



PLASTIC
MOULD STEEL



POWDER
METALLURGY

PLASTIC MOULD STEEL

BÖHLER M390
MICROCLEAN®

M390 塑膠模具鋼

voestalpine BÖHLER Edelstahl GmbH & Co KG
www.voestalpine.com/boehler-edelstahl

voestalpine

ONE STEP AHEAD.



梧濟工業股份有限公司
WU JII INDUSTRY CO., LTD.

帶給您多項優異功能的高性能鋼種

BENEFIT IN RESPECT OF VERSATILITY AND PERFORMANCE

BÖHLER M390 MICROCLEAN is a martensitic chromium steel produced with powder metallurgy. Due to its alloying concept this steel offers **high wear resistance** and **good corrosion resistance** – the perfect combination for **best application properties**.

百樂 M390 超微淨粉末高速鋼是用粉末冶金方式生產的麻田散鐵的含鉻鋼。由於其合金設計，該鋼材具有高耐磨性和良好的耐腐蝕性-最佳應用性能的完美組合。

- » 高耐磨耗性
- » 良好的抗腐蝕性
- » 極佳的表面加工性
- » 高鏡面拋光性
- » 高韌性
- » 最小的尺寸變形
- » 較好地抵抗振動和機械衝擊

能夠提供您

- » 長且穩定的模具壽命
- » 生產過程的可重複性
- » 高精密度的零配件

帶給您的優勢

- » 提高產能
- » 降低單位成本

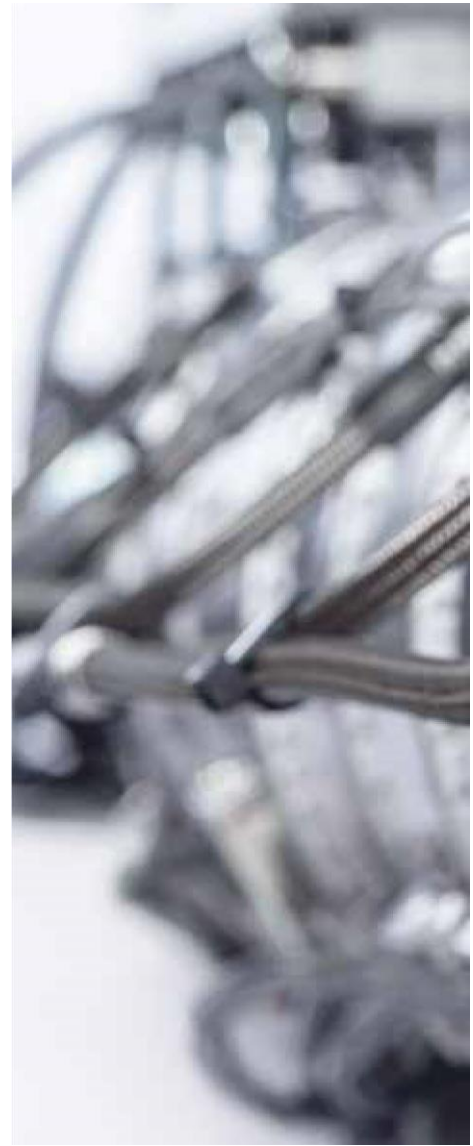
- » High wear resistance
- » Good corrosion resistance
- » Excellent grindability
- » High mirrorfinish polishability
- » High toughness
- » Minimum dimensional changes
- » Better resistance to vibrations and mechanical shocks

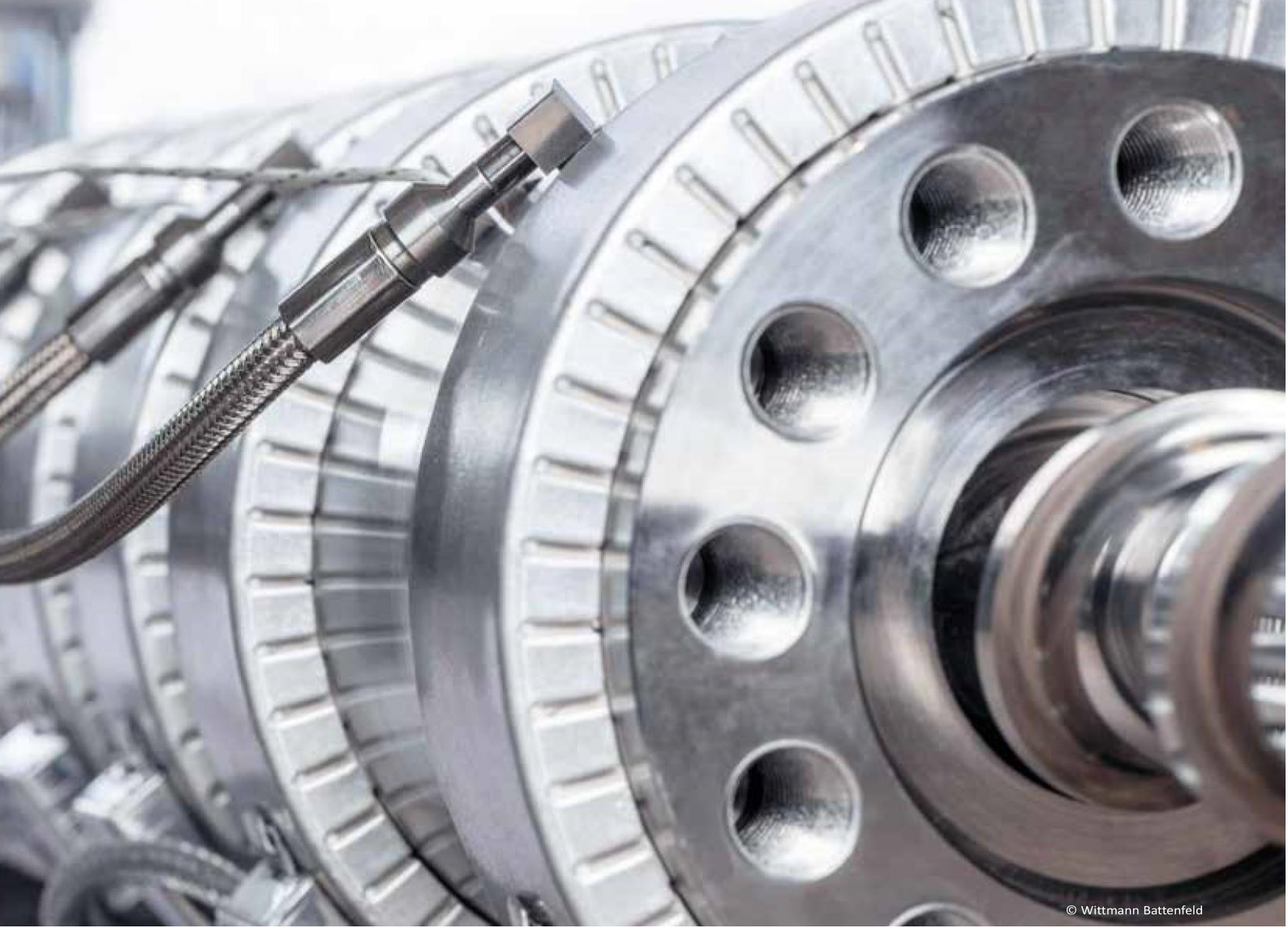
ENABLE

- » Long and constant tool life
- » Reproducibility of production processes
- » High precision components

BENEFIT

- » **INCREASED PRODUCTIVITY**
- » **REDUCED UNIT COSTS**





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FIELD OF APPLICATIONS

- » Mould inserts for the production of CDs and DVDs
- » Moulds for the processing of chemically aggressive plastics containing highly abrasive fillers
- » Moulds for the processing of duroplasts
- » Moulds for the production of chips for the electronics industry
- » Screws for injection moulding machines
- » Non return valves
- » Linings for injection moulding cylinders

Due to its outstanding property profile **BÖHLER M390 MICROCLEAN** is used in fields aside from plastics processing industry, such as:

- » Machine components for the paper and food processing industry
- » Knives

適用的產業

- » 製作 CD 或 DVD 的模仁
- » 用於含有高磨耗性添加物的化學侵蝕性塑料之模具
- » 用於熱固性塑膠(duroplast)之模具
- » 生產電子行業晶片之模具
- » 射出機的螺桿
- » 止回閥
- » 塑膠射出缸內襯

BÖHLER M390 MICROCLEAN 因為有著卓越的性能，除了用在塑膠加工業以外也常用在以下行業

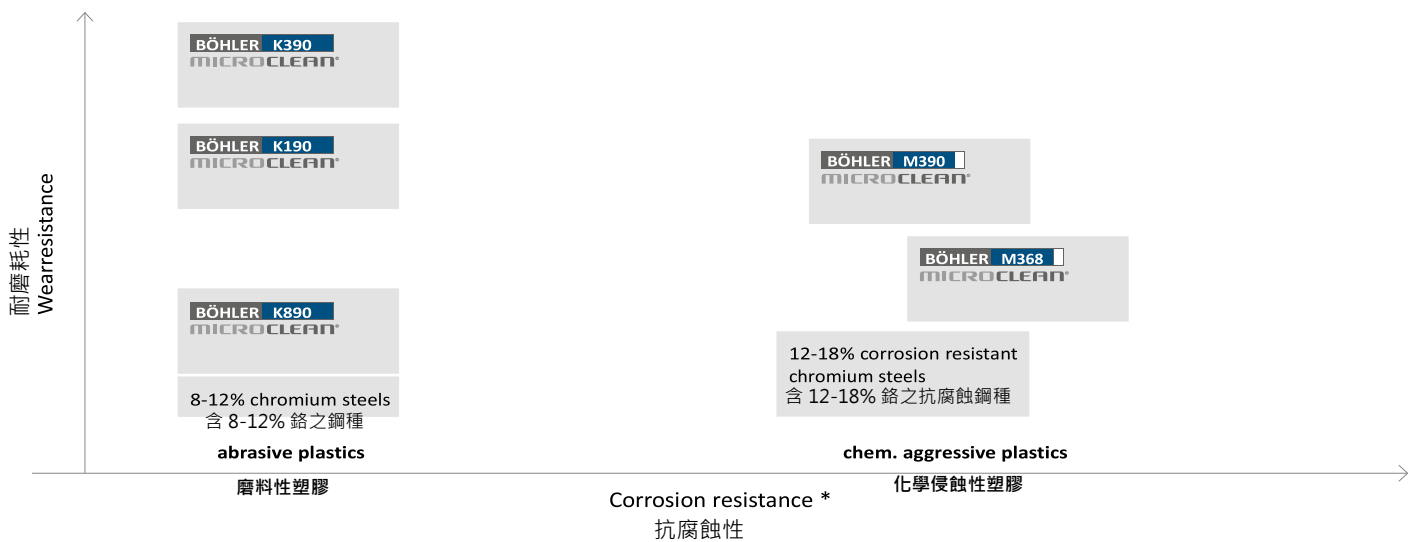
- » 造紙或食品加工業的機械零件
- » 刀具業

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

C	Si	Mn	Cr	Mo	V	W
1,90	0,70	0,30	20,00	1,00	4,00	0,60



Property profile of BÖHLER tool steels for the plastics processing industry BÖHLER 針對塑膠加工業所提供的鋼種



* High tempered, weight loss test with 20% boiling acetic acid, 24 h.
 高溫回火後·置放在沸騰之20%乙酸中24小時·再計算重量損失



MICROCLEAN (超微淨) 材料之優勢

THE ADVANTAGES OF MICROCLEAN MATERIALS

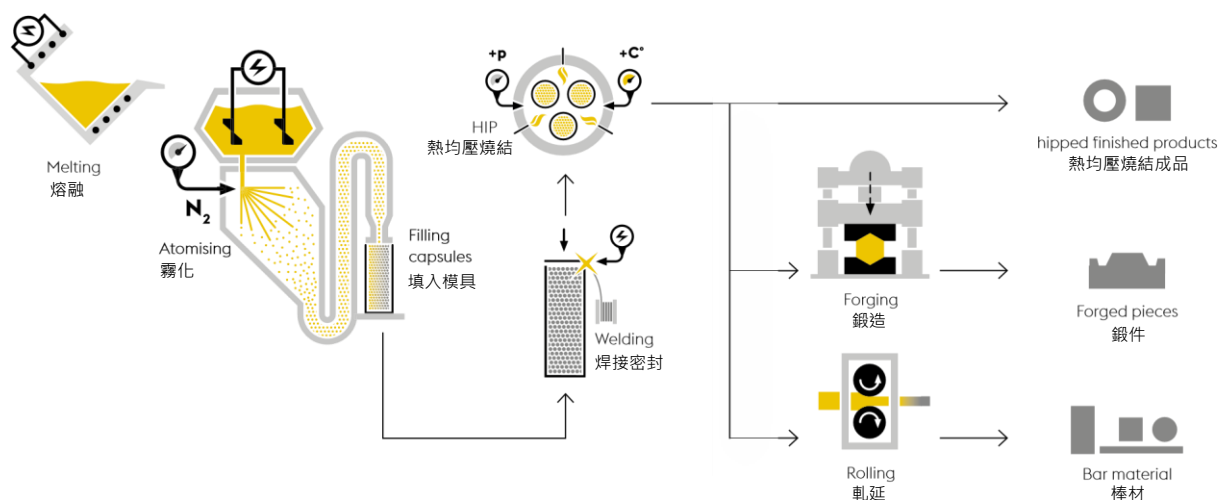
THE WORLD'S MOST MODERN PM STEEL PRODUCTION PLANT.

voestalpine BÖHLER develops and produces high-performance PM-high speed steels and -tool steels, which increase the life of the tool by several hundred percent. voestalpine BÖHLER sets a worldwide benchmark with the development of a powder plant of the 3rd generation. These materials, known by the name **MICROCLEAN**, offer even further improvements in wear resistance, corrosion resistance, compressive strength, toughness, fatigue strength and polishability.

全世界最先進的粉末冶金鋼材製造工廠

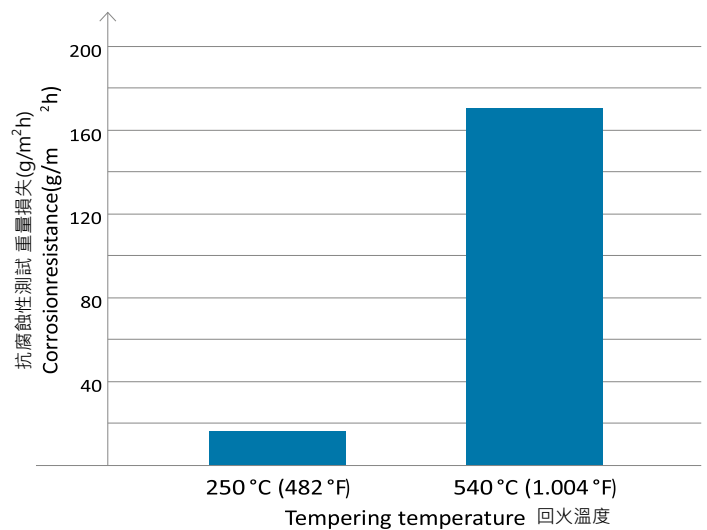
奧鋼聯百樂鋼開發並製造高性能粉末高速鋼和工具鋼，能夠協助提升模具壽命高達數百個百分比。奧鋼聯百樂鋼的第三代粉末工廠為全球的粉末冶金樹立了新的標竿。MICROCLEAN(百樂鋼粉末冶金牌號)在耐磨性、抗腐蝕性、抗壓強度、韌性、疲勞強度和拋光性等性能甚至有了進一步的改善。

Flow chart 製造流程





Corrosion resistance 抗腐蝕性



For highest corrosion resistance use lower tempering temperatures.

Heat treatment: austenitizing at 1150 °C (2,100 °F) / 20 min. / 5 bar, without subzero-cooling

Weight loss test: measured after 24 h with 20 % boiling acetic acid

為了獲得最高的耐腐蝕性，請使用較低的回火溫度。

熱處理：在 1150 °C (2,100 °F)/20 分鐘/5 大氣壓的環境中沃斯田鐵化和冷卻，不做深冷

重量損失測試：置放在沸騰之 20% 乙酸中 24 小時，再計算重量損失

通過最嚴格標準之檢測

TESTED FOR HIGHEST REQUIREMENTS



Physical properties 物理性質

Density at 20°C (68°F)	20°C 時的密度	7,54 kg/dm ³ (0.272 lbs/in ³)
Thermal conductivity at 20°C (68°F)	20°C 時的熱傳導	16,5 W/(m.K) (114 Btu in/ft ² h°F)

從 20°C 加熱至目標溫度的熱膨脹係數

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

100 °C	200 °C	300 °C	400 °C	500 °C	
10,4	10,7	11,0	11,2	11,6	10 ⁻⁶ m/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	
5.78	5.94	6.11	6.22	6.44	10 ⁻⁶ in/in°F

Regarding 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**.

關於本產品目錄中未提到的產品用途或加工步驟，請與我們聯繫諮詢，我們將按照每個個案狀況提供專業技術建議。





為了極度高要求所設計的鋼材

A STEEL FOR EXTREMELY HIGH REQUIREMENTS

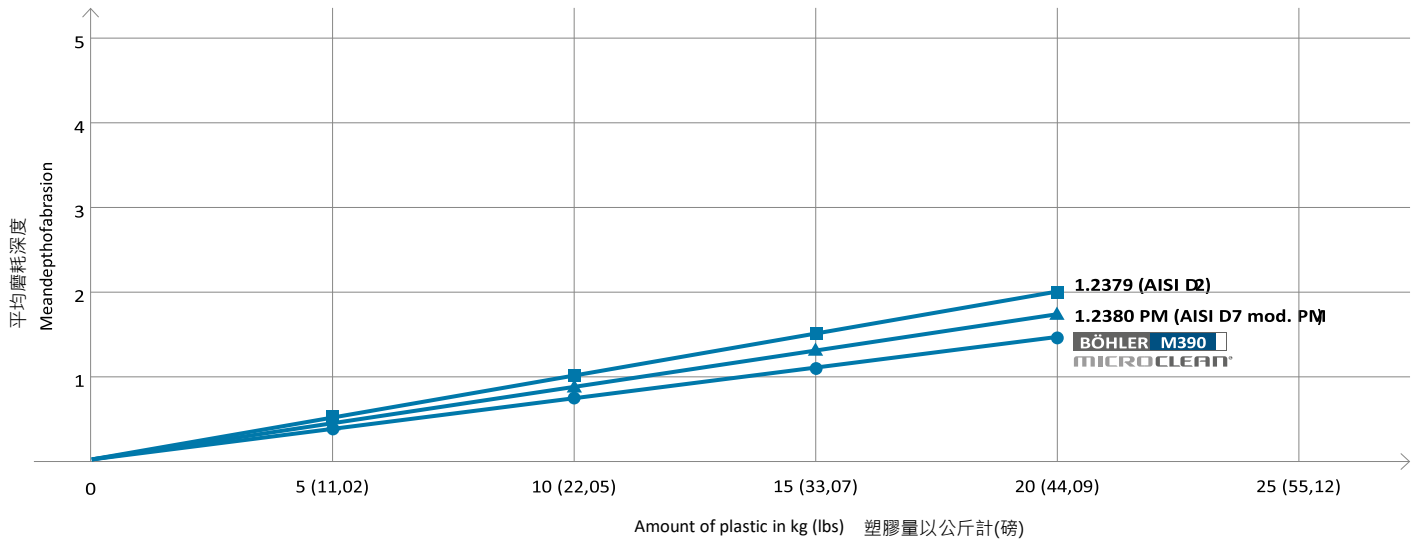
在 300°C(570°F)時注入高磨耗性的 PA66 加 30%玻璃纖維，以及在 400°C(750°F)注入同時具有磨耗性和腐蝕性的 PES 加 30%玻璃纖維兩種情況作測試，BÖHLER M390 與 1.2379(D2)和 1.2380 PM 相比之下具有最佳的耐磨性和耐腐蝕性。

在 PES 加工過程中會形成具腐蝕性的含硫降解物並顯著增加模具的負荷。將上述鋼材暴露在這樣的環境中，BÖHLER M390 被移除的部份遠較 1.2379 (D2)或 1.2380 PM 少。

During both, the injection of purely abrasive acting PA66 with 30% glass fibres at 300 °C (570 °F) and the injection of abrasive and corrosive acting PES with 30% glass fibres at 400 °C (750 °F), BÖHLER M390 MICROCLEAR shows the best wear and corrosion resistance in comparison to 1.2379 (D2) and 1.2380 PM.

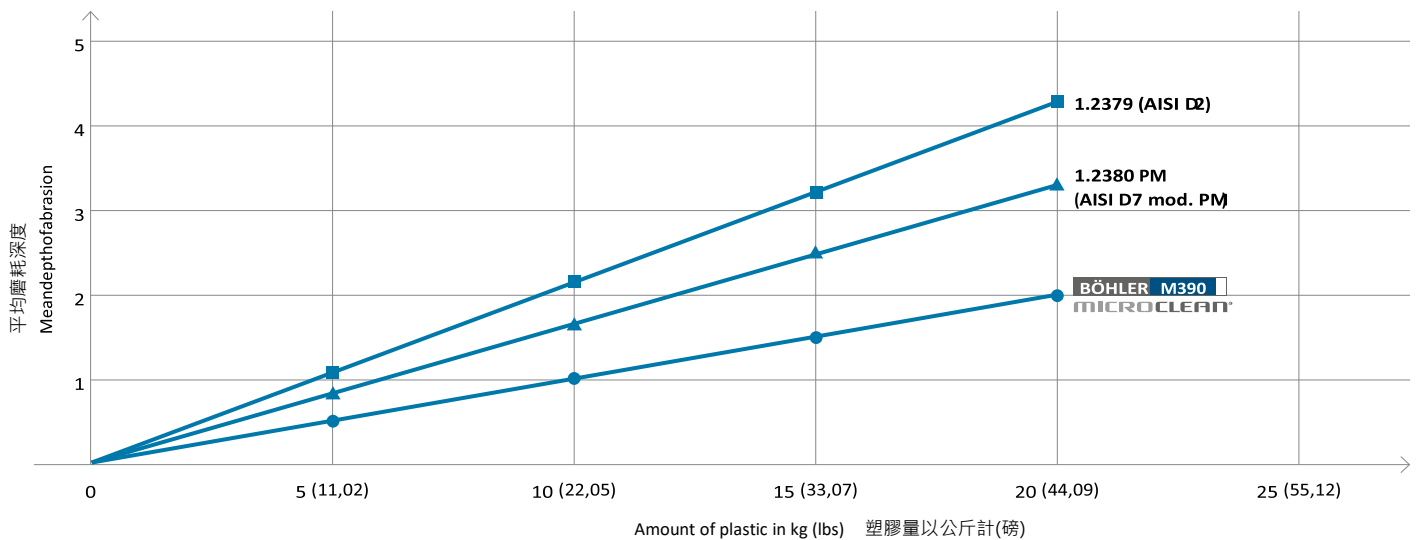
The formation of corrosive sulfurous degradation products during processing of PES significantly increases the load on the tool. BÖHLER M390 MICROCLEAR shows under these exposures in direct comparison to 1.2379 (D2) and 1.2380 PM a clear reduced material removal.

Abrasive wear (Plate wear test) 磨粒磨耗



Plastic: Polyamide 66 (PA66), Trade name: Ultramid A3WG6, Glass fibre content: 30 wt.%, Temperature: 300 °C (570 °F)
 塑料：聚酰胺 66 (PA66) · 商品名稱：Ultramid A3WG6 · 玻璃纖維含量：30 wt.% · 溫度：300°C (570°F)

Abrasive and corrosive wear (Plate wear test) 磨粒以及腐蝕磨耗 (試片磨耗測試)



Plastic: Polyethersulfon (PES), Trade name: Ultrason E2010G6, Glass fibre content: 30 wt.%, Temperature: 400 °C (750 °F)
 塑料：聚醚砜 (PES) · 商品名：Ultrason E2010G6 · 玻璃纖維含量：30 wt.% · 溫度：400°C (750°F)

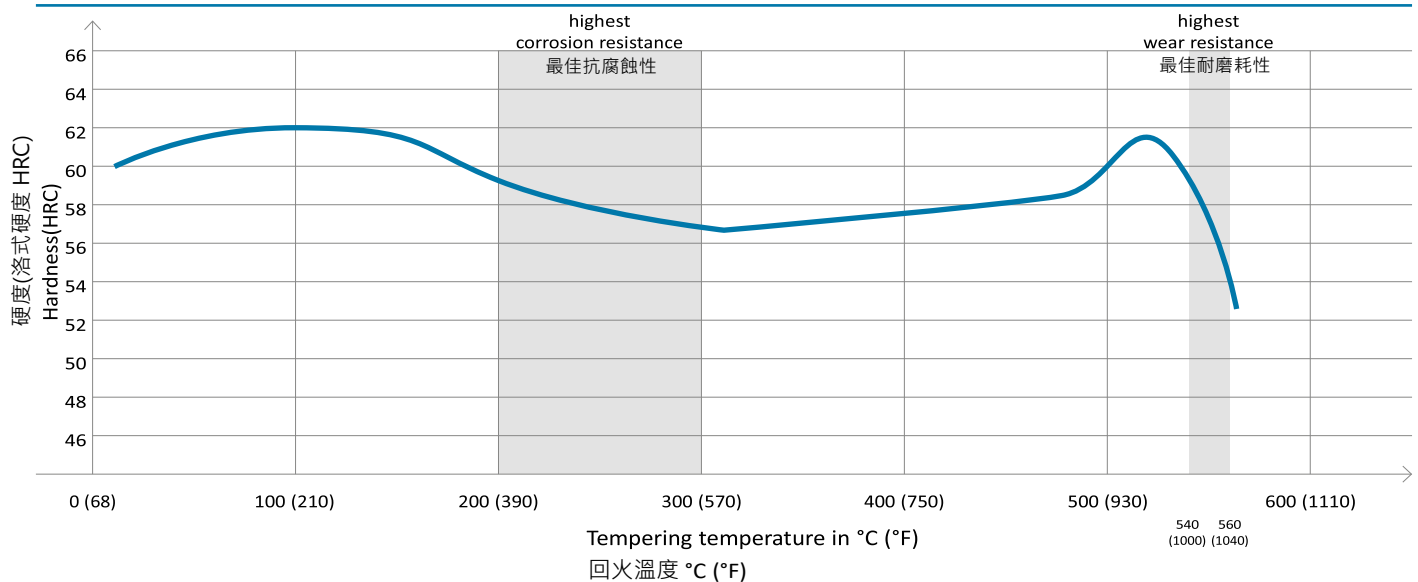
Source: Institute for Plastics Processing at the University of Leoben

資料來源: Institute for Plastics Processing at the University of Leoben

熱處理建議

HEAT TREATMENT RECOMMENDATIONS

Tempering chart (without subzero treatment) 回火曲線 (不含深冷)

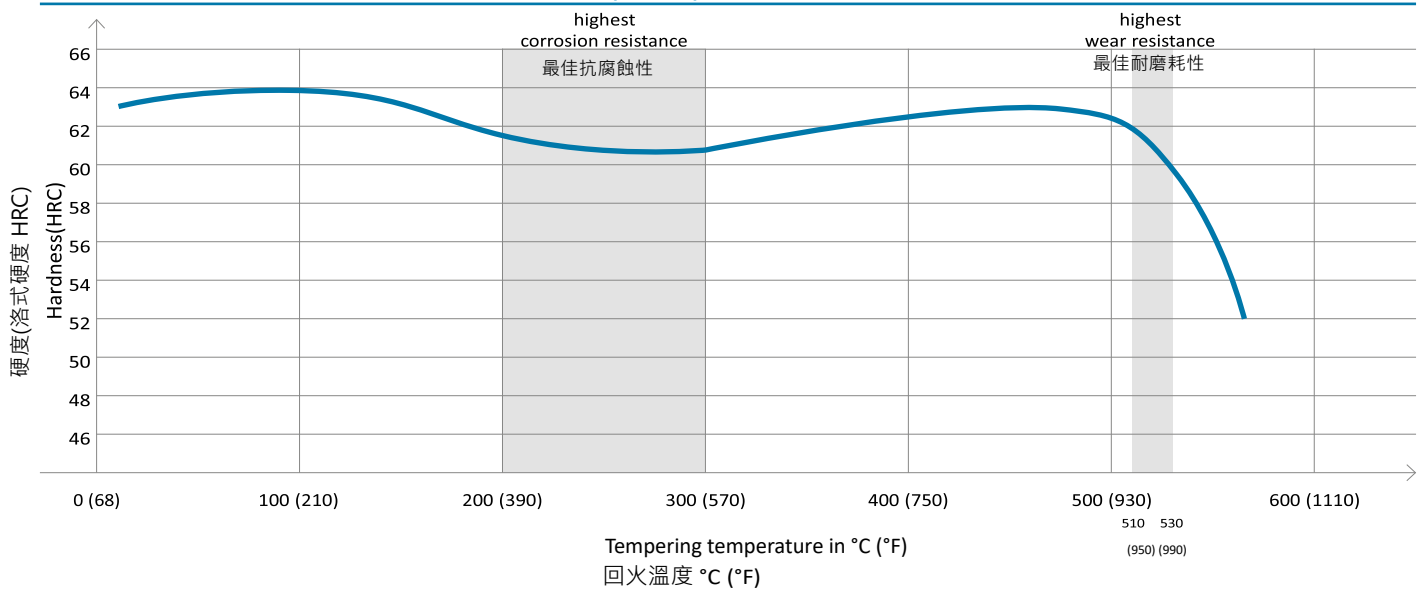


Vacuum hardening: 1150 °C (2100 °F) / 30 min / N₂, 5 bar
Tempering: 2 x 2 hours
Specimen dimensions: dia. 20.5 x 15 mm (0.81 x 0.59 inch)

真空淬火：1150°C (2100°F) / 30 分鐘 / N₂, 5 大氣壓
回火：2 x 2 小時
樣品尺寸：直徑 20.5 x 15 公厘 (0.81 x 0.59 英寸)



Tempering chart (with subzero treatment) 回火曲線 (含深冷)



Vacuum hardening: 1150 °C (2100 °F) / 30 min / N₂, 5 bar
 Subzero treatment: -70 °C (-95 °F), 2 hours
 Tempering: 2 x 2 hours
 Specimen dimensions: dia. 20.5 x 15 mm (0.81 x 0.59 inch)
 真空淬火: 1150°C (2100°F) / 30 分鐘 / N₂, 5 大氣壓
 深冷製程: -70 °C (-95 °F), 2 小時
 回火: 2 x 2 小時
 樣品尺寸: 直徑 20.5 x 15 公厘 (0.81 x 0.59 英寸)

熱處理建議

HEAT TREATMENT RECOMMENDATIONS

Heat treatment from supplier

- » Supplied condition: max. 280 HB
- » Optimal soft annealing is only possible after hot forming.

Stress relieving

- » 650 °C (1200 °F)
- » After through-heating, soak for 4 hours in a neutral atmosphere.
- » Furnace cooling up to 300 °C (570 °F), followed by air

Hardening

- » 1100 to 1180 °C (2010 – 2155 °F)/oil, N₂
- » Holding time:
After through-heating:
20–30 minutes for a hardening temperature of 1100–1150 °C (2010 – 2100 °F)
5–10 minutes for a hardening temperature of 1180 °C (2155 °F)

Tempering for highest corrosion resistance

- » Subzero treatment 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: 200 to 300 °C (390 – 570 °F)

鋼廠出貨之熱處理

- » 出廠狀況: 最大 280 HB
- » 熱成形後才能作最適的軟化退火

應力消除

- » 650 °C (1200 °F)
- » 中心溫度到達後, 在中性氣體中持溫約四小時
- » 爐冷至 300 °C (570 °F), 接下來繼續空冷

Tempering for highest wear resistance

- » Subzero treatment recommended
- » A subzero treatment immediately following hardening leads to increased tempering hardness values at austenitising temperatures ≥ 1150 °C (≥ 2100 °F), [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.
- » Triple tempering 20 °C (68 °F) above the secondary hardening maximum is necessary in order to achieve a complete transformation of retained austenite.

硬化

- » 1100 至 1180 °C 之間 /油, N₂
- » 持溫時間
透熱後:
硬化溫度在 1100–1150 °C 之間, 持溫 20–30 分鐘
硬化溫度在 1180 °C, 持溫 5–10 分鐘

回火以獲得最高的耐腐蝕性

- » 作深冷以轉化殘留沃斯田鐵
- » 緩慢加熱至回火溫度
- » 爐中時間計算方法為: 每 20mm 厚度加一小時, 但至少需回火兩小時
- » 有關回火後可達到的硬度的資訊, 請參閱回火表
- » 回火溫度: 200 至 300 °C

回火以獲得最高的耐磨性

- » 建議作深冷處理
- » 硬化後立刻作深冷處理會使沃斯田鐵溫度時 ≥ 1150 °C 硬度增加 [有應力破裂之風險]
- » 緩慢加熱至回火溫度
- » 爐中時間計算方法為: 每 20mm 厚度加一小時, 但至少需回火兩小時
- » 有關回火後可達到的硬度的資訊, 請參閱回火表
- » 為了使殘留沃斯田鐵完全轉化, 在二次回火後須作第三次回火, 溫度需較二次回火最高硬化溫度高 20 °C



加工建議

MACHINING

RECOMMENDATIONS

Turning with sintered carbide 碳化鎢車削

Depth of cut mm (inch) 車削深度 公厘(英吋)	0.5 – 2 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)	over 8 (over .31)
Feed mm / rev. (inch/rev.) 進料 公厘/轉速 (英吋/轉速)	0.1 – 0.3 (.004 – .012)	0.2 – 0.4 (.008 – .016)	0.3 – 0.8 (.012 – .031)	0.5 – 1.5 (.020 – .060)
Cutting speed v_c (m/min) (f.p.m) 車削速度 公厘/分鐘	130 – 260 (425 – 850)	100 – 220 (330 – 720)	80 – 140 (260 – 460)	30 – 90 (100 – 295)
Recommended BOEHLERIT-geometry 建議切削幾何(BOEHLERIT 品牌)	FP, FMP	MP, MRP	MRP	RP, BR, BRP
BOEHLERIT grade BOEHLERIT 牌號	LCP15T	LCP15T, LCP25T	LCP25T, LC240F	LC240F
ISO grade 通用牌號	P15	P15, P20	P20, P30	P30, P40

Condition: soft annealed. Figures given are guidelines only.
條件：軟退火。上述數字僅供參考，仍需依實際狀況調整。

Turning with high speed steel 高速鋼車削

Depth of cut mm (inch) 車削深度 公厘(英吋)	0.5 (.02)	3 (.12)	6 (.24)
Feed mm / rev. (inch/rev.) 進給速率 公厘/轉速 (英吋/轉速)	0.1 (.004)	0.4 (.016)	0.8 (.031)
BÖHLER-/DIN-grade BÖHLER 高速鋼牌號/通用牌號	S700 / DIN S10-4-3-10		
Cutting speed v_c (m/min) (f.p.m) 車削速度 公厘/分鐘			
Tool life 60 min. 刀具壽命 60 分鐘為準，車削速度為	30 – 20 (100 – 65)	20 – 15 (65 – 50)	18 – 10 (60 – 35)
Rake angle 法前角	14°	14°	14°
Clearance angle 法後角	8°	8°	8°
Inclination angle 斜角	-4°	-4°	-4°

Drilling with sintered carbide 碳化鎢鑽孔

Drill diameter mm (inch) 孔徑 公厘 (英吋)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed mm/rev. (inch/rev.) 進給速率 公厘/轉速 (英吋/轉速)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BOEHLERIT/ISO-grade BOEHLERIT 牌號/通用牌號	HB10 / K10		
Cutting speed v_c (m/min) (f.p.m) 車削速度 公厘/分鐘	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)
Point angle 鑽頂角	115° – 120°	115° – 120°	115° – 120°
Clearance angle 法後角	5°	5°	5°



Milling with sintered carbide 碳化鎢銑削

Cutting speed v_c (m/min) (f.p.m) 車削速度 公厘/分鐘	160 – 230 (525 – 755)	150 – 200 (490 – 655)	120 – 170 (395 – 560)
BOEHLERIT grade BOEHLERIT 牌號	BCH10M, BCP25M	BCH30M, BCP35M	BCH30M, BCK20M
ISO grade 通用牌號	H10, P25	H30, P35	H30, K20
F_z Milling 90° mm (inch) 90°每刃進給速率 公厘/刃	0.1 – 0.3 (.004 – .012)	0.1 – 0.3 (.004 – .012)	0.1 – 0.3 (.004 – .012)
F_z Milling 45° mm (inch) 45°每刃進給速率 公厘/刃	0.15 – 0.8 (.006 – .031)	0.15 – 0.8 (.006 – .031)	0.15 – 0.8 (.006 – .031)
F_z High feed cutting mm (inch) 高速每刃進給速率 公厘/刃	0.8 – 2.5 (.031 – .10)	0.8 – 2.5 (.031 – .10)	0.6 – 3.0 (.024 – .12)

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

Feed mm/tooth (inch/tooth) 每刃進給速率 公厘/刃	up to 0.2 (.008)
Cutting speed v_c (m/min) (f.p.m) 車削速度 公厘/分鐘	
BOEHLERIT SBF/ISO P25	120 – 60 (395 – 195)
BOEHLERIT SB40/ISO P40	70 – 45 (230 – 150)
BOEHLERIT ROYAL 635/ISO P35	80 – 60 (260 – 195)

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