The Edge To Innovation

EPBTS-TH / EPSBE-TH

Epoch TH Hard Ball Strong
Epoch Super Hard Ball Evolution

MOLDINO Tool Engineering, Ltd.

New Product News | No.0812E-7 | 2021-7

Uses newly developed ATH Coating to enable high-efficient machining of high-hardness materials.

Features of New Advanced TH Coating

01 Hardness and oxidation resistance of TH Coating is further improved. Enables longer life and higher efficient when cutting high-hardness materials.
(Si nano composite coating with finer crystal particles)

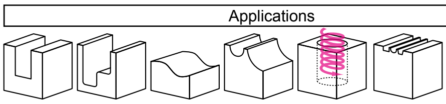
02 Exhibits amazing performance when cutting high-hardness materials (55HRC or higher).
Cold-worked die steel, HSS, tool steel, composite materials, carbide alloys, etc.

03 Long life for both dry cutting and wet cutting

Applicable range

Copper | Carbon steel Alloy steel | Stainless steel Tool steel | Pre-hardened steel | Hardened steel 45~55HRC | Hardened steel 55~72HRC

Applications



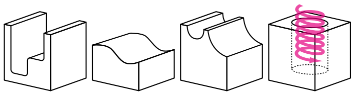
Mold making | Parts processing

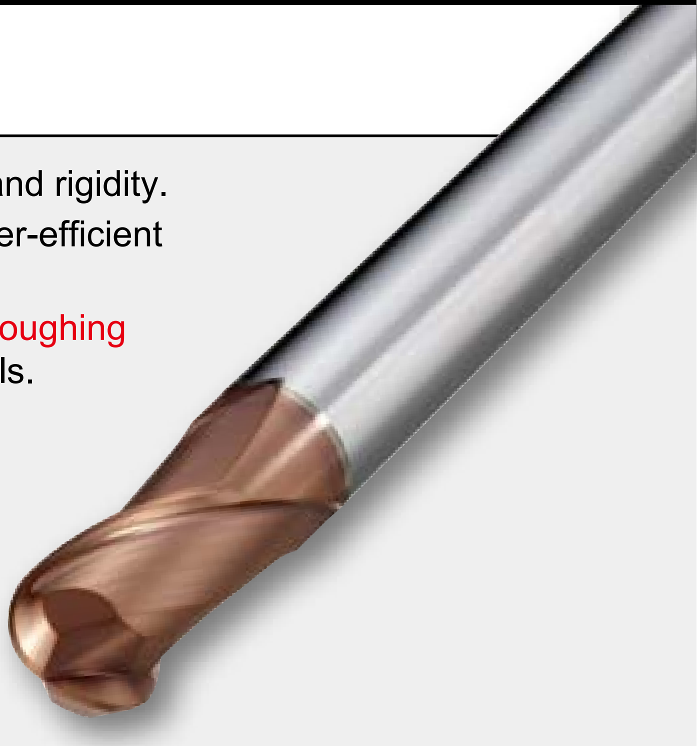
EPBTS-TH
R1.5～R6［7 Items］

EPSBE-TH
R0.05～R1［58 Items］

Epoch TH Hard Ball Strong

Applications

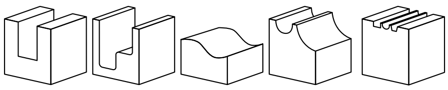


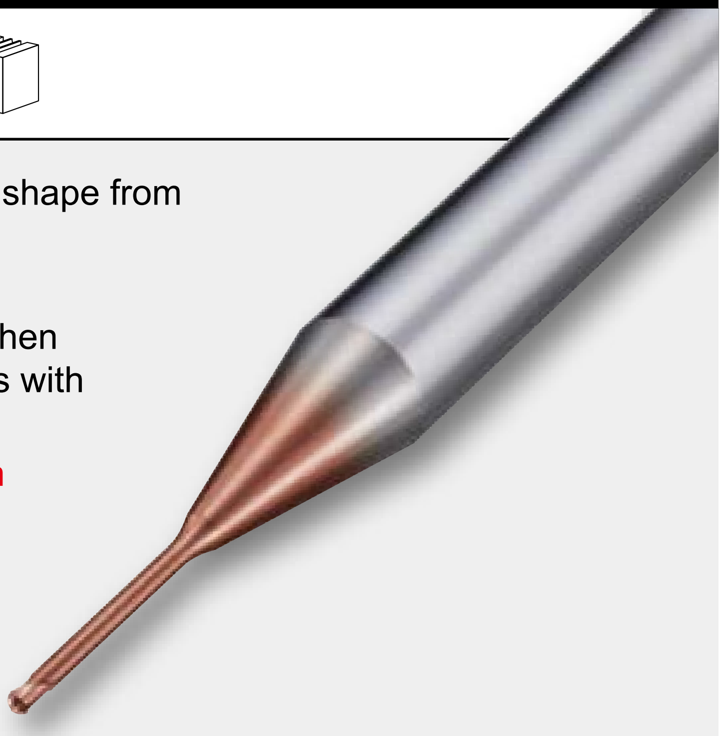


- 3D ball shape with good chip removal and rigidity.
- Rigid flute tip shape enables even higher-efficient machining.
- Ideal for high-efficient machining from roughing to finishing of 40HRC or higher materials.
- Exhibits superior performance particularly for cutting materials with hardnesses of 55HRC or higher.

Epoch Super Hard Ball Evolution

Applications

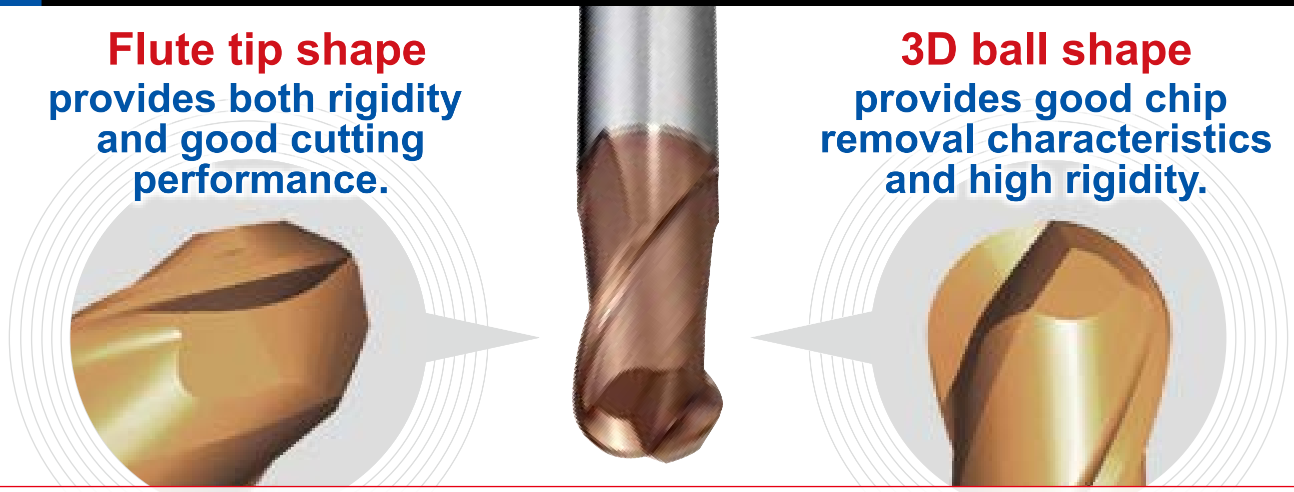




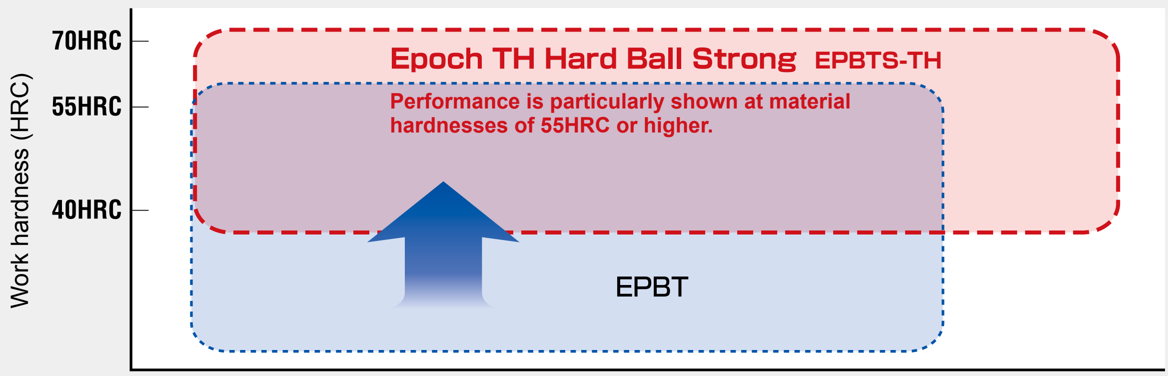
- Double face (2-stage flank) prevents shape from being broken.
- Abundant neck length variations.
- 2 Enables long life for cutting even when direct-cutting high hardness materials with hardnesses of more than 60HRC.
- Lineup with *R* accuracy of +0.001mm to -0.005mm (high-accuracy rating product)

Epoch TH Hard Ball Strong

Features



Enables high-efficient machining with increased cutting depth and feed rate. Ideal for high-efficient machining from roughing to finishing of 40HRC or higher materials.



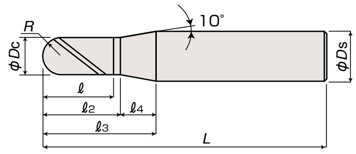
Overview diagram of cutting regions

Dimensions

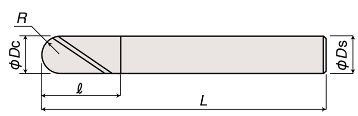
※See p. 8 EPSB Evolution for tools with *R* less than 1.5.

R accuracy：±0.005
Helix angle：30°

Tolerance on dia.：0 −0.010
Tolerance on shank：h5



A type



B type

EPBTS2○○○-TH

Cutting Conditions P10

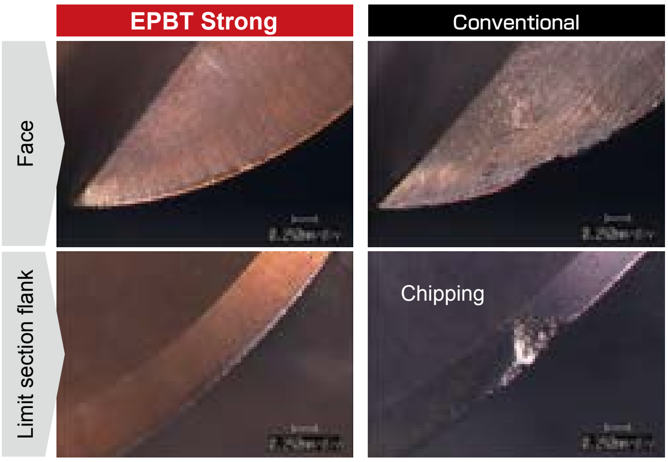
Item code	Stock	Size (mm) Ball radius *R*	Tool dia. *Dc*	Flute length ℓ	Under neck length ℓ2	ℓ3	ℓ4	Overall length *L*	Shank dia. *Ds*	Type
EPBTS2030-TH	●	1.5	3	4.5	5.5	14.0	8.5	70	6	A
EPBTS2040-TH	●	2	4	6	7.0	12.7	5.7	70	6	A
EPBTS2050-TH	●	2.5	5	7.5	8.5	11.3	2.8	80	6	A
EPBTS2060-TH	●	3	6	9	—	—	—	90	6	B
EPBTS2080-TH	●	4	8	12	—	—	—	100	8	B
EPBTS2100-TH	●	5	10	15	—	—	—	100	10	B
EPBTS2120-TH	●	6	12	18	—	—	—	110	12	B

●：Stocked items.

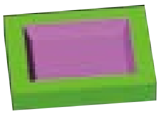
Field Data

01 High-efficient pocket machining (Cold-worked forged steel)

Tool wear condition after machining two pockets



VB:0.027mm **VB:0.451mm**



Width : 40mm Height : 30mm Depth : 10mm
Work material : SKD11Ⓗ (60HRC)
Tool : R5x2NT, Dry
n=5,700min^{-1} (v_c=179m/min), v_f=1,480mm/min (f_z=0.13mm/t)
$a_p \times a_e$=0.5mm×1.5mm

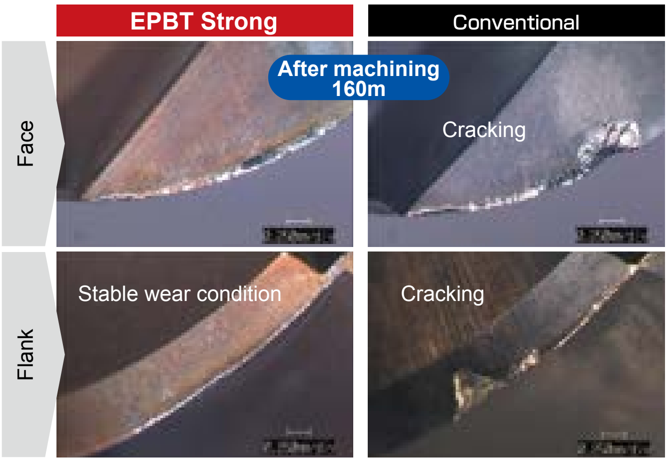
Production50 Data

	Tool	EPBTS2100-TH	Conventional hardened ball end mill
	Cutting conditions	n=5,700min^{-1} v_f=1,480mm/min $a_p \times a_e$=0.5mm×1.5mm	n=10,000min^{-1} v_f=3,200mm/min $a_p \times a_e$=0.2mm×1.0mm
Y	Tool cost ratio (100%=conventional product)	120	100
P	Tool life (work/pcs.)	20	20
Td	Tool replacement time (min./pcs.)	1	1
M	Machine cost (Yen/pcs.)	¥100	¥100
Tc	Cutting time (min./work)	8	15
	Cutting efficient ratio (%)	183%	100%
K	Total cost (Yen/work)	**¥1,400**	**¥2,000**

1.8×machining efficiency!
Machining costs reduced 30%!

02 High-performance bottom roughing (High hardness plastic material)

EPBTS-TH with new flute shape has high flute tip strength and excellent chipping resistance.



VB:0.034mm **VB:0.324mm**

Work material : HPM38Ⓗ (52HRC) Tool : R5x2NT, Wet
n=8,000min^{-1} (v_c=251m/min), v_f=2,500mm/min (f_z=0.15mm/t) $a_p \times a_e$=0.5mm×1.5mm

Production50 Data

	Tool	EPBTS2100-TH	Conventional hardened ball end mill
	Cutting conditions	n=8,000min^{-1} v_f=2,500mm/min $a_p \times a_e$=0.5mm×1.5mm	n=10,000min^{-1} v_f=3,200mm/min $a_p \times a_e$=0.2mm×1.0mm
Y	Tool cost ratio (100%=conventional product)	130	100
P	Tool life (work/pcs.)	2	2
Td	Tool replacement time (min./pcs.)	1	1
M	Machine cost (Yen/pcs.)	¥100	¥100
Tc	Cutting time (min./work)	33	70
	Cutting efficient ratio (%)	210%	100%
K	Total cost (Yen/work)	**¥9,850**	**¥12,050**

2.1×machining efficiency!
Machining costs reduced 20%!

03 High-performance bottom roughing (High hardness plastic material)

Production50 Data

Work material : DAC55 (45HRC)

	Tool	EPBTS2100-TH	MOLDINO Tool Engineering's conventional ball end mill
	Cutting conditions	n=8,000min^{-1} v_f=1,600mm/min, Dry $a_p \times a_e$=1mm×2mm	n=8,000min^{-1} v_f=2,000mm/min, Dry $a_p \times a_e$=0.5mm×1.5mm
Y	Tool cost ratio (100%=conventional product)	120	100
P	Tool life (work/pcs.)	2	2
Td	Tool replacement time (min./pcs.)	1	1
M	Machine cost (Yen/pcs.)	¥100	¥100
Tc	Cutting time (min./work)	56	120
	Cutting efficient ratio (%)	213%	100%
K	Total cost (Yen/work)	**¥11,650**	**¥17,050**

2.1×machining efficiency!
Machining costs reduced 32%!

04 High-performance bottom roughing (Plastic mold)

Production50 Data

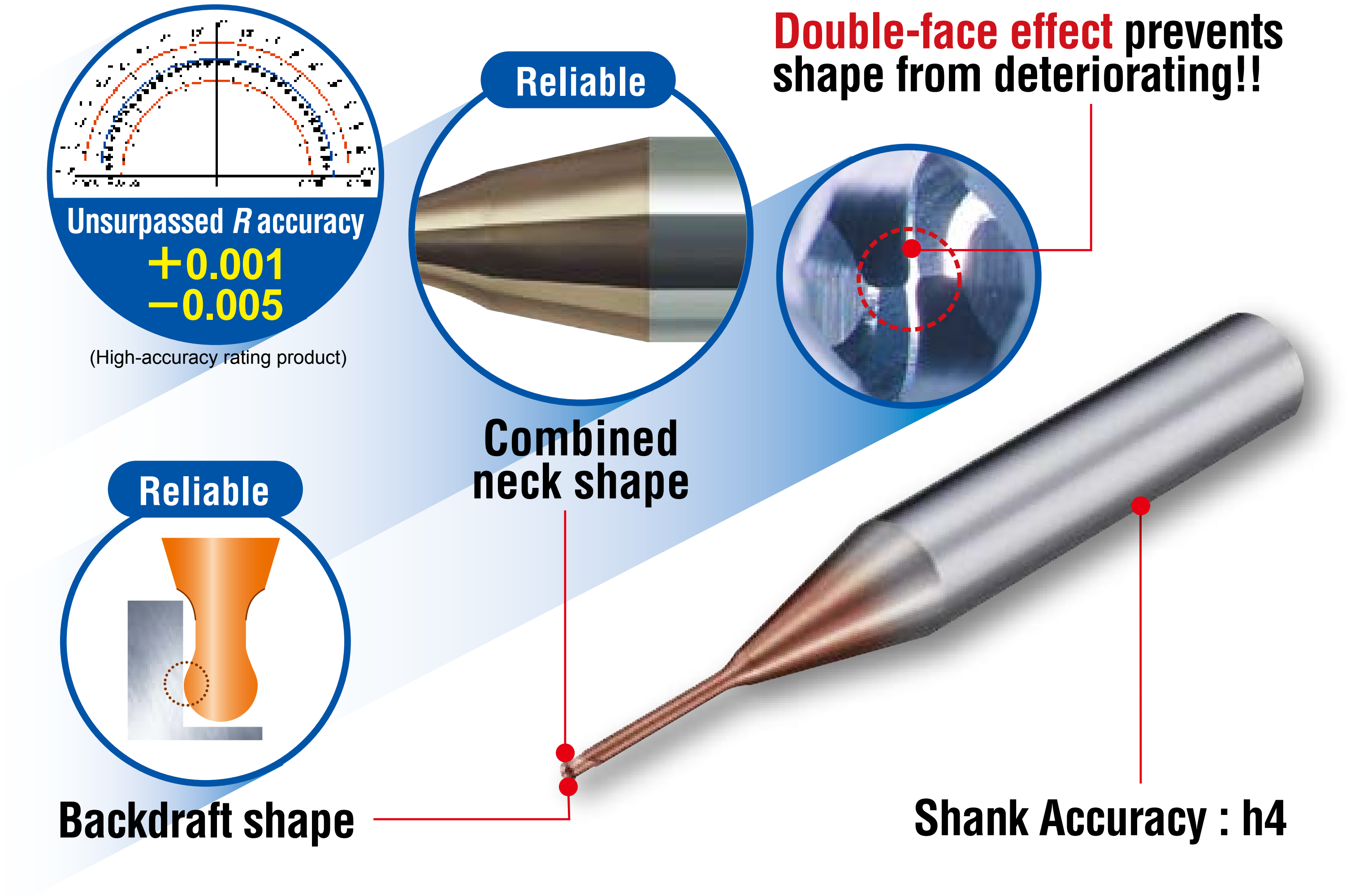
Work material : Pre-hardened steel (40HRC)

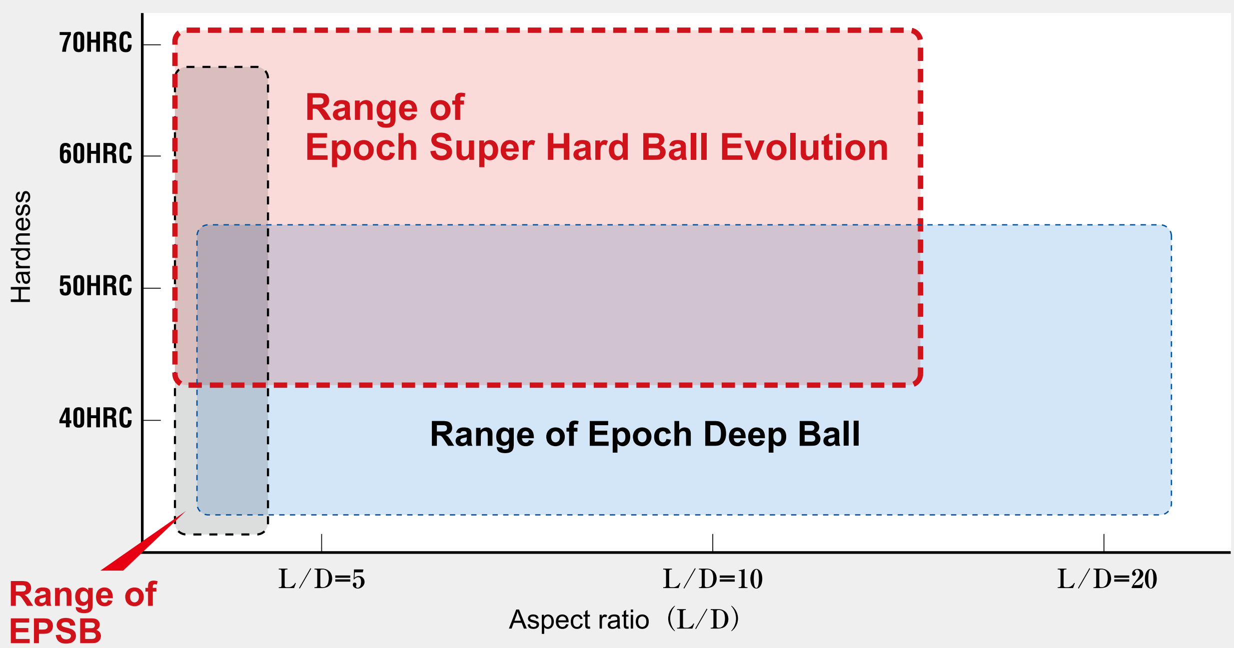
	Tool	EPBTS2120-TH	MOLDINO Tool Engineering's conventional ball end mill
	Cutting conditions	n=8,000min^{-1} v_f=4,200mm/min, Dry $a_p \times a_e$=1.8mm×2.4mm	n=8,000min^{-1} v_f=2,690mm/min, Dry $a_p \times a_e$=0.5mm×1.5mm
Y	Tool cost ratio (100%=conventional product)	120	100
P	Tool life (work/pcs.)	2	2
Td	Tool replacement time (min./pcs.)	1	1
M	Machine cost (Yen/pcs.)	¥100	¥100
Tc	Cutting time (min./work)	64	106
	Cutting efficient ratio (%)	156%	100%
K	Total cost (Yen/work)	**¥12,850**	**¥15,650**

1.5×machining efficiency!
Machining costs reduced 18%!

Epoch Super hard Ball Evolution

Features



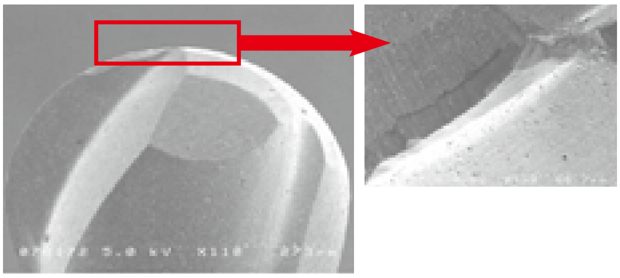


Overview diagram of cutting regions

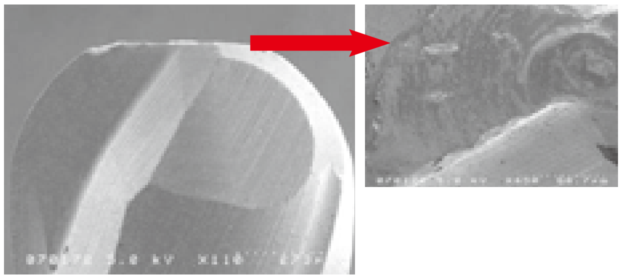
Field Data

01 Tool wear can be greatly suppressed.

EPSB Evolution



Conventional Hard Ball End Mill

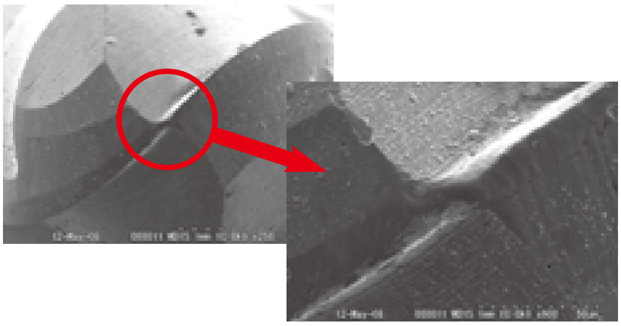


EPSBE maintains *R* accuracy even after cutting.

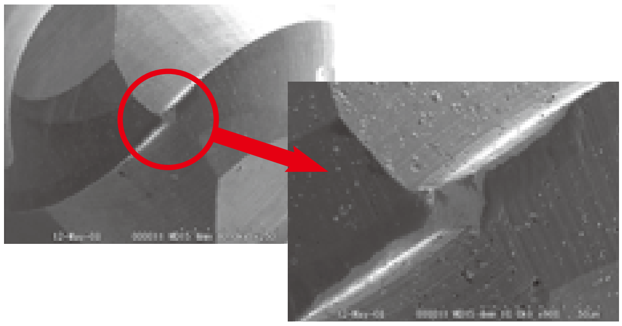
Work material ：SKD11(60HRC) Tool：*R*0.5mm × Under neck length 3mm × 2Flutes L=120m After cutting
n=28,000min^{-1} (v_c=38m/min) v_f=1,764mm/min (f_z=0.032mm/t) a_p=0.05mm a_e=0.14mm (Air Blow)

02 Bottom cutting evaluation of HAP40 (65HRC)

EPSB Evolution



Conventional TH Coating

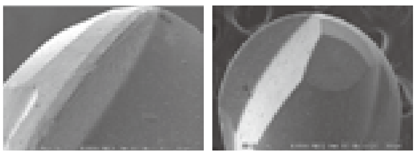


New TH Coating suppresses wear even more than previous products.

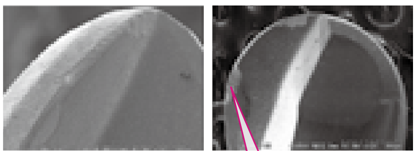
Work material：HAP40(65HRC) Tool：*R*0.3mm × Under neck length 1.8mm × 2Flutes
n=30,000min^{-1} (v_c=69m/min) v_f=1,300mm/min (f_z=0.025mm/t) a_p=0.01mm a_e=0.02mm (Air Blow)

03 Comparison with conventinal long-neck tools for high hardness materials

EPSB Evolution

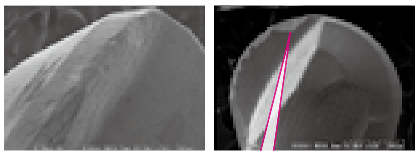


Conventional Hard Ball End Mill A



Chipping on cutting surface

Conventional Hard Ball End Mill B



Major chipping on cutting surface

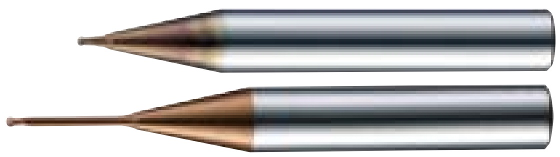
Conventional Hard Ball End Mill C

High wear

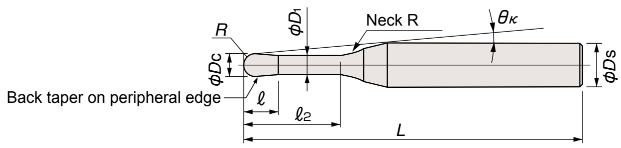
L=200m

Work material：SKD11(60HRC)
Tool：*R*0.5mm× Under neck length 10mm× 2Flutes
n=16,000min^{-1} (v_c=125m/min) v_f=960mm/min (f_z=0.03mm/t)
a_p=0.01mm a_e=0.03mm (Air Blow)

※See p. 4 EPBT Strong for tools with *R* over than 1.5.



Tolerance on shank：h4



EPSBE2○○○-○○.○○-TH

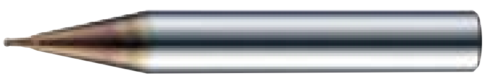
Standard rating product

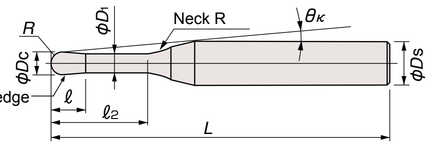
R accuracy +0.003㎜～−0.007㎜

Cutting Conditions P11

Item code	Stock	Size (mm) Ball radius *R*	Tool dia. *Dc*	Flute length *ℓ*	Neck dia. *D1*	Under neck length *ℓ2*	Overall length *L*	Shank dia. *Ds*	Neck R	Interference angle *θκ*	The effective under-neck length for the various draft angles 0.5°	1°	1.5°	2°	3°
EPSBE2001-0.15-TH	●	0.05	0.1	0.08	0.08	0.15	45	4	1	11.82	0.30	0.32	0.33	0.35	0.38
EPSBE2001-0.3-TH	●	0.05	0.1	0.08	0.08	0.3	45	4	1	11.64	0.46	0.48	0.50	0.52	0.57
EPSBE2001-0.75-TH	●	0.05	0.1	0.08	0.08	0.75	45	4	1	11.12	0.93	0.97	1.01	1.04	1.10
EPSBE2002-0.3-TH	●	0.1	0.2	0.15	0.17	0.3	45	4	1	11.66	0.49	0.50	0.52	0.54	0.58
EPSBE2002-0.6-TH	●	0.1	0.2	0.15	0.17	0.6	45	4	1	11.30	0.80	0.83	0.86	0.88	0.93
EPSBE2002-1-TH	●	0.1	0.2	0.15	0.17	1	45	4	1	10.86	1.22	1.26	1.30	1.33	1.39
EPSBE2002-1.5-TH	●	0.1	0.2	0.15	0.17	1.5	45	4	1	10.35	1.74	1.79	1.84	1.88	2.05
EPSBE2002-2-TH	●	0.1	0.2	0.15	0.17	2	45	4	1	9.88	2.25	2.32	2.37	2.45	2.71
EPSBE2003-0.45-TH	●	0.15	0.3	0.25	0.27	0.45	45	4	2	11.53	0.73	0.77	0.80	0.84	0.91
EPSBE2003-0.9-TH	●	0.15	0.3	0.25	0.27	0.9	45	4	2	11.00	1.21	1.27	1.32	1.37	1.47
EPSBE2003-1.5-TH	●	0.15	0.3	0.25	0.27	1.5	45	4	2	10.36	1.84	1.92	1.99	2.06	2.18
EPSBE2003-2-TH	●	0.15	0.3	0.25	0.27	2	45	4	2	9.88	2.36	2.46	2.55	2.62	2.76
EPSBE2003-3-TH	●	0.15	0.3	0.25	0.27	3	45	4	2	9.05	3.41	3.53	3.64	3.73	4.02
EPSBE2004-0.6-TH	●	0.2	0.4	0.3	0.37	0.6	45	4	2	11.39	0.88	0.93	0.97	1.01	1.09
EPSBE2004-1.2-TH	●	0.2	0.4	0.3	0.37	1.2	45	4	2	10.69	1.52	1.59	1.65	1.71	1.82
EPSBE2004-2-TH	●	0.2	0.4	0.3	0.37	2	45	4	2	9.88	2.36	2.46	2.54	2.62	2.75
EPSBE2004-3-TH	●	0.2	0.4	0.3	0.37	3	45	4	2	9.03	3.41	3.53	3.63	3.73	4.01
EPSBE2004-3.5-TH	●	0.2	0.4	0.3	0.37	3.5	45	4	2	8.65	3.93	4.06	4.18	4.27	4.67
EPSBE2004-4-TH	●	0.2	0.4	0.3	0.37	4	45	4	2	8.30	4.45	4.59	4.71	4.83	5.33
EPSBE2005-0.75-TH	●	0.25	0.5	0.35	0.47	0.75	45	4	2	11.25	1.04	1.09	1.13	1.18	1.27
EPSBE2005-1.5-TH	●	0.25	0.5	0.35	0.47	1.5	45	4	2	10.39	1.83	1.91	1.98	2.05	2.17
EPSBE2005-3-TH	●	0.25	0.5	0.35	0.47	3	45	4	2	9.00	3.41	3.53	3.63	3.72	3.99
EPSBE2005-5-TH	●	0.25	0.5	0.35	0.47	5	45	4	2	7.64	5.48	5.65	5.78	6.01	6.65
EPSBE2006-0.9-TH	●	0.3	0.6	0.4	0.57	0.9	45	4	4	11.10	1.33	1.42	1.51	1.59	1.75
EPSBE2006-1.8-TH	●	0.3	0.6	0.4	0.57	1.8	45	4	4	10.08	2.30	2.44	2.56	2.68	2.88
EPSBE2006-3-TH	●	0.3	0.6	0.4	0.57	3	45	4	4	8.98	3.58	3.77	3.93	4.07	4.32
EPSBE2006-5-TH	●	0.3	0.6	0.4	0.57	5	45	4	4	7.59	5.70	5.94	6.14	6.32	6.63
EPSBE2006-6-TH	●	0.3	0.6	0.4	0.57	6	45	4	4	7.04	6.75	7.02	7.23	7.42	7.96
EPSBE2008-1.2-TH	●	0.4	0.8	0.5	0.77	1.2	45	4	4	10.79	1.65	1.75	1.84	1.93	2.11
EPSBE2008-2.4-TH	●	0.4	0.8	0.5	0.77	2.4	45	4	4	9.47	2.94	3.10	3.24	3.36	3.59
EPSBE2010-1.5-TH	●	0.5	1	0.8	0.96	1.5	45	6	4	11.01	2.01	2.12	2.21	2.31	2.49
EPSBE2010-3-TH	●	0.5	1	0.8	0.96	3	45	6	4	9.88	3.61	3.78	3.93	4.06	4.30
EPSBE2010-6-TH	●	0.5	1	0.8	0.96	6	45	6	4	8.20	6.76	7.02	7.23	7.42	7.92
EPSBE2010-8-TH	●	0.5	1	0.8	0.96	8	45	6	4	7.36	8.85	9.15	9.40	9.61	10.58
EPSBE2010-10-TH	●	0.5	1	0.8	0.96	10	50	6	4	6.68	10.93	11.27	11.54	11.98	13.23
EPSBE2012-1.8-TH	●	0.6	1.2	1.1	1.15	1.8	45	6	4	10.78	2.36	2.47	2.58	2.68	2.86
EPSBE2012-3.6-TH	●	0.6	1.2	1.1	1.15	3.6	45	6	4	9.46	4.27	4.45	4.61	4.75	5.01
EPSBE2015-2.25-TH	●	0.75	1.5	1.35	1.44	2.25	45	6	4	10.43	2.87	2.99	3.10	3.20	3.40
EPSBE2015-4.5-TH	●	0.75	1.5	1.35	1.44	4.5	45	6	4	8.84	5.24	5.43	5.61	5.76	6.03
EPSBE2015-8-TH	●	0.75	1.5	1.35	1.44	8	45	6	4	7.14	8.89	9.17	9.41	9.61	10.56
EPSBE2015-12-TH	●	0.75	1.5	1.35	1.44	12	50	6	4	5.85	13.03	13.39	13.74	14.38	15.87
EPSBE2020-3-TH	●	1	2	1.7	1.92	3	45	6	4	9.79	3.71	3.84	3.96	4.07	4.29
EPSBE2020-6-TH	●	1	2	1.7	1.92	6	45	6	4	7.81	6.84	7.07	7.26	7.43	7.89
EPSBE2020-8-TH	●	1	2	1.7	1.92	8	45	6	4	6.88	8.92	9.19	9.42	9.61	10.54
EPSBE2020-12-TH	●	1	2	1.7	1.92	12	50	6	4	5.55	13.06	13.41	13.76	14.39	15.85
EPSBE2020-16-TH	●	1	2	1.7	1.92	16	50	6	4	4.65	17.19	17.59	18.32	19.17	21.16
EPSBE2020-20-TH	●	1	2	1.7	1.92	20	55	6	4	4.01	21.30	21.90	22.88	23.96	26.47

●：Stocked items.





EPSBE2○○○-○.○○-H-TH

High-accuracy rating product

R accuracy +0.001mm~−0.005mm

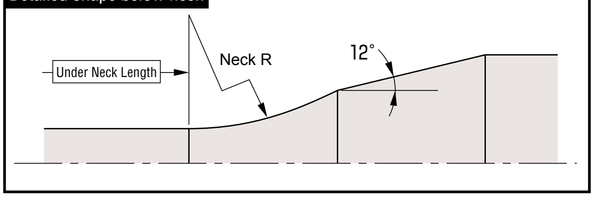
Inspection certificate included

Cutting Conditions P11

Item code	Stock	Size (mm)									The effective under-neck length for the various draft angles				
		Ball radius *R*	Tool dia. *Dc*	Flute length *ℓ*	Neck dia. *D1*	Under neck length *ℓ2*	Overall length *L*	Shank dia. *Ds*	Neck R	Interference angle *θκ*	0.5°	1°	1.5°	2°	3°
EPSBE2001-0.15-H-TH	●	0.05	0.1	0.08	0.08	0.15	45	4	1	11.82	0.30	0.32	0.33	0.35	0.38
EPSBE2002-0.3-H-TH	●	0.1	0.2	0.15	0.17	0.3	45	4	1	11.66	0.49	0.50	0.52	0.54	0.58
EPSBE2003-0.45-H-TH	●	0.15	0.3	0.25	0.27	0.45	45	4	2	11.53	0.73	0.77	0.80	0.84	0.91
EPSBE2004-0.6-H-TH	●	0.2	0.4	0.3	0.37	0.6	45	4	2	11.39	0.88	0.93	0.97	1.01	1.09
EPSBE2005-0.75-H-TH	●	0.25	0.5	0.35	0.47	0.75	45	4	2	11.25	1.04	1.09	1.13	1.18	1.27
EPSBE2006-0.9-H-TH	●	0.3	0.6	0.4	0.57	0.9	45	4	4	11.10	1.33	1.42	1.51	1.59	1.75
EPSBE2008-1.2-H-TH	●	0.4	0.8	0.5	0.77	1.2	45	4	4	10.79	1.65	1.75	1.84	1.93	2.11
EPSBE2010-1.5-H-TH	●	0.5	1	0.8	0.96	1.5	45	6	4	11.01	2.01	2.12	2.21	2.31	2.49
EPSBE2012-1.8-H-TH	●	0.6	1.2	1.1	1.15	1.8	45	6	4	10.78	2.36	2.47	2.58	2.68	2.86
EPSBE2015-2.25-H-TH	●	0.75	1.5	1.35	1.44	2.25	45	6	4	10.43	2.87	2.99	3.10	3.20	3.40
EPSBE2020-3-H-TH	●	1	2	1.7	1.92	3	45	6	4	9.79	3.71	3.84	3.96	4.07	4.29

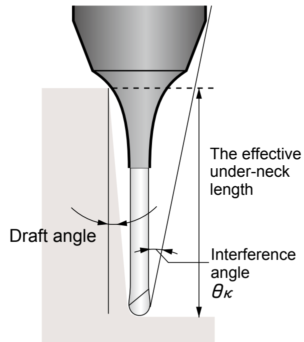
●：Stocked Items.

Detailed shape below neck



【Note】

If the workpiece has draft angle, the interference length will be longer than the under-neck length. Please refer to the effective under-neck length for the various draft angles.
In addition, the angle at which the tool will interfere with the workpiece is shown as the "interference angle θκ", and should also be referred to.

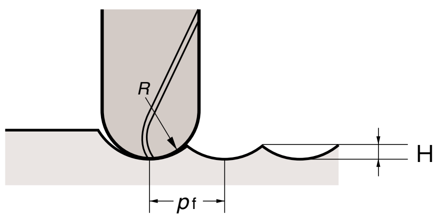


Theoritical Cusp height in end milling (μm)

	Pick feed：*pf* (mm)										
Ball radius *R* (mm)	0.02	0.03	0.04	0.05	0.075	0.1	0.15	0.2	0.3	0.4	0.5
0.1	0.50	1.13	2.02	3.18	–	–	–	–	–	–	–
0.3	0.17	0.38	0.67	1.04	2.35	4.20	9.53	–	–	–	–
0.5	0.10	0.23	0.40	0.63	1.41	2.51	5.66	10.10	23.03	41.74	66.99
1	0.05	0.11	0.20	0.31	0.70	1.25	2.82	5.01	11.31	20.20	31.75
1.5	0.03	0.08	0.13	0.21	0.47	0.83	1.88	3.34	7.52	13.39	20.98
2	0.03	0.06	0.10	0.16	0.35	0.63	1.41	2.50	5.63	10.03	15.69
2.5	0.02	0.05	0.08	0.13	0.28	0.50	1.13	2.00	4.50	8.01	12.53
3	0.017	0.04	0.07	0.10	0.23	0.42	0.94	1.67	3.75	6.67	10.43
4	0.013	0.03	0.05	0.08	0.18	0.31	0.70	1.25	2.81	5.00	7.82
5	0.010	0.02	0.04	0.06	0.14	0.25	0.56	1.00	2.25	4.00	6.25
6	0.008	0.02	0.03	0.05	0.12	0.21	0.47	0.83	1.88	3.33	5.21

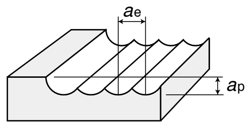
Pick feed and Cusp height

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



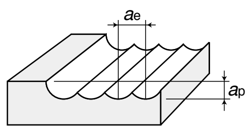
Recommended Cutting Conditions

Epoch TH Hard Ball Strong **EPBTS-TH**



＜Roughing＞

	Work material	Pre-hardened steels (35～45HRC) CENA1,NAK80		Hardened steels (45～55HRC) SKD61,SKT4		Hardened steels (55～65HRC) SKD11,SKH51		Hardened steels (65～72HRC) SKH,HAP	
High speed	Depth of cut (mm)	a_p=0.12Dc a_e=0.36Dc		a_p=0.1Dc a_e=0.3Dc		a_p=0.06Dc a_e=0.18Dc		a_p=0.05Dc a_e=0.15Dc	
	Ball radius R×Tool dia. Dc (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
	***R*1.5×3**	37,700	3,620	27,500	2,810	22,400	2,280	13,200	1,110
	***R*2×4**	28,300	3,620	20,600	2,800	16,800	2,280	9,900	1,110
	***R*2.5×5**	22,800	3,650	16,700	2,840	13,600	2,310	8,000	1,120
	***R*3×6**	19,200	3,690	14,000	2,860	11,400	2,330	6,800	1,140
	***R*4×8**	14,700	3,760	10,700	2,910	8,800	2,390	5,200	1,160
	***R*5×10**	11,800	3,780	8,600	2,920	7,000	2,380	4,100	1,150
	***R*6×12**	9,800	3,650	7,200	2,850	5,800	2,300	3,400	1,110
General	Depth of cut (mm)	a_p=0.12Dc a_e=0.36Dc		a_p=0.1Dc a_e=0.3Dc		a_p=0.08Dc a_e=0.24Dc		a_p=0.07Dc a_e=0.21Dc	
	Ball radius R×Tool dia. Dc (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
	***R*1.5×3**	17,300	1,560	14,300	1,030	12,200	730	7,100	340
	***R*2×4**	13,000	1,560	10,700	1,030	9,200	740	5,300	340
	***R*2.5×5**	10,500	1,580	8,600	1,030	7,400	740	4,300	340
	***R*3×6**	8,800	1,580	7,300	1,050	6,200	740	3,600	350
	***R*4×8**	6,800	1,630	5,600	1,080	4,800	770	2,800	360
	***R*5×10**	5,400	1,620	4,500	1,080	3,800	760	2,200	350
	***R*6×12**	4,500	1,570	3,700	1,030	3,200	740	1,900	350



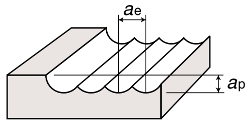
t: Finishing cut amount
p_f: Pick feed

＜Finishing＞

	Work material	Pre-hardened steels (35～45HRC) CENA1,NAK80		Hardened steels (45～55HRC) SKD61,SKT4		Hardened steels (55～65HRC) SKD11,SKH51		Hardened steels (65～72HRC) SKH,HAP	
High speed	Depth of cut (mm)	a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc	
	Ball radius R×Tool dia. Dc (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
	***R*1.5×3**	27,500	3,890	26,400	3,200	23,100	2,800	17,600	2,130
	***R*2×4**	24,200	4,150	22,000	3,550	17,600	2,660	13,200	2,000
	***R*2.5×5**	20,900	4,020	18,150	3,310	14,850	2,550	11,000	1,910
	***R*3×6**	17,600	3,910	14,300	3,030	12,100	2,440	8,800	1,780
	***R*4×8**	13,200	3,200	11,000	2,550	8,800	1,680	6,600	1,470
	***R*5×10**	11,000	2,890	8,800	2,220	7,040	1,640	5,280	1,280
	***R*6×12**	8,800	2,400	7,260	1,910	5,830	1,490	4,400	1,110
General	Depth of cut (mm)	a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc		a_p=0.05～0.1 a_e=0.02Dc	
	Ball radius R×Tool dia. Dc (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
	***R*1.5×3**	17,000	2,620	15,400	1,850	14,300	1,720	11,000	1,320
	***R*2×4**	13,000	2,430	11,000	1,760	10,560	1,580	7,920	1,190
	***R*2.5×5**	10,500	2,260	9,130	1,670	7,040	1,440	6,490	1,100
	***R*3×6**	8,500	2,060	7,590	1,600	5,280	1,410	5,280	1,060
	***R*4×8**	6,400	1,690	5,720	1,320	4,180	1,170	3,960	870
	***R*5×10**	5,100	1,460	4,510	1,130	3,520	1,000	3,190	770
	***R*6×12**	4,200	1,240	3,850	1,000	2,640	880	2,640	660

【Note】①Use the appropriate coolant for the work material and machining shape.
②These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.

Epoch Super Hard Ball Evolution EPSBE-TH



Work material					1		2		3		4		5	
					Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut					100%		85%		80%		65%		55%	
Ball radius *R*	Tool dia.	Under neck length	Standard depth of cut (mm) *ap*	*ae*	Revolution *n* min^{-1}	Feed rate *vf* mm/min	Revolution *n* min^{-1}	Feed rate *vf* mm/min	Revolution *n* min^{-1}	Feed rate *vf* mm/min	Revolution *n* min^{-1}	Feed rate *vf* mm/min	Revolution *n* min^{-1}	Feed rate *vf* mm/min
0.05	0.1	0.15	0.006	0.018	59,500	360	54,100	320	51,400	280	46,000	250	43,300	190
0.05	0.1	0.3	0.005	0.015	59,500	360	50,000	320	51,400	280	46,000	250	43,300	190
0.05	0.1	0.75	0.003	0.009	35,700	210	32,500	200	30,800	170	27,600	150	26,000	120
0.1	0.2	0.3	0.016	0.048	55,400	660	50,400	600	47,900	520	42,800	460	40,300	360
0.1	0.2	0.6	0.014	0.042	55,400	660	50,400	600	47,900	520	42,800	460	40,300	360
0.1	0.2	1	0.012	0.036	41,600	500	37,800	450	35,900	390	32,100	350	30,200	270
0.1	0.2	1.5	0.007	0.021	33,300	400	30,200	360	28,700	310	25,700	280	24,200	220
0.1	0.2	2	0.006	0.018	33,300	350	30,200	310	28,700	270	25,700	240	24,200	190
0.15	0.3	0.45	0.017	0.051	50,600	910	46,000	830	43,700	710	39,100	630	36,800	500
0.15	0.3	0.9	0.017	0.051	50,600	910	46,000	830	43,700	710	39,100	630	36,800	500
0.15	0.3	1.5	0.013	0.039	37,900	610	34,500	560	32,800	480	29,300	430	27,600	340
0.15	0.3	2	0.01	0.03	30,300	470	27,600	430	26,200	370	23,400	330	22,100	260
0.15	0.3	3	0.007	0.021	30,300	440	27,600	400	26,200	340	23,400	300	22,100	240
0.2	0.4	0.6	0.035	0.105	43,800	1,050	39,800	960	37,800	820	33,800	730	31,800	570
0.2	0.4	1.2	0.032	0.096	43,800	1,050	39,800	960	37,800	820	33,800	730	31,800	570
0.2	0.4	2	0.022	0.066	35,000	840	31,800	760	30,200	650	27,100	590	25,500	460
0.2	0.4	3	0.013	0.039	28,000	630	25,500	570	24,200	490	21,600	440	20,400	340
0.2	0.4	3.5	0.01	0.03	28,000	630	25,500	570	24,200	490	21,600	440	20,400	340
0.2	0.4	4	0.008	0.024	28,000	540	25,500	490	24,200	420	21,600	370	20,400	290
0.25	0.5	0.75	0.036	0.108	37,300	1,190	34,000	1,090	32,300	930	28,900	830	27,200	650
0.25	0.5	1.5	0.036	0.108	37,300	1,190	34,000	1,090	32,300	930	28,900	830	27,200	650
0.25	0.5	3	0.024	0.072	28,000	840	25,500	770	24,200	650	21,600	580	20,400	460
0.25	0.5	5	0.016	0.048	23,100	650	21,000	590	20,000	500	17,900	450	16,800	350
0.3	0.6	0.9	0.04	0.12	35,000	1,430	31,800	1,300	30,200	1,110	27,100	1,000	25,500	780
0.3	0.6	1.8	0.036	0.108	35,000	1,430	31,800	1,300	30,200	1,110	27,100	1,000	25,500	780
0.3	0.6	3	0.028	0.084	27,000	1,100	24,500	1,000	23,300	860	20,900	770	19,600	600
0.3	0.6	5	0.018	0.054	22,200	910	20,200	820	19,200	710	17,100	630	16,100	490
0.3	0.6	6	0.013	0.039	22,200	830	20,200	750	19,200	640	17,100	570	16,100	450
0.4	0.8	1.2	0.065	0.195	29,200	1,680	26,500	1,530	25,200	1,310	22,500	1,170	21,200	920
0.4	0.8	2.4	0.065	0.195	29,200	1,680	26,500	1,530	25,200	1,310	22,500	1,170	21,200	920
0.5	1	1.5	0.08	0.24	28,600	2,060	26,000	1,870	24,700	1,600	22,100	1,430	20,800	1,120
0.5	1	3	0.08	0.24	28,600	2,060	26,000	1,870	24,700	1,600	22,100	1,430	20,800	1,120
0.5	1	6	0.035	0.105	22,300	1,610	20,300	1,460	19,300	1,250	17,200	1,110	16,200	870
0.5	1	8	0.035	0.105	19,300	1,350	17,500	1,230	16,600	1,050	14,900	940	14,000	740
0.5	1	10	0.022	0.066	19,300	1,270	17,500	1,160	16,600	990	14,900	890	14,000	690
0.6	1.2	1.8	0.08	0.24	25,300	2,190	23,000	1,990	21,800	1,700	19,500	1,520	18,400	1,190
0.6	1.2	3.6	0.08	0.24	25,300	2,190	23,000	1,990	21,800	1,700	19,500	1,520	18,400	1,190
0.75	1.5	2.25	0.085	0.255	21,400	2,310	19,500	2,110	18,500	1,800	16,500	1,600	15,600	1,260
0.75	1.5	4.5	0.08	0.24	21,400	2,310	19,500	2,110	18,500	1,800	16,500	1,600	15,600	1,260
0.75	1.5	8	0.05	0.15	18,300	1,870	16,700	1,700	15,800	1,450	14,200	1,300	13,300	1,020
0.75	1.5	12	0.05	0.15	16,600	1,590	15,100	1,450	14,400	1,240	12,900	1,110	12,100	870
1	2	3	0.16	0.48	18,400	2,650	16,700	2,400	15,900	2,060	14,200	1,840	13,400	1,450
1	2	6	0.16	0.48	18,400	2,650	16,700	2,400	15,900	2,060	14,200	1,840	13,400	1,450
1	2	8	0.13	0.39	18,400	2,650	16,700	2,400	15,900	2,060	14,200	1,840	13,400	1,450
1	2	12	0.07	0.21	15,300	1,960	13,900	1,780	13,200	1,520	11,800	1,360	11,100	1,070
1	2	16	0.07	0.21	14,600	1,750	13,300	1,600	12,600	1,360	11,300	1,220	10,600	950
1	2	20	0.045	0.135	13,500	1,620	12,300	1,480	11,600	1,250	10,400	1,120	9,800	880

※Standard cutting depth is shown as the criteria for Group 1 workpieces.
For other groups, adjust the cutting depth according to the cutting depth factors in the above table.

【Note】①Use the appropriate coolant for the work material and machining shape.
②These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.

MOLDINO

The Edge To Innovation

The diagrams and table data are examples of test results, and are not guaranteed values.
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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.

MOLDINO 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.moldino.com/en/
Database for selection Cutting Tool Products【TOOL SEARCH】
TOOLSEARCH　Search Web

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

China — **MOLDINO Tool Engineering (Shanghai), Ltd.**
Room 2604-2605, Metro Plaza, 555 Loushanguan Road, Changning Disctrict,Shanghai, 200051, China
Tel +86-(0)21-3366-3058 Fax +86-(0)21-3366-3050

America — **MITSUBISHI MATERIALS U.S.A. CORPORATION**
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

Mexico — **MMC METAL DE MEXICO, S.A. DE C.V.**
Av. La Cañada No.16, Parque Industrial Bernardo Quintana, El Marques, Querétaro, CP 76246, México
Tel +52-442-1926800

Brazil — **MMC METAL DO BRASIL LTDA.**
Rua Cincinato Braga, 340 13° andar.Bela Vista – CEP 01333-010 São Paulo – SP ., Brasil
Tel +55(11)3506-5600 Fax +55(11)3506-5677

Thailand — **MMC Hardmetal (Thailand) Co.,Ltd. MOLDINO Division**
622 Emporium Tower, Floor 22/1-4, Sukhumvit Road, Klong Tan, Klong Toei,
Bangkok 10110, Thailand
TEL:+66-(0)2-661-8175 FAX:+66-(0)2-661-8176

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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