

WARMARE 熱作工具鋼
HOT WORK TOOL STEEL

BÖHLER W360 
ISOBLOC®



HOT WORK
TOOL STEEL

高硬度之熱作工具鋼

HOT WORK TOOL STEEL WITH HIGH HARDNESS

BÖHLER W360 ISOBLOC 是為了溫鍛和熱鍛之模具及沖頭等應用所開發出之熱作工具鋼。此鋼種可廣泛運用於各種須兼顧硬度和韌性之應用。

***BÖHLER W360 ISOBLOC** was developed as a tool steel for dies and punches in warm and hot forging. The steel can be used for a variety of applications where hardness and toughness are required.*

特性

- 高硬度 (建議使用硬度: 52 – 57 HRC)
- 優異之韌性
- 非常良好之抗回火軟化性
- 良好之熱傳導性
- 可使用水冷卻
- 均質化之金相組織

Properties

- High hardness (recommended in use: 52 – 57 HRC)
- Exceptional toughness
- High temper resistance
- Good thermal conductivity
- Can be cooled with water
- Homogeneous microstructure

應用

- 溫鍛和熱鍛之模具及沖頭
- 高速鍛壓機之工具
- 對韌性有高度要求之冷作應用
- 擠出工具，如模具
- 壓鑄模中的芯銷和模仁
- 塑膠加工產業中的特殊應用

Applications and uses

- Dies and punches in warm and hot forging
- Tooling for high speed presses
- Toughness-critical cold work applications
- Extrusion tooling, e.g. dies
- Core pins and inserts in die-casting dies
- Specific applications in the plastic processing sector



BÖHLER W360 ISOBLOC是為滿足市場需求而開發的，兼具高速鋼的高硬度和熱作工具鋼的極佳韌性之綜合優勢。這些特性可以顯著地延長工具的使用壽命。

***BÖHLER W360 ISOBLOC** has been developed to meet the requirements of the market and has the combined advantages of the high hardness of a high speed steel with the very good toughness of a hot work tool steel. These are characteristics which can significantly increase the life-time of your tool.*



電渣重熔之煉鋼製程可確保高冶金清淨度，因此具有最佳之材料特性。

Electroslag remelting ensures a high metallurgical cleanliness and therefore best material properties

藉由比較自證其優異品質

THE COMPARISON SPEAKS FOR ITSELF

BÖHLER W360 ISOBLOC之優異特性歸功於其專利合金成分，以及電渣重熔之煉鋼製程。

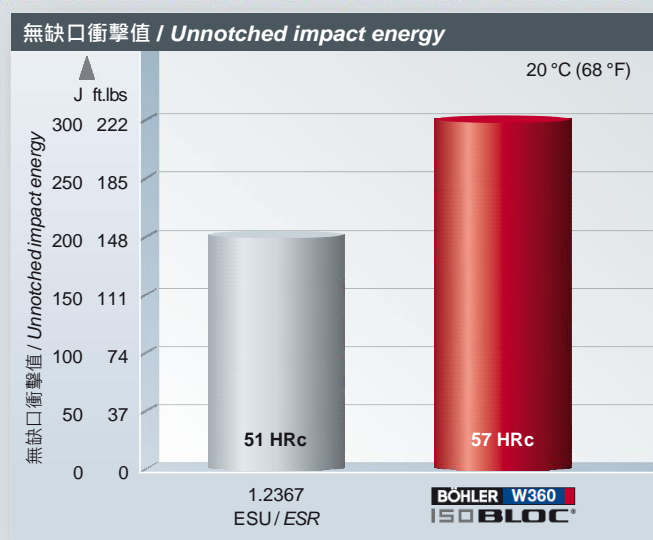
BÖHLER W360 ISOBLOC owes its excellent properties to a patented alloying concept and the electroslag remelting process.

韌性

韌性可使熱作鋼避免斷裂，並增強對熱龜裂和熱衝擊之抵抗，是熱作鋼中最重要的特性之一。通常高硬度與低韌性會相伴存在，但W360 ISOBLOC並非如此，此鋼種可兼顧高硬度和相對高之韌性。

Toughness

The toughness of hot work tool steels is one of the most important properties for safety against fracture and increased resistance to heat-checking and thermal shock. High hardness is usually associated with low toughness. This is not the case for W360 ISOBLOC.



BÖHLER W360 ISOBLOC 硬度較高之下韌性較1.2367 ESR更高 / BÖHLER W360/ISOBLOC has a significantly higher toughness than 1.2367 ESR – at a higher hardness.

主要鋼材特性之比較

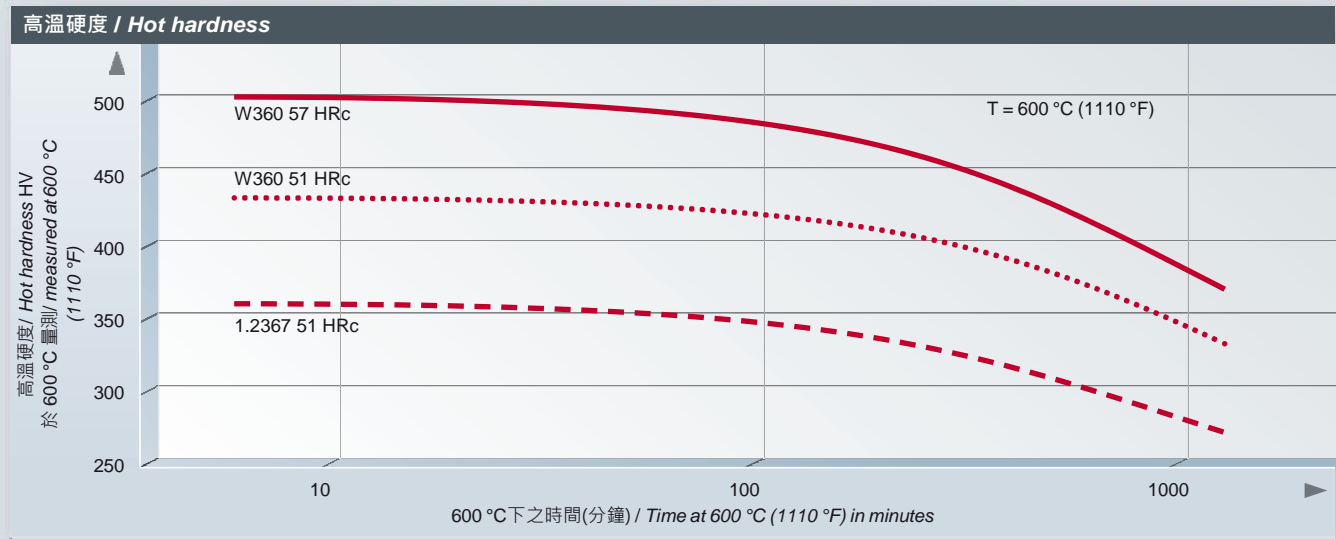
COMPARISON OF THE MAJOR STEEL PROPERTIES

高溫硬度

W360 ISOBLOC除了有極佳之韌性外，也具有出色之高溫穩定性，這些特性也使此鋼種於熱負載時，仍能維持高溫硬度和穩定性。具備這些優秀性能之W360 ISOBLOC，可提升對熱疲勞和災難性失效之高抵抗性。

Hot hardness

Alongside the outstanding toughness, W360 ISOBLOC is distinguished by its high thermal stability. This is reflected in the high hot hardness and the stability of the material under thermal loading. These properties, combined in W360 ISOBLOC, ensure a high resistance to thermal fatigue and catastrophic failure.



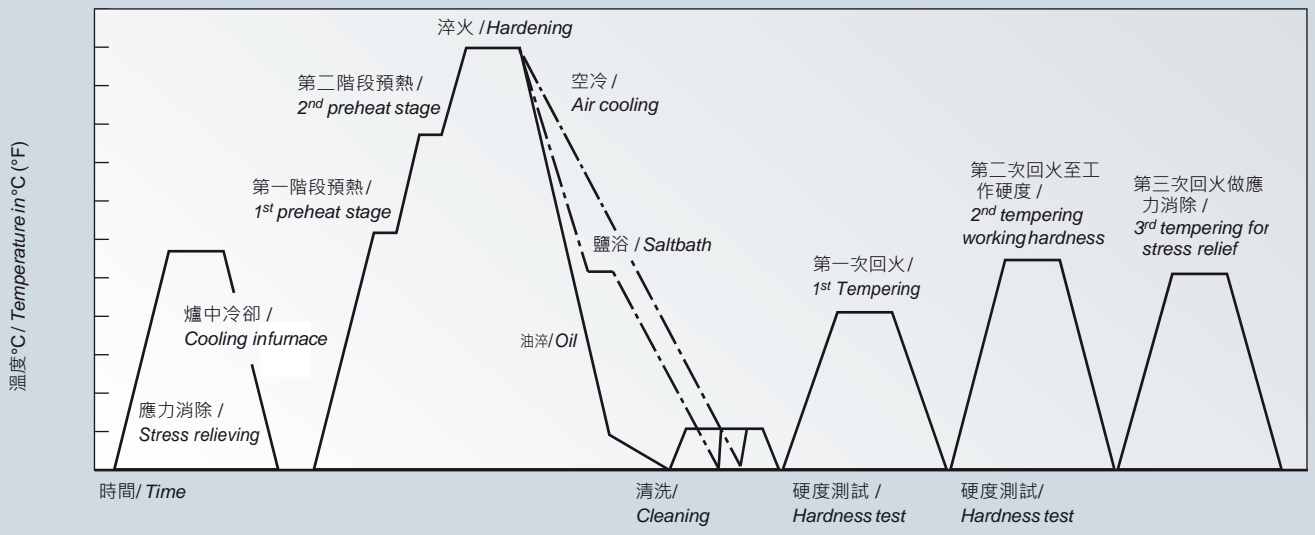
常溫硬度均為51 HRC 時，加熱後BÖHLER W360 ISOBLOC之高溫硬度較 1.2885 和 1.2367 之高溫硬度更高，若將 BÖHLER W360 ISOBLOC 之常溫硬度提高至 57 HRC，能更進一步提升高溫硬度。

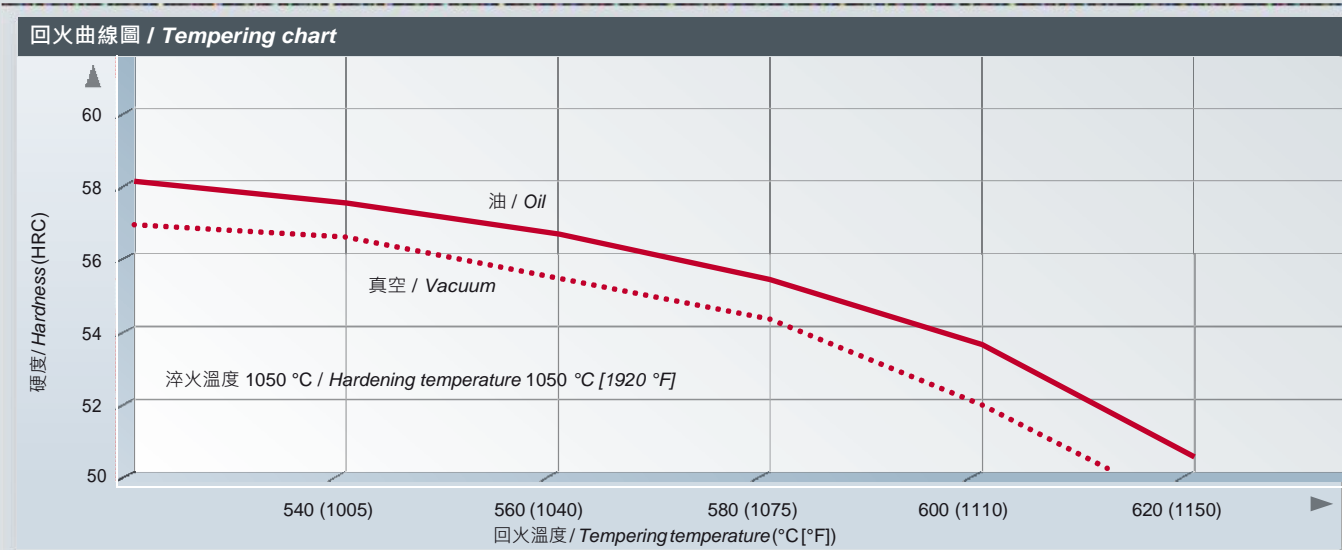
At 51 HRC, BÖHLER W360 ISOBLOC has a higher hot hardness than 1.2885 and 1.2367. If the hardness of BÖHLER W360 ISOBLOC is increased to 57 HRC, then the result is a further increase in the hot hardness.

最佳性能

BEST PROPERTIES

熱處理製程 / Heat treatment sequence





數據和事實

NUMBERS, DATA, FACTS

從實驗室至客戶端

從鋼種研發階段開始，BÖHLER就將節省加工成本作為此鋼種的重點特性之一。

以下為BÖHLER W360 ISOBLOC 之數據和資料。

From laboratory to customer

BÖHLER recognises cost effectiveness of tooling as a central concern during the development process.

The facts and figures of BÖHLER W360 ISOBLOC at a glance.

合金成分 (平均 %) / <i>Chemical composition (average %)</i>					
C	Si	Mn	Cr	Mo	V
0,50	0,20	0,25	4,50	3,00	0,55



物理特性 / Physical properties

測試條件: 淬火並回火 / Condition: hardened and tempered

於20 °C之密度 / Density at 20 °C
Density at 68 °F

7,6 kg/dm³
0.274 lbs/in³

於20 °C之電阻率 / Electrical resistivity at 20 °C
Electrical resistivity at 68 °F

0,59 Ohm.mm²/m
0.98 x 10⁻³ Ohm circular-mil per ft

從20 °C 升溫至下列溫度之熱膨脹 / Thermal expansion between 20 °C (68 °F) and ... °C (°F)

100 °C	200 °C	300 °C	400 °C	500 °C	600 °C	700 °C	
11,1	11,5	11,9	12,3	12,8	13,2	13,6	10 ⁻⁶ m/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	1110 °F	1290 °F	
6.2	6.4	6.6	6.8	7.1	7.3	7.6	10 ⁻⁶ in/in °F

熱傳導係數 W/(m.k) / Thermal conductivity Btu/ft h °F

	100 °C	200 °C	300 °C	400 °C	500 °C	
	31,5	32,3	32,6	32,5	31,9	in W/(m.K)
	210 °F	390 °F	570 °F	750 °F	930 °F	
	18.2	18.7	18.8	18.8	18.4	Btu/ in/ft ² h °F

數據和事實

NUMBERS, DATA, FACTS

交貨狀態

- 退火，硬度最高至 205 HB

熱處理

退火

- 750 至 800 °C，持溫時間為6至8小時。
- 在爐中緩慢降溫，並控制每小時冷卻10 到 20 °C至600 °C，再以空冷方式繼續冷卻。

應力消除

- 650 至 700 °C
- 充分加熱後，在中性氣體中放置1至2個小時
- 在爐中緩慢冷卻

淬火

- 淬火溫度為1050 °C/ 冷卻方式可使用油淬、鹽浴 (500 至 550 °C)、空冷有氣淬功能之真空爐
- 充分加熱後之持溫時間: 15 至 30 分鐘

回火 (按照回火曲線圖)

淬火後立刻緩慢升溫至回火溫度，爐中停留時間之計算方式為：每20mm厚/一小時，至少兩小時。空氣中冷卻。建議此鋼種須回火至少3次。

Supplied condition

- Annealed, 205 HB max.

Heat treatment

Annealing

- 750 bis 800 °C (1380 to 1470 °F), Holding time 6 to 8 hours
- Slow, controlled cooling in furnace at a rate of 10 to 20 °C/h (50 to 68 °F/h) down to approx. 600 °C (1110 °F), further cooling in air.

Stress relieving

- 650 bis 700 °C (1200 to 1290 °F)
- After through-heating, soak for 1 to 2 hours in a neutral atmosphere.
- Cool slowly in furnace.

Hardening

- 1050 °C (1920 °F)/oil, salt bath 500 bis 550 °C (930 to 1020 °F), air, vacuum furnace with gas quenching
- Holding time after through-heating: 15 to 30 minutes

Tempering (according to tempering chart)

Slowly heat to tempering temperature immediately after hardening. Time in furnace: 1 hour for every 20 mm of workpiece thickness but at least 2 hours. Cool in air. We recommend that the steel be tempered at least 3 times.

連續冷卻 CCT 曲線圖 / Continuous cooling CCT curves

沃斯田鐵化溫度 : 1050 °C
 持溫時間 : 30 分鐘

5 ... 100 各相佔比 %

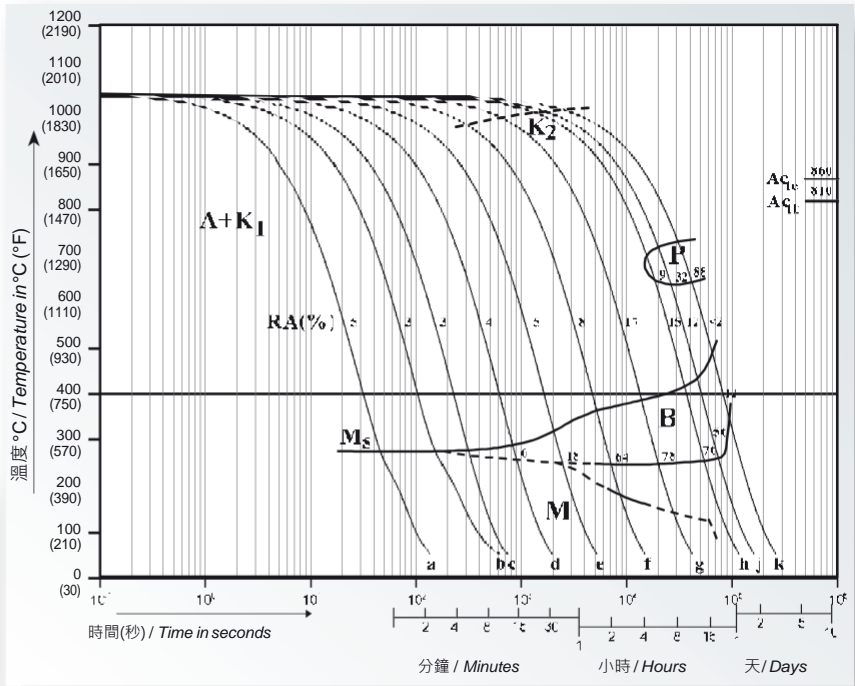
0,15 ... 400 冷卻參數 (λ), 例如從 800 至 500 °C 之冷卻時間 ($s \times 10^{-2}$)

Austenizing temperature: 1050 °C (1920 °F)
 Holding time: 30 minutes

5 ... 100 phase percentages

0.15 ... 400 cooling parameter (λ), i.e. duration of cooling from 800 – 500 °C (1470 – 930 °F) in $s \times 10^{-2}$

試片 / Sample	λ	HV ₁₀
a	0,15	785
b	0,50	760
c	1,10	762
d	3,00	754
e	8,00	724
f	23,00	582
g	65,00	498
h	180,00	453
j	250,00	415
k	400,00	294



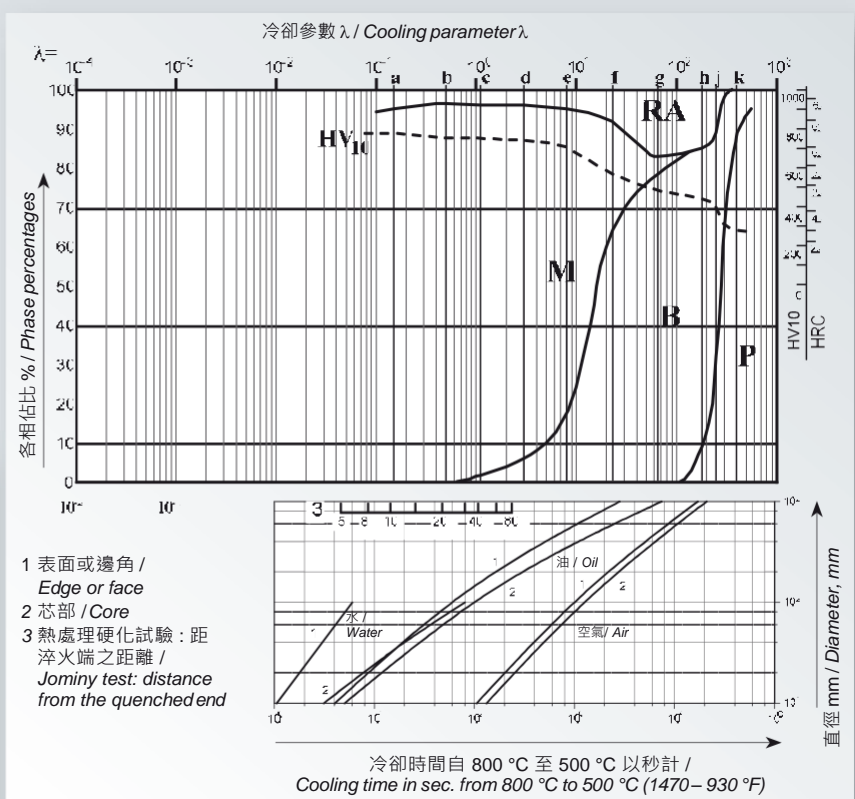
相圖 / Quantitative phase diagram

- K_{1,2} 碳化物 / Carbide
- RA 殘留沃斯田鐵 / Retained austenite
- A 沃斯田鐵 / Austenite
- M 麻田散鐵 / Martensite
- P 波來鐵 / Pearlite
- B 變韌鐵 / Bainite

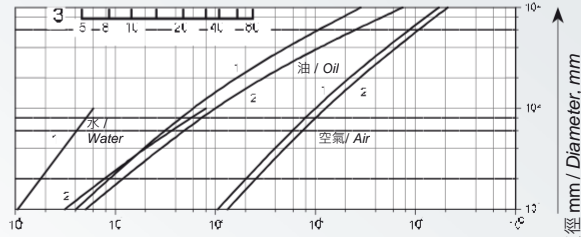
退火金相組織 / Annealed microstructure



BÖHLER W360 ISO BLOC 0 10 μm



- 1 表面或邊角 / Edge or face
- 2 芯部 / Core
- 3 熱處理硬化試驗 : 距淬火端之距離 / Jominy test: distance from the quenched end



冷卻時間自 800 °C 至 500 °C 以秒計 / Cooling time in sec. from 800 °C to 500 °C (1470 – 930 °F)

加工建議

MACHINING RECOMMENDATIONS

條件: 退火材 · 建議值僅供參考

使用碳化鎢車削				
加工深度 mm	0,5 – 1	1 – 4	4 – 8	über 8
進給 mm/轉	0,1 – 0,3	0,2 – 0,4	0,3 – 0,6	0,5 – 1,5
BOEHLERIT-牌號	SB10, SB20	SB10, SB20, SB30	SB30, EB20	SB30, SB40
ISO-牌號	P10, P20	P10, P20, P30	P30, M20	P30, P40
加工速度 v_c (m/min)				
捨棄式刀片 刀具壽命 15 min	310 – 200	220 – 130	180 – 100	120 – 50
硬焊刀具 刀具壽命30 min	260 – 150	210 – 100	130 – 85	90 – 50
鍍膜捨棄式刀具 刀具壽命 15 min BOEHLERIT ROYAL 121 BOEHLERIT ROYAL 131	最高至 300 最高至 240	最高至 270 最高至 175	最高至 195 最高至 135	最高至 125 最高至 70
硬焊刀具角度				
法後角	6° – 8°	6° – 8°	6° – 8°	6° – 8°
法前角	12°	12°	12°	12°
斜角	0°	-4°	-4°	-4°

使用高速鋼車削					
加工深度mm	0,5	3	6	10	超過 10
進給mm/轉	0,1	0,5	1,0	1,5	超過 1,5
BOEHLERIT/DIN-牌號	S700/DIN S10-4-3-10				
加工速度 v_c (m/min)					
刀具壽命 60 min	45 – 30	30 – 22	22 – 18	18 – 12	16 – 8
法前角	14°	14°	14°	14°	14°
法後角	8°	8°	8°	8°	8°
斜角	0°	0°	-4°	-4°	-4°

插入式銑刀銑削				
進給 mm/齒	最高至 0,2	0,2 – 0,4		
加工速度 v_c (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			

使用碳化鎢鑽孔				
鑽孔直徑 mm	3 – 8	8 – 20	20 – 40	
進給 mm/齒	0,02 – 0,05	0,05 – 0,12	0,12 – 0,18	
BOEHLERIT / ISO 牌號	HB10/K10	HB10/K10	HB10/K10	
加工速度 v_c (m/min)				
	50 – 35	50 – 35	50 – 35	
鑽頂角	115 – 120°	115 – 120°	115 – 120°	
法後角	5°	5°	5°	

Condition: annealed, figures given are guidelines only

Turning with sintered carbide				
Depth of cut mm (inches)	0.5 – 1 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)	over 8 (over .31)
Feed mm / rev. (inches/rev.)	0.1 – 0.3 (.004 – .012)	0.2 – 0.4 (.008 – .016)	0.3 – 0.6 (.012 – .024)	0.5 – 1.5 (.020 – .060)
BOEHLERIT grade	SB10, SB20	SB10, SB20, EB10	SB30, EB20	SB30, SB40
ISO grade	P10, P20	P10, P20, M10	P30, M20	P30, P40
Cutting speed v_c m/min (f.p.m)				
Indexable inserts				
Tool life: 15 min.	310 – 200 (1015 – 655)	220 – 130 (720 – 425)	180 – 100 (590 – 330)	120 – 50 (395 – 165)
Brazed carbide tools				
Tool life: 30 min.	260 – 150 (850 – 490)	210 – 100 (690 – 330)	130 – 85 (425 – 280)	90 – 50 (295 – 165)
Coated indexable inserts				
Tool life: 15 min.				
BOEHLERIT ROYAL 121	up to 300 (980)	up to 270 (885)	up to 195 (640)	up to 125 (410)
BOEHLERIT ROYAL 131	up to 240 (790)	up to 175 (575)	up to 135 (445)	up to 70 (230)
Tool angles for brazed carbide tools				
Clearance angle	6° – 8°	6° – 8°	6° – 8°	6° – 8°
Rake angle	12°	12°	12°	12°
Inclination angle	0°	-4°	-4°	-4°

Turning with high speed steel					
Depth of cut mm (inches)	0.5 (.02)	3 (.12)	6 (.24)	10 (.40)	over 10 (.40)
Feed mm / rev. (inches/rev.)	0.1 (.004)	0.5 (.020)	1.0 (.040)	1.5 (.060)	over 1.5 (.060)
HSS-grade BÖHLER/DIN	S700 / DIN S10-4-3-10				
Cutting speed v_c m/min (f.p.m)					
Tool life: 60 min.	45 – 30 (150 – 100)	30 – 22 (100 – 70)	22 – 18 (70 – 60)	18 – 12 (60 – 40)	16 – 8 (50 – 25)
Rake angle	14°	14°	14°	14°	14°
Clearance angle	8°	8°	8°	8°	8°
Inclination angle	0°	0°	-4°	-4°	-4°

Milling with inserted tooth cutter				
Feed mm/tooth (inches/tooth)	up to 0.2 (.008)	0.2 – 0.4 (.008 – .016)		
Cutting speed v_c m/min (f.p.m)				
BOEHLERIT SBF / ISO P25	150 – 100 (490 – 330)	110 – 60 (360 – 195)		
BOEHLERIT SB40 / ISO P40	100 – 60 (330 – 195)	70 – 40 (230 – 130)		
BOEHLERIT ROYAL 131 / ISO P35	130 – 85 (425 – 280)			

Drilling with inserted carbide				
Drill diameter mm (inches)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)	
Feed mm / rev. (inches/rev.)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)	
BOEHLERIT/ISO grade	HB10 / K10	HB10 / K10	HB10 / K10	
Cutting speed v_c m/min (f.p.m)				
	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)	
Point angle	115° – 120°	115° – 120°	115° – 120°	
Clearance angle	5°	5°	5°	



SPECIAL STEEL FOR THE WORLD'S TOP PERFORMERS

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