HIGH SPEED STEELS

Application Segments

Cutting Tools | Automotive

Available Product Variants

Long Products* | Plates

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

Product Description

BÖHLER S390 MICROCLEAN – "The decathlete"
This grade is our PM steel with many positive usage properties. For twist drills, taps, mills, broaches, or cold-work applications, BÖHLER S390 MICROCLEAN is always a high performer.

Process Melting

Powder metallurgy

Properties

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

Applications

- Motorsport industry
- End Mills
- Powder Pressing
- Special Cutting Tools
- Pill punching dies
- Broaches and Reamers
- Fine Blanking, Stamping, Blanking
- Rolling
- Twist Drills and Taps
- Cold Forming / Coining
- Gear Cutting, Shaving and Shaping Tools
- Shearing / Machine Knives
- Wear parts

Chemical composition (wt. %)

C	Cr	Mo	V	W	Co
1.64	4.80	2.00	4.80	10.40	8.00

Material characteristics

	Compressive strength	Grindability	Red hardness	Toughness	Wear resistance	Edge Stability
BÖHLER S390 MICROCLEAN	★★★★	★★★	★★★★	★★★★	★★★★	★★★★
BÖHLER S290 MICROCLEAN	★★★★★	★	★★★★	★★	★★★★★	★★★★
BÖHLER S393 MICROCLEAN	★★★★	★★★	★★★★	★★★★	★★★★	★★★★
BÖHLER S590 MICROCLEAN	★★★★	★★★	★★★★	★★★	★★★	★★★
BÖHLER S690 MICROCLEAN	★★★	★★★	★★	★★★★★	★★★	★★
BÖHLER S790 MICROCLEAN	★★★	★★★	★★	★★★★	★★	★★★
BÖHLER S792 MICROCLEAN	★★★	★★★	★★	★★★★	★★	★★★
BÖHLER S793 MICROCLEAN	★★★	★★★	★★★★	★★★	★★★	★★★

Delivery condition

Annealed

Hardness (HB)	max. 320 | drawn execution max. 320 HB
Tensile Strength (MPa)	max. 1,080

Hardened and Tempered

Hardness (HRC)	64 to 68

Heat treatment

Annealing

Temperature	770 to 840 °C	4 h || controlled slow cooling in furnace (10 to 20°C/h / (50 to 68°F/h) to 740°C/2h (1364°F/2 h) || cooling in furnace,

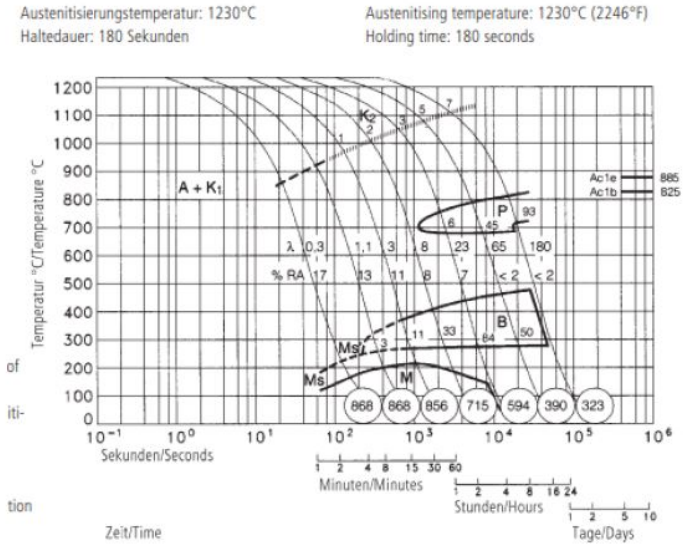
Stress relieving

Temperature	600 to 650 °C	Slow cooling in 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	1,100 to 1,230 °C	Salt bath, vacuum || Preheating: 1st stage ~ 500 °C (930 °F), 2nd stage ~ 850 °C (1560 °F), 3rd stage ~1050 °C (1920 °F) || Austenitising: 1100 - 1230 °C (2012 °F - 2246 °F), holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating. || Quenching: oil, warm bath (500 - 550 °C (930 °F - 1020 °F)), gas
Temperature	550 to 570 °C	Slow heating to tempering temperature immediately after austenitising. || Holding time in the furnace 1 hour per 20 mm material thickness (at least 1 hour) || Slow cooling to room temperature between each tempering step || 3 tempering cycles recommended || Hardness see tempering chart

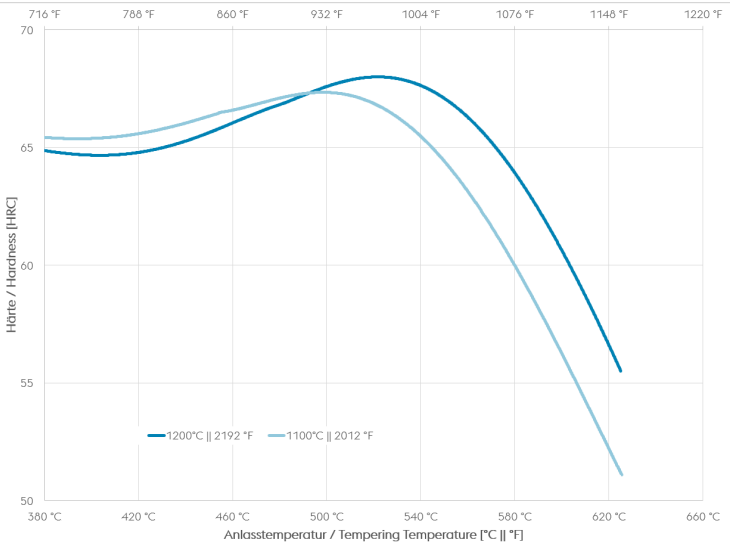
Continuous cooling CCT curves



Austenitising temperature: 1230°C (2246°F)
Holding time: 180 seconds

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

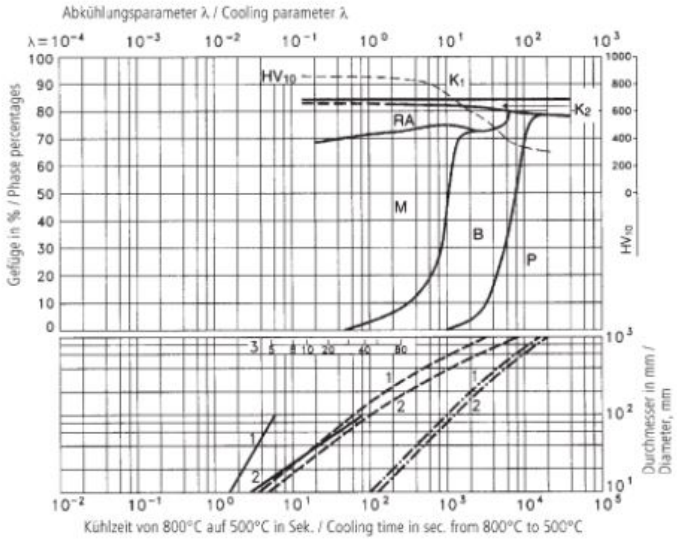
Tempering Chart



Quantitative phase diagram

Austenitisierungstemperatur: 1230°C
Haltedauer: 180 Sekunden

Austenitising temperature: 1230°C (2246°F)
Holding time: 180 seconds



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

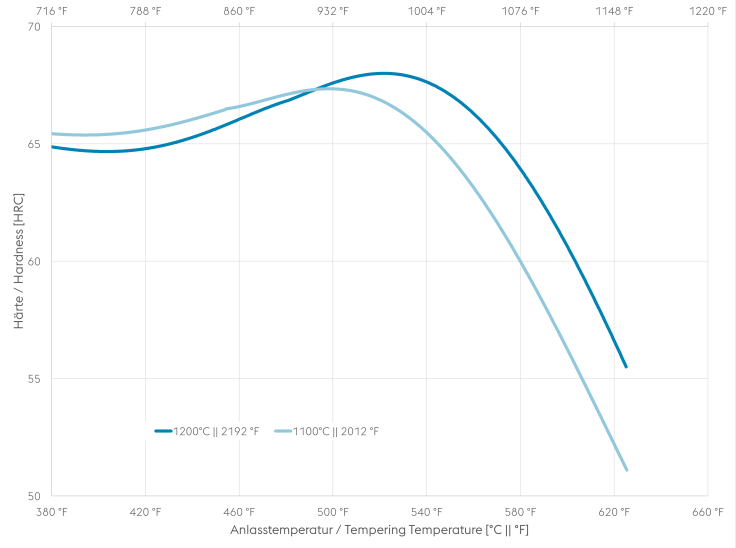
1....Edge or Face
2....Core
3....Jominy test: distance from quenched end

— watercooling

– – oilcooling

– · – aircooling

Tempering Chart



Holdingtime 3x2 hours

Specimensize: square 25mm

Austenitising in vacuum

Physical Properties

Temperature (°C)	20
Density (kg/dm^3)	8.1
Thermal conductivity (W/(m.K))	17
Specific heat (kJ/kg K)	0.42
Spec. electrical resistance (Ohm.mm^2/m)	0.61
Modulus of elasticity (10^{3}N/mm^2)	231

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

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10^{-6} m/(m.K))	10	10.5	10.8	11.2	11.3	11.4	11.6

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ONE STEP AHEAD.