

UNION TOOL

# Tungsten Carbide End Mills UNIMAX Series

## HTNB HARDMAX 2 Flute Taper Neck Ball End Mills

Additional 38 / Total 196 Models



UNION TOOL CO.



Size **R0.1~R2**

**HTNB** **Super MG** **HARD MAX** **30°** **R ±0.005** **Shank Dia 0/-0.005** **Back Taper Geometry**

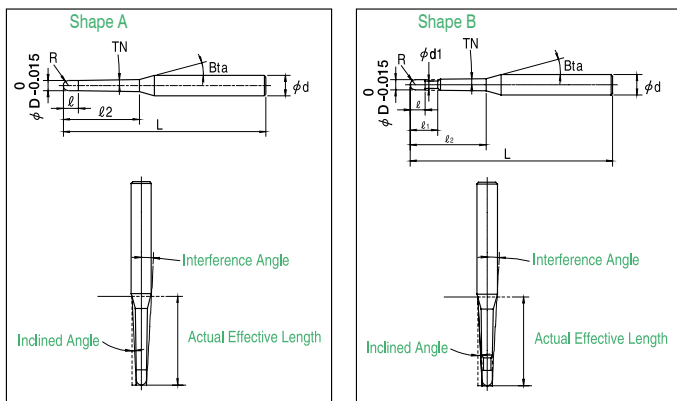
Additional 38 Models

Material Applications (☆ Highly Recommended ◎ Recommended ○ Suggested)

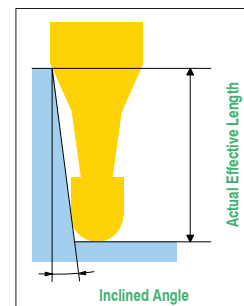
Work Material															
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS			CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
			~55HRC	~60HRC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

**Features**

Higher rigidity with modified taper neck shape.  
 HARDMAX offers outstanding heat resistance and low friction properties on hard milling up to 65HRC.  
 Radius Tolerance: ± 0.005  
 Diameter Tolerance: 0/-0.015



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Total 196 models

Revised Interference Angle Unit (mm)

Model Number	Radius of Ball Nose R	Neck Taper Angle TN	Neck Length l <sub>2</sub>	Effective Length l <sub>1</sub>	Length of Cut l	Neck Diameter Ø d <sub>1</sub>	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ø d	Shape	Interference Angle	Effective Length by Inclined Angles - : Interference				
												30'	1°	1°30'	2°	3°
												HTNB 2002-015-1	R0.1	30°	1.5	-
HTNB 2002-020-1	2	50	4	12.63	-	2.01	2.08	2.15	2.31							
HTNB 2002-030-1	3	50	4	11.37	-	3.05	3.15	3.26	3.50							
HTNB 2002-015-2	1°	1.5	50	4	13.41	-	-	1.51	1.56	1.68						
HTNB 2002-020-2		2	50	4	12.69	-	-	2.03	2.10	2.25						
HTNB 2002-030-2		3	50	4	11.46	-	-	3.06	3.17	3.40						
HTNB 2002-015-3	1°30'	1.5	50	4	13.46	-	-	-	1.53	1.64						
HTNB 2002-020-3		2	50	4	12.76	-	-	-	2.04	2.19						
HTNB 2002-030-3		3	50	4	11.56	-	-	-	3.08	3.31						

\* Additional model

Model Number	Radius of Ball Nose R	Neck Taper Angle TN	Neck Length $\ell_2$	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\varnothing d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$	Shape	Interference Angle	Effective Length by Inclined Angles										
												- : Interference										
												30'	1°	1°30'	2°	3°						
HTNB 2003-020-1	R0.15	30'	2	-	0.24	-	16°	50	4	A	12.62	-	2.01	2.08	2.15	2.30						
HTNB 2003-030-1			3					50	4		11.34	-	3.05	3.15	3.25	3.49						
HTNB 2003-020-2		1°	2					50	4		12.68	-	-	2.03	2.10	2.25						
HTNB 2003-030-2			3					50	4		11.43	-	-	3.06	3.17	3.40						
HTNB 2003-020-3		1°30'	2					50	4		12.75	-	-	-	2.05	2.19						
HTNB 2003-030-3			3					50	4		11.52	-	-	-	3.08	3.31						
HTNB 2004-030-1	R0.2	30'	3	-	0.32	-	16°	50	4	A	11.30	-	3.04	3.14	3.25	3.48						
HTNB 2004-040-1			4					50	4		10.23	-	4.08	4.21	4.35	4.67						
HTNB 2004-060-1			6					50	4		8.60	-	6.14	6.34	6.56	7.04						
HTNB 2004-030-2		1°	3					50	4		11.38	-	-	3.06	3.17	3.39						
HTNB 2004-040-2			4					50	4		10.33	-	-	4.10	4.23	4.54						
HTNB 2004-060-2		6	50					4	8.72		-	-	6.16	6.37	6.84							
HTNB 2004-030-3		1°30'	3					50	4		11.48	-	-	-	3.08	3.30						
HTNB 2004-040-3			4					50	4		10.44	-	-	-	4.12	4.42						
HTNB 2004-060-3			6					50	4		8.84	-	-	-	6.19	6.64						
HTNB 2005-040-1	R0.25	30'	4	-	0.4	-	16°	50	4	A	10.17	-	4.08	4.21	4.35	4.66						
HTNB 2005-060-1			6					50	4		8.52	-	6.14	6.34	6.55	7.03						
HTNB 2005-080-1			8					50	4		7.33	-	8.21	8.48	8.76	9.41						
HTNB 2005-100-1			10					50	4		6.43	-	10.27	10.61	10.97	11.78						
HTNB 2005-040-2		1°	4					50	4		10.27	-	-	4.10	4.23	4.54						
HTNB 2005-060-2			6					50	4		8.64	-	-	6.16	6.37	6.84						
HTNB 2005-080-2			8					50	4		7.45	-	-	8.23	8.51	9.13						
HTNB 2005-100-2		10	50					4	6.55		-	-	10.30	10.65	11.43							
HTNB 2005-040-3		1°30'	4					50	4		10.38	-	-	-	4.12	4.41						
HTNB 2005-060-3			6					50	4		8.76	-	-	-	6.19	6.64						
HTNB 2005-080-3			8					50	4		7.57	-	-	-	8.26	8.86						
HTNB 2005-100-3			10					50	4		6.67	-	-	-	10.33	11.09						
HTNB 2006-040-1		R0.3	30'					4	0.9		0.48	0.56	16°	50	4	B	10.10	-	4.08	4.21	4.34	4.65
HTNB 2006-060-1								6						50	4		8.44	-	6.14	6.34	6.55	7.03
HTNB 2006-080-1								8						50	4		7.24	-	8.21	8.47	8.76	9.40
HTNB 2006-100-1	10			50	4	6.33	-	10.27		10.61				10.97	11.77							
HTNB 2006-120-1	12			50	4	5.63	-	12.34		12.74				13.18	14.14							
HTNB 2006-160-1	16			50	4	4.61	-	16.46		17.01				17.59	18.89							
* HTNB 2006-200-1	20		50	4	3.90	-	20.60	21.28		22.01				23.64								
HTNB 2006-040-2	1°		4	50	4	10.21	-	-		4.10				4.23	4.53							
HTNB 2006-060-2			6	50	4	8.55	-	-		6.17				6.37	6.83							
HTNB 2006-080-2			8	50	4	7.36	-	-		8.23				8.51	9.13							
HTNB 2006-100-2			10	50	4	6.45	-	-		10.30				10.65	11.43							
HTNB 2006-120-2			12	50	4	5.74	-	-		12.37				12.79	13.72							
* HTNB 2006-140-2			14	50	4	5.18	-	-		14.43				14.93	16.03							
HTNB 2006-160-2			16	50	4	4.71	-	-		16.50				17.07	18.32							
* HTNB 2006-200-2			20	50	4	3.99	-	-		20.64				21.34	22.92							
HTNB 2006-040-3	1°30'		4	50	4	10.31	-	-		-				4.12	4.41							
HTNB 2006-060-3			6	50	4	8.67	-	-		-				6.19	6.64							
HTNB 2006-080-3			8	50	4	7.48	-	-		-				8.26	8.86							
HTNB 2006-100-3			10	50	4	6.57	-	-		-				10.34	11.09							
HTNB 2006-120-3			12	50	4	5.86	-	-		-				12.40	13.31							
HTNB 2006-160-3		16	50	4	4.82	-	-	-	16.54	17.76												

\* Additional model

Model Number	Radius of Ball Nose R	Neck Taper Angle TN	Neck Length $l_2$	Effective Length $l_1$	Length of Cut $l$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Shape	Interference Angle	Effective Length by Inclined Angles - : Interference										
												30'	1°	1°30'	2°	3°						
* HTNB 2008-060-1	R0.4	30'	6	1.2	0.64	0.76	16°	50	4	B	8.26	-	6.14	6.34	6.54	7.01						
HTNB 2008-080-1			8					50	4		7.04	-	8.21	8.47	8.75	9.38						
HTNB 2008-120-1			12					60	4		5.44	-	12.33	12.74	13.17	14.13						
* HTNB 2008-160-1		16	60					4	4.43		-	16.47	17.01	17.59	18.88							
* HTNB 2008-060-2		1°	6					50	4		8.37	-	-	6.17	6.37	6.82						
HTNB 2008-080-2			8					50	4		7.16	-	-	8.23	8.51	9.12						
HTNB 2008-120-2			12					60	4		5.55	-	-	12.37	12.79	13.72						
* HTNB 2008-160-2		16	60					4	4.53		-	-	16.50	17.06	18.31							
* HTNB 2008-060-3		1°30'	6					50	4		8.49	-	-	-	6.20	6.64						
HTNB 2008-080-3			8					50	4		7.28	-	-	-	8.26	8.86						
HTNB 2008-120-3			12					60	4		5.67	-	-	-	12.40	13.30						
* HTNB 2008-160-3		16	60					4	4.63		-	-	-	16.54	17.75							
* HTNB 2010-060-1		R0.5	30°					6	1.5		0.8	0.95	16°	50	4	B	8.06	-	6.14	6.33	6.54	7.00
HTNB 2010-080-1								8						50	4		6.84	-	8.21	8.47	8.75	9.37
* HTNB 2010-100-1								10						50	4		5.93	-	10.27	10.60	10.96	11.74
HTNB 2010-120-1	12			50	4	5.24	-	12.33		12.73				13.16	14.11							
HTNB 2010-160-1	16			50	4	4.25	-	16.46		17.00				17.58	18.86							
HTNB 2010-200-1	20			60	4	3.57	-	20.60		21.27				22.00	23.61							
HTNB 2010-220-1	22			60	4	3.31	-	22.66		23.41				24.20	25.98							
HTNB 2010-260-1	26			65	4	2.88	-	26.79		27.67				28.62	No Interference							
HTNB 2010-320-1	32			70	4	2.41	-	32.98		34.07				35.24	No Interference							
HTNB 2010-360-1	36			80	4	2.18	-	37.11		38.34				39.66	No Interference							
* HTNB 2010-060-2	1°		6	50	4	8.17	-	-		6.18				6.38	6.82							
HTNB 2010-080-2			8	50	4	6.95	-	-		8.24				8.51	9.12							
* HTNB 2010-100-2			10	50	4	6.04	-	-		10.31				10.66	11.42							
HTNB 2010-120-2			12	50	4	5.35	-	-		12.38				12.79	13.72							
* HTNB 2010-140-2			14	50	4	4.79	-	-		14.45				14.93	16.02							
HTNB 2010-160-2			16	50	4	4.34	-	-		16.51				17.07	18.31							
* HTNB 2010-180-2			18	50	4	3.97	-	-		18.58				19.21	20.61							
HTNB 2010-200-2			20	60	4	3.65	-	-		20.64				21.35	22.91							
HTNB 2010-220-2			22	60	4	3.39	-	-		22.71				23.48	25.21							
HTNB 2010-260-2			26	65	4	2.95	-	-		26.85				27.76	No Interference							
HTNB 2010-320-2	32		70	4	2.48	-	-	33.05		34.18				No Interference								
HTNB 2010-360-2	36		80	4	2.24	-	-	37.18		38.46				No Interference								
* HTNB 2010-060-3	1°30'		6	50	4	8.28	-	-		-				6.21	6.65							
HTNB 2010-080-3			8	50	4	7.06	-	-		-				8.28	8.87							
* HTNB 2010-100-3			10	50	4	6.16	-	-		-				10.35	11.10							
HTNB 2010-120-3			12	50	4	5.45	-	-		-				12.42	13.32							
HTNB 2010-160-3			16	50	4	4.44	-	-		-				16.56	17.77							
HTNB 2010-200-3			20	60	4	3.74	-	-		-				20.70	22.21							
HTNB 2010-220-3			22	60	4	3.47	-	-		-				22.77	24.44							
HTNB 2010-260-3			26	65	4	3.03	-	-		-				26.91	28.88							
HTNB 2010-320-3			32	70	4	2.55	-	-		-				33.11	No Interference							
HTNB 2010-360-3			36	80	4	2.30	-	-		-				37.25	No Interference							

\* Additional model


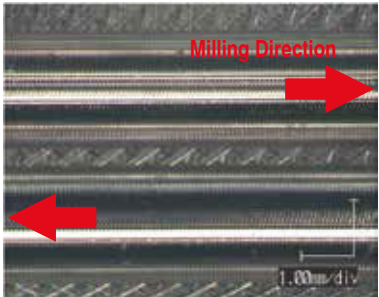
Model Number	Radius of Ball Nose	Neck Taper Angle	Neck Length	Effective Length	Length of Cut	Neck Diameter	Shank Taper Angle	Overall Length	Shank Diameter	Shape	Interference Angle	Effective Length by Inclined Angles - : Interference												
	R	TN	ℓ <sub>2</sub>	ℓ <sub>1</sub>	ℓ	Ød <sub>1</sub>	Bta	L	Ød			30'	1°	1°30'	2°	3°								
HTNB 2015-100-1	R0.75	30'	10	2.25	1.2	1.42	16°	60	4	B	5.36	-	10.27	10.59	10.93	11.70								
HTNB 2015-120-1			12					60	4		4.69	-	12.33	12.72	13.14	14.08								
HTNB 2015-160-1			16					60	4		3.75	-	16.46	16.99	17.56	18.82								
HTNB 2015-200-1			20					60	4		3.12	-	20.59	21.26	21.98	23.57								
HTNB 2015-220-1			22					60	4		2.88	-	22.66	23.39	24.18	No Interference								
HTNB 2015-260-1			26					70	4		2.50	-	26.79	27.66	28.60	No Interference								
HTNB 2015-300-1			30					70	4		2.20	-	30.92	31.93	33.01	No Interference								
HTNB 2015-360-1			36					80	4		1.87	-	37.11	38.33	No Interference	No Interference								
HTNB 2015-100-2			1°					10	60		4	5.46	-	-	10.31	10.65	11.39							
HTNB 2015-120-2								12	60		4	4.79	-	-	12.38	12.78	13.69							
HTNB 2015-160-2								16	60		4	3.83	-	-	16.51	17.06	18.29							
HTNB 2015-200-2								20	60		4	3.20	-	-	20.65	21.34	22.89							
HTNB 2015-260-2								26	70		4	2.56	-	-	26.85	27.76	No Interference							
HTNB 2015-300-2								30	70		4	2.26	-	-	30.98	32.03	No Interference							
HTNB 2015-360-2								36	80		4	1.92	-	-	37.18	No Interference	No Interference							
HTNB 2015-100-3								1°30'	10		60	4	5.57	-	-	-	10.36	11.09						
HTNB 2015-120-3									12		60	4	4.89	-	-	-	12.43	13.31						
HTNB 2015-160-3									16		60	4	3.92	-	-	-	16.57	17.76						
HTNB 2015-200-3		20							60		4	3.28	-	-	-	20.71	22.21							
HTNB 2015-260-3		26							70		4	2.63	-	-	-	26.91	No Interference							
HTNB 2015-300-3		30							70		4	2.32	-	-	-	31.05	No Interference							
HTNB 2015-360-3		36							80		4	1.98	-	-	-	No Interference	No Interference							
HTNB 2020-120-1		R1							30'		12	3	1.6	1.91	16°	60	4	B	4.05	-	12.34	12.72	13.14	14.05
HTNB 2020-160-1											16					60	4		3.19	-	16.47	16.99	17.55	18.80
HTNB 2020-200-1											20					60	4		2.63	-	20.60	21.26	21.97	No Interference
HTNB 2020-220-1								22			60					4	2.42		-	22.66	23.39	24.17	No Interference	
HTNB 2020-240-1			24					60			4					2.23	-		24.73	25.53	26.38	No Interference		
HTNB 2020-260-1			26					60			4					2.08	-		26.79	27.66	28.59	No Interference		
HTNB 2020-280-1			28					70			4					1.94	-		28.86	29.80	No Interference	No Interference		
HTNB 2020-300-1			30					70			4					1.83	-		30.92	31.93	No Interference	No Interference		
HTNB 2020-320-1			32					70			4					1.72	-		32.99	34.07	No Interference	No Interference		
HTNB 2020-340-1			34					70			4					1.63	-		35.05	36.20	No Interference	No Interference		
HTNB 2020-360-1			36					80			4					1.54	-		37.12	38.33	No Interference	No Interference		
HTNB 2020-400-1			40					80			4					1.40	-		41.25	No Interference	No Interference	No Interference		
HTNB 2020-100-2			1°					10	60		4					4.77	-		-	10.34	10.66	11.40		
HTNB 2020-120-2								12	60		4					4.13	-		-	12.40	12.80	13.69		
HTNB 2020-160-2	16			60	4	3.26	-	-	16.53	17.08	18.29													
HTNB 2020-200-2	20			60	4	2.69	-	-	20.67	21.35	No Interference													
HTNB 2020-220-2	22			60	4	2.48	-	-	22.73	23.49	No Interference													
HTNB 2020-240-2	24			60	4	2.29	-	-	24.80	25.63	No Interference													
HTNB 2020-260-2	26			60	4	2.13	-	-	26.87	27.77	No Interference													
HTNB 2020-280-2	28			70	4	2.00	-	-	28.94	29.91	No Interference													
HTNB 2020-300-2	30			70	4	1.88	-	-	31.00	No Interference	No Interference													
HTNB 2020-320-2	32			70	4	1.77	-	-	33.07	No Interference	No Interference													
HTNB 2020-340-2	34			70	4	1.67	-	-	35.14	No Interference	No Interference													
HTNB 2020-360-2	36			80	4	1.59	-	-	37.20	No Interference	No Interference													
HTNB 2020-400-2	40	80	4	1.44	-	-	No Interference	No Interference	No Interference															

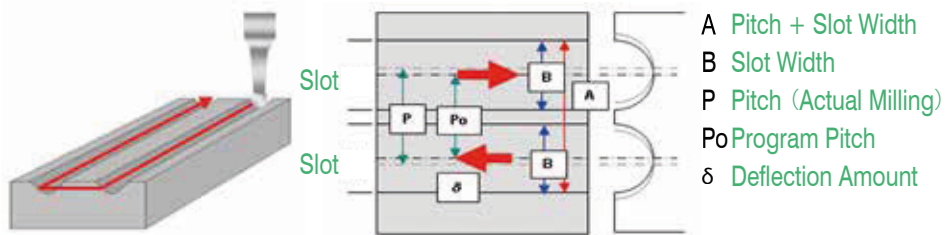
\* Additional model

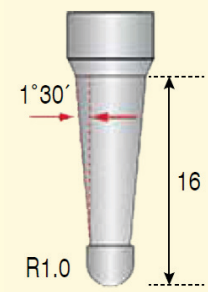
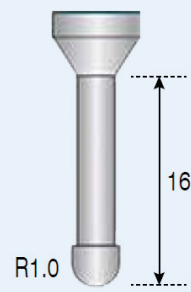
Model Number	Radius of Ball Nose R	Neck Taper Angle TN	Neck Length $l_2$	Effective Length $l_1$	Length of Cut $l$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Shape	Interference Angle	Effective Length by Inclined Angles - : Interference											
												30'	1°	1°30'	2°	3°							
* HTNB 2020-120-3	R1	1°30'	12	3	1.6	1.91	16°	60	4	B	4.22	-	-	-	12.46	13.33							
HTNB 2020-160-3			60					4	3.34		-	-	-	16.60	17.78								
HTNB 2020-200-3			60					4	2.76		-	-	-	20.74	No Interference								
HTNB 2020-220-3			60					4	2.54		-	-	-	22.81	No Interference								
* HTNB 2020-240-3			60					4	2.35		-	-	-	24.88	No Interference								
HTNB 2020-260-3			60					4	2.19		-	-	-	26.95	No Interference								
* HTNB 2020-280-3			70					4	2.05		-	-	-	29.02	No Interference								
HTNB 2020-300-3			70					4	1.93		-	-	-	No Interference	No Interference								
HTNB 2020-320-3			70					4	1.82		-	-	-	No Interference	No Interference								
* HTNB 2020-340-3			70					4	1.72		-	-	-	No Interference	No Interference								
HTNB 2020-360-3			80					4	1.63		-	-	-	No Interference	No Interference								
HTNB 2020-400-3			80					4	1.48		-	-	-	No Interference	No Interference								
HTNB 2030-200-1			R1.5					30'	20		4.5	2.4	2.89	16°	60	6	B	3.71	-	20.59	21.23	21.92	23.46
* HTNB 2030-220-1									60						6	3.43		-	22.65	23.36	24.13	25.83	
HTNB 2030-260-1									70						6	2.97		-	26.78	27.63	28.54	No Interference	
HTNB 2030-300-1									70						6	2.62		-	30.91	31.90	32.96	No Interference	
HTNB 2030-320-1	70	6		2.48	-	32.98	34.04		35.17	No Interference													
HTNB 2030-360-1	80	6		2.23	-	37.11	38.30		39.58	No Interference													
HTNB 2030-400-1	80	6		2.03	-	41.23	42.57		44.00	No Interference													
HTNB 2030-420-1	90	6		1.94	-	43.30	44.70		No Interference	No Interference													
HTNB 2030-520-1	100	6		1.60	-	53.62	55.38		No Interference	No Interference													
HTNB 2030-200-2	1°	20		60	6	3.79	-		-	20.66					21.33	22.83							
HTNB 2030-260-2		26		70	6	3.04	-		-	26.87					27.75	29.72							
HTNB 2030-300-2		30		70	6	2.69	-		-	31.00					32.03	No Interference							
HTNB 2030-320-2		32		70	6	2.54	-		-	33.07					34.17	No Interference							
HTNB 2030-360-2		36		80	6	2.29	-		-	37.20					38.44	No Interference							
HTNB 2030-400-2		40		80	6	2.08	-		-	41.33					42.72	No Interference							
HTNB 2030-420-2		42		90	6	1.99	-		-	43.40					No Interference	No Interference							
* HTNB 2030-480-2		48		100	6	1.77	-	-	49.60	No Interference					No Interference								
HTNB 2030-520-2		52		100	6	1.64	-	-	53.74	No Interference					No Interference								
* HTNB 2030-620-2		62		100	6	1.39	-	-	No Interference	No Interference					No Interference								
HTNB 2030-200-3		1°30'		20	60	6	3.88	-	-	20.75					22.20								
HTNB 2030-260-3				26	70	6	3.12	-	-	26.96					28.87								
HTNB 2030-300-3				30	70	6	2.76	-	-	31.09					No Interference								
HTNB 2030-320-3				32	70	6	2.61	-	-	33.16					No Interference								
HTNB 2030-360-3				36	80	6	2.35	-	-	37.30					No Interference								
HTNB 2030-400-3				40	80	6	2.14	-	-	41.44					No Interference								
HTNB 2030-420-3	42			90	6	2.05	-	-	43.51	No Interference													
HTNB 2030-580-3	58			100	6	1.53	-	-	No Interference	No Interference													
* HTNB 2040-300-1	R2	30'		30	6	3.2	3.87	16°	80	6					B	1.88		-	30.91	31.88	No Interference	No Interference	
* HTNB 2040-200-2		1°		20					80	6						2.81		-	-	20.67	21.32	No Interference	
* HTNB 2040-300-2				30					80	6						1.93		-	-	31.00	No Interference	No Interference	
* HTNB 2040-360-2				36					80	6						1.63		-	-	37.21	No Interference	No Interference	
HTNB 2040-400-1				30'					40	80						6		1.43	-	41.23	No Interference	No Interference	No Interference
HTNB 2040-620-1		62	120						6	0.94	-	No Interference	No Interference	No Interference		No Interference							
HTNB 2040-400-2		1°	40	80					6	1.47	-	-	No Interference	No Interference		No Interference							
HTNB 2040-600-2			60	120					6	1.00	-	-	No Interference	No Interference		No Interference							
HTNB 2040-410-3			1°30'	41					80	6	1.48	-	-	No Interference		No Interference							

\* Additional model

Tool	HTNB 2020-160-3
Spindle Speed	10,000 min <sup>-1</sup>
Feed Rate	800 mm/min
Axial Depth $a_p$	0.03 mm
Radial Depth $a_e$	2.3 mm
Overhang Length	25 mm
Coolant	Air Blow Through Spindle
Milling Size	Slot Length 105 mm × 2 Slots Slot Depth 1.0 mm

	<b>HTNB</b>
Tool Wear	
Milling Surface	



Model	HTNB	HLB
Tool		
Deflection Amount $= \{(A-B) - P_o\} / 2$	: 1 Reference Value	2
$= (B \cdot \text{Measured Diameter})$ Slot Width Error	: 1 Reference Value	1.85

Taper Neck deflection is half of straight type.

High rigidity tool offers precise milling with less deflection.

# HTNB Milling Conditions

WORK MATERIAL			COPPER / CARBON STEELS Cu / S45 / S50C					PREHARDENED STEELS / HARDENED STEELS NAK / SKD (30~45HRC)				
Model Number	Radius of Ball Nose (mm)	Neck Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth		Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth	
						Roughing (mm)	Finishing (mm)				Roughing (mm)	Finishing (mm)
2002	R0.1	1.5	42,000	640	0.008	0.02	0.015	29,000	430	0.006	0.02	0.015
		2	33,000	370	0.006	0.02	0.011	23,500	260	0.005	0.02	0.011
		3	27,000	270	0.002	0.02	0.010	19,000	165	0.001	0.02	0.009
2003	R0.15	2	36,000	650	0.009	0.03	0.018	25,200	400	0.007	0.03	0.016
		3	33,000	500	0.004	0.03	0.015	23,000	330	0.003	0.03	0.014
2004	R0.2	3	42,000	1,300	0.018	0.04	0.031	29,000	800	0.014	0.04	0.028
		4	33,000	800	0.008	0.04	0.024	23,000	520	0.006	0.04	0.023
		6	27,000	550	0.005	0.04	0.020	19,000	330	0.004	0.04	0.017
2005	R0.25	4	36,000	1,330	0.020	0.05	0.037	28,000	870	0.016	0.05	0.031
		6	29,000	900	0.012	0.05	0.031	23,000	650	0.009	0.05	0.028
		8	23,500	600	0.007	0.05	0.026	19,000	450	0.006	0.05	0.024
		10	20,000	480	0.004	0.05	0.024	18,000	380	0.003	0.05	0.021
2006	R0.3	4	44,000	2,340	0.032	0.06	0.053	32,500	1,500	0.025	0.06	0.046
		6	36,000	1,500	0.018	0.06	0.042	29,000	1,100	0.014	0.06	0.038
		8	28,500	1,150	0.018	0.06	0.040	24,000	770	0.014	0.06	0.032
		10	28,500	950	0.014	0.06	0.033	24,000	720	0.011	0.06	0.030
		12	28,500	950	0.009	0.06	0.033	24,000	720	0.007	0.06	0.030
		14	26,500	800	0.007	0.06	0.030	23,000	660	0.005	0.06	0.029
		16	25,000	700	0.005	0.06	0.028	22,000	600	0.004	0.06	0.027
		20	20,000	400	0.003	0.06	0.020	17,000	330	0.002	0.06	0.019
2008	R0.4	6	36,000	2,000	0.023	0.08	0.056	24,000	1,300	0.019	0.08	0.054
		8	28,500	1,500	0.023	0.08	0.053	20,000	950	0.019	0.08	0.048
		12	28,500	1,200	0.018	0.08	0.042	16,500	600	0.014	0.08	0.036
		16	25,000	900	0.010	0.08	0.036	15,000	500	0.008	0.08	0.033
2010	R0.5	6	35,000	2,900	0.050	0.1	0.083	23,000	1,850	0.040	0.1	0.080
		8	28,000	2,200	0.050	0.1	0.079	19,000	1,500	0.040	0.1	0.079
		10	24,000	1,800	0.035	0.1	0.075	17,000	1,300	0.030	0.1	0.076
		12	19,000	1,360	0.027	0.1	0.072	14,000	1,000	0.022	0.1	0.071
		14	18,000	1,200	0.025	0.1	0.067	13,000	900	0.020	0.1	0.069
		16	18,000	1,150	0.025	0.1	0.064	13,000	850	0.020	0.1	0.065
		18	17,500	1,120	0.018	0.1	0.064	12,500	800	0.013	0.1	0.064
		20	17,000	1,100	0.016	0.1	0.065	12,000	800	0.013	0.1	0.067
		22	17,000	1,100	0.016	0.1	0.065	12,000	800	0.013	0.1	0.067
		26	16,000	1,000	0.015	0.1	0.063	11,000	700	0.012	0.1	0.064
		32	12,000	750	0.011	0.1	0.063	9,000	550	0.009	0.1	0.061
2015	R0.75	10	20,000	2,300	0.065	0.15	0.115	13,000	1,600	0.050	0.15	0.123
		12	18,000	2,000	0.055	0.15	0.111	13,000	1,500	0.045	0.15	0.115
		16	16,000	1,600	0.050	0.15	0.100	12,000	1,200	0.030	0.15	0.100
		20	14,000	1,400	0.035	0.15	0.100	10,000	950	0.025	0.15	0.095
		22	14,000	1,400	0.035	0.15	0.100	10,000	950	0.025	0.15	0.095
		26	12,000	1,200	0.025	0.15	0.100	10,000	900	0.020	0.15	0.090
		30	10,000	950	0.020	0.15	0.095	8,000	700	0.015	0.15	0.088
		36	10,000	950	0.020	0.15	0.095	7,000	600	0.015	0.15	0.086



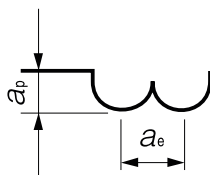
# HTNB Milling Conditions

WORK MATERIAL			HARDENED STEELS SKD / SKT (45~55HRC)					HARDENED STEELS SKD / SKS (55~65HRC)				
Model Number	Radius of Ball Nose (mm)	Neck Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth		Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth	
						Roughing (mm)	Finishing (mm)				Roughing (mm)	Finishing (mm)
2002	R0.1	1.5	28,000	330	0.006	0.016	0.012	28,000	260	0.005	0.012	0.009
		2	22,000	210	0.004	0.016	0.010	22,000	190	0.004	0.012	0.009
		3	17,500	150	0.001	0.016	0.009	17,500	130	0.001	0.012	0.007
2003	R0.15	2	23,500	350	0.006	0.024	0.015	23,500	300	0.005	0.018	0.013
		3	21,500	250	0.003	0.024	0.012	21,500	200	0.002	0.018	0.009
2004	R0.2	3	27,000	670	0.012	0.032	0.025	27,000	500	0.010	0.024	0.019
		4	22,000	430	0.006	0.032	0.020	22,000	380	0.005	0.024	0.017
		6	18,000	300	0.004	0.032	0.017	18,000	260	0.003	0.024	0.014
2005	R0.25	4	27,500	650	0.014	0.04	0.024	27,500	625	0.011	0.03	0.023
		6	22,000	530	0.008	0.04	0.024	22,000	500	0.007	0.03	0.023
		8	17,000	380	0.005	0.04	0.022	17,000	350	0.004	0.03	0.021
		10	16,000	330	0.002	0.04	0.021	16,000	300	0.002	0.03	0.019
2006	R0.3	4	25,500	850	0.022	0.048	0.033	25,500	713	0.018	0.036	0.028
		6	21,000	700	0.012	0.048	0.033	21,000	550	0.010	0.036	0.026
		8	17,000	510	0.012	0.048	0.030	17,000	425	0.010	0.036	0.025
		10	17,000	470	0.009	0.048	0.028	16,000	390	0.008	0.036	0.024
		12	16,000	400	0.006	0.048	0.025	15,000	350	0.005	0.036	0.023
		14	15,500	370	0.004	0.048	0.024	14,500	320	0.004	0.036	0.022
		16	15,000	350	0.003	0.048	0.023	14,500	300	0.003	0.036	0.021
		20	12,000	200	0.001	0.048	0.017	11,000	180	0.001	0.036	0.016
2008	R0.4	6	21,000	900	0.016	0.064	0.043	21,000	800	0.013	0.048	0.038
		8	17,000	680	0.016	0.064	0.040	17,000	600	0.013	0.048	0.035
		12	14,000	480	0.012	0.064	0.034	14,000	420	0.010	0.048	0.030
		16	13,000	420	0.006	0.064	0.032	12,500	350	0.006	0.048	0.028
2010	R0.5	6	23,000	1,500	0.034	0.08	0.065	22,000	1,200	0.028	0.06	0.055
		8	19,000	1,130	0.034	0.08	0.059	18,000	920	0.028	0.06	0.051
		10	16,000	950	0.027	0.08	0.059	15,500	770	0.022	0.06	0.050
		12	12,600	760	0.019	0.08	0.060	12,600	615	0.015	0.06	0.049
		14	12,000	700	0.017	0.08	0.058	12,000	540	0.014	0.06	0.045
		16	12,000	700	0.017	0.08	0.058	12,000	540	0.014	0.06	0.045
		18	11,000	640	0.011	0.08	0.058	11,000	490	0.010	0.06	0.045
		20	11,000	640	0.011	0.08	0.058	11,000	490	0.009	0.06	0.045
		22	11,000	640	0.011	0.08	0.058	11,000	490	0.009	0.06	0.045
		26	10,000	570	0.010	0.08	0.057	10,000	460	0.009	0.06	0.046
		32	9,000	490	0.008	0.08	0.054	9,000	380	0.007	0.06	0.042
2015	R0.75	10	13,000	1,200	0.040	0.12	0.092	13,000	950	0.035	0.09	0.073
		12	11,000	950	0.035	0.12	0.086	11,000	750	0.030	0.09	0.068
		16	11,000	900	0.030	0.12	0.082	11,000	750	0.025	0.09	0.068
		20	10,000	800	0.020	0.12	0.080	10,000	650	0.018	0.09	0.065
		22	10,000	800	0.020	0.12	0.080	10,000	650	0.018	0.09	0.065
		26	9,000	700	0.017	0.12	0.078	9,000	600	0.015	0.09	0.067
		30	8,000	600	0.013	0.12	0.075	8,000	500	0.013	0.09	0.063
		36	7,000	500	0.013	0.12	0.071	7,000	400	0.013	0.09	0.057

# HTNB Milling Conditions

WORK MATERIAL			COPPER / CARBON STEELS Cu / S45 / S50C					PREHARDENED STEELS / HARDENED STEELS NAK / SKD (30~45HRC)				
Model Number	Radius of Ball Nose (mm)	Neck Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth		Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth	
						Roughing (mm)	Finishing (mm)				Roughing (mm)	Finishing (mm)
2020	R1	10	19,000	3,300	0.110	0.2	0.174	12,000	2,100	0.100	0.2	0.175
		12	17,000	2,900	0.090	0.2	0.171	12,000	2,000	0.095	0.2	0.167
		16	15,000	2,350	0.081	0.2	0.157	11,000	1,700	0.065	0.2	0.155
		20	11,000	1,600	0.068	0.2	0.145	8,400	1,100	0.055	0.2	0.131
		22	11,000	1,600	0.063	0.2	0.145	8,400	1,050	0.050	0.2	0.125
		24	11,000	1,500	0.063	0.2	0.136	8,400	1,050	0.050	0.2	0.125
		26	10,000	1,350	0.063	0.2	0.135	7,350	900	0.050	0.2	0.122
		28	10,000	1,350	0.050	0.2	0.135	7,350	870	0.038	0.2	0.118
		30	10,000	1,350	0.050	0.2	0.135	7,350	870	0.038	0.2	0.118
		32	10,000	1,350	0.041	0.2	0.135	7,350	850	0.032	0.2	0.116
		34	10,000	1,350	0.041	0.2	0.135	7,000	800	0.032	0.2	0.114
		36	10,000	1,350	0.041	0.2	0.135	7,000	800	0.032	0.2	0.114
40	10,000	1,350	0.041	0.2	0.135	7,000	800	0.032	0.2	0.114		
2030	R1.5	20	11,000	2,350	0.095	0.3	0.214	8,400	1,500	0.075	0.3	0.179
		22	11,000	2,350	0.090	0.3	0.214	8,400	1,500	0.071	0.3	0.179
		26	10,000	2,050	0.085	0.3	0.205	7,600	1,300	0.068	0.3	0.171
		30	10,000	2,000	0.081	0.3	0.200	7,500	1,250	0.065	0.3	0.167
		32	10,000	1,900	0.081	0.3	0.190	7,500	1,200	0.065	0.3	0.160
		36	9,000	1,700	0.073	0.3	0.189	6,000	950	0.058	0.3	0.158
		40	8,500	1,600	0.065	0.3	0.188	6,000	950	0.053	0.3	0.158
		42	8,500	1,600	0.063	0.3	0.188	6,000	950	0.050	0.3	0.158
		48	8,500	1,570	0.052	0.3	0.185	6,000	920	0.042	0.3	0.153
		52	8,500	1,550	0.045	0.3	0.182	6,000	900	0.036	0.3	0.150
62	5,600	930	0.035	0.3	0.166	5,000	700	0.025	0.3	0.140		
2040	R2	20	8,400	1,900	0.125	0.4	0.226	5,400	1,030	0.096	0.4	0.191
		30	7,600	1,600	0.100	0.4	0.211	4,800	850	0.083	0.4	0.177
		36	6,900	1,400	0.094	0.4	0.203	3,900	650	0.074	0.4	0.167
		40	6,500	1,300	0.086	0.4	0.200	3,900	650	0.068	0.4	0.167
		41	6,500	1,300	0.086	0.4	0.200	3,900	650	0.068	0.4	0.167
		60	4,300	780	0.063	0.4	0.181	3,300	500	0.050	0.4	0.152
		62	4,300	750	0.063	0.4	0.174	3,300	480	0.050	0.4	0.145
Radial Depth (mm)	Roughing	$a_e \leq 0.1D$					$a_e \leq 0.1D$					
	Finishing	$a_e \leq V_f / n$										

a<sub>p</sub> : Axial Depth (mm)  
 a<sub>e</sub> : Radial Depth (mm)  
 D : Outside Diameter (mm)  
 n : Spindle Speed (min<sup>-1</sup>)  
 V<sub>f</sub> : Feed Rate (mm/min)



## HTNB Milling Conditions

WORK MATERIAL			HARDENED STEELS SKD / SKT (45~55HRC)					HARDENED STEELS SKD / SKS (55~65HRC)				
Model Number	Radius of Ball Nose (mm)	Neck Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth		Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth	
						Roughing (mm)	Finishing (mm)				Roughing (mm)	Finishing (mm)
2020	R1	10	12,000	1,800	0.074	0.16	0.150	12,000	1,350	0.064	0.12	0.113
		12	10,500	1,430	0.065	0.16	0.136	10,500	1,070	0.055	0.12	0.102
		16	10,500	1,360	0.056	0.16	0.130	10,500	1,070	0.046	0.12	0.102
		20	9,450	1,150	0.048	0.16	0.122	9,450	920	0.038	0.12	0.097
		22	9,450	1,150	0.043	0.16	0.122	9,450	920	0.036	0.12	0.097
		24	8,400	1,020	0.043	0.16	0.121	8,400	800	0.036	0.12	0.095
		26	8,400	1,020	0.043	0.16	0.121	8,400	800	0.036	0.12	0.095
		28	7,350	850	0.033	0.16	0.116	7,350	690	0.028	0.12	0.094
		30	7,350	850	0.033	0.16	0.116	7,350	690	0.028	0.12	0.094
		32	7,350	850	0.028	0.16	0.116	7,350	690	0.023	0.12	0.094
		34	6,500	745	0.028	0.16	0.115	6,500	610	0.023	0.12	0.094
		36	6,500	745	0.028	0.16	0.115	6,500	610	0.023	0.12	0.094
40	6,500	745	0.028	0.16	0.115	6,500	610	0.023	0.12	0.094		
2030	R1.5	20	8,000	1,400	0.065	0.24	0.175	8,000	1,200	0.053	0.18	0.150
		22	8,000	1,400	0.062	0.24	0.175	8,000	1,200	0.050	0.18	0.150
		26	7,500	1,200	0.060	0.24	0.160	7,500	1,050	0.048	0.18	0.140
		30	7,000	1,100	0.057	0.24	0.157	7,000	980	0.047	0.18	0.140
		32	7,000	1,100	0.056	0.24	0.157	7,000	950	0.046	0.18	0.136
		36	6,000	950	0.050	0.24	0.158	6,000	800	0.042	0.18	0.133
		40	5,500	850	0.045	0.24	0.155	5,500	750	0.038	0.18	0.136
		42	5,500	850	0.043	0.24	0.155	5,500	750	0.036	0.18	0.136
		48	5,500	820	0.035	0.24	0.149	5,500	720	0.030	0.18	0.131
		52	5,500	800	0.031	0.24	0.145	5,500	700	0.026	0.18	0.127
62	4,700	600	0.023	0.24	0.128	4,700	530	0.021	0.18	0.113		
2040	R2	20	5,200	980	0.085	0.32	0.188	5,200	840	0.066	0.24	0.162
		30	4,500	770	0.074	0.32	0.171	4,500	690	0.059	0.24	0.153
		36	3,900	670	0.065	0.32	0.172	3,900	560	0.052	0.24	0.144
		40	3,600	600	0.059	0.32	0.167	3,600	530	0.048	0.24	0.147
		41	3,600	600	0.059	0.32	0.167	3,600	530	0.048	0.24	0.147
		60	3,100	450	0.043	0.32	0.145	3,100	400	0.036	0.24	0.129
		62	3,100	420	0.043	0.32	0.135	3,100	380	0.036	0.24	0.123
Radial Depth (mm)		Roughing	$a_e \leq 0.08D$					$a_e \leq 0.06D$				
		Finishing	$a_e \leq V_f / n$									

### Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- The neck length and taper angle may affect the milling parameters. In operation, fine adjustments may be required.
- Recommend air blow or oil mist.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend water soluble or oil base coolant for Copper.



## Advisory for Safe Use of UNIMAX Tungsten Carbide 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.

Do not use flammable cutting oils.

### Advisory for regrinding UNIMAX Tungsten Carbide End Mills

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



#### U.S. HEADQUARTERS

1260 N. Fee Ana Street, Anaheim, CA 92807-1817

TEL: 714-521-6242 FAX: 714-521-8642

<http://www.usuniontool.com>

#### UPPER MIDWEST REGIONAL SERVICE CENTER

155 Bridgepoint Drive, South St. Paul, MN 55075

TEL: 651-552-0440 FAX: 651-552-0435

Prices & Specifications are subject to change without notice.



#### Single Source Technologies

2600 Superior Court  
Auburn Hills, MI 48326

(877) 228-2884

[SST.MillingTeam@singlesourcetech.com](mailto:SST.MillingTeam@singlesourcetech.com)

[www.singlesourcetech.com](http://www.singlesourcetech.com)