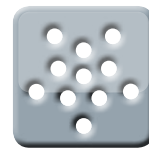




塑料模具钢
PLASTIC MOULD STEEL

BÖHLER M368 ■
MICROCLEAN®



POWDER METALLURGY
粉末冶金



PLASTIC MOULD STEEL
塑料模具钢

给您带来的好处

YOUR BENEFIT

BÖHLER M368 MICROCLEAN是一种使用粉末冶金方式生产的马氏体铬钢。因其独有的合金设计，它具有**高耐磨性、高韧性和高耐腐蚀性** – 是多种最佳应用特性完美结合的产物。

BÖHLER M368 MICROCLEAN is a martensitic chromium steel produced with powder metallurgy. Due to its alloying concept this steel offers **high wear resistance, high toughness and high corrosion resistance** – the perfect combination for **best application properties**.

- 高耐磨性
- 高韧性
- 高耐腐蚀性
- 优异的磨削性
- 良好的抛光性
- 高尺寸稳定性

能够实现

- 大尺寸模具的生产
- 长久稳定的模具使用寿命
- 生产过程的可持续性
- 高精度零件

收益

- 提高生产率
- 降低单位成本

- high wear resistance
- high toughness
- high corrosion resistance
- excellent grindability
- good polishability
- high dimensional stability

enable

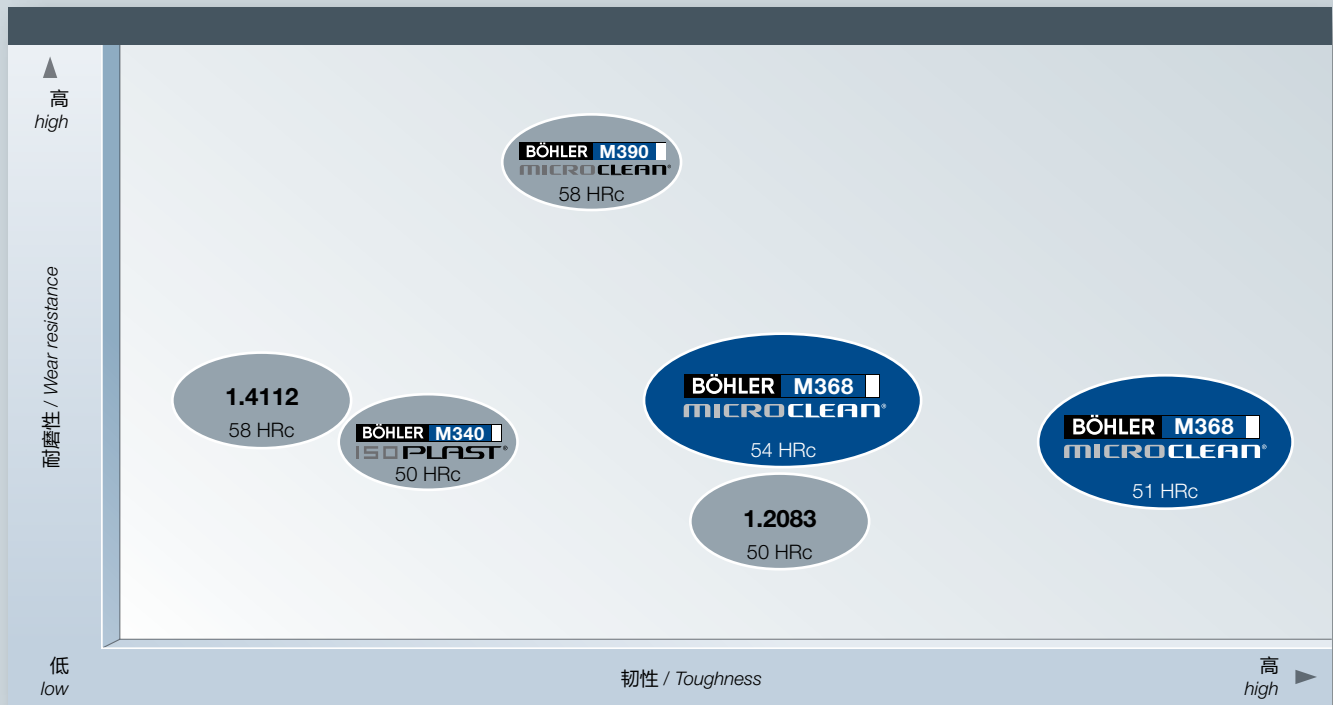
- production of big tools
- long and constant tool life
- reproducibility of production processes
- high precision components

Benefit

- increased productivity
- reduced unit costs

产品定位

PRODUCT POSITIONING



化学成分 (平均值%) / Chemical composition (average %)						
碳 C	硅 Si	锰 Mn	铬 Cr	钼 Mo	钒 V	其它 / others
0,54	0,45	0,40	17,3	1,10	0,10	+氮 N

专利产品 / patented

最高标准的使用质量

MAXIMUM QUALITY IN USE

适用于:

- 模具镶件
- 用于加工含高耐磨填料且具有强化学腐蚀性塑料的模具
- 食品加工行业的模具和刀片
- 电子工业的模具
- 注塑机螺杆
- 注塑料筒的衬套

for:

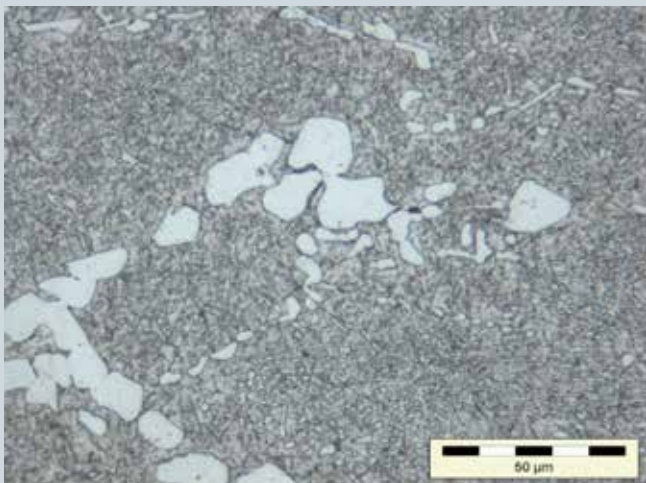
- *Mould inserts*
- *Moulds for the processing of chemically aggressive plastics containing highly abrasive fillers*
- *Moulds and knives for the food-processing industry*
- *Moulds for the electronic industry*
- *Screws for injection moulding machines*
- *Linings for injection moulding cylinders*

超凡出众的组织均质性

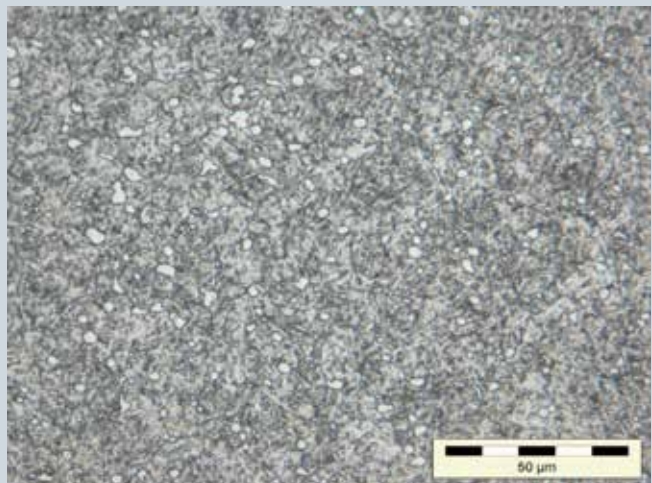
IMPRESSIVE HOMOGENEITY

由于**BÖHLER M368 MICROCLEAN**采用粉末冶金方式生产，与传统和ESR生产的标准产品（例如 1.4112）相比，可实现无偏析的微观组织，显著提高组织均质性。

*Due to powder metallurgical production of **BÖHLER M368 MICROCLEAN** a segregation-free microstructure with significantly improved homogeneity in comparison to conventional and ESR-produced standard products like e.g. 1.4112 could be achieved.*



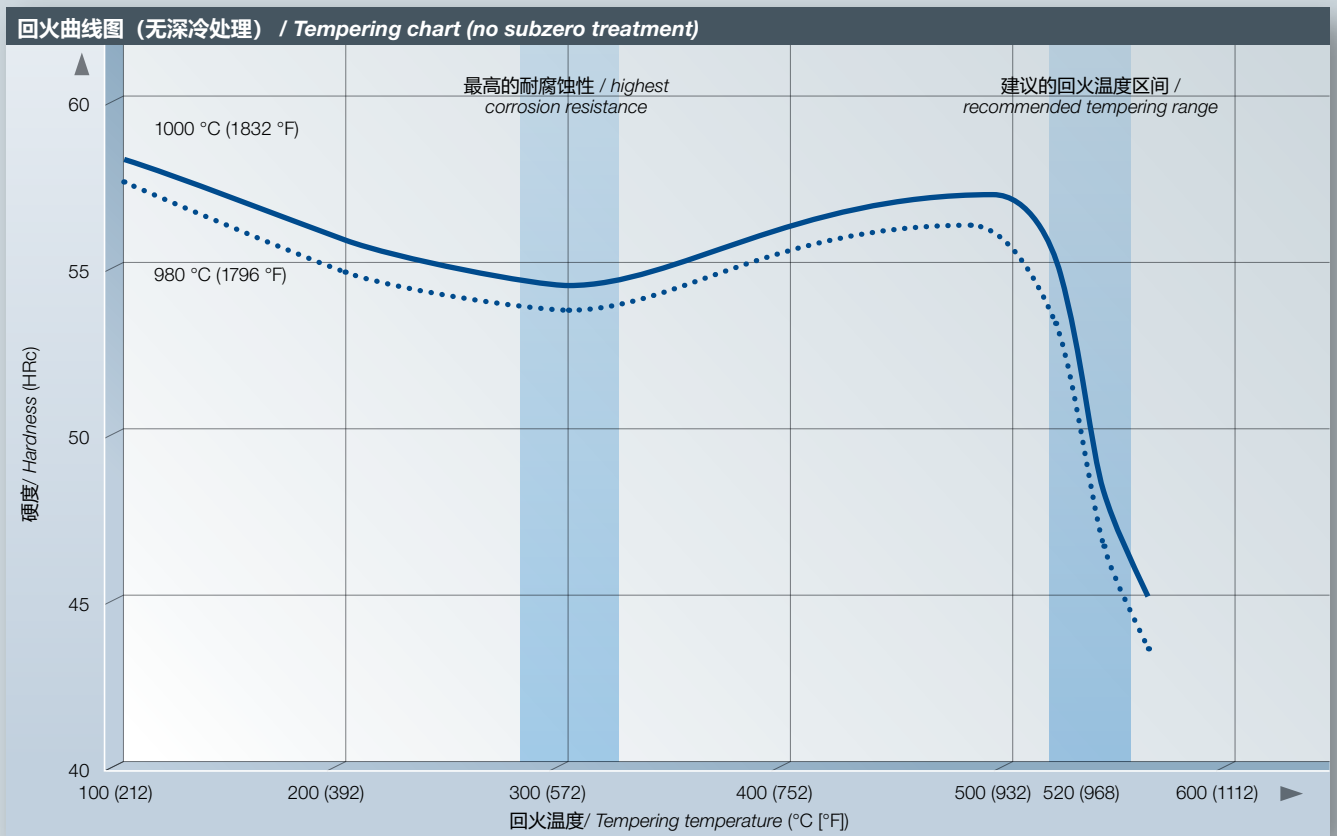
1.4112的微观组织 / Microstructure 1.4112



BÖHLER M368的微观组织 /
Microstructure BÖHLER M368 MICROCLEAN

热处理

HEAT TREATMENT



快速淬火 / Fast quenching

交货状态

- 软性退火至最高280 HB

应力消除

- 650-700 °C (1200 - 1290 °F)
- 工件热透后，在中性气体中保温1至2小时
- 在炉中慢慢冷却

淬火

- 980-1000 °C, 氮气
- 在等温的条件下保温15-30分钟
- 针对大模具，我们建议采用980 °C (1796 °F)的低淬火温度和 >520 °C (968 °F)的高回火温度。

回火

- 淬火后立即缓慢加热到回火温度
- 炉中的保温时间：每20毫米 (0.79英寸) 的工件厚度为1小时，但至少2小时。
- 空气中冷却
- 我们建议回火3次
- 我们建议用 >520 °C (968 °F)的温度回火，在获得最佳耐磨性的同时，也具备良好的耐腐蚀性和韧性。该条件下的耐腐蚀性，适合大部分塑料模具的应用。
- 为获得最高的耐腐蚀性，可选择在约300 °C (572 °F)的温度下回火；如果还需要获得最好的尺寸稳定性，我们建议做一次深冷处理。
- 可获得的硬度：48 – 55 HRC

Delivery condition

- *Soft annealed max. 280 HB*

Stress relieving

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

Hardening

- *980 to 1000 °C (1796 – 1830 °F), N₂*
- *Following temperature equalisation: 15 – 30 min. holding time*
- *For big moulds we recommend a low hardening temperature of 980 °C (1796 °F) and a high tempering temperature (> 520 °C / 968 °F).*

Tempering

- *Slowly heat to tempering temperature immediately after hardening*
- *Time in furnace: 1 hour for every 20 mm (0.79 inch) of workpiece thickness but at least 2 hours.*
- *Cool in air*
- *We recommend that the steel be tempered 3 times*
- *We recommend for optimal combination of good corrosion- and highest wear-resistance and toughness a tempering temperature > 520 °C (968 °F). In this case the corrosion-resistance will be suitable for most plastic mould applications.*
- *For highest corrosion-resistance optional a tempering at approx. 300 °C (572 °F) is possible. If additional highest requirements for dimensional stability are necessary, an additional subzero-treatment is recommended.*
- *Obtainable hardness: 48 – 55 HRC*

热处理

HEAT TREATMENT

CCT 曲线图 / Continuous cooling CCT curves

奥氏体化温度：1000 °C
保温时间：15 分钟

7 ... 60 相位百分比%

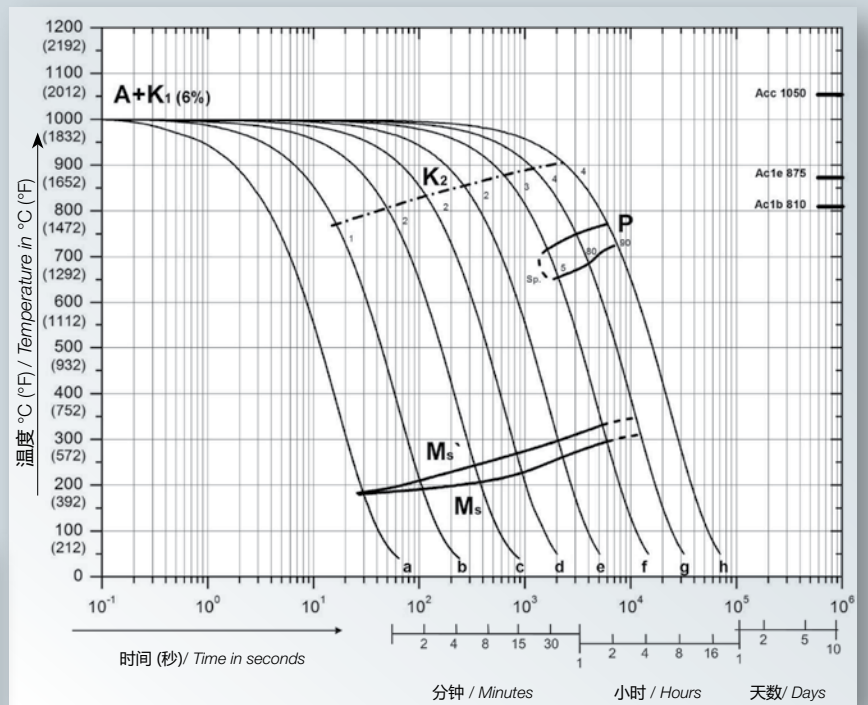
0,08 ... 110 冷却参数 (λ), d.h.
即从 800 到 500 °C 的冷却时间,
单位：秒 $\times 10^{-2}$

Austenizing temperature: 1000 °C (1830 °F)
Holding time: 15 minutes

7 ... 60 phase percentages

0.08 ... 110 cooling parameter (λ), i.e. duration of
cooling from 800 – 500° C
(1470 – 930 °F) in $s \times 10^{-2}$

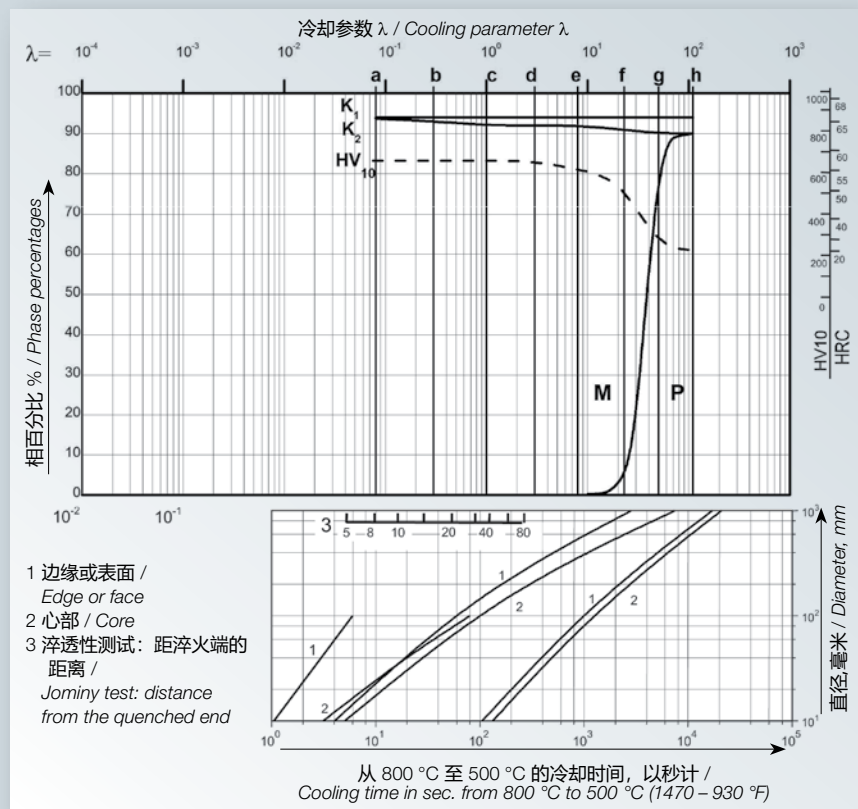
样品 / Sample	λ	HV ₁₀
a	0,08	660
b	0,30	660
c	1,10	660
d	3,00	660
e	8,00	620
f	23,00	570
g	50,00	235
h	110,00	215



定量相图 /

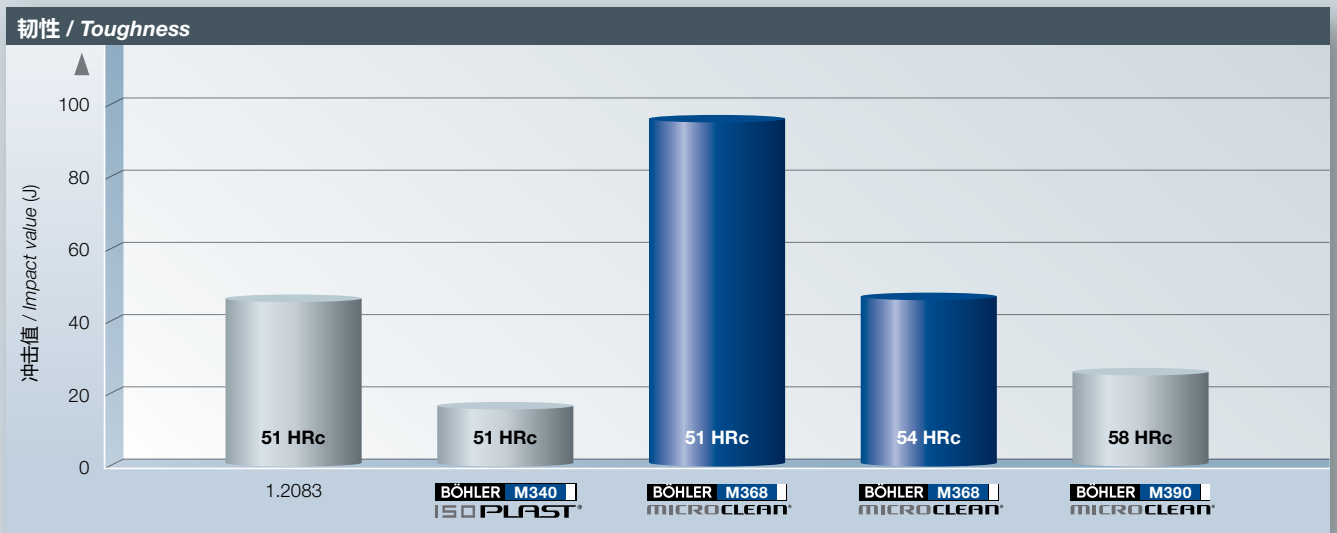
Quantitative phase diagram

- K1 在奥氏体化过程中未溶解的碳化物 (6%) /
carbides which are not dissolved during
austenitization (6%)
- K2 从奥氏体化温度淬火过程中碳化物开始析出 /
start of carbide precipitation during
quenching from austenitizing temperature
- Ms-Ms' 晶界马氏体的范围 /
range of grain boundary martensite
- A 奥氏体 / Austenite
- M 马氏体 / Martensite
- P 珠光体 / Pearlite



非凡的特性

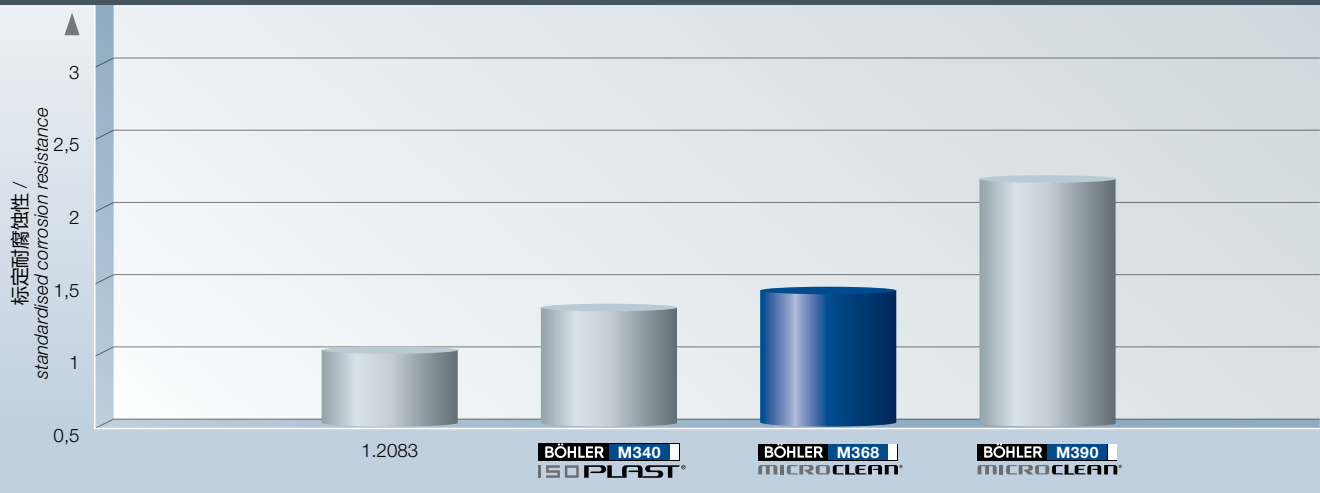
EXCEPTIONAL PROPERTIES



取自403 x 303毫米母材的样块，高温回火
样块大小：10 x 7 x 55毫米（无缺口）

*Samples from motherblock 403 x 303 mm, high tempered
Sample size: 10 x 7 x 55 mm (unnotched)*

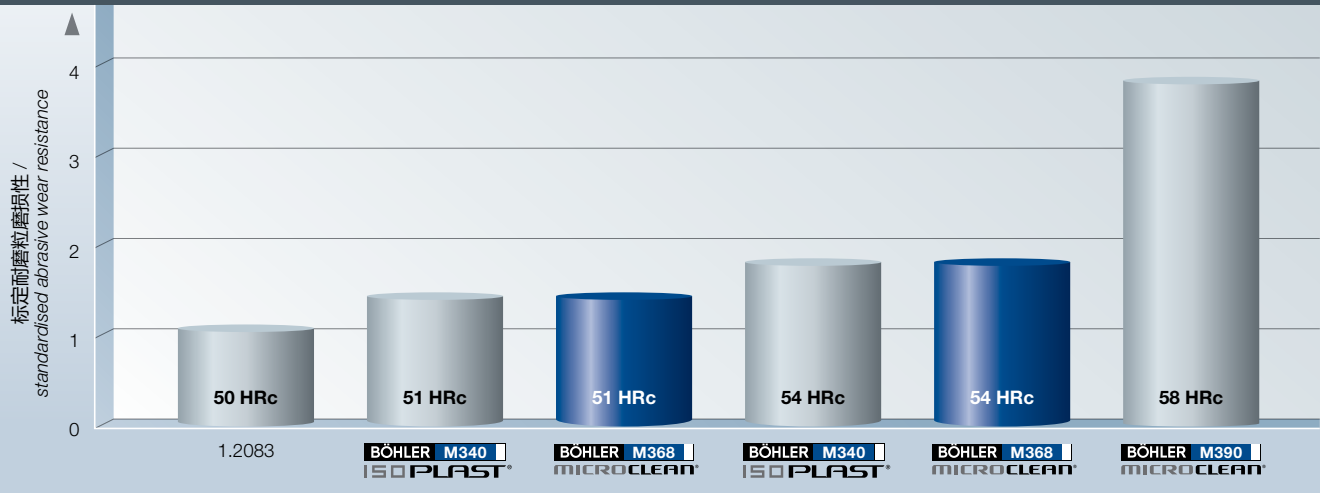
耐腐蚀性 (失重测试 - 依据德国工业标准, DIN 50905-2) / Corrosion resistance (weight loss - test according DIN 50905-2)



取自403 x 303毫米母材的样块, 高温回火
 腐蚀介质: 20%沸腾醋酸, 24小时

Samples from motherblock 403 x 303 mm, high tempered
 Corrosion medium: 20% boiling acetic acid, 24 h

耐磨性 / Wear resistance



取自403 x 303毫米母材的样块, 高温回火
 小板块磨损试验
 塑料: 尼龙 66 (PA66)含50%的玻璃纤维含
 温度: 300 °C
 样块尺寸: 12 x 15毫米

Samples from motherblock 403 x 303 mm, high tempered
 Small-plate-wear-test
 Plastic: Polyamide 66 (PA66), Glass fibre content: 50 wt.%,
 Temperature: 300 °C (570 °F)
 Sample size: 12 x 15 mm

物理性能

PHYSICAL PROPERTIES

20 °C (68 °F) 时的密度 / Density at 20 °C Density at 68 °F	7,7 kg/dm ³ 0.278 lbs/in ³
20 °C (68 °F) 时的比热 / Specific heat capacity at 20 °C Specific heat capacity at 68 °F	460 J/(kg.K) 0.110 Btu/lb °F
具有磁性的 / Magnetic properties existing	

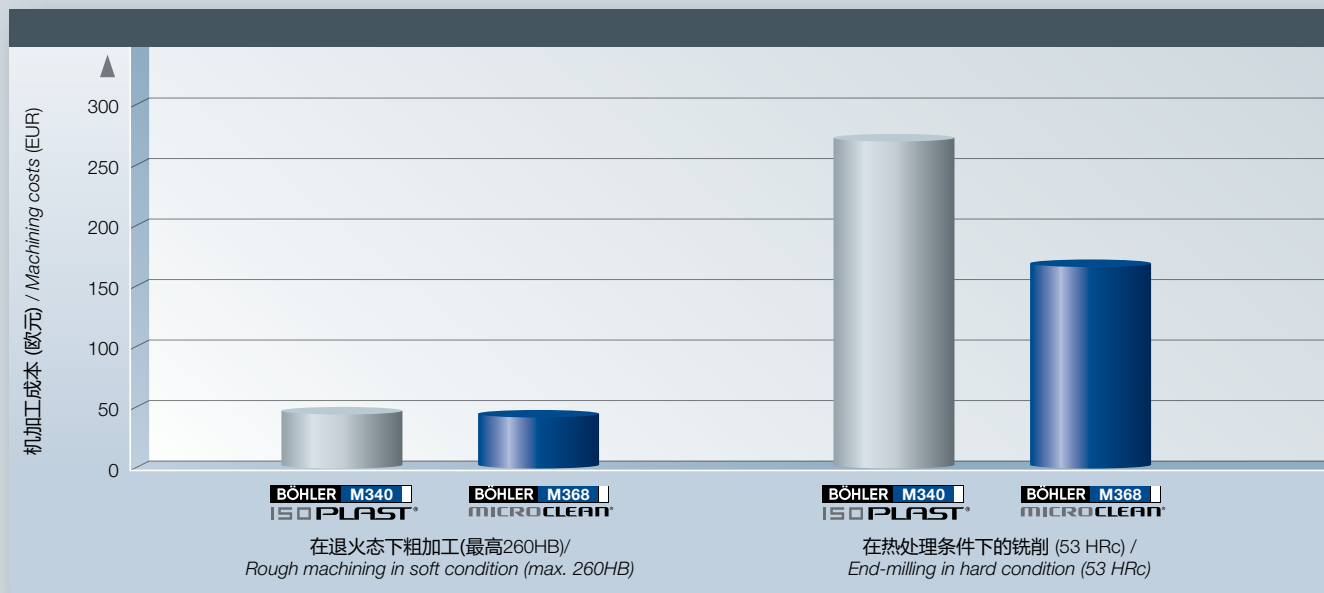
20 °C (68 °F) 至 ... °C 时的热膨胀系数 / Thermal expansion between 20 °C (68 °F) and ... °C (°F)					
100 °C	200 °C	300 °C	400 °C	500 °C	
10,30	10,82	11,20	11,56	11,87	10 ⁻⁶ m/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	
5.72	6.01	6.22	6.42	6.59	10 ⁻⁶ in/(in °F)

弹性模量 / Modulus of elasticity						
20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	
219	215	209	201	193	183	10 ³ N/mm ²
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 ³ KSI

传热导率 / Thermal conductivity						
20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	
22,3	22,8	23,8	24,3	25,0	25,6	W/(m K)
68 °F	210 °F	390 °F	570 °F	750 °F	930 °F	
12.92	13.17	13.75	14.08	14.50	14.83	Btu/(ft h °F)

机加工的成本优势

YOUR COST ADVANTAGE DURING MACHINING



在机加工实验室的真实条件下测试，公司：PROFACTOR

Tested under real conditions in the machining laboratory, company: PROFACTOR.

使用工具：

粗加工：圆角刀 V101-05 Depo; $v_c = 180 - 220 \text{ m/min.}, 1000 \text{ cm}^3$
 端铣：硬质合金-球头铣刀 V201-05 Emuge; $v_c = 1000 \text{ m/min.}, 1000 \text{ cm}^2$

Used tools:

Rough machining: Torus cutter V101-05 Depo; $v_c = 180 - 220 \text{ m/min.}, 1000 \text{ cm}^3$
 End-milling: CC-ball cutter V201-05 Emuge; $v_c = 1000 \text{ m/min.}, 1000 \text{ cm}^2$

机加工建议

MACHINING RECOMMENDATIONS

条件: 退火态下的数据, 仅供参考 / Condition: annealed, figures given are guidelines only

硬质合金刀具车削 / Turning with sintered carbide			
切削深度, 毫米(英寸) / Depth of cut (inches)	0,5 – 1 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)
进给量, 毫米/转(英寸/转) / Feed mm/rev (inches/rev.)	0,1 – 0,2 (.004 – .008)	0,2 – 0,4 (.008 – .016)	0,3 – 0,6 (.012 – .024)
BÖHLERIT 牌号 / BÖHLERIT grade	SB10, SB20, EB10	SB20, EB10, EB20	SB30, EB20, HB10
ISO 牌号 / ISO grade	P10, P20, M10	P20, M10, M20	P30, M20, K10
切削速度, 米/分钟 (英尺/分钟) / Cutting speed v _c (m/min) (f.p.m)			
镶嵌硬质合金刀片 / Indexable inserts			
刀具寿命: 15分钟 / Tool life: 15 min.	260 – 200 (850 – 655)	200 – 150 (655 – 490)	150 – 110 (490 – 360)
钎焊硬质合金刀具 / Brazed tools			
刀具寿命: 30分钟 / Tool life: 30 min.	210 – 170 (690 – 560)	170 – 130 (560 – 425)	140 – 90 (460 – 295)
涂覆镶嵌硬质合金刀片 / Coated indexable inserts			
BÖHLERIT LC 225 C	至 / up to 260 (850)	至 / up to 220 (720)	至 / up to 150 (490)
BÖHLERIT LC 235 C	至 / up to 230 (750)	至 / up to 180 (590)	至 / up to 130 (425)
钎焊硬质合金刀具的切削角度 / Tool angles for brazed tools			
前角 / Rake angle	12° – 15°	12° – 15°	12° – 15°
后角 / Clearance angle	6° – 8°	6° – 8°	6° – 8°
倾角 / Inclination angle	0°	0°	-4°
高速钢刀具车削 / Turning with high speed steel			
切削深度, 毫米(英寸) / Depth of cut, mm (inches)	0,5 (.02)	3 (.12)	6 (.24)
进给量, 毫米/转(英寸/转) / Feed mm/rev (inches/rev.)	0,1 (.004)	0,5 (.02)	1,0 (.04)
BÖHLERIT 高速钢/DIN 标准 / HSS等级 BÖHLERIT/DIN	S700 / DIN S10-4-3-10		
切削速度, 米/分钟 (英尺/分钟) / Cutting speed v _c (m/min) (f.p.m)			
刀具寿命: 60分钟 / Tool life: 60 min.	55 – 45 (180 – 150)	45 – 35 (150 – 115)	35 – 25 (115 – 80)
前角 / Rake angle	14° – 18°	14° – 18°	14° – 18°
后角 / Clearance angle	8° – 10°	8° – 10°	8° – 10°
倾角 / Inclination angle	0°	0°	0°
镶齿铣刀铣削 / Milling with inserted tooth cutter			
进给量, 毫米/齿(英寸/齿) / Feed mm/tooth (inches/tooth)	bis / up to 0,2 (.008)	0,2 – 0,3 (.008 – .012)	
切削速度, 米/分钟 (英尺/分钟) / Cutting speed v _c (m/min) (f.p.m)			
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)	--	
镶嵌硬质合金刀具钻孔 / Drilling with sintered carbide			
钻头直径, 毫米(英寸) / Drill diameter, mm (inches)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
进给量, 毫米/转(英寸/转) / Feed mm/rev (inches/rev.)	0,02 – 0,05 (.001 – .002)	0,05 – 0,12 (.002 – .005)	0,12 – 0,18 (.005 – .007)
BÖHLERIT/ISO-标准 / BÖHLERIT/ISO grade	HB10 / K10		
切削速度, 米/分钟 (英尺/分钟) / Cutting speed v _c (m/min) (f.p.m)			
	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)
顶角 / Point angle	115° – 120°	115° – 120°	115° – 120°
后角 / Clearance angle	5°	5°	5°



SPECIAL STEEL FOR THE WORLD'S TOP PERFORMERS

Your partner:

Bohlasia Steels Sdn Bhd (199501020895)
18 Jalan Utarid U5/15, Seksyen U5,
40150 Shah Alam, Selangor, Malaysia
T. +60/3/7842 1448 F. +60/3/7842 1454/5
E. sales@bohler-bohlasia.com.my
www.bohler-bohlasia.com.my