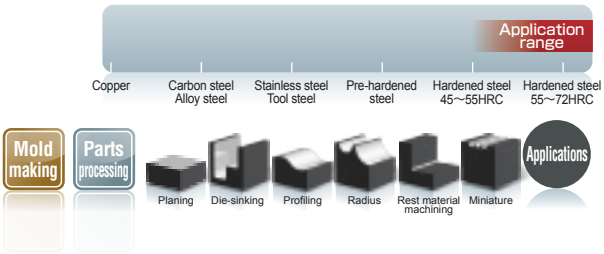
Advanced Engineering

New Product News No.1602E
2016-2



CBN End Mills

Epoch®
CBN High Precision Ball End Mill

Achieves high-accuracy machining of hardened steels !!

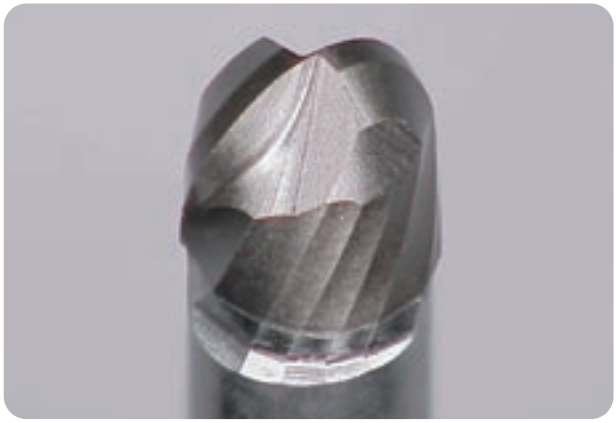
Mitsubishi Hitachi Tool Engineering, Ltd.

Features of Epoch® CBN High

① Dedication to high accuracy and high quality

- The low cutting force high-strength flute shape suppresses damage and enables to handle applications from roughing to finishing.
- High-rigidity design improves machining accuracy.
- High-quality flute edge improves surface roughness.
- *R* tolerance : ±0.003mm (*R*0.3 or less)
- High-accuracy h4 shank specification
- All tools include actual measured values for outer diameter

Newly designed low cutting force high-strength flute shape



Helix flute design for excellent cutting performance

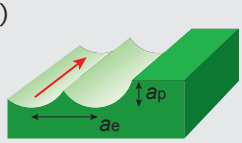
▶ Reduces cutting force

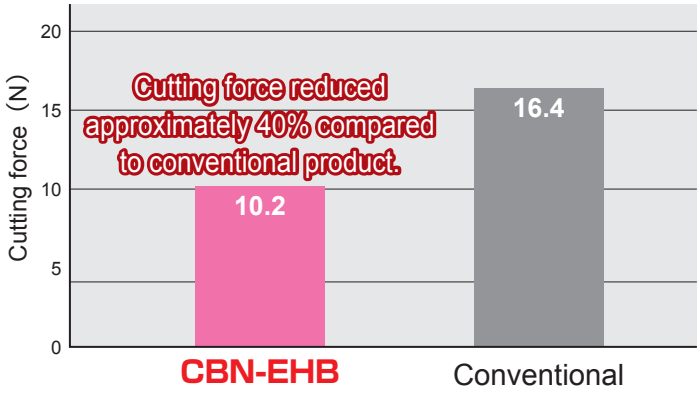
Higher-strength flute edge shape

▶ Improves tool life

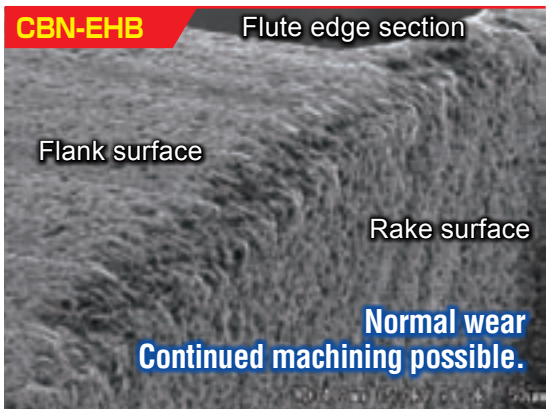
Tool：CBN-EHB2010-2.5
(*R*0.5 ×Under neck length 2.5mm)
Machine：Vertical M/C (HSK-E25)
Work Material：SLD (60HRC)
Coolant：Mist-blow
n=40,000min^{-1} (v_c=125m/min)
v_f=2,400mm/min (f_z=0.03mm/t)
$a_p \times a_e$=**0.03mm×0.09mm**

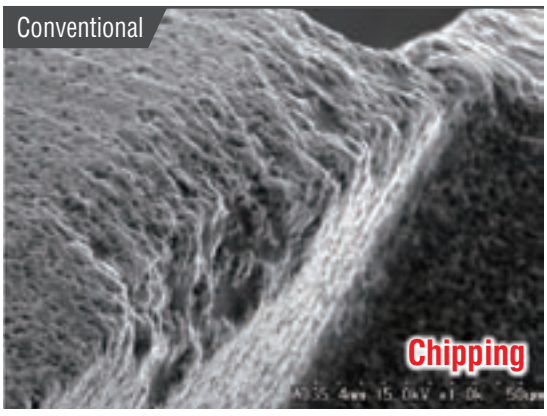
<Model shape>





【After 120m cutting】





Newly designed flute shape enables machining with suppressed damage even if cutting depth is increased!

Precision Ball End Mill

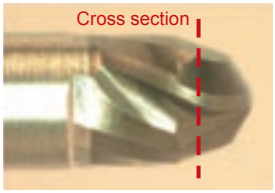
② Expanded lineup

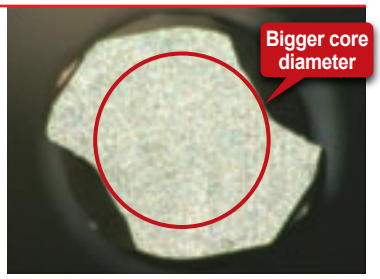
- High-demand items such as short under-neck length types or small-diameter types have been greatly expanded!

③ Regrindable flute shape (*R*0.3 or more)

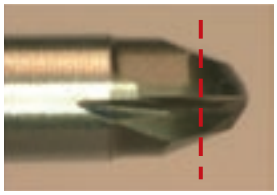
Original shape provides core diameter and wall thickness to increase rigidity. PAT. P

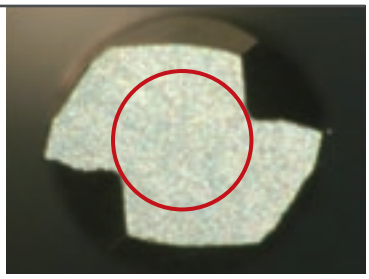
CBN-EHB



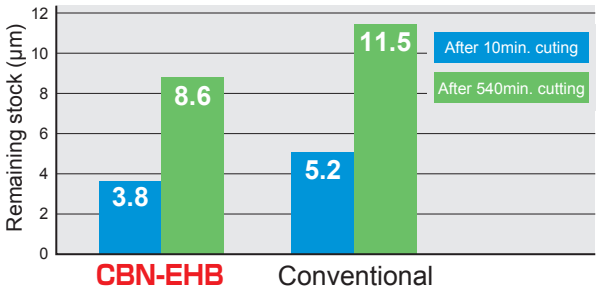


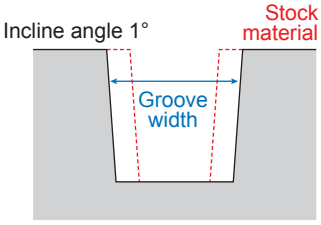
Conventional





Tool：CBN-EHB2010-2.5
(*R*0.5 ×Under neck length 2.5mm)
Machine：Vertical M/C (HSK-E32)
Work material：SLD (60HRC)
Coolant：Mist-blow
n=40,000min^{-1} (v_c=125m/min)
v_f=1,600mm/min (f_z=0.02mm/t)
Cutting pitch：0.02mm
Stock material：0.02mm

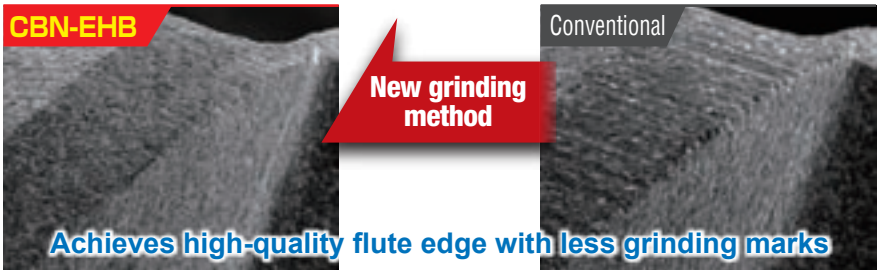




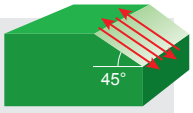
Measurement of difference from theoretical groove width after finishing

Higher rigidity design enables high accuracy machining to be continued for a longer time!

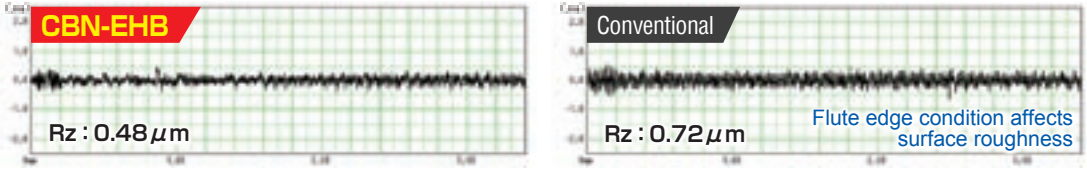
New grinding method provides high-quality flute edge



Tool：CBN-EHB2006-3 (*R*0.3×Under neck length 3mm)　Machine：Vertical M/C (HSK-E25)
Work material：SLD (60HRC)　Coolant：Mist-blow　n=40,000min^{-1} (v_c=75m/min)
v_f=700mm/min (f_z=0.0088mm/t)　Cutting pitch：0.01mm　Stock material：0.01mm　Cutting length：20m



<Model shape>



High-quality flute edge improves finishing surface roughness!

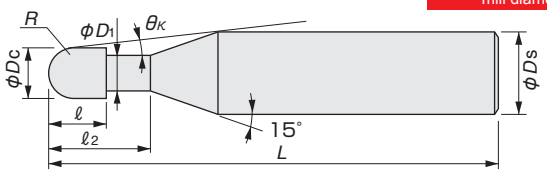
Epoch® CBN High Precision Ball End Mill

Planing Die-sinking Profiling Radius Hard Material Machining Miniature Finishing Rib Miniature

R tolerance: R≦0.3 : ±0.003, 0.3<R : ±0.005

h4: 0～−0.004 (mm)

Includes actual measured mill diameter value.



CBN-EHB2○○○-○○.○○

Actual measured mill diameter value is shown on case.

Regrinding of tools with R0.3 or larger is possible. (Necessary total length is at least 40mm.) Please contact us for details.

CBN Helix 25°

Item Code	Stock	Size (mm) Display of actual measured mill dia. for all tools								Actual Effective Length in Incline Angles				
		Ball radius R	Mill dia. Dc	Under neck length ℓ2	Flute length ℓ	Neck dia. D1	Overall length L	Shank dia. Ds	Interference angle θK	0.5°	1°	1.5°	2°	3°
CBN-EHB2002-0.5	●	0.1	0.2	0.5	0.12	0.18	50	4	14.15	0.55	0.56	0.58	0.60	0.64
CBN-EHB2002-0.75	●			0.75	0.12	0.18	50	4	13.71	0.81	0.83	0.86	0.89	0.95
CBN-EHB2002-1	●			1	0.12	0.18	50	4	13.30	1.06	1.10	1.13	1.17	1.26
CBN-EHB2002-1.5	●			1.5	0.12	0.18	50	4	12.55	1.58	1.63	1.69	1.75	1.88
CBN-EHB2002-2	●			2	0.12	0.18	50	4	11.88	2.10	2.17	2.24	2.32	2.50
CBN-EHB2003-0.5	●	0.15	0.3	0.5	0.18	0.27	50	4	14.17	0.56	0.58	0.60	0.61	0.65
CBN-EHB2003-0.75	●			0.75	0.18	0.27	50	4	13.72	0.82	0.85	0.87	0.90	0.96
CBN-EHB2003-1	●			1	0.18	0.27	50	4	13.30	1.08	1.11	1.15	1.19	1.27
CBN-EHB2003-1.5	●			1.5	0.18	0.27	50	4	12.53	1.60	1.65	1.70	1.76	1.89
CBN-EHB2003-2	●			2	0.18	0.27	50	4	11.84	2.12	2.18	2.26	2.34	2.52
CBN-EHB2003-3	●			3	0.18	0.27	50	4	10.67	3.15	3.25	3.37	3.49	3.76
CBN-EHB2004-0.75	●	0.2	0.4	0.75	0.4	0.37	50	4	13.77	0.82	0.84	0.87	0.89	0.95
CBN-EHB2004-1	●			1	0.4	0.37	50	4	13.33	1.08	1.11	1.14	1.18	1.26
CBN-EHB2004-1.5	●			1.5	0.4	0.37	50	4	12.54	1.60	1.65	1.70	1.75	1.88
CBN-EHB2004-2	●			2	0.4	0.37	50	4	11.83	2.11	2.18	2.25	2.33	2.50
CBN-EHB2004-3	●			3	0.4	0.37	50	4	10.63	3.15	3.25	3.36	3.48	3.75
CBN-EHB2005-1	●	0.25	0.5	1	0.5	0.47	50	4	13.37	1.08	1.11	1.14	1.17	1.25
CBN-EHB2005-1.5	●			1.5	0.5	0.47	50	4	12.55	1.60	1.64	1.69	1.75	1.87
CBN-EHB2005-2.5	●			2.5	0.5	0.47	50	4	11.18	2.63	2.71	2.80	2.90	3.11
CBN-EHB2005-3	●			3	0.5	0.47	50	4	10.59	3.15	3.25	3.36	3.47	3.73
CBN-EHB2006-1	●	0.3	0.6	1	0.55	0.57	50	4	13.40	1.08	1.10	1.13	1.17	1.24
CBN-EHB2006-1.5	●			1.5	0.55	0.57	50	4	12.56	1.59	1.64	1.69	1.74	1.86
CBN-EHB2006-3	●			3	0.55	0.57	50	4	10.55	3.14	3.24	3.35	3.46	3.72
CBN-EHB2008-1.5	●	0.4	0.8	1.5	0.7	0.77	50	4	12.58	1.59	1.63	1.68	1.73	1.83
CBN-EHB2008-2.5	●			2.5	0.7	0.77	50	4	11.09	2.62	2.70	2.79	2.88	3.08
CBN-EHB2008-4	●			4	0.7	0.77	50	4	9.41	4.17	4.31	4.45	4.60	4.94
CBN-EHB2010-1.5	●	0.5	1	1.5	1	0.96	50	4	12.57	1.61	1.64	1.69	1.73	1.83
CBN-EHB2010-2.5	●			2.5	1	0.96	50	4	11.00	2.64	2.71	2.80	2.88	3.08
CBN-EHB2010-4	●			4	1	0.96	50	4	9.25	4.19	4.32	4.46	4.61	4.94
CBN-EHB2010-5	●			5	1	0.96	50	4	8.36	5.22	5.39	5.57	5.76	6.19
CBN-EHB2015-2.5	●	0.75	1.5	2.5	1.35	1.45	50	4	10.76	2.65	2.72	2.79	2.87	3.04
CBN-EHB2015-5	●			5	1.35	1.45	50	4	7.86	5.23	5.39	5.56	5.74	6.15
CBN-EHB2015-7.5	●			7.5	1.35	1.45	50	4	6.18	7.82	8.07	8.33	8.62	9.26
CBN-EHB2020-2.5	●	1	2	2.5	1.65	1.94	50	4	10.43	2.66	2.72	2.78	2.85	3.01
CBN-EHB2020-5	●			5	1.65	1.94	50	4	7.21	5.25	5.39	5.55	5.73	6.11
CBN-EHB2020-7.5	●			7.5	1.65	1.94	50	4	5.50	7.83	8.07	8.32	8.60	9.22
CBN-EHB2020-10	●			10	1.65	1.94	50	4	4.44	10.41	10.74	11.10	11.48	12.33

● : Stocked Items.

Cutting Conditions

＜High efficiency condition＞

Work material			Hardened Steels (50～55HRC) HPM38				Hardened Steels (55～62HRC) SKD11,YXR3				Hardened Steels (62～64HRC) SKH51,HAP10				Hardened Steels (64～70HRC) HAP40,HAP72			
Ball radius R (mm)	Mill dia. Dc (mm)	Under neck length ℓ_2 (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e
0.1	0.2	0.5	50,000	480	0.006	0.018	50,000	420	0.006	0.018	50,000	350	0.004	0.012	50,000	290	0.004	0.012
		0.75	50,000	480	0.004	0.012	50,000	420	0.004	0.012	50,000	350	0.003	0.009	50,000	290	0.003	0.009
		1	50,000	480	0.003	0.009	50,000	420	0.003	0.009	50,000	350	0.002	0.006	50,000	290	0.002	0.006
		1.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.15	0.3	0.5	50,000	720	0.009	0.027	50,000	620	0.009	0.027	50,000	530	0.007	0.021	50,000	430	0.006	0.018
		0.75	50,000	720	0.009	0.027	50,000	620	0.009	0.027	50,000	530	0.007	0.021	50,000	430	0.006	0.018
		1	50,000	720	0.008	0.024	50,000	620	0.008	0.024	50,000	530	0.006	0.018	50,000	430	0.005	0.015
		1.5	50,000	720	0.005	0.015	50,000	620	0.005	0.015	50,000	530	0.004	0.012	50,000	430	0.003	0.009
		2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.2	0.4	0.75	50,000	1,020	0.012	0.036	50,000	880	0.012	0.036	50,000	750	0.01	0.03	50,000	610	0.008	0.024
		1	50,000	1,020	0.012	0.036	50,000	880	0.012	0.036	50,000	750	0.01	0.03	50,000	610	0.008	0.024
		1.5	50,000	1,020	0.008	0.024	50,000	880	0.008	0.024	50,000	750	0.007	0.021	50,000	610	0.005	0.015
		2	50,000	1,020	0.006	0.018	50,000	880	0.006	0.018	50,000	750	0.005	0.015	50,000	610	0.004	0.012
		3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.25	0.5	1	50,000	1,280	0.015	0.045	50,000	1,110	0.015	0.045	50,000	940	0.012	0.036	50,000	770	0.01	0.03
		1.5	50,000	1,280	0.015	0.045	50,000	1,110	0.015	0.045	50,000	940	0.012	0.036	50,000	770	0.01	0.03
		2.5	50,000	1,280	0.008	0.024	50,000	1,110	0.008	0.024	50,000	940	0.006	0.018	50,000	770	0.005	0.015
		3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.3	0.6	1	50,000	1,620	0.018	0.054	50,000	1,400	0.018	0.054	50,000	1,190	0.015	0.045	50,000	970	0.012	0.036
		1.5	50,000	1,620	0.018	0.054	50,000	1,400	0.018	0.054	50,000	1,190	0.015	0.045	50,000	970	0.012	0.036
		3	50,000	1,620	0.009	0.027	50,000	1,400	0.009	0.027	50,000	1,190	0.007	0.021	50,000	970	0.006	0.018
0.4	0.8	1.5	50,000	2,160	0.024	0.072	50,000	1,870	0.024	0.072	50,000	1,580	0.02	0.06	50,000	1,300	0.016	0.048
		2.5	50,000	2,160	0.024	0.072	50,000	1,870	0.024	0.072	50,000	1,580	0.02	0.06	50,000	1,300	0.016	0.048
		4	40,000	1,730	0.012	0.036	40,000	1,500	0.012	0.036	40,000	1,270	0.01	0.03	40,000	1,040	0.008	0.024
0.5	1	1.5	40,000	2,400	0.03	0.09	40,000	2,080	0.03	0.09	40,000	1,760	0.024	0.072	40,000	1,440	0.02	0.06
		2.5	40,000	2,400	0.03	0.09	40,000	2,080	0.03	0.09	40,000	1,760	0.024	0.072	40,000	1,440	0.02	0.06
		4	36,000	2,160	0.02	0.06	36,000	1,870	0.02	0.06	36,000	1,580	0.016	0.048	36,000	1,300	0.013	0.039
		5	32,000	1,920	0.015	0.045	32,000	1,660	0.015	0.045	32,000	1,410	0.012	0.036	32,000	1,150	0.01	0.03
0.75	1.5	2.5	27,000	2,430	0.045	0.135	27,000	2,110	0.045	0.135	27,000	1,780	0.036	0.108	27,000	1,460	0.03	0.09
		5	27,000	2,430	0.045	0.135	27,000	2,110	0.045	0.135	27,000	1,780	0.036	0.108	27,000	1,460	0.03	0.09
		7.5	21,000	1,890	0.03	0.09	21,000	1,640	0.03	0.09	21,000	1,390	0.024	0.072	21,000	1,130	0.02	0.06
1	2	2.5	20,000	2,400	0.06	0.18	20,000	2,080	0.06	0.18	20,000	1,760	0.048	0.144	20,000	1,440	0.04	0.12
		5	20,000	2,400	0.06	0.18	20,000	2,080	0.06	0.18	20,000	1,760	0.048	0.144	20,000	1,440	0.04	0.12
		7.5	18,000	2,160	0.04	0.12	18,000	1,870	0.04	0.12	18,000	1,580	0.032	0.096	18,000	1,300	0.027	0.081
		10	16,000	1,920	0.03	0.09	16,000	1,660	0.03	0.09	16,000	1,410	0.024	0.072	16,000	1,150	0.02	0.06

【Note】 1) Use the appropriate coolant for the work material and machining shape.
2) This standard cutting condition table is intended as reference cutting conditions. The conditions should be adjusted as necessary according to the actual conditions of machined shape, purpose, machine used, etc.
3) If the machine rotation speed is insufficient, reduce the rotation speed and feed rate by the same ratio.

Cutting Conditions

＜Finishing condition＞

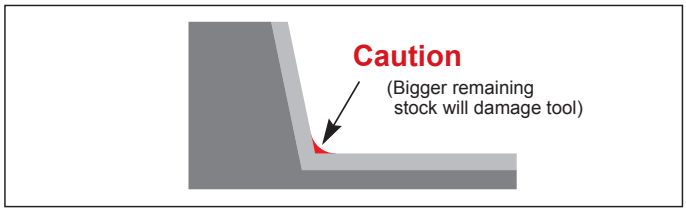
Work material			Hardened Steels (50～55HRC) HPM38				Hardened Steels (55～62HRC) SKD11,YXR3				Hardened Steels (62～64HRC) SKH51,HAP10				Hardened Steels (64～70HRC) HAP40,HAP72			
Ball radius R (mm)	Mill dia. Dc (mm)	Under neck length ℓ_2 (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e	Revolution n min^{-1}	Feed rate v_f mm/min	Depth of cut (mm) a_p	Depth of cut (mm) a_e
0.1	0.2	0.5	50,000	420	0.004	0.004	50,000	350	0.004	0.004	50,000	290	0.004	0.004	50,000	220	0.004	0.004
		0.75	50,000	420	0.003	0.003	50,000	350	0.003	0.003	50,000	290	0.003	0.003	50,000	220	0.003	0.003
		1	50,000	420	0.002	0.002	50,000	350	0.002	0.002	50,000	290	0.002	0.002	50,000	220	0.002	0.002
		1.5	50,000	420	0.001	0.001	50,000	350	0.001	0.001	50,000	290	0.001	0.001	50,000	220	0.001	0.001
		2	50,000	420	0.001	0.001	50,000	350	0.001	0.001	50,000	290	0.001	0.001	50,000	220	0.001	0.001
0.15	0.3	0.5	50,000	620	0.006	0.006	50,000	530	0.006	0.006	50,000	430	0.006	0.006	50,000	340	0.006	0.006
		0.75	50,000	620	0.006	0.006	50,000	530	0.006	0.006	50,000	430	0.006	0.006	50,000	340	0.006	0.006
		1	50,000	620	0.005	0.005	50,000	530	0.005	0.005	50,000	430	0.005	0.005	50,000	340	0.005	0.005
		1.5	50,000	620	0.003	0.003	50,000	530	0.003	0.003	50,000	430	0.003	0.003	50,000	340	0.003	0.003
		2	50,000	620	0.003	0.003	50,000	530	0.003	0.003	50,000	430	0.003	0.003	50,000	340	0.003	0.003
		3	40,000	500	0.002	0.002	40,000	420	0.002	0.002	40,000	350	0.002	0.002	40,000	270	0.002	0.002
0.2	0.4	0.75	50,000	880	0.008	0.008	50,000	750	0.008	0.008	50,000	610	0.008	0.008	50,000	480	0.008	0.008
		1	50,000	880	0.008	0.008	50,000	750	0.008	0.008	50,000	610	0.008	0.008	50,000	480	0.008	0.008
		1.5	50,000	880	0.005	0.005	50,000	750	0.005	0.005	50,000	610	0.005	0.005	50,000	480	0.005	0.005
		2	50,000	880	0.004	0.004	50,000	750	0.004	0.004	50,000	610	0.004	0.004	50,000	480	0.004	0.004
		3	50,000	880	0.003	0.003	50,000	750	0.003	0.003	50,000	610	0.003	0.003	50,000	480	0.003	0.003
0.25	0.5	1	50,000	1,110	0.01	0.01	50,000	940	0.01	0.01	50,000	770	0.01	0.01	50,000	600	0.01	0.01
		1.5	50,000	1,110	0.01	0.01	50,000	940	0.01	0.01	50,000	770	0.01	0.01	50,000	600	0.01	0.01
		2.5	50,000	1,110	0.005	0.005	50,000	940	0.005	0.005	50,000	770	0.005	0.005	50,000	600	0.005	0.005
		3	48,000	1,060	0.005	0.005	48,000	900	0.005	0.005	48,000	730	0.005	0.005	48,000	570	0.005	0.005
0.3	0.6	1	50,000	1,400	0.012	0.012	50,000	1,190	0.012	0.012	50,000	970	0.012	0.012	50,000	760	0.012	0.012
		1.5	50,000	1,400	0.012	0.012	50,000	1,190	0.012	0.012	50,000	970	0.012	0.012	50,000	760	0.012	0.012
		3	50,000	1,400	0.006	0.006	50,000	1,190	0.006	0.006	50,000	970	0.006	0.006	50,000	760	0.006	0.006
0.4	0.8	1.5	50,000	1,870	0.016	0.016	50,000	1,580	0.016	0.016	50,000	1,300	0.016	0.016	50,000	1,010	0.016	0.016
		2.5	50,000	1,870	0.016	0.016	50,000	1,580	0.016	0.016	50,000	1,300	0.016	0.016	50,000	1,010	0.016	0.016
		4	40,000	1,500	0.008	0.008	40,000	1,270	0.008	0.008	40,000	1,040	0.008	0.008	40,000	810	0.008	0.008
0.5	1	1.5	40,000	2,080	0.02	0.02	40,000	1,760	0.02	0.02	40,000	1,440	0.02	0.02	40,000	1,120	0.02	0.02
		2.5	40,000	2,080	0.02	0.02	40,000	1,760	0.02	0.02	40,000	1,440	0.02	0.02	40,000	1,120	0.02	0.02
		4	36,000	1,870	0.013	0.013	36,000	1,580	0.013	0.013	36,000	1,300	0.013	0.013	36,000	1,010	0.013	0.013
		5	32,000	1,660	0.01	0.01	32,000	1,410	0.01	0.01	32,000	1,150	0.01	0.01	32,000	900	0.01	0.01
0.75	1.5	2.5	27,000	2,110	0.03	0.03	27,000	1,780	0.03	0.03	27,000	1,460	0.03	0.03	27,000	1,130	0.03	0.03
		5	27,000	2,110	0.03	0.03	27,000	1,780	0.03	0.03	27,000	1,460	0.03	0.03	27,000	1,130	0.03	0.03
		7.5	21,000	1,640	0.02	0.02	21,000	1,390	0.02	0.02	21,000	1,130	0.02	0.02	21,000	880	0.02	0.02
1	2	2.5	20,000	2,080	0.04	0.04	20,000	1,760	0.04	0.04	20,000	1,440	0.04	0.04	20,000	1,120	0.04	0.04
		5	20,000	2,080	0.04	0.04	20,000	1,760	0.04	0.04	20,000	1,440	0.04	0.04	20,000	1,120	0.04	0.04
		7.5	18,000	1,870	0.027	0.027	18,000	1,580	0.027	0.027	18,000	1,300	0.027	0.027	18,000	1,010	0.027	0.027
		10	16,000	1,660	0.02	0.02	16,000	1,410	0.02	0.02	16,000	1,150	0.02	0.02	16,000	900	0.02	0.02

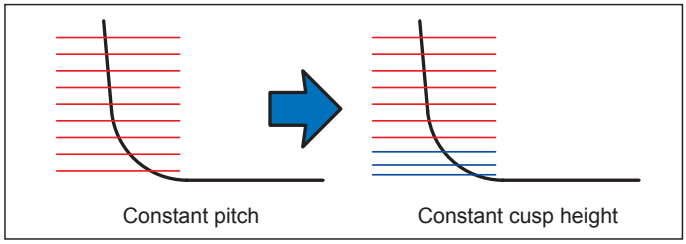
【Note】 1) Use the appropriate coolant for the work material and machining shape.
2) This standard cutting condition table is intended as reference cutting conditions. The conditions should be adjusted as necessary according to the actual conditions of machined shape, purpose, machine used, etc.
3) If the machine rotation speed is insufficient, reduce the rotation speed and feed rate by the same ratio.

Cautions

＜About semi-finishing＞

For stable machining, perform semi finishing to remove remaining stock in the corners. (This will make the machining amount for finishing uniform.)
At this time, it is recommended that the program should be set so that the cusp height will be a constant amount. In addition, it is recommended that semi finishing should be performed with CBN end mill.

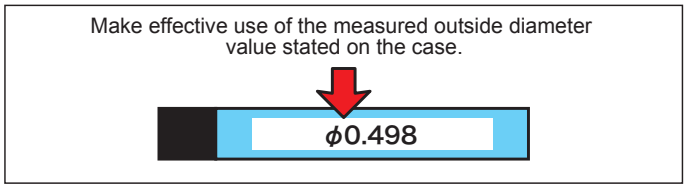


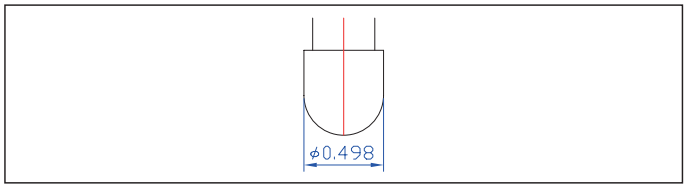


＜Input of diameter correction value＞

For Epoch CBN High Precision Ball End Mill, the measured outside diameter value is stated on the case.
Inputting the actual measured value for the tool diameter in CAM from roughing to finishing will enable improved final machining accuracy.

【Input example】
Ball end mill: Tool diameter Ø0.498 → *R*0.249





＜Regarding corner speed reduction＞

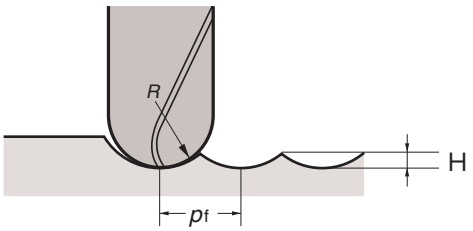
If the actual feed rate of the machine does not reach the set value (such as when workpiece is small and speed cannot be increased, etc.), sudden increases/decreases in feed rate may occur, which can cause chipping, etc.
In such cases, input the feed rate that the machine can support.

Ball end mill pick feed and theoretical cusp height table (μm)

		Pick Feed : p_f (mm)										
		0.01	0.015	0.02	0.03	0.04	0.05	0.06	0.08	0.1	0.15	0.2
Ball radius *R* (mm)	0.1	0.13	0.28	0.50	1.13	2.02	3.18	4.61	8.35	13.40	—	—
	0.15	0.08	0.19	0.33	0.75	1.34	2.10	3.03	5.43	8.58	20.10	—
	0.2	0.06	0.14	0.25	0.56	1.00	1.57	2.26	4.04	6.35	14.60	26.79
	0.25	0.05	0.11	0.20	0.45	0.80	1.25	1.81	3.22	5.05	11.52	20.87
	0.3	0.04	0.09	0.17	0.38	0.67	1.04	1.50	2.68	4.20	9.53	17.16
	0.4	0.03	0.07	0.13	0.28	0.50	0.78	1.13	2.01	3.14	7.09	12.70
	0.5	0.03	0.06	0.10	0.23	0.40	0.63	0.90	1.60	2.51	5.66	10.10
	0.75	0.02	0.04	0.07	0.15	0.27	0.42	0.60	1.07	1.67	3.76	6.70
	1	0.01	0.03	0.05	0.11	0.20	0.31	0.45	0.80	1.25	2.82	5.01

Feed pitch and cusp height

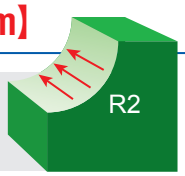
$$H = R - \sqrt{R^2 - p_f^2/4} \fallingdotseq p_f^2/8R$$



Field Data

R shape machining example by Z constant machining【After cutting 1,500m】

Tool：CBN-EHB2010-2.5(*R*0.5 ×Under neck length 2.5mm)　Machine：Vertical M/C (HSK-E25)
Work material：YXR3 (58HRC)　Coolant：Mist-blow　n=40,000min^{-1}(v_c=125m/min)
v_f=1,760mm/min(f_z=0.022mm/t)　Cutting pitch：0.02mm　Stock material：0.02mm



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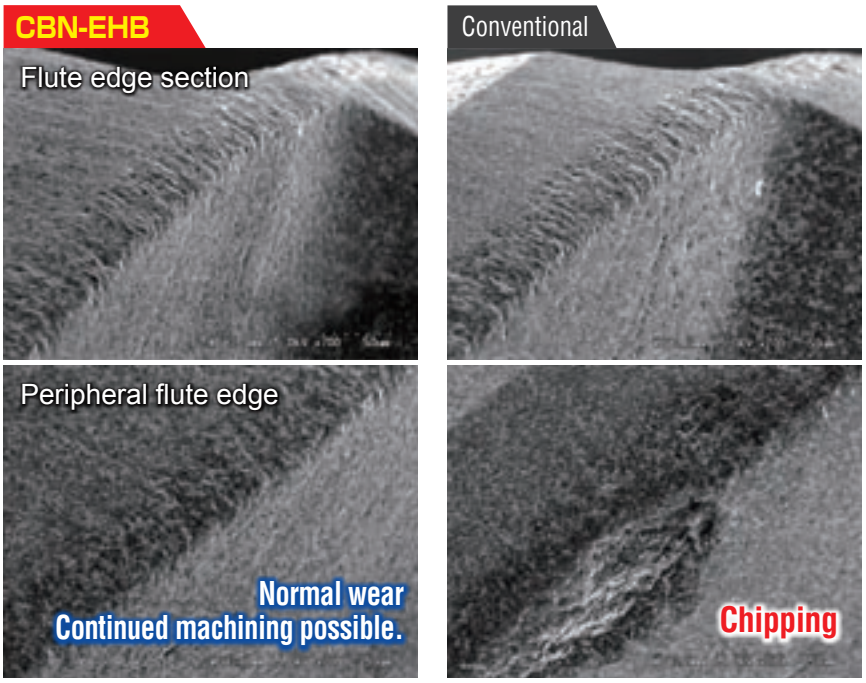
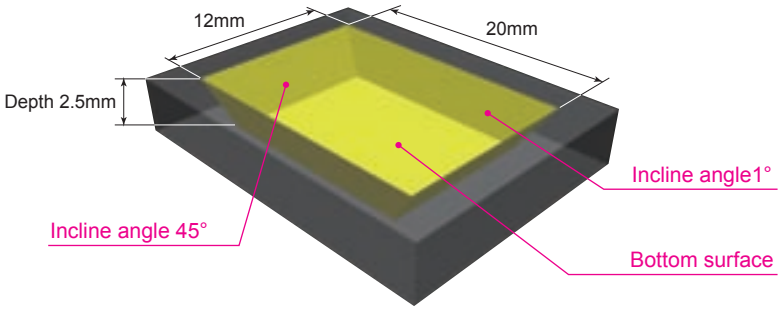
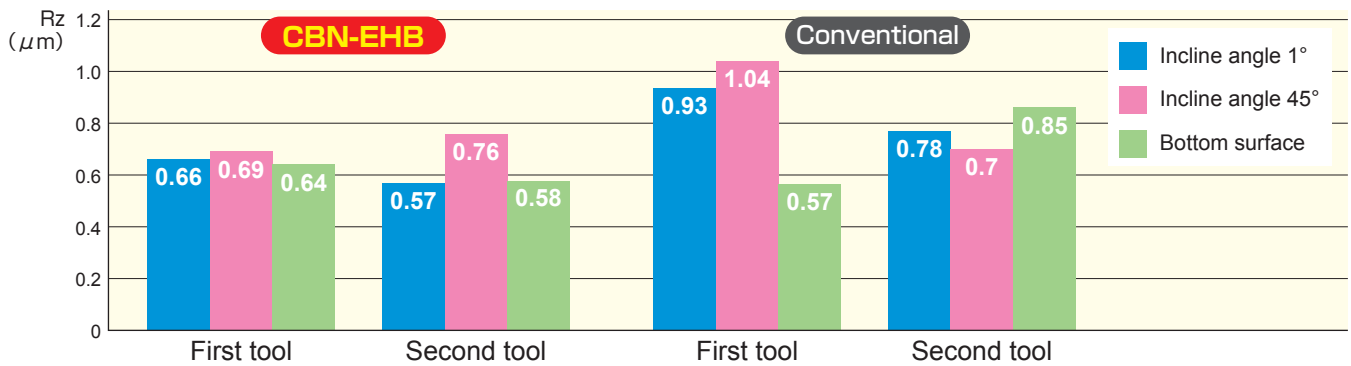


Low cutting force high-strength flute shape suppresses damage and provides longer tool life than conventional product!

Example of pocket-shaped finishing

Tool：CBN-EHB2010-2.5(*R*0.5 ×Under neck length 2.5mm)　Machine：Vertical M/C (HSK-E32)
Work material：SLD(60HRC)　Coolant：Mist Blow　n=40,000min^{-1}(v_c=125m/min)
v_f=1,600mm/min(f_z=0.02mm/t)　Cutting pitch：0.02mm　Stock material：0.02mm　Cutting length：15m

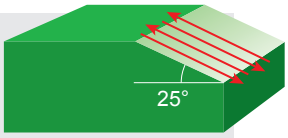




Provides better surface roughness with good repetition for all surfaces compared to conventional product!

Example of inclined surface finishing by scan machining① 【After machining 25m】

Tool：CBN-EHB2002-0.5(*R*0.1×Under neck length 0.5mm)
Machine：Vertical M/C(HSK-E25)　Work material：DC53(62HRC)　Coolant：Mist Blow
n=40,000min^{-1}(v_c=25m/min)　v_f=350mm/min(f_z=0.0044mm/t)
Cutting pitch：0.01mm　Stock material：0.006mm



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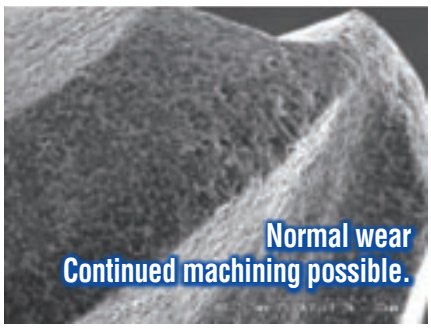
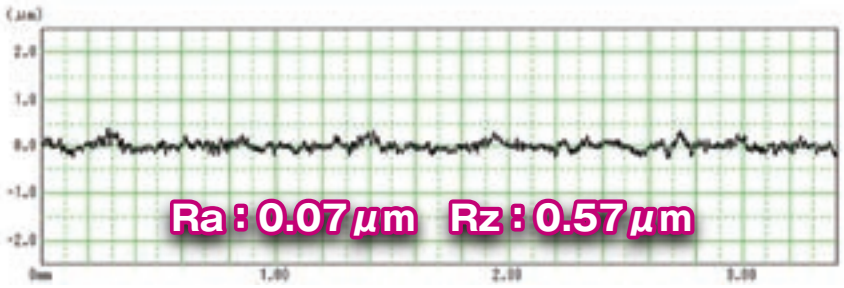
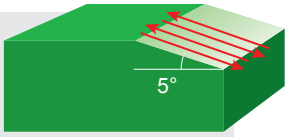




Example of inclined surface finishing by scan machining② 【After machining 60m】

Tool：CBN-EHB2003-0.5(*R*0.15×Under neck length 0.5mm)
Machine：Vertical M/C (HSK-E25)　Work Material：PD613(61HRC)　Coolant：Mist-blow
n=40,000min^{-1}(v_c=38m/min)　v_f=500mm/min(f_z=0.0063mm/t)
Cutting pitch：0.01mm　Stock material：0.01mm



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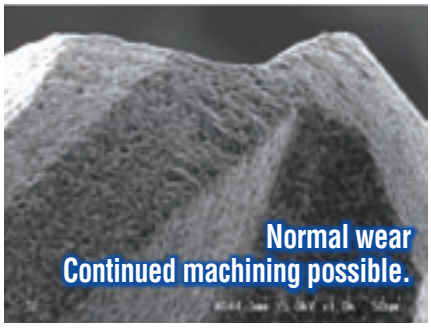
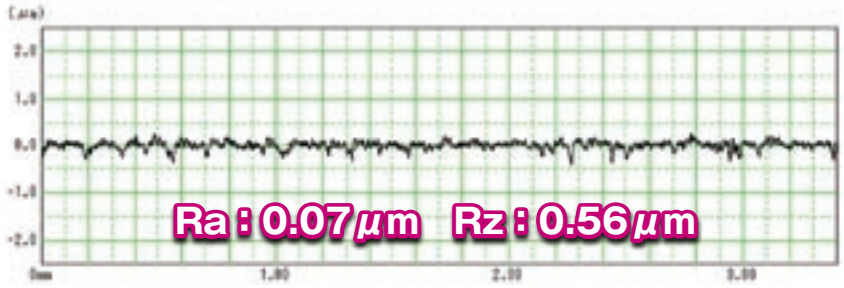
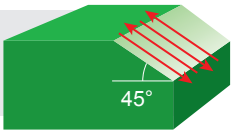




Example of inclined surface finishing by scan machining③ 【After machining 20m】

Tool：CBN-EHB2006-3(*R*0.3×Under neck length 3mm)　Machine：Vertical M/C (HSK-E25)
Work material：SLD (60HRC)　Coolant：Mist-blow　n=40,000min^{-1}(v_c=75m/min)
v_f=700mm/min(f_z=0.0088mm/t)　Cutting pitch：0.01mm　Stock material：0.01mm



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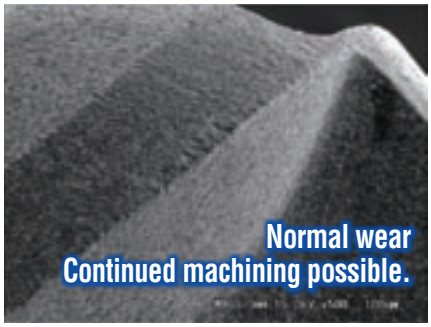
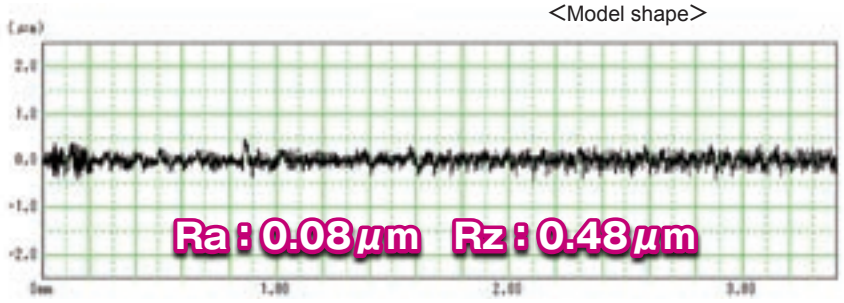




Lower wear after machining and good surface roughness for a variety of work materials and cutting conditions!

Epoch® CBN High Precision Ball End Mill

×

Hi-Pre²

The high-strength flute shape of the Epoch CBN high-precision ball end mill shows excellent performance even in roughing. By using this product, not only for finishing but also for roughing, machining with higher accuracy than conventional carbide tools can be achieved.

Hi-Pre² = "High Precision Pre-finishing"

For making high precision dies&molds, the accuracy of roughing and semi-finishing processes are very important as well as finishing.
High precision from roughing enables the optimization of the total production process including polishing or adjustment!
This is "Hi-Pre²" , Mitsubishi Hitachi Tool propose.

Is only the finishing process important for high precision machining?

Before finishing process

High Precision Roughing & Semi-finishing

It's important to keep high precision since here!

High Precision Finishing

Polishing or Adjustment Process

Machining process

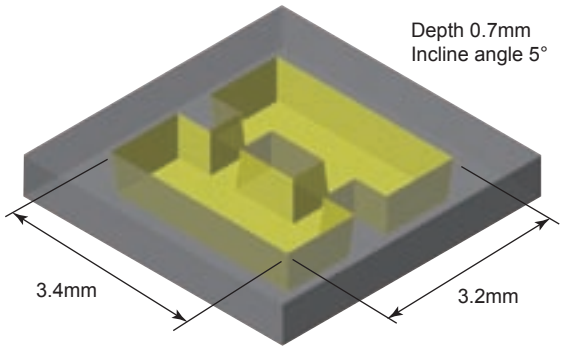
Total process

Takes advantage for total process!

Example of pocket-shaped finishing

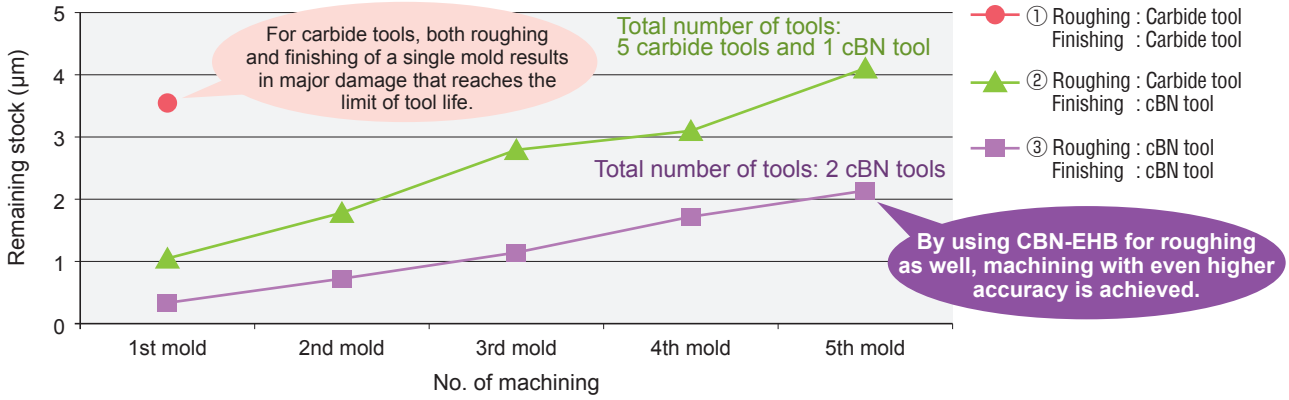
Comparison of changes in remaining stock for each machining pattern from ① to ③

Machining pattern		Roughing	Finishing	Note
①	Using only carbide tools	Carbide tool	Carbide tool	——
②	Conventional use of CBN tools	Carbide tool	cBN tool	For roughing, tool must be changed after each mold. Finishing is performed with 1 tool.
③	Hi-Pre²	cBN tool	cBN tool	Machining with 1 tool each for roughing and finishing.

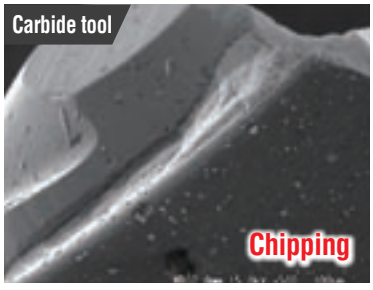


Tool：【cBN】CBN-EHB2004-0.75 【Carbide】EPDBEH2004-0.75-ATH（*R*0.2×Under neck length 0.75mm）
Machine：Vertical M/C（HSK-E25） Work material：ASP23（64HRC） Coolat：Mist-blow
【Roughing】n=40000min^{-1}（v_c=50m/min）
v_f=600mm/min（f_z=0.0075mm/t）
$a_p \times a_e$=0.01mm×0.03mm
Machining time for 1 mold is approx. 30 min.
【Finishing】n=40000min^{-1}（v_c=50m/min）
v_f=500mm/min（f_z=0.0063mm/t）
Cutting pitch 0.01mm Stock material 0.01mm
Machining time for 1 mold is approx. 10 min.

Remaining stock after finishing



Tool condition after roughing (After machining 1 mold)



With CBN-EHB, damage is suppressed and remaining stock is reduced!

⇒Improved accuracy in roughing process

【Remaining stock after first mold roughing】
CBN-EHB ：0.004mm
Carbide tool：0.014mm

Merits

■**Improved machining accuracy**
⇒ It is effective in not only reducing remaining stock but also reducing cutting step due to tool changes.

■**Reduced number of tools used**
⇒ Labor for creating programs and tool setting is reduced.

■**Reduced tool cost**
⇒ Tool life which exceeds the cost difference compared to carbide tools

Re-grinding compatibility range table

Item Code	Product	Line up tool dia. (mm)	Shape	Re-grinding compatibility range(mm)	
				Outer Dia.	End
CBN-EHB	Epoch CBN High Precision Ball End Mill	0.2～2		×	0.6～2

For regrinding of this tool, please contact the person incharge. We will reproduce the special tip shape.

The diagrams and table data are examples of test results, and are not guaranteed values.
"Epoch" and "Hi-Pre²" are a registered trademark of Mitsubishi Hitachi Tool.

⚠ Attentions on Safety

1. Cautions regarding handling

(1) When removing the tool from its case (packaging), be careful that the tool does not pop out or is dropped. Be particularly careful regarding contact with the tool flutes.
(2) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

2. Cautions regarding mounting

(1) Before use, check the outside appearance of the tool for scratches, cracks, etc. and that it is firmly mounted in the collet chuck, etc.
(2) If abnormal chattering, etc. occurs during use, stop the machine immediately and remove the cause of the chattering.

3. Cautions during use

(1) Before use, confirm the dimensions and direction of rotation of the tool and milling work material.
(2) The numerical values in the standard cutting conditions table should be used as criteria when starting new work. The cutting conditions should be adjusted as appropriate when the cutting depth is large, the rigidity of the machine being used is low, or according to the conditions of the work material.
(3) Cutting tools are made of a hard material. During use, they may break and fly off. In addition, cutting chips may also fly off. Since there is a danger of injury to workers, fire, or eye damage from such flying pieces, a safety cover should be attached when work is performed and safety equipment such as safety goggles should be worn to create a safe environment for work.
(4) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use where there is a risk of fire or explosion. **Please caution of fire while using oil base coolant, fire prevention is necessary.**
(5) Do not use the tool for any purpose other than that for which it is intended.

4. Cautions regarding regrinding

(1) If regrinding is not performed at the proper time, there is a risk of the tool breaking. Replace the tool with one in good condition, or perform regrinding.
(2) Grinding dust will be created when regrinding a tool. When regrinding, be sure to attach a safety cover over the work area and wear safety clothes such as safety goggles, etc.
(3) This product contains the specified chemical substance cobalt and its inorganic compounds. When performing regrinding or similar processing, be sure to handle the processing in accordance with thelocal laws and regulations regarding prevention of hazards due to specified chemical substances.

Advanced Engineering

Mitsubishi Hitachi Tool Engineering, Ltd.

Head Office
Hulic Ryogoku Bldg. 8F, 4-31-11, Ryogoku, Sumida-ku, Tokyo, Japan 130-0026
International Sales Dept. : TEL +81-3-6890-5103 FAX +81-3-6890-5128

Official Web Site
http://www.mmc-hitachitool.co.jp/e/
Database for selection Cutting Tool Products【TOOL SEARCH】
TOOLSEARCH Search Web

Europe **MMC Hitachi Tool Engineering Europe GmbH**
Itterpark 12, 40724 Hilden,Germany.
Tel +49-(0)2103-24820 Fax +49-(0)2103-248230

America **MITSUBISHI MATERIALS U.S.A. CORPORATION HT Division**
DETROIT OFFICE Customer service
41700 Gardenbrook Road, Suite 120, Novi, MI 48375-1320 U.S.A.
Tel +1(248) 308-2620 Fax +1(248) 308-2627
CHICAGO OFFICE
1314B North Plum Grove Road, Schaumburg, IL 60173 U.S.A.
Tel +1(847) 252-6371 Fax +1(248) 308-2627

China **MMC Hitachi Tool Engineering(Shanghai),Ltd.**
11F, Chuang Xing Financial Center, 288 Nanjing RD (West) Shanghai, China 200003
Tel +86-(0)21-3366-3058 Fax +86-(0)21-3366-3050

Thailand **MMC Hardmetal(Thailand)Co.,Ltd. HT-Division**
399 Interchange 21 Building, 20th Floor, Unit no. 2015, Sukhumvit 21 Asoke Road, Klongtoey Nua, Wattana, Bangkok 10110, Thailand
Tel +66-(0)2-611-2520 Fax +66-(0)2-611-2521

Indonesia **Mitsubishi Hitachi Tool Engineering, Ltd. Indonesia Representative office**
Cikarang Industrial Estate, Jl. Jababeka XII-B Blok W26, Cikarang Bekasi, West Java Indonesia 17530
Tel +62-(0)21-898-31433 Fax +62-(0)21-893-6735

India **Hitachi Metals (India) Pvt. Ltd.**
Plot No 94 & 95,Sector 8, IMT Manesar ,Gurgaon-122050 , Haryana, India
Tel +91-124-4812315 Fax +91-124-2290015

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