BÖHLER

PLASTIC MOULD STEEL

POWDER METALLURGY

PLASTIC MOULD STEEL

BÖHLER M390
MICROCLEAN®

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

voestalpine
ONE STEP AHEAD.

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 consistant tool life
» Reproducibility of production processes
» High precision components

BENEFIT

» INCREASED PRODUCTIVITY
» REDUCED UNIT COSTS

FIELD OF APPLICATIONS

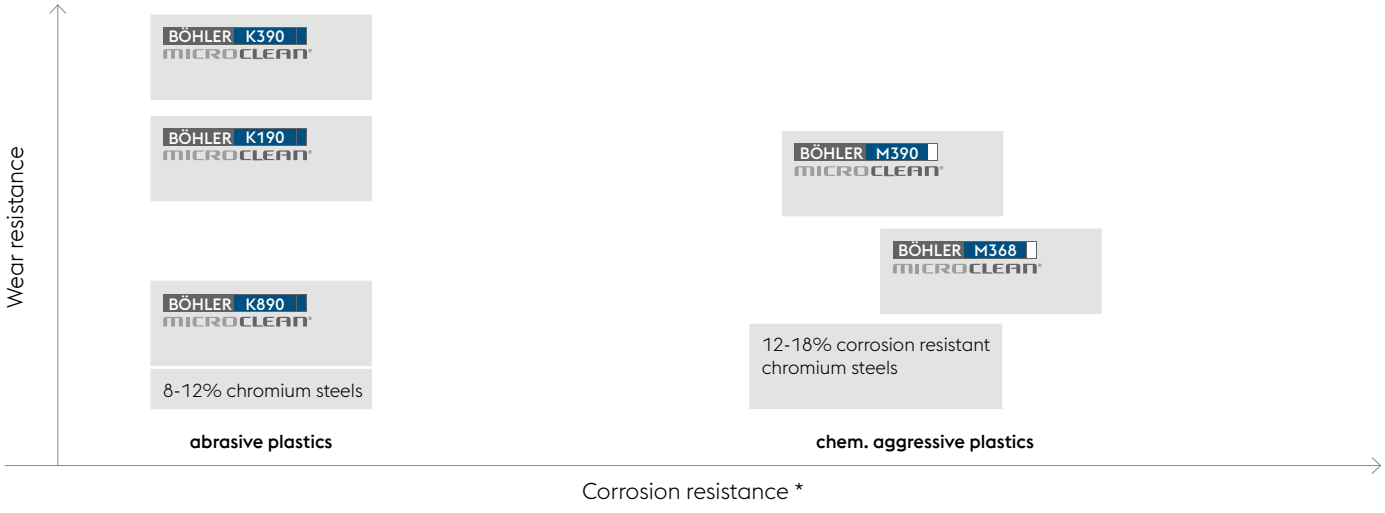
» Mould inserts for the production of CDs and DVDs
» Moulds for the processing of chemically aggressive plastics containing highly abrasive fillers
» Moulds for the processing of duroplasts
» Moulds for the production of chips for the electronics industry
» Screws for injection moulding machines
» Non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



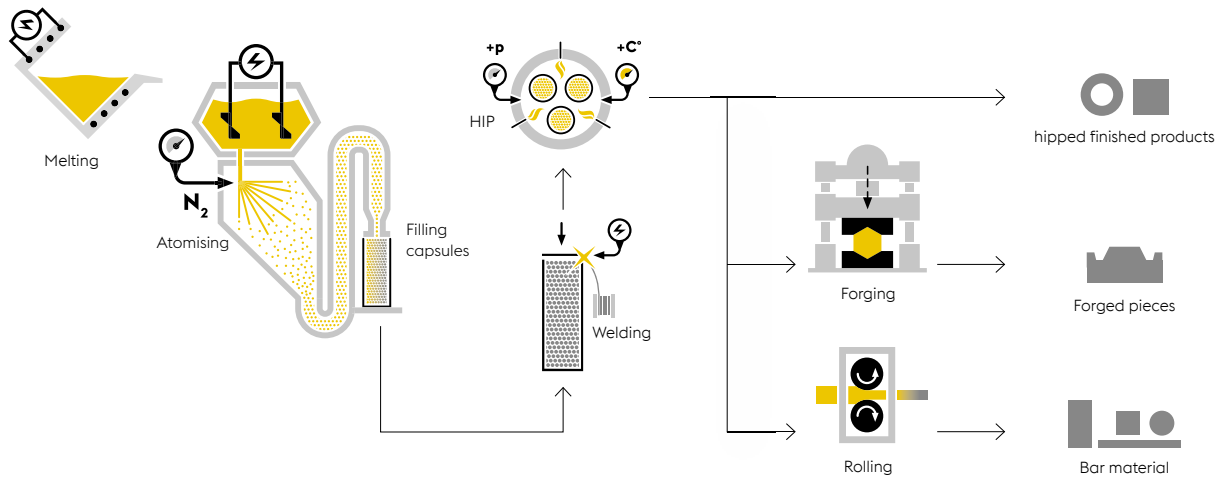
* High tempered, weight loss test with 20% boiling acetic acid, 24 h.

THE ADVANTAGES OF MICROCLEAN MATERIALS

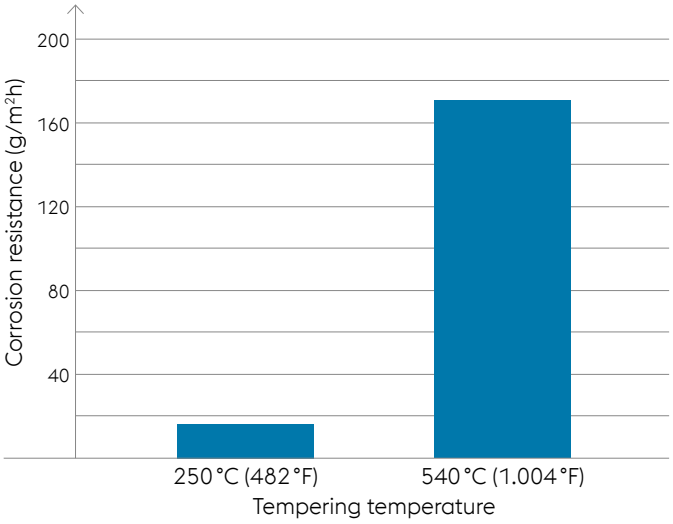
THE WORLD'S MOST MODERN PM STEEL PRODUCTION PLANT.

voestalpine BÖHLER developes 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.

Flow chart

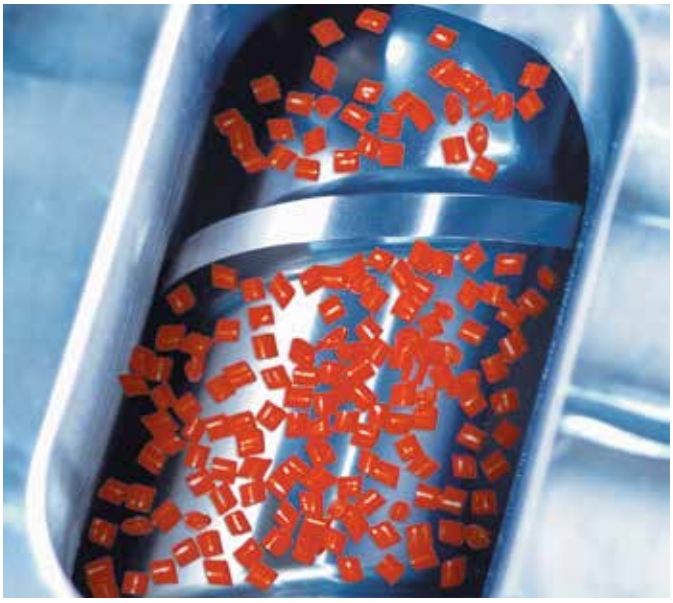


Corrosion resistance



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/dm³ (0.272 lbs/in³)
Thermal conductivity at 20 °C (68 °F)	16,5 W/(m.K) (114 Btu in/ft² 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^{-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

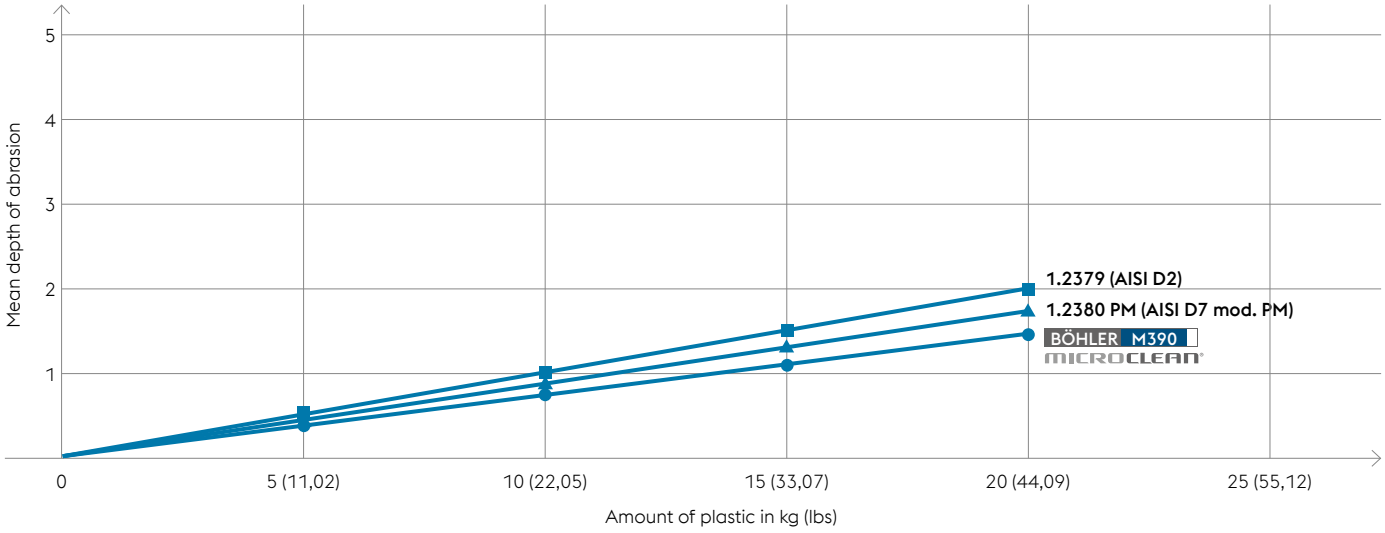
Regarding applications and processing steps that are not expressly mentioned in this product description/data sheet, the customer shall in each individual case be required to **consult us**.

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 MICROCLEAN shows the best wear and corrosion resistance in comparison to 1.2379 (D2) and 1.2380 PM.

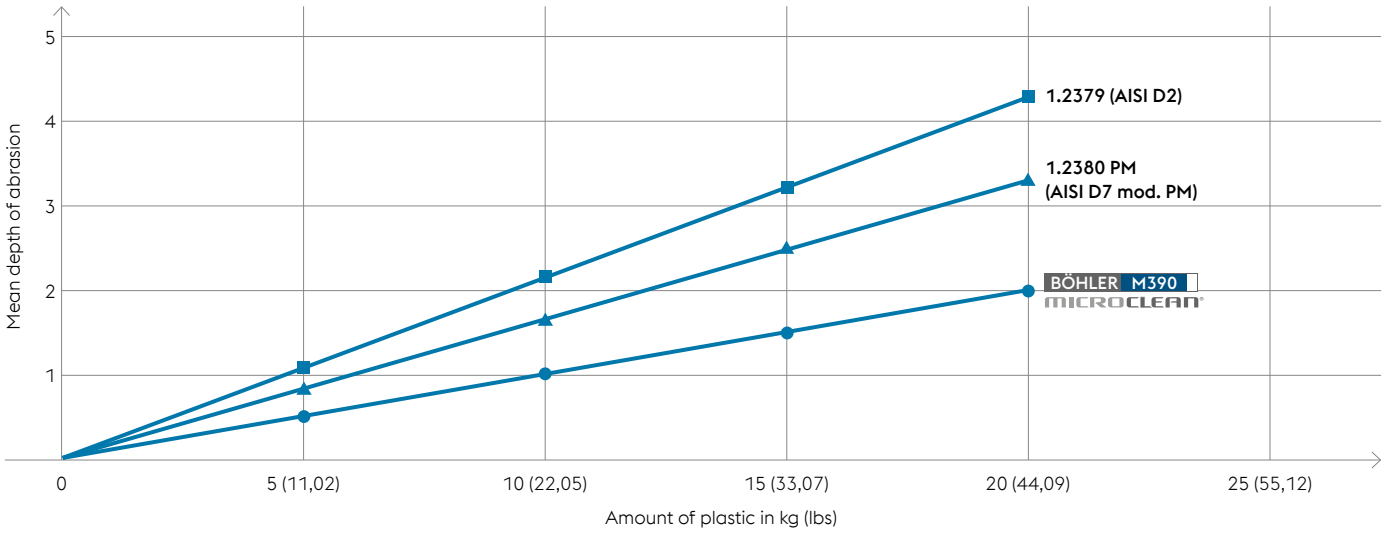
The formation of corrosive sulfurous degradation products during processing of PES significantly increases the load on the tool. BÖHLER M390 MICROCLEAN shows under these exposures in direct comparison to 1.2379 (D2) and 1.2380 PM a clear reduced material removal.

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)

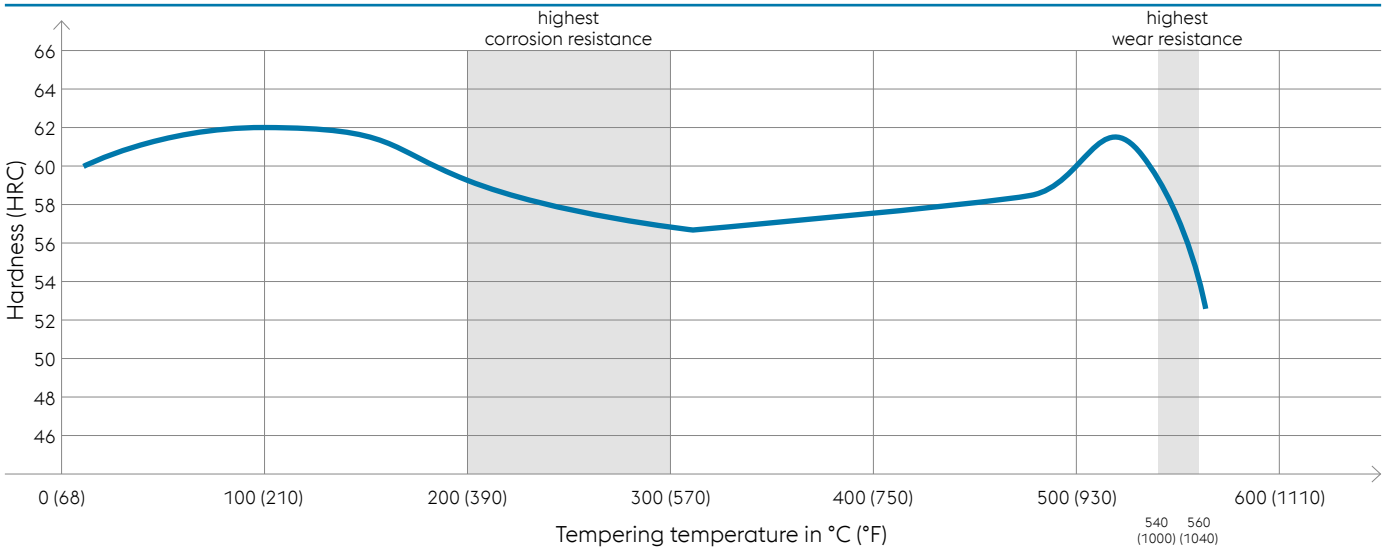


Plastic: Polyethersulfon (PES), Trade name: Ultrason E2010G6, Glass fibre content: 30 wt.%, Temperature: 400 °C (750 °F)

Source: Institute for Plastics Processing at the University of Leoben

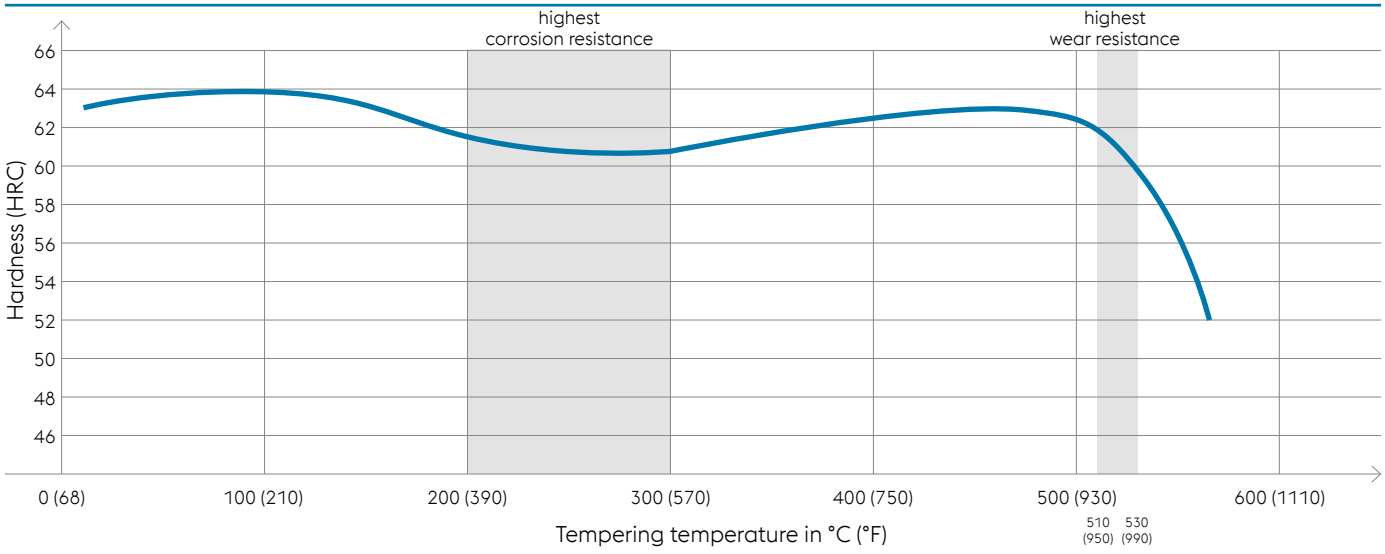
HEAT TREATMENT RECOMMENDATIONS

Tempering chart (without subzero treatment)



Vacuum hardening: 1150 °C (2100 °F) / 30 min / N_2, 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_2, 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_2
» 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 ≥ 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.


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

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

Milling with inserted tooth cutter

Feed mm/tooth (inch/tooth)	up to 0.2 (.008)
Cutting speed v_c (m/min) (f.p.m)	
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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