



MRBSH230SF

MUGEN COATING PREMIUM Plus
2-Flute Long Neck Ball End Mill
with Short Shank
for Hardened Steel and High accuracy cutting



High precision and long tool life even for hardened steel up to 70 HRC

MRBSH230SF

R0.05 ~ R3 Total 115 sizes

Achieves long tool life and high precision cutting even for 70HRC hardened steel



Features

Total 115 sizes include new addition 32 sizes realize abundant line up variations of under neck length



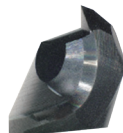
Coating

1	New coating MUGEN COATING PREMIUM Plus with high Oxidation resistance and abrasion resistance
---	---

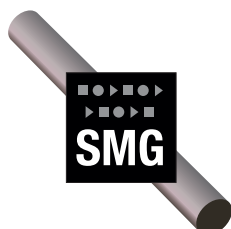
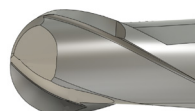
Introduced in the previous page

Shape

2-1	Cutting edge shape with reduced cutting load
2-2	Achieves high rigidity with optimal tool overhung
	High accuracy precision shank supported shrink fit chuck
2-3	Highly accurate R shape that is smooth and seamless



Tolerance range
0.002 mm



Material

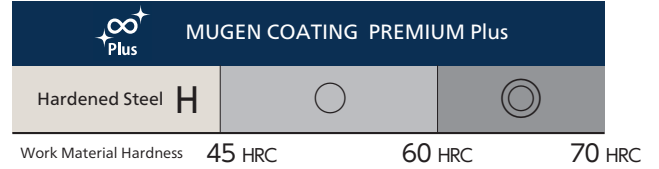
3	Super micro grain carbide with improved fracture resistance
---	---

Feature
1

Long tool life

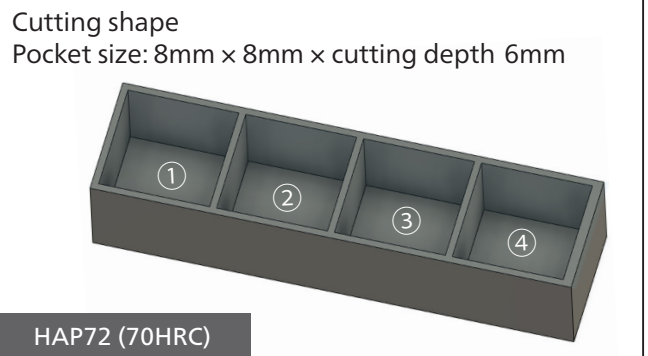
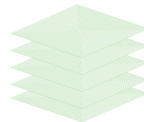
Coating MUGEN COATING PREMIUM Plus

MUGEN COATING PREMIUM Plus is suitable for machining above 60HRC
Demonstrates same performance with MUGEN COATING PREMIUM even on machining 45 ~ 60HRC



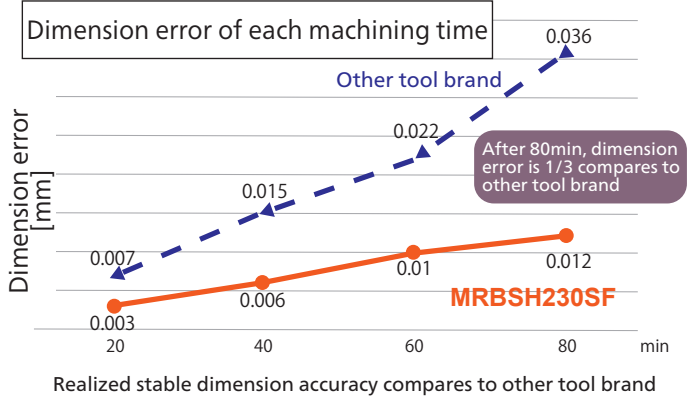
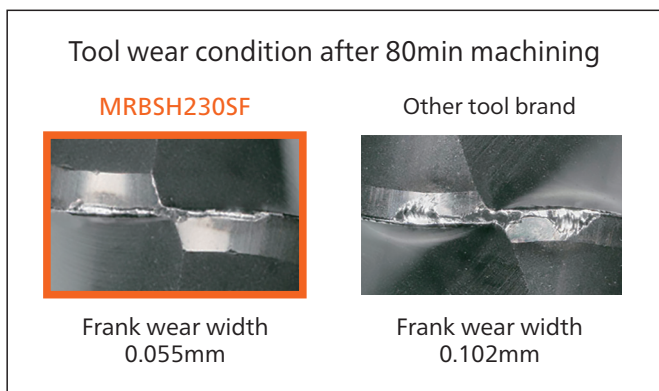
Comparison of dimensional accuracy

HAP72 (70HRC)
Comparison of dimensional accuracy after roughing
Tool : MRBSH230SF R1x6
Cutting content:
Roughing contour lines for 4 pockets
Stock : 0.02mm
Target : 7.960mm
Cutting time : 20min/per pocket
Tool path : Roughing contour line



Roughing

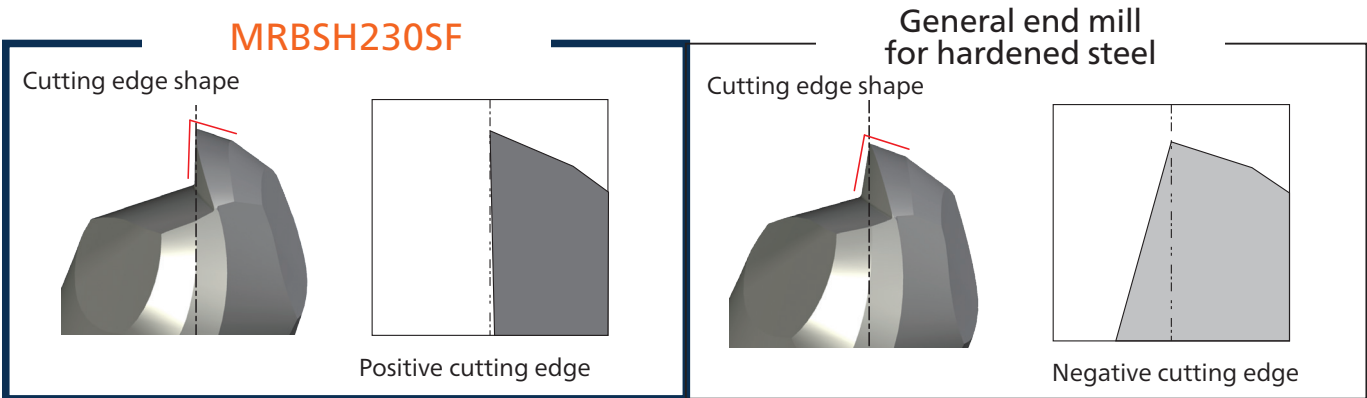
$n = 16,000 \text{ min}^{-1}$, $V_f = 1,200 \text{ mm/min}$, $a_p 0.1 \times a_e 0.3 \text{ mm}$, Oil Mist



High precision and long tool life even for hardened steel up to 70 HRC

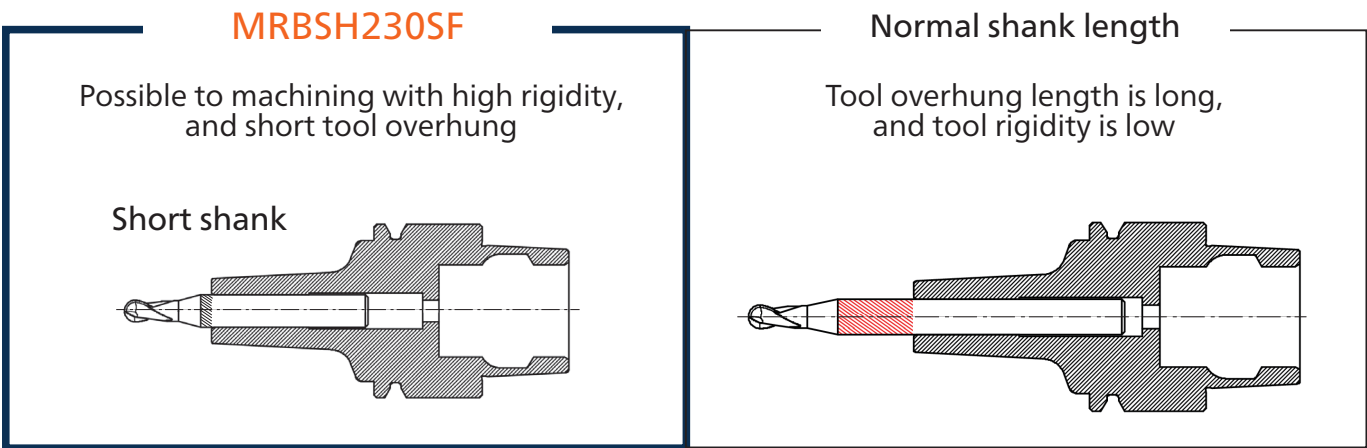
Feature 2-1 Improved machinability Shape Cutting edge

Sharp cutting edge with reduced cutting load and new material with fracture resistance realizes long tool life and high precision for hardened steel



Cutting load is reduced by positive cutting edge and by adopting a new material Super micro grain carbide prevent chipping even with hardened steel. Negative cutting edge shape with high cutting load

Feature 2-2 Improved cutting accuracy Shape Optimal overhung length



Feature 2-2 Compatible with high accuracy shrink-fit chuck Shape High accuracy shank

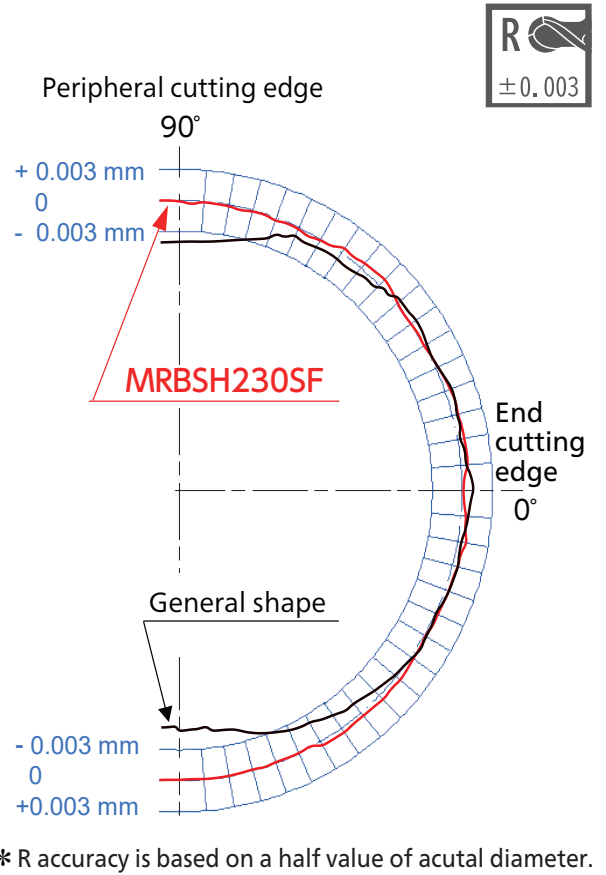
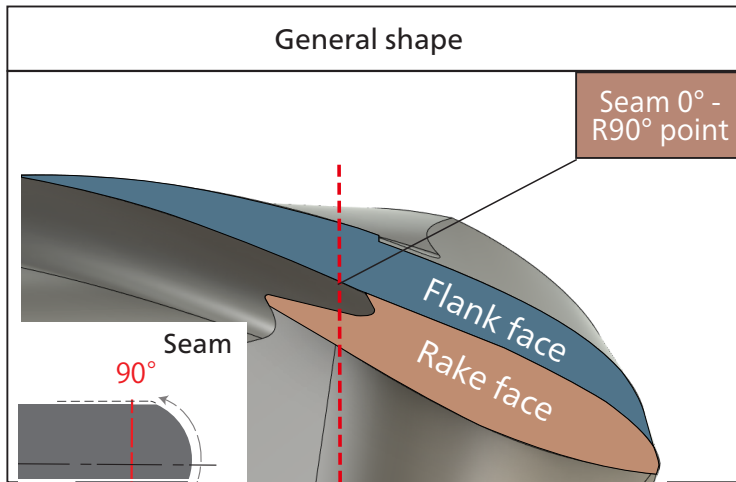
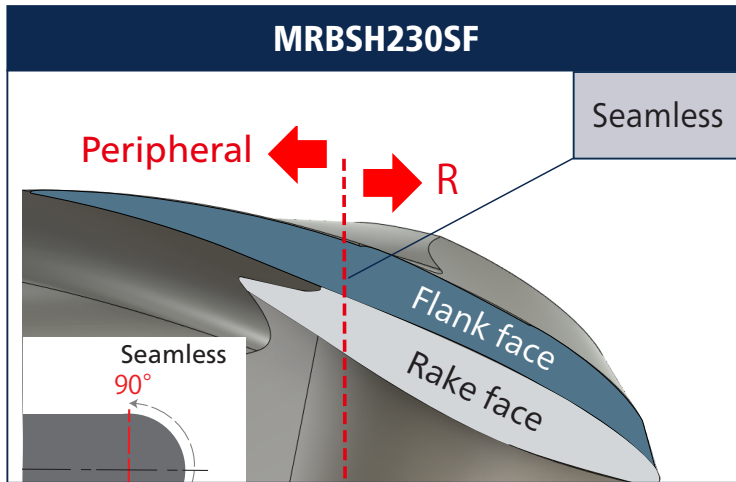


Feature
2-3

High accuracy R

Shape Highly accurate R

Seamless design on rake face and flank face from R-curve to peripheral cutting edge realized high precision R accuracy



Feature
3

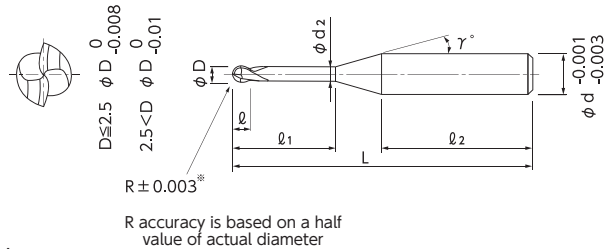
Upgrade abrasion ability

Material Carbide material



New material adopted 「**Super micro grain carbide**」 to specialize abrasion resistance and fracture resistance.

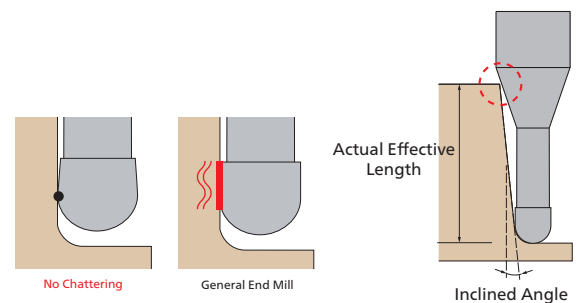
High precision and long tool life even for hardened steel up to 70 HRC



- Realize stable cutting performance even for 70 HRC hardened steels.
- Developed new MUGEN COATING PREMIUM Plus to upgrade oxidation resistance and abrasion resistance.
- Adopt optimized new tool material and tool design to reduce cutting load.
- R accuracy is $\pm 0.003\text{mm}$ (R accuracy is based on a half value of actual diameter).
- Shank diameter tolerance, high accuracy type, is $-0.001 \sim -0.003$.

Work Material

Hardened Steel H	
45~60HRC	60~70HRC
○	◎



Unit [Size : mm]

Code No.	Radius (R)	Under Neck Length (l1)	Length of Cut (l)	Dia. (D)	Neck Dia. (d2)	Neck Taper Angle (γ)	Shank Dia. (d)	Shank Length (l2)	Overall Length (L)	Actual effective length depending on inclined angle of workpiece				
										30°	1°	1°30'	2°	3°
08-00537-00052	R0.05	0.2	0.07	0.1	0.085	15°	4	27.4	35	0.23	0.24	0.24	0.25	0.27
08-00537-00056		0.25	0.07	0.1	0.085	15°	4	27.4	35	0.28	0.29	0.30	0.31	0.33
08-00537-00053		0.3	0.07	0.1	0.085	15°	4	27.3	35	0.33	0.34	0.35	0.36	0.39
08-00537-00054		0.4	0.07	0.1	0.085	15°	4	27.2	35	0.44	0.45	0.46	0.48	0.52
08-00537-00055		0.5	0.07	0.1	0.085	15°	4	27.1	35	0.54	0.56	0.57	0.59	0.64
08-00537-00076	R0.075	0.25	0.1	0.15	0.13	15°	4	27.5	35	0.29	0.30	0.31	0.31	0.33
08-00537-00072		0.3	0.1	0.15	0.13	15°	4	27.4	35	0.34	0.35	0.36	0.37	0.40
08-00537-00077		0.4	0.1	0.15	0.13	15°	4	27.3	35	0.44	0.46	0.47	0.49	0.52
08-00537-00073		0.5	0.1	0.15	0.13	15°	4	27.2	35	0.55	0.56	0.58	0.60	0.65
08-00537-00074		0.6	0.1	0.15	0.13	15°	4	27.1	35	0.65	0.67	0.69	0.72	0.77
08-00537-00075		0.7	0.1	0.15	0.13	15°	4	27.0	35	0.75	0.78	0.80	0.83	0.89
08-00537-00101	R0.1	0.3	0.15	0.2	0.18	15°	4	27.5	35	0.34	0.35	0.36	0.37	0.39
08-00537-00106		0.4	0.15	0.2	0.18	15°	4	27.4	35	0.44	0.46	0.47	0.48	0.51
08-00537-00102		0.5	0.15	0.2	0.18	15°	4	27.3	35	0.55	0.56	0.58	0.60	0.64
08-00537-00107		0.6	0.15	0.2	0.18	15°	4	27.2	35	0.65	0.67	0.69	0.71	0.76
08-00537-00103		0.75	0.15	0.2	0.18	15°	4	27.1	35	0.81	0.83	0.86	0.89	0.95
08-00537-00104		0.85	0.15	0.2	0.18	15°	4	27.0	35	0.91	0.94	0.97	1.00	1.07
08-00537-00105		1	0.15	0.2	0.18	15°	4	26.8	35	1.06	1.10	1.13	1.17	1.26
08-00537-00150	R0.15	0.5	0.2	0.3	0.28	15°	4	27.5	35	0.55	0.56	0.57	0.59	0.63
08-00537-00151		0.6	0.2	0.3	0.28	15°	4	27.4	35	0.65	0.67	0.69	0.71	0.75
08-00537-00152		0.75	0.2	0.3	0.28	15°	4	27.3	35	0.80	0.83	0.85	0.88	0.94
08-00537-00153		1	0.2	0.3	0.28	15°	4	27.0	35	1.06	1.09	1.13	1.17	1.25
08-00537-00154		1.25	0.2	0.3	0.28	15°	4	26.8	35	1.32	1.36	1.41	1.45	1.56
08-00537-00155		1.5	0.2	0.3	0.28	15°	4	26.5	35	1.58	1.63	1.68	1.74	1.87
08-00537-00201	R0.2	0.5	0.3	0.4	0.37	15°	4	27.7	35	0.56	0.58	0.59	0.60	0.64
08-00537-00207		0.65	0.3	0.4	0.37	15°	4	27.6	35	0.72	0.74	0.76	0.78	0.83
08-00537-00202		0.8	0.3	0.4	0.37	15°	4	27.4	35	0.87	0.90	0.92	0.95	1.01

How to Order

When you order, indicate MRBSH230SF (R)×(l1).

※(γ) is reference value.

Unit [Size : mm]

Code No.	Radius (R)	Under Neck Length (ℓ1)	Length of Cut (ℓ)	Dia. (D)	Neck Dia. (d2)	Neck Taper Angle (γ)	Shank Dia. (d)	Shank Length (ℓ2)	Overall Length (L)	Actual effective length depending on inclined angle of workpiece				
										30°	1°	1°30′	2°	3°
08-00537-00203	R0.2	1	0.3	0.4	0.37	15°	4	27.2	35	1.08	1.11	1.14	1.18	1.26
08-00537-00208		1.25	0.3	0.4	0.37	15°	4	27.0	35	1.34	1.38	1.42	1.47	1.57
08-00537-00204		1.5	0.3	0.4	0.37	15°	4	26.7	35	1.60	1.65	1.70	1.75	1.88
08-00537-00209		1.75	0.3	0.4	0.37	15°	4	26.5	35	1.86	1.91	1.98	2.04	2.19
08-00537-00205		2	0.3	0.4	0.37	15°	4	26.2	35	2.11	2.18	2.25	2.33	2.50
08-00537-00210		2.25	0.3	0.4	0.37	15°	4	26.0	35	2.37	2.45	2.53	2.62	2.81
08-00537-00206		2.5	0.3	0.4	0.37	15°	4	25.7	35	2.63	2.72	2.81	2.90	3.13
08-00537-00251	R0.25	0.5	0.35	0.5	0.46	15°	4	27.8	35	0.58	0.59	0.61	0.62	0.65
08-00537-00252		1	0.35	0.5	0.46	15°	4	27.3	35	1.10	1.13	1.16	1.19	1.27
08-00537-00253		1.5	0.35	0.5	0.46	15°	4	26.8	35	1.61	1.66	1.71	1.77	1.89
08-00537-00254		2	0.35	0.5	0.46	15°	4	26.3	35	2.13	2.20	2.27	2.34	2.51
08-00537-00255		2.5	0.35	0.5	0.46	15°	4	25.8	35	2.65	2.73	2.82	2.92	3.14
08-00537-00256		3	0.35	0.5	0.46	15°	4	25.3	35	3.16	3.27	3.38	3.49	3.76
08-00537-00307	R0.3	0.6	0.45	0.6	0.56	15°	4	27.9	35	0.68	0.70	0.71	0.73	0.76
08-00537-00300		1	0.45	0.6	0.56	15°	4	27.5	35	1.10	1.12	1.15	1.19	1.26
08-00537-00301		1.5	0.45	0.6	0.56	15°	4	27.0	35	1.61	1.66	1.71	1.76	1.88
08-00537-00302		2	0.45	0.6	0.56	15°	4	26.5	35	2.13	2.19	2.26	2.34	2.50
08-00537-00303		2.5	0.45	0.6	0.56	15°	4	26.0	35	2.65	2.73	2.82	2.91	3.12
08-00537-00304		3	0.45	0.6	0.56	15°	4	25.5	35	3.16	3.26	3.37	3.49	3.75
08-00537-00305		3.5	0.45	0.6	0.56	15°	4	25.0	35	3.68	3.80	3.92	4.06	4.37
08-00537-00306		4	0.45	0.6	0.56	15°	4	29.5	40	4.20	4.33	4.48	4.64	4.99
08-00537-00401	R0.4	1	0.6	0.8	0.76	15°	4	27.9	35	1.09	1.12	1.14	1.17	1.24
08-00537-00402		2	0.6	0.8	0.76	15°	4	26.9	35	2.13	2.19	2.25	2.32	2.48
08-00537-00403		3	0.6	0.8	0.76	15°	4	25.9	35	3.16	3.26	3.36	3.47	3.72
08-00537-00405		4	0.6	0.8	0.76	15°	4	24.9	35	4.19	4.33	4.47	4.62	4.97
08-00537-00406		5	0.6	0.8	0.76	15°	4	28.9	40	5.23	5.40	5.58	5.77	6.21
08-00537-00507		R0.5	1	0.75	1	0.95	15°	4	28.3	35	1.11	1.13	1.15	1.18
08-00537-00508	1.5		0.75	1	0.95	15°	4	27.8	35	1.63	1.66	1.71	1.75	1.86
08-00537-00501	2		0.75	1	0.95	15°	4	27.3	35	2.14	2.20	2.26	2.33	2.48
08-00537-00502	2.5		0.75	1	0.95	15°	4	26.8	35	2.66	2.73	2.82	2.90	3.10
08-00537-00503	3		0.75	1	0.95	15°	4	26.3	35	3.18	3.27	3.37	3.48	3.72
08-00537-00504	4		0.75	1	0.95	15°	4	25.3	35	4.21	4.34	4.48	4.63	4.97
08-00537-00505	5		0.75	1	0.95	15°	4	29.3	40	5.24	5.41	5.59	5.78	6.21
08-00537-00506	6		0.75	1	0.95	15°	4	28.3	40	6.28	6.48	6.69	6.93	7.45
08-00537-00602	R0.6	2.4	0.9	1.2	1.15	15°	4	27.2	35	2.55	2.62	2.69	2.77	2.95
08-00537-00603		4	0.9	1.2	1.15	15°	4	25.6	35	4.21	4.33	4.47	4.61	4.94
08-00537-00605		6	0.9	1.2	1.15	15°	4	28.6	40	6.27	6.47	6.68	6.91	7.43
08-00537-00606		8	0.9	1.2	1.15	15°	4	26.6	40	8.34	8.61	8.90	9.21	9.91
08-00537-00751	R0.75	2	1.1	1.5	1.45	15°	4	28.2	35	2.13	2.18	2.23	2.29	2.42
08-00537-00752		3	1.1	1.5	1.45	15°	4	27.2	35	3.17	3.25	3.34	3.44	3.66
08-00537-00753		4	1.1	1.5	1.45	15°	4	26.2	35	4.20	4.32	4.45	4.59	4.91
08-00537-00754		6	1.1	1.5	1.45	15°	4	29.2	40	6.27	6.46	6.67	6.89	7.39
08-00537-00755		8	1.1	1.5	1.45	15°	4	27.2	40	8.34	8.60	8.88	9.19	9.88
08-00537-00756		10	1.1	1.5	1.45	15°	4	25.2	40	10.40	10.74	11.10	11.49	12.36
08-00537-00805	R0.8	8	1.2	1.6	1.55	15°	4	27.4	40	8.33	8.60	8.88	9.18	9.87
08-00537-00901	R0.9	3	1.3	1.8	1.74	15°	4	27.8	35	3.18	3.26	3.35	3.44	3.65
08-00537-00902		4	1.3	1.8	1.74	15°	4	26.8	35	4.22	4.33	4.46	4.59	4.89
08-00537-00903		6	1.3	1.8	1.74	15°	4	29.8	40	6.28	6.47	6.67	6.89	7.38
08-00537-00904		8	1.3	1.8	1.74	15°	4	27.8	40	8.35	8.61	8.89	9.19	9.87
08-00537-00905		10	1.3	1.8	1.74	15°	4	25.8	40	10.42	10.75	11.11	11.49	12.35
08-00537-01006	R1	2	1.5	2	1.94	15°	4	29.1	35	2.14	2.19	2.23	2.28	2.38
08-00537-01000		3	1.5	2	1.94	15°	4	28.1	35	3.18	3.25	3.34	3.43	3.63
08-00537-01001		4	1.5	2	1.94	15°	4	27.1	35	4.21	4.32	4.45	4.58	4.87
08-00537-01002		6	1.5	2	1.94	15°	4	25.1	35	6.28	6.46	6.66	6.88	7.36

MRBSH230SF

MUGEN COATING PREMIUM Plus

2-Flute Long Neck Ball End Mill with Short Shank for Hardened Steel and High accuracy cutting

Unit [Size : mm]

Code No.	Radius (R)	Under Neck Length (ℓ1)	Length of Cut (ℓ)	Dia. (D)	Neck Dia. (d2)	Neck Taper Angle (γ)	Shank Dia. (d)	Shank Length (ℓ2)	Overall Length (L)	Actual effective length depending on inclined angle of workpiece				
										30°	1°	1°30′	2°	3°
08-00537-01003	R1	8	1.5	2	1.94	15°	4	28.1	40	8.35	8.60	8.88	9.18	9.84
08-00537-01004		10	1.5	2	1.94	15°	4	26.1	40	10.41	10.74	11.10	11.48	12.33
08-00537-01005		12	1.5	2	1.94	15°	4	29.1	45	12.48	12.88	13.31	13.77	14.82
08-00537-01251	R1.25	4	2.3	2.5	2.4	15°	4	28.0	35	4.28	4.39	4.50	4.62	4.90
08-00537-01252		6	2.3	2.5	2.4	15°	4	26.0	35	6.35	6.53	6.72	6.92	7.39
08-00537-01253		8	2.3	2.5	2.4	15°	4	29.0	40	8.42	8.67	8.93	9.22	9.88
08-00537-01254		10	2.3	2.5	2.4	15°	4	27.0	40	10.48	10.81	11.15	11.52	12.36
08-00537-01256		15	2.3	2.5	2.4	15°	4	27.0	45	15.65	16.15	16.69	17.27	Free
08-00537-01500	R1.5	6	2.5	3	2.85	15°	6	33.1	45	6.44	6.61	6.79	7.00	7.45
08-00537-01501		8	2.5	3	2.85	15°	6	31.1	45	8.50	8.75	9.01	9.29	9.93
08-00537-01502		10	2.5	3	2.85	15°	6	29.1	45	10.57	10.89	11.23	11.59	12.42
08-00537-01503		12	2.5	3	2.85	15°	6	27.1	45	12.64	13.03	13.44	13.89	14.91
08-00537-01504		14	2.5	3	2.85	15°	6	30.1	50	14.71	15.17	15.66	16.19	17.39
08-00537-01505		16	2.5	3	2.85	15°	6	28.1	50	16.77	17.31	17.88	18.49	19.88
08-00537-01507		18	2.5	3	2.85	15°	6	31.1	55	18.84	19.45	20.09	20.79	22.36
08-00537-01506		20	2.5	3	2.85	15°	6	29.1	55	20.91	21.58	22.31	23.09	24.85
08-00537-02000	R2	8	3	4	3.8	15°	6	32.8	45	8.58	8.81	9.06	9.33	9.93
08-00537-02001		10	3	4	3.8	15°	6	30.8	45	10.65	10.95	11.28	11.63	12.42
08-00537-02002		12	3	4	3.8	15°	6	28.8	45	12.72	13.09	13.49	13.93	14.90
08-00537-02004		15	3	4	3.8	15°	6	30.8	50	15.82	16.30	16.82	17.38	18.63
08-00537-02005		20	3	4	3.8	15°	6	30.8	55	20.99	21.65	22.36	23.13	Free
08-00537-02006		25	3	4	3.8	15°	6	30.8	60	26.16	27.00	27.90	28.88	Free
08-00537-02502	R2.5	10	3.5	5	4.8	15°	6	32.7	45	10.63	10.92	11.22	11.55	Free
08-00537-02503		15	3.5	5	4.8	15°	6	27.7	45	15.80	16.27	16.77	Free	Free
08-00537-02504		20	3.5	5	4.8	15°	6	27.7	50	20.97	21.62	Free	Free	Free
08-00537-02505		25	3.5	5	4.8	15°	6	27.7	55	26.14	26.96	Free	Free	Free
08-00537-02506		30	3.5	5	4.8	15°	6	27.7	60	31.31	Free	Free	Free	Free
08-00537-03000	R3	10	6	6	5.7	-	6	34.4	45	Free	Free	Free	Free	Free
08-00537-03001		15	6	6	5.7	-	6	29.4	45	Free	Free	Free	Free	Free
08-00537-03002		20	6	6	5.7	-	6	29.4	50	Free	Free	Free	Free	Free
08-00537-03003		25	6	6	5.7	-	6	29.4	55	Free	Free	Free	Free	Free
08-00537-03004		30	6	6	5.7	-	6	29.4	60	Free	Free	Free	Free	Free
08-00537-03005		35	6	6	5.7	-	6	29.4	65	Free	Free	Free	Free	Free
08-00537-03006		40	6	6	5.7	-	6	29.4	70	Free	Free	Free	Free	Free

How to Order

When you order, indicate MRBSH230SF (R)×(ℓ1).

※(γ) is reference value.

Recommended Conditions (Metric)

Work Material			High Speed Steels/Hardened Steels SKH51·SKD11 (~62HRC)				High Speed Steels SKH55·HAP40 (~66HRC)				High Speed Steels SKH57·HAP72 (~70HRC)			
Radius	Under Neck Length	L/D	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed
			a _p mm	a _e mm	mm/min	min ⁻¹	a _p mm	a _e mm	mm/min	min ⁻¹	a _p mm	a _e mm	mm/min	min ⁻¹
R0.05	0.2	2	0.002	0.005	100	40,000	0.002	0.003	70	40,000	0.002	0.003	50	40,000
	0.25	2.5	0.002	0.005	80	40,000	0.002	0.003	50	40,000	0.002	0.003	40	40,000
	0.3	3	0.002	0.005	70	40,000	0.002	0.003	50	40,000	0.002	0.003	40	40,000
	0.4	4	0.001	0.005	70	40,000	0.001	0.003	50	40,000	0.001	0.002	30	40,000
	0.5	5	0.001	0.003	50	40,000	0.001	0.002	30	40,000	0.001	0.002	20	40,000
R0.075	0.25	1.7	0.002	0.005	160	40,000	0.002	0.003	120	40,000	0.002	0.003	100	40,000
	0.3	2	0.002	0.005	150	40,000	0.002	0.003	100	40,000	0.002	0.003	80	40,000
	0.4	2.7	0.002	0.005	120	40,000	0.002	0.003	70	40,000	0.002	0.003	50	40,000
	0.5	3.3	0.002	0.005	120	40,000	0.002	0.003	70	40,000	0.002	0.003	50	40,000
	0.6	4	0.001	0.003	100	40,000	0.001	0.002	50	40,000	0.001	0.002	40	40,000
R0.1	0.7	4.7	0.001	0.003	80	40,000	0.001	0.002	40	40,000	0.001	0.002	30	40,000
	0.3	1.5	0.005	0.005	300	40,000	0.003	0.003	200	40,000	0.003	0.003	150	40,000
	0.4	2	0.005	0.005	290	40,000	0.003	0.003	200	40,000	0.003	0.003	150	40,000
	0.5	2.5	0.005	0.005	280	40,000	0.003	0.003	180	40,000	0.003	0.003	130	40,000
	0.6	3	0.003	0.005	250	40,000	0.002	0.003	160	40,000	0.002	0.003	120	40,000
	0.75	3.75	0.003	0.005	200	40,000	0.002	0.003	150	40,000	0.002	0.003	110	40,000
	0.85	4.3	0.002	0.005	180	40,000	0.001	0.003	130	40,000	0.001	0.002	100	40,000
R0.15	1	5	0.002	0.003	160	40,000	0.001	0.002	120	40,000	0.001	0.002	90	40,000
	0.5	1.7	0.007	0.01	300	40,000	0.003	0.005	280	40,000	0.003	0.005	210	40,000
	0.6	2	0.005	0.007	300	40,000	0.003	0.005	250	40,000	0.003	0.005	180	40,000
	0.75	2.5	0.005	0.007	280	40,000	0.003	0.005	230	40,000	0.003	0.005	170	40,000
	1	3.3	0.005	0.007	250	40,000	0.003	0.005	200	40,000	0.003	0.005	150	40,000
	1.25	4.2	0.003	0.005	200	40,000	0.002	0.003	160	40,000	0.002	0.003	120	40,000
R0.2	1.5	5	0.003	0.005	180	40,000	0.002	0.003	120	40,000	0.002	0.003	90	40,000
	0.5	1.25	0.03	0.03	720	40,000	0.009	0.02	580	40,000	0.009	0.02	420	35,000
	0.65	1.6	0.025	0.03	720	40,000	0.009	0.02	580	40,000	0.009	0.02	420	35,000
	0.8	2	0.02	0.03	720	40,000	0.008	0.02	580	40,000	0.008	0.02	420	35,000
	1	2.5	0.02	0.03	720	40,000	0.008	0.02	580	40,000	0.008	0.02	400	35,000
	1.25	3.1	0.015	0.02	620	40,000	0.006	0.02	470	40,000	0.006	0.02	320	35,000
	1.5	3.75	0.01	0.02	500	40,000	0.005	0.01	400	40,000	0.005	0.01	280	35,000
	1.75	4.4	0.01	0.02	450	40,000	0.005	0.01	340	40,000	0.005	0.01	250	35,000
	2	5	0.007	0.01	380	40,000	0.005	0.007	300	40,000	0.005	0.007	220	35,000
R0.25	2.25	5.6	0.005	0.01	330	40,000	0.003	0.005	280	40,000	0.003	0.005	200	35,000
	2.5	6.25	0.005	0.007	300	40,000	0.003	0.005	260	40,000	0.003	0.005	190	35,000
	0.5	1	0.03	0.04	860	40,000	0.015	0.03	650	40,000	0.015	0.02	450	30,000
	1	2	0.02	0.03	860	40,000	0.01	0.02	650	35,000	0.01	0.02	450	30,000
	1.5	3	0.01	0.03	720	40,000	0.007	0.02	520	35,000	0.007	0.02	350	30,000
	2	4	0.01	0.02	650	40,000	0.007	0.01	400	35,000	0.007	0.01	270	30,000
	2.5	5	0.007	0.01	530	40,000	0.005	0.007	360	35,000	0.005	0.007	240	30,000
	3	6	0.007	0.01	420	35,000	0.005	0.007	320	35,000	0.005	0.007	220	30,000
R0.3	0.6	1	0.03	0.08	1,000	40,000	0.02	0.05	720	35,000	0.02	0.05	540	28,000
	1	1.7	0.03	0.06	1,000	40,000	0.02	0.05	720	30,000	0.02	0.05	540	25,000
	1.5	2.5	0.03	0.06	1,000	40,000	0.02	0.05	720	30,000	0.02	0.05	540	25,000
	2	3.3	0.03	0.06	1,000	40,000	0.02	0.05	720	30,000	0.02	0.05	540	25,000
	2.5	4.1	0.02	0.04	840	40,000	0.02	0.03	640	30,000	0.02	0.03	480	25,000
	3	5	0.02	0.04	840	40,000	0.02	0.03	600	30,000	0.02	0.03	450	25,000
	3.5	5.9	0.01	0.03	600	30,000	0.01	0.02	420	30,000	0.01	0.02	310	25,000
	4	6.7	0.01	0.03	600	30,000	0.01	0.02	420	30,000	0.01	0.02	310	25,000
R0.4	1	1.3	0.08	0.12	1,600	38,000	0.06	0.1	1,200	35,000	0.035	0.1	900	28,000
	2	2.5	0.07	0.1	1,600	35,000	0.05	0.1	1,200	30,000	0.03	0.1	900	25,000
	3	3.75	0.05	0.1	1,600	35,000	0.05	0.05	1,200	30,000	0.03	0.05	900	25,000
	4	5	0.04	0.06	1,200	30,000	0.03	0.05	860	25,000	0.02	0.05	640	20,000
	5	6.25	0.03	0.05	1,000	25,000	0.02	0.03	620	25,000	0.015	0.03	460	20,000

MRBSH230SF

Recommended Conditions (Metric)

Work Material			High Speed Steels/Hardened Steels SKH51·SKD11 (~62HRC)				High Speed Steels SKH55·HAP40 (~66HRC)				High Speed Steels SKH57·HAP72 (~70HRC)			
Radius	Under Neck Length	L/D	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed
			a _p mm	a _e mm	mm/min	min ⁻¹	a _p mm	a _e mm	mm/min	min ⁻¹	a _p mm	a _e mm	mm/min	min ⁻¹
R0.5	1	1	0.1	0.2	2,000	30,000	0.08	0.12	1,400	25,000	0.05	0.12	1,000	20,000
	1.5	1.5	0.1	0.2	2,000	30,000	0.08	0.12	1,400	25,000	0.05	0.12	1,000	20,000
	2	2	0.1	0.2	2,000	30,000	0.08	0.1	1,400	25,000	0.05	0.1	1,000	20,000
	2.5	2.5	0.1	0.2	2,000	30,000	0.08	0.1	1,400	25,000	0.05	0.1	1,000	20,000
	3	3	0.1	0.2	2,000	30,000	0.08	0.1	1,400	25,000	0.05	0.1	1,000	20,000
	4	4	0.05	0.15	1,600	28,000	0.05	0.1	1,200	25,000	0.03	0.1	900	20,000
R0.6	5	5	0.04	0.1	1,400	25,000	0.03	0.05	920	20,000	0.02	0.05	700	16,000
	6	6	0.04	0.05	1,200	22,000	0.02	0.05	740	20,000	0.015	0.05	550	16,000
	2.4	2	0.1	0.2	2,000	30,000	0.08	0.1	1,600	25,000	0.05	0.1	1,200	20,000
	4	3.3	0.1	0.2	2,000	30,000	0.06	0.1	1,600	25,000	0.05	0.1	1,200	20,000
R0.75	6	5	0.05	0.1	1,400	25,000	0.03	0.07	1,000	20,000	0.02	0.07	750	16,000
	8	6.7	0.03	0.07	1,200	22,000	0.02	0.05	850	20,000	0.015	0.05	650	16,000
	2	1.3	0.1	0.3	2,500	30,000	0.1	0.2	2,000	25,000	0.06	0.2	1,500	20,000
	3	2	0.1	0.3	2,500	30,000	0.1	0.2	2,000	25,000	0.06	0.2	1,500	20,000
	4	2.7	0.1	0.3	2,000	25,000	0.1	0.2	1,600	22,000	0.06	0.2	1,200	18,000
R0.8	6	4	0.1	0.2	1,600	22,000	0.1	0.1	1,200	20,000	0.06	0.1	950	16,000
	8	5.3	0.05	0.2	1,400	20,000	0.05	0.1	1,000	18,000	0.03	0.1	700	13,000
R0.9	10	6.7	0.05	0.1	1,200	18,000	0.05	0.05	850	16,000	0.03	0.05	650	13,000
	8	5	0.07	0.2	1,400	20,000	0.05	0.1	1,000	16,000	0.03	0.1	750	13,000
	3	1.7	0.12	0.3	2,500	25,000	0.1	0.25	2,000	20,000	0.08	0.2	1,500	16,000
	4	2.2	0.12	0.25	2,500	25,000	0.1	0.2	1,800	20,000	0.08	0.2	1,500	16,000
	6	3.3	0.12	0.25	2,500	25,000	0.1	0.2	1,600	18,000	0.08	0.2	1,200	16,000
R1	8	4.4	0.08	0.2	2,300	23,000	0.08	0.15	1,400	17,000	0.06	0.1	750	13,000
	10	5.6	0.08	0.2	1,700	18,000	0.08	0.12	1,100	14,000	0.03	0.1	750	11,000
	2	1	0.2	0.5	2,500	25,000	0.15	0.3	2,000	20,000	0.1	0.3	1,500	16,000
	3	1.5	0.2	0.5	2,500	25,000	0.15	0.3	2,000	20,000	0.1	0.3	1,500	16,000
	4	2	0.2	0.5	2,500	25,000	0.15	0.3	2,000	20,000	0.1	0.3	1,500	16,000
	6	3	0.2	0.3	2,000	22,000	0.15	0.3	1,600	20,000	0.1	0.3	1,200	16,000
	8	4	0.1	0.2	1,600	18,000	0.1	0.15	1,200	16,000	0.06	0.15	950	13,000
R1.25	10	5	0.1	0.2	1,400	16,000	0.1	0.1	1,000	14,000	0.06	0.1	750	11,000
	12	6	0.07	0.1	1,200	14,000	0.05	0.1	850	12,000	0.03	0.1	650	9,500
	4	1.6	0.2	0.5	2,500	20,000	0.15	0.4	2,000	18,000	0.1	0.4	1,500	14,000
	6	2.4	0.2	0.5	2,500	20,000	0.15	0.4	2,000	18,000	0.1	0.4	1,500	14,000
	8	3.2	0.2	0.3	2,100	20,000	0.15	0.3	1,800	18,000	0.1	0.3	1,300	14,000
R1.5	10	4	0.15	0.2	1,800	18,000	0.1	0.15	1,500	16,000	0.06	0.15	1,100	13,000
	15	6	0.07	0.15	1,200	14,000	0.05	0.1	900	12,000	0.03	0.1	700	9,500
	6	2	0.2	0.6	2,500	18,000	0.2	0.5	2,000	15,000	0.12	0.5	1,500	12,000
	8	2.7	0.2	0.6	2,500	18,000	0.2	0.5	2,000	15,000	0.12	0.5	1,500	12,000
	10	3.3	0.2	0.4	2,100	18,000	0.15	0.3	1,800	15,000	0.1	0.3	1,300	12,000
	12	4	0.2	0.4	2,000	18,000	0.1	0.3	1,500	15,000	0.06	0.3	1,100	12,000
	14	4.7	0.1	0.3	1,600	16,000	0.1	0.2	1,200	12,000	0.06	0.2	900	10,000
	16	5.3	0.1	0.3	1,600	16,000	0.1	0.2	1,200	12,000	0.06	0.2	900	10,000
R2	18	6	0.1	0.2	1,400	16,000	0.1	0.15	960	12,000	0.06	0.15	750	9,500
	20	6.7	0.08	0.2	1,200	14,000	0.08	0.1	850	12,000	0.06	0.1	650	9,500
	8	2	0.2	0.8	2,500	15,000	0.2	0.6	2,000	12,000	0.15	0.6	1,500	9,500
	10	2.5	0.2	0.8	2,500	15,000	0.2	0.6	2,000	12,000	0.15	0.6	1,500	9,500
	12	3	0.2	0.8	2,500	15,000	0.2	0.6	2,000	12,000	0.15	0.6	1,500	9,500
	15	3.75	0.2	0.8	2,000	15,000	0.15	0.6	1,600	12,000	0.12	0.6	1,200	9,500
R2.5	20	5	0.1	0.6	1,700	14,000	0.1	0.4	1,200	10,000	0.08	0.4	900	8,000
	25	6.25	0.1	0.4	1,200	14,000	0.1	0.2	850	10,000	0.08	0.2	650	8,000
	10	2	0.2	1.2	2,500	12,000	0.2	0.7	2,000	10,000	0.15	0.7	1,500	8,000
R2.5	15	3	0.2	1.2	2,500	12,000	0.2	0.7	2,000	10,000	0.15	0.7	1,500	8,000
	20	4	0.2	1	2,000	10,000	0.15	0.6	1,600	8,500	0.12	0.6	1,200	6,500

Recommended Conditions (Metric)

Work Material			High Speed Steels/Hardened Steels SKH51·SKD11 (~62HRC)				High Speed Steels SKH55·HAP40 (~66HRC)				High Speed Steels SKH57·HAP72 (~70HRC)			
Radius	Under Neck Length	L/D	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed	Depth of Cut		Feed	Spindle Speed
			ap mm	ae mm	mm/min	min ⁻¹	ap mm	ae mm	mm/min	min ⁻¹	ap mm	ae mm	mm/min	min ⁻¹
R2.5	25	5	0.15	0.8	1,800	8,600	0.1	0.3	1,200	7,200	0.08	0.3	1,000	6,500
	30	6	0.15	0.5	1,500	7,600	0.1	0.2	860	6,400	0.08	0.2	750	6,000
R3	10	1.7	0.3	1.2	2,500	8,000	0.2	1	2,000	7,000	0.15	1	1,500	5,500
	15	2.5	0.3	1.2	2,500	8,000	0.2	1	2,000	7,000	0.15	1	1,500	5,500
	20	3.3	0.3	1.2	2,500	8,000	0.2	1	2,000	7,000	0.15	1	1,500	5,500
	25	4.1	0.2	1	2,200	8,000	0.15	0.7	1,600	7,000	0.12	0.7	1,200	5,500
	30	5	0.2	1	1,800	7,000	0.15	0.7	1,300	6,500	0.12	0.7	950	5,000
	35	5.8	0.17	0.8	1,600	6,800	0.12	0.5	1,200	5,800	0.1	0.5	800	4,500
	40	6.7	0.15	0.6	1,200	6,400	0.1	0.4	1,000	5,200	0.08	0.4	650	4,000
Notes			<p>※ Recommended RPM based upon ideal conditions. RPM may be adjusted to match the capabilities of your machine while maintaining constant feed rate per cutting tooth.</p> <p>※1 Depth of Cut ap indicates Axial Depth of Cut, ae indicates Radial Depth of Cut. ※2 In case of chattering etc., please adjust cutting conditions if necessary. ※3 At point where cutting load is high such as at corners, pay attention to setting cutting conditions and tool paths particularly. ※4 Adjust both spindle speed and feed at the same rate. ※5 A shrink fit type is recommended for tool holder. When using collet type or others, strictly adhere to minimum gripping length. ※6 We recommend using oil mist coolant.</p>											

MRBSH230SF

Recommended Conditions (Inch)

Work Material			High Speed Steels / Hardened Steels SKH51 (M2)•SKD11 (D2) (~62HRC)					High Speed Steels SKH55•HAP40 (~66HRC)					High Speed Steels SKH57•HAP72 (~70HRC)				
Radius	Under Neck Length	L/D	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed
			ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM
R0.05	0.2	2	.00008	.00020	.00005	3.94	40,000	.00008	.00012	.00003	2.76	40,000	.00008	.00012	.00002	1.97	40,000
	0.25	2.5	.00008	.00020	.00004	3.15	40,000	.00008	.00012	.00002	1.97	40,000	.00008	.00012	.00002	1.57	40,000
	0.3	3	.00008	.00020	.00003	2.76	40,000	.00008	.00012	.00002	1.97	40,000	.00008	.00012	.00002	1.57	40,000
	0.4	4	.00004	.00020	.00003	2.76	40,000	.00004	.00012	.00002	1.97	40,000	.00004	.00008	.00001	1.18	40,000
	0.5	5	.00004	.00012	.00002	1.97	40,000	.00004	.00008	.00001	1.18	40,000	.00004	.00008	.00001	0.79	40,000
R0.075	0.25	1.7	.00008	.00020	.00008	6.30	40,000	.00008	.00012	.00006	4.72	40,000	.00008	.00012	.00005	3.94	40,000
	0.3	2	.00008	.00020	.00007	5.91	40,000	.00008	.00012	.00005	3.94	40,000	.00008	.00012	.00004	3.15	40,000
	0.4	2.7	.00008	.00020	.00006	4.72	40,000	.00008	.00012	.00003	2.76	40,000	.00008	.00012	.00002	1.97	40,000
	0.5	3.3	.00008	.00020	.00006	4.72	40,000	.00008	.00012	.00003	2.76	40,000	.00008	.00012	.00002	1.97	40,000
	0.6	4	.00004	.00012	.00005	3.94	40,000	.00004	.00008	.00002	1.97	40,000	.00004	.00008	.00002	1.57	40,000
R0.1	0.7	4.7	.00004	.00012	.00004	3.15	40,000	.00004	.00008	.00002	1.57	40,000	.00004	.00008	.00001	1.18	40,000
	0.3	1.5	.00020	.00020	.00015	11.81	40,000	.00012	.00012	.00010	7.87	40,000	.00012	.00012	.00007	5.91	40,000
	0.4	2	.00020	.00020	.00014	11.42	40,000	.00012	.00012	.00010	7.87	40,000	.00012	.00012	.00007	5.91	40,000
	0.5	2.5	.00020	.00020	.00014	11.02	40,000	.00012	.00012	.00009	7.09	40,000	.00012	.00012	.00006	5.12	40,000
	0.6	3	.00012	.00020	.00012	9.84	40,000	.00008	.00012	.00008	6.30	40,000	.00008	.00012	.00006	4.72	40,000
	0.75	3.75	.00012	.00020	.00010	7.87	40,000	.00008	.00012	.00007	5.91	40,000	.00008	.00012	.00005	4.33	40,000
	0.85	4.3	.00008	.00020	.00009	7.09	40,000	.00004	.00012	.00006	5.12	40,000	.00004	.00008	.00005	3.94	40,000
R0.15	1	5	.00008	.00012	.00008	6.30	40,000	.00004	.00008	.00006	4.72	40,000	.00004	.00008	.00004	3.54	40,000
	0.5	1.7	.00028	.00039	.00015	11.81	40,000	.00012	.00020	.00014	11.02	40,000	.00012	.00020	.00010	8.27	40,000
	0.6	2	.00020	.00028	.00015	11.81	40,000	.00012	.00020	.00012	9.84	40,000	.00012	.00020	.00009	7.09	40,000
	0.75	2.5	.00020	.00028	.00014	11.02	40,000	.00012	.00020	.00011	9.06	40,000	.00012	.00020	.00008	6.69	40,000
	1	3.3	.00020	.00028	.00012	9.84	40,000	.00012	.00020	.00010	7.87	40,000	.00012	.00020	.00007	5.91	40,000
	1.25	4.2	.00012	.00020	.00010	7.87	40,000	.00008	.00012	.00008	6.30	40,000	.00008	.00012	.00006	4.72	40,000
	1.5	5	.00012	.00020	.00009	7.09	40,000	.00008	.00012	.00006	4.72	40,000	.00008	.00012	.00004	3.54	40,000
R0.2	0.5	1.25	.00118	.00118	.00035	28.35	40,000	.00035	.00079	.00029	22.83	40,000	.00035	.00079	.00024	16.54	35,000
	0.65	1.6	.00098	.00118	.00035	28.35	40,000	.00035	.00079	.00029	22.83	40,000	.00035	.00079	.00024	16.54	35,000
	0.8	2	.00079	.00118	.00035	28.35	40,000	.00031	.00079	.00029	22.83	40,000	.00031	.00079	.00024	16.54	35,000
	1	2.5	.00079	.00118	.00035	28.35	40,000	.00031	.00079	.00029	22.83	40,000	.00031	.00079	.00022	15.75	35,000
	1.25	3.1	.00059	.00079	.00031	24.41	40,000	.00024	.00079	.00023	18.50	40,000	.00024	.00079	.00018	12.60	35,000
	1.5	3.75	.00039	.00079	.00025	19.69	40,000	.00020	.00039	.00020	15.75	40,000	.00020	.00039	.00016	11.02	35,000
	1.75	4.4	.00039	.00079	.00022	17.72	40,000	.00020	.00039	.00017	13.39	40,000	.00020	.00039	.00014	9.84	35,000
	2	5	.00028	.00039	.00019	14.96	40,000	.00020	.00028	.00015	11.81	40,000	.00020	.00028	.00012	8.66	35,000
	2.25	5.6	.00020	.00039	.00016	12.99	40,000	.00012	.00020	.00014	11.02	40,000	.00012	.00020	.00011	7.87	35,000
	2.5	6.25	.00020	.00028	.00015	11.81	40,000	.00012	.00020	.00013	10.24	40,000	.00012	.00020	.00011	7.48	35,000
R0.25	0.5	1	.00118	.00157	.00042	33.86	40,000	.00059	.00118	.00032	25.59	40,000	.00059	.00079	.00030	17.72	30,000
	1	2	.00079	.00118	.00042	33.86	40,000	.00039	.00079	.00037	25.59	35,000	.00039	.00079	.00030	17.72	30,000
	1.5	3	.00039	.00118	.00035	28.35	40,000	.00028	.00079	.00029	20.47	35,000	.00028	.00079	.00023	13.78	30,000
	2	4	.00039	.00079	.00032	25.59	40,000	.00028	.00039	.00022	15.75	35,000	.00028	.00039	.00018	10.63	30,000
	2.5	5	.00028	.00039	.00026	20.87	40,000	.00020	.00028	.00020	14.17	35,000	.00020	.00028	.00016	9.45	30,000
	3	6	.00028	.00039	.00024	16.54	35,000	.00020	.00028	.00018	12.60	35,000	.00020	.00028	.00014	8.66	30,000
	0.6	1	.00118	.00315	.00049	39.37	40,000	.00079	.00197	.00040	28.35	35,000	.00079	.00197	.00038	21.26	28,000
R0.3	1	1.7	.00118	.00236	.00049	39.37	40,000	.00079	.00197	.00047	28.35	30,000	.00079	.00197	.00043	21.26	25,000
	1.5	2.5	.00118	.00236	.00049	39.37	40,000	.00079	.00197	.00047	28.35	30,000	.00079	.00197	.00043	21.26	25,000
	2	3.3	.00118	.00236	.00049	39.37	40,000	.00079	.00197	.00047	28.35	30,000	.00079	.00197	.00043	21.26	25,000
	2.5	4.1	.00079	.00157	.00041	33.07	40,000	.00079	.00118	.00042	25.20	30,000	.00079	.00118	.00038	18.90	25,000
	3	5	.00079	.00157	.00041	33.07	40,000	.00079	.00118	.00039	23.62	30,000	.00079	.00118	.00035	17.72	25,000
	3.5	5.9	.00039	.00118	.00039	23.62	30,000	.00039	.00079	.00028	16.54	30,000	.00039	.00079	.00024	12.20	25,000
	4	6.7	.00039	.00118	.00039	23.62	30,000	.00039	.00079	.00028	16.54	30,000	.00039	.00079	.00024	12.20	25,000
	1	1.3	.00315	.00472	.00083	62.99	38,000	.00236	.00394	.00067	47.24	35,000	.00138	.00394	.00063	35.43	28,000
R0.4	2	2.5	.00276	.00394	.00090	62.99	35,000	.00197	.00394	.00079	47.24	30,000	.00118	.00394	.00071	35.43	25,000
	3	3.75	.00197	.00394	.00090	62.99	35,000	.00197	.00197	.00079	47.24	30,000	.00118	.00197	.00071	35.43	25,000
	4	5	.00157	.00236	.00079	47.24	30,000	.00118	.00197	.00068	33.86	25,000	.00079	.00197	.00063	25.20	20,000
	5	6.25	.00118	.00197	.00079	39.37	25,000	.00079	.00118	.00049	24.41	25,000	.00059	.00118	.00045	18.11	20,000

Recommended Conditions (Inch)

Work Material			High Speed Steels / Hardened Steels SKH51 (M2)·SKD11 (D2) (~62HRC)					High Speed Steels SKH55·HAP40 (~66HRC)					High Speed Steels SKH57·HAP72 (~70HRC)				
Radius	Under Neck Length	L/D	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed
			ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM
R0.5	1	1	.00394	.00787	.00131	78.74	30,000	.00315	.00472	.00110	55.12	25,000	.00197	.00472	.00098	39.37	20,000
	1.5	1.5	.00394	.00787	.00131	78.74	30,000	.00315	.00472	.00110	55.12	25,000	.00197	.00472	.00098	39.37	20,000
	2	2	.00394	.00787	.00131	78.74	30,000	.00315	.00394	.00110	55.12	25,000	.00197	.00394	.00098	39.37	20,000
	2.5	2.5	.00394	.00787	.00131	78.74	30,000	.00315	.00394	.00110	55.12	25,000	.00197	.00394	.00098	39.37	20,000
	3	3	.00394	.00787	.00131	78.74	30,000	.00315	.00394	.00110	55.12	25,000	.00197	.00394	.00098	39.37	20,000
	4	4	.00197	.00591	.00112	62.99	28,000	.00197	.00394	.00094	47.24	25,000	.00118	.00394	.00089	35.43	20,000
R0.6	5	5	.00157	.00394	.00110	55.12	25,000	.00118	.00197	.00091	36.22	20,000	.00079	.00197	.00086	27.56	16,000
	6	6	.00157	.00197	.00107	47.24	22,000	.00079	.00197	.00073	29.13	20,000	.00059	.00197	.00068	21.65	16,000
	2.4	2	.00394	.00787	.00131	78.74	30,000	.00315	.00394	.00126	62.99	25,000	.00197	.00394	.00118	47.24	20,000
R0.75	4	3.3	.00394	.00787	.00131	78.74	30,000	.00236	.00394	.00126	62.99	25,000	.00197	.00394	.00118	47.24	20,000
	6	5	.00197	.00394	.00110	55.12	25,000	.00118	.00276	.00098	39.37	20,000	.00079	.00276	.00092	29.53	16,000
	8	6.7	.00118	.00276	.00107	47.24	22,000	.00079	.00197	.00084	33.46	20,000	.00059	.00197	.00080	25.59	16,000
	2	1.3	.00394	.01181	.00164	98.43	30,000	.00394	.00787	.00157	78.74	25,000	.00236	.00787	.00148	59.06	20,000
	3	2	.00394	.01181	.00164	98.43	30,000	.00394	.00787	.00157	78.74	25,000	.00236	.00787	.00148	59.06	20,000
R0.8	4	2.7	.00394	.01181	.00157	78.74	25,000	.00394	.00787	.00143	62.99	22,000	.00236	.00787	.00131	47.24	18,000
	6	4	.00394	.00787	.00143	62.99	22,000	.00394	.00394	.00118	47.24	20,000	.00236	.00394	.00117	37.40	16,000
	8	5.3	.00197	.00787	.00138	55.12	20,000	.00197	.00394	.00109	39.37	18,000	.00118	.00394	.00106	27.56	13,000
	10	6.7	.00197	.00394	.00131	47.24	18,000	.00197	.00197	.00105	33.46	16,000	.00118	.00197	.00098	25.59	13,000
	8	5	.00276	.00787	.00138	55.12	20,000	.00197	.00394	.00123	39.37	16,000	.00118	.00394	.00114	29.53	13,000
R0.9	3	1.7	.00472	.01181	.00197	98.43	25,000	.00394	.00984	.00197	78.74	20,000	.00315	.00787	.00185	59.06	16,000
	4	2.2	.00472	.00984	.00197	98.43	25,000	.00394	.00787	.00177	70.87	20,000	.00315	.00787	.00185	59.06	16,000
	6	3.3	.00472	.00984	.00197	98.43	25,000	.00394	.00787	.00175	62.99	18,000	.00315	.00787	.00148	47.24	16,000
	8	4.4	.00315	.00787	.00197	90.55	23,000	.00315	.00591	.00162	55.12	17,000	.00236	.00394	.00114	29.53	13,000
	10	5.6	.00315	.00787	.00186	66.93	18,000	.00315	.00472	.00155	43.31	14,000	.00118	.00394	.00134	29.53	11,000
R1	2	1	.00787	.01969	.00197	98.43	25,000	.00591	.01181	.00197	78.74	20,000	.00394	.01181	.00185	59.06	16,000
	3	1.5	.00787	.01969	.00197	98.43	25,000	.00591	.01181	.00197	78.74	20,000	.00394	.01181	.00185	59.06	16,000
	4	2	.00787	.01969	.00197	98.43	25,000	.00591	.01181	.00197	78.74	20,000	.00394	.01181	.00185	59.06	16,000
	6	3	.00787	.01181	.00179	78.74	22,000	.00591	.01181	.00157	62.99	20,000	.00394	.01181	.00148	47.24	16,000
	8	4	.00394	.00787	.00175	62.99	18,000	.00394	.00591	.00148	47.24	16,000	.00236	.00591	.00144	37.40	13,000
	10	5	.00394	.00787	.00172	55.12	16,000	.00394	.00394	.00141	39.37	14,000	.00236	.00394	.00134	29.53	11,000
	12	6	.00276	.00394	.00169	47.24	14,000	.00197	.00394	.00139	33.46	12,000	.00118	.00394	.00135	25.59	9,500
R1.25	4	1.6	.00787	.01969	.00246	98.43	20,000	.00591	.01575	.00219	78.74	18,000	.00394	.01575	.00211	59.06	14,000
	6	2.4	.00787	.01969	.00246	98.43	20,000	.00591	.01575	.00219	78.74	18,000	.00394	.01575	.00211	59.06	14,000
	8	3.2	.00787	.01181	.00207	82.68	20,000	.00591	.01181	.00197	70.87	18,000	.00394	.01181	.00183	51.18	14,000
	10	4	.00591	.00787	.00197	70.87	18,000	.00394	.00591	.00185	59.06	16,000	.00236	.00591	.00167	43.31	13,000
	15	6	.00276	.00591	.00169	47.24	14,000	.00197	.00394	.00148	35.43	12,000	.00118	.00394	.00145	27.56	9,500
R1.5	6	2	.00787	.02362	.00273	98.43	18,000	.00787	.01969	.00262	78.74	15,000	.00472	.01969	.00246	59.06	12,000
	8	2.7	.00787	.02362	.00273	98.43	18,000	.00787	.01969	.00262	78.74	15,000	.00472	.01969	.00246	59.06	12,000
	10	3.3	.00787	.01575	.00230	82.68	18,000	.00591	.01181	.00236	70.87	15,000	.00394	.01181	.00213	51.18	12,000
	12	4	.00787	.01575	.00219	78.74	18,000	.00394	.01181	.00197	59.06	15,000	.00236	.01181	.00180	43.31	12,000
	14	4.7	.00394	.01181	.00197	62.99	16,000	.00394	.00787	.00197	47.24	12,000	.00236	.00787	.00177	35.43	10,000
	16	5.3	.00394	.01181	.00197	62.99	16,000	.00394	.00787	.00197	47.24	12,000	.00236	.00787	.00177	35.43	10,000
	18	6	.00394	.00787	.00172	55.12	16,000	.00394	.00591	.00157	37.80	12,000	.00236	.00591	.00155	29.53	9,500
R2	20	6.7	.00315	.00787	.00169	47.24	14,000	.00315	.00394	.00139	33.46	12,000	.00236	.00394	.00135	25.59	9,500
	8	2	.00787	.03150	.00328	98.43	15,000	.00787	.02362	.00328	78.74	12,000	.00591	.02362	.00311	59.06	9,500
	10	2.5	.00787	.03150	.00328	98.43	15,000	.00787	.02362	.00328	78.74	12,000	.00591	.02362	.00311	59.06	9,500
	12	3	.00787	.03150	.00328	98.43	15,000	.00787	.02362	.00328	78.74	12,000	.00591	.02362	.00311	59.06	9,500
	15	3.75	.00787	.03150	.00262	78.74	15,000	.00591	.02362	.00262	62.99	12,000	.00472	.02362	.00249	47.24	9,500
	20	5	.00394	.02362	.00239	66.93	14,000	.00394	.01575	.00236	47.24	10,000	.00315	.01575	.00221	35.43	8,000
R2.5	25	6.25	.00394	.01575	.00169	47.24	14,000	.00394	.00787	.00167	33.46	10,000	.00315	.00787	.00160	25.59	8,000
	10	2	.00787	.04724	.00410	98.43	12,000	.00787	.02756	.00394	78.74	10,000	.00591	.02756	.00369	59.06	8,000
	15	3	.00787	.04724	.00410	98.43	12,000	.00787	.02756	.00394	78.74	10,000	.00591	.02756	.00369	59.06	8,000
	20	4	.00787	.03937	.00394	78.74	10,000	.00591	.02362	.00371	62.99	8,500	.00472	.02362	.00363	47.24	6,500

MRBSH230SF

Recommended Conditions (Inch)

Work Material			High Speed Steels / Hardened Steels SKH51 (M2)·SKD11 (D2) (~62HRC)					High Speed Steels SKH55·HAP40 (~66HRC)					High Speed Steels SKH57·HAP72 (~70HRC)				
Radius	Under Neck Length	L/D	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed	Depth of Cut		Feed per tooth	Feed	Spindle Speed
			ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM	ap Inch	ae Inch	IPT fz	IPM	RPM
R2.5	25	5	.00591	.03150	.00412	70.87	8,600	.00394	.01181	.00328	47.24	7,200	.00315	.01181	.00303	39.37	6,500
	30	6	.00591	.01969	.00389	59.06	7,600	.00394	.00787	.00265	33.86	6,400	.00315	.00787	.00246	29.53	6,000
R3	10	1.7	.01181	.04724	.00615	98.43	8,000	.00787	.03937	.00562	78.74	7,000	.00591	.03937	.00537	59.06	5,500
	15	2.5	.01181	.04724	.00615	98.43	8,000	.00787	.03937	.00562	78.74	7,000	.00591	.03937	.00537	59.06	5,500
	20	3.3	.01181	.04724	.00615	98.43	8,000	.00787	.03937	.00562	78.74	7,000	.00591	.03937	.00537	59.06	5,500
	25	4.1	.00787	.03937	.00541	86.61	8,000	.00591	.02756	.00450	62.99	7,000	.00472	.02756	.00429	47.24	5,500
	30	5	.00787	.03937	.00506	70.87	7,000	.00591	.02756	.00394	51.18	6,500	.00472	.02756	.00374	37.40	5,000
	35	5.8	.00669	.03150	.00463	62.99	6,800	.00472	.01969	.00407	47.24	5,800	.00394	.01969	.00350	31.50	4,500
	40	6.7	.00591	.02362	.00369	47.24	6,400	.00394	.01575	.00379	39.37	5,200	.00315	.01575	.00320	25.59	4,000
	Notes			<p>※Recommended RPM based upon ideal conditions. RPM may be adjusted to match the capabilities of your machine while maintaining constant feed rate per cutting tooth.</p> <p>※1 Depth of Cut ap indicates Axial Depth of Cut, ae indicates Radial Depth of Cut. ※2 In case of chattering etc., please adjust cutting conditions if necessary. ※3 At point where cutting load is high such as at corners, pay attention to setting cutting conditions and tool paths particularly. ※4 Adjust both spindle speed and feed at the same rate. ※5 A shrink fit type is recommended for tool holder. When using collet type or others, strictly adhere to minimum gripping length. ※6 We recommend using oil mist coolant.</p>													

Comparison of dimensional accuracy

HAP72 (70HRC)

Comparison of dimensional accuracy after finishing

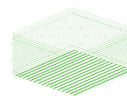
Tool : MRBSH230SF R1×6

Cutting content: Finishing for 1 pocket

Cutting time : 32min/per pocket

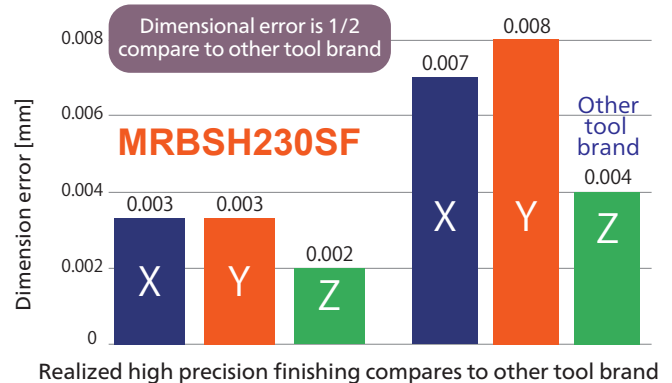
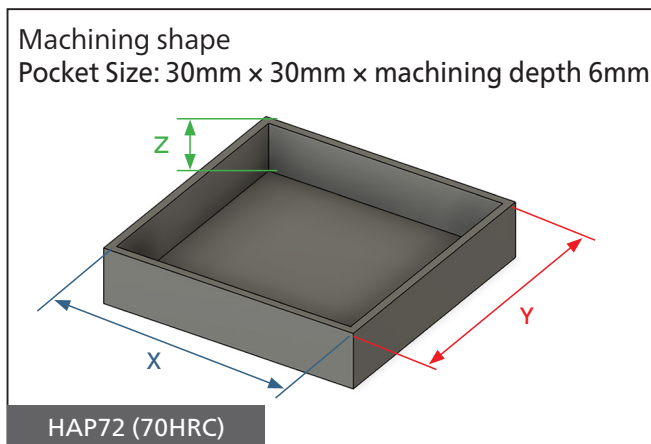
Tool path : Contour line finishing (Side)

Scanning line finishing (Bottom)



Finishing

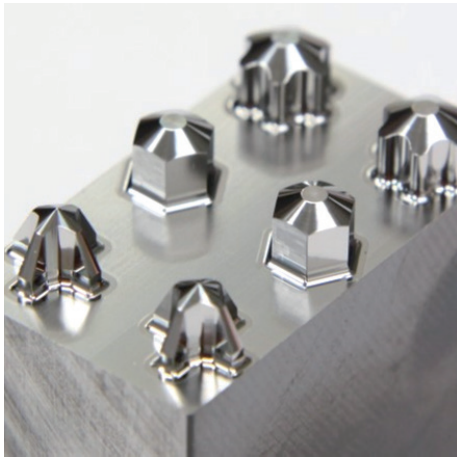
$n = 16,000 \text{min}^{-1}$, $V_f = 1,000 \text{mm/min}$, $a_p 0.03 \times a_e 0.03 \text{mm}$, Oil Mist



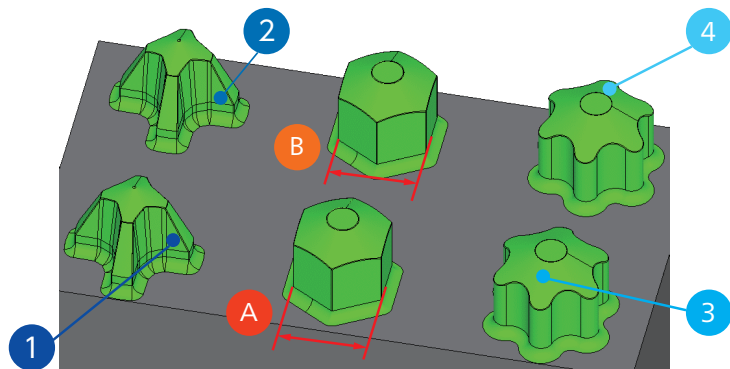
Machining Case 1

3 difference shapes on screw head (punch sample)

Realize high precision even machining on 68HRC hardened steel



Work Material : HAP72 (68HRC)
 Coolant : Oil mist
 Total machining time : 8hr 25min
 Work size : 20×35mm
 Machining depth : 5.1mm



Surface Roughness

		Unit [μm]	
Measuring position		Ra	Rz
1	At the beginning	0.176	1.320
2	At the end	0.155	1.125
3	At the beginning	0.114	0.963
4	At the end	0.142	0.877

Accuracy

		Unit [mm]			
Measuring position		Target	Actual	Error	Deflection
A	At the beginning	5.080	5.087	0.007	under 0.001
B	At the end	5.080	5.090	0.010	0.001

Process	Roughing	Semi-finishing Side & Finishing Bottom	Stock	Finishing
Tool	MRBSH230SF R1×4	MRBSH230SF R1×4	MRBSH230SF R0.5×4	MRBSH230SF R0.5×4
Spindle speed [min^{-1}]	16,000		18,000	
Feed [mm/min]	1,500	600	300	400
Depth of cut $a_p \times a_e$ [mm]	0.1 × 0.3	pf : 0.03	pf : 0.03	pf : 0.02
Stock [mm]	0.015	Side 0.01 Bottom —	0.01	—
Machining time	181 min	95 min	80 min	149 min

※ pf : pick feed

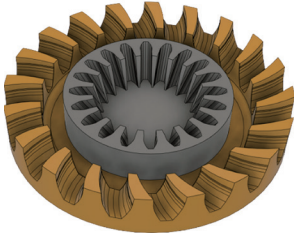
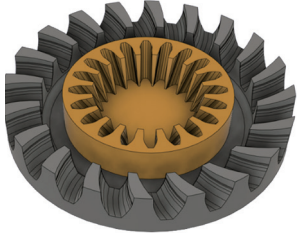
Machining Case 2

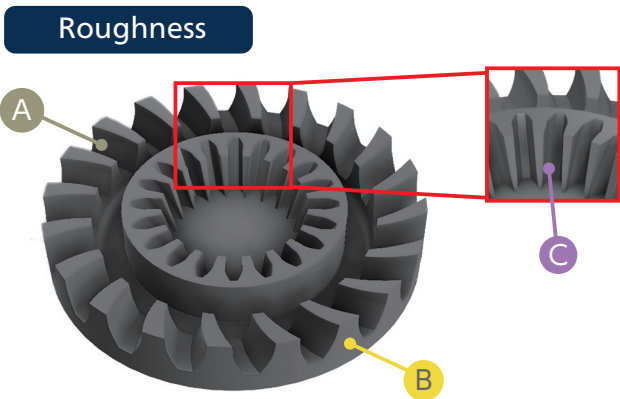
Gear & Gear Sample

High precision and long tool life even for hardened steel up to 70HRC



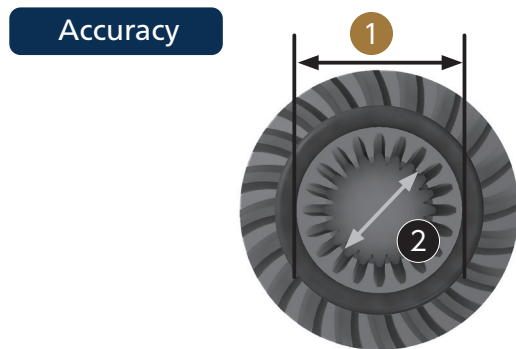
Material : HAP72 (70HRC)
 Coolant : Oil mist
 Total machining time : 11hr 33min
 Work size : Φ 40 (Base 50x45 mm)
 Machining depth : 6mm

Process	Roughing	Semi-finishing	Finishing	Roughing	Semi-finishing	Finishing
Machining position	Peripheral gear 			Inside gear 		
Tool	MRBSH230SF R1x6	MRBSH230SF R1x6	MRBSH230SF R1x6	MRBSH230SF R0.5x6	MRBSH230SF R0.5x6	MRBSH230SF R0.5x6
Spindle speed [min ⁻¹]	12,000			14,000		
Feed [mm/min]	1,800		1,200	1,000		700
Depth of cut [mm]	ap 0.06 ae 0.3	Pick feed 0.1	Pick feed 0.03	ap 0.03 ae 0.15	Pick feed 0.05	Pick feed 0.02
Stock [mm]	0.03	0.01	—	0.03	0.01	—
Machining time	2hr 36min	51 min	3hr 30min	3hr 6min	22 min	1hr 8min
Total machining time	6hr 57min			4hr 36min		



	A	B	C
Tool	MRBSH230SF R1x6	MRBSH230SF R0.5x6	
Ra	0.133	0.137	0.282
Rz	0.815	1.336	1.676

Measuring instrument: Keyence VK-X250



	1	2
Tool	MRBSH230SF R1x6	MRBSH230SF R0.5x6
Target	24.500	15.480
Actual	24.505	15.472
Error	0.005	0.008

Measuring instrument : Nikon microscope MM-60

Machining Case 3

Gear shape punch mold

High precision even during long finishing over 4 hours



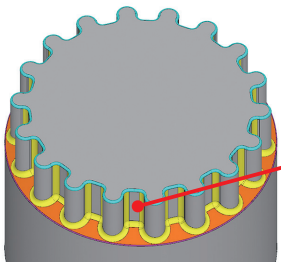
Material : HAP40 (65HRC)

Coolant : Oil mist

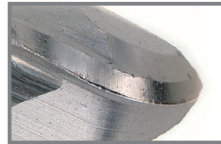
Total machining time : 8hr 46min

Work size : Φ 25x50mm Machining depth : 6mm

Surface Roughness

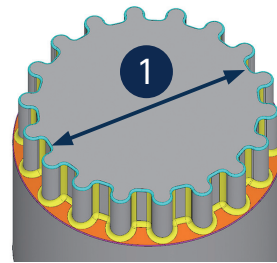


Unit [μ m]	
Measuring position	Side
Ra	0.031
Rz	0.225



R edge retreat amount
0.003mm after side finishing
for 2 hours

Accuracy



Unit [mm]	
Measuring position	1
Target	20.644
Actual	20.647
Error	0.003

Tool wear

Process	Roughing	Stock removal	Semi-finishing	Finishing
Tool	MRBSH230SF R1x6	MRBSH230SF R0.5x5	MRBSH230SF R0.5x5	MRBSH230SF R0.5x5
Rake side				
Peripheral cutting edge				
R end cutting edge				
Spindle speed [min^{-1}]	20,000			12,000
Feed [mm/min]	1,600	920	920	460
Depth of cut [mm] $a_p \times a_e$	0.15 x 0.3	0.03x0.1	Side face: 0.03x0.02 Surface: 0.02x0.05	pf : 0.015
Stock [mm]	0.03		0.01	—
Machining time	24 min	3hr 8min	1hr 8min	4hr 6min

Machining Case 4

Fine Branking Sample

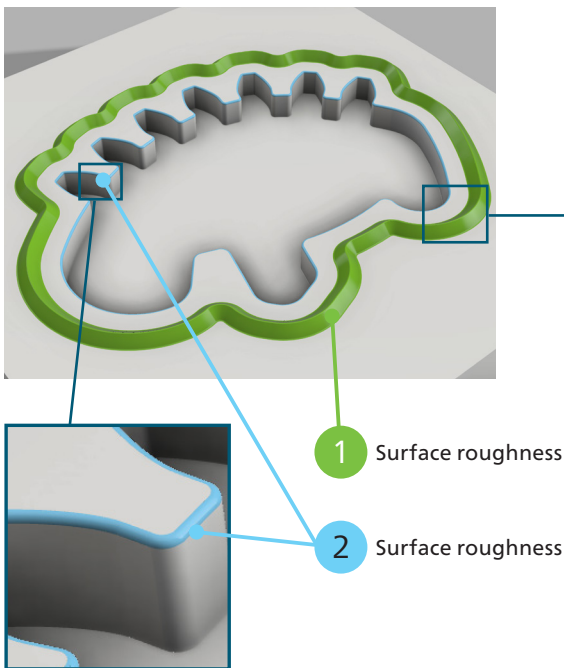
Machining accuracy achieved by high R accuracy of $\pm 3\mu\text{m}$



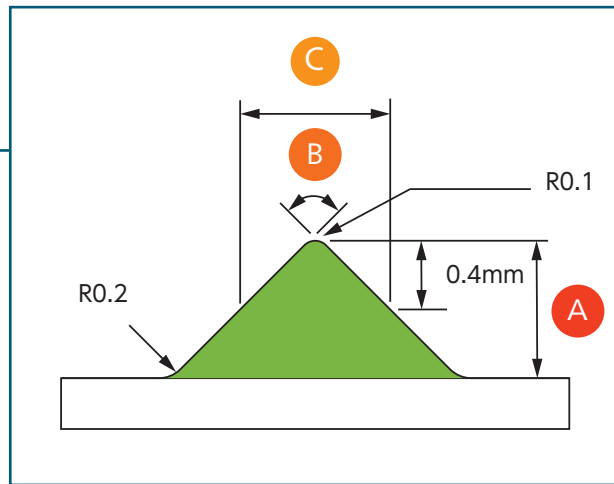
Material : YXR3 (61HRC)
 Coolant : Oil mist
 Total machining time : 7hr 27min
 Work size : 60x60mm
 Cutting depth : 4mm

※Total machining time includes WEDM process (white part) both blank holder part and die part

Surface Roughness



Accuracy

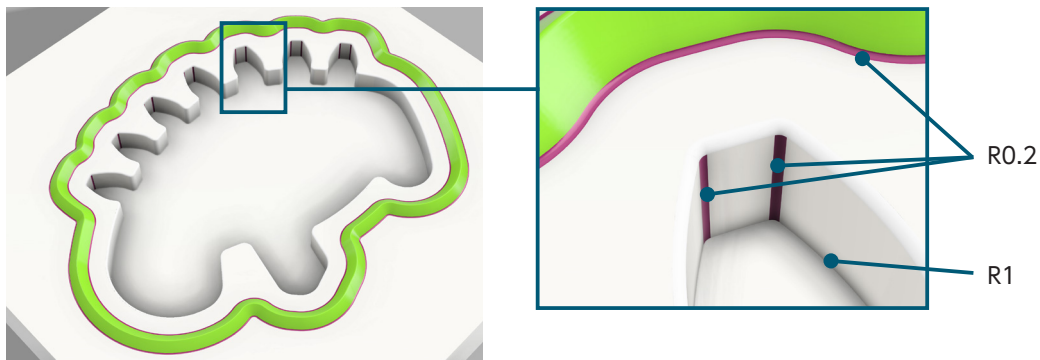


Unit [μm]

Measuring position	1	2
Tool	MRBSH230SF R0.5x2	MRBSH230SF R0.2x1
Ra	0.145	0.080
Rz	1.192	0.521

Measuring position	A	B	C
Target	0.958mm	90°0'00"	0.883mm
Actual	0.958mm	90°15'10"	0.888mm
Error	0.000mm	0°15'10"	0.005mm

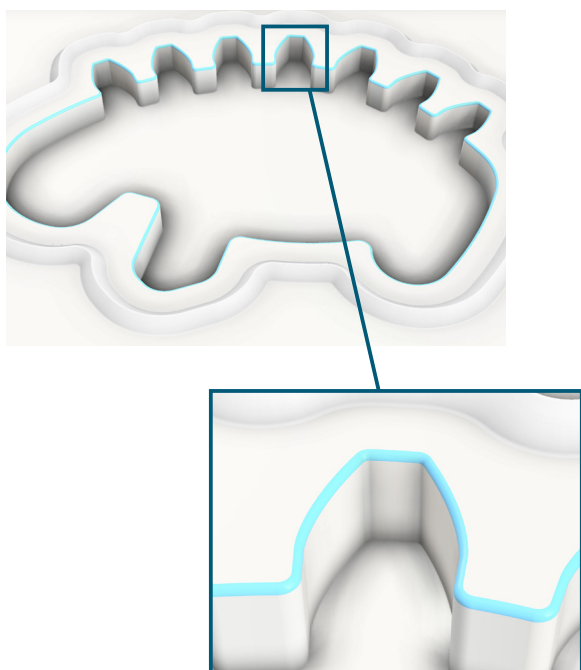
Blank holder



Process	Roughing	Semi-finishing	Finishing	Stock	Finishing	Stock	Stock
Tool	MRBSH230SF R1x4	MRBSH230SF R1x4		MRBSH230SF R0.5x2		MRBSH230SF R0.25x1.5	MRBSH230SF R0.2x1
Spindle speed [min ⁻¹]	25,000			30,000			
Feed [mm/min]	2,500			1,000		540	540
Depth of cut [mm]	0.2 x 0.5	pf : 0.05	pf : 0.08	pf : 0.05	pf : 0.03	pf : 0.03	pf : 0.02
Stock [mm]	0.03	0.01	-	0.01	- (Only corner part 0.005)		-
Machining time	39 min	40 min	1hr 6min	1hr 3min		47 min	1hr 26min

※ pf : pick feed

Die



Process	Roughing	Finishing
Tool	MRBSH230SF R0.25x1.5	MRBSH230SF R0.2x1
Spindle speed [min ⁻¹]	30,000	
Feed [mm/min]	540	
Depth of cut [mm] ap x ae	0.01 x 0.03	pf : 0.01
Stock [mm]	0.003	-
Machining time	1hr 11min	35 min

※ pf : pick feed

NS TOOL CO.,LTD.

www.ns-tool.com
6F., Sumitomo Fudosan Oimachi Ekimae Bldg.,
1-28-1 Oi, Shinagawa-ku, Tokyo 140-0014, Japan
TEL. +81-3-3774-2459 FAX. +81-3-3774-2460

NS TOOL USA, INC.

us.ns-tool.com
2265 Building # 3, Star CT.,
Rochester Hills, MI 48309, USA
TEL. +1-248-829-1960



CAUTION

Attention on Safety

- 1) When removing tools from cases, be careful of getting-out of tools and don't touch directly the cutting edges.
- 2) Never touch the cutting edges directly with bare hand.
- 3) Use safety covers and eye protection, as tools may be broken.
- 4) Use holders, etc. that match the tools and nature of the processing operations. The tool should be firmly attached to the holder to prevent shaking.
- 5) The work materials clamp firmly.
- 6) Make sure of dimensions of tools and work pieces before starting operation.
- 7) It is necessary to adjust conditions according to the dimensions of work materials and the machine.
- 8) Select a cutting fluid appropriate to the particular usage. Using a non-water cutting fluid could lead to fires due to sparks generated during processing or heat caused by breakage. Ensure that you take proper fire-prevention measures.
- 9) If abnormal sound, etc. occurs during processing, stop the machine immediately.
- 10) Don't modify tools.

