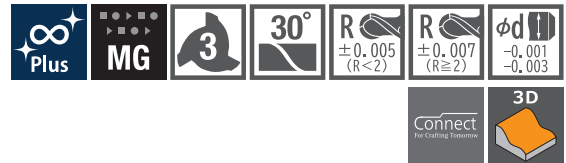


High-efficiency high-precision die machining with improved cutting edge rigidity and chip evacuation

MUGEN COATING PREMIUM Plus
 High Efficient 3-Flute Small-Diameter
 Long Neck Ball End Mill for Hardened Steel

MRBSH330



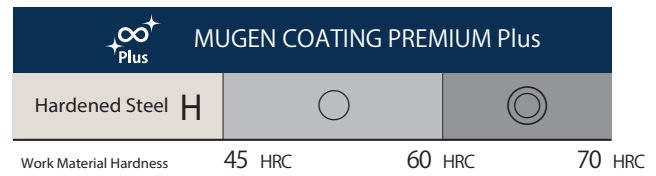
R0.1 ~ R3 Total 31 sizes



Features

Feature 1	Long tool life	Coating MUGEN COATING PREMIUM Plus
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MUGEN COATING PREMIUM Plus is suitable for machining above 60HRC
 Demonstrates same performance with MUGEN COATING PREMIUM even on machining 45 ~ 60HRC



Comparison with other tool brand on roughing process

- Tool size : R1
- Work Material : HAP40 (64HRC)
- Spindle speed : 20,000 min⁻¹
- Feed : 2,400 mm/min

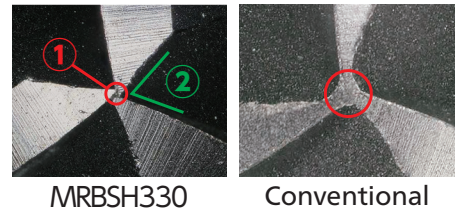
Realize long tool life during high speed machining even comparing with other tool brands

Comparison under the same rate of depth of cut ap 0.23 x ae 0.3 mm

	Before use	After 60min	After 90min	After 120min
MRBSH330 R1×6				
Other tool brand A 4-flute ball end mill R1				
Other tool brand B 4-flute ball end mill R1				

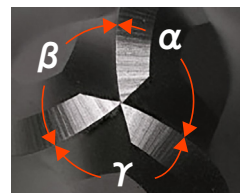
Feature 2 High efficiency Cutting edge shape · Unequal flute spacing · 3-Flute · Chip evacuation

2-1
Optimized center ball shape reduces cutting load to enable high depth of cut



2-2
Optimized chip pocket design realizes smooth chip removal

2-3
Unequal flute prevent chattering



$\alpha \neq \beta \neq \gamma$

2-4
Adopting strong spiral gash for the large diameters to reduce cutting load, break up the chips to improve the chip removal ability and unequal flute prevents chattering ($R \geq 1.5$)



MRBSH330

Conventional

Machining efficiency comparison with conventional product

- Work Material : YXR7 (63HRC)
- Coolant : Oil mist
- Work size : 50 × 50 mm



Process	MRBSH330		Conventional 2-flute ball end mill	
	Diamond shape	Circle shape pocket	Diamond shape	Circle shape pocket
Tool size	R3 × 20	R1.5 × 10	R3 × 20	R1.5 × 10
Spindle speed (min ⁻¹)	7,000	15,000	7,000	15,000
Feed (mm/min)	3,000	2,600	2,000	1,800
Depth of cut (ap × ae mm)	0.25 × 1	0.25 × 0.5	0.2 × 1	0.15 × 0.3
Machining time	42min 9sec	16min 23sec	73min 11sec	55min 34sec

Total machining time reduced by 55%



Introduction of NS Connect
Scanning the barcode on the back of the case to get various information

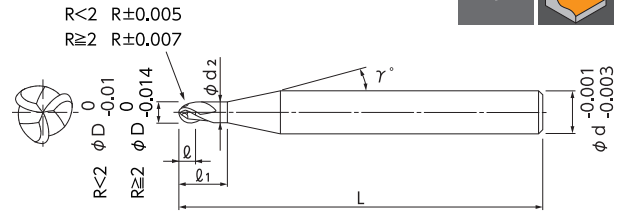
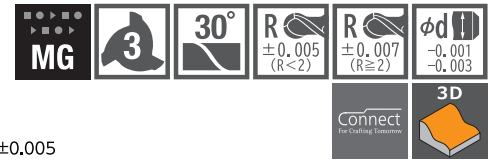


- Features
- Size and Milling conditions
 - Video of machining



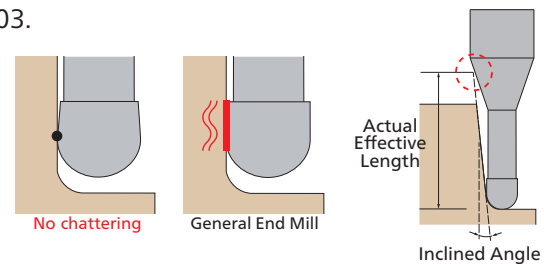
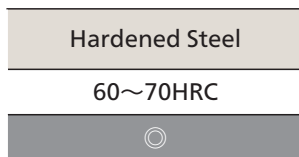
Available to check the information anytime, anywhere before use

High-efficiency high-precision die machining with improved cutting edge rigidity and chip evacuation



- High-efficiency 3-flute ball end mill optimizes a shape of central edge and enables high depth of cutting.
- Even hardened steel of 45 to 70HRC can be machining with long tool life and high efficiency.
- Shank diameter tolerance, high accuracy type, is - 0.001 ~ - 0.003.

Work Material



Unit [Size : mm]

Code No.	Radius (R)	Under Neck Length	Length of Cut (ℓ)	Dia. (D)	Neck Dia. (d2)	Neck Taper Angle (γ)	Shank Dia. (d)	Overall Length (L)	Actual effective length depending on inclined angle of workpiece				
									30°	1°	1°30'	2°	3°
08-00634-01003	R0.1	0.3	0.15	0.2	0.18	12°	4	45	0.35	0.36	0.38	0.39	0.42
08-00634-01005		0.5	0.15	0.2	0.18	12°	4	45	0.56	0.58	0.61	0.63	0.69
08-00634-01505	R0.15	0.5	0.2	0.3	0.28	12°	4	45	0.56	0.58	0.60	0.62	0.67
08-00634-01506		0.6	0.2	0.3	0.28	12°	4	45	0.66	0.69	0.71	0.74	0.81
08-00634-01507		0.75	0.2	0.3	0.28	12°	4	45	0.82	0.85	0.88	0.92	1.01
08-00634-01510	R0.2	1	0.2	0.3	0.28	12°	4	45	1.08	1.12	1.17	1.22	1.34
08-00634-02005		0.5	0.3	0.4	0.37	12°	4	45	0.58	0.60	0.62	0.64	0.69
08-00634-02008		0.8	0.3	0.4	0.37	12°	4	45	0.89	0.93	0.96	1.00	1.09
08-00634-02010	R0.25	1	0.3	0.4	0.37	12°	4	45	1.10	1.14	1.19	1.24	1.35
08-00634-02510		1.5	0.35	0.5	0.46	12°	4	45	1.65	1.71	1.78	1.85	2.03
08-00634-03010	R0.3	1	0.45	0.6	0.56	12°	4	45	1.12	1.16	1.20	1.25	1.35
08-00634-03015		1.5	0.45	0.6	0.56	12°	4	45	1.64	1.71	1.77	1.84	2.02
08-00634-03020		2	0.45	0.6	0.56	12°	4	45	2.17	2.25	2.34	2.44	2.68
08-00634-05020	R0.5	2	0.75	1	0.95	12°	4	45	2.18	2.26	2.34	2.43	2.65
08-00634-05025		2.5	0.75	1	0.95	12°	4	45	2.70	2.80	2.91	3.03	3.31
08-00634-05030		3	0.75	1	0.95	12°	4	45	3.22	3.35	3.48	3.63	3.97
08-00634-07503	R0.75	3	1.1	1.5	1.45	12°	4	45	3.21	3.33	3.45	3.58	3.89
08-00634-07504		4	1.1	1.5	1.45	12°	4	45	4.26	4.41	4.59	4.78	5.22
08-00634-10003	R1	3	1.5	2	1.94	12°	4	45	3.23	3.33	3.44	3.56	3.85
08-00634-10004		4	1.5	2	1.94	12°	4	45	4.27	4.42	4.58	4.76	5.17
08-00634-10006		6	1.5	2	1.94	12°	4	45	6.36	6.60	6.86	7.15	7.83
08-00634-15006	R1.5	6	2.5	3	2.85	12°	6	60	6.56	6.78	7.03	7.31	7.95
08-00634-15008		8	2.5	3	2.85	12°	6	60	8.64	8.96	9.31	9.70	10.60
08-00634-15010		10	2.5	3	2.85	12°	6	60	10.73	11.14	11.59	12.09	13.26
08-00634-20008	R2	8	3	4	3.8	12°	6	65	8.74	9.05	9.38	9.74	10.60
08-00634-20010		10	3	4	3.8	12°	6	65	10.83	11.22	11.66	12.14	13.25
08-00634-20012		12	3	4	3.8	12°	6	65	12.91	13.40	13.94	14.53	15.91
08-00634-30010	R3	10	6	6	5.7	-	6	65	Free	Free	Free	Free	Free
08-00634-30015		15	6	6	5.7	-	6	65	Free	Free	Free	Free	Free
08-00634-30020		20	6	6	5.7	-	6	65	Free	Free	Free	Free	Free

How to Order When you order, indicate MRBSH330(R)×(ℓ1).

※(γ) is reference value.

Recommended Milling 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
R0.1	0.3	1.5	0.006	0.007	450	40,000	0.004	0.005	300	40,000	0.004	0.005	220	40,000
	0.5	2.5	0.006	0.007	400	40,000	0.004	0.005	250	40,000	0.004	0.005	190	40,000
R0.15	0.5	1.7	0.01	0.01	450	40,000	0.005	0.005	400	40,000	0.005	0.005	300	40,000
	0.6	2	0.007	0.007	450	40,000	0.005	0.005	350	40,000	0.005	0.005	270	40,000
	0.75	2.5	0.007	0.007	400	40,000	0.005	0.005	350	40,000	0.005	0.005	250	40,000
R0.2	1	3.3	0.007	0.007	350	40,000	0.005	0.005	300	40,000	0.005	0.005	220	40,000
	0.5	1.25	0.035	0.04	1,100	40,000	0.013	0.02	850	40,000	0.013	0.02	650	35,000
	0.8	2	0.03	0.03	1,000	40,000	0.012	0.02	850	40,000	0.012	0.02	600	35,000
R0.25	1	2.5	0.03	0.03	1,000	40,000	0.012	0.02	850	40,000	0.012	0.02	600	35,000
	1	2	0.03	0.03	1,300	40,000	0.015	0.02	1,000	35,000	0.015	0.02	700	30,000
R0.3	1.5	3	0.015	0.03	1,000	40,000	0.01	0.02	800	35,000	0.01	0.02	500	30,000
	1	1.7	0.045	0.06	1,500	40,000	0.03	0.05	1,100	30,000	0.03	0.05	800	25,000
	1.5	2.5	0.045	0.06	1,500	40,000	0.03	0.05	1,100	30,000	0.03	0.05	800	25,000
R0.5	2	3.3	0.045	0.06	1,500	40,000	0.03	0.05	1,100	30,000	0.03	0.05	800	25,000
	2	2	0.15	0.2	3,000	30,000	0.12	0.1	2,000	25,000	0.075	0.1	1,500	20,000
	2.5	2.5	0.15	0.2	3,000	30,000	0.12	0.1	2,000	25,000	0.075	0.1	1,500	20,000
R0.75	3	3	0.15	0.2	3,000	30,000	0.12	0.1	2,000	25,000	0.075	0.1	1,500	20,000
	3	2	0.15	0.3	3,800	30,000	0.15	0.2	3,000	25,000	0.09	0.2	2,200	20,000
R1	4	2.7	0.15	0.3	3,000	25,000	0.15	0.2	2,400	22,000	0.09	0.2	1,800	18,000
	3	1.5	0.3	0.5	3,800	25,000	0.22	0.3	3,000	20,000	0.15	0.3	2,200	16,000
	4	2	0.3	0.5	3,800	25,000	0.22	0.3	3,000	20,000	0.15	0.3	2,200	16,000
R1.5	6	3	0.3	0.3	3,000	22,000	0.22	0.3	2,400	20,000	0.15	0.3	1,800	16,000
	6	2	0.3	0.6	3,800	18,000	0.25	0.5	3,000	15,000	0.15	0.5	2,250	12,000
	8	2.7	0.3	0.6	3,800	18,000	0.25	0.5	3,000	15,000	0.15	0.5	2,250	12,000
R2	10	3.3	0.3	0.6	3,200	18,000	0.25	0.5	2,600	15,000	0.15	0.5	2,000	12,000
	8	2	0.3	0.8	3,800	15,000	0.25	0.6	3,000	12,000	0.18	0.6	2,250	9,500
	10	2.5	0.3	0.8	3,800	15,000	0.25	0.6	3,000	12,000	0.18	0.6	2,250	9,500
R3	12	3	0.3	0.8	3,800	15,000	0.25	0.6	3,000	12,000	0.18	0.6	2,250	9,500
	10	1.7	0.38	1.2	3,800	8,000	0.25	1	3,000	7,000	0.18	1	2,250	5,500
	15	2.5	0.38	1.2	3,800	8,000	0.25	1	3,000	7,000	0.18	1	2,250	5,500
	20	3.3	0.38	1.2	3,800	8,000	0.25	1	3,000	7,000	0.18	1	2,250	5,500

Notes

※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.

※1 Depth of Cut : a_p = Axial Depth of Cut / a_e = Radial Depth of Cut.

※2 Adjust milling condition according to machine rigidity and clamp condition of work material.

※3 In case of chattering etc., please adjust cutting conditions if necessary.

※4 At point where cutting load is high such as at corners, pay attention to setting cutting conditions and tool paths particularly.

※5 If machine tool vibration is high during machining, adjust the feed rate as necessary.

※6 Attention to a risk of chipping and breakage when insufficient chip flow.

※7 Adjust both spindle speed and feed at the same rate.

※8 Overhang of end mill should be as short as possible from spindle nose.

※9 We recommend using oil mist coolant.

Recommended Milling 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
R0.1	0.3	1.5	.00024	.00028	.00015	17.72	40,000	.00016	.00020	.00010	11.81	40,000	.00016	.00020	.00007	8.66	40,000
	0.5	2.5	.00024	.00028	.00013	15.75	40,000	.00016	.00020	.00008	9.84	40,000	.00016	.00020	.00006	7.48	40,000
R0.15	0.5	1.7	.00039	.00028	.00015	17.72	40,000	.00020	.00020	.00013	15.75	40,000	.00020	.00020	.00010	11.81	40,000
	0.6	2	.00028	.00028	.00015	17.72	40,000	.00020	.00020	.00011	13.78	40,000	.00020	.00020	.00009	10.63	40,000
	0.75	2.5	.00028	.00028	.00013	15.75	40,000	.00020	.00020	.00011	13.78	40,000	.00020	.00020	.00008	9.84	40,000
	1	3.3	.00028	.00028	.00011	13.78	40,000	.00020	.00020	.00010	11.81	40,000	.00020	.00020	.00007	8.66	40,000
R0.2	0.5	1.25	.00138	.00157	.00036	43.31	40,000	.00053	.00079	.00028	33.46	40,000	.00051	.00079	.00024	25.59	35,000
	0.8	2	.00118	.00118	.00033	39.37	40,000	.00049	.00079	.00028	33.46	40,000	.00047	.00079	.00022	23.62	35,000
	1	2.5	.00118	.00118	.00033	39.37	40,000	.00049	.00079	.00028	33.46	40,000	.00047	.00079	.00022	23.62	35,000
R0.25	1	2	.00118	.00118	.00043	51.18	40,000	.00061	.00079	.00037	39.37	35,000	.00059	.00079	.00031	27.56	30,000
	1.5	3	.00059	.00118	.00033	39.37	40,000	.00041	.00079	.00030	31.50	35,000	.00039	.00079	.00022	19.69	30,000
R0.3	1	1.7	.00177	.00236	.00049	59.06	40,000	.00122	.00197	.00048	43.31	30,000	.00118	.00197	.00042	31.50	25,000
	1.5	2.5	.00177	.00236	.00049	59.06	40,000	.00122	.00197	.00048	43.31	30,000	.00118	.00197	.00042	31.50	25,000
	2	3.3	.00177	.00236	.00049	59.06	40,000	.00122	.00197	.00048	43.31	30,000	.00118	.00197	.00042	31.50	25,000
R0.5	2	2	.00591	.00787	.00131	118.11	30,000	.00490	.00394	.00105	78.74	25,000	.00295	.00394	.00098	59.06	20,000
	2.5	2.5	.00591	.00787	.00131	118.11	30,000	.00490	.00394	.00105	78.74	25,000	.00295	.00394	.00098	59.06	20,000
	3	3	.00591	.00787	.00131	118.11	30,000	.00490	.00394	.00105	78.74	25,000	.00295	.00394	.00098	59.06	20,000
R0.75	3	2	.00591	.01181	.00166	149.61	30,000	.00612	.00787	.00157	118.11	25,000	.00354	.00787	.00144	86.61	20,000
	4	2.7	.00591	.01181	.00157	118.11	25,000	.00612	.00787	.00143	94.49	22,000	.00354	.00787	.00131	70.87	18,000
R1	3	1.5	.01181	.01969	.00199	149.61	25,000	.00898	.01181	.00197	118.11	20,000	.00591	.01181	.00180	86.61	16,000
	4	2	.01181	.01969	.00199	149.61	25,000	.00898	.01181	.00197	118.11	20,000	.00591	.01181	.00180	86.61	16,000
	6	3	.01181	.01181	.00179	118.11	22,000	.00898	.01181	.00158	94.49	20,000	.00591	.01181	.00148	70.87	16,000
R1.5	6	2	.01181	.02362	.00277	149.61	18,000	.01020	.01969	.00262	118.11	15,000	.00591	.01969	.00246	88.58	12,000
	8	2.7	.01181	.02362	.00277	149.61	18,000	.01020	.01969	.00262	118.11	15,000	.00591	.01969	.00246	88.58	12,000
	10	3.3	.01181	.02362	.00233	125.98	18,000	.01020	.01969	.00227	102.36	15,000	.00591	.01969	.00219	78.74	12,000
R2	8	2	.01181	.03150	.00233	149.61	15,000	.01020	.02362	.00328	118.11	12,000	.00709	.02362	.00311	88.58	9,500
	10	2.5	.01181	.03150	.00332	149.61	15,000	.01020	.02362	.00328	118.11	12,000	.00709	.02362	.00311	88.58	9,500
	12	3	.01181	.03150	.00332	149.61	15,000	.01020	.02362	.00328	118.11	12,000	.00709	.02362	.00311	88.58	9,500
R3	10	1.7	.01496	.04724	.00623	149.61	8,000	.01020	.03937	.00562	118.11	7,000	.00709	.03937	.00537	88.58	5,500
	15	2.5	.01496	.04724	.00623	149.61	8,000	.01020	.03937	.00562	118.11	7,000	.00709	.03937	.00537	88.58	5,500
	20	3.3	.01496	.04724	.00623	149.61	8,000	.01020	.03937	.00562	118.11	7,000	.00709	.03937	.00537	88.58	5,500

Notes

- ※ 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.
- ※ 1 Depth of Cut : ap = Axial Depth of Cut / ae = Radial Depth of Cut.
- ※ 2 Adjust milling condition according to machine rigidity and clamp condition of work material.
- ※ 3 In case of chattering etc., please adjust cutting conditions if necessary.
- ※ 4 At point where cutting load is high such as at corners, pay attention to setting cutting conditions and tool paths particularly.
- ※ 5 If machine tool vibration is high during machining, adjust the feed rate as necessary.
- ※ 6 Attention to a risk of chipping and breakage when insufficient chip flow.
- ※ 7 Adjust both spindle speed and feed at the same rate.
- ※ 8 Overhang of end mill should be as short as possible from spindle nose.
- ※ 9 We recommend using oil mist coolant.

Machining case

HAP40 (64HRC) Two-stage pocket mold

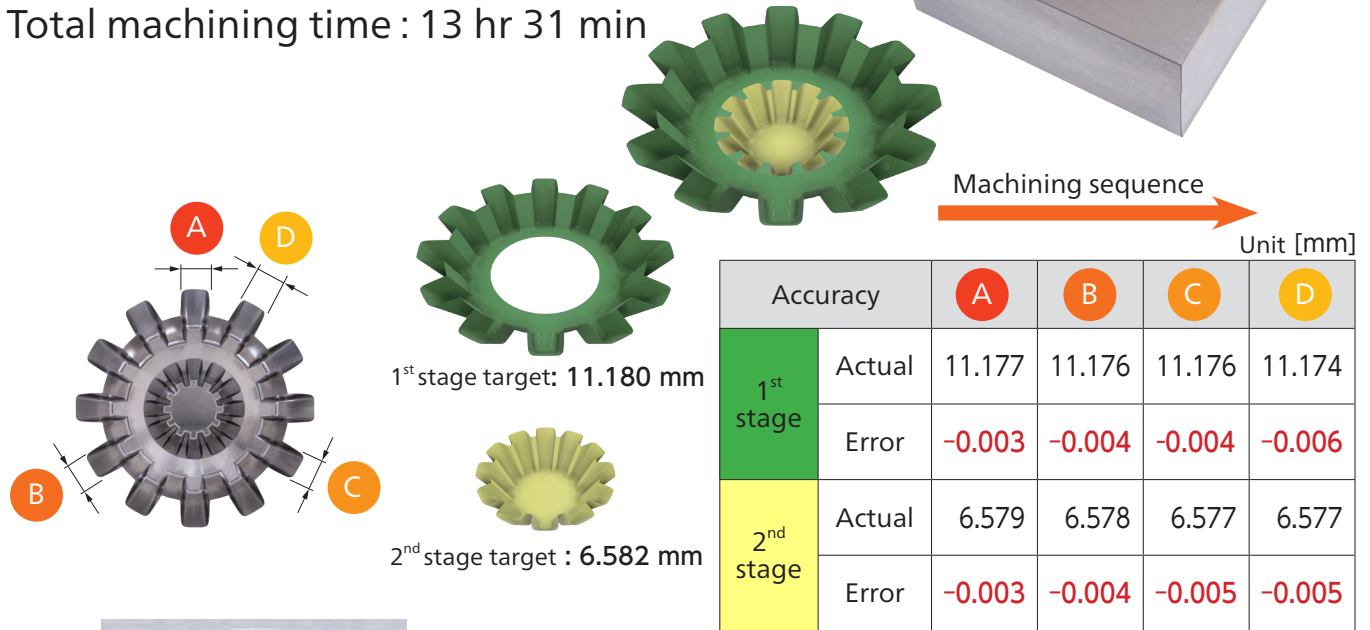
Realize long tool life and high efficiency machining for complex shapes even on hardened steels

Work Material : **HAP40 (64HRC)**
as the same as SKH40

Work size : **100 × 100 mm**

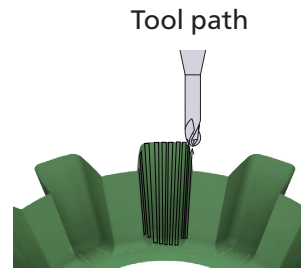
Coolant : Oil mist

Total machining time : 13 hr 31 min



Surface roughness				
	1	2	3	4
Ra	0.053	0.067	0.065	0.070

Unit [μm]



Machining position	1 st stage		2 nd stage	1 st stage		2 nd stage		
	Roughing	Semi-Roughing	Roughing	Semi-Finishing	Finishing	Semi-Roughing	Semi-Finishing	Finishing
Tool	MRBSH330 R3 × 20	MRBSH330 R1.5 × 10		MRBSH330 R1.5 × 10	MRBSH330 R1.5 × 10	MRBSH330 R1 × 6	MRBSH330 R1 × 6	MRBSH330 R1 × 6
Spindle speed [min ⁻¹]	7,000	15,000	15,000	10,000	10,000	15,000	13,000	13,000
Feed [mm/min]	2,500	2,000	2,500	1,800	1,500	1,500	1,500	1,300
Depth of cut ap × ae [mm]	0.25 × 1	0.15 × 0.1	0.2 × 0.8	0.05 × 0.05	0.035 × 0.035	0.15 × 0.1	0.04 × 0.04	0.03 × 0.03
Stock [mm]	0.1	0.08	0.1	0.035	0	0.08	0.03	0
Machining time	2hr 5min	54min	38min	2hr 30min	4hr 4min	10min	1hr 23min	1hr 47min