Size R **0.03** ~ R **6**

HB

Super MG | HARD MAX | Shank Dia 0/-0.005

Applicable Work Material (◎Most Suitable ○Suitable)

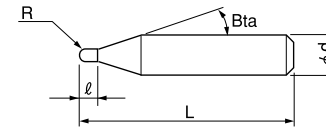
Work Material													Suitable Coolant ◎Recommendation
CARBON STEELS S45C S55C	ALLOY STEELS SK·SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS (~55HRC)	HARDENED STEELS (~60HRC)	HARDENED STEELS (~65HRC)	CAST IRON	ALUMINIUM ALLOYS	GRAPHITE	COPPER	PLASTIC	TITANIUM	HEATPROOF STEELS	
○	○	◎	◎	◎ ※5	◎ ※5	○			◎ ※3			○ ※1	◎Airblow/Oil Mist Water Soluble·Oil

※1 Most suitable to use oil for the stainless steel and the heat resisting alloy steel
※3 Recommend Oil or Water Soluble coolant for Copper milling
※5 Recommend Hardened Steels up to 55 HRC for Ball End Mill: R0.03 R0.05

2 Flutes/Straight Flute Type offers Excellent rigidity
For outstanding heat resistance and lubricant properties on Hard Milling right up to 65 HRC
Offers market leading longer tool life

Ball Radius	R Accuracy	Helix Angle	Number of Flutes
R0.03~R0.05 Shank	R ±0.002	0°	2 Flutes R0.05 ϕ6 Shank = Single Flute
R0.05~R3 Shank	R ±0.005	30° *	
R4~R6	R ±0.007		

*R0.05



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle

(Total 42 models)

Unit (mm)

Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕ d	
HB 20006-0006	R0.03	0.06	11°	50	4	
HB 20008-0008	R0.04	0.08	11°	50	4	
HB 2001-0010	R0.05	0.1	11°	50	4	

Next Page➡

Unit (mm)

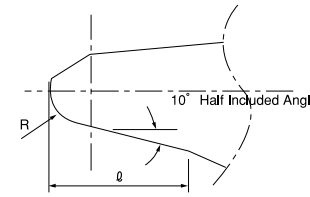
Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter φ d	
HB 1001-0020-6	R0.05	0.2	11°	50	6	
HB 2002-0030	R0.1	0.3	16°	50	4	
HB 2002-0020-6		0.2	16°	50	6	
HB 2003-0045	R0.15	0.45	16°	50	4	
HB 2003-0030-6		0.3	16°	50	6	
HB 2004-0060	R0.2	0.6	16°	50	4	
HB 2004-0040-6		0.4	16°	50	6	
HB 2005-0075	R0.25	0.75	16°	50	4	
HB 2005-0050-6		0.5	16°	50	6	
HB 2006-0090	R0.3	0.9	16°	50	4	
HB 2006-0060-6		0.6	16°	50	6	
HB 2008-0120	R0.4	1.2	16°	50	4	
HB 2008-0080-6		0.8	16°	50	6	
HB 2010-0150	R0.5	1.5	16°	50	4	
HB 2010-0250		2.5	16°	50	4	
HB 2010-0100-6		1	16°	50	6	
HB 2015-0200	R0.75	2	16°	50	4	
HB 2015-0400		4	16°	50	4	
HB 2015-0150-6		1.5	16°	50	6	
HB 2020-0300	R1	3	16°	60	4	
HB 2020-0600		6	16°	60	4	
HB 2020-0200-6		2	16°	60	6	
HB 2025-0375	R1.25	3.75	16°	60	4	
HB 2025-0600		6	16°	60	4	
HB 2025-0250-6		2.5	16°	60	6	
HB 2030-0450	R1.5	4.5	16°	70	6	
HB 2030-0800		8	16°	70	6	
HB 2040-0600	R2	6	16°	70	6	
HB 2040-0800		8	16°	70	6	
HB 2050-0800	R2.5	8	16°	80	6	
HB 2050-1200		12	16°	80	6	
HB 2060-1000	R3	10	—	80	6	
HB 2060-1200		12	—	80	6	

Next Page➡

Unit (mm)

Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter φ d	
HB 2080-1200	R4	12	—	90	8	
HB 2080-1400		14	—	90	8	
HB 2100-1500	R5	15	—	100	10	
HB 2100-1800		18	—	100	10	
HB 2120-1800	R6	18	—	110	12	
HB 2120-2200		22	—	110	12	

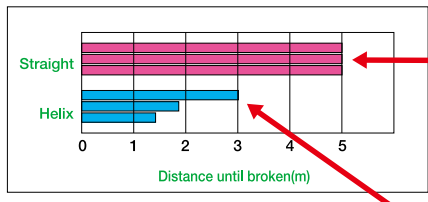
HB1001-0020-6 is a tapered ball end mill with single tapered flute of 10°
(See right hand side figure). R0.05→Straight Flute Type R0.1～R6→Helix Angle 30°



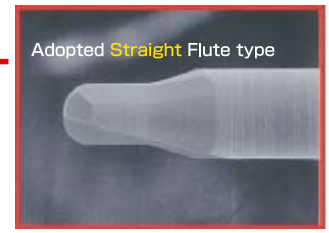
2 Flutes Super Micro Diameter Ball End Mills

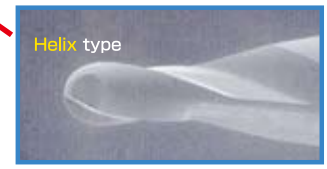
Straight Flute Design can achieve higher rigidity than helix type tool
R Tolerance +/-0.002 DiameterTolerance 0/-0.01

Straight Flute Type vs. Helix Type Breakage testing



Spindle Speed	54,000 min^{-1} (Vc 17m/min)
Feed Rate	200 mm/min (fz 0.0019 mm/t)
Coolant	Airblow (Nozzle)
Slotting	100mm × a_p 0.002 × 50 path





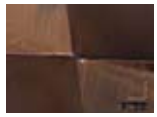
Straight Type could mill stably without breakage for 5 m!

Example: Milling parameter Test NAK80 (40HRC)

a_p	1mm × 20 = 20 mm
a_e	3 mm
Overhang Length	30 mm
Pocket Size	200mm×10mm×20mm (X × Y × Z)
Coolant	Water Soluble(Nozzle)

Catalog parameter is most stable, but it could mill with double feed rate of catalog parameter

Roughing Process

			Speed (min^{-1})	Velocity (m/min)	Feed Rate (mm/min)	Feed/Flute (mm/t)	Cycle Time (min)
①			10,000	314	3,120	0.156	43
② Catalog Parameter			10,500	330	1,900	0.09	71
③			8,500	267	2,600	0.153	52
④			10,500	330	4,500	0.214	33

Finishing Process

			Speed (min^{-1})	Velocity (m/min)	Feed Rate (mm/min)	Feed/Flute (mm/t)	Cycle Time (min)
① Catalog Parameter			10,500	329.7	1,900	0.09	68
②			20,000	628	3,600	0.09	35
③			20,000	628	4,800	0.12	28
④			6,000	188.4	1,440	0.12	92

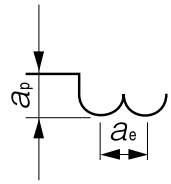
Milling conditions for HB/HB-S

WORK MATERIAL			COPPER				PREHARDENED STEELS/HARDENED STEELS NAK・SKD (30～45HRC)				HARDENED STEELS SKD・SKT (45～55HRC)				HARDENED STEELS SKD・SKT (55～65HRC)				
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	
20006	R0.03	0.06	40,000	200	0.030	less than 0.005	40,000	160	0.030	less than 0.003	—	—	—	—	—	—	—	—	※1
20008	R0.04	0.08	40,000	260	0.040	less than 0.007	40,000	200	0.040	less than 0.004	—	—	—	—	—	—	—	—	※1
2001	R0.05	0.1	40,000	300	0.050	less than 0.01	40,000	300	0.040	less than 0.005	30,000	200	0.040	less than 0.004	—	—	—	—	※1
2002	R0.1	0.2	54,000	430	0.008	0.012	54,000	630	0.060	0.020	44,300	500	0.048	0.016	32,800	375	0.028	0.010	
		0.3	54,000	430	0.008	0.007	54,000	430	0.051	0.020	44,300	345	0.040	0.016	32,800	260	0.023	0.010	
2003	R0.15	0.3	54,000	720	0.013	0.020	54,000	750	0.090	0.030	44,300	600	0.072	0.024	32,800	450	0.042	0.015	
		0.45	54,000	720	0.013	0.012	54,000	715	0.075	0.030	44,300	575	0.060	0.024	32,800	430	0.035	0.015	
2004	R0.2	0.4	54,000	870	0.016	0.028	54,000	1,000	0.120	0.040	44,300	800	0.096	0.032	32,800	600	0.056	0.020	
		0.6	54,000	870	0.016	0.016	54,000	880	0.105	0.040	44,300	700	0.084	0.032	32,800	525	0.049	0.020	
2005	R0.25	0.5	56,000	1,250	0.022	0.035	53,000	1,250	0.150	0.050	43,500	1,000	0.120	0.040	32,200	750	0.070	0.025	
		0.75	56,000	1,250	0.022	0.021	50,000	1,000	0.125	0.050	41,350	800	0.100	0.040	30,600	600	0.058	0.025	
2006	R0.3	0.6	58,000	1,510	0.026	0.042	52,000	1,380	0.180	0.060	42,650	1,100	0.144	0.048	31,500	825	0.084	0.030	
		0.9	58,000	1,510	0.026	0.025	48,500	1,020	0.155	0.060	40,500	810	0.124	0.048	30,000	610	0.072	0.030	
2008	R0.4	0.8	52,000	1,870	0.036	0.056	48,000	1,500	0.240	0.080	39,500	1,200	0.192	0.064	29,250	900	0.112	0.040	
		1.2	52,000	1,870	0.036	0.033	45,000	1,085	0.200	0.080	37,500	870	0.160	0.064	27,800	650	0.093	0.040	
2010	R0.5	1	41,000	1,660	0.040	0.063	45,000	1,560	0.300	0.100	36,900	1,250	0.240	0.080	27,300	940	0.140	0.050	
		1.5	41,000	1,660	0.040	0.037	42,000	1,250	0.255	0.100	35,000	1,000	0.200	0.080	25,900	750	0.117	0.050	
		2.5	41,000	1,660	0.040	0.022	40,000	1,000	0.200	0.100	31,500	800	0.160	0.080	23,000	600	0.090	0.050	
2012	R0.6	1.2	34,000	1,740	0.051	0.072	40,100	1,550	0.360	0.120	32,800	1,250	0.288	0.096	24,400	940	0.168	0.060	★
2015	R0.75	1.5	27,000	1,830	0.068	0.087	35,000	1,600	0.450	0.150	28,700	1,280	0.360	0.120	21,500	960	0.210	0.075	
		2	27,000	1,830	0.068	0.052	34,500	1,250	0.382	0.150	27,300	1,000	0.300	0.120	20,000	750	0.175	0.075	
		4	27,000	1,830	0.068	0.052	34,000	1,000	0.325	0.150	26,000	800	0.260	0.120	19,250	600	0.152	0.075	
2020	R1	2	20,000	1,780	0.089	0.112	30,000	1,850	0.600	0.200	24,600	1,480	0.480	0.160	18,250	1,110	0.280	0.100	
		3	20,000	1,780	0.089	0.080	27,900	1,500	0.510	0.200	23,300	1,200	0.408	0.160	17,250	900	0.238	0.100	
		6	20,000	1,780	0.089	0.067	26,500	1,350	0.435	0.200	22,000	1,080	0.348	0.160	16,250	810	0.203	0.100	
2025	R1.25	2.5	16,000	1,840	0.115	0.090	28,000	2,100	0.750	0.250	23,000	1,680	0.600	0.200	17,000	1,260	0.350	0.125	
		3.75	16,000	1,840	0.115	0.080	27,500	1,850	0.640	0.250	21,850	1,480	0.512	0.200	16,250	1,110	0.299	0.125	
		6	16,000	1,840	0.115	0.067	25,500	1,600	0.542	0.250	21,000	1,280	0.430	0.200	15,500	960	0.251	0.125	
2030	R1.5	3	13,000	2,220	0.171	0.197	25,500	2,520	0.957	0.300	21,000	2,050	0.766	0.240	15,500	1,530	0.447	0.150	★
		4.5	13,000	2,220	0.171	0.168	25,500	2,470	0.900	0.300	21,000	2,000	0.720	0.240	15,500	1,500	0.420	0.150	
		8	13,000	2,220	0.171	0.100	25,500	2,350	0.765	0.300	21,000	1,880	0.612	0.240	15,500	1,410	0.357	0.150	
2040	R2	4	10,000	2,080	0.208	0.266	21,000	2,450	1.380	0.400	17,300	1,960	1.100	0.320	12,800	1,470	0.644	0.200	★
		6	10,000	2,080	0.208	0.200	21,000	2,400	1.200	0.400	17,300	1,920	0.960	0.320	12,800	1,440	0.560	0.200	
		8	10,000	2,080	0.208	0.134	21,000	2,350	1.020	0.400	17,300	1,880	0.816	0.320	12,800	1,410	0.476	0.200	

※1） In case of Slotting, Decrease feed rate more than 50% from the table

WORK MATERIAL			COPPER				PREHARDENED STEELS/HARDENED STEELS NAK・SKD (30～45HRC)				HARDENED STEELS SKD・SKT (45～55HRC)				HARDENED STEELS SKD・SKT (55～65HRC)				
Model Number	Radius of Ball Nose	Length of Cut (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	Speed (min^{-1})	Feed (mm/min)	※a_e (mm)	※a_p (mm)	
2050	R2.5	5	8,300	1,990	0.240	0.215	18,000	2,560	1.660	0.500	14,800	2,050	1.330	0.400	11,000	1,530	0.770	0.250	★
		8	8,300	1,990	0.240	0.200	18,000	2,450	1.500	0.500	14,800	1,960	1.200	0.400	11,000	1,470	0.700	0.250	
		12	8,300	1,990	0.240	0.180	18,000	2,300	1.275	0.500	14,800	1,840	1.020	0.400	11,000	1,380	0.595	0.250	
2060	R3	6	6,900	1,940	0.281	0.290	16,000	2,700	2.340	0.600	13,000	2,160	1.870	0.480	9,600	1,620	1.090	0.300	★
		10	6,900	1,940	0.281	0.250	16,000	2,500	1.800	0.600	13,000	2,000	1.440	0.480	9,600	1,500	0.840	0.300	
		12	6,900	1,940	0.281	0.230	16,000	2,400	1.530	0.600	13,000	1,920	1.225	0.480	9,600	1,440	0.715	0.300	
2080	R4	8	5,720	1,000	0.175	0.400	12,500	2,300	3.100	0.800	10,250	1,840	2.480	0.640	7,600	1,380	1.446	0.400	★
		12	5,720	1,000	0.175	0.400	12,500	2,100	2.400	0.800	10,250	1,680	1.920	0.640	7,600	1,260	1.120	0.400	
		14	5,720	1,000	0.175	0.400	12,500	2,000	2.050	0.800	10,250	1,600	1.640	0.640	7,600	1,200	0.957	0.400	
2100	R5	10	4,550	700	0.154	0.500	10,500	2,200	3.750	1.000	8,650	1,780	3.000	0.800	6,400	1,340	1.750	0.500	★
		15	4,550	700	0.154	0.500	10,500	1,900	3.000	1.000	8,650	1,520	2.400	0.800	6,400	1,140	1.400	0.500	
		18	4,550	700	0.154	0.500	10,500	1,700	2.550	1.000	8,650	1,360	2.040	0.800	6,400	1,020	1.190	0.500	
2120	R6	12	3,770	600	0.159	0.600	9,000	1,850	4.420	1.200	7,380	1,480	3.540	0.960	5,450	1,110	2.060	0.600	★
		18	3,770	600	0.159	0.600	9,000	1,700	3.600	1.200	7,380	1,360	2.880	0.960	5,450	1,020	1.680	0.600	
		22	3,770	600	0.159	0.600	9,000	1,600	3.050	1.200	7,380	1,280	2.440	0.960	5,450	960	1.423	0.600	
Milling Amount			For Semi-Finishing ～Finishing:Condition is mentioined in above table Roughing:a_e ≦0.4D Finishing:a_p ＞0.1(Max 0.1)				For Semi-Finishing ～Finishing:Condition is mentioined in above table Roughing:a_e ≦0.4D Finishing:a_p ＞0.1(Max 0.1)				For Semi-Finishing ～Finishing:Condition is mentioined in above table Roughing:a_e ≦0.35D Finishing:a_p ＞0.1(Max 0.1)				For Semi-Finishing ～Finishing:Condition is mentioined in above table Roughing:a_e ≦0.25D Finishing:a_p ＞0.1(Max 0.1)				

a_p : Axial Depth (mm)
a_e : Radial Depth (mm)
D : Outside Diameter (mm)
n : Speed (min^{-1})
Vf : Feed (mm/min)



Note :
- Recommend Airblow or Oil Mist.When milling copper, recommend Water soluble or Oil coolant
- This parameter is only for reference. In operation, we recommend fine adjustments to these parameters according to the milling,shape,purpose,machine capability and the operation environment
- When the parameter exceed the machine's maximum spindle speed, decrease both the spindle speed and the feed rate by the same proportion
- Use a machine that has high rigidity and generates low level of vibration. Recommended level of vibration: less than 5 μm for small size (φ d≦ 1)
- Remove chip to prevent heat generation and ignition by milling processing

★HB Short Shank Series
2012-0120、2030-0300、2040-0400、2050-0500、2060-0600、2080-0800、2100-1000、2120-1200