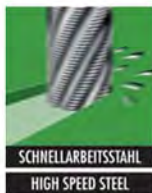


S600



BÖHLER S600

高速钢
HIGH SPEED STEEL

BÖHLER S600

钢材主要性能对照表

Qualitative comparison of the major steel properties

牌号 / Grade BÖHLER	红硬性 Red hardness	耐磨耗性 Wear resistance	韧性 Toughness	研磨加工性 Grindability	抗压强度 Compressive strength
S200	Medium	Medium	Medium	Medium	Medium
S400	Medium	Medium	Medium	Medium	Medium
S401	Medium	Medium	Medium	Medium	Medium
S404	Medium	Medium	Medium	Medium	Medium
S500	Medium	Medium	Medium	Medium	Medium
S600	High	High	High	High	High
S607	Medium	Medium	Medium	Medium	Medium
S700	Medium	Medium	Medium	Medium	Medium
S705	Medium	Medium	Medium	Medium	Medium
S290 MICROCLEAN	Medium	Medium	Medium	Medium	Medium
S390 MICROCLEAN	Medium	Medium	Medium	Medium	Medium
S590 MICROCLEAN	Medium	Medium	Medium	Medium	Medium
S690 MICROCLEAN	Medium	Medium	Medium	Medium	Medium
S790 MICROCLEAN	Medium	Medium	Medium	Medium	Medium

本表是为方便您选用钢材而设计。但是在此无法详列在不同使用状态下，各种应力条件对钢材性质之影响。

我们的专业技术顾问非常乐意协助您解决任何有关钢材选用及加工的问题

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.

性能

钨钼系高速钢，有良好的韧性与切削能力，可在多种场合广泛使用。
BOHLER S600也可以为高负荷的工具提供 ISORAPID电渣重熔的材料。

针对客户对AISI M2材料的特殊要求，我们也可以提供Bohler S601材料，它是Bohler S600材料的改良钢种。

其它相同类型的钢材，为根据客户的特殊要求，制造麻花钻所开发。May-Dorrenberg (扭转轧制) 制程。
(Bohler S614)

用途

攻牙刀，麻花钻，绞刀，拉刀，金属锯，各式的加工刀具，木工刀具，冷作刚。

Properties

Tungsten-molybdenum high speed steel with excellent toughness and cutting properties, for a wide variety of uses.
BÖHLER S600 is also available in the special grade ISORAPID for heavy duty tools.

BÖHLER S601 a modified version of BÖHLER S600 and corresponding to customer's specifications for AISI M2.

Another HSS grade of the same type is available which was specifically developed for making twist drills by the May-Dörrenberg (twist rolling) process (BÖHLER S614).

Applications

Taps, twist drills, reamers, broaching tools, metal saws, milling tools of all types, woodworking tools, cold work tools.

化学成份 (平均值%) / Chemical composition (average %)

C	Cr	Mo	V	W
0,90	4,10	5,00	1,80	6,20

标准

Standards

DIN / EN
~ 1.3554 LW
< 1.3343 >
HS6-5-2C

AISI
~ M2 reg. C

UNS
~ T11302

BS
~ BM2

UNE
F5603
6-5-2

UNI
HS6-5-2
~ X82WMoV6 5

JIS
~ SKH51

GOST
~ R6M5

SIS
2722

AIR
~ E-Z85WCDV6

AFNOR
~ Z80WDCV6
~ Z90WDCV06-05-04-02

热成型

锻造:

1100–900°C, 随炉慢冷, 或是保温材料中冷却

热处理

退火:

770–840°C 随炉慢冷却 (10–20°C/小时) 至600°C, 然后空冷, 退火后硬度最高280HB。

应力消除:

600–650°C 随炉慢冷, 消除因大量加工或复杂形状加工所产生的应力。完全热透后, 中性气体中保温1到2小时。

淬火:

1190–1230°C

油冷, 气冷, 盐浴 (500–550°C), 高压气冷(氮气)。

形状简单的工件采用高温淬火, 复杂的工件采用低温淬火。韧性对冷作工具是重要的, 也低温淬火。工件烧透后, 保温时间不少于80秒, 以满足碳化物充分溶解的需要。最长的保温时间为150秒, 以避免过热。

通常用工件从预热后进入盐槽至往上拿开的时间来代替均热时间 (包括表面和心部透烧的过程)。见“浸入时间曲线图”。

也可进行真空淬火。

在真空炉内的时间取决于相应的工件尺寸和炉体参数。

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 (1110°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 set up 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, air, salt bath (500 - 550°C (932 - 1022°F), gas.
Upper temperature range for parts of simple shape, lower for parts of complex shape.

For coldworking tools also lower temperatures are of importance for higher toughness.

Soaking time after heating up the whole section of a workpiece 80 seconds minimum is required for dissolving sufficient carbides.

Maximum soaking time 150 seconds to avoid detriments by oversoaking.

In practice instead of soaking time the time of exposure from placing the workpiece into the salt bath after preheating 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 workpiece size and furnace parameters.

浸入时间曲线 (盐浴)

奥氏体化时间
(淬火温度)

—— 80 秒
- - - - 150 秒

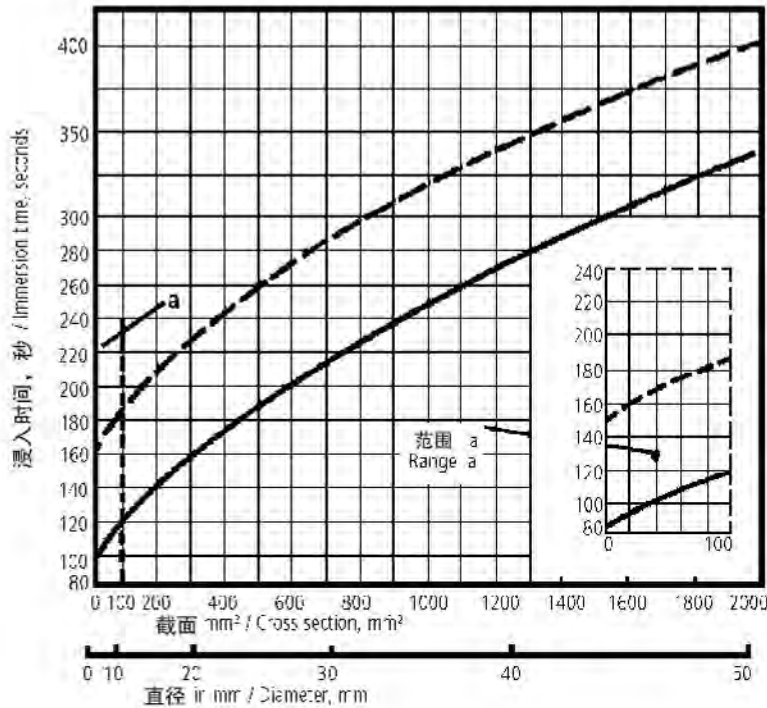
550°C, 850°C和1050°C预热

Immersion time chart (salt bath)

Austenitising time
(hardening temperature)

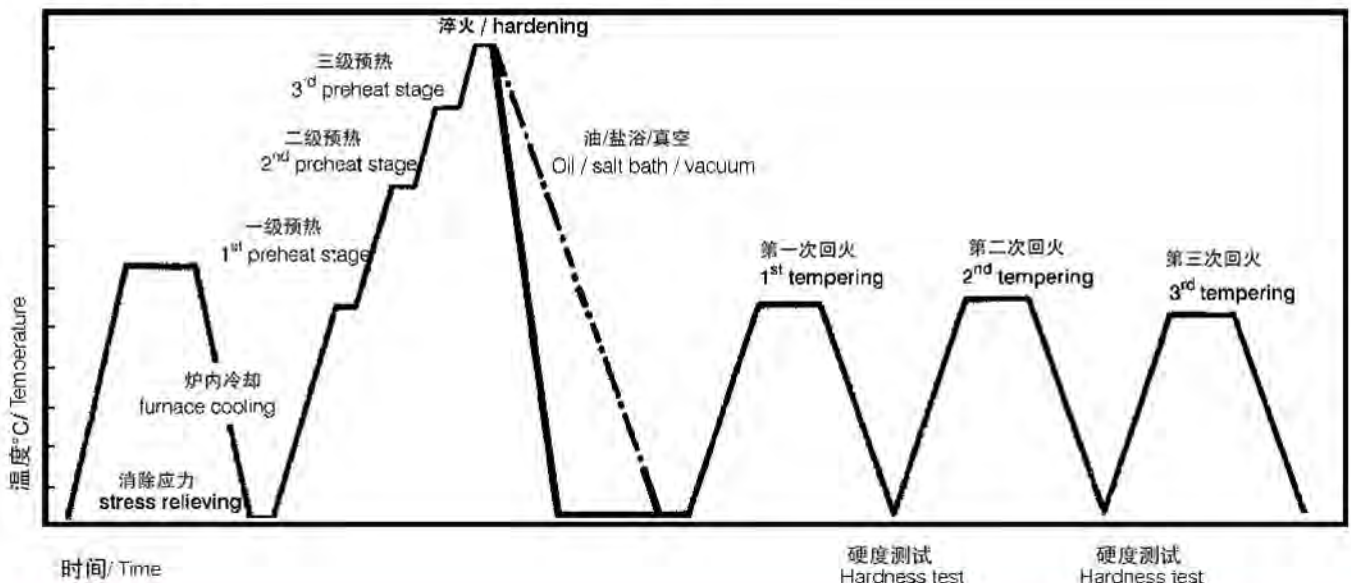
—— 80 seconds
- - - - 150 seconds

Preheating at 550°C (1022°F),
850°C (1562°F) and 1050°C (1922°F).



热处理流程

Heat treatment sequence



BÖHLER S600

回火:

淬火后立即回火，缓慢加热至回火温度/保温时间：工件厚度每20mm一个小时，但至少2小时/然后空冷，（最少保持时间：1小时）。
第一次回火和第二次回火至工作温度。
平均硬度值见回火曲线图。
第三次回火用于消除应力，比最高回火温度低30-50℃。
回火后可得硬度：64-66HRC。

Tempering:

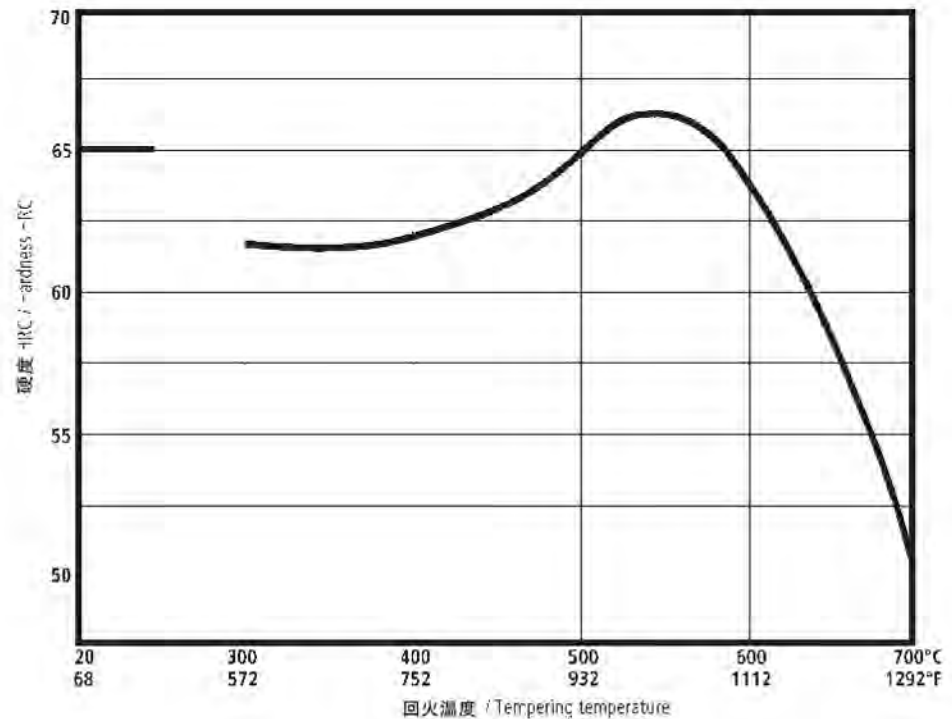
Slow heating to tempering temperature immediately after hardening/time in furnace:
1 hour for every 20 mm of workpiece thickness, but not less than 2 hours/ air cooling (minimum holding time: 1 hour).
1st tempering and 2nd tempering to desired working hardness.
Average obtainable hardness values are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

回火曲线图

淬火温度：1210℃
试样尺寸：20X20mm 正方。

Tempering chart

Hardening temperature: 1210°C (2210°F)
Specimen size: square 20 mm



表面处理

氮化:

该钢制件适合盐浴，离子和气体氮化。

Surface treatment

Nitriding:

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

连续冷却CCT曲线图 / Continuous cooling CCT curves

奥氏体化温度: 1210°C
保温时间: 150秒

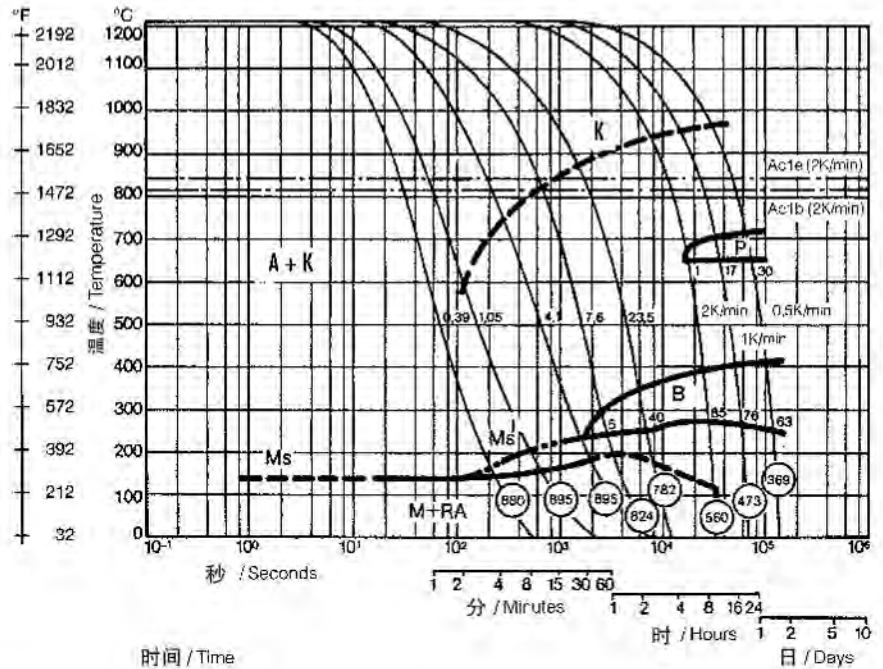
- 维氏硬度
- 1...30 相含量百分比 %
- 0,39...23,5 冷却参数, 即从800°C连续冷却到500°C所需的时间, 单位为秒 $\times 10^{-2}$
- 2 K/min 0,5 在800°C-500°C范围内的冷却速率单位为K/分钟
- Ms-Ms' 马氏体相变温度区间

Austenitising temperature: 1210°C (2210°F)
Holding time: 150 seconds

- Vickers hardness
- 1...30 phase percentages
- 0.39...23.5 cooling parameter, i.e. duration of cooling from 800-500°C (1472-932°F) in $s \times 10^{-2}$
- 2 K/min 0.5 K/min cooling rate in K/min in the 800 - 500°C (1472 - 932°F) range
- Ms-Ms'.....range of grain boundary martensite formation

化学成份 (平均值%) / Chemical composition (average %)

C	Si	Mn	P	S	Cr	Mo	V	W
0,88	0,22	0,35	0,021	0,011	4,12	4,97	1,77	6,50

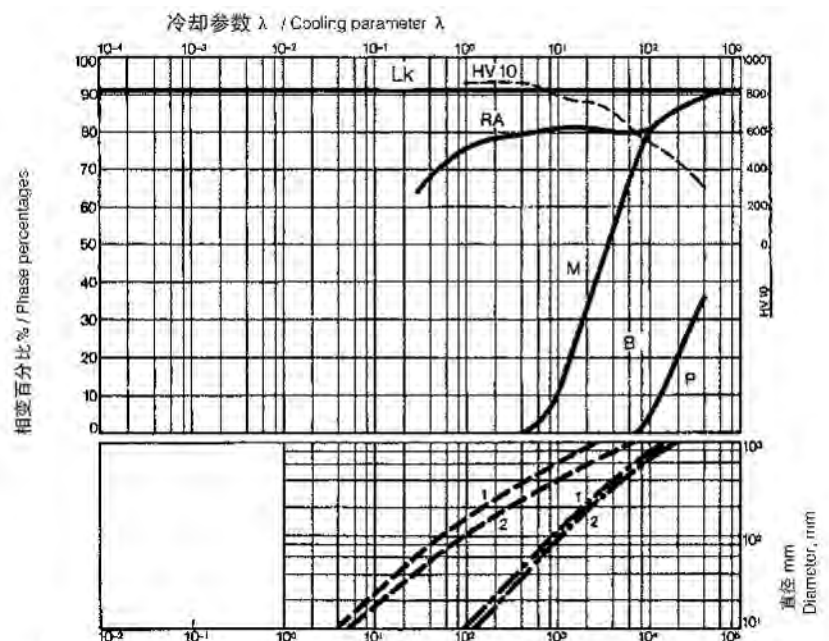


定量相图 / Quantitative phase diagram

- A... 奥氏体 / Austenite
- B... 贝氏体 / Bainite
- K... 碳化物 / Carbide
- M... 珠光体 / Martensite
- P... 马氏体 / Pearlite
- Lk... 莱氏体 / Ledeburite carbide
- RA... 残留奥氏体 / Retained austenite

- 油冷 / Oil cooling
- · - 空冷 / Air cooling

- 1... 边缘或表面 / Edge or face
- 2... 心部 / Core



从800°C冷却到500°C所需时间, 单位为秒 / Cooling time in sec. from 800°C to 500°C (1472 - 932°F)

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等温变态TTT曲线图 / Isothermal TTT curves

奥氏体化温度: 1210°C

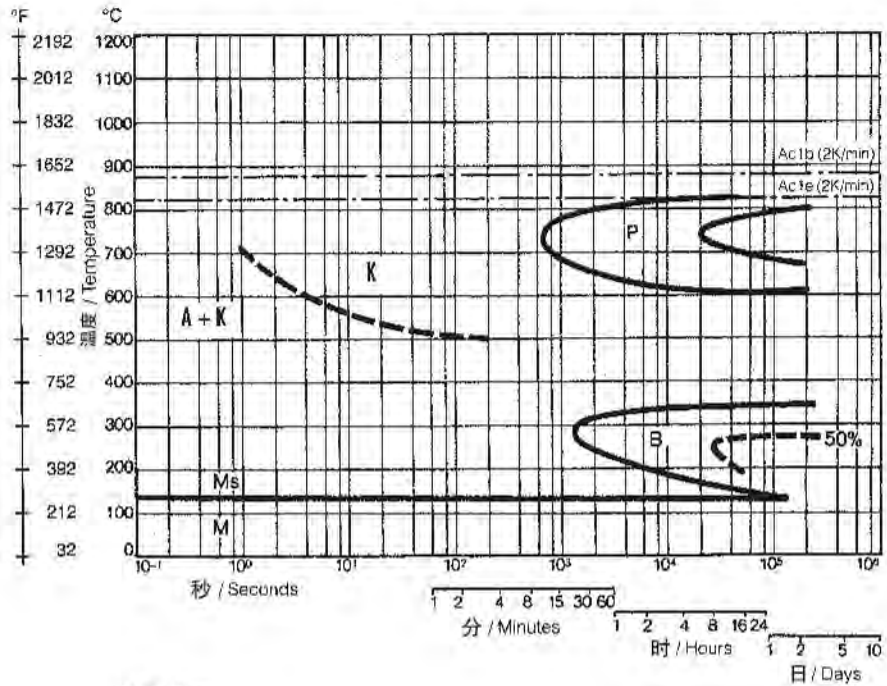
保温: 150秒

Austenitising temperature: 1210°C (2210°F)

Holding time: 150 seconds

化学成份 (平均值%) / Chemical composition (average %)

C	Si	Mn	P	S	Cr	Mo	V	W
0,88	0,22	0,35	0,021	0,011	4,12	4,97	1,77	6,50



时间 / Time

机加工建议

状态: 退火, 平均值

以硬质合金车削

车削深度 mm	0,5 – 1	1 – 4	4 – 8	– 8
进给 mm/rev.	0,1 – 0,3	0,2 – 0,4	0,3 – 0,6	0,5 – 1,5
BOEHLERIT-牌号	SB10,SB20	SB10, SB20, EB10	SB30, EB20	SB30, SB40
ISO 牌号	P10,P20	P10, P20, M10	P30, M20	P30, P40
切削速度 Vc m/min				
可换式硬质合金刀具 加工 15分钟	210 – 150	160 – 110	110 – 80	70 – 45
钎焊硬质合金刀具 加工30分钟	150 – 110	135 – 85	90 – 60	70 – 35
表面镀层可换式硬质合金刀片 加工15分钟				
BOEHLERIT ROYAL 121	–210	– 180	–130	– 80
BOEHLERIT ROYAL 131	–140	– 140	–100	– 60
钎焊硬质合金刀具切削角度				
前角	6 – 12°	6 – 12°	6 – 12°	6 – 12°
后角	6 – 8°	6 – 8°	6 – 8°	6 – 8°
倾角	0°	– 4°	– 4°	– 4°

以高速钢车削

切削深度 mm	0,5	3	6
进给 mm/rev	0,1	0,4	0,8
BÖHLER/DIN- 牌号	S700 / DIN 510-4-3-10		
切削速度 Vc m/min			
加工60分钟	30 – 20	20 – 15	18 10
前角	14°	14°	14°
后角	8°	8°	8°
倾角	– 4°	– 4°	– 4°

以硬质合金铣削

进给 mm/rev	– 0,2	0,2 – 0,4
切削速度 Vc m/min		
BOEHLERIT SBF/ ISO P25	150 – 100	110 – 60
BOEHLERIT SB40/ ISO P40	100 – 60	70 – 40
BOEHLERIT ROYAL 131 / ISO P35	130 – 85	--

以硬质合金钻孔

	3 – 8	8 – 20	20 – 40
进给 mm/rev	0,02 – 0,05	0,05 – 0,12	0,12 – 0,18
BOEHLERIT / ISO- 牌号	HB10/K10	HB10/K10	HB10/K10
切削速度 Vc m/min			
	50 – 35	50 – 35	50 – 35
顶角	115 – 120°	115 – 120°	115 – 120°
后角	5°	5°	5°

BÖHLER S600

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
BOEHLERIT grade	SB10, SB20	SB10, SB20, EB10	SB30, EB20	SB30, SB40
ISO grade	P10, P20	P10, P20, M10	P30, M20	P30, P40
cutting speed, m/min				
indexable carbide inserts edge life 15 min	210 to 150	160 to 110	110 to 80	70 to 45
braze 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 BOEHLERIT ROYAL 121 BOEHLERIT ROYAL 131	to 210 to 140	to 180 to 140	to 130 to 100	to 80 to 60
cutting angles for braze carbide tipped tools rake angle clearance angle angle of inclination	6 to 12° 6 to 8° 0°	6 to 12° 6 to 8° -4°	6 to 12° 6 to 8° -4°	6 to 12° 6 to 8° -4°

Turning with HSS tools

depth of cut, mm	0.5	3	6
feed, mm/rev.	0.1	0.4	0.8
HSS-grade BÖHLER/DIN	S700 / DIN S10-4-3-10		
cutting speed, m/min			
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
cutting speed, m/min		
BOEHLERIT SBF/ ISO P25	150 to 100	110 to 60
BOEHLERIT SB40/ ISO P40	100 to 60	70 to 40
BOEHLERIT 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
BOEHLERIT / ISO-grade	HB10/K10	HB10/K10	HB10/K10
cutting speed, m/min			
	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°

物理性能

Physical properties

密度 /
Density at 20°C (68°F) 8,10kg/dm³

热传导系数 /
Thermal conductivity at 20°C (68°F) 22,0W/(m.K)

比热 /
Specific heat at 20°C (68°F) 433J/(kg.K)

电阻率 /
Electrical resistivity at 20°C (68°F) 0,47Ohm.mm²/m

弹性模量 /
Modulus of elasticity at 20°C (68°F) 219 x10³N/mm²

热膨胀系数 20°C 与 ...°C, 10⁻⁶ m/(m.K)

Thermal expansion between 20°C (68°F) and ...°C (°F), 10⁻⁶ m/(m.K) at

100°C (210°F)	200°C (390°F)	300°C (570°F)	400°C (750°F)	500°C (930°F)	600°C (1110°F)	700°C (1290°F)
11,5	11,7	12,2	12,4	12,7	13,0	12,9

由于本产品说明书没有描述具体的用途和加工步骤，用户在使用过程中若有疑问，可以就具体问题咨询我方有关人员。

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.

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