HARD MACHINING OF STEEL GRADES UP TO 65 HRC

High-efficiency carbide cutters with ultra-high performance in hard machining applications

pokolm

PREMIUMTOOLS. WE KNOW HOW.

HIGHLY EFFICIENT MACHINING OF HARDENED STEEL GRADES - OUTSTANDING DURABILITY, HIGH PRECISION

POKOLM's new solid carbide milling cutters for use with materials up to 65 HRC have set completely new standards in this cutting application.

The entire product line of ball and angular radius cutters is distinguished by extreme durability, high precision, and outstanding quality of finish.

In terms of design, the heavy-duty tools stand out by a cutting edge geometry specifically optimised to tackle hard milling applications, rounded out by a coating of unequalled wear resistance.

The specially designed, tangential shaft transition confers superior bending fracture strength compared with conventional models.

Diameters from 0.2 mm to 12.00 mm and working depths of up to 20 x d are finely graduated to meet a broad variety of customer requirements.

Advantages at a glance

- High efficiency thanks to outstanding durability
- High precision and quality of surface finish
- Special cutting edge geometries designed for hard milling
- Coating with unmatched wear resistance
- Tangential shaft transition for improved bending fracture strength
- Product range with finely graduated diameters and machining depths

Description Tool Order Number Key

Sample: C 2 HA - 060 - 020 - 200 - 01

Tool type
B - ball nose end mill
C - corner radius end mills

Number of flutes [z]
2 - 2 flutes

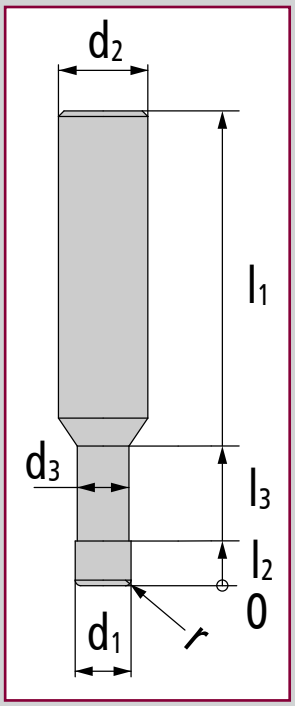
Main application
HA - hard machining

Cutting diameter [d1]
060 - 6.0 mm

Corner radius [r]
020 - 0.20 mm

Machining depth [l3]
200 - 20.0 mm
000 - without machining depth

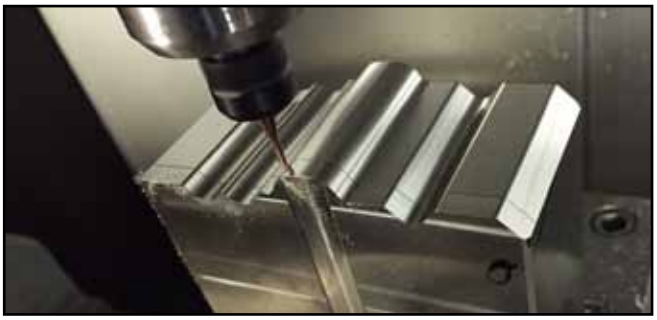
Variant counter



POKOLM'S NEW SOLID CARBIDE END MILLS UP TO 65 HRC - CLEAR WINNERS IN DIRECT BENCHMARK TEST

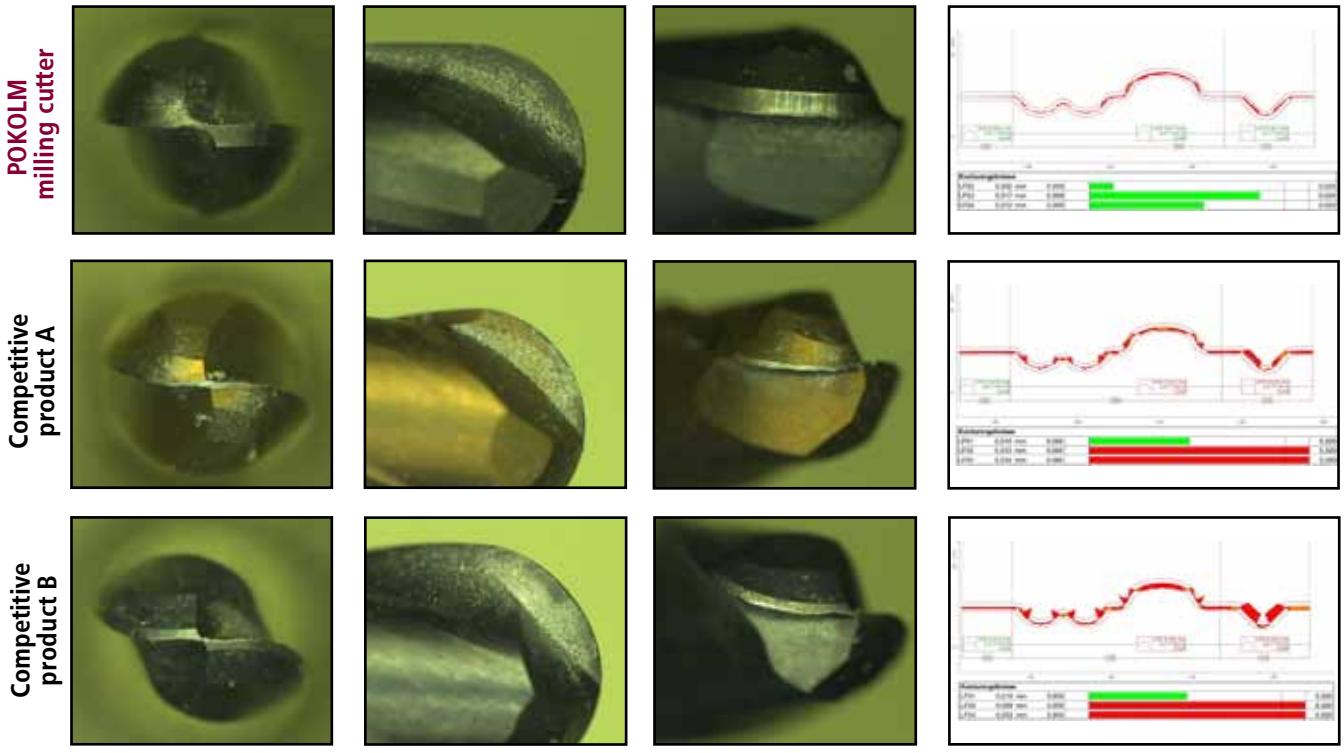
Benchmark testing in a lab setting

POKOLM's innovative solid carbide ball nose cutters for use with materials of up to hardness of 65 HRC had to face up to competitive products designed for cutting similar materials in a head-to-head challenge.
All test candidates were used to machine geometries from 1.2379 60+2 HRC in identical test set-ups. All tools had a cutting diameter of 2.0 mm and a machining depth of 12 mm.



Tool wear and dimensional accuracy of the ACTUAL contours vs. theoretical TAGET contours was determined downstream of the smoothing process using a contour meter.

Machine	HERMLE C 600U
Electric spindle	**POKOLM** HSL 1
Coolant	internal air
Coating	PVTix
V_c [m/min]	100
V_f [mm/min]	960
n(s) [min^{-1}]	16,000
D_c [mm]	2.0
f_z [mm]	0.03
a_p [mm]	0.03
a_e [mm]	0.03
Life length [m]	195
Tool life [min]	360



Benchmark test: definitive results

After four hours of milling, the **POKOLM** tool shows much less wear than the competitive products, as well as better dimensional accuracy of the ACTUAL/TARGET contour.

END MILLS FOR STEEL UP TO 65 HRC

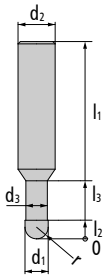
Ball nose end mills | 2 flutes

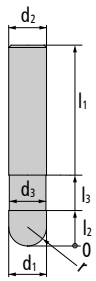
2 flutes, plain shank, right hand helix angle

- center cutting end mill
- ball nose
- with and without clearance between shank and flute up to 20 x d
- high precision: r = +/- 0,005 ; d1 < Ø 6 = 0/- 0,015; d1 > Ø 6 = 0/- 0,02

wd. | short | long

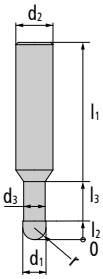
Ball nose end mills	catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
	B2HA-003-015-015-01	0.3	0.3	1.5	0.27	50	0.15	4	2	2.06	2.21	2.35	2.48	2.71	1,5	15		UMGC PVTix
	B2HA-004-020-015-01	0.4	0.4	1.5	0.385	50	0.2	4	2	1.92	2.07	2.19	2.30	2.51	1,5	15		UMGC PVTix
	B2HA-004-020-030-01	0.4	0.4	3	0.385	50	0.2	4	2	3.54	3.74	3.91	4.06	4.32	1,5	15		UMGC PVTix
	B2HA-004-020-050-01	0.4	0.4	5	0.385	50	0.2	4	2	5.66	5.92	6.13	6.31	6.62	1,5	15		UMGC PVTix
	B2HA-005-025-030-01	0.5	0.5	3	0.48	50	0.25	4	2	3.56	3.75	3.92	4.06	4.32	1,5	15		UMGC PVTix
	B2HA-005-025-050-01	0.5	0.5	5	0.48	50	0.25	4	2	5.68	5.93	6.13	6.31	6.62	1,5	15		UMGC PVTix
	B2HA-005-025-100-01	0.5	0.5	10	0.48	50	0.25	4	2	10.90	11.26	11.53	11.77	12.70	1,5	15		UMGC PVTix
	B2HA-006-030-030-01	0.6	0.6	3	0.58	50	0.3	4	2	3.55	3.75	3.90	4.05	4.31	1,5	15		UMGC PVTix
	B2HA-006-030-050-01	0.6	0.6	5	0.58	50	0.3	4	2	5.67	5.92	6.13	6.31	6.62	1,5	15		UMGC PVTix
	B2HA-006-030-100-01	0.6	0.6	10	0.58	50	0.3	4	2	10.90	11.25	11.53	11.77	12.65	1,5	15		UMGC PVTix
	B2HA-008-040-030-01	0.8	0.8	3	0.78	50	0.4	4	2	3.55	3.74	3.90	4.04	4.29	1,5	15		UMGC PVTix
	B2HA-008-040-050-01	0.8	0.8	5	0.78	50	0.4	4	2	5.67	5.92	6.12	6.30	6.60	1,5	15		UMGC PVTix
	B2HA-008-040-100-01	0.8	0.8	10	0.78	50	0.4	4	2	10.89	11.25	11.52	11.76	12.62	1,5	15		UMGC PVTix
	B2HA-010-050-050-01	1	1	5	0.98	50	0.5	4	2	5.66	5.91	6.11	6.29	6.59	1,5	15		UMGC PVTix
	B2HA-010-050-100-01	1	1	10	0.98	50	0.5	4	2	10.89	11.24	11.52	11.75	12.59	1,5	15		UMGC PVTix
	B2HA-010-050-150-01	1	1	15	0.98	50	0.5	4	2	16.07	16.49	16.82	17.38	19.22	1,5	15		UMGC PVTix
	B2HA-015-075-050-01	1.5	1.5	5	1.45	50	0.75	4	2	5.74	5.96	6.14	6.31	6.60	1,5	15		UMGC PVTix
	B2HA-015-075-100-01	1.5	1.5	10	1.45	50	0.75	4	2	10.95	11.28	11.54	11.76	12.54	1,5	15		UMGC PVTix
	B2HA-015-075-150-01	1.5	1.5	15	1.45	50	0.75	4	2	16.12	16.52	16.84	17.36	19.18	1,5	15		UMGC PVTix
	B2HA-015-075-200-01	1.5	1.5	20	1.45	75	0.75	4	2	21.26	21.73	22.28	23.34	-	1,5	15		UMGC PVTix
	B2HA-020-100-050-01	2	2	5	1.95	50	1	4	2	5.73	5.94	6.12	6.28	6.56	1,5	15		UMGC PVTix
	B2HA-020-100-100-01	2	2	10	1.95	50	1	4	2	10.94	11.26	11.52	11.75	12.46	1,5	15		UMGC PVTix

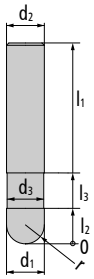




Ball nose end mills

with AT | short | long

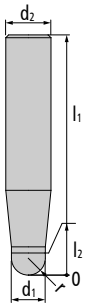


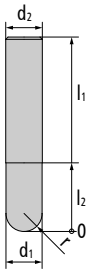


catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
B2HA-020-100-150-01	2	2	15	1.95	50	1	4	2	16.11	16.51	16.82	17.31	19.10	1,5	15		UMGC PVTix
B2HA-020-100-200-01	2	2	20	1.95	75	1	4	2	21.25	21.72	22.25	23.29	-	1,5	15		UMGC PVTix
B2HA-030-150-100-01	3	3	10	2.95	58	1.5	6	2	10.92	11.23	11.49	11.71	12.30	1,5	15		UMGC PVTix
B2HA-030-150-150-01	3	3	15	2.95	58	1.5	6	2	16.09	16.49	16.80	17.22	18.94	1,5	15		UMGC PVTix
B2HA-030-150-200-01	3	3	20	2.95	75	1.5	6	2	21.24	21.70	22.18	23.20	25.57	1,5	15		UMGC PVTix
B2HA-030-150-250-01	3	3	25	2.95	75	1.5	6	2	26.37	26.88	27.88	29.18	-	1,5	15		UMGC PVTix
B2HA-040-200-100-01	4	4	10	3.9	58	2	6	2	11.01	11.29	11.52	11.72	12.20	1,5	15		UMGC PVTix
B2HA-040-200-150-01	4	4	15	3.9	58	2	6	2	16.17	16.53	16.82	17.17	18.84	1,5	15		UMGC PVTix
B2HA-040-200-200-01	4	4	20	3.9	75	2	6	2	21.30	21.73	22.16	23.15	-	1,5	15		UMGC PVTix
B2HA-040-200-250-01	4	4	25	3.9	75	2	6	2	26.43	26.91	27.86	29.14	-	1,5	15		UMGC PVTix
B2HA-050-250-100-01	5	5	10	4.9	58	2.5	6	2	10.99	11.26	11.49	11.69	-	1,5	15		UMGC PVTix
B2HA-050-250-150-01	5	5	15	4.9	58	2.5	6	2	16.15	16.51	16.80	-	-	1,5	15		UMGC PVTix
B2HA-050-250-200-01	5	5	20	4.9	75	2.5	6	2	21.29	21.71	-	-	-	1,5	15		UMGC PVTix
B2HA-050-250-250-01	5	5	25	4.9	75	2.5	6	2	26.42	26.89	-	-	-	1,5	15		UMGC PVTix
B2HA-060-300-100-01	6	6	10	5.85	58	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-060-300-150-01	6	6	15	5.85	58	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-060-300-200-01	6	6	20	5.85	75	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-060-300-250-01	6	6	25	5.85	75	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix

Ball nose end mills

no wd. | short | long





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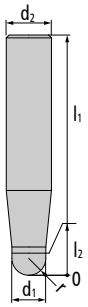
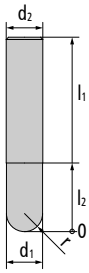
B2HA-002-010-000-01	0.2	0.2	-	-	50	0.1	4	2	0.35	0.45	0.54	0.63	0.81	1,5	15		UMGC PVTix
B2HA-003-015-000-01	0.3	0.3	-	-	50	0.15	4	2	0.47	0.57	0.67	0.76	0.95	1,5	15		UMGC PVTix
B2HA-004-020-000-01	0.4	0.4	-	-	50	0.2	4	2	0.56	0.65	0.74	0.82	0.97	1,5	15		UMGC PVTix
B2HA-005-025-000-01	0.5	0.5	-	-	50	0.25	4	2	0.67	0.77	0.86	0.94	1.10	1,5	15		UMGC PVTix
B2HA-006-030-000-01	0.6	0.6	-	-	50	0.3	4	2	0.78	0.89	0.98	1.06	1.22	1,5	15		UMGC PVTix
B2HA-008-040-000-01	0.8	0.8	-	-	50	0.4	4	2	1.01	1.12	1.21	1.30	1.47	1,5	15		UMGC PVTix
B2HA-010-050-000-01	1	1	-	-	50	0.5	4	2	1.26	1.34	1.45	1.54	1.72	1,5	15		UMGC PVTix
B2HA-010-050-000-02	1	1	-	-	75	0.5	4	2	1.26	1.34	1.45	1.54	1.72	1,5	15		UMGC PVTix
B2HA-015-075-000-01	1.5	1.5	-	-	50	0.75	4	2	1.77	1.90	2.02	2.12	2.31	1,5	15		UMGC PVTix
B2HA-015-075-000-02	1.5	1.5	-	-	75	0.75	4	2	1.77	1.90	2.02	2.12	2.31	1,5	15		UMGC PVTix
B2HA-020-100-000-01	2	2	-	-	50	1	4	2	2.30	2.45	2.58	2.69	2.89	1,5	15		UMGC PVTix

Ball nose end mills

no wd. | short | long





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B2HA-020-100-000-02	2	2	-	-	75	1	4	2	2.30	2.45	2.58	2.69	2.89	1,5	15		UMGC PVTix
B2HA-030-150-000-01	3	3	-	-	58	1.5	6	2	3.36	3.53	3.68	3.80	4.03	1,5	15		UMGC PVTix
B2HA-030-150-000-02	3	3	-	-	75	1.5	6	2	3.36	3.53	3.68	3.80	4.03	1,5	15		UMGC PVTix
B2HA-040-200-000-01	4	4	-	-	58	2	6	2	4.41	4.60	4.76	4.90	5.15	1,5	15		UMGC PVTix
B2HA-040-200-000-02	4	4	-	-	75	2	6	2	4.41	4.60	4.76	4.90	5.15	1,5	15		UMGC PVTix
B2HA-050-250-000-01	5	5	-	-	58	2.5	6	2	5.45	5.67	5.84	5.99	6.25	1,5	15		UMGC PVTix
B2HA-050-250-000-02	5	5	-	-	75	2.5	6	2	5.45	5.67	5.84	5.99	6.25	1,5	15		UMGC PVTix
B2HA-060-300-000-01	6	6	-	-	58	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-060-300-000-02	6	6	-	-	75	3	6	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-080-400-000-01	8	8	-	-	63	4	8	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-080-400-000-02	8	8	-	-	90	4	8	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-100-500-000-01	10	10	-	-	72	5	10	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-100-500-000-02	10	10	-	-	100	5	10	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-120-600-000-01	12	12	-	-	83	6	12	2	-	-	-	-	-	1,5	15		UMGC PVTix
B2HA-120-600-000-02	12	12	-	-	110	6	12	2	-	-	-	-	-	1,5	15		UMGC PVTix

Cutting rates | Application data

BALL NOSE CUTTERS - copying 3D										
d_1 [mm]	Application	Hardened steel								
		up to 48 HRC			up to 55 HRC			up to 65 HRC		
		v_c [m/min]	f_z [mm/tooth]	a_p [mm]	V_c [m/min]	f_z [mm/tooth]	a_p [mm]	V_c [m/min]	f_z [mm/tooth]	a_p [mm]
0.2 - 0.5	Roughing	-	-	-	-	-	-	-	-	-
	Pre finishing	-	-	-	-	-	-	-	-	-
	Finishing	170 - 250	0.005 - 0.02	0.01 - 0.02	160 - 200	0.005 - 0.015	0.005 - 0.02	90 - 160	0.005 - 0.01	0.01 - 0.02
0.6 - 0.8	Roughing	-	-	-	-	-	-	-	-	-
	Pre finishing	-	-	-	-	-	-	-	-	-
	Finishing	170 - 250	0.015 - 0.025	0.02 - 0.04	160 - 200	0.01 - 0.02	0.02 - 0.035	90 - 160	0.01 - 0.015	0.015 - 0.03
1.0 - 1.5	Roughing	150 - 190	0.025 - 0.035	0.1 - 0.2	120 - 160	0.025 - 0.03	0.1 - 0.15	70 - 120	0.005 - 0.01	0.04 - 0.075
	Pre finishing	160 - 220	0.04 - 0.05	0.05 - 0.15	140 - 180	0.025 - 0.045	0.05 - 0.1	80 - 140	0.02 - 0.025	0.025 - 0.05
	Finishing	170 - 250	0.025 - 0.03	0.04 - 0.05	160 - 200	0.02 - 0.025	0.035 - 0.05	90 - 160	0.01 - 0.015	0.02 - 0.03
2.0	Roughing	150 - 190	0.035 - 0.06	0.2 - 0.35	120 - 160	0.03 - 0.055	0.15 - 0.35	70 - 120	0.01 - 0.015	0.05 - 0.15
	Pre finishing	160 - 220	0.05 - 0.085	0.1 - 0.25	140 - 180	0.045 - 0.08	0.1 - 0.2	80 - 140	0.03 - 0.04	0.035 - 0.075
	Finishing	170 - 250	0.03 - 0.035	0.05 - 0.07	160 - 200	0.025 - 0.03	0.05 - 0.07	90 - 160	0.015 - 0.025	0.025 - 0.04
3.0	Roughing	150 - 190	0.05 - 0.07	0.35 - 0.55	120 - 160	0.05 - 0.065	0.3 - 0.55	70 - 120	0.01 - 0.02	0.1 - 0.2
	Pre finishing	160 - 220	0.085 - 0.095	0.25 - 0.35	140 - 180	0.07 - 0.09	0.2 - 0.35	80 - 140	0.035 - 0.05	0.05 - 0.1
	Finishing	170 - 250	0.035 - 0.04	0.07 - 0.1	160 - 200	0.03 - 0.035	0.05 - 0.1	90 - 160	0.015 - 0.03	0.03 - 0.05
4.0	Roughing	150 - 190	0.07 - 0.85	0.45 - 0.7	120 - 160	0.065 - 0.075	0.4 - 0.7	70 - 120	0.015 - 0.02	0.1 - 0.2
	Pre finishing	160 - 220	0.095 - 0.115	0.35 - 0.5	140 - 180	0.08 - 0.105	0.3 - 0.5	80 - 140	0.04 - 0.05	0.05 - 0.15
	Finishing	170 - 250	0.04 - 0.065	0.1 - 0.12	160 - 200	0.035 - 0.065	0.1 - 0.12	90 - 160	0.025 - 0.035	0.04 - 0.06
5.0	Roughing	150 - 190	0.08 - 0.09	0.55 - 0.9	120 - 160	0.075 - 0.085	0.5 - 0.9	70 - 120	0.015 - 0.025	0.15 - 0.3
	Pre finishing	160 - 220	0.11 - 0.13	0.45 - 0.6	140 - 180	0.09 - 0.12	0.4 - 0.6	80 - 140	0.045 - 0.06	0.1 - 0.2
	Finishing	170 - 250	0.06 - 0.075	0.12 - 0.15	160 - 200	0.04 - 0.07	0.11 - 0.14	90 - 160	0.03 - 0.04	0.05 - 0.08
6.0	Roughing	150 - 190	0.085 - 0.1	0.85 - 1.25	120 - 160	0.08 - 0.095	0.8 - 1.25	70 - 120	0.02 - 0.025	0.25 - 0.4
	Pre finishing	160 - 220	0.12 - 0.145	0.5 - 0.7	140 - 180	0.105 - 0.13	0.45 - 0.7	80 - 140	0.05 - 0.07	0.15 - 0.25
	Finishing	170 - 250	0.065 - 0.08	0.13 - 0.16	160 - 200	0.06 - 0.075	0.13 - 0.15	90 - 160	0.03 - 0.04	0.065 - 0.08
8.0	Roughing	150 - 190	0.095 - 0.115	1.1 - 1.7	120 - 160	0.09 - 0.105	1.1 - 1.7	70 - 120	0.02 - 0.03	0.35 - 0.5
	Pre finishing	160 - 220	0.14 - 0.155	0.65 - 0.95	140 - 180	0.115 - 0.145	0.6 - 0.95	80 - 140	0.065 - 0.08	0.2 - 0.3
	Finishing	170 - 250	0.075 - 0.09	0.145 - 0.17	160 - 200	0.07 - 0.085	0.14 - 0.17	90 - 160	0.035 - 0.045	0.07 - 0.09
10.0	Roughing	150 - 190	0.11 - 0.135	1.4 - 2.1	120 - 160	0.105 - 0.125	1.4 - 2.1	70 - 120	0.03 - 0.035	0.4 - 0.65
	Pre finishing	160 - 220	0.15 - 0.185	0.8 - 1.2	140 - 180	0.13 - 0.17	0.8 - 1.2	80 - 140	0.07 - 0.085	0.2 - 0.35
	Finishing	170 - 250	0.08 - 0.095	0.15 - 0.2	160 - 200	0.075 - 0.09	0.17 - 0.2	90 - 160	0.035 - 0.05	0.08 - 0.1
12.0	Roughing	150 - 190	0.13 - 0.14	1.65 - 2.5	120 - 160	0.115 - 0.13	1.6 - 2.5	70 - 120	0.03 - 0.035	0.5 - 0.8
	Pre finishing	160 - 220	0.16 - 0.195	0.95 - 1.45	140 - 180	0.15 - 0.18	0.9 - 1.45	80 - 140	0.075 - 0.09	0.25 - 0.45
	Finishing	170 - 250	0.085 - 0.1	0.16 - 0.25	160 - 200	0.08 - 0.095	0.2 - 0.25	90 - 160	0.035 - 0.055	0.09 - 0.15

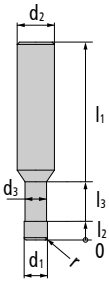
END MILLS FOR STEEL UP TO 65 HRC

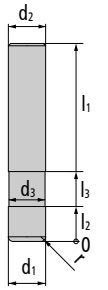
Toric / Corner radius end mills | 2 flutes

2 flutes, plain shank, right hand helix angle

- center cutting end mill
- with and without clearance between shank and flute up to 20 x d
- high precision: r = +/- 0,005 ; d1 < Ø 6 = 0/- 0,015; d1 > Ø 6 = 0/- 0,02

wd. | short | long

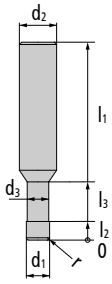


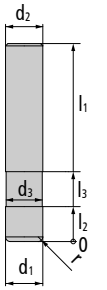


Corner radius end mills — catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
C2HA-004-010-015-01	0.4	0.4	1.5	0.385	50	0.1	4	2	1.93	2.08	2.21	2.32	2.53	1,5	30		UMGC PVTix
C2HA-004-010-030-01	0.4	0.4	3	0.385	50	0.1	4	2	3.55	3.75	3.92	4.07	4.34	1,5	30		UMGC PVTix
C2HA-004-010-050-01	0.4	0.4	5	0.385	50	0.1	4	2	5.67	5.93	6.14	6.32	6.64	1,5	30		UMGC PVTix
C2HA-005-010-015-01	0.5	0.5	1.5	0.48	50	0.1	4	2	1.96	2.10	2.22	2.34	2.54	1,5	30		UMGC PVTix
C2HA-005-010-030-01	0.5	0.5	3	0.48	50	0.1	4	2	3.57	3.77	3.93	4.08	4.34	1,5	30		UMGC PVTix
C2HA-005-010-050-01	0.5	0.5	5	0.48	50	0.1	4	2	5.68	5.94	6.15	6.33	6.64	1,5	30		UMGC PVTix
C2HA-005-010-100-01	0.5	0.5	10	0.48	50	0.1	4	2	10.91	11.26	11.54	11.78	12.71	1,5	30		UMGC PVTix
C2HA-006-010-030-01	0.6	0.6	3	0.58	50	0.1	4	2	3.57	3.77	3.93	4.08	4.34	1,5	30		UMGC PVTix
C2HA-006-010-050-01	0.6	0.6	5	0.58	50	0.1	4	2	5.68	5.94	6.15	6.33	6.64	1,5	30		UMGC PVTix
C2HA-006-010-100-01	0.6	0.6	10	0.58	50	0.1	4	2	10.91	11.26	11.54	11.78	12.71	1,5	30		UMGC PVTix
C2HA-008-010-030-01	0.8	0.8	3	0.78	50	0.1	4	2	3.57	3.77	3.93	4.08	4.34	1,5	30		UMGC PVTix
C2HA-008-010-050-01	0.8	0.8	5	0.78	50	0.1	4	2	5.68	5.94	6.15	6.33	6.64	1,5	30		UMGC PVTix
C2HA-008-010-100-01	0.8	0.8	10	0.78	50	0.1	4	2	10.91	11.26	11.54	11.78	12.71	1,5	30		UMGC PVTix
C2HA-008-010-150-01	0.8	0.8	15	0.78	50	0.1	4	2	16.08	16.51	16.84	17.45	19.35	1,5	30		UMGC PVTix
C2HA-010-020-050-01	1	1	5	0.98	50	0.2	4	2	5.68	5.93	6.14	6.32	6.63	1,5	30		UMGC PVTix
C2HA-010-020-100-01	1	1	10	0.98	50	0.2	4	2	10.90	11.26	11.54	11.77	12.68	1,5	30		UMGC PVTix
C2HA-010-020-150-01	1	1	15	0.98	50	0.2	4	2	16.08	16.51	16.84	17.43	19.32	1,5	30		UMGC PVTix
C2HA-010-020-200-01	1	1	20	0.98	75	0.2	4	2	21.23	21.71	22.33	23.42	25.95	1,5	30		UMGC PVTix
C2HA-015-020-050-01	1.5	1.5	5	1.45	50	0.2	4	2	5.76	6.00	6.19	6.37	6.67	1,5	30		UMGC PVTix
C2HA-015-020-100-01	1.5	1.5	10	1.45	50	0.2	4	2	10.97	11.31	11.58	11.81	12.72	1,5	30		UMGC PVTix
C2HA-015-020-150-01	1.5	1.5	15	1.45	50	0.2	4	2	16.13	16.55	16.87	17.47	19.35	1,5	30		UMGC PVTix
C2HA-015-020-200-01	1.5	1.5	20	1.45	75	0.2	4	2	21.28	21.75	22.36	23.45	-	1,5	30		UMGC PVTix
C2HA-020-020-050-01	2	2	5	1.95	50	0.2	4	2	5.76	6.00	6.19	6.37	6.67	1,5	30		UMGC PVTix

Corner radius end mills

wd. | short | long

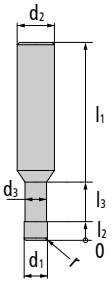


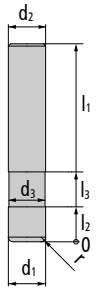


catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
C2HA-020-020-100-01	2	2	10	1.95	50	0.2	4	2	10.97	11.31	11.58	11.81	12.72	1,5	30		UMGC PVTix
C2HA-020-020-150-01	2	2	15	1.95	50	0.2	4	2	16.13	16.55	16.87	17.47	-	1,5	30		UMGC PVTix
C2HA-020-020-200-01	2	2	20	1.95	75	0.2	4	2	21.28	21.75	22.36	23.45	-	1,5	30		UMGC PVTix
C2HA-020-020-250-01	2	2	25	1.95	75	0.2	4	2	26.40	26.92	28.06	-	-	1,5	30		UMGC PVTix
C2HA-020-050-050-01	2	2	5	1.95	50	0.5	4	2	5.75	5.98	6.17	6.33	6.63	1,5	30		UMGC PVTix
C2HA-020-050-100-01	2	2	10	1.95	50	0.5	4	2	10.96	11.29	11.56	11.78	12.62	1,5	30		UMGC PVTix
C2HA-020-050-150-01	2	2	15	1.95	50	0.5	4	2	16.13	16.53	16.85	17.41	19.26	1,5	30		UMGC PVTix
C2HA-020-050-200-01	2	2	20	1.95	75	0.5	4	2	21.27	21.74	22.32	23.39	-	1,5	30		UMGC PVTix
C2HA-020-050-250-01	2	2	25	1.95	75	0.5	4	2	26.40	26.91	28.02	-	-	1,5	30		UMGC PVTix
C2HA-030-020-100-01	3	3	10	2.95	58	0.2	6	2	10.97	11.31	11.58	11.81	12.72	1,5	30		UMGC PVTix
C2HA-030-020-150-01	3	3	15	2.95	58	0.2	6	2	16.13	16.55	16.87	17.47	19.35	1,5	30		UMGC PVTix
C2HA-030-020-200-01	3	3	20	2.95	75	0.2	6	2	21.28	21.75	22.36	23.45	25.99	1,5	30		UMGC PVTix
C2HA-030-020-250-01	3	3	25	2.95	75	0.2	6	2	26.40	26.92	28.06	29.43	-	1,5	30		UMGC PVTix
C2HA-030-050-100-01	3	3	10	2.95	58	0.5	6	2	10.96	11.29	11.56	11.78	12.62	1,5	30		UMGC PVTix
C2HA-030-050-150-01	3	3	15	2.95	58	0.5	6	2	16.13	16.53	16.85	17.41	19.26	1,5	30		UMGC PVTix
C2HA-030-050-200-01	3	3	20	2.95	75	0.5	6	2	21.27	21.74	22.32	23.39	25.89	1,5	30		UMGC PVTix
C2HA-030-050-250-01	3	3	25	2.95	75	0.5	6	2	26.40	26.91	28.02	29.37	-	1,5	30		UMGC PVTix
C2HA-040-020-100-01	4	4	10	3.9	58	0.2	6	2	11.07	11.38	11.64	11.86	12.77	1,5	30		UMGC PVTix
C2HA-040-020-150-01	4	4	15	3.9	58	0.2	6	2	16.22	16.61	16.91	17.52	-	1,5	30		UMGC PVTix
C2HA-040-020-200-01	4	4	20	3.9	75	0.2	6	2	21.35	21.80	22.41	23.50	-	1,5	30		UMGC PVTix
C2HA-040-020-250-01	4	4	25	3.9	75	0.2	6	2	26.47	26.97	28.11	-	-	1,5	30		UMGC PVTix
C2HA-040-050-100-01	4	4	10	3.9	58	0.5	6	2	11.05	11.36	11.62	11.84	12.68	1,5	30		UMGC PVTix
C2HA-040-050-150-01	4	4	15	3.9	58	0.5	6	2	16.21	16.59	16.90	17.46	19.31	1,5	30		UMGC PVTix
C2HA-040-050-200-01	4	4	20	3.9	75	0.5	6	2	21.34	21.79	22.37	23.44	-	1,5	30		UMGC PVTix
C2HA-040-050-250-01	4	4	25	3.9	75	0.5	6	2	26.46	26.96	28.07	-	-	1,5	30		UMGC PVTix
C2HA-050-020-100-01	5	5	10	4.9	58	0.2	6	2	11.07	11.38	11.64	11.86	-	1,5	30		UMGC PVTix
C2HA-050-020-200-01	5	5	20	4.9	75	0.2	6	2	21.35	21.80	-	-	-	1,5	30		UMGC PVTix
C2HA-050-050-100-01	5	5	10	4.9	58	0.5	6	2	11.06	11.36	11.62	11.84	-	1,5	30		UMGC PVTix
C2HA-050-050-200-01	5	5	20	4.9	75	0.5	6	2	21.34	21.79	-	-	-	1,5	30		UMGC PVTix
C2HA-060-020-100-01	6	6	10	5.85	58	0.2	6	2	-	-	-	-	-	1,5	30		UMGC PVTix

Corner radius end mills

wd. | short | long

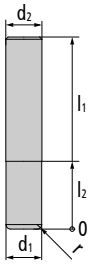


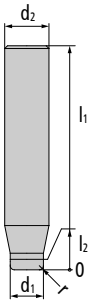


catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
C2HA-060-020-200-01	6	6	20	5.85	75	0.2	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-050-100-01	6	6	10	5.85	58	0.5	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-050-200-01	6	6	20	5.85	75	0.5	6	2	-	-	-	-	-	1,5	30		UMGC PVTix

Corner radius end mills

no wd.| short | long

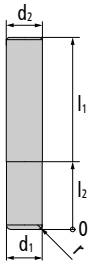


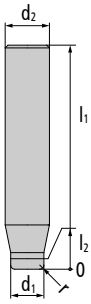


catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)	Features	Q/C
C2HA-004-010-000-01	0.4	0.4	-	-	50	0.1	4	2	0.58	0.69	0.78	0.86	1.02	1.5	30		UMGC PVTix
C2HA-005-010-000-01	0.5	0.5	-	-	50	0.1	4	2	0.71	0.82	0.91	1.00	1.17	1,5	30		UMGC PVTix
C2HA-006-010-000-01	0.6	0.6	-	-	50	0.1	4	2	0.83	0.94	1.04	1.14	1.31	1,5	30		UMGC PVTix
C2HA-008-010-000-01	0.8	0.8	-	-	50	0.1	4	2	1.06	1.19	1.30	1.40	1.59	1,5	30		UMGC PVTix
C2HA-010-020-000-01	1	1	-	-	50	0.2	4	2	1.27	1.41	1.53	1.63	1.82	1,5	30		UMGC PVTix
C2HA-010-020-000-02	1	1	-	-	75	0.2	4	2	1.27	1.41	1.53	1.63	1.82	1,5	30		UMGC PVTix
C2HA-015-020-000-01	1.5	1.5	-	-	50	0.2	4	2	1.84	2.00	2.14	2.26	2.47	1,5	30		UMGC PVTix
C2HA-015-020-000-02	1.5	1.5	-	-	75	0.2	4	2	1.84	2.00	2.14	2.26	2.47	1,5	30		UMGC PVTix
C2HA-020-020-000-01	2	2	-	-	50	0.2	4	2	2.39	2.58	2.73	2.86	3.09	1,5	30		UMGC PVTix
C2HA-020-020-000-02	2	2	-	-	75	0.2	4	2	2.39	2.58	2.73	2.86	3.09	1,5	30		UMGC PVTix
C2HA-020-050-000-01	2	2	-	-	50	0.5	4	2	2.36	2.53	2.67	2.80	3.02	1,5	30		UMGC PVTix
C2HA-020-050-000-02	2	2	-	-	75	0.5	4	2	2.36	2.53	2.67	2.80	3.02	1,5	30		UMGC PVTix
C2HA-030-020-000-01	3	3	-	-	58	0.2	6	2	3.48	3.70	3.87	4.03	4.29	1,5	30		UMGC PVTix
C2HA-030-020-000-02	3	3	-	-	75	0.2	6	2	3.48	3.70	3.87	4.03	4.29	1,5	30		UMGC PVTix
C2HA-030-050-000-01	3	3	-	-	58	0.5	6	2	3.45	3.66	3.83	3.98	4.24	1,5	30		UMGC PVTix
C2HA-030-050-000-02	3	3	-	-	75	0.5	6	2	3.45	3.66	3.83	3.98	4.24	1,5	30		UMGC PVTix
C2HA-040-020-000-01	4	4	-	-	58	0.2	6	2	4.55	4.80	5.00	5.17	5.46	1,5	30		UMGC PVTix
C2HA-040-020-000-02	4	4	-	-	75	0.2	6	2	4.55	4.80	5.00	5.17	5.46	1,5	30		UMGC PVTix

Corner radius end mills

no wd. | short | long





catalogue no.	d_1	l_2	l_3	d_3	l_1	r	d_2	z	Effective working length at X° of draft 0.5°	1°	1.5°	2°	3°	γ (chip angle)	λ (helix angle)		Features Q/C
C2HA-040-050-000-01	4	4	-	-	58	0.5	6	2	4.53	4.77	4.96	5.13	5.41	1,5	30		UMGC PVTix
C2HA-040-050-000-02	4	4	-	-	75	0.5	6	2	4.53	4.77	4.96	5.13	5.41	1,5	30		UMGC PVTix
C2HA-050-020-000-01	5	5	-	-	58	0.2	6	2	5.61	5.87	6.10	6.29	6.61	1,5	30		UMGC PVTix
C2HA-050-020-000-02	5	5	-	-	75	0.2	6	2	5.61	5.87	6.10	6.29	6.61	1,5	30		UMGC PVTix
C2HA-050-050-000-01	5	5	-	-	58	0.5	6	2	5.59	5.86	6.07	6.25	6.56	1,5	30		UMGC PVTix
C2HA-050-050-000-02	5	5	-	-	75	0.5	6	2	5.59	5.86	6.07	6.25	6.56	1,5	30		UMGC PVTix
C2HA-060-020-000-01	6	6	-	-	58	0.2	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-020-000-02	6	6	-	-	75	0.2	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-050-000-01	6	6	-	-	58	0.5	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-050-000-02	6	6	-	-	75	0.5	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-100-000-01	6	6	-	-	58	1	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-060-100-000-02	6	6	-	-	75	1	6	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-080-050-000-01	8	8	-	-	63	0.5	8	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-080-050-000-02	8	8	-	-	90	0.5	8	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-080-100-000-01	8	8	-	-	63	1	8	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-080-100-000-02	8	8	-	-	90	1	8	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-100-100-000-01	10	10	-	-	72	1	10	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-100-100-000-02	10	10	-	-	100	1	10	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-100-150-000-01	10	10	-	-	72	1.5	10	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-100-150-000-02	10	10	-	-	100	1.5	10	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-120-100-000-01	12	12	-	-	83	1	12	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-120-100-000-02	12	12	-	-	110	1	12	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-120-200-000-01	12	12	-	-	83	2	12	2	-	-	-	-	-	1,5	30		UMGC PVTix
C2HA-120-200-000-02	12	12	-	-	110	2	12	2	-	-	-	-	-	1,5	30		UMGC PVTix

Cutting rates | Application data

CORNER RADIUS CUTTERS - copying 3D										
d_1 [mm]	Application	Hardened steel								
		up to 48 HRC			up to 55 HRC			up to 65 HRC		
		v_c [m/min]	f_z [mm/tooth]	a_p [mm]	V_c [m/min]	f_z [mm/tooth]	a_p [mm]	V_c [m/min]	f_z [mm/tooth]	a_p [mm]
0.2 - 0.5	Roughing	-	-	-	-	-	-	-	-	-
	Pre finishing	-	-	-	-	-	-	-	-	-
	Finishing	170 - 250	0.015 - 0.02	0.01 - 0.02	160 - 200	0.016 - 0.018	0.01 - 0.02	90 - 160	0.005 - 0.01	0.01 - 0.02
0.6 - 0.8	Roughing	-	-	-	-	-	-	-	-	-
	Pre finishing	-	-	-	-	-	-	-	-	-
	Finishing	170 - 250	0.015 - 0.025	0.02 - 0.03	160 - 200	0.01 - 0.02	0.02 - 0.03	90 - 160	0.005 - 0.01	0.02 - 0.03
1.0 - 1.5	Roughing	150 - 190	0.02 - 0.025	0.2 - 0.5	120 - 160	0.015 - 0.02	0.2 - 0.5	70 - 120	0.005 - 0.01	0.15 - 0.25
	Pre finishing	160 - 220	0.025 - 0.045	0.08 - 0.1	140 - 180	0.02 - 0.04	0.05 - 0.1	80 - 140	0.01 - 0.015	0.035 - 0.045
	Finishing	170 - 250	0.02 - 0.025	0.03 - 0.04	160 - 200	0.015 - 0.02	0.03 - 0.04	90 - 160	0.005 - 0.01	0.03 - 0.04
2.0	Roughing	150 - 190	0.025 - 0.03	0.3 - 0.6	120 - 160	0.02 - 0.025	0.3 - 0.6	70 - 120	0.005 - 0.01	0.2 - 0.3
	Pre finishing	160 - 220	0.025 - 0.045	0.1 - 0.12	140 - 180	0.025 - 0.045	0.1 - 0.12	80 - 140	0.01 - 0.015	0.04 - 0.05
	Finishing	170 - 250	0.02 - 0.025	0.035 - 0.05	160 - 200	0.015 - 0.02	0.035 - 0.05	90 - 160	0.005 - 0.01	0.035 - 0.05
3.0	Roughing	150 - 190	0.03 - 0.04	0.3 - 0.6	120 - 160	0.03 - 0.035	0.3 - 0.6	70 - 120	0.01 - 0.015	0.2 - 0.3
	Pre finishing	160 - 220	0.04 - 0.065	0.12 - 0.15	140 - 180	0.035 - 0.06	0.12 - 0.15	80 - 140	0.015 - 0.02	0.045 - 0.055
	Finishing	170 - 250	0.02 - 0.025	0.04 - 0.05	160 - 200	0.015 - 0.02	0.04 - 0.05	90 - 160	0.01 - 0.015	0.04 - 0.05
4.0	Roughing	150 - 190	0.04 - 0.05	0.3 - 0.6	120 - 160	0.035 - 0.045	0.3 - 0.6	70 - 120	0.01 - 0.02	0.2 - 0.3
	Pre finishing	160 - 220	0.045 - 0.08	0.13 - 0.18	140 - 180	0.04 - 0.075	0.12 - 0.18	80 - 140	0.02 - 0.025	0.05 - 0.06
	Finishing	170 - 250	0.025 - 0.03	0.05 - 0.075	160 - 200	0.02 - 0.025	0.05 - 0.075	90 - 160	0.01 - 0.015	0.05 - 0.075
5.0	Roughing	150 - 190	0.04 - 0.055	0.3 - 0.6	120 - 160	0.035 - 0.05	0.3 - 0.6	70 - 120	0.015 - 0.02	0.2 - 0.3
	Pre finishing	160 - 220	0.06 - 0.095	0.14 - 0.19	140 - 180	0.045 - 0.085	0.16 - 0.24	80 - 140	0.025 - 0.03	0.06 - 0.08
	Finishing	170 - 250	0.03 - 0.035	0.055 - 0.08	160 - 200	0.025 - 0.03	0.055 - 0.08	90 - 160	0.015 - 0.02	0.055 - 0.08
6.0	Roughing	150 - 190	0.045 - 0.06	0.3 - 0.6	120 - 160	0.04 - 0.055	0.3 - 0.6	70 - 120	0.015 - 0.02	0.2 - 0.3
	Pre finishing	160 - 220	0.08 - 0.13	0.16 - 0.32	140 - 180	0.075 - 0.12	0.18 - 0.26	80 - 140	0.03 - 0.04	0.07 - 0.09
	Finishing	170 - 250	0.03 - 0.04	0.07 - 0.1	160 - 200	0.025 - 0.035	0.07 - 0.1	90 - 160	0.015 - 0.02	0.07 - 0.1
8.0	Roughing	150 - 190	0.055 - 0.07	0.3 - 0.6	120 - 160	0.05 - 0.065	0.3 - 0.6	70 - 120	0.02 - 0.025	0.2 - 0.3
	Pre finishing	160 - 220	0.12 - 0.145	0.18 - 0.3	140 - 180	0.11 - 0.135	0.2 - 0.3	80 - 140	0.035 - 0.045	0.08 - 0.15
	Finishing	170 - 250	0.035 - 0.045	0.075 - 0.11	160 - 200	0.03 - 0.04	0.075 - 0.11	90 - 160	0.02 - 0.025	0.075 - 0.11
10.0	Roughing	150 - 190	0.065 - 0.095	0.3 - 0.6	120 - 160	0.065 - 0.085	0.3 - 0.6	70 - 120	0.025 - 0.030	0.2 - 0.3
	Pre finishing	160 - 220	0.13 - 0.18	0.2 - 0.36	140 - 180	0.125 - 0.17	0.24 - 0.36	80 - 140	0.04 - 0.055	0.12 - 0.18
	Finishing	170 - 250	0.04 - 0.05	0.09 - 0.14	160 - 200	0.035 - 0.045	0.09 - 0.14	90 - 160	0.02 - 0.025	0.09 - 0.14
12.0	Roughing	150 - 190	0.085 - 0.115	0.3 - 0.6	120 - 160	0.08 - 0.105	0.3 - 0.6	70 - 120	0.030 - 0.04	0.2 - 0.3
	Pre finishing	160 - 220	0.14 - 0.19	0.26 - 0.39	140 - 180	0.135 - 0.18	0.26 - 0.39	80 - 140	0.045 - 0.06	0.14 - 0.2
	Finishing	170 - 250	0.045 - 0.045	0.1 - 0.17	160 - 200	0.04 - 0.045	0.1 - 0.17	90 - 160	0.025 - 0.03	0.1 - 0.17

FROM PRACTICE TO PRACTICE

JOB DESCRIPTION:

Running two factories in the city of Siegen, the Fuchs Schraubenwerk company is renowned for its sophisticated products such as formed parts, special-purpose bolts, high-tension bolts, and steel construction bolts. The roots of the owner-operated, long-going firm with about 200 employees go way back into the early 19th century.

Just a few years ago, the company's own tool production was upgraded with an Okuma-made machining centre, type "Genos M460R". This is used to fabricate lines of punching and forming tools made of tempered HSS steel for the production segment. Having said that, the machining of 1.3343 material is far from a trivial task, confronting the cutting tool with a couple of very tricky challenges.

Therefore, Fuchs discussed the concrete problem of excessive crater wear and poor durability of the carbide cutters with **POKOLM**'s technical field representative in charge. The aim was to find a full carbide cutter capable of fulfilling the stringent requirements imposed by the cutting of tempered HSS steel, which could be capable of cutting a specific test specimen in a face-to-face comparison. A convenient test object was found in a deburring matrix taken from the production process of special-purpose bolts. The Ø 60 mm cylindrical part had a height of 35 mm. 30 units were to be made. The assignment was to machine a bevel with contours produced in the middle of the top surface.

MACHINE	MATERIAL	PROGRAMMING SYSTEM
Okuma „Genos M460R"	1.3343, 58+2HRC	OSP-P300M-R

In a practical test, two carbide ball cutters with 2 flutes and 4 mm diameter were put to a direct comparative test in an identical setting. The two systems consisted in a high-quality cutter as used previously by Fuchs, and a **POKOLM** cutter selected from the new line of products for up to 65 HRC, which was as optimised in terms of geometry, carbide metal, and coating.

The test specimen before and after the machining process

EXAMPLE FROM PRACTICE:

Seat:	Hydraulic chuck SK40	
Cooling:	Air, exterior	
V_c [m/min]	130	
V_f [mm/min]	828	
n(s) [min^{-1}]	10,350	
D_c [mm]	4.0	
f_z [mm]	0.04	
a_p [mm]	0.1	
a_e [mm]	0.1	
Tool:	Competitor product	POKOLM, up to 65 HRC
Tool life:	**90 min**	**210 min**
Component parts:	3 units	7 units

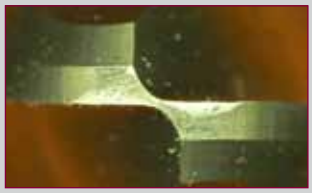
RESULT:

The result couldn't be much more obvious:

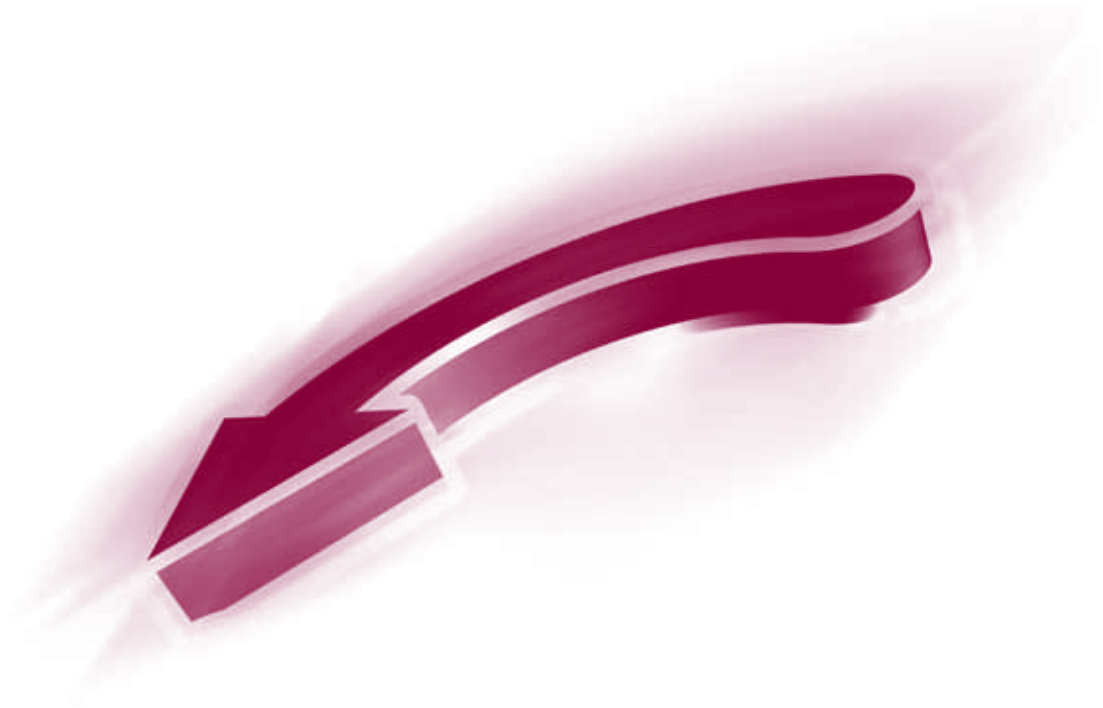
The new **POKOLM** system could handle 7 pieces across a tool life of 210 min. Showing massive crater wear, the conventional model had reached the end of the line after 90 minutes and 3 pieces.

But the **POKOLM** cutter did not only rate best with a view to tool life but also to efficiency.

Competitor milling cutter



POKOLM milling cutter



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