HIGH SPEED STEELS

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 | ksi)	max. 950 | 138

Heat treatment

Annealing

Temperature	770 to 840 °C | 1,418 to 1,544 °F	Controlled slow cooling in furnace (10 - 20°C / h (50 - 68°F / h) to approx. 600°C (1110°F), air cooling.

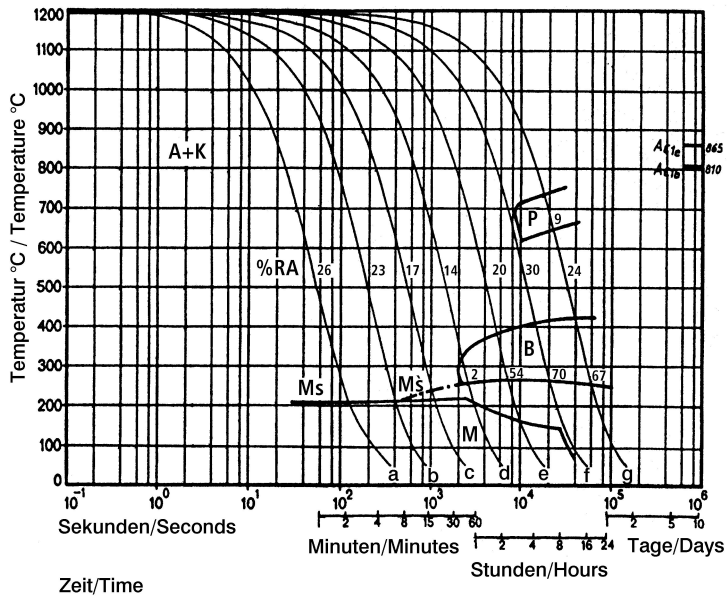
Stress relieving

Temperature	600 to 650 °C | 1,112 to 1,202 °F	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 | 2,084 to 2,156 °F	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 | 1,022 to 1,058 °F	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

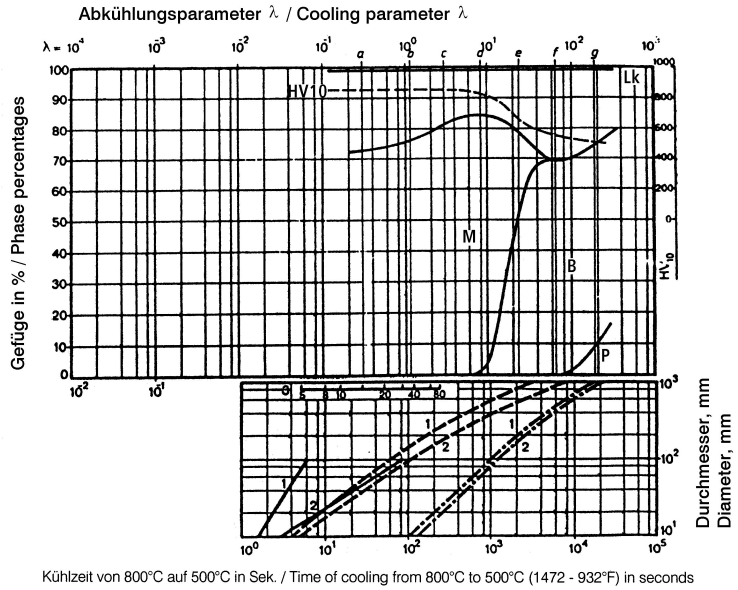


Austenitising temperature: 1190°C (2174°F)
Holding time: 180 seconds

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
K....Carbide
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RA...Retained Austenite

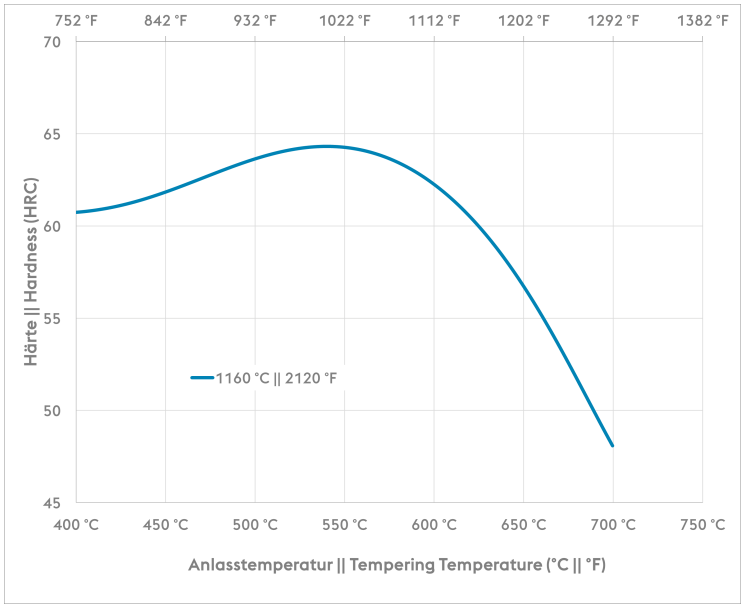
1....Edge or Face
2....Core
3....Jominy test: distance from quenched end

— watercooling

– – oilcooling

– · – aircooling

Tempering Chart



Hardening temperature: 1160°C (2120°F)

Physical Properties

Temperature (°C | °F)	20 | 68
Density (kg/dm^3 | lb/in^3)	7.9 | 0.29
Thermal conductivity (W/(m.K) | BTU/ft h °F)	19 | 10.98
Specific heat (kJ/kg K | BTU/lb °F)	0.46 | 0.1099
Spec. electrical resistance (Ohm.mm^2/m | 10^{-4} Ohm.inch^2/ft)	0.5 | 2.36
Modulus of elasticity (10^3N/mm^2 | 10^3ksi)	217 | 31.47

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

Temperature (°C | °F)	100 | 212	200 | 392	300 | 572	400 | 752	500 | 932	600 | 1,112	700 | 1,292
Thermal expansion (10^{-6} m/(m.K) | 10^{-6} inch/inch.°F)	11.5 | 6.4	11.7 | 6.5	12.2 | 6.8	12.4 | 6.9	12.7 | 7.1	13 | 7.2	13 | 7.2

Für weitere Spezifikationen und technische Anforderungen kontaktieren Sie bitte unsere regionalen voestalpine BÖHLER Vertriebsgesellschaften.

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voestalpine
ONE STEP AHEAD.