



S705



SCHNELLARBEITSSTAHL
HIGH-SPEED STEEL

BÖHLER S705

HIGH SPEED STEEL

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Qualitative comparison of the major steel properties

BÖHLER Marke / Grade	Warmhärte Red hardness	Verschleißwiderstand Wear resistance	Zähigkeit Toughness	Schleifbarkeit Grindability	Druckbelastbarkeit Compressive strength
S200	■	■	■	■	■
S400	■	■	■	■	■
S401	■	■	■	■	■
S404	■	■	■	■	■
S500	■	■	■	■	■
S600	■	■	■	■	■
S607	■	■	■	■	■
S700	■	■	■	■	■
S705	■	■	■	■	■
S390 MICROCLEAN	■	■	■	■	■
S590 MICROCLEAN	■	■	■	■	■
S690 MICROCLEAN	■	■	■	■	■
S790 MICROCLEAN	■	■	■	■	■

This table is intended to facilitate the steel choice. It does not, however, take into account the various stress conditions imposed by the different types of application. Our technical consultancy staff will be glad to assist you in any questions concerning the use and processing of steels.

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Properties

Cobalt alloyed, tungsten-molybdenum high speed steel possessing high hardness, excellent cutting properties, high red hardness and good toughness. BÖHLER S705 is also available in the special grade ISO RA PID for heavy duty tools.

Applications

Turning and planing tools of all types, milling cutters, taps, twist drills, wood working tools, cold work tools.

Chemical analysis

(Average values, in %)

C	Si	Mn	Cr	Mo	V	W	Co
0,92	0,40	0,30	4,10	5,00	1,90	6,40	4,80

Standards

DIN / EN
< 1.3243 >
HS6-5-2-5

AISI
~ M41

UNS
~ T11341

BS
~ BM35

UNE
~ F5613
~ 6-5-2-5

UNI
~ HS6-5-2-5

JIS
SKH55

SIS
2723

AFNOR
Z90WDKCV06-05-05-04-02

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Hot forming

Forging:

1100 to 900 °C (2012 to 1652 °F)
Slow cooling in furnace or in thermoinsulating material.

Heat treatment

Annealing:

770 to 840 °C (1418 to 1544 °F) / Controlled slow cooling in furnace (10 to 20 °C/h / (50 to 68 °F/h) to approx. 600 °C (1112 °F), air cooling. Hardness after annealing: max. 280 Brinell. **Stress relieving:** 600 to 650 °C (1112 to 1202 °F) Slow cooling in furnace. To relieve stresses setup by extensive machining or in tools of intricate shape. After through heating, hold in neutral atmosphere for 1 to 2 hours.

Hardening:

1190 to 1230 °C (2174 to 2246 °F) Oil, salt bath (500 to 550 °C (932 to 1022 °F), vacuum. Upper temperature range for parts of simple shape, lower for parts of complex shape. For cold working tools also lower temperatures are of importance for higher toughness. Soaking time after heating up the whole section of a work piece 80 seconds minimum is required for dissolving sufficient carbides. Maximum soaking time 150 seconds to avoid detriments by over soaking. In practice instead of soaking time the time of exposure from placing the work piece into the salt bath after pre heating until removing (including the stages of heating to the specified surface temperature and of heating to the temperature throughout the whole section) is used. "see immersion time diagrams".
Vacuum hardening is also possible. The time in the vacuum furnace depends on the relevant work piece size and furnace parameters.

Immersion time chart (salt bath)

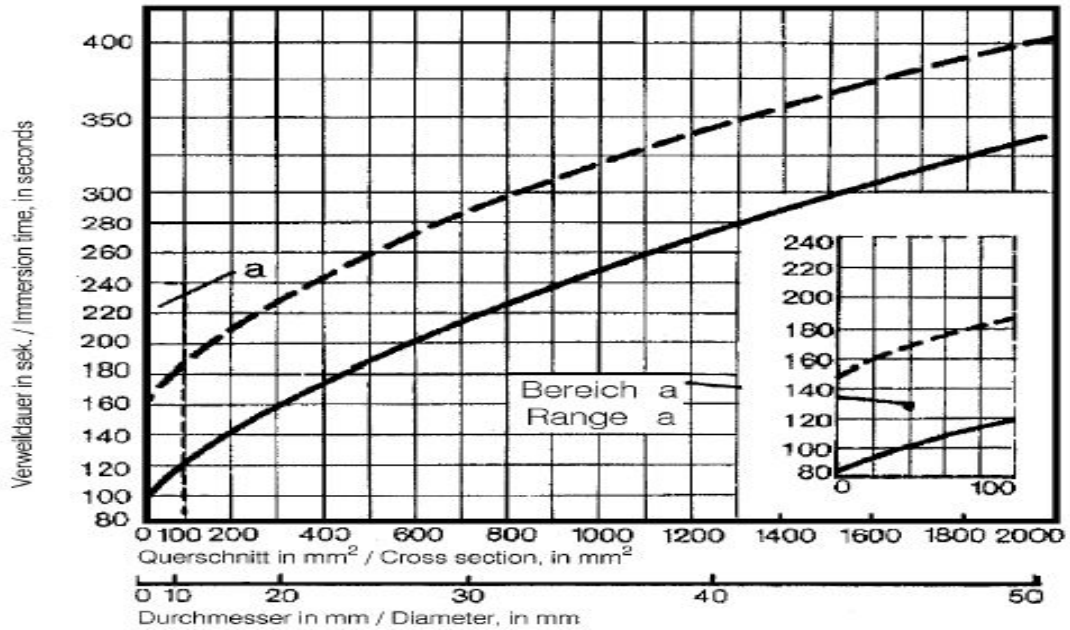
Austenitising time (hardening temperature)

80 seconds

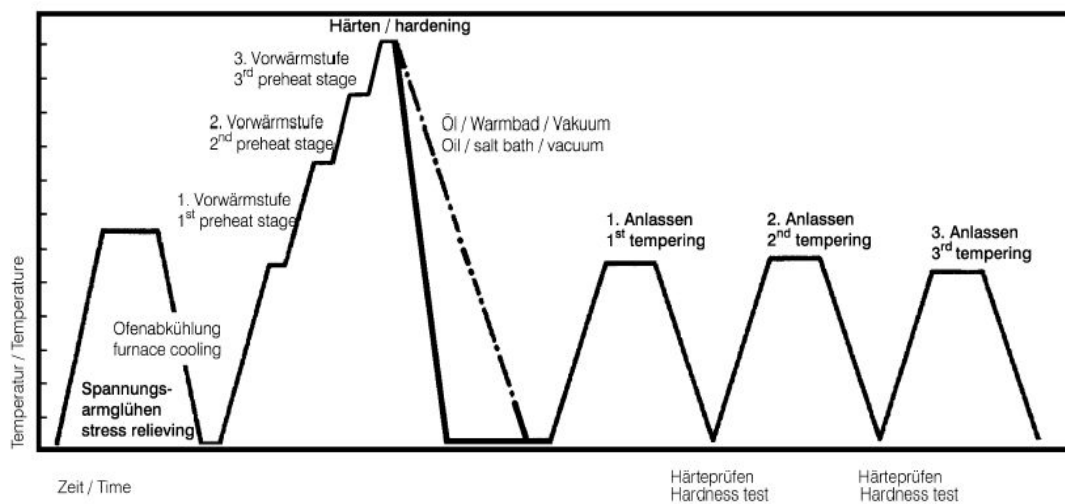
----- 150 seconds

Preheating at 550 °C (1022 °F),

850 °C (1562 °F) and 1050 °C (1922 °F).



Heat treatment sequence



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Tempering:

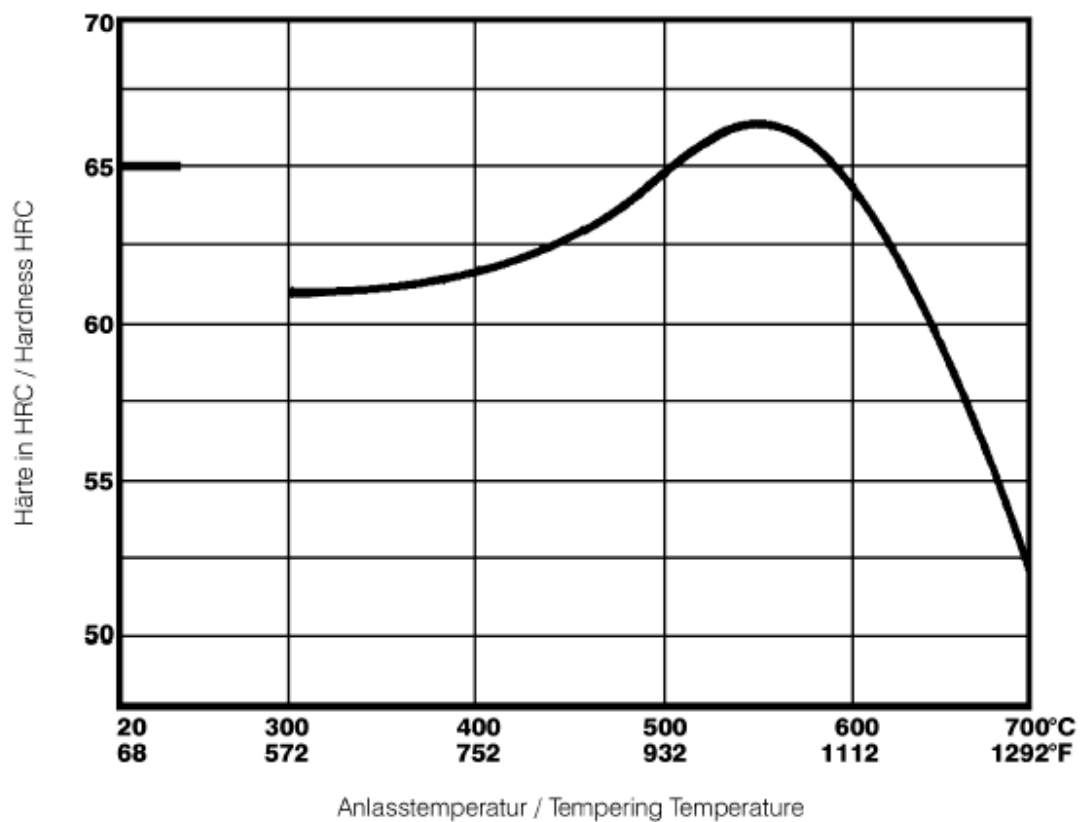
Slow heating to tempering temperature immediately after hardening/time in furnace: 1 hour for every 20 mm of work piece thickness, but not less than 2 hours/ air cooling (minimum holding time: 1 hour). 1st tempering and 2nd tempering to desired working hardness. Average obtainable hardness values are shown in the tempering chart.

3rd tempering for stress relieving, 30 - 50 °C (86-122 °F) below highest tempering temperature. Obtainable hardness after tempering: 64 - 66 HRC.

Tempering chart

Hardening temperature: 1200 °C (2192 °F)

Specimen size: square 20 mm



Surface treatment

Nitriding:

Parts made from this steel can be bath, plasma and gas nitriding.

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Continuous cooling CCT curves

Chemische Zusammensetzung, in %
Chemical analysis, in %

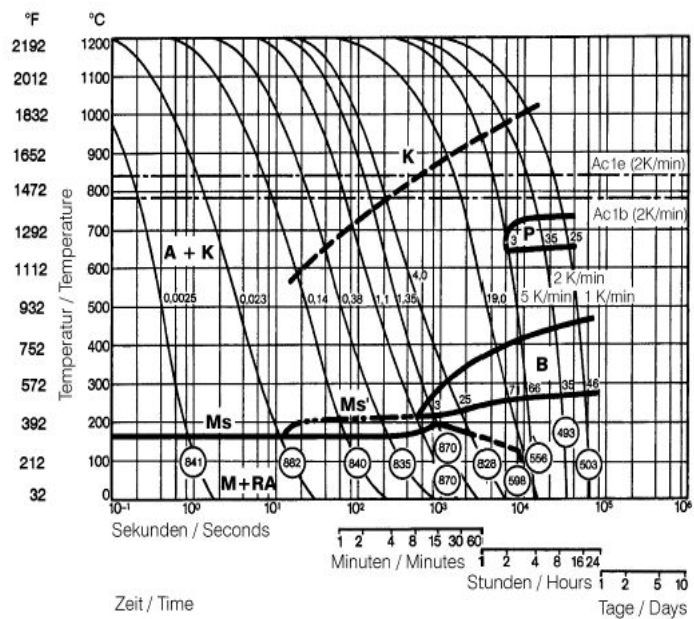
C	Si	Mn	P	S	Cr	Mo	V	W	Co
0,89	0,25	0,25	0,019	0,010	4,13	4,75	1,82	6,12	4,62

Austenitising temperature: 1200°C
Haltedauer: 150 Sekunden

○ Härte in HV
3 ... 25 Gefügeanteile in %
0,0025 ... 19,0 Abkühlungsparameter, d. h.
Abkühlungsdauer von 800°C bis 500°C
in $s \times 10^{-2}$
5 K/min ... 1 K/min Abkühlungsgeschwindigkeit
in K/min im Bereich von 800 - 500°C
Ms-Ms' Bereich der Korngrenzenmartensit-
bildung

Austenitising temperature: 1200°C (2192°F)
Holding time: 150 seconds

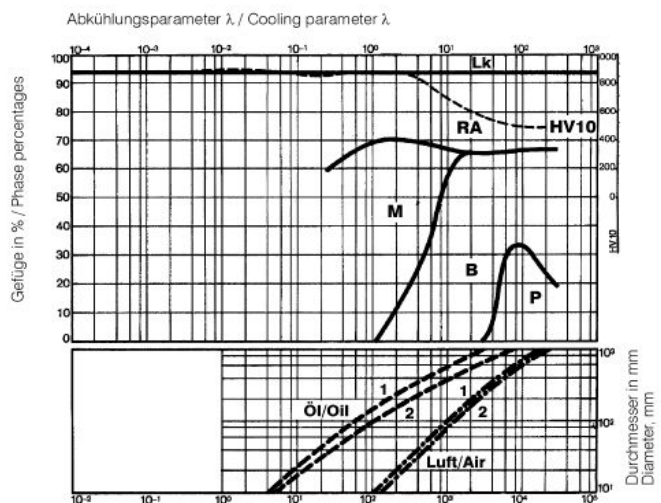
○ Vickers hardness
3 ... 25 phase percentages
0,0025 ... 19,0 cooling parameter, i.e. duration of
cooling from 800-500°C (1472-932°F) in $s \times 10^{-2}$
5 K/min ... 1 K/min cooling rate in K/min in the
800 - 500°C (1472 - 932°F) range
Ms-Ms' range of grain boundary martensite
formation



Quantitative phase diagram

A... Austenit / Austenite
B... Bainit / Bainite
M... Martensit / Martensite
P... Perlit / Perlite
Lk... Ledeburitkarbid / Ledeburite carbide
RA... Restaustenit / Retained austenite

1 Werkstückrand / Edge or face
2 Werkstückzentrum / Core



Kühlzeit von 800°C auf 500°C in Sek. / Cooling time in sec. from 800°C to 500°C (1472 - 932°F)

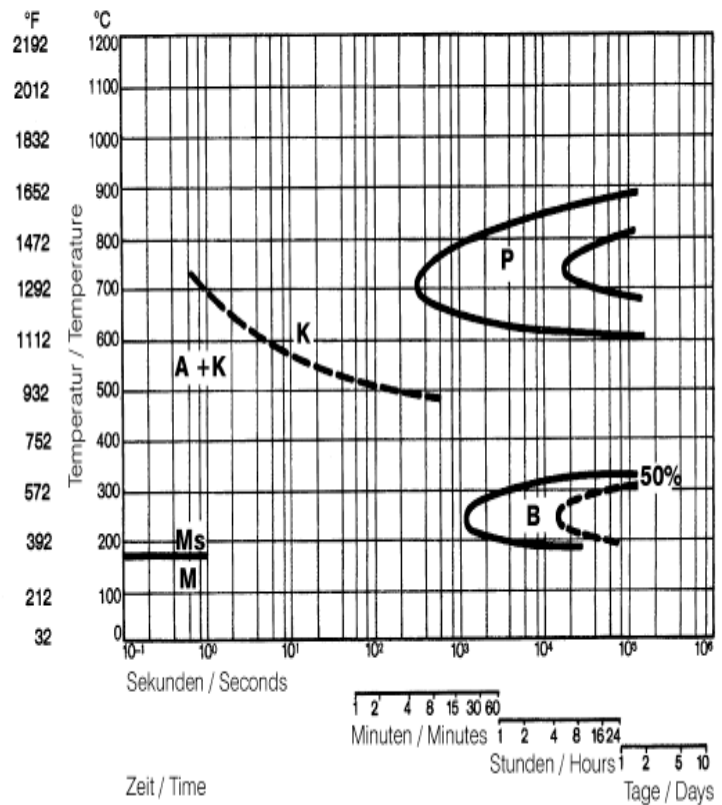
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Isothermal TTT curves

Chemische Zusammensetzung % Chemical composition %	C	Si	Mn	P	S	Cr	Mo	V	W	Co
	0,89	0,25	0,25	0,019	0,010	4,13	4,75	1,82	6,12	4,62

Austenitising temperature: 1200°C
Haltedauer: 150 Sekunden

Austenitising temperature: 1200°C (2192°F)
Holding time: 150 seconds



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Recommendation for machining

(Condition annealed, average values)

Turning with carbide tipped tools

depth of cut, mm	0.5 to 1	1 to 4	4 to 8	over 8
feed, mm/rev.	0.1 to 0.3	0.2 to 0.4	0.3 to 0.6	0.5 to 1.5
BÖHLERIT grade	SB10,SB20,	SB10,SB20,EB10	SB30,EB20	SB30,SB40
ISO grade	P10,P20,	P10,P20,M10	P30,M20	P30,P40
<i>cutting speed, m/min</i>				
indexable carbide inserts				
edge life 15 min	210 to 150	160 to 110	110 to 80	70 to 45
brazed carbide tipped tools				
edge life 30 min	150 to 110	135 to 85	90 to 60	70 to 35
hardfaced indexable carbide inserts				
edge life 15 min				
BÖHLERIT ROYAL 121/ISO P20	to 210	to 180	to 130	to 80
BÖHLERIT ROYAL 131/ISO P35	to 140	to 140	to 100	to 60
cutting angles for brazed carbide tipped tools				
clearance angle	6 to 8°	6 to 8°	6 to 8°	6 to 8°
rake angle	6 to 12°	6 to 12°	6 to 12°	6 to 12°
angle of inclination	0°	- 4°	- 4°	- 4°

Turning with HSS tools

depth of cut, mm	0.5	3	6
feed, mm/rev.	0.1	0.4	0.8
HSS-grade BOHLER/DIN	S700 /S10-4-3-10		
<i>cutting speed, m/min</i>			
edge life 60 min	30 to 20	20 to 15	18 to 10
rake angle	14°	14°	14°
clearance angle	8°	8°	8°
angle of inclination	- 4°	- 4°	- 4°

Milling with carbide tipped cutters

feed, mm/tooth	to 0.2	0.2 to 0.4
<i>cutting speed, m/min</i>		
BÖHLERIT SBF / ISO P25	150 to 100	110 to 60
BÖHLERIT SB40 / ISO P40	100 to 60	70 to 40
BÖHLERIT ROYAL 131/ISO P35	130 to 85	—

Drilling with carbide tipped tools

drill diameter, mm	3 to 8	8 to 20	20 to 40
feed, mm/rev.	0.02 to 0.05	0.05 to 0.12	0.12 to 0.18
BÖHLERIT / ISO-grade	HB10/K10	HB10/K10	HB10/K10
<i>cutting speed, m/min</i>			
	50 to 35	50 to 35	50 to 35
top angle	115 to 120°	115 to 120°	115 to 120°
clearance angle	5°	5°	5°

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Physical properties

Dichte bei /
Density at20°C (68°F)8,10kg/dm³

Wärmeleitfähigkeit bei /
Thermal conductivity at20°C (68°F)19W/(m.K)

Spezifische Wärme bei /
Specific heat at20°C (68°F)460J/(kg.K)

Spez. elektr. Widerstand bei /
Electrical resistivity at20°C (68°F)0,60Ohm.mm²/m

Elastizitätsmodul bei /
Modulus of elasticity at20°C (68°F)217x10³ ...N/mm²

Wärmeausdehnung zwischen 20°C und ...°C, 10 ⁻⁶ m/(m.K) bei Thermal Expansion between 20°C (68°F) and ...°C (°F), 10 ⁻⁶ m/(m.K) at	Temperatur / Temperature		10 ⁻⁶ m/(m.K)
	°C	°F	
	100°C	212°F	11,5
	200°C	392°F	11,7
	300°C	572°F	12,2
	400°C	752°F	12,4
	500°C	932°F	12,7
	600°C	1112°F	13,0
	700°C	1292°F	12,9

As regards applications and processing steps that are not expressly mentioned in this product description/data sheet, the customer shall in each individual case be required to consult us.
