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	
1.3326	SEL
HS1-4-2	EN
M52	AISI

Standards	
4957	EN ISO
A600	ASTM

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 S400	★★★	★★★	★★★	★★★	★★	★★
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.

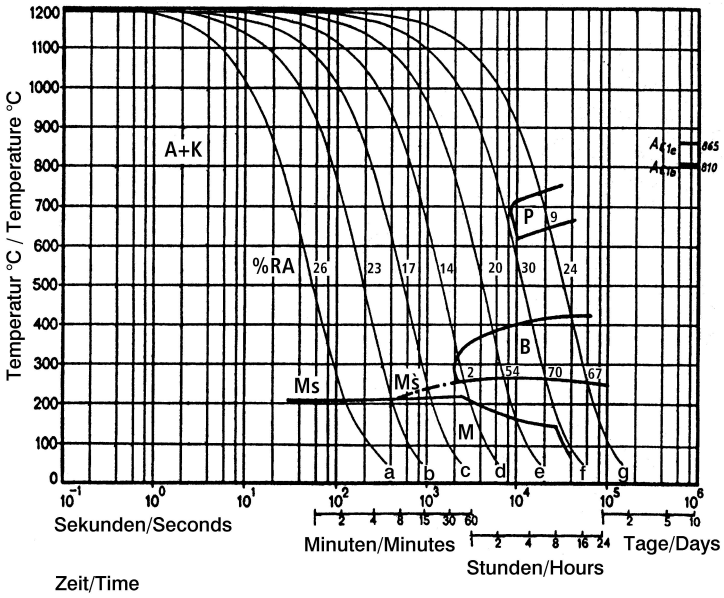
Stress relieving

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

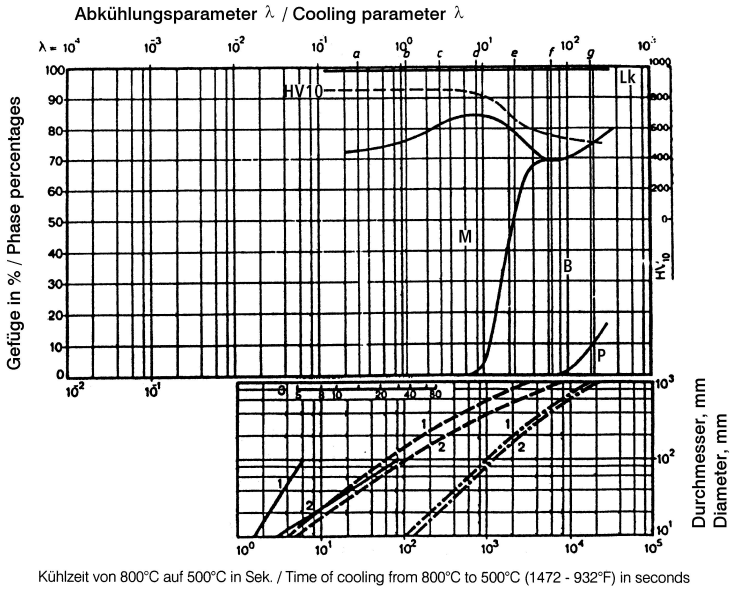


Austenitising temperature: 1190°C (2174°F)
Holding time: 180 seconds

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

Sample	λ	HV10	Sample	λ	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



A....Austenite
B....Bainite
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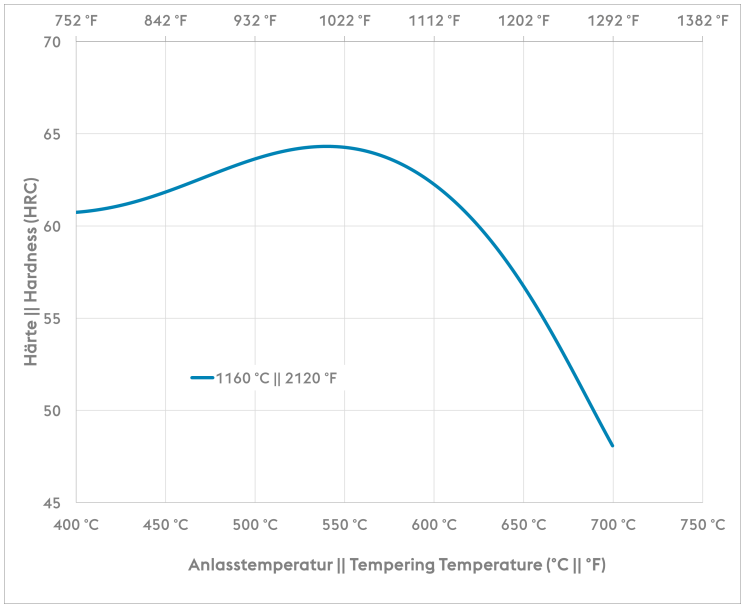
1....Edge or Face
2....Core
3....Jominy test: distance from quenched end

— watercooling

– – oilcooling

– · – aircooling

Tempering Chart



Hardening temperature: 1160°C (2120°F)

Physical Properties

Temperature (°C)	**20**
Density (kg/dm³)	7.9
Thermal conductivity (W/(m.K))	19
Specific heat (kJ/kg K)	0.46
Spec. electrical resistance (Ohm.mm²/m)	0.5
Modulus of elasticity (10³N/mm²)	217

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

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10^{-6} 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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ONE STEP AHEAD.