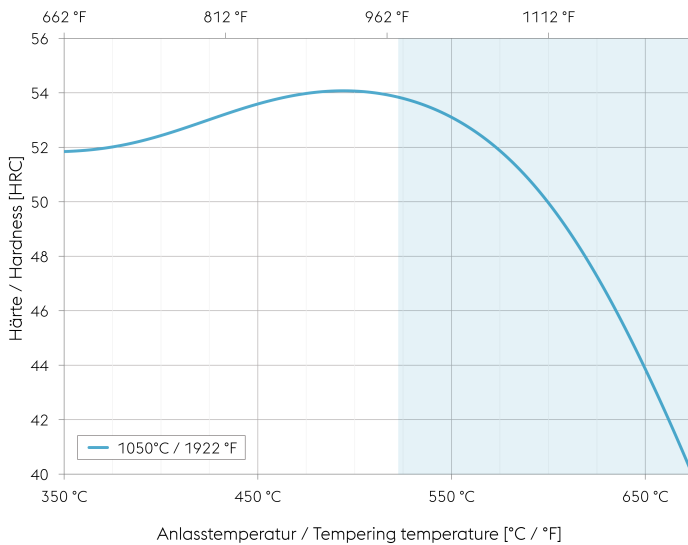


A... Austenite  
B... Bainite  
F... Ferrite  
K... Carbide  
M... Martensite  
P... Perlite  
RA... Retained austenite

----- Oil cooling  
- · - Air cooling

1... Edge or face  
2... Core  
3... Jominy test: distance from end

## Tempering chart



### Tempering:

Slow heating to tempering temperature immediately after hardening / time in furnace 1 hour for each 0,787 inch (20 mm) of work piece 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. 30°C (86°F) above maximum secondary hardness.

2nd tempering to desired working hardness.

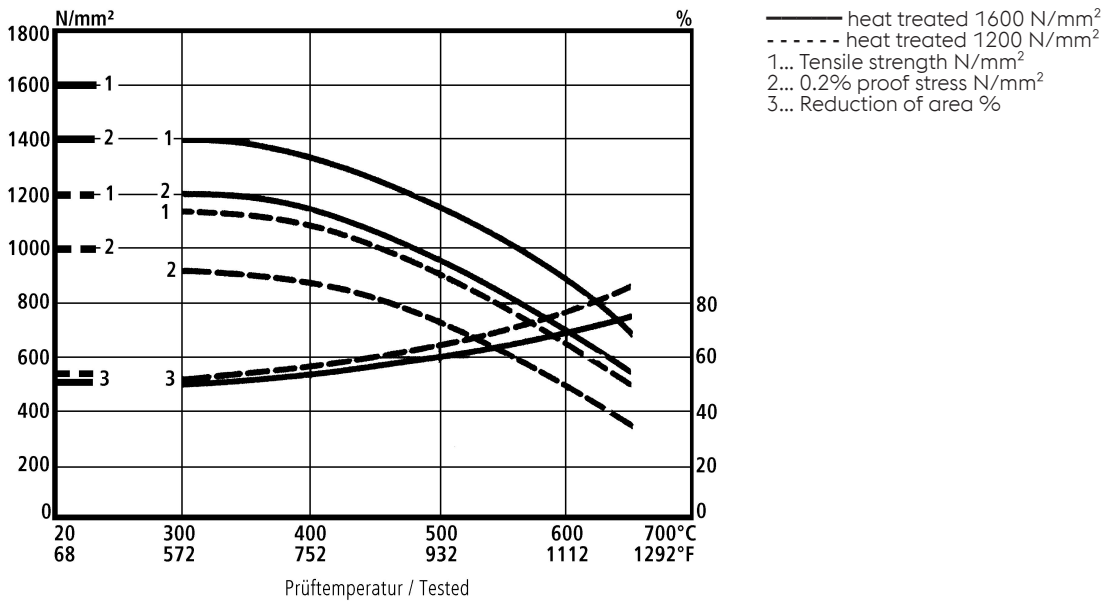
The tempering chart shows average tempered hardness values.

3rd for stress relieving at a temperature 86 to 122°F (30 - 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



## Propiedades físicas

Temperatura (°C)	20
Densidad (kg/dm <sup>3</sup> )	7,9
Conductividad térmica (W/(m.K))	-
Calor específico (kJ/kg K)	0,46
Resistencia eléctrica específica (Ohm.mm <sup>2</sup> /m)	0,5
Módulo de elasticidad (10 <sup>3</sup> N/mm <sup>2</sup> )	215

## Expansión térmica

Temperatura (°C)	100	200	300	400	500	600	700
Expansión térmica (10 <sup>-6</sup> m/(m.K))	11,5	12	12,2	12,5	12,9	13	13,2

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

**Open Die Forgings:** Product Variant may differ in terms of melting process, technical data, delivery, and surface condition as well as available product dimensions. Please contact the business unit Open Die Forgings of voestalpine BÖHLER Edelstahl GmbH & Co KG.

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ONE STEP AHEAD.