



PLASTIC  
MOULD STEEL



POWDER  
METALLURGY

# PLASTIC MOLD STEEL

**BÖHLER M390**   
**MICROCLEAN®**



## 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**.

- » 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 consistent 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:

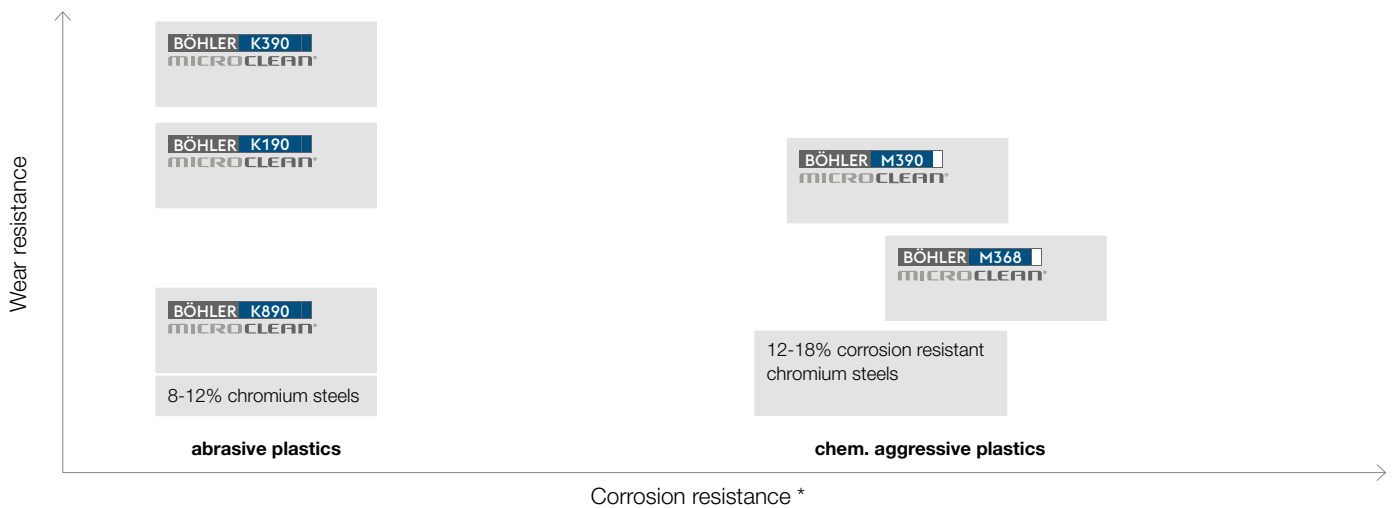
- » Machine components for the paper and food processing industry
- » Knives

### Chemical composition (average %)

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



\* High tempered, weight loss test with 20% boiling acetic acid, 24 h.

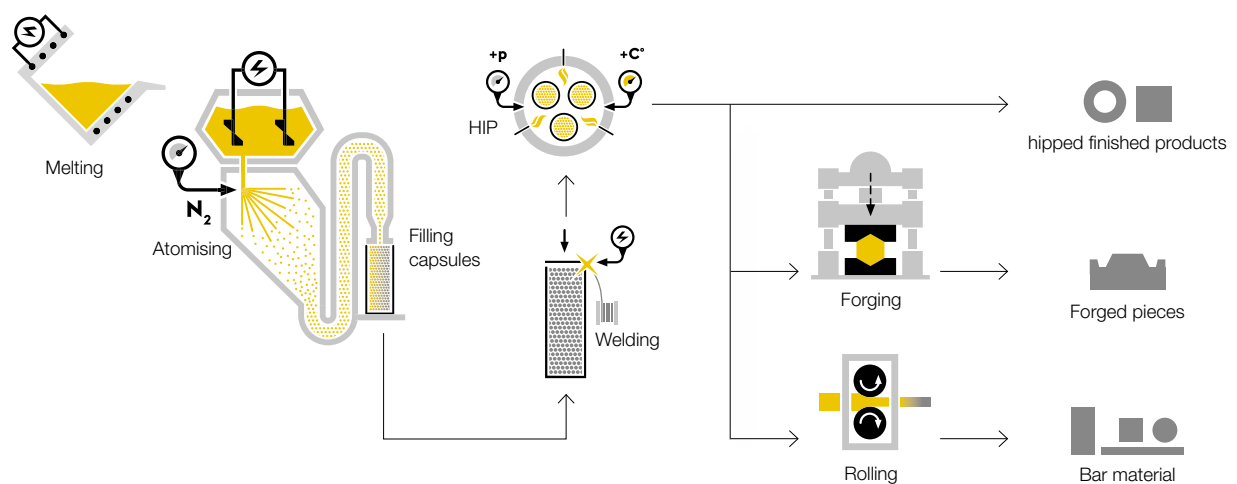


# THE ADVANTAGES OF MICROCLEAN MATERIALS

## THE WORLD'S MOST MODERN PM STEEL PRODUCTION PLANT.

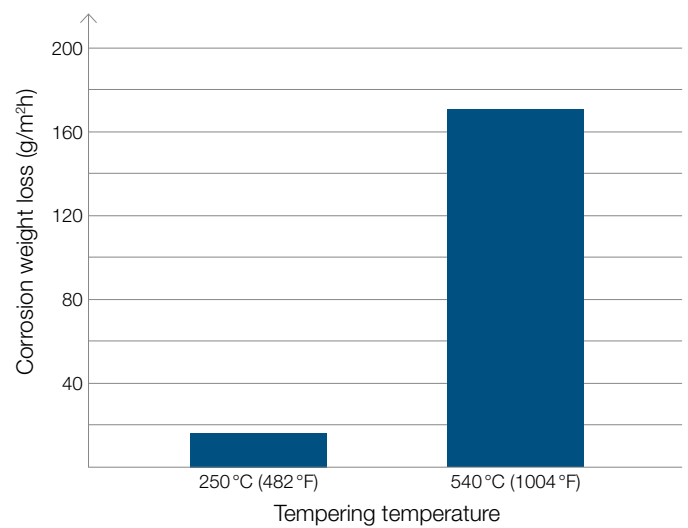
**voestalpine BÖHLER** develops and produces high-performance PM-high speed steels and -tool steels, which increase the life of the tool by several hundred percent. **voestalpine BÖHLER** sets a worldwide benchmark with the development of a powder plant of the 3<sup>rd</sup> generation. These materials,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

### Flow chart





### Corrosion resistance



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

# TESTED FOR HIGHEST REQUIREMENTS

## Physical properties

Density at 20 °C (68 °F)	7.54 kg/dm <sup>3</sup> (0.272 lbs/in <sup>3</sup> )
Thermal conductivity at 20 °C (68 °F)	16.5 W/(m.K) (114 Btu in/ft <sup>2</sup> h°F)

## 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 <sup>-6</sup> m/(m.K)
210 °F	390 °F	570 °F	750 °F	930 °F	
5.78	5.94	6.11	6.22	6.44	10 <sup>-6</sup> 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**.





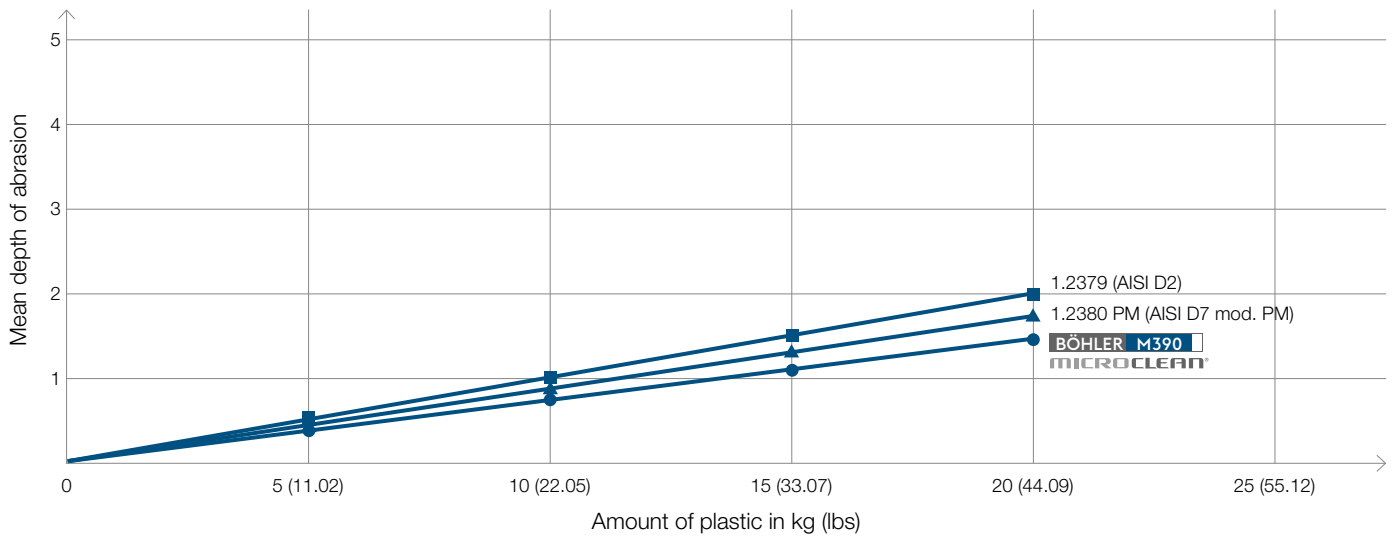
## A STEEL FOR EXTREMELY HIGH REQUIREMENTS

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.

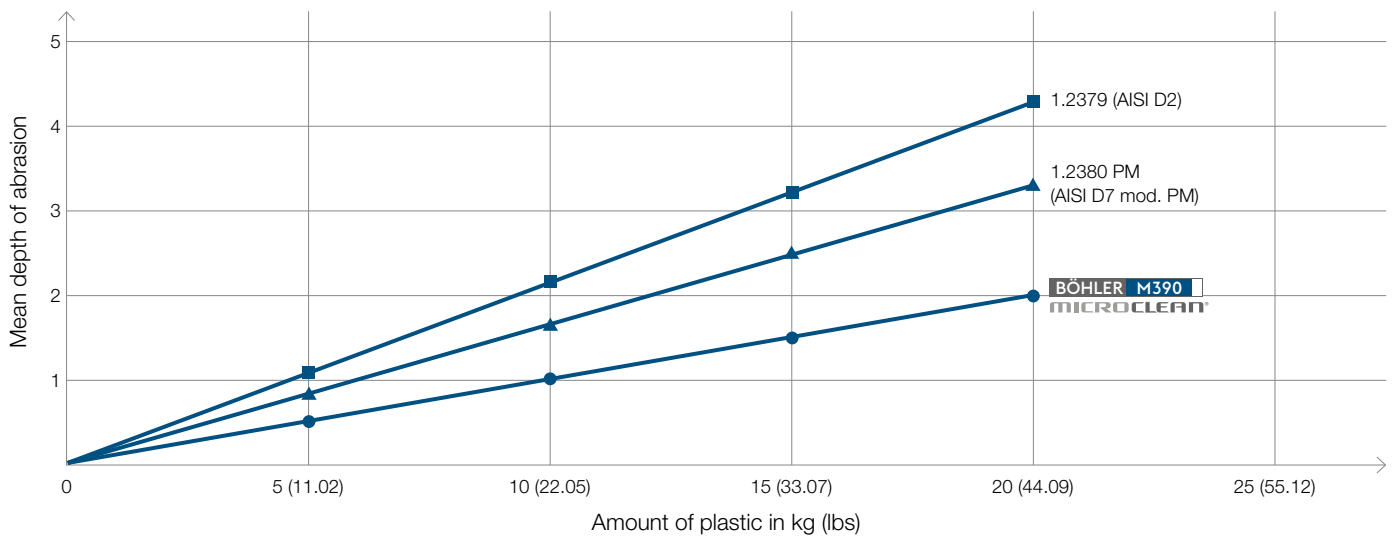


### Abrasive wear (Plate wear test)



Plastic: Polyamide 66 (PA66), Trade name: Ultramid A3WG6, Glass fibre content: 30 wt.%, Temperature: 300 °C (570 °F)

### Abrasive and corrosive wear (Plate wear test)

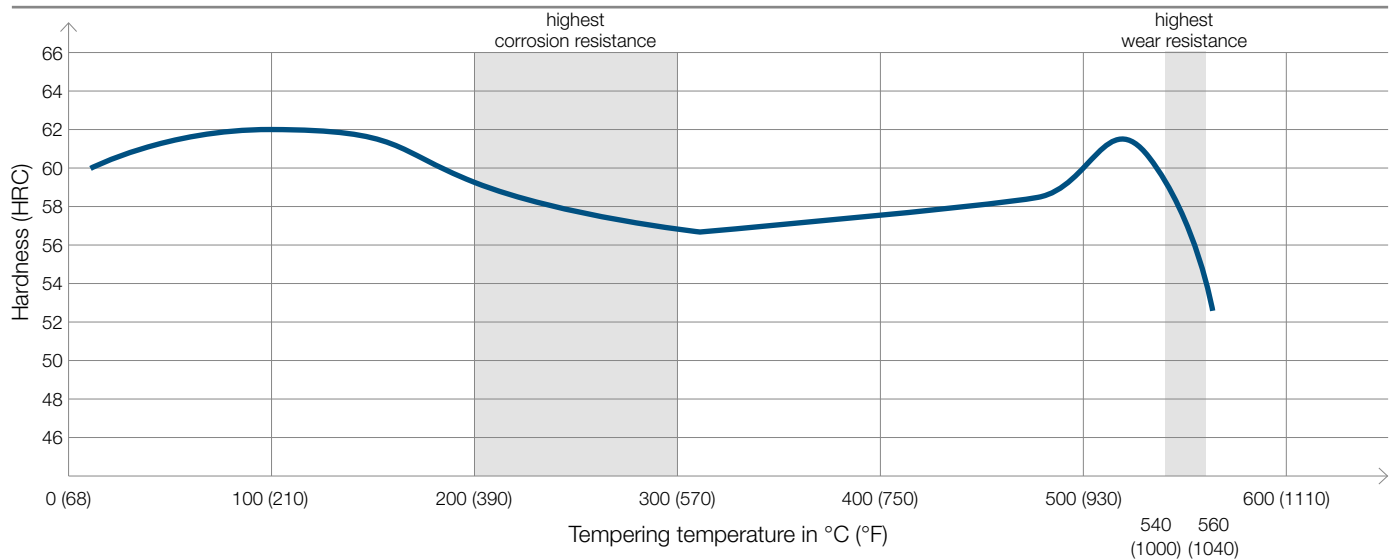


Plastic: Polyethersulfon (PES), Trade name: Ultrason E2010G6, Glass fibre content: 30 wt.%, Temperature: 400 °C (750 °F)

Source: Institute for Plastics Processing at the University of Leoben

# HEAT TREATMENT RECOMMENDATIONS

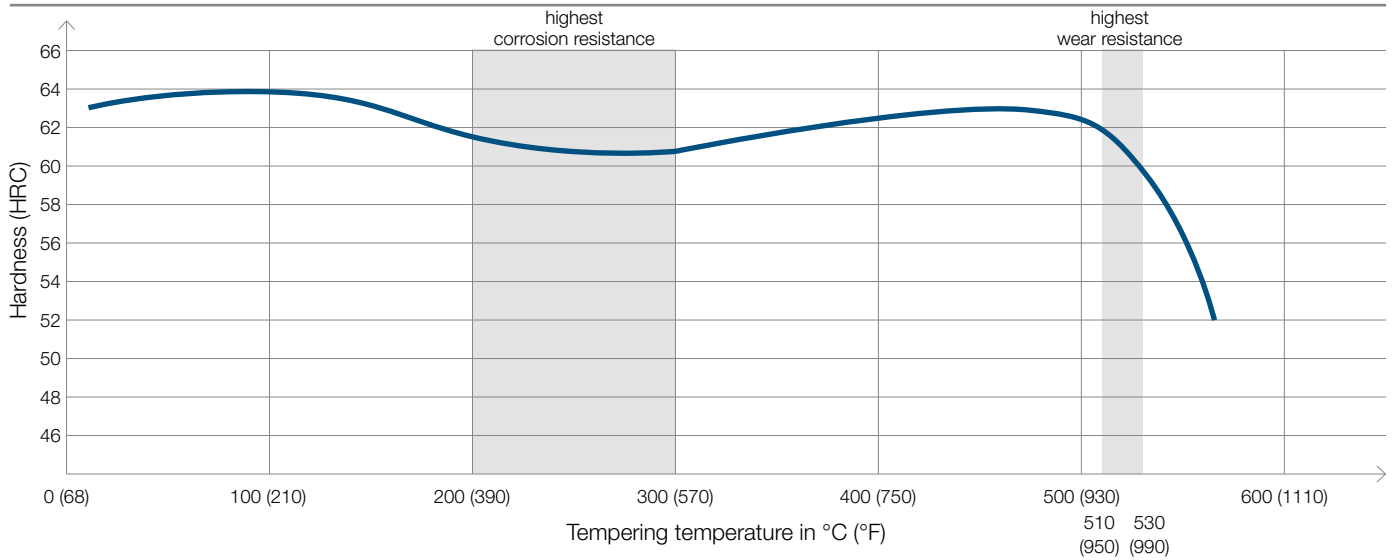
## Tempering chart (without subzero treatment)



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



### Tempering chart (with subzero treatment)



Vacuum hardening: 1150 °C (2100 °F) / 30 min / N<sub>2</sub>, 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)

# 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, N<sub>2</sub>
- » 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)

## Tempering for highest wear resistance

- » Subzero treatment recommended
- » A subzero treatment immediately following hardening leads to increased tempering hardness values at austenitising temperatures  $\geq 1150$  °C ( $\geq 2100$  °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.



IWA

Genkinger  
HUBTEX

# MACHINING RECOMMENDATIONS

## Turning with sintered carbide

Depth of cut mm (inch)	0.5 – 2 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)	over 8 (over .31)
Feed mm / rev. (inch/rev.)	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)	130 – 260 (425 – 850)	100 – 220 (330 – 720)	80 – 140 (260 – 460)	30 – 90 (100 – 295)
Recommended BOEHLERIT-geometry	FP, FMP	MP, MRP	MRP	RP, BR, BRP
BOEHLERIT grade	LCP15T	LCP15T, LCP25T	LCP25T, LC240F	LC240F
ISO grade	P15	P15, P20	P20, P30	P30, P40

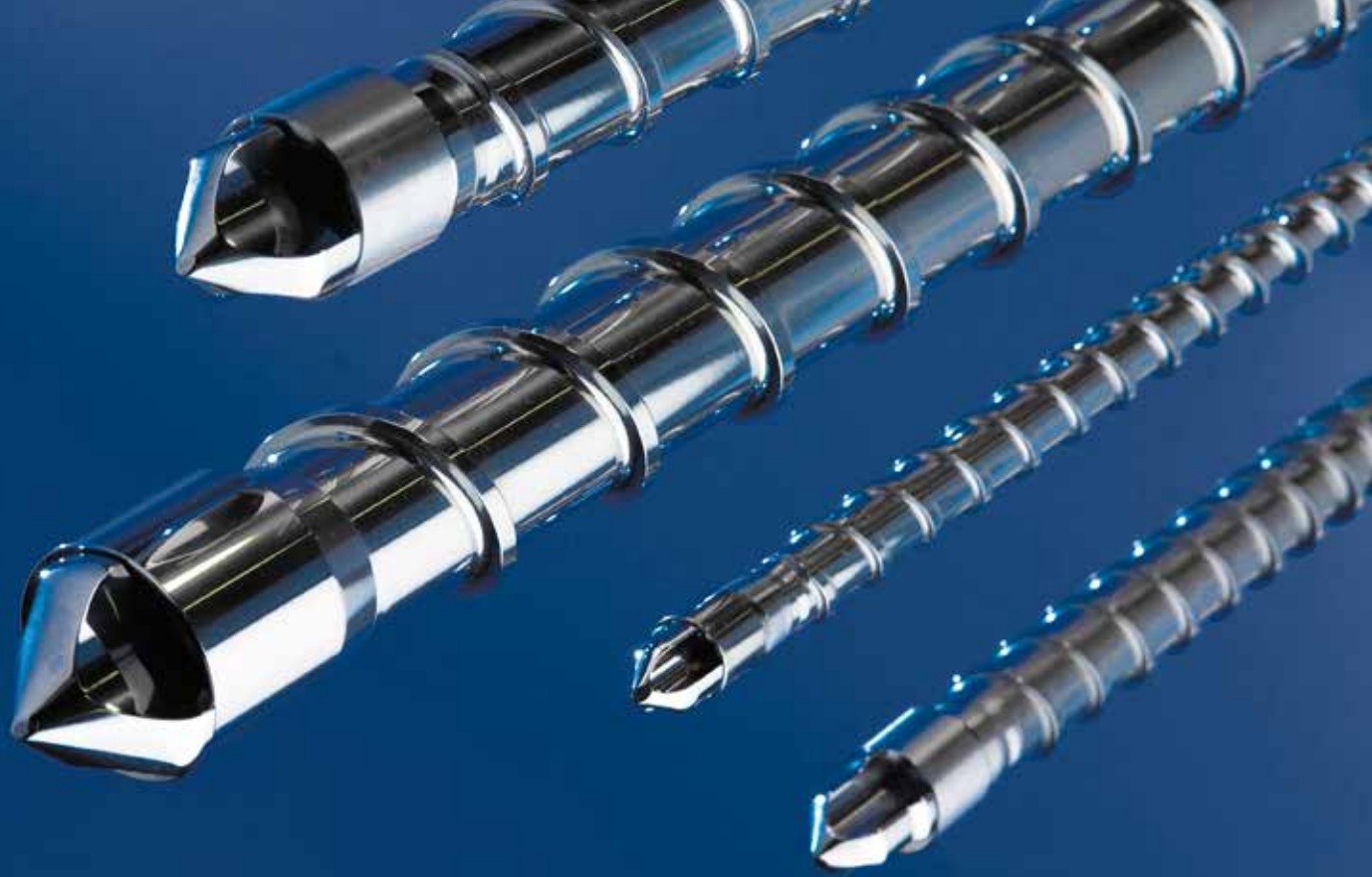
Condition: soft annealed. Figures given are guidelines only.

## Turning with high speed steel

Depth of cut mm (inch)	0.5 (.02)	3 (.12)	6 (.24)
Feed mm / rev. (inch/rev.)	0.1 (.004)	0.4 (.016)	0.8 (.031)
BÖHLER-/DIN-grade	S700 / DIN S10-4-3-10		
Cutting speed $v_c$ (m/min) (f.p.m)			
Tool life 60 min.	30 – 20 (100 – 65)	20 – 15 (65 – 50)	18 – 10 (60 – 35)
Rake angle	14°	14°	14°
Clearance angle	8°	8°	8°
Inclination angle	-4°	-4°	-4°

## Drilling with sintered carbide

Drill diameter mm (inch)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed mm/rev. (inch/rev.)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BOEHLERIT/ISO-grade	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°



### Milling with sintered carbide

<b>Cutting speed <math>v_c</math> (m/min) (f.p.m)</b>	160 – 230 (525 – 755)	150 – 200 (490 – 655)	120 – 170 (395 – 560)
<b>BOEHLERIT grade</b>	BCH10M, BCP25M	BCH30M, BCP35M	BCH30M, BCK20M
<b>ISO grade</b>	H10, P25	H30, P35	H30, K20
<b><math>F_z</math> Milling 90° mm (inch)</b>	0.1 – 0.3 (.004 – .012)	0.1 – 0.3 (.004 – .012)	0.1 – 0.3 (.004 – .012)
<b><math>F_z</math> Milling 45° mm (inch)</b>	0.15 – 0.8 (.006 – .031)	0.15 – 0.8 (.006 – .031)	0.15 – 0.8 (.006 – .031)
<b><math>F_z</math> High feed cutting mm (inch)</b>	0.8 – 2.5 (.031 – .10)	0.8 – 2.5 (.031 – .10)	0.6 – 3.0 (.024 – .12)

### Milling with inserted tooth cutter

<b>Feed mm/tooth (inch/tooth)</b>	up to 0.2 (.008)
<b>Cutting speed <math>v_c</math> (m/min) (f.p.m)</b>	
<b>BOEHLERIT SBF/ISO P25</b>	120 – 60 (395 – 195)
<b>BOEHLERIT SB40/ISO P40</b>	70 – 45 (230 – 150)
<b>BOEHLERIT ROYAL 635/ISO P35</b>	80 – 60 (260 – 195)

The data contained in this brochure is merely for general information and therefore shall not be binding on the company. We may be bound only through a contract explicitly stipulating such data as binding. Measurement data are laboratory values and can deviate from practical analyses. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.

MATERIALS | MOLD BASES | PVD COATINGS | ADDITIVE

**EDRO**

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