

PLASTIC  
MOULD STEEL

## PLASTIC MOULD STEEL

**BÖHLER M340**  
**ISOPLAST®**

# 恰恰符合 您的需求 EXACTLY TO YOUR LIKING



An increase in productivity in high-tech mould-making can only be achieved by using mould steels with materials properties trimmed specifically towards the intended use. Due to the increased share of **glass-fiber reinforced** plastics, **BÖHLER M340 ISOPLAST** is also increasingly suitable for this kind of processing. In addition, this grade also provides **good food resistance**. Approvals for the food industry are available from voestalpine BÖHLER Edelstahl.

The following properties are decisive: **Wear resistance, corrosion resistance, toughness, etchability and polishability**. An optimum combination of properties appropriate to the intended use is made possible by specifically tailoring the heat treatment.

## BÖHLER M340 ISOPLAST PROVIDES YOU WITH THESE ADVANTAGES.

若要提高高科技模具製造的生產力，則需使用特殊設計之模具鋼材，針對大量製造而調整材料特性，才得以達成目標。現今越來越多製程使用添加玻璃纖維之塑料，由於**BÖHLER M340 ISOPLAST**非常適合用於此類製程，也越來越廣泛地被應用。此外，該鋼種用於食品用途不易變質，奧鋼聯BÖHLER Edelstahl也通過並取得食品工業的相關認證。

使M340擁有決定性之優勢的幾項特性：耐磨耗性、抗腐蝕性、韌性、易咬花也易拋光。通過客製化的熱處理，可以使M340達到適合預計用途之最佳性能組合。

BÖHLER M340 ISOPLAST為您提供以上優勢。



## 為了極高要求而設計的鋼種 A STEEL FOR EXTREMELY HIGH REQUIREMENTS

**BÖHLER M340 ISOPLAST** is a high performance plastic mould steel with a hardness of max. 56 HRC:

- » Excellent corrosion resistance properties
- » Suitable for heat treatment in vacuum furnaces
- » Fine carbide structure
- » Good dimensional stability with appropriate heat treatment
- » Excellent high wear resistance / edge-holding ability
- » Good machinability
- » Good polishability

**BÖHLER M340 ISOPLAST** 是一種高性能的塑膠模具鋼材，該鋼種的最高硬度為56 HRC:

- » 優異的抗腐蝕性
- » 適合在真空爐中熱處理
- » 細緻的碳化物組織
- » 在適當的熱處理下具有良好的尺寸穩定性
- » 優異的耐磨耗性/邊角維持性
- » 加工性佳
- » 拋光性佳

### Chemical composition (average %) 合金成分(平均%)

C	Si	Mn	Cr	Mo	V	+N
0.54	0.45	0.40	17.30	1.10	0.10	

# 穩定之性能 最高等級之表現

## UNIVERSAL & TOP PERFORMING

Advantages which highlight the cost saving potential of BÖHLER M340 ISOPLAST:

Well balanced material properties for an efficient tool manufacturing process:

- » Good machinability
- » Consistently high quality
- » Good polishability
- » Dimensional stability
- » Technical assistance and advice in tool manufacture and use

The usage of BÖHLER M340 ISOPLAST demonstrates its steadiness in several requirements:

- » Highest precision parts
- » Processability of plastics containing abrasive (GF, CF, ...) and corrosive fillers
- » Elevated processing temperatures
- » Higher tool economy
- » Applications for food processing
- » Instruments and knives typical for cutting applications

BÖHLER M340 ISOPLAST 擁有之性能優勢有效地替使用者節省成本

平衡的材料特性能使模具生產過程維持高效率

- » 加工性佳
- » 穩定維持高品質
- » 拋光性佳
- » 尺寸穩定性佳
- » 模具製造及使用過程中的技術協助與建議

BÖHLER M340 ISOPLAST 在以下應用中證明了其穩定性

- » 高精密之零配件
- » 加工含磨料(玻纖/碳纖)及具腐蝕性之塑膠
- » 高工作溫度
- » 高經濟價值之模具
- » 食品加工業之應用
- » 刀具或常用於切割之工具





## MICROSTRUCTURE

Comparison BÖHLER M340 ISOPLAST with WNr. 1.4112-ESR. The fine, homogeneous microstructure results in good machinability and properties in service.

### 金相組織

將BÖHLER M340 ISOPLAST與WNr. 1.4112-ESR兩者之金相組織作比較，前者細緻並均勻之微觀結構可以提供較良好的加工性及使用性能



BÖHLER M340 ISOPLAST, 200x

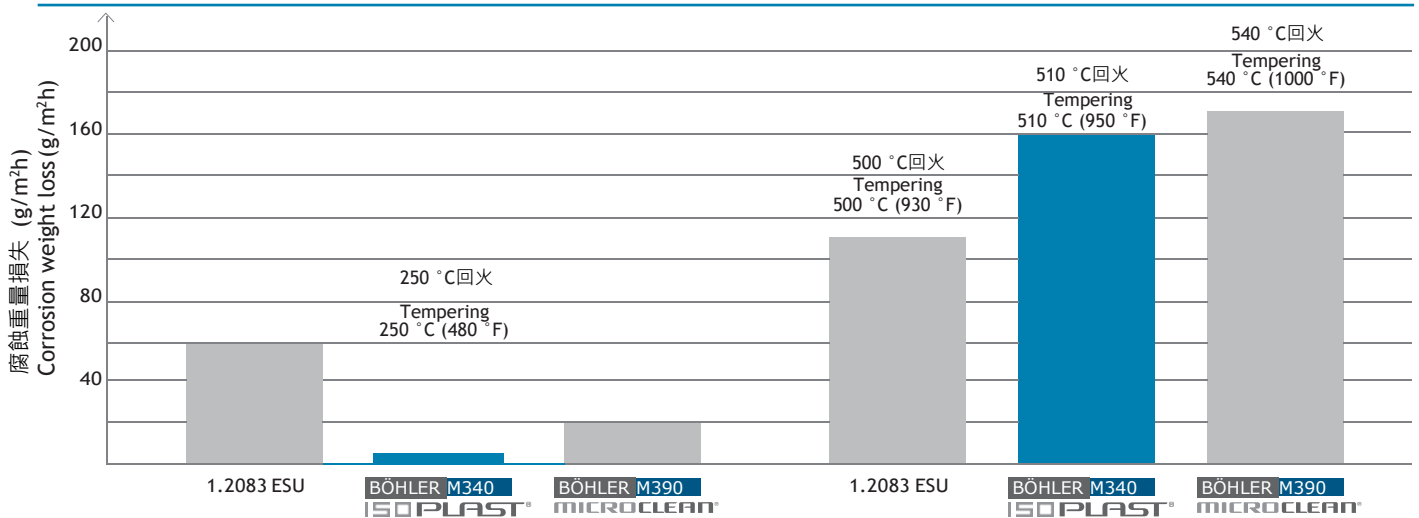


WNr. 1.4112-ESR, 200x



# 材料特性 MATERIAL PROPERTIES

## Corrosion resistance 抗腐蝕性



Heat treatment: without subzero treatment

Hardening temperature: 1.2083 at 1020 °C (1870 °F); M340 ISOPLAST at 1000 °C (1830 °F); M390 MICROCLEAN at 1150 °C (2100 °F)

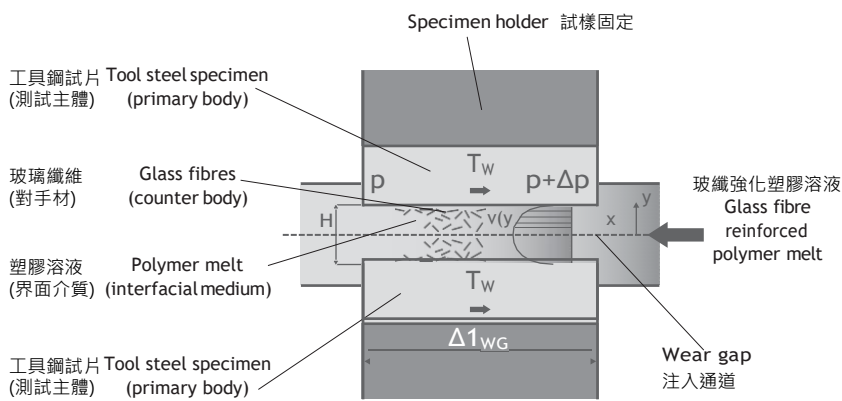
Weight loss test: measured after 24h in 20% boiling acidic acid

熱處理: 未深冷處理

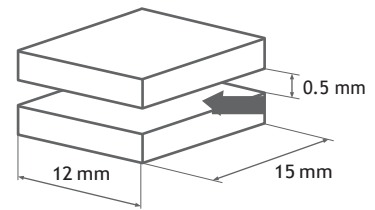
硬化溫度: 1.2083 加熱至 1020 °C; M340 ISOPLAST 加熱至 1000 °C; M390 MICROCLEAN 加熱至 1150 °C

重量損失試驗: 回火處理後, 採用沸騰20%醋酸溶液24小時。

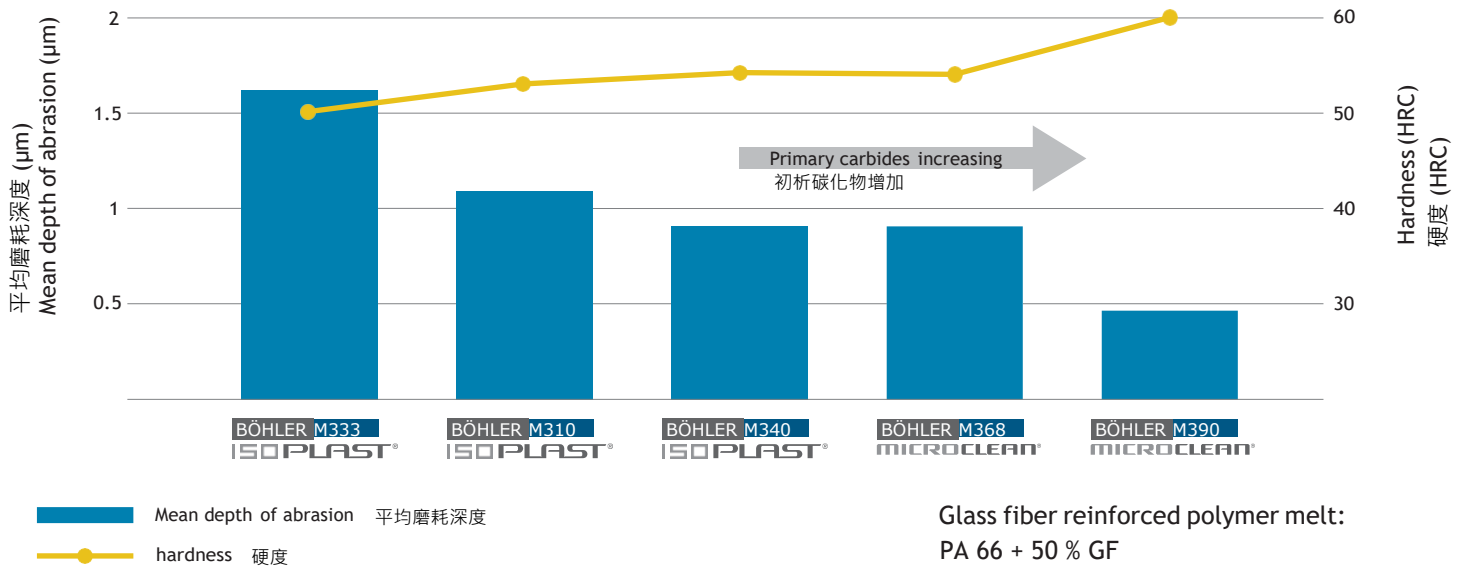
Small Plates Wear Tests 小樣本磨耗測試



測試樣本的平均磨損深度或重量損失就能測試出耐磨性  
 Mean depth of abrasion or weight loss of the testing plates indicates the wear resistance.



Wear resistance with plate-wear test 抗磨耗性試片測試之結果



Glass fiber reinforced polymer melt:  
 PA 66 + 50 % GF

玻纖強化塑膠  
 PA 66 + 50 % 玻纖



# HEAT TREATMENT 熱處理建議

## Supplied condition

- » Soft annealed with max. 260 HB

## Stress relieving

- » approx. 650 °C (1200 °F)
- » After temperature equalization, soak for 1 to 2 hours in neutral atmosphere. Slow cooling in furnace.

## Hardening

- » 980 to 1000 °C (1800 – 1830 °F) / N<sub>2</sub>
- » Holding time after temperature equalization: 15 to 30 minutes

## Achievable hardness

- » max. 56 HRC

## 鋼廠之熱處理

- » 軟退火至最高 260 HB

## 應力消除

- » 回火溫度約 650 °C (1200 °F)
- » 內外溫度一致後，在中性氣體中持溫約一至兩小時，再放置爐內冷卻

## 硬化

- » 980 至 1000 °C / 氮氣淬
- » 內外溫度一致後，在中性氣體中持溫約 15 至 30 分鐘

## 最高可達硬度

- » 最高至 56 HRC

## Tempering for highest corrosion resistance

- » Deep freezing for transformation of retained austenite
- » Slow heating to tempering temperature
- » Time in furnace 1 hour for each 20 mm (0.79 inch) of workpiece thickness, but at least 2 hours
- » For information on the achievable hardness after tempering please refer to the tempering chart.
- » Tempering: 250 to 350 °C (480 – 660 °F)

## Tempering for highest wear resistance

- » Deep freezing recommended
- » A deep freezing treatment immediately following hardening leads to increased tempering hardness values [Risk of stress cracking]
- » Slow heating to tempering temperature
- » Time in furnace 1 hour for each 20 mm (0.79 inch) of workpiece thickness, but at least 2 hours
- » For information on the achievable hardness after tempering please refer to the tempering chart.

## 獲得最高耐腐蝕性之回火

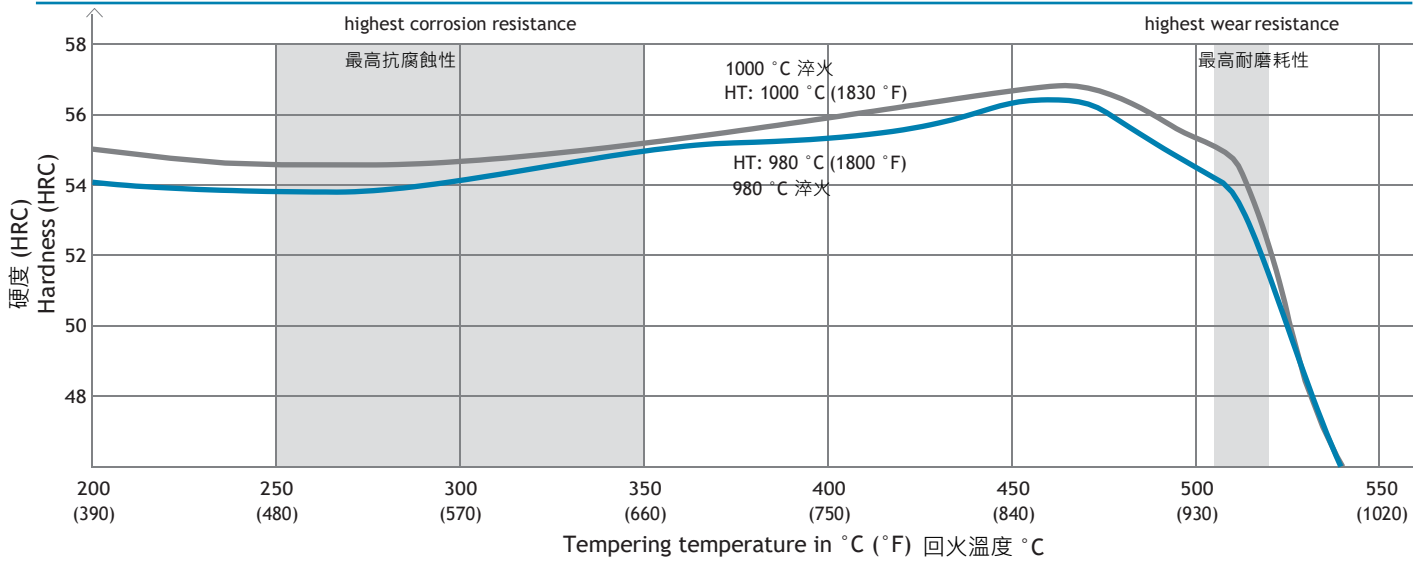
- » 深冷促使殘留沃斯田鐵相轉變
- » 緩慢昇溫至回火溫度
- » 爐中持溫時間計算方法: 每20mm厚度加一小時，但至少需回火兩小時
- » 回火後可達硬度之資訊請參閱回火硬度溫度關係曲線圖
- » 回火溫度: 250 to 350 °C

## 獲得最高耐磨性之回火

- » 建議進行深冷處理
- » 硬化後，立刻進行深冷處理，可提升回火硬度值，[具應力開裂風險]
- » 緩慢加熱至回火溫度
- » 爐中持溫時間計算方法: 每20mm厚度加一小時，但至少需回火兩小時
- » 回火後可達硬度之資訊請參閱回火硬度溫度關係曲線圖



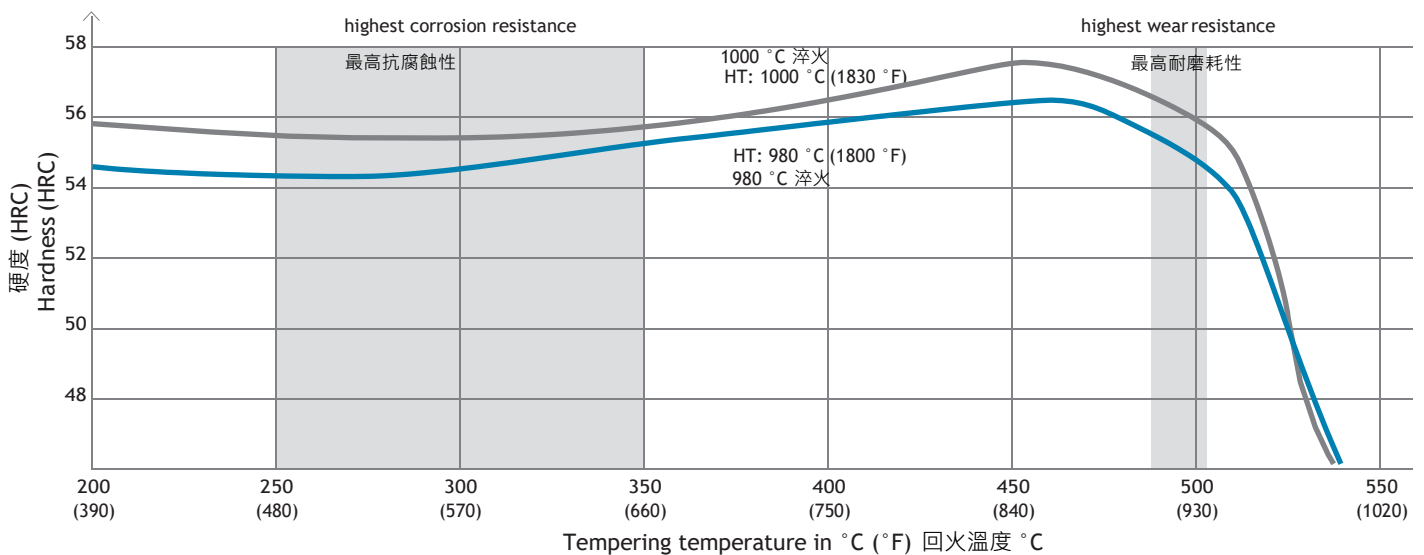
Tempering chart (without subzero treatment) 回火硬度溫度關係曲線圖 (無深冷)



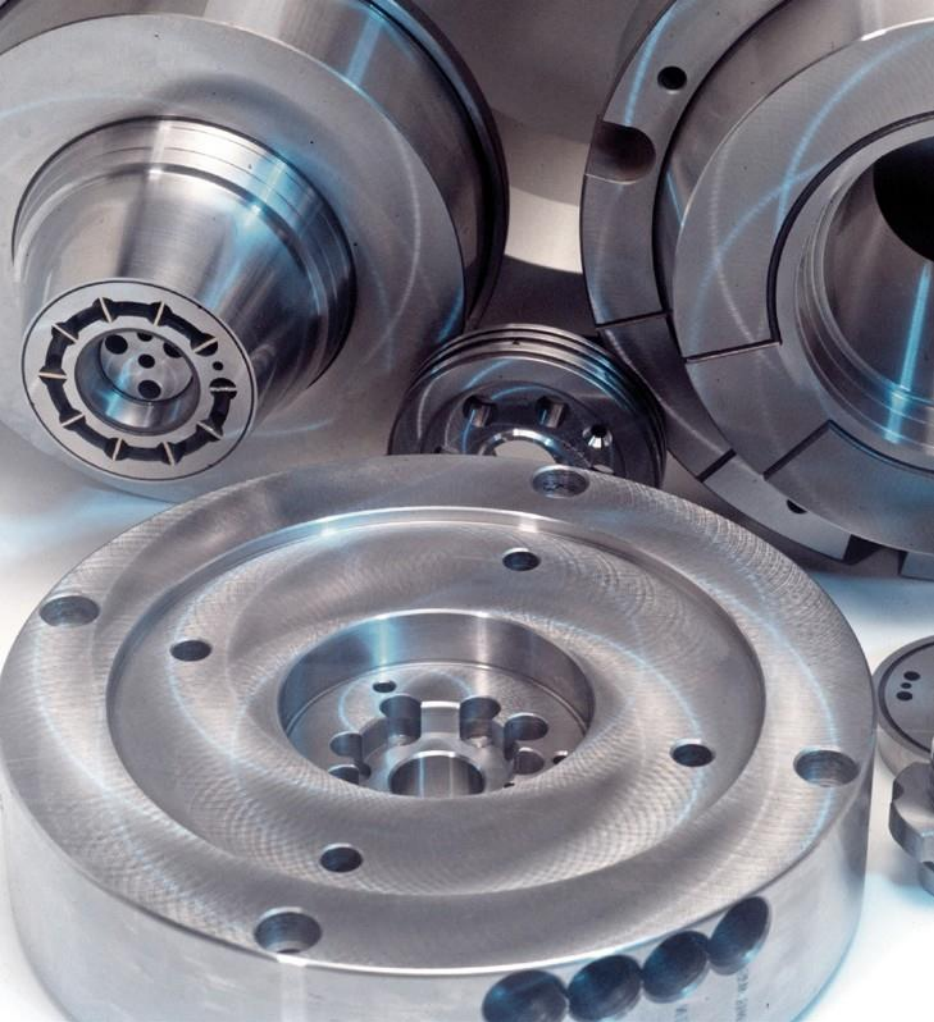
Heat treatment: Hardening in vacuum furnace; Tempering 3 x 2 h  
熱處理：在真空爐中作硬化；回火3次 x 2小時

回火硬度溫度關係曲線圖 (含深冷)

Tempering chart (with subzero treatment)



Heat treatment: Hardening in vacuum furnace; Tempering 3 x 2 h  
熱處理：在真空爐中作硬化；回火3次 x 2小時

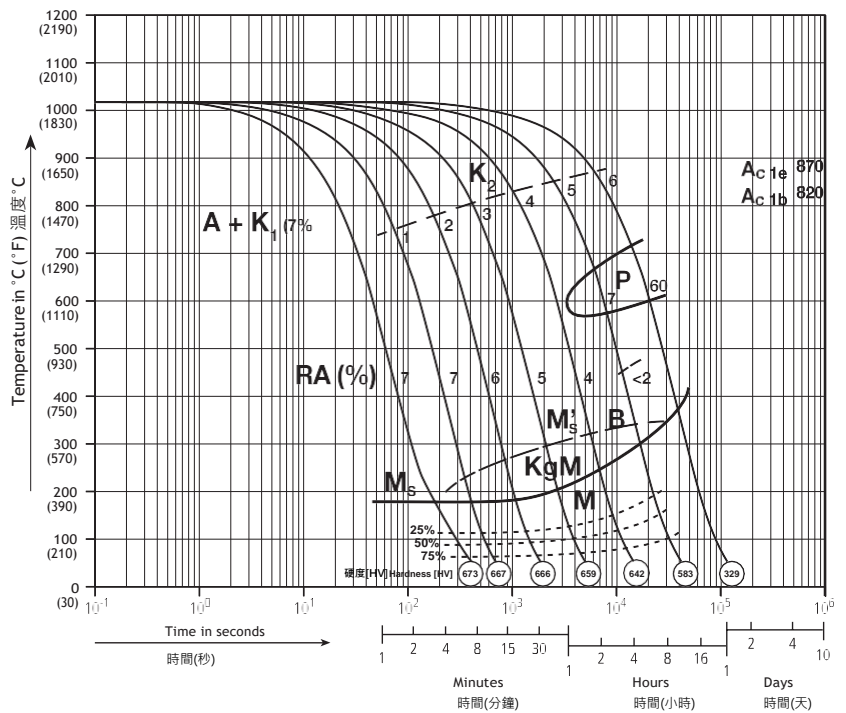


**Continuous cooling CCT curves 持續冷卻CCT曲線圖**

Austenitizing temperature: 1000 °C (1830 °F)  
 Holding time: 30 minutes  
 沃斯田鐵化溫度: 1000 °C  
 持溫時間: 30分鐘

7...60 Phase percentages in %  
 相百分比

0.4...180 Cooling parameter, i.e. duration of cooling from 800 – 500 °C (1470 – 930 °F) in  $s \times 10^{-2}$   
 冷卻參數 · 例如800 – 500 °C 之冷卻時間，以  $s \times 10^{-2}$  為單位



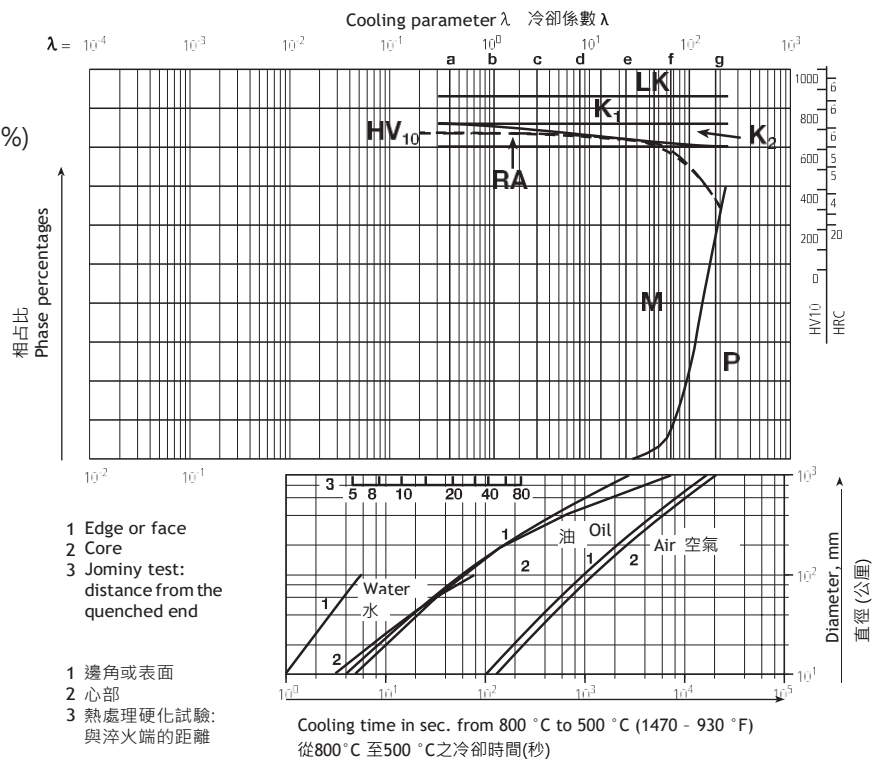


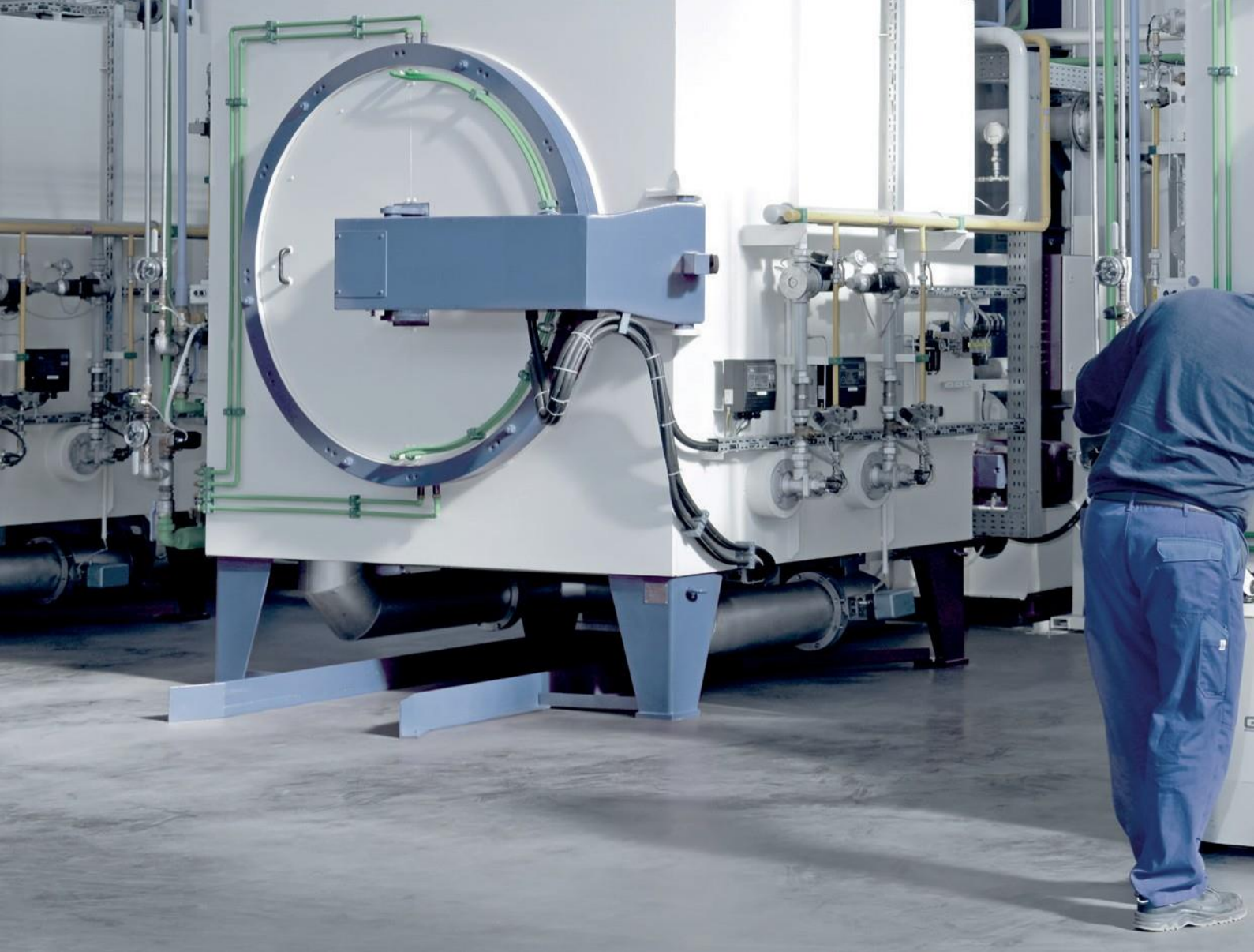
# 頂尖的性能 歸功於適宜的熱處理

## TOP PERFORMANCE THANKS TO PROPER TREATMENT

### Quantitative phase diagram 定量相圖

- K1 Carbides which are not dissolved during austenitization (7%)  
沃斯田鐵化過程中未溶解的碳化物(7%)
- K2 Start of carbide precipitation during quenching from austenitizing temperature  
碳化物開始從沃斯田鐵化溫度淬火中析出
- Ms-Ms' Range of grain boundary martensite  
麻田散鐵晶界範圍
- LK Ledeburitic carbides  
粒滴斑鐵碳化物
- RA Retained austenite  
殘留沃斯田鐵
- A Austenite  
沃斯田鐵
- M Martensite  
麻田散鐵
- P Pearlite  
波來鐵
- B Bainite  
變韌鐵





# NUMBERS, FACTS 數據與事實 AND DATA

## 物理性質(20°C下)

密度	20°C	7.70 kg/dm <sup>3</sup>
	68°F	0.278 lbs/in <sup>3</sup>
比熱容量	20°C	460 J/(kg.K)
	68°F	0.110 Btu/lb°F
導熱係數	20°C	18.2 W/(m.K)
	68°F	10.52 Btu/ft h°F

有磁化性可能

## Physical properties

Density at	20°C	7.70 kg/dm <sup>3</sup>
	68°F	0.278 lbs/in <sup>3</sup>
Specific heat capacity at	20°C	460 J/(kg.K)
	68°F	0.110 Btu/lb°F
Thermal conductivity at	20°C	18.2 W/(m.K)
	68°F	10.52 Btu/ft h°F

Magnetizability existing



#### Thermal conductivity 熱傳導係數

100 °C	200 °C	300 °C	400 °C	500 °C	
19.2	21.0	22.0	22.7	23.6	W/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	
11.10	12.13	12.71	13.12	13.64	Btu/ft h°F

#### 20°C與各目標溫度間之熱膨脹係數

#### Thermal expansion between 20 °C (68 °F) and ... °C (°F)

100 °C	200 °C	300 °C	400 °C	500 °C	
10.88	10.78	11.21	11.61	11.90	10 <sup>-6</sup> m/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	
6.04	5.99	6.23	6.45	6.61	10 <sup>-6</sup> in/in°F

#### Modulus of elasticity 彈性係數

20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	
219	215	209	201	193	183	10 <sup>9</sup> N/mm <sup>2</sup>
68 °F	210 °F	390 °F	570 °F	750 °F	930 °F	
31.8	31.2	30.3	29.1	28.0	26.5	10 <sup>3</sup> KSI

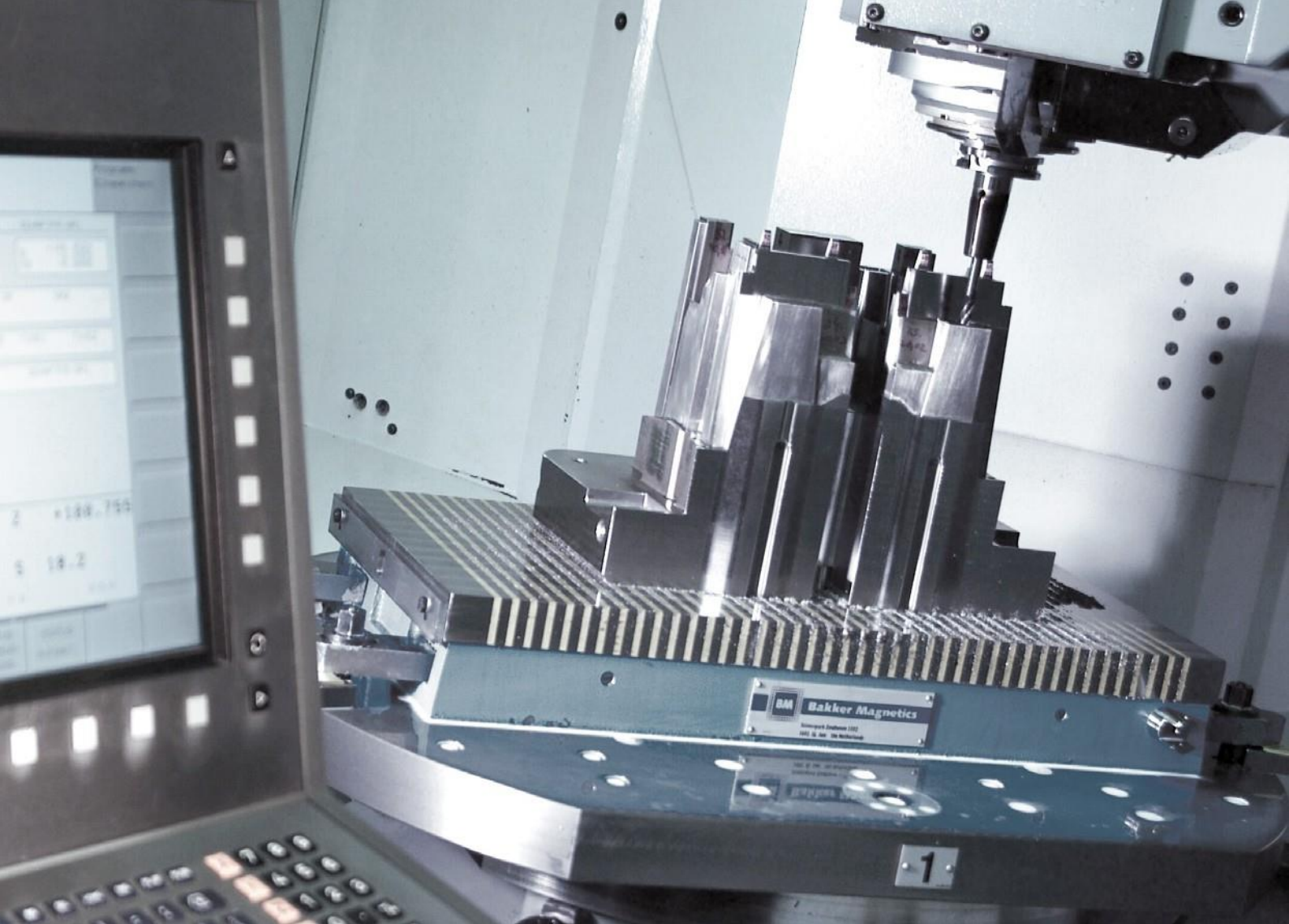
# 加工建議

# MACHINING GUIDELINES

## Turning with sintered carbide 碳化鎢切削

Depth of cut mm (inch)	切削深度 公厘	0.5 – 1 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)
Feed mm/rev. (inch/rev.)	進給速度 公厘/轉速	0.1 – 0.2 (.004 – .008)	0.2 – 0.4 (.008 – .016)	0.3 – 0.6 (.012 – .024)
BÖHLERIT grade	BÖHLERIT 牌號	SB10, SB20, EB10	SB20, EB10, EB20	SB30, EB20, HB10
ISO grade	ISO 牌號	P10, P20, M10	P20, M10, M20	P30, M20, K10
Cutting speed $v_c$ (m/min) (f.p.m) 切削速度 $v_c$ (公尺/分鐘)				
Indexable inserts	捨棄式刀片	260 – 200 (850 – 655)	200 – 150 (655 – 490)	150 – 110 (490 – 360)
Tool life: 15 min.	刀具壽命: 15分鐘			
Brazed tools	硬鐸刀具	210 – 170 (690 – 560)	170 – 130 (560 – 425)	140 – 90 (460 – 295)
Tool life: 30min.	刀具壽命: 30分鐘			
Coated indexable inserts	鍍膜捨棄式刀片			
BÖHLERIT LC 225 C		up to 260 (850)	up to 220 (720)	up to 150 (490)
BÖHLERIT LC 235 C		up to 230 (755)	up to 180 (590)	up to 130 (425)
Tool angles for brazed	硬鐸刀具角度			
tools Rake angle	刀具法前角	12° – 15°	12° – 15°	12° – 15°
Clearance angle	法後角	6° – 8°	6° – 8°	6° – 8°
Inclination angle	斜角	0°	0°	-4°

Condition is soft annealed, guidelines 此加工建議適用於軟退火之熱處理狀況



### Milling with inserted tooth cutter 碳化鎢插入式銑刀銑削

Feed mm/tooth (inch/tooth)	進給量 公厘/每齒	up to 0.2 (.008)	0.2 – 0.3 (.008 – .012)
Cutting speed $v_c$ (m/min) (f.p.m) 切削速度 公尺/分鐘			
BÖHLERIT LW 225		220 – 200 (720 – 655)	140 – 60 (460 – 195)
BÖHLERIT SB40 / ISO P40		100 – 60 (330 – 195)	70 – 40 (230 – 130)
BÖHLERIT LC 444 W		140 – 110 (460 – 360)	–

### Drilling with sintered carbide 碳化鎢鑽孔

Drill diameter mm (inch)	孔徑 公厘	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed mm/rev. (inch/rev.)	進給量 公厘/轉速	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BÖHLERIT/ISO grade	牌號	HB10/K10		
Cutting speed $v_c$ (m/min) (f.p.m)	加工速度 公尺/分鐘	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)
Point angle	尖角	115° – 120°	115° – 120°	115° – 120°
Clearance angle	法後角	5°	5°	5°

Condition is soft annealed, guidelines 此加工建議適用於軟退火之熱處理狀況

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