

## Tungsten Carbide End Mills UNIMAX Series



HARDMAX 2 Flutes Long Neck Ball End Mills

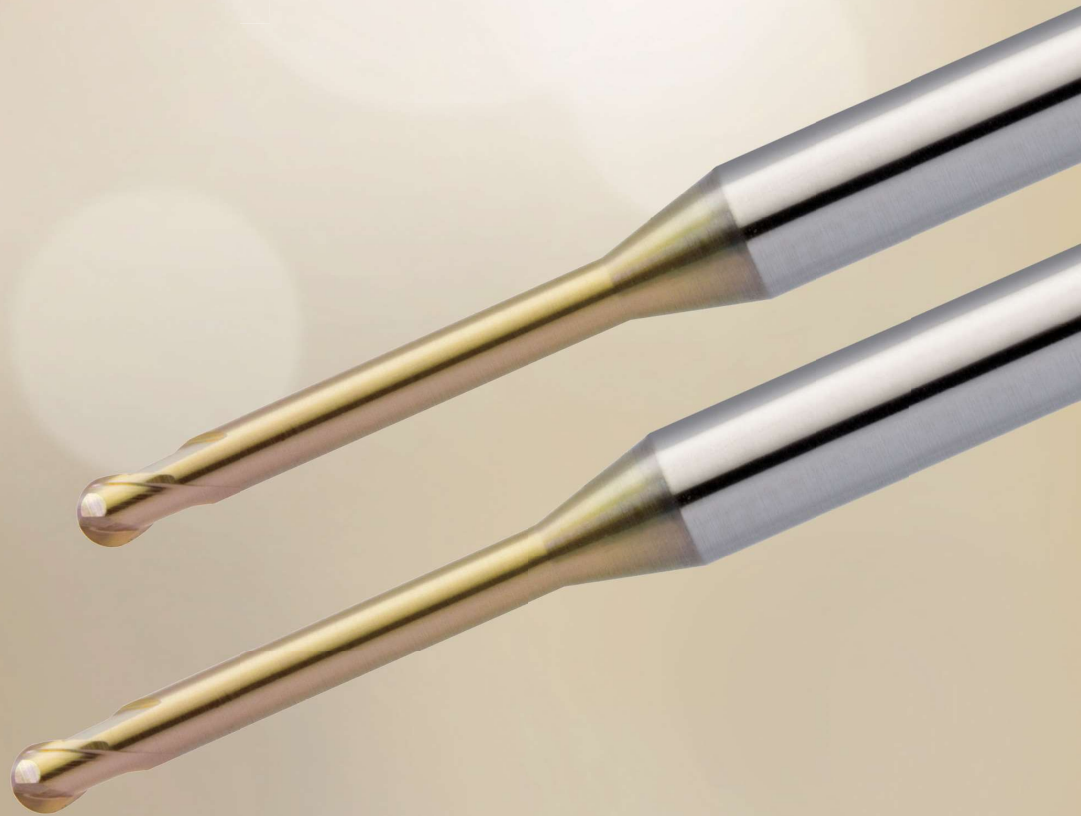
### HSLB

Total 325 Models

HARDMAX 2 Flutes Short Shank Long Neck Ball End Mills

### HSLB-S

Total 61 Models





Size **R0.05~R3**

**HSLB**

Super  
**MG**

**HARD  
MAX**

Shank Dia  
0/-0.005

Back Taper  
Geometry

Back taper geometry does not apply to R0.45 or below, and  $l_s / D \leq 10$ .

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**

**1 Variable rake angle design.**

Optimized rake angles are designed from the ball tip to the peripheral cutting edge.

**2 HARDMAX coating.**

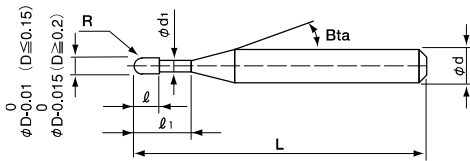
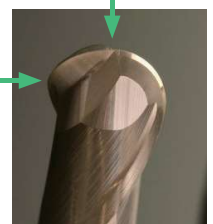
HARDMAX coating offers heat resistance, durability and lubricity at a high level.

**3 Suitable for various coolant types.**

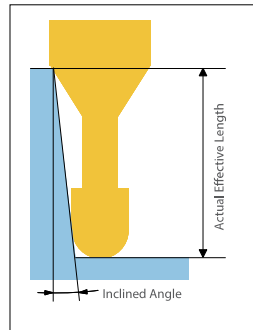
Every coolant offers stable milling.

Tip point : Negative

Peripheral cutting edge: Slightly negative



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.



Radius of Ball Nose	Diameter Tolerance	Ball Radius Accuracy	Helix Angle
R0.05 ~ R0.075	0/-0.01	±0.002	
R0.1 ~ R3	0/-0.015	±0.005	

How to find the best long neck ball series for your material applications

Series	Features	Ball tip design	Copper	Carbon Steels	40HRC	50HRC	55HRC	60HRC	65HRC	70HRC
<b>HGLB</b>	Especially for hard materials	Super negative				○	◎	◎	◎	◎
<b>HSLB HSLB-S</b>	For hard materials	Negative	○	○	◎	◎	◎	◎	◎	
<b>HLB</b>	Multi-purpose	Positive	◎	○	◎	◎	◎	○		
<b>CSELB</b>	Multi-purpose Excellent surface quality	Standard	◎	◎	◎	◎	○			

# HARDMAX 2 Flute Long Neck Ball End Mills

Total 325 models

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle $\beta$	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles								
									30°	1°	1°30'	2°	3°				
HSLB 2001-002	RO.05	0.2	0.08	0.095	11°	45	4	HSLB	0.21	0.23	0.25	0.27	0.31				
HSLB 2001-003		0.3				0.32	0.35	0.37	0.40	0.45							
HSLB 2001-005		0.5				0.54	0.57	0.61	0.64	0.72							
HSLB 20015-003	RO.075	0.3	0.12	0.135	11°	45	4	HSLB	0.36	0.38	0.40	0.42	0.47				
HSLB 20015-005		0.5				0.57	0.60	0.63	0.67	0.75							
HSLB 20015-010		1				1.10	1.15	1.21	1.27	1.43							
HSLB 2002-003	RO.1	0.3	0.16	0.19	16°	45	4	HSLB	0.39	0.42	0.44	0.46	0.50				
HSLB 2002-005		0.5				0.61	0.64	0.66	0.69	0.74							
HSLB 2002-005-6		0.5				50	6	HSLB	0.61	0.64	0.66	0.69	0.74				
HSLB 2002-0075		0.75				45	4	HSLB	0.87	0.91	0.95	0.98	1.05				
HSLB 2002-010		1				45	4	HSLB	1.13	1.18	1.22	1.26	1.35				
HSLB 2002-010-6		1				50	6	HSLB	1.13	1.18	1.22	1.26	1.35				
HSLB 2002-0125		1.25				45	4	HSLB	1.38	1.44	1.49	1.54	1.65				
HSLB 2002-015		1.5				45	4	HSLB	1.64	1.71	1.76	1.82	1.96				
HSLB 2002-015-6		1.5				50	6	HSLB	1.64	1.71	1.76	1.82	1.96				
HSLB 2002-0175		1.75				45	4	HSLB	1.90	1.97	2.04	2.11	2.26				
HSLB 2002-020		2				45	4	HSLB	2.16	2.24	2.31	2.39	2.57				
HSLB 2002-020-6		2				50	6	HSLB	2.16	2.24	2.31	2.39	2.57				
HSLB 2002-0225		2.25				45	4	HSLB	2.42	2.51	2.59	2.68	2.87				
HSLB 2002-025		2.5				45	4	HSLB	2.68	2.77	2.86	2.96	3.18				
HSLB 2002-030		3				45	4	HSLB	3.20	3.30	3.41	3.53	3.79				
HSLB 2003-005		RO.15				0.5	0.24	0.29	16°	45	4	HSLB	0.60	0.63	0.66	0.68	0.73
HSLB 2003-006						0.6				45	4	HSLB	0.71	0.74	0.77	0.80	0.85
HSLB 2003-0075						0.75				45	4	HSLB	0.87	0.91	0.94	0.97	1.04
HSLB 2003-010	1		45	4	HSLB	1.13				1.18	1.22	1.26	1.34				
HSLB 2003-010-6	1		50	6	HSLB	1.13				1.18	1.22	1.26	1.34				
HSLB 2003-0125	1.25		45	4	HSLB	1.38				1.43	1.48	1.53	1.64				
HSLB 2003-015	1.5		45	4	HSLB	1.64				1.70	1.76	1.82	1.94				
HSLB 2003-015-6	1.5		50	6	HSLB	1.64				1.70	1.76	1.82	1.94				
HSLB 2003-0175	1.75		45	4	HSLB	1.90				1.97	2.03	2.10	2.25				
HSLB 2003-020	2		45	4	HSLB	2.16				2.24	2.31	2.38	2.56				
HSLB 2003-020-6	2		50	6	HSLB	2.16				2.24	2.31	2.38	2.56				
HSLB 2003-0225	2.25		45	4	HSLB	2.42				2.50	2.58	2.67	2.86				
HSLB 2003-025	2.5		45	4	HSLB	2.68				2.77	2.86	2.95	3.17				
HSLB 2003-030	3		45	4	HSLB	3.20				3.30	3.41	3.52	3.78				
HSLB 2003-040	4		45	4	HSLB	4.23				4.37	4.51	4.66	5.00				
HSLB 2003-050	5		45	4	HSLB	5.26				5.43	5.61	5.80	6.23				
HSLB 2004-005	RO.2	0.5	0.32	0.39	16°	45	4	HSLB	0.60	0.63	0.65	0.68	0.72				
HSLB 2004-0075		0.75				45	4	HSLB	0.86	0.90	0.93	0.96	1.03				
HSLB 2004-010		1				45	4	HSLB	1.13	1.17	1.21	1.25	1.33				
HSLB 2004-010-6		1				50	6	HSLB	1.13	1.17	1.21	1.25	1.33				
HSLB 2004-0125		1.25				45	4	HSLB	1.37	1.43	1.48	1.52	1.63				
HSLB 2004-015		1.5				45	4	HSLB	1.64	1.70	1.75	1.81	1.93				
HSLB 2004-015-6		1.5				50	6	HSLB	1.64	1.70	1.75	1.81	1.93				
HSLB 2004-0175		1.75				45	4	HSLB	1.90	1.97	2.03	2.09	2.24				
HSLB 2004-020		2				45	4	HSLB	2.16	2.23	2.30	2.38	2.55				
HSLB 2004-020-6		2				50	6	HSLB	2.16	2.23	2.30	2.38	2.55				
HSLB 2004-0225	2.25	45	4	HSLB	2.42	2.50	2.58	2.66	2.85								

## HARDMAX 2 Flute Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2004-025	R0.2	2.5	0.32	0.39	16°	45	4	HSLB	2.68	2.76	2.85	2.95	3.16
HSLB 2004-025-6		2.5				50	6	HSLB	2.68	2.76	2.85	2.95	3.16
HSLB 2004-030		3				45	4	HSLB	3.20	3.30	3.40	3.52	3.77
HSLB 2004-030-6		3				50	6	HSLB	3.20	3.30	3.40	3.52	3.77
HSLB 2004-035		3.5				45	4	HSLB	3.71	3.83	3.95	4.09	4.38
HSLB 2004-040		4				45	4	HSLB	4.23	4.36	4.50	4.66	4.99
HSLB 2004-040-6		4				50	6	HSLB	4.23	4.36	4.50	4.66	4.99
HSLB 2004-045		4.5				45	4	HSLB	4.74	4.89	5.05	5.22	5.61
HSLB 2004-050		5				45	4	HSLB	5.26	5.43	5.60	5.79	6.22
HSLB 2004-060		6				45	4	HSLB	6.29	6.49	6.70	6.93	7.44
HSLB 2005-010	R0.25	1	0.4	0.49	16°	45	4	HSLB	1.12	1.17	1.21	1.24	1.32
HSLB 2005-0125		1.25				45	4	HSLB	1.37	1.43	1.47	1.52	1.62
HSLB 2005-015		1.5				45	4	HSLB	1.63	1.70	1.75	1.80	1.92
HSLB 2005-015-6		1.5				50	6	HSLB	1.63	1.70	1.75	1.80	1.92
HSLB 2005-0175		1.75				45	4	HSLB	1.90	1.96	2.02	2.09	2.23
HSLB 2005-020		2				45	4	HSLB	2.16	2.23	2.30	2.37	2.54
HSLB 2005-020-6		2				50	6	HSLB	2.16	2.23	2.30	2.37	2.54
HSLB 2005-0225		2.25				45	4	HSLB	2.42	2.50	2.57	2.66	2.84
HSLB 2005-025		2.5				45	4	HSLB	2.68	2.76	2.85	2.94	3.15
HSLB 2005-025-6		2.5				50	6	HSLB	2.68	2.76	2.85	2.94	3.15
HSLB 2005-030		3				45	4	HSLB	3.20	3.29	3.40	3.51	3.76
HSLB 2005-030-6		3				50	6	HSLB	3.20	3.29	3.40	3.51	3.76
HSLB 2005-035		3.5				45	4	HSLB	3.71	3.83	3.95	4.08	4.37
HSLB 2005-040		4				45	4	HSLB	4.23	4.36	4.50	4.65	4.98
HSLB 2005-040-6		4				50	6	HSLB	4.23	4.36	4.50	4.65	4.98
HSLB 2005-045		4.5				45	4	HSLB	4.74	4.89	5.05	5.22	5.59
HSLB 2005-050		5				45	4	HSLB	5.26	5.42	5.60	5.79	6.21
HSLB 2005-055		5.5				45	4	HSLB	5.77	5.96	6.15	6.36	6.82
HSLB 2005-060		6				45	4	HSLB	6.29	6.49	6.70	6.93	7.43
HSLB 2005-070		7				45	4	HSLB	7.32	7.55	7.80	8.06	8.65
HSLB 2005-080	8	45	4	HSLB	8.35	8.62	8.90	9.20	9.88				
HSLB 2005-090	9	45	4	HSLB	9.38	9.68	10.00	10.34	11.10				
HSLB 2005-100	10	50	4	HSLB	10.42	10.75	11.10	11.48	12.32				
HSLB 2006-010	R0.3	1	0.48	0.59	16°	45	4	HSLB	1.12	1.16	1.20	1.24	1.31
HSLB 2006-0125		1.25				45	4	HSLB	1.37	1.42	1.47	1.51	1.61
HSLB 2006-015		1.5				45	4	HSLB	1.63	1.69	1.74	1.80	1.91
HSLB 2006-015-6		1.5				50	6	HSLB	1.63	1.69	1.74	1.80	1.91
HSLB 2006-0175		1.75				45	4	HSLB	1.89	1.96	2.02	2.08	2.22
HSLB 2006-020		2				45	4	HSLB	2.15	2.23	2.29	2.36	2.52
HSLB 2006-020-6		2				50	6	HSLB	2.15	2.23	2.29	2.36	2.52
HSLB 2006-0225		2.25				45	4	HSLB	2.42	2.49	2.57	2.65	2.83
HSLB 2006-025		2.5				45	4	HSLB	2.67	2.76	2.84	2.93	3.14
HSLB 2006-025-6		2.5				50	6	HSLB	2.67	2.76	2.84	2.93	3.14
HSLB 2006-030		3				45	4	HSLB	3.19	3.29	3.39	3.50	3.75
HSLB 2006-030-6		3				50	6	HSLB	3.19	3.29	3.39	3.50	3.75
HSLB 2006-035		3.5				45	4	HSLB	3.71	3.82	3.94	4.07	4.36
HSLB 2006-040		4				45	4	HSLB	4.23	4.36	4.49	4.64	4.97
HSLB 2006-040-6		4				50	6	HSLB	4.23	4.36	4.49	4.64	4.97
HSLB 2006-045		4.5				45	4	HSLB	4.74	4.89	5.04	5.21	5.58

## HARDMAX 2 Flute Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle $\beta$	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2006-050	RO.3	5	0.48	0.59	16°	45	4	HSLB	5.26	5.42	5.59	5.78	6.20
HSLB 2006-050-6		5				50	6	HSLB	5.26	5.42	5.59	5.78	6.20
HSLB 2006-055		5.5				45	4	HSLB	5.77	5.95	6.14	6.35	6.81
HSLB 2006-060		6				45	4	HSLB	6.29	6.49	6.69	6.92	7.42
HSLB 2006-060-6		6				50	6	HSLB	6.29	6.49	6.69	6.92	7.42
HSLB 2006-065		6.5				45	4	HSLB	6.80	7.02	7.25	7.49	8.03
HSLB 2006-070		7				45	4	HSLB	7.32	7.55	7.80	8.06	8.64
HSLB 2006-080		8				45	4	HSLB	8.35	8.61	8.90	9.20	9.87
HSLB 2006-080-6		8				50	6	HSLB	8.35	8.61	8.90	9.20	9.87
HSLB 2006-090		9				45	4	HSLB	9.38	9.68	10.00	10.34	11.09
HSLB 2006-100		10				50	4	HSLB	10.41	10.74	11.10	11.47	12.31
HSLB 2006-100-6		10				50	6	HSLB	10.41	10.74	11.10	11.47	12.31
HSLB 2006-120		12				50	4	HSLB	12.48	12.87	13.30	13.75	14.76
HSLB 2007-020		RO.35				2	0.56	0.69	16°	45	4	HSLB	2.15
HSLB 2007-040	4		45	4	HSLB	4.22				4.35	4.49	4.63	4.96
HSLB 2007-060	6		45	4	HSLB	6.29				6.48	6.69	6.91	7.41
HSLB 2007-080	8		45	4	HSLB	8.35				8.61	8.89	9.19	9.86
HSLB 2008-020	RO.4	2	0.64	0.79	16°	45	4	HSLB	2.15	2.22	2.28	2.35	2.50
HSLB 2008-020-6		2				50	6	HSLB	2.15	2.22	2.28	2.35	2.50
HSLB 2008-030		3				45	4	HSLB	3.19	3.28	3.38	3.49	3.73
HSLB 2008-030-6		3				50	6	HSLB	3.19	3.28	3.38	3.49	3.73
HSLB 2008-040		4				45	4	HSLB	4.22	4.35	4.48	4.63	4.95
HSLB 2008-040-6		4				50	6	HSLB	4.22	4.35	4.48	4.63	4.95
HSLB 2008-050		5				45	4	HSLB	5.25	5.41	5.58	5.77	6.17
HSLB 2008-060		6				45	4	HSLB	6.29	6.48	6.68	6.91	7.40
HSLB 2008-060-6		6				50	6	HSLB	6.29	6.48	6.68	6.91	7.40
HSLB 2008-070		7				45	4	HSLB	7.32	7.54	7.79	8.04	8.62
HSLB 2008-080		8				45	4	HSLB	8.35	8.61	8.89	9.18	9.84
HSLB 2008-080-6		8				50	6	HSLB	8.35	8.61	8.89	9.18	9.84
HSLB 2008-090		9				45	4	HSLB	9.38	9.67	9.99	10.32	11.07
HSLB 2008-100		10				50	4	HSLB	10.41	10.74	11.09	11.46	12.29
HSLB 2008-100-6		10				50	6	HSLB	10.41	10.74	11.09	11.46	12.29
HSLB 2008-120		12				50	4	HSLB	12.47	12.87	13.29	13.74	14.74
HSLB 2008-160		16				50	4	HSLB	16.60	17.13	17.69	18.29	19.63
HSLB 2009-020		RO.45				2	0.72	0.89	16°	45	4	HSLB	2.15
HSLB 2009-040	4		45	4	HSLB	4.22				4.35	4.48	4.62	4.94
HSLB 2009-060	6		45	4	HSLB	6.28				6.48	6.68	6.90	7.39
HSLB 2009-080	8		45	4	HSLB	8.35				8.61	8.88	9.18	9.83
HSLB 2009-100	10		45	4	HSLB	10.41				10.73	11.08	11.45	12.28
HSLB 2009-120	12		50	4	HSLB	12.47				12.86	13.28	13.73	14.73
HSLB 2009-140	14		50	4	HSLB	14.54				14.99	15.48	16.01	17.18
HSLB 2009-160	16		50	4	HSLB	16.60				17.12	17.68	18.29	19.62
HSLB 2009-180	18	55	4	HSLB	18.66	19.25	19.89	20.56	22.07				
HSLB 2010-020	RO.5	2	0.8	0.98	16°	45	4	HSLB	2.16	2.22	2.28	2.35	2.49
HSLB 2010-025		2.5				45	4	HSLB	2.68	2.76	2.83	2.92	3.11
HSLB 2010-030		3				45	4	HSLB	3.20	3.29	3.38	3.49	3.72
HSLB 2010-030-6		3				50	6	HSLB	3.20	3.29	3.38	3.49	3.72
HSLB 2010-040		4				45	4	HSLB	4.23	4.35	4.49	4.63	4.94
HSLB 2010-040-6		4				50	6	HSLB	4.23	4.35	4.49	4.63	4.94

## HARDMAX 2 Flute Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle $\beta$	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2010-050	R0.5	5	0.8	0.98	16°	45	4	HSLB	5.26	5.42	5.59	5.77	6.16
HSLB 2010-050-6		5				50	6	HSLB	5.26	5.42	5.59	5.77	6.16
HSLB 2010-060		6				45	4	HSLB	6.29	6.48	6.69	6.90	7.39
HSLB 2010-060-6		6				50	6	HSLB	6.29	6.48	6.69	6.90	7.39
HSLB 2010-070		7				45	4	HSLB	7.32	7.55	7.79	8.04	8.61
HSLB 2010-070-6		7				50	6	HSLB	7.32	7.55	7.79	8.04	8.61
HSLB 2010-080		8				45	4	HSLB	8.36	8.61	8.89	9.18	9.84
HSLB 2010-080-6		8				50	6	HSLB	8.36	8.61	8.89	9.18	9.84
HSLB 2010-090		9				45	4	HSLB	9.39	9.68	9.99	10.32	11.06
HSLB 2010-100		10				45	4	HSLB	10.42	10.74	11.09	11.46	12.28
HSLB 2010-100-6		10				50	6	HSLB	10.42	10.74	11.09	11.46	12.28
HSLB 2010-120		12				45	4	HSLB	12.48	12.87	13.29	13.74	14.73
HSLB 2010-120-6		12				50	6	HSLB	12.48	12.87	13.29	13.74	14.73
HSLB 2010-140		14				50	4	HSLB	14.54	15.00	15.49	16.01	17.18
HSLB 2010-140-6		14				60	6	HSLB	14.54	15.00	15.49	16.01	17.18
HSLB 2010-160		16				50	4	HSLB	16.61	17.13	17.69	18.29	19.62
HSLB 2010-160-6		16				60	6	HSLB	16.61	17.13	17.69	18.29	19.62
HSLB 2010-180		18				55	4	HSLB	18.67	19.26	19.89	20.57	22.07
HSLB 2010-200		20				55	4	HSLB	20.73	21.39	22.09	22.85	24.52
HSLB 2010-200-6		20				70	6	HSLB	20.73	21.39	22.09	22.85	24.52
HSLB 2010-220-6		22				70	6	HSLB	22.80	23.52	24.29	25.12	26.97
HSLB 2012-025		R0.6				2.5	0.96	1.19	16°	45	4	HSLB	2.54
HSLB 2012-040	4		45	4	HSLB	4.08				4.20	4.32	4.45	4.75
HSLB 2012-060	6		45	4	HSLB	6.15				6.33	6.52	6.73	7.19
HSLB 2012-060-6	6		50	6	HSLB	6.15				6.33	6.52	6.73	7.19
HSLB 2012-080	8		45	4	HSLB	8.21				8.46	8.72	9.01	9.64
HSLB 2012-080-6	8		50	6	HSLB	8.21				8.46	8.72	9.01	9.64
HSLB 2012-100	10		45	4	HSLB	10.27				10.59	10.92	11.28	12.09
HSLB 2012-100-6	10		50	6	HSLB	10.27				10.59	10.92	11.28	12.09
HSLB 2012-120	12		45	4	HSLB	12.33				12.72	13.12	13.56	14.54
HSLB 2012-120-6	12		50	6	HSLB	12.33				12.72	13.12	13.56	14.54
HSLB 2012-140	14		50	4	HSLB	14.40				14.85	15.33	15.84	16.98
HSLB 2012-160	16		50	4	HSLB	16.46				16.98	17.53	18.12	19.43
HSLB 2012-160-6	16		60	6	HSLB	16.46				16.98	17.53	18.12	19.43
HSLB 2012-180	18		55	4	HSLB	18.52				19.11	19.73	20.39	21.88
HSLB 2012-200	20		60	4	HSLB	20.58				21.23	21.93	22.67	24.33
HSLB 2014-060	R0.7		6	1.12	1.37	16°				45	4	HSLB	6.18
HSLB 2014-080		8	45				4	HSLB	8.24	8.49	8.75	9.03	9.66
HSLB 2014-120		12	45				4	HSLB	12.37	12.75	13.15	13.59	14.56
HSLB 2014-160		16	50				4	HSLB	16.49	17.01	17.56	18.14	19.45
HSLB 2015-030	R0.75	3	1.2	1.47	16°	45	4	HSLB	3.08	3.16	3.24	3.33	3.53
HSLB 2015-040		4				45	4	HSLB	4.11	4.23	4.34	4.47	4.76
HSLB 2015-060		6				45	4	HSLB	6.18	6.35	6.55	6.75	7.20
HSLB 2015-060-6		6				50	6	HSLB	6.18	6.35	6.55	6.75	7.20
HSLB 2015-080		8				45	4	HSLB	8.24	8.48	8.75	9.03	9.65
HSLB 2015-080-6		8				50	6	HSLB	8.24	8.48	8.75	9.03	9.65
HSLB 2015-100		10				45	4	HSLB	10.30	10.61	10.95	11.30	12.10
HSLB 2015-100-6		10				50	6	HSLB	10.30	10.61	10.95	11.30	12.10
HSLB 2015-120	12	45	4	HSLB	12.37	12.74	13.15	13.58	14.55				

## HARDMAX 2 Flute Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2015-120-6	R0.75	12	1.2	1.47	16°	50	6	HSLB	12.37	12.74	13.15	13.58	14.55
HSLB 2015-140		14				50	4	HSLB	14.43	14.87	15.35	15.86	16.99
HSLB 2015-160		16				50	4	HSLB	16.49	17.00	17.55	18.14	19.44
HSLB 2015-160-6		16				60	6	HSLB	16.49	17.00	17.55	18.14	19.44
HSLB 2015-180		18				55	4	HSLB	18.55	19.13	19.75	20.41	21.89
HSLB 2015-200		20				55	4	HSLB	20.62	21.26	21.95	22.69	24.34
HSLB 2015-200-6		20				60	6	HSLB	20.62	21.26	21.95	22.69	24.34
HSLB 2015-220		22				55	4	HSLB	22.68	23.39	24.15	24.97	No Interference
HSLB 2015-250		25				65	4	HSLB	25.77	26.59	27.45	28.38	No Interference
HSLB 2015-300		30				70	4	HSLB	30.93	31.91	32.96	34.08	No Interference
HSLB 2016-040	R0.8	4	1.28	1.58	16°	45	4	HSLB	4.09	4.20	4.32	4.45	4.72
HSLB 2016-080		8				45	4	HSLB	8.22	8.46	8.72	9.00	9.62
HSLB 2016-120		12				45	4	HSLB	12.35	12.72	13.12	13.55	14.51
HSLB 2016-160		16				50	4	HSLB	16.47	16.98	17.53	18.11	19.41
HSLB 2016-200		20				55	4	HSLB	20.60	21.24	21.93	22.66	No Interference
HSLB 2018-040	R0.9	4	1.44	1.78	16°	45	4	HSLB	4.09	4.20	4.31	4.43	4.70
HSLB 2018-060		6				45	4	HSLB	6.15	6.33	6.51	6.71	7.15
HSLB 2018-080		8				45	4	HSLB	8.22	8.46	8.71	8.99	9.60
HSLB 2018-100		10				45	4	HSLB	10.28	10.59	10.91	11.26	12.04
HSLB 2018-120		12				45	4	HSLB	12.34	12.72	13.11	13.54	14.49
HSLB 2018-160		16				50	4	HSLB	16.47	16.97	17.52	18.10	19.39
HSLB 2018-180		18				55	4	HSLB	18.53	19.10	19.72	20.37	21.83
HSLB 2018-200		20				55	4	HSLB	20.59	21.23	21.92	22.65	No Interference
HSLB 2018-220		22				60	4	HSLB	22.66	23.36	24.12	24.93	No Interference
HSLB 2018-250		25				65	4	HSLB	25.75	26.56	27.42	28.34	No Interference
HSLB 2018-300	30	70	4	HSLB	30.91	31.88	32.92	No Interference	No Interference				
HSLB 2020-030	R1	3	1.6	1.98	16°	45	4	HSLB	3.06	3.13	3.20	3.28	3.46
HSLB 2020-040		4				45	4	HSLB	4.09	4.19	4.30	4.42	4.68
HSLB 2020-040-6		4				50	6	HSLB	4.09	4.19	4.30	4.42	4.68
HSLB 2020-060		6				45	4	HSLB	6.15	6.32	6.50	6.70	7.13
HSLB 2020-060-6		6				50	6	HSLB	6.15	6.32	6.50	6.70	7.13
HSLB 2020-080		8				45	4	HSLB	8.21	8.45	8.70	8.97	9.58
HSLB 2020-080-6		8				50	6	HSLB	8.21	8.45	8.70	8.97	9.58
HSLB 2020-100		10				45	4	HSLB	10.28	10.58	10.90	11.25	12.02
HSLB 2020-100-6		10				50	6	HSLB	10.28	10.58	10.90	11.25	12.02
HSLB 2020-120		12				45	4	HSLB	12.34	12.71	13.10	13.53	14.47
HSLB 2020-120-6		12				50	6	HSLB	12.34	12.71	13.10	13.53	14.47
HSLB 2020-130		13				45	4	HSLB	13.37	13.77	14.20	14.67	15.69
HSLB 2020-140		14				50	4	HSLB	14.40	14.84	15.31	15.80	16.92
HSLB 2020-160		16				50	4	HSLB	16.46	16.97	17.51	18.08	19.36
HSLB 2020-160-6		16				60	6	HSLB	16.46	16.97	17.51	18.08	19.36
HSLB 2020-180		18				55	4	HSLB	18.53	19.10	19.71	20.36	No Interference
HSLB 2020-200		20				55	4	HSLB	20.59	21.23	21.91	22.64	No Interference
HSLB 2020-200-6		20				70	6	HSLB	20.59	21.23	21.91	22.64	24.26
HSLB 2020-220		22				60	4	HSLB	22.65	23.36	24.11	24.91	No Interference
HSLB 2020-250		25				65	4	HSLB	25.75	26.55	27.41	28.33	No Interference
HSLB 2020-250-6	25	80	6	HSLB	25.75	26.55	27.41	28.33	30.38				
HSLB 2020-270	27	65	4	HSLB	27.81	28.68	29.61	No Interference	No Interference				
HSLB 2020-300	30	70	4	HSLB	30.90	31.88	32.91	No Interference	No Interference				

**HARDMAX 2 Flute Long Neck Ball End Mills**

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2020-300-6	R1	30	1.6	1.98	16°	80	6	HSLB	30.90	31.88	32.91	34.02	36.50
HSLB 2020-320		32				70	4	HSLB	32.97	34.01	35.11	No Interference	No Interference
HSLB 2020-350		35				80	4	HSLB	36.06	37.20	38.42	No Interference	No Interference
HSLB 2020-350-6		35				80	6	HSLB	36.06	37.20	38.42	39.72	No Interference
HSLB 2020-400		40				80	4	HSLB	41.22	42.52	No Interference	No Interference	No Interference
HSLB 2020-400-6		40				90	6	HSLB	41.22	42.52	43.92	45.41	No Interference
HSLB 2025-060	R1.25	6	2	2.45	16°	45	4	HSLB	6.20	6.36	6.53	6.72	7.14
HSLB 2025-080		8				45	4	HSLB	8.26	8.49	8.74	9.00	9.59
HSLB 2025-100		10				45	4	HSLB	10.32	10.62	10.94	11.28	12.03
HSLB 2025-150		15				50	4	HSLB	15.48	15.94	16.44	16.97	No Interference
HSLB 2025-200		20				55	4	HSLB	20.64	21.27	21.94	22.66	No Interference
HSLB 2025-250		25				65	4	HSLB	25.79	26.59	27.44	No Interference	No Interference
HSLB 2025-300		30				70	4	HSLB	30.95	31.92	No Interference	No Interference	No Interference
HSLB 2025-350	35	70	4	HSLB	36.11	37.24	No Interference	No Interference	No Interference				
HSLB 2030-060	R1.5	6	2.4	2.95	16°	60	6	HSLB	6.19	6.34	6.51	6.68	7.08
HSLB 2030-060-3		6			—	60	3	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2030-060-4		6			60	4	HSLB	6.19	6.34	6.51	6.68	7.08	
HSLB 2030-080		8			60	6	HSLB	8.25	8.47	8.71	8.96	9.53	
HSLB 2030-100		10			60	6	HSLB	10.31	10.60	10.91	11.24	11.98	
HSLB 2030-120		12			60	6	HSLB	12.38	12.73	13.11	13.52	14.42	
HSLB 2030-140		14			60	6	HSLB	14.44	14.86	15.31	15.79	16.87	
HSLB 2030-150		15			60	6	HSLB	15.47	15.93	16.41	16.93	18.09	
HSLB 2030-160		16			60	6	HSLB	16.50	16.99	17.51	18.07	19.32	
HSLB 2030-180		18			60	6	HSLB	18.56	19.12	19.71	20.35	21.77	
HSLB 2030-200		20			70	6	HSLB	20.63	21.25	21.91	22.63	24.21	
HSLB 2030-220		22			70	6	HSLB	22.69	23.38	24.12	24.90	26.66	
HSLB 2030-250		25			70	6	HSLB	25.78	26.57	27.42	28.32	30.33	
HSLB 2030-270		27			70	6	HSLB	27.85	28.70	29.62	30.60	No Interference	
HSLB 2030-300		30			70	6	HSLB	30.94	31.90	32.92	34.01	No Interference	
HSLB 2030-320		32			80	6	HSLB	33.00	34.03	35.12	36.29	No Interference	
HSLB 2030-350		35			80	6	HSLB	36.10	37.22	38.42	39.71	No Interference	
HSLB 2030-400		40			80	6	HSLB	41.25	42.55	43.92	No Interference	No Interference	
HSLB 2035-100		R1.75			10	2.8	3.45	16°	60	6	HSLB	10.31	10.59
HSLB 2035-150	15		60	6	HSLB				15.46	15.91	16.39	16.90	18.04
HSLB 2035-200	20		65	6	HSLB				20.62	21.23	21.89	22.59	24.16
HSLB 2035-250	25		70	6	HSLB				25.78	26.56	27.39	28.29	No Interference
HSLB 2035-300	30		70	6	HSLB				30.93	31.88	32.89	33.98	No Interference
HSLB 2035-400	40		90	6	HSLB				41.25	42.53	43.90	No Interference	No Interference
HSLB 2035-450	45	90	6	HSLB	46.40	47.85	49.40	No Interference	No Interference				
HSLB 2040-080	R2	8	3.2	3.95	16°	70	6	HSLB	8.23	8.44	8.66	8.89	9.42
HSLB 2040-080-4		8			—	70	4	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2040-100		10			70	6	HSLB	10.30	10.57	10.86	11.17	11.87	
HSLB 2040-120		12			70	6	HSLB	12.36	12.70	13.06	13.45	14.31	
HSLB 2040-140		14			70	6	HSLB	14.42	14.83	15.26	15.73	16.76	
HSLB 2040-150		15			70	6	HSLB	15.45	15.89	16.36	16.86	17.99	
HSLB 2040-160		16			70	6	HSLB	16.49	16.96	17.46	18.00	19.21	
HSLB 2040-180		18			70	6	HSLB	18.55	19.09	19.66	20.28	No Interference	
HSLB 2040-200		20			70	6	HSLB	20.61	21.22	21.86	22.56	No Interference	
HSLB 2040-220		22			70	6	HSLB	22.67	23.35	24.07	24.84	No Interference	



## HARDMAX 2 Flute Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Series	Effective Length by Inclined Angles				
									30°	1°	1°30'	2°	3°
HSLB 2040-250	R2	25	3.2	3.95	16°	70	6	HSLB	25.77	26.54	27.37	28.25	No Interference
HSLB 2040-270		27				70	6	HSLB	27.83	28.67	29.57	30.53	No Interference
HSLB 2040-300		30				70	6	HSLB	30.93	31.87	32.87	No Interference	No Interference
HSLB 2040-320		32				80	6	HSLB	32.99	34.00	35.07	No Interference	No Interference
HSLB 2040-350		35				80	6	HSLB	36.08	37.19	38.37	No Interference	No Interference
HSLB 2040-400		40				90	6	HSLB	41.24	42.51	No Interference	No Interference	No Interference
HSLB 2040-450		45				90	6	HSLB	46.40	47.84	No Interference	No Interference	No Interference
HSLB 2040-500		50				100	6	HSLB	51.55	53.16	No Interference	No Interference	No Interference
HSLB 2040-600		60				120	6	HSLB	61.87	No Interference	No Interference	No Interference	No Interference
HSLB 2050-100		R2.5				10	4	4.95	16°	70	6	HSLB	10.28
HSLB 2050-150	15		70	6	HSLB	15.44				15.86	16.31	16.80	No Interference
HSLB 2050-200	20		70	6	HSLB	20.60				21.19	21.82	No Interference	No Interference
HSLB 2050-250	25		70	6	HSLB	25.75				26.51	No Interference	No Interference	No Interference
HSLB 2050-300	30		80	6	HSLB	30.91				31.83	No Interference	No Interference	No Interference
HSLB 2050-350	35		80	6	HSLB	36.07				No Interference	No Interference	No Interference	No Interference
HSLB 2050-400	40		90	6	HSLB	41.22				No Interference	No Interference	No Interference	No Interference
HSLB 2050-450	45		100	6	HSLB	46.38				No Interference	No Interference	No Interference	No Interference
HSLB 2050-500	50		100	6	HSLB	51.54				No Interference	No Interference	No Interference	No Interference
HSLB 2060-100	R3		10	4.8	5.95	—				80	6	HSLB	No Interference
HSLB 2060-150		15	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-180		18	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-200		20	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-220		22	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-250		25	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-270		27	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-300		30	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-320		32	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-350		35	80				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-400		40	90				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-450		45	100				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-500		50	120				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-600		60	120				6	HSLB	No Interference	No Interference	No Interference	No Interference	No Interference



Size **R0.1~R3**

Short Shank Series

**HSLB-S**



Back taper geometry does not apply to R0.4 or below, and  $l_1 / D \leq 10$ .

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										
○	○	○	○	○	○	○			○			○	○		

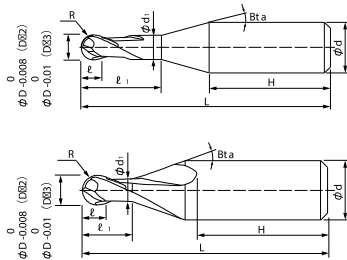
**Features**

**1 Short shank for high accuracy shrink-fit holder.**

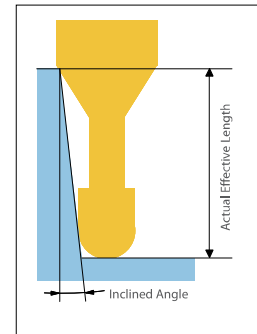
**2 Variable rake angle design.**  
Optimized rake angles are designed from the ball tip to the peripheral cutting edge.

**3 HARDMAX coating.**  
HARDMAX coating offers heat resistance, durability and lubricity at a high level.

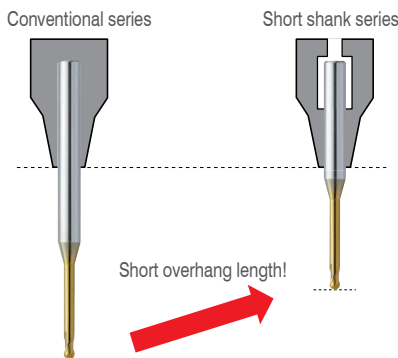
**4 Suitable for various coolant types.**  
Every coolant offers stable milling.



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.



Short overhang length with short shank length!



Short overhang length minimizes tool run-out :

1. High precision milling
2. Minimizes vibration and chattering
3. Longer tool life

Ideal for tool holders where the maximum insertion is short.

Tighter Tolerance Design! Diameter Tolerance, Ball Radius Accuracy, and Shank Diameter Tolerance

**HSB / HSLB Tolerance**

Radius of Ball Nose	Diameter Tolerance	Ball Radius Accuracy	Shank Diameter Tolerance
R0.1 ~ R3	0/-0.015	±0.005	0/-0.005 (h5)

**HSB-S / HSLB-S Tolerance**

Radius of Ball Nose	Diameter Tolerance	Ball Radius Accuracy	Shank Diameter Tolerance
R0.1 ~ R1	<b>0/-0.008</b>	±0.003	<b>0/-0.004 (h4)</b>
R1.5 ~ R2	<b>0/-0.01</b>		
R3		±0.005	

Shank diameter tolerance h4!

# HARDMAX 2 Flute Short Shank Long Neck Ball End Mills

Total 61 models

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Shank Length H	Series	Effective Length by Inclined Angles				
										30°	1°	1°30'	2°	3°
HSLB 2002-005S	RO.1	0,5	0.16	0.19	16°	35	4	26.0	HSLB-S	0.63	0.66	0.68	0.71	0.76
HSLB 2002-010S		1				35	4	25.5	HSLB-S	1.15	1.20	1.24	1.28	1.37
HSLB 2003-005S	RO.15	0.5	0.24	0.29	16°	35	4	26.0	HSLB-S	0.63	0.65	0.68	0.70	0.75
HSLB 2003-0075S		0.75				35	4	26.0	HSLB-S	0.89	0.92	0.96	0.99	1.05
HSLB 2003-010S		1				35	4	25.5	HSLB-S	1.15	1.19	1.23	1.27	1.36
HSLB 2003-015S		1.5				35	4	25.0	HSLB-S	1.66	1.72	1.77	1.83	1.96
HSLB 2004-005S	RO.2	0.5	0.32	0.39	16°	35	4	26.5	HSLB-S	0.63	0.65	0.67	0.70	0.74
HSLB 2004-010S		1				35	4	26.0	HSLB-S	1.15	1.19	1.23	1.26	1.35
HSLB 2004-015S		1.5				35	4	25.5	HSLB-S	1.66	1.71	1.77	1.82	1.95
HSLB 2004-020S		2				35	4	25.0	HSLB-S	2.18	2.25	2.32	2.39	2.56
HSLB 2004-025S		2.5				35	4	24.5	HSLB-S	2.70	2.78	2.87	2.96	3.17
HSLB 2004-030S		3				35	4	24.0	HSLB-S	3.21	3.31	3.42	3.53	3.79
HSLB 2005-010S	RO.25	1	0.4	0.49	16°	35	4	26.0	HSLB-S	1.15	1.19	1.22	1.26	1.34
HSLB 2005-015S		1.5				35	4	25.5	HSLB-S	1.65	1.71	1.76	1.82	1.94
HSLB 2005-020S		2				35	4	25.0	HSLB-S	2.18	2.24	2.31	2.39	2.55
HSLB 2005-025S		2.5				35	4	24.5	HSLB-S	2.69	2.78	2.86	2.96	3.16
HSLB 2005-030S		3				35	4	24.0	HSLB-S	3.21	3.31	3.41	3.53	3.77
HSLB 2006-010S	RO.3	1	0.48	0.59	16°	35	4	26.0	HSLB-S	1.14	1.18	1.22	1.25	1.33
HSLB 2006-015S		1.5				35	4	25.5	HSLB-S	1.65	1.71	1.76	1.81	1.93
HSLB 2006-020S		2				35	4	25.0	HSLB-S	2.17	2.24	2.31	2.38	2.54
HSLB 2006-030S		3				35	4	24.0	HSLB-S	3.21	3.31	3.41	3.52	3.76
HSLB 2006-040S		4				40	4	28.0	HSLB-S	4.24	4.37	4.51	4.66	4.99
HSLB 2006-050S		5				40	4	27.0	HSLB-S	5.27	5.44	5.61	5.80	6.21
HSLB 2006-060S		6				40	4	26.0	HSLB-S	6.30	6.50	6.71	6.93	7.43
HSLB 2008-020S	RO.4	2	0.64	0.79	16°	35	4	25.5	HSLB-S	2.17	2.23	2.30	2.37	2.52
HSLB 2008-030S		3				35	4	24.5	HSLB-S	3.21	3.30	3.40	3.50	3.74
HSLB 2008-040S		4				35	4	23.5	HSLB-S	4.24	4.36	4.50	4.64	4.97
HSLB 2008-060S		6				40	4	26.5	HSLB-S	6.30	6.49	6.70	6.92	7.41
HSLB 2010-020S	RO.5	2	0.8	0.98	16°	35	4	25.5	HSLB-S	2.18	2.24	2.30	2.36	2.51
HSLB 2010-025S		2.5				35	4	25.0	HSLB-S	2.70	2.77	2.85	2.93	3.12
HSLB 2010-030S		3				35	4	24.5	HSLB-S	3.21	3.30	3.40	3.50	3.73
HSLB 2010-040S		4				35	4	23.5	HSLB-S	4.24	4.37	4.50	4.64	4.96
HSLB 2010-060S		6				40	4	26.5	HSLB-S	6.31	6.50	6.70	6.92	7.40
HSLB 2010-080S		8				40	4	24.5	HSLB-S	8.37	8.63	8.90	9.20	9.85
HSLB 2015-030S	RO.75	3	1.2	1.47	16°	35	4	25.5	HSLB-S	3.10	3.18	3.26	3.35	3.55
HSLB 2015-040S		4				35	4	24.5	HSLB-S	4.13	4.24	4.36	4.49	4.77
HSLB 2015-060S		6				40	4	27.5	HSLB-S	6.19	6.37	6.56	6.76	7.22
HSLB 2015-080S		8				40	4	25.5	HSLB-S	8.25	8.50	8.76	9.04	9.67
HSLB 2015-100S		10				40	4	23.5	HSLB-S	10.32	10.63	10.96	11.32	12.11
HSLB 2020-030S	R1	3	1.6	1.98	16°	35	4	26.5	HSLB-S	3.07	3.14	3.21	3.29	3.47
HSLB 2020-040S		4				35	4	25.5	HSLB-S	4.10	4.20	4.31	4.43	4.70
HSLB 2020-060S		6				35	4	23.5	HSLB-S	6.16	6.33	6.51	6.71	7.14
HSLB 2020-080S		8				40	4	26.5	HSLB-S	8.23	8.46	8.72	8.99	9.59
HSLB 2020-100S		10				40	4	24.5	HSLB-S	10.29	10.59	10.92	11.26	12.04
HSLB 2020-120S		12				45	4	27.5	HSLB-S	12.35	12.72	13.12	13.54	14.48
HSLB 2020-140S		14				45	4	25.5	HSLB-S	14.41	14.85	15.32	15.82	16.93
HSLB 2020-160S		16				50	4	28.5	HSLB-S	16.48	16.98	17.52	18.10	19.38
HSLB 2020-200S		20				50	4	24.5	HSLB-S	20.60	21.24	21.92	22.65	No Interference

## HARDMAX 2 Flute Short Shank Long Neck Ball End Mills

Model Number	Radius of Ball Nose R	Effective Length $\ell_1$	Length of Cut $\ell$	Neck Diameter $\phi d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\phi d$	Shank Length H	Series	Effective Length by Inclined Angles				
										30°	1°	1°30'	2°	3°
HSLB 2030-060-4S	R1.5	6	2.4	2.95	16°	35	4	25.0	HSLB-S	6.20	6.35	6.52	6.69	7.09
HSLB 2030-080-4S		8				40	4	28.0	HSLB-S	8.26	8.48	8.72	8.97	9.54
HSLB 2030-100-4S		10				40	4	26.0	HSLB-S	10.32	10.61	10.92	11.25	No Interference
HSLB 2030-120-4S		12				40	4	24.0	HSLB-S	12.38	12.74	13.12	13.53	No Interference
HSLB 2030-160-4S		16				45	4	25.0	HSLB-S	16.51	17.00	17.52	No Interference	No Interference
HSLB 2030-200-4S		20				50	4	26.0	HSLB-S	20.64	21.26	No Interference	No Interference	No Interference
HSLB 2040-080-4S	R2	8	3.2	3.95	—	35	4	24.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2040-100-4S		10				40	4	28.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2040-120-4S		12				40	4	26.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2040-160-4S		16				45	4	27.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2040-200-4S		20				50	4	28.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-150S	R3	15	4.8	5.95	—	45	6	28.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference
HSLB 2060-200S		20				50	6	28.0	HSLB-S	No Interference	No Interference	No Interference	No Interference	No Interference

# HSLB / HSLB-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)	Effective 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 (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2001	R0.05	0.2	48,000	55	0.002	0.002	48,000	45	0.002	0.002	48,000	45	0.002	0.002	36,000	22	0.002	0.002
		0.3	48,000	55	0.002	0.002	48,000	45	0.002	0.002	48,000	45	0.002	0.002	36,000	22	0.002	0.002
		0.5	48,000	35	0.002	0.002	48,000	35	0.002	0.002	48,000	35	0.002	0.002	36,000	17	0.002	0.002
20015	R0.075	0.3	48,000	90	0.004	0.004	48,000	70	0.004	0.004	48,000	70	0.004	0.004	36,000	35	0.004	0.004
		0.5	48,000	60	0.004	0.004	48,000	50	0.004	0.004	48,000	50	0.004	0.004	36,000	25	0.004	0.004
		1	48,000	60	0.001	0.002	48,000	20	0.001	0.002	48,000	20	0.001	0.002	36,000	10	0.001	0.002
2002	R0.1	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
		0.5	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
		0.75	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
		1	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
		1.25	60,000	160	0.002	0.004	54,000	140	0.001	0.002	54,000	95	0.001	0.002	40,500	45	0.001	0.002
		1.5	60,000	130	0.002	0.003	48,000	80	0.001	0.002	48,000	65	0.001	0.002	36,000	30	0.001	0.002
		1.75	60,000	110	0.001	0.002	48,000	60	0.001	0.001	48,000	50	0.001	0.001	36,000	25	0.001	0.001
		2	60,000	90	0.001	0.002	48,000	50	0.001	0.001	48,000	40	0.001	0.001	36,000	20	0.001	0.001
		2.25	53,000	70	0.001	0.001	44,200	40	0.001	0.001	44,200	30	0.001	0.001	33,180	15	0.001	0.001
		2.5	46,850	60	0.001	0.001	40,450	30	0.001	0.001	40,450	20	0.001	0.001	30,350	10	0.001	0.001
		3	33,750	30	0.001	0.001	33,600	20	0.001	0.001	33,600	15	0.001	0.001	25,200	7	0.001	0.001
2003	R0.15	0.5	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
		0.6	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
		0.75	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
		1	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
		1.25	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
		1.5	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
		1.75	60,000	280	0.005	0.007	45,000	250	0.003	0.006	43,500	145	0.002	0.004	32,500	70	0.002	0.004
		2	60,000	210	0.004	0.007	45,000	190	0.003	0.005	43,500	110	0.002	0.004	32,500	55	0.002	0.004
		2.25	55,600	190	0.003	0.006	41,500	160	0.002	0.004	40,000	95	0.001	0.003	30,000	45	0.001	0.003
		2.5	51,250	175	0.003	0.005	38,500	135	0.002	0.004	37,750	85	0.001	0.003	28,300	40	0.001	0.003
		3	42,500	140	0.002	0.004	32,000	80	0.002	0.004	32,000	65	0.001	0.002	24,000	30	0.001	0.002
2004	R0.2	0.5	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
		0.75	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
		1	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
		1.25	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
		1.5	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
		1.75	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
		2	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
		2.25	47,500	430	0.008	0.016	36,000	360	0.006	0.01	33,750	210	0.004	0.007	25,270	100	0.004	0.007
		2.5	45,000	360	0.007	0.012	34,500	300	0.005	0.008	32,500	190	0.004	0.007	24,300	95	0.004	0.007
		3	40,000	250	0.005	0.008	31,900	210	0.004	0.008	30,500	160	0.003	0.005	22,800	80	0.003	0.005
		3.5	36,000	210	0.004	0.007	28,700	180	0.003	0.006	27,400	140	0.002	0.004	20,550	70	0.002	0.004
		4	32,000	180	0.003	0.005	25,500	150	0.002	0.004	24,300	120	0.002	0.004	18,200	60	0.002	0.004
		4.5	28,500	150	0.002	0.004	23,500	125	0.002	0.003	22,400	100	0.001	0.003	16,800	50	0.001	0.003
		5	25,000	120	0.002	0.003	21,500	100	0.001	0.002	20,500	80	0.001	0.002	15,350	40	0.001	0.002
6	18,000	60	0.001	0.002	18,000	60	0.001	0.002	17,000	45	0.001	0.002	12,750	20	0.001	0.002		

**HSLB / HSLB-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)	Effective 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 (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2005	R0.25	1	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
		1.25	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
		1.5	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
		1.75	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
		2	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
		2.25	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
		2.5	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
		3	40,000	500	0.01	0.02	31,000	400	0.007	0.01	28,550	230	0.005	0.008	21,400	115	0.005	0.008
		3.5	36,350	340	0.007	0.017	29,000	270	0.005	0.008	27,100	160	0.003	0.006	20,300	80	0.003	0.006
		4	32,700	180	0.005	0.015	27,150	150	0.003	0.008	25,650	100	0.002	0.005	19,900	50	0.002	0.005
		4.5	29,900	150	0.004	0.01	25,700	130	0.002	0.007	24,500	85	0.002	0.004	18,350	43	0.002	0.004
		5	27,000	135	0.003	0.008	24,200	110	0.002	0.005	23,500	75	0.002	0.004	17,600	35	0.002	0.004
		5.5	24,150	110	0.002	0.006	22,750	90	0.001	0.004	22,400	60	0.001	0.003	16,800	30	0.001	0.003
		6	21,350	90	0.002	0.005	21,300	75	0.001	0.003	21,300	50	0.001	0.002	16,000	25	0.001	0.002
		7	18,600	75	0.001	0.004	18,600	55	0.001	0.002	18,600	35	0.001	0.002	13,950	17	0.001	0.002
		8	15,900	60	0.001	0.003	15,900	40	0.001	0.002	15,900	25	0.001	0.002	11,950	12	0.001	0.002
		9	15,400	55	0.001	0.002	14,750	30	0.001	0.001	14,750	20	0.001	0.001	11,050	10	0.001	0.001
10	14,900	50	0.001	0.002	13,600	20	0.001	0.001	13,600	15	0.001	0.001	10,200	7	0.001	0.001		
2006	R0.3	1	40,000	1,400	0.045	0.15	30,000	1,500	0.03	0.13	26,500	1,000	0.015	0.09	20,000	500	0.015	0.09
		1.25	40,000	1,250	0.035	0.14	30,000	1,350	0.025	0.11	26,500	900	0.01	0.08	20,000	450	0.01	0.08
		1.5	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
		1.75	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
		2	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
		2.25	40,000	950	0.025	0.1	30,000	1,000	0.015	0.09	26,500	660	0.008	0.065	20,000	330	0.008	0.07
		2.5	40,000	800	0.02	0.1	30,000	800	0.015	0.09	26,500	520	0.008	0.065	20,000	260	0.008	0.065
		3	40,000	800	0.02	0.1	30,000	800	0.015	0.09	26,500	520	0.008	0.065	20,000	260	0.008	0.065
		3.5	40,000	500	0.015	0.09	30,000	500	0.01	0.075	26,500	340	0.006	0.05	20,000	170	0.006	0.05
		4	40,000	500	0.015	0.09	30,000	500	0.01	0.075	26,500	340	0.006	0.05	20,000	170	0.006	0.05
		4.5	32,000	400	0.01	0.075	25,000	390	0.007	0.05	23,000	260	0.005	0.04	18,000	130	0.005	0.04
		5	32,000	400	0.01	0.075	25,000	390	0.007	0.05	23,000	260	0.005	0.04	18,000	130	0.005	0.04
		5.5	28,000	350	0.008	0.065	23,000	350	0.006	0.05	21,000	230	0.004	0.04	15,750	115	0.004	0.04
		6	24,000	300	0.007	0.06	21,000	320	0.005	0.04	19,500	210	0.004	0.03	15,000	105	0.004	0.03
		6.5	22,000	270	0.006	0.06	19,500	300	0.004	0.04	18,500	190	0.003	0.03	13,900	95	0.003	0.03
		7	20,000	250	0.006	0.05	18,500	280	0.004	0.03	17,500	180	0.003	0.02	13,100	90	0.003	0.02
		8	16,000	200	0.005	0.05	16,000	240	0.003	0.02	16,000	160	0.003	0.02	12,000	80	0.003	0.02
9	15,450	185	0.004	0.035	15,450	200	0.002	0.017	15,450	135	0.002	0.017	11,580	65	0.002	0.017		
10	14,900	175	0.003	0.02	14,900	175	0.002	0.015	14,900	115	0.002	0.015	11,100	55	0.002	0.015		
12	13,800	150	0.002	0.015	13,800	110	0.001	0.01	13,800	70	0.001	0.01	10,350	35	0.001	0.01		
2007	R0.35	2	37,000	1,350	0.045	0.17	28,500	1,400	0.03	0.135	25,000	900	0.015	0.1	18,750	450	0.015	0.1
		4	31,250	920	0.035	0.15	25,750	975	0.025	0.12	23,750	650	0.012	0.09	17,800	325	0.012	0.09
		6	25,500	500	0.025	0.13	23,000	550	0.02	0.11	22,500	400	0.01	0.08	16,850	200	0.01	0.08
		8	19,000	270	0.007	0.06	17,000	320	0.005	0.04	16,500	220	0.004	0.025	12,350	110	0.004	0.025
2008	R0.4	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
		3	35,000	1,400	0.05	0.19	27,000	1,400	0.03	0.15	23,500	900	0.015	0.1	17,500	450	0.015	0.1
		4	35,000	1,200	0.04	0.17	27,000	1,200	0.025	0.135	23,500	600	0.012	0.095	17,500	300	0.012	0.095

**HSLB / HSLB-S Milling Conditions**

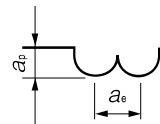
WORK MATERIAL			PREHARDENED STEELS / HARDENED STEELS NAK / STAVAX (~55HRC)				HARDENED STEELS SKD11 (55~62HRC)				HARDENED STEELS HAP10 (62~66HRC)				HARDENED STEELS HAP72 (66~70HRC)			
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2008	R0.4	5	31,500	900	0.03	0.15	25,000	900	0.02	0.12	22,000	500	0.01	0.085	16,500	250	0.01	0.085
		6	28,000	600	0.02	0.12	23,000	600	0.012	0.095	20,500	400	0.006	0.065	15,500	200	0.006	0.065
		7	23,750	460	0.016	0.105	20,500	480	0.009	0.08	18,750	340	0.005	0.062	14,000	170	0.005	0.062
		8	19,500	330	0.012	0.095	18,000	375	0.007	0.07	17,000	285	0.005	0.06	12,750	140	0.005	0.06
		9	17,500	290	0.011	0.09	16,000	350	0.006	0.06	15,700	250	0.005	0.05	11,800	125	0.005	0.05
		10	15,000	260	0.01	0.085	14,700	340	0.005	0.06	14,650	225	0.004	0.05	11,000	110	0.004	0.05
		12	14,000	220	0.005	0.06	13,700	290	0.003	0.04	13,650	140	0.002	0.03	10,250	70	0.002	0.03
		16	13,300	185	0.003	0.02	11,100	150	0.001	0.013	11,100	90	0.001	0.013	8,300	45	0.001	0.013
2009	R0.45	2	32,500	1,650	0.1	0.28	25,500	1,800	0.55	0.21	22,000	1,300	0.025	0.14	16,500	650	0.025	0.14
		4	32,500	1,650	0.08	0.25	25,500	1,800	0.04	0.18	22,000	1,300	0.02	0.13	16,500	650	0.02	0.13
		6	29,000	800	0.035	0.17	22,000	800	0.02	0.13	20,000	620	0.015	0.11	15,000	310	0.015	0.11
		8	25,500	700	0.015	0.11	18,500	500	0.01	0.09	18,500	420	0.01	0.09	13,850	210	0.01	0.09
		10	20,000	400	0.012	0.1	15,700	400	0.008	0.08	15,700	300	0.008	0.08	11,800	150	0.008	0.08
		12	15,000	280	0.01	0.09	13,300	300	0.006	0.07	13,300	220	0.006	0.07	10,000	110	0.006	0.07
		14	14,000	240	0.007	0.07	12,000	250	0.004	0.035	12,000	160	0.004	0.035	9,000	80	0.004	0.035
		16	13,700	220	0.005	0.05	10,800	200	0.003	0.03	10,800	130	0.003	0.03	8,100	65	0.003	0.03
18	13,000	200	0.004	0.025	9,750	150	0.002	0.015	9,750	100	0.002	0.015	7,300	50	0.002	0.015		
2010	R0.5	2	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	0.2	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
		3	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
		4	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
		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
		6	30,000	1,150	0.06	0.23	21,500	1,250	0.03	0.17	19,700	1,050	0.025	0.15	14,500	525	0.025	0.15
		7	24,250	800	0.04	0.19	20,000	900	0.02	0.14	19,000	750	0.02	0.14	14,250	375	0.02	0.14
		8	24,000	800	0.025	0.155	18,500	580	0.015	0.12	18,400	480	0.015	0.12	13,800	240	0.015	0.12
		9	23,000	700	0.021	0.14	16,650	500	0.012	0.1	16,550	420	0.012	0.1	12,400	210	0.012	0.1
		10	22,000	600	0.018	0.13	14,800	430	0.01	0.09	14,700	360	0.01	0.09	11,100	180	0.01	0.09
		12	14,150	320	0.015	0.12	13,400	380	0.008	0.08	13,300	290	0.008	0.08	9,950	145	0.008	0.08
		14	13,500	280	0.012	0.1	12,000	350	0.007	0.08	12,000	220	0.007	0.08	9,000	110	0.007	0.08
		16	12,750	240	0.008	0.08	10,500	250	0.005	0.045	10,500	160	0.005	0.045	7,850	80	0.005	0.045
		18	12,350	220	0.006	0.065	9,750	200	0.004	0.035	9,750	130	0.004	0.035	7,300	65	0.004	0.035
20	12,000	200	0.005	0.03	9,000	150	0.003	0.02	9,000	100	0.003	0.02	6,750	50	0.003	0.02		
22	12,000	150	0.003	0.02	9,000	110	0.002	0.012	9,000	75	0.002	0.012	6,750	35	0.002	0.012		
2012	R0.6	2.5	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
		4	30,000	2,000	0.12	0.36	20,000	2,000	0.06	0.24	17,500	1,750	0.036	0.2	13,100	875	0.036	0.2
		6	30,000	2,000	0.12	0.36	20,000	2,000	0.06	0.24	17,500	1,750	0.036	0.2	13,100	875	0.036	0.2
		8	20,200	800	0.05	0.23	16,600	900	0.025	0.17	15,850	750	0.025	0.17	11,900	375	0.025	0.17
		10	15,500	480	0.03	0.18	15,500	580	0.015	0.13	15,350	480	0.015	0.13	11,500	240	0.015	0.13
		12	12,400	360	0.02	0.15	12,400	430	0.01	0.095	12,250	360	0.01	0.095	9,200	180	0.01	0.095
		14	11,850	320	0.018	0.14	11,200	380	0.008	0.085	11,100	290	0.008	0.085	8,300	145	0.008	0.085
		16	11,300	280	0.014	0.12	10,000	360	0.007	0.08	10,000	230	0.007	0.08	7,500	115	0.007	0.08
		18	10,900	260	0.011	0.1	9,400	300	0.006	0.07	9,400	190	0.006	0.07	7,050	95	0.006	0.07
2014	R0.7	6	25,200	2,000	0.13	0.42	17,150	2,000	0.065	0.27	15,000	1,750	0.036	0.23	11,250	875	0.036	0.23
		8	25,200	1,300	0.08	0.32	15,350	1,250	0.04	0.23	14,050	1,050	0.03	0.2	10,550	525	0.03	0.2

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)	Effective 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 (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2014	R0.7	12	13,500	450	0.035	0.21	12,500	460	0.025	0.18	12,000	300	0.02	0.16	9,000	150	0.02	0.16
		16	10,000	320	0.016	0.145	9,050	390	0.01	0.12	8,850	230	0.012	0.12	6,650	115	0.012	0.12
2015	R0.75	3	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	0.25	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
		6	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
		8	23,500	1,300	0.1	0.37	15,000	1,250	0.045	0.25	14,000	1,050	0.03	0.21	10,500	525	0.03	0.21
		10	23,500	1,300	0.1	0.37	15,000	1,250	0.045	0.25	14,000	1,050	0.03	0.21	10,500	525	0.03	0.21
		12	13,100	480	0.03	0.21	13,000	580	0.02	0.17	13,000	480	0.02	0.17	9,750	240	0.02	0.17
		14	11,200	400	0.025	0.19	10,900	485	0.015	0.145	10,900	385	0.015	0.145	8,200	190	0.015	0.145
		16	9,350	320	0.02	0.17	8,850	390	0.012	0.13	8,800	290	0.012	0.13	6,600	145	0.012	0.13
		18	9,150	300	0.019	0.165	8,400	370	0.011	0.125	8,400	255	0.011	0.125	6,300	125	0.011	0.125
		20	9,000	280	0.018	0.16	8,000	350	0.01	0.12	8,000	220	0.01	0.12	6,000	110	0.01	0.12
		22	8,580	245	0.014	0.13	7,150	320	0.008	0.12	7,150	165	0.008	0.12	5,350	80	0.008	0.12
		25	8,100	210	0.01	0.11	6,250	220	0.006	0.09	6,250	120	0.005	0.08	4,700	60	0.005	0.08
30	7,600	175	0.006	0.04	5,370	135	0.004	0.03	5,370	75	0.003	0.03	4,000	35	0.003	0.03		
2016	R0.8	4	30,000	2,500	0.25	0.58	17,500	2,100	0.12	0.4	15,300	1,800	0.06	0.3	11,500	900	0.06	0.3
		8	30,000	2,500	0.16	0.48	17,500	2,100	0.08	0.32	15,300	1,800	0.05	0.275	11,500	900	0.05	0.275
		12	13,500	500	0.04	0.245	13,500	600	0.024	0.19	13,400	490	0.024	0.19	10,050	245	0.024	0.19
		16	10,800	375	0.03	0.21	10,800	450	0.016	0.15	10,700	370	0.016	0.15	8,000	185	0.016	0.15
		20	10,300	330	0.025	0.19	9,750	400	0.013	0.13	9,650	230	0.013	0.13	8,000	115	0.013	0.13
2018	R0.9	4	30,000	2,700	0.28	0.65	15,000	2,000	0.14	0.48	13,000	1,750	0.07	0.34	9,750	875	0.07	0.34
		6	30,000	2,700	0.18	0.54	15,000	2,000	0.07	0.34	13,000	1,750	0.04	0.26	9,750	875	0.04	0.26
		8	30,000	2,700	0.18	0.54	15,000	2,000	0.07	0.34	13,000	1,750	0.04	0.26	9,750	875	0.04	0.26
		10	25,750	2,000	0.14	0.48	14,400	1,650	0.06	0.32	12,900	1,425	0.035	0.24	9,700	713	0.035	0.24
		12	21,500	1,350	0.1	0.41	13,800	1,350	0.05	0.29	12,800	1,100	0.03	0.23	9,600	550	0.03	0.23
		16	15,550	860	0.065	0.33	11,700	900	0.03	0.22	11,150	730	0.02	0.18	8,400	365	0.02	0.18
		18	9,600	375	0.03	0.23	9,600	450	0.015	0.16	9,500	370	0.01	0.13	7,150	185	0.01	0.13
		20	9,300	350	0.027	0.21	9,050	420	0.014	0.15	9,000	330	0.009	0.12	6,750	165	0.009	0.12
		22	9,000	320	0.025	0.2	8,500	400	0.012	0.14	8,500	290	0.008	0.15	6,400	145	0.008	0.15
		25	8,500	280	0.02	0.18	7,750	320	0.01	0.1	7,750	220	0.007	0.09	5,800	110	0.007	0.09
2020	R1	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
		4	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
		8	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
		10	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
		12	19,500	1,350	0.12	0.45	12,400	1,350	0.06	0.34	11,500	1,100	0.045	0.27	8,650	550	0.045	0.27
		13	19,500	1,350	0.12	0.45	12,400	1,350	0.06	0.34	11,500	1,100	0.045	0.27	8,650	550	0.045	0.27
		14	19,500	1,350	0.12	0.45	12,400	1,350	0.06	0.34	11,500	1,100	0.045	0.27	8,650	550	0.045	0.27
		16	10,800	500	0.05	0.3	10,800	600	0.03	0.24	10,700	490	0.03	0.24	8,000	245	0.03	0.24
		18	9,700	435	0.04	0.28	9,700	520	0.025	0.22	9,650	430	0.025	0.22	7,250	215	0.025	0.22
		20	8,650	375	0.035	0.25	8,650	450	0.02	0.19	8,560	370	0.02	0.19	6,400	185	0.02	0.19
		22	8,450	350	0.032	0.245	8,200	440	0.018	0.18	8,200	330	0.018	0.18	6,150	165	0.018	0.18
		25	8,250	320	0.03	0.24	7,800	440	0.016	0.16	7,800	290	0.016	0.16	5,850	145	0.016	0.16
		27	8,050	300	0.027	0.22	7,400	390	0.015	0.16	7,400	250	0.015	0.16	5,550	120	0.015	0.16



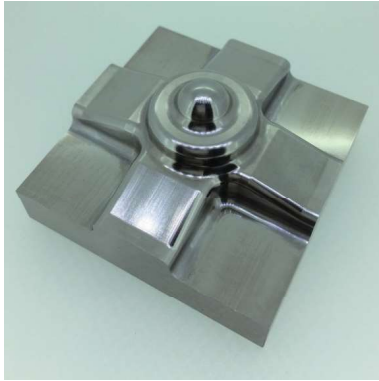
WORK MATERIAL			PREHARDENED STEELS / HARDENED STEELS NAK / STAVAX (~55HRC)				HARDENED STEELS SKD11 (55~62HRC)				HARDENED STEELS HAP10 (62~66HRC)				HARDENED STEELS HAP72 (66~70HRC)			
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2020	R1	30	7,850	280	0.024	0.2	7,000	350	0.014	0.16	7,000	220	0.014	0.16	5,250	110	0.014	0.16
		32	7,650	260	0.02	0.18	6,550	300	0.012	0.12	6,550	190	0.012	0.12	4,900	90	0.012	0.12
		35	7,450	240	0.016	0.16	6,150	250	0.01	0.09	6,150	160	0.01	0.09	4,600	80	0.01	0.09
		40	7,000	200	0.01	0.06	5,250	150	0.006	0.04	5,250	100	0.006	0.04	3,950	50	0.006	0.04
2025	R1.25	6	25,000	3,000	0.35	0.85	12,400	2,200	0.17	0.6	11,000	1,850	0.1	0.45	8,250	920	0.1	0.45
		8	25,000	3,000	0.24	0.76	12,400	2,200	0.13	0.51	11,000	1,850	0.08	0.38	8,250	920	0.08	0.38
		10	25,000	3,000	0.24	0.76	12,400	2,200	0.13	0.51	11,000	1,850	0.08	0.38	8,250	920	0.08	0.38
		15	17,300	1,400	0.145	0.57	11,000	1,400	0.08	0.44	10,300	1,140	0.06	0.35	7,700	570	0.06	0.35
		20	9,600	520	0.06	0.38	9,600	630	0.04	0.31	9,600	510	0.04	0.31	7,200	255	0.04	0.31
		25	6,900	375	0.042	0.32	6,900	450	0.024	0.235	6,840	370	0.024	0.235	5,150	185	0.024	0.235
		30	6,500	320	0.025	0.24	6,200	400	0.02	0.22	6,200	280	0.02	0.22	4,650	140	0.02	0.22
2030	R1.5	6	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	0.4	1	10,500	2,200	0.2	0.7	9,200	1,900	0.12	0.55	6,900	950	0.12	0.55
		10	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
		12	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
		14	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
		15	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
		16	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
		18	17,750	2,180	0.24	0.8	9,800	1,800	0.13	0.57	8,900	1,500	0.08	0.47	6,650	760	0.08	0.47
		20	14,500	1,360	0.18	0.7	9,250	1,400	0.1	0.5	8,600	1,150	0.075	0.45	6,450	575	0.075	0.45
		22	11,250	940	0.12	0.57	8,625	1,000	0.07	0.44	8,300	830	0.06	0.41	6,200	410	0.06	0.41
		25	8,000	520	0.07	0.45	8,000	630	0.05	0.38	8,000	510	0.05	0.38	6,000	255	0.05	0.38
		27	6,850	440	0.06	0.41	6,850	540	0.04	0.33	6,850	440	0.04	0.33	5,100	220	0.04	0.33
		30	5,750	375	0.05	0.38	5,750	450	0.03	0.29	5,700	370	0.03	0.29	4,275	185	0.03	0.29
		32	5,650	350	0.045	0.37	5,550	440	0.025	0.28	5,500	340	0.025	0.28	4,100	170	0.025	0.28
35	5,550	335	0.045	0.36	5,350	440	0.025	0.27	5,350	310	0.025	0.27	4,000	155	0.025	0.27		
40	5,350	300	0.04	0.34	4,900	390	0.02	0.24	4,850	250	0.02	0.24	3,650	125	0.02	0.24		
2035	R1.75	10	19,000	3,000	0.35	1.05	10,000	2,200	0.17	0.75	8,400	1,900	0.11	0.61	6,300	950	0.11	0.61
		15	19,000	3,000	0.35	1.05	10,000	2,200	0.17	0.75	8,400	1,900	0.11	0.61	6,300	950	0.11	0.61
		20	19,000	3,000	0.35	1.05	10,000	2,200	0.17	0.75	8,400	1,900	0.11	0.61	6,300	950	0.11	0.61
		25	13,000	1,750	0.21	0.83	8,450	1,400	0.11	0.61	7,650	1,200	0.08	0.52	5,750	600	0.08	0.52
		30	6,900	520	0.08	0.52	6,900	630	0.06	0.45	6,900	510	0.06	0.45	5,200	255	0.06	0.45
		40	5,750	410	0.06	0.45	5,550	510	0.04	0.37	5,500	380	0.04	0.37	4,150	190	0.04	0.37
2040	R2	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
		10	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
		12	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		14	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		15	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		16	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		18	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		20	18,000	3,200	0.4	1.2	9,000	2,300	0.2	0.85	7,900	2,000	0.13	0.7	5,900	1,000	0.13	0.7
		22	15,000	2,350	0.32	1.05	8,500	1,850	0.16	0.75	7,650	1,600	0.11	0.6	5,750	810	0.11	0.6
		25	12,500	1,500	0.25	0.95	8,000	1,450	0.13	0.7	7,450	1,250	0.09	0.55	5,600	625	0.09	0.55

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)	Effective 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 (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> Axial Depth (mm)	a <sub>e</sub> Radial Depth (mm)
2040	R2	27	9,750	1,000	0.17	0.76	7,500	1,050	0.09	0.55	7,200	890	0.07	0.5	5,400	440	0.07	0.5
		30	7,000	550	0.1	0.6	7,000	660	0.06	0.45	7,000	540	0.06	0.45	5,250	270	0.06	0.45
		32	6,500	535	0.09	0.59	6,500	640	0.055	0.44	6,500	520	0.055	0.44	4,850	260	0.055	0.44
		35	6,000	520	0.09	0.59	6,000	630	0.055	0.43	6,000	510	0.055	0.43	4,500	255	0.055	0.43
		40	4,300	375	0.065	0.5	4,300	450	0.04	0.39	4,300	370	0.04	0.39	3,200	185	0.04	0.39
		45	4,150	330	0.058	0.47	4,000	440	0.033	0.36	4,000	300	0.033	0.36	3,000	150	0.033	0.36
		50	4,000	300	0.053	0.44	3,750	400	0.03	0.33	3,750	260	0.03	0.33	2,800	130	0.03	0.33
		60	3,900	280	0.048	0.4	3,500	350	0.028	0.3	3,500	220	0.028	0.3	2,600	110	0.028	0.3
2050	R2.5	10	14,400	3,200	0.5	1.5	7,200	2,300	0.25	1.05	6,350	2,000	0.16	0.88	4,750	1,000	0.16	0.88
		15	14,400	3,200	0.5	1.5	7,200	2,300	0.25	1.05	6,350	2,000	0.16	0.88	4,750	1,000	0.16	0.88
		20	14,400	3,200	0.5	1.5	7,200	2,300	0.25	1.05	6,350	2,000	0.16	0.88	4,750	1,000	0.16	0.88
		25	12,200	2,350	0.405	1.35	6,800	1,850	0.205	0.95	6,250	1,600	0.135	0.805	4,650	800	0.135	0.805
		30	10,000	1,500	0.31	1.2	6,400	1,450	0.16	0.88	6,200	1,250	0.11	0.73	4,650	625	0.11	0.73
		35	8,000	1,050	0.21	1	6,200	1,070	0.12	0.76	6,100	900	0.095	0.68	4,600	450	0.095	0.68
		40	6,000	570	0.125	0.78	6,000	690	0.08	0.625	6,000	570	0.08	0.625	4,500	285	0.08	0.625
		45	5,150	500	0.11	0.72	5,150	600	0.07	0.4	5,100	500	0.07	0.4	3,800	250	0.07	0.4
		50	4,300	430	0.09	0.65	4,300	510	0.06	0.18	4,200	435	0.06	0.18	3,150	215	0.06	0.18
2060	R3	10	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
		15	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
		18	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
		20	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
		22	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
		25	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
		27	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
		30	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
		32	12,000	3,100	0.54	1.7	6,300	2,250	0.27	1.15	5,600	2,000	0.18	0.9	4,200	1,000	0.18	0.9
		35	11,000	2,750	0.48	1.6	6,100	2,050	0.25	1.05	5,500	1,800	0.175	0.8	4,150	900	0.175	0.8
		40	9,000	2,050	0.375	1.35	5,750	1,600	0.2	0.8	5,350	1,400	0.15	0.65	4,000	700	0.15	0.65
		45	7,000	1,300	0.26	1.1	5,350	1,150	0.15	0.55	5,150	1,000	0.125	0.45	3,850	500	0.125	0.45
		50	5,000	600	0.15	0.9	5,000	720	0.1	0.3	5,000	600	0.1	0.3	3,750	300	0.1	0.3
60	3,600	430	0.105	0.75	3,600	510	0.08	0.22	3,550	435	0.08	0.22	2,650	215	0.08	0.22		



Note:

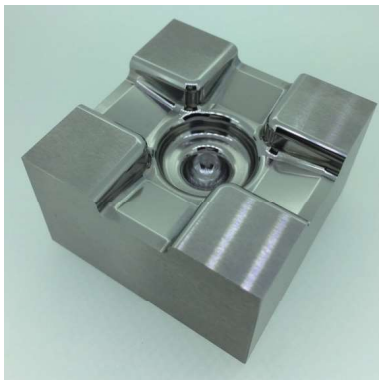
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- Every coolant offers stable milling.



Size : 50 x 50 x 30 mm

No.	Process	Tool	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	Cycle Time (h:m)
1	Roughing	HMS φ 10 × L22	2,000	1,000	17.5	0.2	0:59:48
2	Semi-roughing	HSB R3	5,700	2,200	0.2	0.3	0:37:55
3	Semi-roughing	HSLB R2 × EL8	7,900	2,000	0.15	0.3	0:05:44
4	Finishing	HLRS φ 6 × CR0.1 × EL12	4,000	1,080	—	1.35	1:38:31
5	Semi-finishing	HSLB R2 × EL8	7,900	1,000	0.04	0.04	0:04:08
6	Finishing	HSLB R1.75 × EL10	16,800	920	0.04	0.04	2:26:27
7	Finishing	HSLB R1 × EL3	12,250	900	0.03	0.03	0:11:17

Total 6:03:50



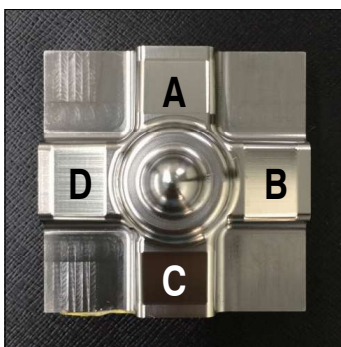
Size : 50 x 50 x 30 mm

No.	Process	Tool	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	Cycle Time (h:m)
1	Roughing	HSB R5	3,750	1,750	0.3	1.7	0:35:28
2	Semi-roughing	HSB R3	5,700	2,200	0.2	0.3	0:29:29
3	Semi-roughing	HSLB R2 × EL8	7,900	2,000	0.15	0.3	0:20:42
4	Semi-finishing	HSLB R2 × EL8	7,900	1,000	0.04	0.04	1:30:26
5	Semi-finishing	HSLB R1.75 × EL10	8,400	920	—	—	0:34:04
6	Finishing	HSLB R1.75 × EL10	16,800	920	0.04	0.04	2:17:59
7	Finishing	HSLB R1 × EL3	12,250	900	0.03	0.03	0:08:02

Total 5:56:10

- Coolant : Air blow Oil Mist
- R1.75 Surface roughness : Ra 0.10 ~ 0.24 μm (Ave 0.17 μm)

**R1.75 × EL10** Surface condition by different milling conditions.



	Milling condition A	Milling condition B	Milling condition C	Milling condition D	Milling condition E
Spindle Speed (min <sup>-1</sup> )	8,400				16,800
Feed Rate (mm/min)	1,900	1,390	1,230	920	920
a <sub>p</sub> a <sub>e</sub> (mm)	0.04	0.04	0.04	0.04	0.04
Feed per tooth (mm/t)	0.11	0.083	0.073	0.055	0.027
Feed rate ratio	100%	75%	66%	50%	50%

※ A is based on the catalog milling conditions.



**Test A~D** Compared milling surfaces with 4 different feed rates and the spindle speed of 8,400 min  
 Result . . . The milling surface improved **with reduced feed per tooth**.

**Test E** Tested with the double spindle speed of 16,800 min  
 Result . . . The milling surface improved even more (Ra 0.17 μm) **with increased spindle speed**.



## 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. UNION TOOL, INC.

(U.S. HEADQUARTERS)  
1260 N. Fee Ana Street, Anaheim, CA 92807-1817 U.S.A.  
Tel: 1-714-521-6242 Fax: 1-714-521-8642

#### NORTHERN CALIFORNIA REGIONAL SERVICE CENTER

(Customer Service, Santa Clara, California)  
1805 Little Orchard Street, Suite 120, San Jose, CA 95125 U.S.A.  
Tel: 1-408-982-0205 Fax: 1-408-982-0320

#### UPPER MIDWEST REGIONAL SERVICE CENTER

(Customer Service, Minneapolis, Minnesota)  
155 Bridgepoint Drive, Unit 3 South St. Paul, MN 55075 U.S.A.  
Tel: 1-651-552-0440 Fax: 1-651-552-0435

#### TAIWAN UNION TOOL CORP.

No.180, Zhong-Zun Street., 14 Neighborhood, Bin-Hai Vil.,  
Lu-Zhu Dist., Taoyuan City, 338 TAIWAN  
Tel: 886-3-354-3111 Fax: 886-3-354-3110

#### UNION TOOL EUROPE S.A.

Avenue des Champs-Montants 14aCH-2074 Marin /  
Neuchatel SWITZERLAND  
Tel: 41-32-756-6633 Fax: 41-32-756-6634

#### UNION TOOL (SHANGHAI) Co., LTD.

No.9-10, Lane 385, Gaoji Road, Sijing High New Technology  
Development Zone, Songjiang District, Shanghai, 201601 CHINA  
Tel: 86-21-5762-8577 Fax: 86-21-5762-8436

#### UNION TOOL HONG KONG LTD.

Unit 2803 & 05, 28/F, Peninsula Tower, 538 Castle Peak Road,  
Cheung Sha Wan, Kowloon, HONG KONG  
Tel: 852-2370-3012 Fax: 852-2370-2111

#### DONGGUAN UNIONTOOL LTD.

No.5, Hong Jin Road, Hongmei Town,  
Dongguan City, Guangdong Province 523160, CHINA  
Tel: 86-769-8884-8900 Tel: 86-769-8884-8901  
Fax: 86-769-8884-8296

#### UNION TOOL SINGAPORE PTE LTD.

No.31 Harrison Road, #05-01, SINGAPORE 369649  
Tel: 65-6846-9309 Fax: 65-6846-0197

#### UNION TOOL (THAILAND) CO., LTD.

No.55/73 Moo 15 Bangsaotong Sub-District, Bangsaotong District,  
Samutprakarn 10570 THAILAND  
Tel: 66-2-130-0908 Fax: 66-2-130-0909

 0120-60-2620

<https://www.uniontool.co.jp>

Price & Specifications are subject to change without notice.

202203 HSLB(S) 14KA



Size **R0.05~R3**

**HSLB**

Super  
**MG**

**HARD  
MAX**

Shank Dia  
0/-0.005

Back Taper  
Geometry

Back taper geometry does not apply to R0.45 or below, and  $l_s/D \leq 10$ .

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**

**1 Variable rake angle design.**

Optimized rake angles are designed from the ball tip to the peripheral cutting edge.

**2 HARDMAX coating.**

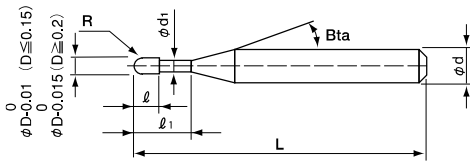
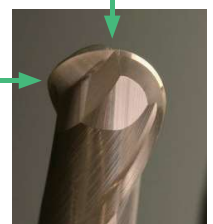
HARDMAX coating offers heat resistance, durability and lubricity at a high level.

**3 Suitable for various coolant types.**

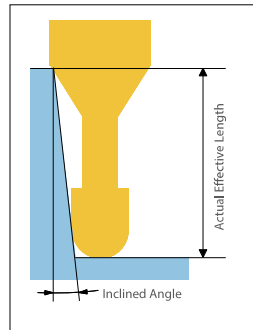
Every coolant offers stable milling.

Tip point : Negative

Peripheral cutting edge: Slightly negative



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.



Radius of Ball Nose	Diameter Tolerance	Ball Radius Accuracy	Helix Angle
R0.05 ~ R0.075	0/-0.01	±0.002	0°
R0.1 ~ R3	0/-0.015	±0.005	30°

How to find the best long neck ball series for your material applications

Series	Features	Ball tip design	Copper	Carbon Steels	40HRC	50HRC	55HRC	60HRC	65HRC	70HRC
<b>HGLB</b>	Especially for hard materials	Super negative				○	◎	◎	◎	◎
<b>HSLB HSLB-S</b>	For hard materials	Negative	○	○	◎	◎	◎	◎	◎	
<b>HLB</b>	Multi-purpose	Positive	◎	○	◎	◎	◎	○		
<b>CSELB</b>	Multi-purpose Excellent surface quality	Standard	◎	◎	◎	◎	○			