

Tungsten Carbide End Mills UNIMAX Series

Published July 2025

NEW

2 Flute Ball End Mills

HWB



For hard materials
from 40HRC to over 60HRC

HWB-S

Short shank series of HWB

CWB



Best for soft materials up to 40 HRC

All flute type has been added to the new coating series.



UNION TOOL CO.

New Coating Series

New coating that exceeds the conventional tools

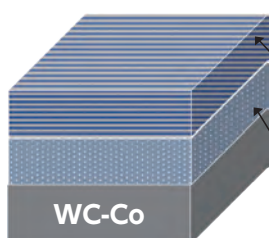
HMG COAT

Suitable for hard materials especially over 65HRC

Developed a hard coating with higher wear resistance than HARDMAX.
Offers longer tool life than conventional tools.

HMW COAT

Upgraded version of HARDMAX coating with improved wear resistance



Ultra-high hardness layer

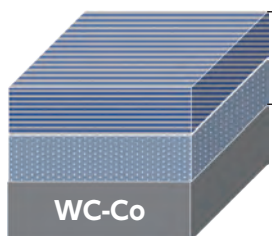
Increased numbers of layers by nano-laminated structure.
Longer tool life due to wear resistance and the suppression of crack propagation.

Shock absorption layer

New nanocomposite structure improves hardness and toughness.

UTW COAT

New coating with the best performance achievable in work materials up to 40HRC



High hardness and high toughness
New nanocomposite structure offers ultra multilayer structure
High toughness and wear resistance provide excellent performance in work materials up to 40HRC

How to find the best series for your material applications

(★ Highly Recommended ● Recommended ○ Suggested)

Model Number			Features	Ball tip design	Copper	Carbon Steels	Prehardened Steels	Hardened Steels				
								~50 HRC	~55 HRC	~60 HRC	~65 HRC	~70 HRC
HMG COAT	HGB		Best suited for Hard Materials	Super Negative 			○	●	●	●	★	★
HMW COAT	HWB		For Hard Materials	Negative 	○	○	●	★	★	★	●	●
UTW COAT	CWB		Multi-purpose Excellent surface quality	Neutral 	●	★	★	●				

HWB/HWB-S



HMWCOAT 2 Flute Ball End Mills / Short Shank Ball End Mills

R0.03~R6

Super
MG

HMW
COAT

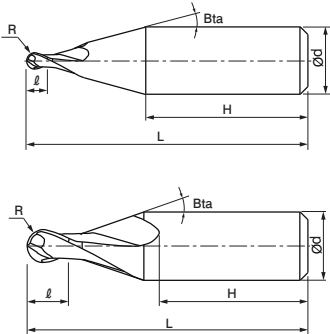
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

Work Material																	
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS					CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON- METALLIC) MATERIALS
			~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC										
○	○	●	★	★	★	●	●	○			○			○	○		

Upgrade

Wear resistance and tool accuracy have been improved with HWB/HWB-S and CWB series.

CSEB				HSB				HGB	
Copper	Raw Materials	~ 30 HRC	~ 40 HRC	~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC	
≡									
CWB				HWB				HGB	
Copper	Raw Materials	~ 30 HRC	~ 40 HRC	~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC	



The shank taper angle and shank length shown are not exact values.

Tool Design

With the same tool shape as our long-selling HSB/HSB-S, the transition from HSB/HSB-S is made easy.

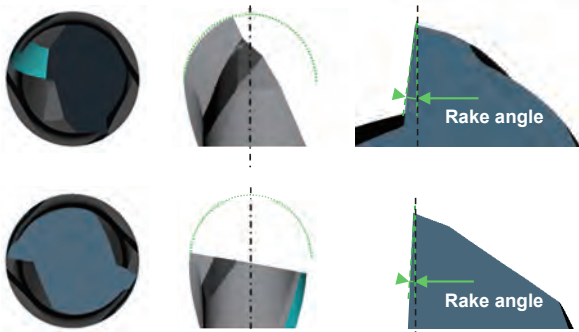
Variable rake angle design

Tip point

Negative rake angle design prevents fracture and chipping.

Peripheral cutting edge

Slightly negative rake angle design reduces cutting resistance and prevents chattering.



High Precision

Even higher accuracy than before!

Conventional HSB

Radius of Ball Nose	Ball Radius Accuracy	Diameter Tolerance	Shank Diameter Tolerance
R0.03 ~ R0.05	± 0.002	0/-0.01	0/-0.005
R0.1 ~ R3	± 0.005	0/-0.015	
R4 ~ R6	± 0.007	0/-0.02	



HWB

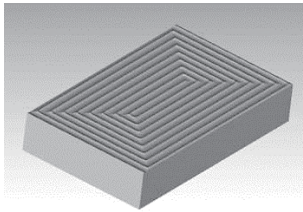
Unit (mm)

Radius of Ball Nose	Ball Radius Accuracy	Diameter Tolerance	Shank Diameter Tolerance	Helix Angle
R0.03 ~ R0.05	± 0.002	0/-0.006	0/-0.004 (h4)	
R0.1 ~ R1	± 0.003			0/-0.009
R1.5 ~ R3				
R4 ~ R6	± 0.007	0/-0.01	0/-0.005(h5)	

Roughing – Tool wear comparison

HWB R6 × L22

SKD11 (60HRC)



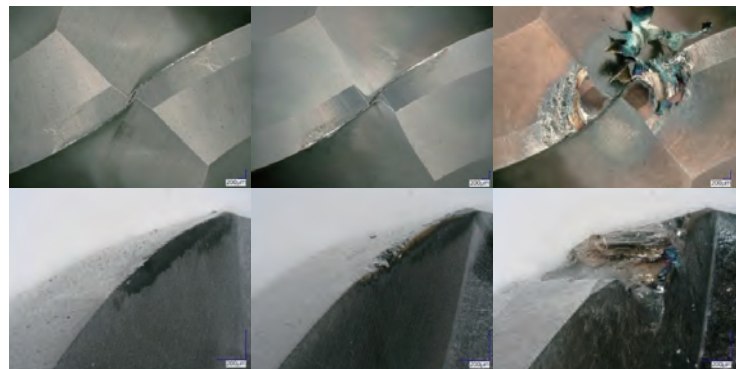
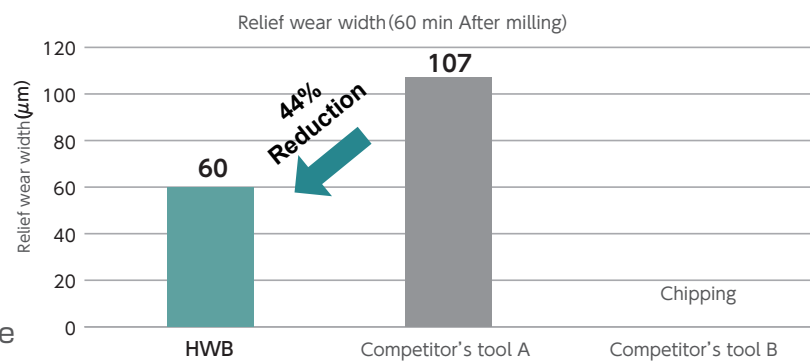
Work Size

200 × 100 × 3.4 mm

Coolant : Air Blow Through Spindle

Overhang Length : 40 mm

Spindle Speed	3,600 (min ⁻¹)
Feed Rate	1,400 (mm/min)
a _p Axial Depth	0.42 (mm)
a _e Radial Depth	2.1 (mm)
Cycle Time	60 min



HWB

Competitor's tool A

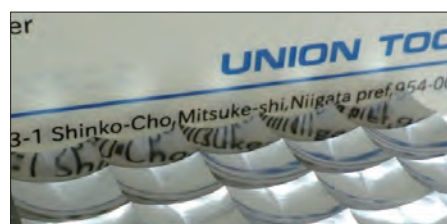
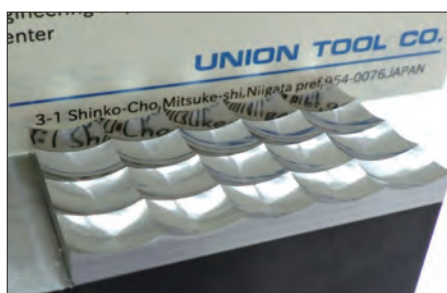
Competitor's tool B

Less tool wear compared with competitor's tool for hard materials

Curved surface milling

HWB R1.5 X L4.5

STAVAX (52HRC)



Smooth surface

Work Size
46 × 26 mm

Coolant : Oil Mist

Process	Tool	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Cycle Time
Roughing	HWB R3 X L6	13,000	2,500	0.15	0.8	8 min 25 sec
Semi-Finish		13,000	2,000	0.11	0.25	2 min 44 sec
Semi-Finish	HWB R1.5 X L4.5	30,000	1,500	0.055	0.025	55 min 56 sec
Finishing		30,000	800	0.02	0.01	3 h 35 min 56 sec

Total 56 models

Unit (mm)

Model Number	Short Shank	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕd	Shank Length H	Series
HWB 20006-0006		R0.03	0.06	11°	50	4	35.7	HWB
HWB 20008-0008		R0.04	0.08	11°	50	4	35.7	HWB
HWB 2001-0010		R0.05	0.1	11°	50	4	35.7	HWB
HWB 2002-0020S	○	R0.1	0.2	16°	35	4	27.3	HWB
HWB 2002-0020			0.2		50	4	42.3	HWB
HWB 2002-0030			0.3		50	4	42.2	HWB
HWB 2003-0030S	○	R0.15	0.3	16°	35	4	27.5	HWB
HWB 2003-0030			0.3		50	4	42.5	HWB
HWB 2003-0045			0.45		50	4	42.3	HWB
HWB 2004-0040S	○	R0.2	0.4	16°	35	4	27.6	HWB
HWB 2004-0040			0.4		50	4	42.6	HWB
HWB 2004-0060			0.6		50	4	42.4	HWB
HWB 2005-0050		R0.25	0.5	16°	50	4	42.7	HWB
HWB 2005-0075			0.75		50	4	42.4	HWB
HWB 2006-0060S	○	R0.3	0.6	16°	35	4	27.5	HWB
HWB 2006-0060			0.6		50	4	42.5	HWB
HWB 2006-0090			0.9		50	4	42.2	HWB
HWB 2008-0080		R0.4	0.8	16°	50	4	42.7	HWB
HWB 2008-0120			1.2		50	4	42.3	HWB
HWB 2010-0100S	○	R0.5	1	16°	35	4	27.8	HWB
HWB 2010-0100			1		50	4	42.8	HWB
HWB 2010-0150			1.5		50	4	42.3	HWB
HWB 2010-0250			2.5		50	4	41.3	HWB
HWB 2012-0180		R0.6	1.8	16°	50	4	42.0	HWB
HWB 2015-0150S	○	R0.75	1.5	16°	35	4	27.7	HWB
HWB 2015-0150			1.5		50	4	42.7	HWB
HWB 2015-0200			2		50	4	42.2	HWB
HWB 2015-0225			2.25		50	4	42.0	HWB
HWB 2015-0400			4		50	4	40.2	HWB
HWB 2020-0200S	○	R1	2	16°	35	4	27.2	HWB
HWB 2020-0200			2		50	4	42.2	HWB
HWB 2020-0300			3		50	4	41.2	HWB
HWB 2020-0600			6		60	4	48.2	HWB
HWB 2030-0300		R1.5	3	16°	50	6	39.0	HWB
HWB 2030-0450			4.5		70	6	57.5	HWB
HWB 2030-0800			8		70	6	54.0	HWB

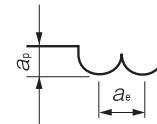
Model Number	Short Shank	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$	Shank Length H	Series
HWB 2040-0400		R2	4	16°	50	6	37.2	HWB
HWB 2040-0600-4			6	—	70	4	58.3	HWB
HWB 2040-0600			6	16°	70	6	55.2	HWB
HWB 2040-0800			8		70	6	53.2	HWB
HWB 2050-0500		R2.5	5	16°	50	6	36.7	HWB
HWB 2050-0750			7.5		80	6	64.2	HWB
HWB 2050-0800			8		80	6	63.7	HWB
HWB 2050-1200			12		80	6	59.7	HWB
HWB 2060-0600		R3	6	—	50	6	35.6	HWB
HWB 2060-0900			9		80	6	62.6	HWB
HWB 2060-1200			12		80	6	59.6	HWB
HWB 2080-0800		R4	8	—	60	8	40.6	HWB
HWB 2080-1200			12		90	8	66.6	HWB
HWB 2080-1400			14		90	8	64.6	HWB
HWB 2100-1000		R5	10	—	70	10	46.6	HWB
HWB 2100-1500			15		100	10	71.6	HWB
HWB 2100-1800			18		100	10	68.6	HWB
HWB 2120-1200		R6	12	—	75	12	48.2	HWB
HWB 2120-1800			18		110	12	77.2	HWB
HWB 2120-2200			22		110	12	73.2	HWB

HWPB/HWPB-S Milling Conditions

WORK MATERIAL			PREHARDENED STEELS/ HARDENED STEELS NAK / STAVAX (~55HRC)				HARDENED STEELS SKD11 (55~62HRC)				HARDENED STEELS HAP10 (62~66HRC)				HARDENED STEELS HAP72 (66~70HRC)			
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
20006	R0.03	0.06	30,000	100	0.002 or below	0.02	—	—	—	—	—	—	—	—	—	—	—	—
20008	R0.04	0.08	30,000	130	0.003 or below	0.03	—	—	—	—	—	—	—	—	—	—	—	—
2001	R0.05	0.1	30,000	200	0.004 or below	0.04	—	—	—	—	—	—	—	—	—	—	—	—
2002	R0.1	0.2	60,000	200	0.003	0.005	60,000	200	0.002	0.003	60,000	130	0.002	0.003	45,000	65	0.002	0.003
		0.3	60,000	200	0.003	0.005	60,000	200	0.002	0.003	60,000	130	0.002	0.003	45,000	65	0.002	0.003
2003	R0.15	0.3	60,000	350	0.006	0.008	45,000	310	0.004	0.007	43,500	180	0.003	0.005	32,500	90	0.003	0.005
		0.45	60,000	350	0.006	0.008	45,000	310	0.004	0.007	43,500	180	0.003	0.005	32,500	90	0.003	0.005
2004	R0.2	0.4	50,000	500	0.01	0.02	37,500	420	0.007	0.012	35,000	240	0.005	0.008	26,250	120	0.005	0.008
		0.6	50,000	500	0.01	0.02	37,500	420	0.007	0.012	35,000	240	0.005	0.008	26,250	120	0.005	0.008
2005	R0.25	0.5	44,000	650	0.015	0.04	33,000	530	0.01	0.02	30,000	300	0.007	0.01	22,500	150	0.007	0.01
		0.75	44,000	650	0.015	0.04	33,000	530	0.01	0.02	30,000	300	0.007	0.01	22,500	150	0.007	0.01
2006	R0.3	0.6	40,000	1,100	0.03	0.13	30,000	1,200	0.02	0.1	26,500	800	0.01	0.075	20,000	400	0.01	0.075
		0.9	40,000	1,100	0.03	0.13	30,000	1,200	0.02	0.1	26,500	800	0.01	0.075	20,000	400	0.01	0.075
2008	R0.4	0.8	35,000	1,600	0.06	0.21	27,000	1,600	0.04	0.17	23,500	1,000	0.02	0.12	17,500	500	0.02	0.12
		1.2	35,000	1,600	0.06	0.21	27,000	1,600	0.04	0.17	23,500	1,000	0.02	0.12	17,500	500	0.02	0.12
2010	R0.5	1	30,000	1,750	0.2	0.4	24,000	2,000	0.1	0.3	21,000	1,750	0.05	0.2	16,000	875	0.05	0.2
		1.5	30,000	1,750	0.2	0.4	24,000	2,000	0.1	0.3	21,000	1,750	0.05	0.2	16,000	875	0.05	0.2
		2.5	30,000	1,750	0.1	0.3	24,000	2,000	0.05	0.2	21,000	1,750	0.03	0.17	16,000	875	0.03	0.17
2012	R0.6	1.8	30,000	2,000	0.22	0.46	20,500	2,000	0.11	0.34	17,800	1,750	0.05	0.23	13,350	875	0.05	0.23
2015	R0.75	1.5	30,000	2,450	0.25	0.55	17,000	2,000	0.12	0.4	15,000	1,750	0.06	0.29	11,250	875	0.06	0.29
		2	30,000	2,450	0.25	0.55	17,000	2,000	0.12	0.4	15,000	1,750	0.06	0.29	11,250	875	0.06	0.29
		2.25	30,000	2,450	0.25	0.55	17,000	2,000	0.12	0.4	15,000	1,750	0.06	0.29	11,250	875	0.06	0.29
		4	30,000	2,450	0.15	0.45	17,000	2,000	0.07	0.31	15,000	1,750	0.04	0.24	11,250	875	0.04	0.24
2020	R1	2	28,000	2,900	0.3	0.7	14,000	2,100	0.15	0.5	12,250	1,800	0.08	0.35	9,200	900	0.08	0.35
		3	28,000	2,900	0.3	0.7	14,000	2,100	0.15	0.5	12,250	1,800	0.08	0.35	9,200	900	0.08	0.35
		6	28,000	2,900	0.2	0.6	14,000	2,100	0.1	0.4	12,250	1,800	0.06	0.3	9,200	900	0.06	0.3
2030	R1.5	3	21,000	3,000	0.4	1	10,500	2,200	0.2	0.7	9,200	1,900	0.12	0.55	6,900	950	0.12	0.55
		4.5	21,000	3,000	0.4	1	10,500	2,200	0.2	0.7	9,200	1,900	0.12	0.55	6,900	950	0.12	0.55
		8	21,000	3,000	0.3	0.9	10,500	2,200	0.15	0.65	9,200	1,900	0.1	0.5	6,900	950	0.1	0.5
2040	R2	4	18,000	3,200	0.5	1.3	9,000	2,300	0.25	0.95	7,900	2,000	0.15	0.75	5,900	1,000	0.15	0.75
		6	18,000	3,200	0.5	1.3	9,000	2,300	0.25	0.95	7,900	2,000	0.15	0.75	5,900	1,000	0.15	0.75
		8	18,000	3,200	0.5	1.3	9,000	2,300	0.25	0.95	7,900	2,000	0.15	0.75	5,900	1,000	0.15	0.75
2050	R2.5	5	15,600	3,500	0.5	1.5	7,800	2,500	0.25	1.05	6,800	2,100	0.15	0.85	5,100	1,050	0.15	0.85
		7.5	15,600	3,500	0.5	1.5	7,800	2,500	0.25	1.05	6,800	2,100	0.15	0.85	5,100	1,050	0.15	0.85
		8	15,600	3,500	0.5	1.5	7,800	2,500	0.25	1.05	6,800	2,100	0.15	0.85	5,100	1,050	0.15	0.85
		12	15,600	3,500	0.5	1.5	7,800	2,500	0.25	1.05	6,800	2,100	0.15	0.85	5,100	1,050	0.15	0.85

HWPB/HWPB-S Milling Conditions

WORK MATERIAL			PREHARDENED STEELS/ HARDENED STEELS NAK / STAVAX (~55HRC)				HARDENED STEELS SKD11 (55~62HRC)				HARDENED STEELS HAP10 (62~66HRC)				HARDENED STEELS HAP72 (66~70HRC)			
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
2060	R3	6	13,000	3,500	0.6	1.8	6,500	2,500	0.3	1.3	5,700	2,200	0.2	1	4,300	1,100	0.2	1
		9	13,000	3,500	0.6	1.8	6,500	2,500	0.3	1.3	5,700	2,200	0.2	1	4,300	1,100	0.2	1
		12	13,000	3,500	0.6	1.8	6,500	2,500	0.3	1.3	5,700	2,200	0.2	1	4,300	1,100	0.2	1
2080	R4	8	9,500	3,000	0.7	2.1	5,200	2,200	0.4	1.7	4,500	1,900	0.25	1.35	3,400	950	0.25	1.35
		12	9,500	3,000	0.7	2.1	5,200	2,200	0.4	1.7	4,500	1,900	0.25	1.35	3,400	950	0.25	1.35
		14	9,500	3,000	0.7	2.1	5,200	2,200	0.4	1.7	4,500	1,900	0.25	1.35	3,400	950	0.25	1.35
2100	R5	10	7,500	2,500	0.8	2.5	4,300	2,000	0.5	2.1	3,750	1,750	0.3	1.7	2,800	875	0.3	1.7
		15	7,500	2,500	0.8	2.5	4,300	2,000	0.5	2.1	3,750	1,750	0.3	1.7	2,800	875	0.3	1.7
		18	7,500	2,500	0.8	2.5	4,300	2,000	0.5	2.1	3,750	1,750	0.3	1.7	2,800	875	0.3	1.7
2120	R6	12	6,200	2,000	0.9	3	3,600	1,750	0.6	2.6	3,150	1,500	0.35	2	2,350	750	0.35	2
		18	6,200	2,000	0.9	3	3,600	1,750	0.6	2.6	3,150	1,500	0.35	2	2,350	750	0.35	2
		22	6,200	2,000	0.9	3	3,600	1,750	0.6	2.6	3,150	1,500	0.35	2	2,350	750	0.35	2



Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- Every coolant offers stable milling.



R0.05~R6



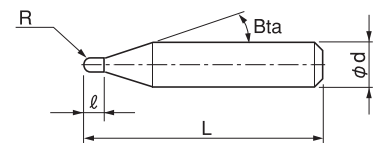
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

Work Material																	
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS					CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON- METALLIC) MATERIALS
			~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC										
★	★	★	●					○	●		●			○	○		

Upgrade

Wear resistance and tool accuracy have been improved with HWB/HWB-S and CWB series.

CSEB				HSB				HGB
Copper	Raw Materials	~ 30 HRC	~ 40 HRC	~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC
≡								
CWB				HWB				HGB
Copper	Raw Materials	~ 30 HRC	~ 40 HRC	~ 50 HRC	~ 55 HRC	~ 60 HRC	~ 65 HRC	~ 70 HRC



The shank taper angle shown is not an exact value.

**Longer tool life
and improved
mirror surface finish**

**Longer tool life and improved mirror
surface finish on SCM Prehardened
Steels compared to conventional tools.**

Longer tool life

Improved mirror surface finish

UTWCOAT
New Coating



**Tool tip has a micro flatland design
reducing milling surface roughness.**

※Micro flatland design at the tip does not apply to below R0.1.



High Precision

Even higher accuracy than before !

Conventional CSEB

Radius of Ball Nose	Ball Radius Accuracy	Diameter Tolerance	Shank Diameter Tolerance
R0.05	± 0.002	0/-0.01	0/-0.005
R0.1 ~ R3	± 0.005	0/-0.015	
R3.25 ~ R6	± 0.007	0/-0.02	



CWB

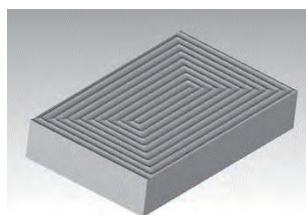
Unit (mm)

Radius of Ball Nose	Ball Radius Accuracy	Diameter Tolerance	Shank Diameter Tolerance	Helix Angle
R0.05	± 0.002	0/-0.006	0/-0.004 (h4)	
R0.1 ~ R1.25	± 0.003	0/-0.009		
R1.5 ~ R2.25	± 0.004			
R2.5 ~ R3	± 0.005			
R3.25 ~ R6	± 0.007	0/-0.01	0/-0.005(h5)	

Roughing wear comparison

CWB R6 × L18

PXA30 (30HRC)

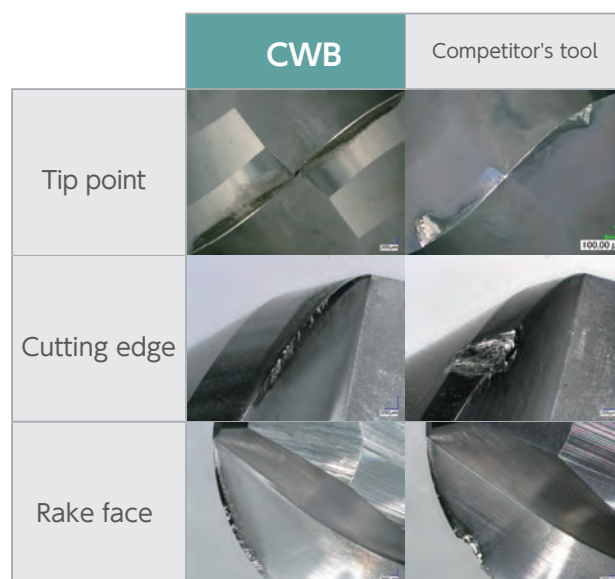


Work Size
200 × 100 × 28 mm

Coolant:
Water Soluble
(Through Spindle)

Overhang Length: 45 mm

Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Cycle Time
8,000	3,200	1.4	4.3	40 min



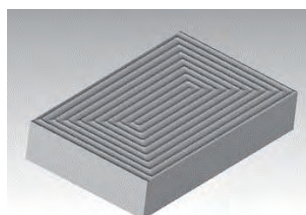
Improved coating performance and the new tool tip design enable higher efficiency milling than the catalog conditions.

Reference: Catalog conditions $n = 8,400 \text{ min}^{-1}$ $V_f = 3,300 \text{ mm/min}$ $a_p = 1.2 \text{ mm}$ $a_e = 3.6 \text{ mm}$

Roughing wear comparison

CWB R3 × L9

Carbon Steels S50C

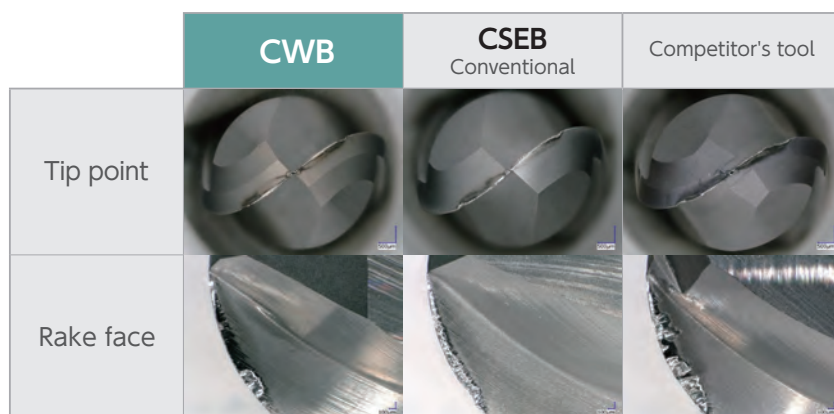


Work Size
200 × 100 × 32 mm

Coolant:
Water Soluble
(Through Spindle)

Overhang Length: 18 mm

Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Cycle Time
14,000	4,000	0.7	2.3	136 min



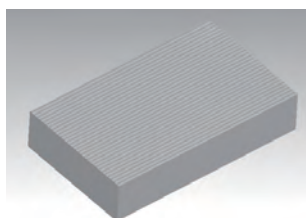
Improved coating performance and the new tool tip design enable higher efficiency milling than the catalog conditions.

Reference: Catalog conditions $n = 16,000 \text{ min}^{-1}$ $V_f = 3,100 \text{ mm/min}$ $a_p = 0.6 \text{ mm}$ $a_e = 1.8 \text{ mm}$

Flat surface finishing: Milling surface comparison

CWB R6 × L18

PXA30(30HRC)



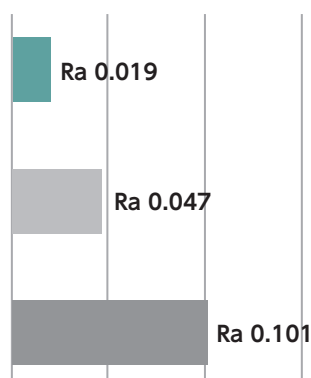
Coolant:
Water Soluble
(Through Spindle)

Overhang Length: 45 mm

Work Size
50 × 15 mm

Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Cycle Time
8,000	800	0.1	0.1	10 min

Arithmetic average roughness R_a (μm)

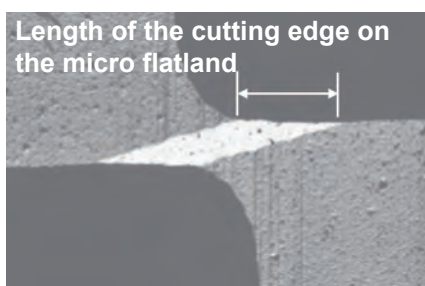


CWB offers better surface roughness and mirror surface finish.

How to achieve an excellent milling surface when finishing flat surface with CWB

Feed per rotation, a_e

By reducing the feed per rotation and a_e to less than the length of the micro flatland, excellent milling surfaces can be obtained consistently.



Recommended conditions
for feed per rotation f and radial depth a_e

Ball R	Feed per rotation f (mm/rev)	a_e Radial Depth (mm)
$0.1 \leq R < 0.25$	0.01	0.01
$0.25 \leq R < 0.5$	0.015	0.015
$0.5 \leq R < 1$	0.03	0.03
$1 \leq R \leq 3$	0.04	0.04
$3 < R \leq 4$	0.06	0.06
$4 < R \leq 5$	0.08	0.08
$5 < R \leq 6$	0.1	0.1

Calculation formula for feed per rotation f

Feed per rotation : f (mm/rev)

$$f = \frac{V_f}{n} \quad \begin{array}{l} V_f = \text{Feed Rate (mm/min)} \\ n = \text{Spindle Speed (min}^{-1}\text{)} \end{array}$$

Total 68 models

Unit (mm)

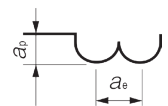
Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕd	Series
CWB 2001-0010	R0.05	0.1	11°	50	4	CWB
CWB 2002-0020	R0.1	0.2	11°	50	4	CWB
CWB 2002-0030		0.3		50	4	CWB
CWB 2003-0030	R0.15	0.3	11°	50	4	CWB
CWB 2003-0045		0.45		50	4	CWB
CWB 2004-0040	R0.2	0.4	11°	50	4	CWB
CWB 2004-0060		0.6		50	4	CWB
CWB 2005-0050	R0.25	0.5	11°	50	4	CWB
CWB 2005-0075		0.75		50	4	CWB
CWB 2006-0060	R0.3	0.6	11°	50	4	CWB
CWB 2006-0090		0.9		50	4	CWB
CWB 2007-0100	R0.35	1	11°	50	4	CWB
CWB 2008-0080	R0.4	0.8	11°	50	4	CWB
CWB 2008-0120		1.2		50	4	CWB
CWB 2009-0130	R0.45	1.3	11°	50	4	CWB
CWB 2010-0100	R0.5	1	11°	50	4	CWB
CWB 2010-0150		1.5		50	4	CWB
CWB 2010-0250		2.5		50	4	CWB
CWB 2011-0160	R0.55	1.6	11°	50	4	CWB
CWB 2012-0180	R0.6	1.8	11°	50	4	CWB
CWB 2013-0190	R0.65	1.9	11°	50	4	CWB
CWB 2014-0210	R0.7	2.1	11°	50	4	CWB
CWB 2015-0150	R0.75	1.5	11°	50	4	CWB
CWB 2015-0200		2		50	4	CWB
CWB 2015-0225		2.25		50	4	CWB
CWB 2015-0400		4		50	4	CWB
CWB 2016-0240	R0.8	2.4	11°	50	4	CWB
CWB 2017-0250	R0.85	2.5	11°	50	4	CWB
CWB 2018-0270	R0.9	2.7	11°	50	4	CWB
CWB 2019-0280	R0.95	2.8	11°	50	4	CWB
CWB 2020-0200	R1	2	11°	50	4	CWB
CWB 2020-0300		3		60	4	CWB
CWB 2020-0600		6		60	4	CWB
CWB 2025-0250	R1.25	2.5	11°	50	4	CWB
CWB 2025-0375		3.75		50	4	CWB
CWB 2025-0600		6		60	4	CWB

Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$	Series
CWB 2030-0300	R1.5	3	11°	50	6	CWB
CWB 2030-0450		4.5		70	6	CWB
CWB 2030-0800		8		70	6	CWB
CWB 2035-0520	R1.75	5.2	11°	70	6	CWB
CWB 2040-0400	R2	4	11°	50	6	CWB
CWB 2040-0600-4		6	—	70	4	CWB
CWB 2040-0600		6	11°	70	6	CWB
CWB 2040-0800		8		70	6	CWB
CWB 2045-0670	R2.25	6.7	11°	70	6	CWB
CWB 2050-0500	R2.5	5	11°	50	6	CWB
CWB 2050-0750		7.5		80	6	CWB
CWB 2050-0800		8		80	6	CWB
CWB 2050-1200		12		80	6	CWB
CWB 2055-0820	R2.75	8.2	11°	80	6	CWB
CWB 2060-0600	R3	6	—	50	6	CWB
CWB 2060-0900		9		80	6	CWB
CWB 2060-1200		12		80	6	CWB
CWB 2065-0970	R3.25	9.7	11°	90	8	CWB
CWB 2070-1050	R3.5	10.5	11°	90	8	CWB
CWB 2075-1120	R3.75	11.2	11°	90	8	CWB
CWB 2080-0800	R4	8	—	60	8	CWB
CWB 2080-1200		12		90	8	CWB
CWB 2080-1400		14		90	8	CWB
CWB 2085-1270	R4.25	12.7	11°	100	10	CWB
CWB 2090-1350	R4.5	13.5	11°	100	10	CWB
CWB 2100-1000	R5	10	—	70	10	CWB
CWB 2100-1500		15		100	10	CWB
CWB 2100-1800		18		100	10	CWB
CWB 2110-1650	R5.5	16.5	11°	110	12	CWB
CWB 2120-1200	R6	12	—	75	12	CWB
CWB 2120-1800		18		110	12	CWB
CWB 2120-2200		22		110	12	CWB

WORK MATERIAL			COPPER / ALUMINUM ALLOYS				CARBON STEELS / ALLOY STEELS S45C / S50C / SK / SCM (~325HB)				PREHARDENED STEELS NAK80 / STAVAX / HPM38 (30~45HRC)				HARDENED STEELS STAVAX / HPM38 / SKD61 (45~55HRC)			
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
2001	R0.05	0.1	30,000	200	0.004 or below	0.04	30,000	200	0.004 or below	0.04	30,000	200	0.004 or below	0.04	30,000	200	0.004 or below	0.04
2002	R0.1	0.2	60,000	350	0.008	0.024	60,000	350	0.008	0.016	60,000	300	0.008	0.024	60,000	300	0.006	0.018
		0.3	60,000	350	0.008	0.024	60,000	350	0.008	0.016	60,000	300	0.008	0.024	60,000	300	0.006	0.018
2003	R0.15	0.3	43,000	500	0.012	0.036	43,000	500	0.012	0.024	54,000	450	0.012	0.036	43,000	450	0.008	0.024
		0.45	43,000	500	0.012	0.036	43,000	500	0.012	0.024	54,000	450	0.012	0.036	43,000	450	0.008	0.024
2004	R0.2	0.4	35,000	1,200	0.03	0.09	35,000	1,200	0.02	0.04	50,000	650	0.025	0.075	35,000	650	0.015	0.045
		0.6	35,000	1,200	0.03	0.09	35,000	1,200	0.02	0.04	50,000	650	0.025	0.075	35,000	650	0.015	0.045
2005	R0.25	0.5	34,000	1,300	0.035	0.105	34,000	1,300	0.03	0.06	45,000	900	0.03	0.09	32,000	900	0.02	0.06
		0.75	34,000	1,300	0.035	0.105	34,000	1,300	0.03	0.06	45,000	900	0.03	0.09	32,000	900	0.02	0.06
2006	R0.3	0.6	33,000	1,500	0.05	0.15	33,000	1,500	0.04	0.08	40,000	1,300	0.045	0.09	30,000	1,300	0.04	0.06
		0.9	33,000	1,500	0.05	0.15	33,000	1,500	0.04	0.08	40,000	1,300	0.045	0.09	30,000	1,300	0.04	0.06
2007	R0.35	1	32,000	1,800	0.07	0.21	32,000	1,600	0.05	0.1	38,000	1,600	0.06	0.12	28,000	1,600	0.05	0.075
2008	R0.4	0.8	30,000	2,200	0.1	0.3	30,000	1,800	0.06	0.12	35,000	1,800	0.07	0.14	25,000	1,700	0.07	0.1
		1.2	30,000	2,200	0.1	0.3	30,000	1,800	0.06	0.12	35,000	1,800	0.07	0.14	25,000	1,700	0.07	0.1
2009	R0.45	1.3	30,000	2,100	0.11	0.33	30,000	1,600	0.07	0.14	33,000	1,700	0.08	0.16	24,000	1,600	0.08	0.12
2010	R0.5	1	30,000	2,000	0.12	0.36	30,000	1,600	0.08	0.16	30,000	1,600	0.09	0.18	22,000	1,600	0.09	0.13
		1.5	30,000	2,000	0.12	0.36	30,000	1,600	0.08	0.16	30,000	1,500	0.09	0.18	22,000	1,600	0.09	0.13
		2.5	30,000	1,700	0.09	0.27	24,000	1,400	0.06	0.12	30,000	1,300	0.075	0.15	21,500	1,300	0.075	0.1
2011	R0.55	1.6	30,000	2,000	0.12	0.36	30,000	1,600	0.08	0.16	30,000	1,600	0.09	0.18	20,000	1,600	0.09	0.13
2012	R0.6	1.8	30,000	2,000	0.13	0.39	30,000	1,600	0.09	0.18	30,000	1,600	0.1	0.2	18,000	1,600	0.1	0.15
2013	R0.65	1.9	30,000	2,000	0.13	0.39	30,000	1,600	0.09	0.18	30,000	1,700	0.1	0.2	18,000	1,500	0.1	0.15
2014	R0.7	2.1	30,000	2,000	0.14	0.42	30,000	1,500	0.1	0.2	30,000	1,700	0.11	0.2	18,000	1,500	0.11	0.16
2015	R0.75	1.5	30,000	2,000	0.15	0.45	30,000	1,600	0.12	0.24	30,000	1,700	0.12	0.24	18,000	1,500	0.12	0.18
		2	30,000	2,000	0.15	0.45	30,000	1,600	0.12	0.24	30,000	1,700	0.12	0.24	18,000	1,500	0.12	0.18
		2.25	30,000	2,000	0.15	0.45	30,000	1,600	0.12	0.24	30,000	1,700	0.12	0.24	18,000	1,500	0.12	0.18
		4	30,000	1,800	0.12	0.36	23,000	1,200	0.08	0.16	30,000	1,400	0.1	0.2	15,000	1,200	0.09	0.13
2016	R0.8	2.4	30,000	2,000	0.16	0.48	30,000	1,600	0.12	0.24	30,000	1,800	0.12	0.36	18,000	1,400	0.1	0.2
2017	R0.85	2.5	30,000	2,000	0.17	0.51	30,000	1,700	0.14	0.28	30,000	1,800	0.14	0.42	18,000	1,400	0.12	0.24
2018	R0.9	2.7	30,000	2,000	0.18	0.54	30,000	1,800	0.16	0.32	30,000	1,900	0.16	0.48	16,000	1,300	0.14	0.28
2019	R0.95	2.8	30,000	2,000	0.19	0.57	30,000	1,900	0.18	0.36	30,000	1,900	0.18	0.54	16,000	1,300	0.16	0.32
2020	R1	2	30,000	2,000	0.2	0.6	30,000	2,000	0.21	0.42	30,000	2,000	0.2	0.6	16,000	1,300	0.17	0.5
		3	30,000	2,000	0.2	0.6	30,000	2,000	0.21	0.42	30,000	2,000	0.2	0.6	16,000	1,300	0.17	0.5
		6	30,000	2,000	0.2	0.6	30,000	2,000	0.14	0.42	30,000	2,000	0.13	0.45	10,800	850	0.1	0.4
2025	R1.25	2.5	27,000	2,300	0.28	0.75	27,000	2,300	0.25	0.5	27,000	2,300	0.25	0.75	13,000	1,100	0.21	0.63
		3.75	27,000	2,300	0.28	0.75	27,000	2,300	0.25	0.5	27,000	2,300	0.25	0.75	13,000	1,100	0.21	0.63
		6	25,000	2,100	0.26	0.67	25,000	2,100	0.23	0.46	24,000	2,000	0.2	0.65	11,000	930	0.14	0.44
2030	R1.5	3	24,000	2,500	0.32	0.9	24,000	2,500	0.32	0.9	24,000	2,500	0.3	0.9	14,000	1,400	0.25	0.76
		4.5	24,000	2,500	0.32	0.9	24,000	2,500	0.32	0.9	24,000	2,500	0.3	0.9	14,000	1,400	0.25	0.76
		8	22,000	2,300	0.28	0.7	22,000	2,300	0.28	0.7	20,000	2,000	0.2	0.65	10,700	1,000	0.18	0.54
2035	R1.75	5.2	24,000	2,700	0.35	1	24,000	2,700	0.35	1	21,000	2,400	0.35	1	12,000	1,700	0.3	0.9

CWB Milling Conditions

WORK MATERIAL			COPPER / ALUMINUM ALLOYS				CARBON STEELS / ALLOY STEELS S45C / S50C / SK / SCM (~325HB)				PREHARDENED STEELS NAK80 / STAVAX / HPM38 (30~45HRC)				HARDENED STEELS STAVAX / HPM38 / SKD61 (45~55HRC)			
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
2040	R2	4	24,000	2,900	0.4	1.2	24,000	2,900	0.4	1.2	18,000	2,400	0.4	1.2	11,000	2,000	0.34	1
		6	24,000	2,900	0.4	1.2	24,000	2,900	0.4	1.2	18,000	2,400	0.4	1.2	11,000	2,000	0.34	1
		8	24,000	2,900	0.4	1.2	24,000	2,900	0.4	1.2	18,000	2,400	0.4	1.2	11,000	2,000	0.34	1
2045	R2.25	6.7	21,000	3,000	0.45	1.3	21,000	3,000	0.45	1.3	16,000	2,400	0.42	1.2	10,000	1,900	0.38	1.1
2050	R2.5	5	18,000	3,000	0.5	1.5	18,000	3,000	0.5	1.5	13,000	2,400	0.45	1.4	9,000	1,800	0.42	1.2
		7.5	18,000	3,000	0.5	1.5	18,000	3,000	0.5	1.5	13,000	2,400	0.45	1.4	9,000	1,800	0.42	1.2
		8	18,000	3,000	0.5	1.5	18,000	3,000	0.5	1.5	13,000	2,400	0.45	1.4	9,000	1,800	0.42	1.2
		12	18,000	3,000	0.5	1.5	18,000	3,000	0.5	1.5	13,000	2,400	0.45	1.4	9,000	1,800	0.42	1.2
2055	R2.75	8.2	17,000	3,000	0.55	1.6	17,000	3,000	0.55	1.6	12,000	2,400	0.5	1.5	8,500	1,800	0.45	1.3
2060	R3	6	16,000	3,100	0.6	1.8	16,000	3,100	0.6	1.8	11,000	2,310	0.55	1.7	7,500	1,800	0.5	1.5
		9	16,000	3,100	0.6	1.8	16,000	3,100	0.6	1.8	11,000	2,310	0.55	1.7	7,500	1,800	0.5	1.5
		12	16,000	3,100	0.6	1.8	16,000	3,100	0.6	1.8	11,000	2,310	0.55	1.7	7,500	1,800	0.5	1.5
2065	R3.25	9.7	15,000	3,100	0.65	1.95	15,000	3,100	0.65	1.95	10,000	2,200	0.59	1.8	7,000	1,800	0.54	1.6
2070	R3.5	10.5	14,000	3,200	0.7	2.1	14,000	3,200	0.7	2.1	9,000	2,100	0.63	1.9	6,500	1,800	0.57	1.7
2075	R3.75	11.2	13,000	3,300	0.75	2.25	13,000	3,300	0.75	2.25	8,200	2,000	0.67	2	6,000	1,800	0.6	1.8
2080	R4	8	12,000	3,300	0.8	2.4	12,000	3,300	0.8	2.4	7,400	1,900	0.72	2.2	5,700	1,800	0.65	2
		12	12,000	3,300	0.8	2.4	12,000	3,300	0.8	2.4	7,400	1,900	0.72	2.2	5,700	1,800	0.65	2
		14	12,000	3,300	0.8	2.4	12,000	3,300	0.8	2.4	7,400	1,900	0.72	2.2	5,700	1,800	0.65	2
2085	R4.25	12.7	12,000	3,300	0.85	2.55	12,000	3,300	0.85	2.55	6,800	1,800	0.75	2.3	5,400	1,700	0.7	2.1
2090	R4.5	13.5	11,000	3,400	0.9	2.7	11,000	3,400	0.9	2.7	6,300	1,700	0.8	2.4	5,100	1,600	0.75	2.2
2100	R5	10	10,000	3,500	1	3	10,000	3,500	1	3	5,200	1,650	0.9	2.7	4,600	1,500	0.85	2.5
		15	10,000	3,500	1	3	10,000	3,500	1	3	5,200	1,650	0.9	2.7	4,600	1,500	0.85	2.5
		18	10,000	3,500	1	3	10,000	3,500	1	3	5,200	1,650	0.9	2.7	4,600	1,500	0.85	2.5
2110	R5.5	16.5	9,000	3,400	1.1	3.3	9,000	3,400	1.1	3.3	4,700	1,500	1	3	4,200	1,350	0.9	2.7
2120	R6	12	8,400	3,300	1.2	3.6	8,400	3,300	1.2	3.6	4,300	1,350	1.1	3.2	3,800	1,250	1	3
		18	8,400	3,300	1.2	3.6	8,400	3,300	1.2	3.6	4,300	1,350	1.1	3.2	3,800	1,250	1	3
		22	8,400	3,300	1.2	3.6	8,400	3,300	1.2	3.6	4,300	1,350	1.1	3.2	3,800	1,250	1	3



Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.



Advisory for Safe Use of End Mills

Correct application and operation is strongly advised to avoid clogging, abrasion, etc, that could cause serious accidents or injuries. Ignition or sparks generated during milling could lead to fire or extreme damage to the work piece. End Mills are made with very sharp cutting edges and must be handled with extra care.

- Never touch the cutting edge with your bare hands, as this could cause serious injury. Special caution is required when opening the package.
- Dropping the tool could cause breakage or flying debris, leading to serious injury.
- During milling, unexpected impact or shock on the tool could cause breakage or flying debris. Ensure to use protective items such as safety glasses and a face guard.
- For best results, fine parameter adjustment may be required, depending on the materials; milling shape and strategy; machine rigidity and spindle capability.
- Use a machine that has high rigidity and generates a low level of vibration. Recommend setting the runout control value at $5\mu\text{m}$ or below for the small diameter tools $\phi 1$ or below.
- Do not use flammable cutting oils.

Advisory for Regrinding End Mills

- Never regrind the tool without wearing safety glasses and a face guard.

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Price & Specifications are subject to change without notice.