

# HIGH SPEED STEELS

## Application Segments

Cutting Tools

## Available Product Variants

Long Products

## Product Description

### BÖHLER S404 – "The discounter"

This very economical class is primarily used for spiral drill bits and has a nearly unbeatable ratio of price to performance.

## Process Melting

Airmelted

## Properties

- > Toughness & Ductility : high
- > Wear Resistance : good
- > Compressive strength : good
- > Edge Stability : good
- > Grindability : high
- > Hot Hardness (red hardness) : good

## Applications

- > Twist Drills and Taps

## Technical data

Material designation		Standards	
1.3326	SEL	4957	EN ISO
HS1-4-2	EN	A600	ASTM
M52	AISI		

## Chemical composition (wt. %)

C	Si	Mn	Cr	Mo	V	W
0.89	0.3	0.3	3.8	4.3	1.8	1

## Material characteristics

	Compressive strength	Grindability	Red hardness	Toughness	Wear resistance	Edge Stability
BÖHLER S404	★★	★★★	★★	★★★	★★	★★
BÖHLER S200	★★★	★★	★★★	★★	★★★	★★
BÖHLER S401	★★	★★★	★★	★★★	★★	★★★
BÖHLER S405	★★★	★★★	★★	★★★	★★	★★
BÖHLER S430	★★	★★★	★★	★★★	★★	★★
BÖHLER S500	★★★★	★★★	★★★★	★★	★★★	★★★
BÖHLER S600	★★★	★★★	★★★	★★	★★	★★★
BÖHLER S607	★★★	★★★	★★★	★★	★★★	★★★
BÖHLER S630	★★★	★★★	★★★	★★	★★	★★★
BÖHLER S705	★★★	★★★	★★★★	★★	★★	★★★★
BÖHLER S730	★★★	★★★	★★★★	★★	★★	★★★★

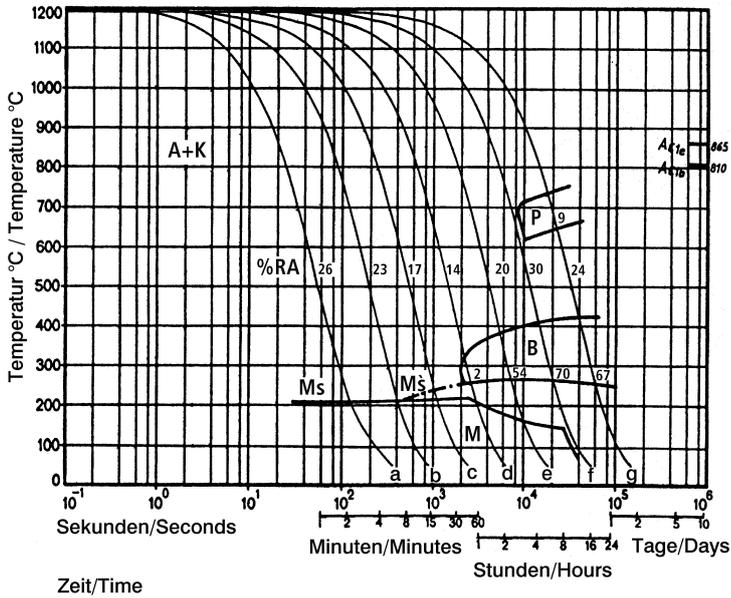
## Delivery condition

Annealed	
Hardness (HB)	max. 280
Tensile Strength (MPa)	max. 950

## Heat treatment

Annealing		
Temperature	770 to 840 °C	Controlled slow cooling in furnace (10 - 20°C / h (50 - 68°F / h) to approx. 600°C (1110°F), air cooling.
Stress relieving		
Temperature	600 to 650 °C	Slow cooling furnace.    To relieve stresses set up by extensive machining or in tools of intricate shape.    After through heating, hold in neutral atmosphere for 1 to 2 hours.
Hardening and Tempering		
Temperature	1,140 to 1,180 °C	Salt bath, vacuum    Preheating: 1st stage ~ 500 °C, 2nd stage ~ 850 °C, 3rd stage ~1050 °C    Austenitising: 1140 - 1180 °C, holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating.   Quenching: oil, warm bath (500 - 550 °C), gas
Temperature	550 to 570 °C	Slow heating to tempering temperature immediately after austenitising.    Dwell time in the furnace 1 hour per 20 mm material thickness (at least 1 hour)    Slow cooling to room temperature    3 tempering cycles recommended    Hardness see tempering chart

Continuous cooling CCT curves

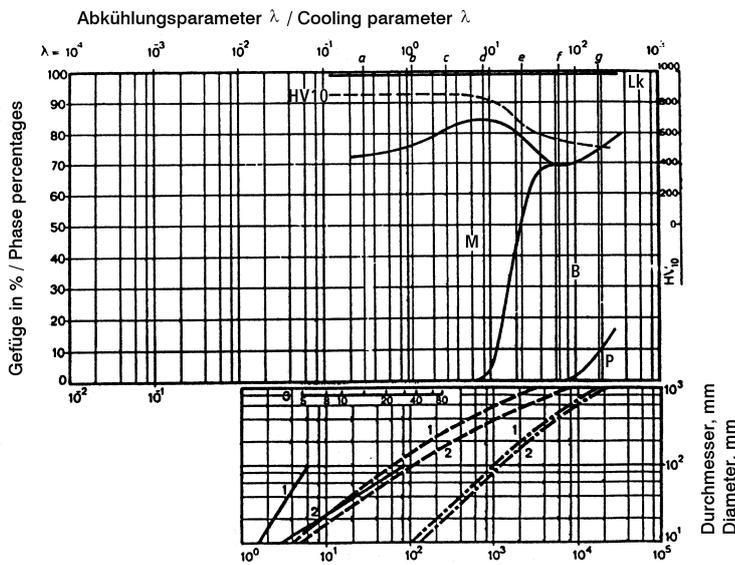


Austenitising temperature: 1190°C (2174°F)  
Holding time: 180 seconds

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

Sample	$\lambda$	HV10	Sample	$\lambda$	HV10
a	0,3	862	e	23,0	647
b	1,1	862	f	65,0	546
c	3,0	858	g	180,0	496
d	8,0	835			

Quantitative phase diagram



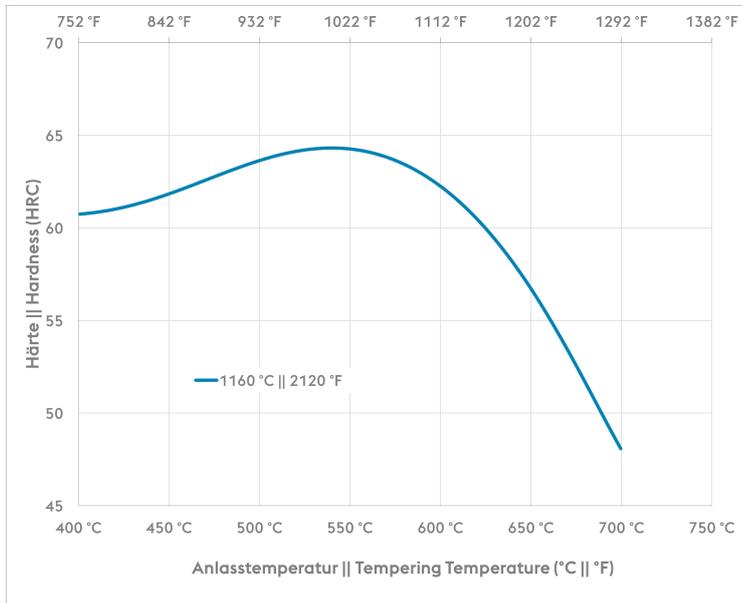
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1....Edge or Face  
2....Core  
3....Jominy test: distance from quenched end

— watercooling  
-- oilcooling  
- - - aircooling

Kühlzeit von 800°C auf 500°C in Sek. / Time of cooling from 800°C to 500°C (1472 - 932°F) in seconds

Tempering Chart



Hardening temperature: 1160°C (2120°F)

Physical Properties

<b>Temperature (°C)</b>	<b>20</b>
Density (kg/dm <sup>3</sup> )	7.9
Thermal conductivity (W/(m.K))	19
Specific heat (kJ/kg K)	0.46
Spec. electrical resistance (Ohm.mm <sup>2</sup> /m)	0.5
Modulus of elasticity (10 <sup>3</sup> N/mm <sup>2</sup> )	217

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

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10 <sup>-6</sup> m/(m.K))	11.5	11.7	12.2	12.4	12.7	13	13

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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