

# ACEROS PARA HERRAMIENTAS DE TRABAJO EN CALIENTE

## Formatos disponibles

Productos largos\*

Chapas

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 de gran resistencia. Principalmente para el procesamiento de aleaciones de metales ligeros, como mandriles, troqueles y recipientes para tubos de metal y extrusión, herramientas de extrusión en caliente, herramientas para fabricación de cuerpos huecos, herramientas para producción de tornillos, tuercas, remaches y pernos.

Para herramientas para fundición a presión, moldes de inyección, insertos a presión, cuchillas de corte en caliente, moldes de plástico.

## Método de obtención

Airmelted + Remelted

## Propiedades

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

## Aplicaciones

- |  |  |   |
|--|--|---|
| > Fundición inyectada                          | > Extrusión  | > Forja (caliente / semicaliente)                             |
| > Elementos de sujeción, tornillos y tuercas   | > Fundición por gravedad / a baja presión                      | > Moldeo por soplado  |
| > Componentes generales de ingeniería mecánica | > Moldeo por inyección   | > Cuchillas de máquinas (fabricantes)                         |
| > Forja fría/ conformación en caliente         | > Forja progresiva (Hatebur)                                   | > Laminación  |
| > Cizallas / Cuchillas                         | > Portaherramientas (fresado, taladrado, torneado y mandriles) | > Ingeniería mecánica / construcción de maquinaria en general |
| > Glasfibre reinforced plastics                |  |   |

## Datos técnicos

Designación		Estándares	
1.2344	SEL	4957	EN ISO
T20813	UNS	G4404	JIS
X40CrMoV5-1	EN	#207	NADCA
H13	AISI		
SKD61	JIS		
B1885	NADCA		

## Composición Química

C	Si	Mn	Cr	Mo	V
0,39	0,90	0,40	5,20	1,40	0,95

## 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)	40 a 55   bars hardened and tempered (BHT)
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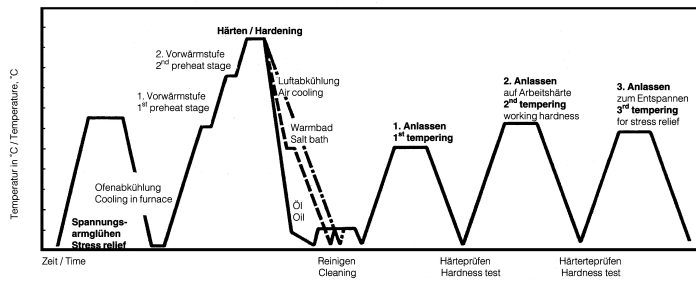
### Endurecido y templado

Dureza (HRC)	30 a 44
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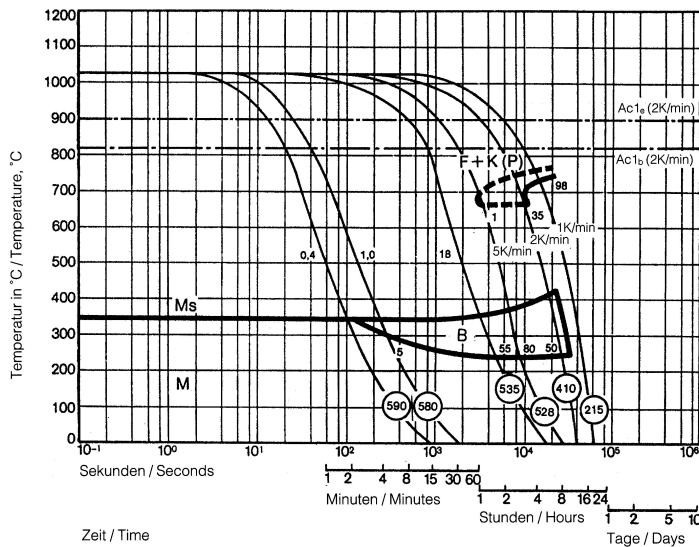
## Tratamiento térmico

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	1.020 a 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



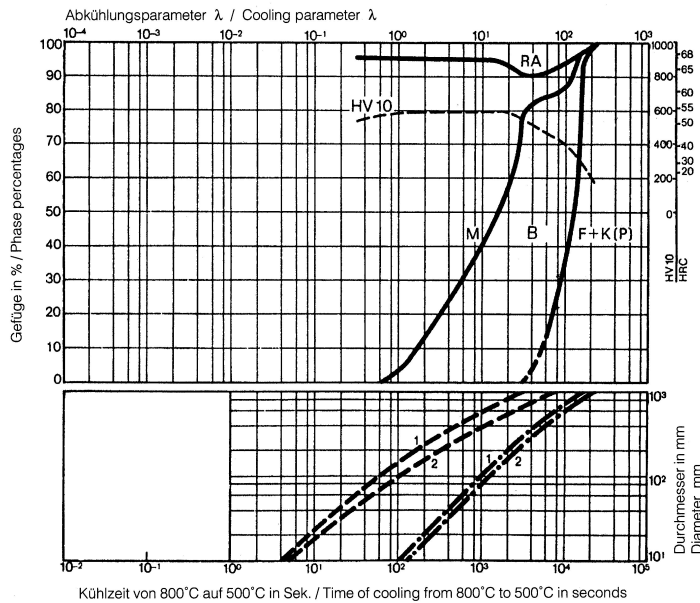
## Continuous cooling CCT curves



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

O 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

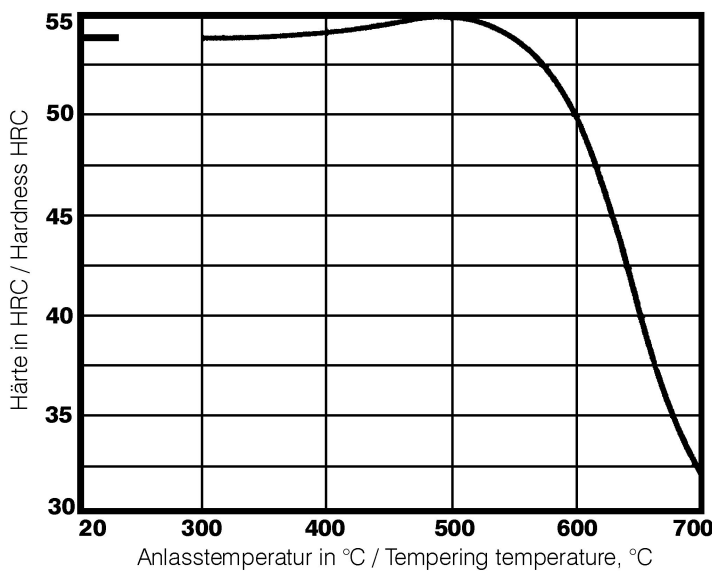


B... Bainite  
F... Ferrite  
K... Carbide  
M... Martensite  
P... Perlite  
RA... Retained austenite

----- 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.

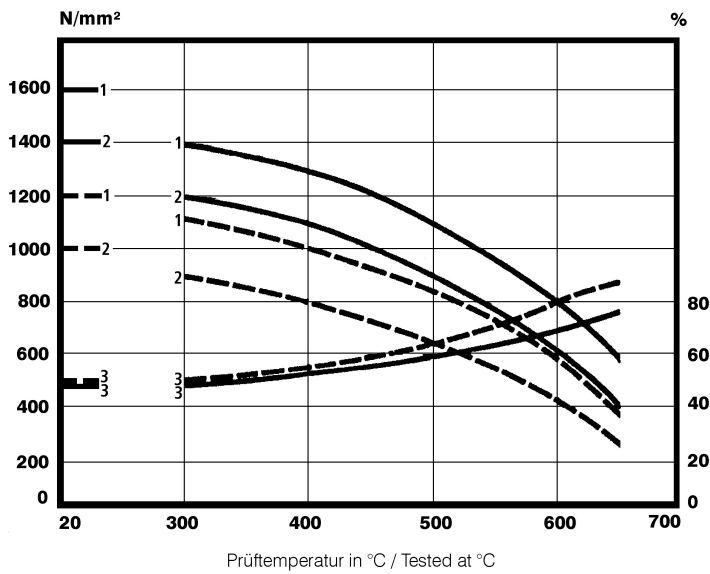
1st tempering approx. 86°F (30°C) above maximum secondary hardness.

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.

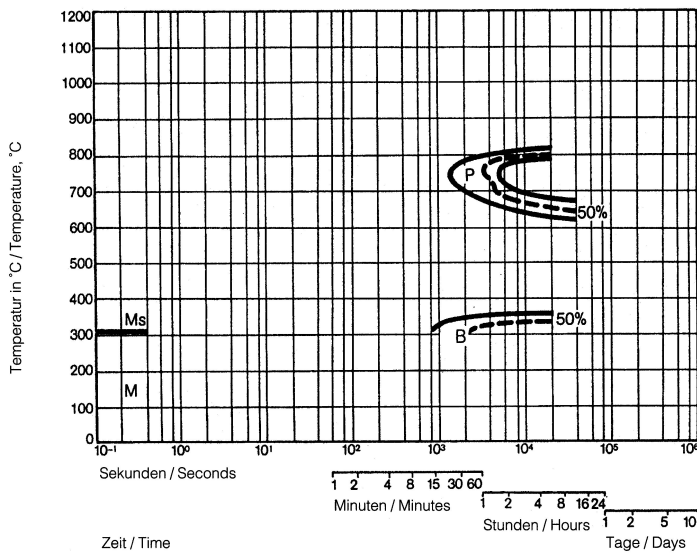
Hardening temperature: 1050°C (1922°F)  
Specimen size: square 50 mm

### Hot strength chart



— heat treated 1600 N/mm<sup>2</sup>  
 - - - - - heat treated 1200 N/mm<sup>2</sup>  
 1... Tensile strength N/mm<sup>2</sup>  
 2... 0.2% proof stress N/mm<sup>2</sup>  
 3... Reduction of area %

### Isothermal TTT curves



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

## Propiedades físicas

Temperatura (°C)	20
Densidad (kg/dm <sup>3</sup> )	7,8
Conductividad térmica (W/(m.K))	22,8
Calor específico (kJ/kg K)	0,47
Resistencia eléctrica específica (Ohm.mm <sup>2</sup> /m)	0,52
Módulo de elasticidad (10 <sup>3</sup> N/mm <sup>2</sup> )	213

## Expansión térmica

Temperatura (°C)	100	200	300	400	500	600
Expansión térmica (10 <sup>-6</sup> m/(m.K))	10,75	11	12,11	12,68	14,17	14,34

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