



MITSUBISHI



MITSUBISHI CARBIDE

TOOLS NEWS

B049G

High Precision Radius Endmill

MIRACLE ORBIT

**New solution for machining dies & molds
(New method to machining dies & molds
instead of ball nose endmill)**

**MIRACLE ORBIT can achieve highly precise and
highly efficient machining die & mold.**

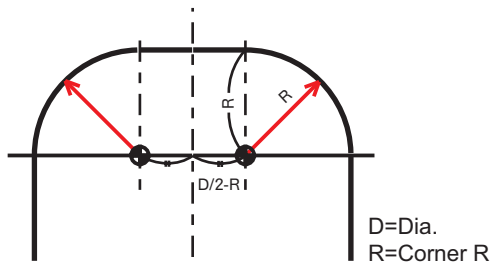
VC-PSRB

MIRACLE ORBIT

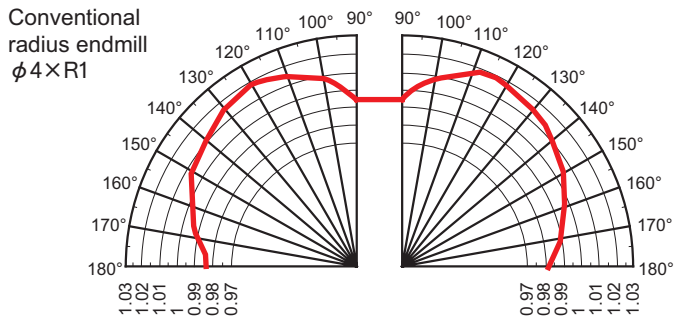
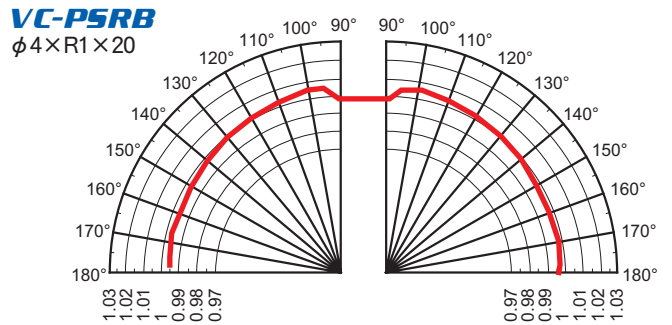
Available 53 sizes

Precision of corner radius

Radius tolerance : $R \pm 0.01\text{mm}$
 Diameter tolerance : $0 - -0.01\text{mm}$



There is no standard to measure radius accuracy of conventional radius endmill. BUT, radius accuracy of MIRACLE ORBIT is measured with fixed center position as shown above figure. Therefore, MIRACLE ORBIT can be used for finishing die & mold with CAD/CAM system.



Geometry of corner radius

The radius geometry (PAT. P) of MIRACLE ORBIT is simultaneous pursuit of cutting edge strength and low cutting force. Seamless relief face between corner radius cutting edge and peripheral cutting edge makes good surface finish. Due to neck relieved, MIRACLE ORBIT can make vertical wall.

High precision in cutting vertical wall

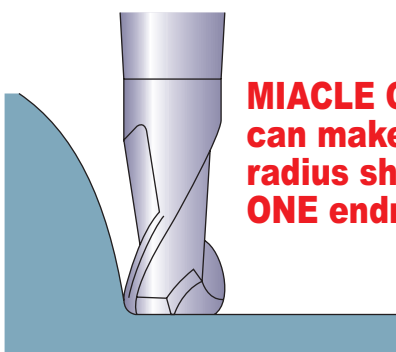


VC-PSRB



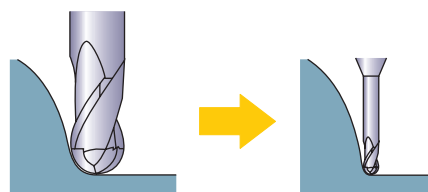
Conventional radius endmill

Suitable for making corner radius shape



MIRACLE ORBIT can make corner radius shape with ONE endmill.

- ① Reduction of number of endmill
- ② Erasing step by changing endmill
- ③ Increase of machining accuracy and efficiency due to bigger diameter

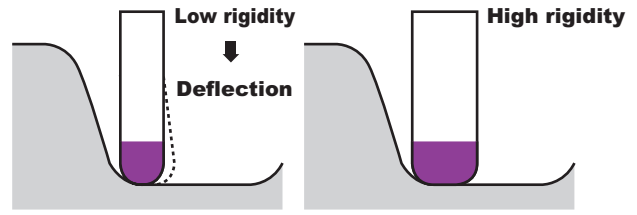
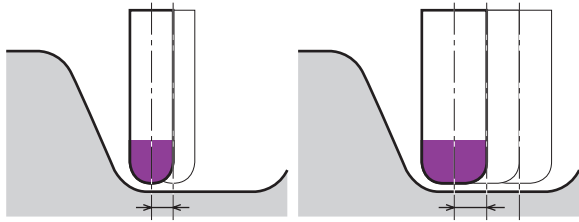


In conventional method by ball nose endmill, small diameter is necessary to make corner radius shape.

High Precision and High Efficiency

Bigger pick feed than ball nose end mill makes high efficiency.

Bigger diameter makes less deflection.



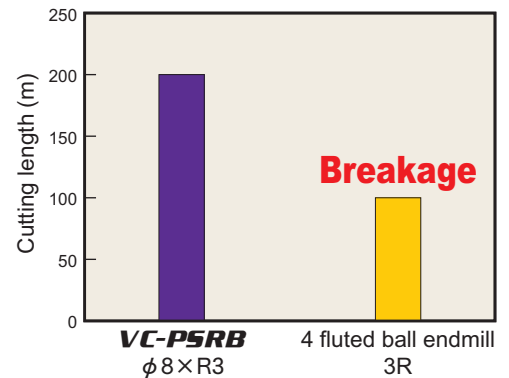
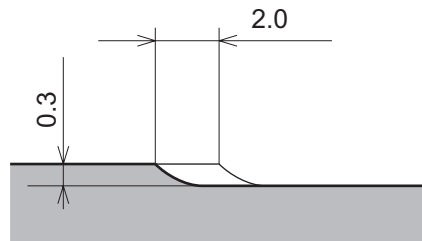
Machining example

Case 1

In machining flat surface, due to high rigidity compared with ball nose endmill, high feed rate machining is possible.

■Cutting condition

Endmill	VC-PSRB $\phi 8 \times R3$
Work material	SKD61 (52HRC)
Revolution	13,000min ⁻¹ (327m/min)
Feed rate	10,400mm/min (0.2mm/tooth)
Cutting method	Climb cut, Air blow



In the machining at high feed rate at 10,000mm/min, breakage happened to ball nose endmill. But MIRACLE ORBIT could cut 200m cutting length and flank wear was still small.

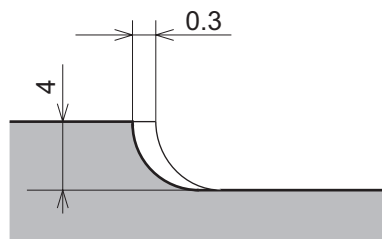
Case 2

The surface roughness by MIRACLE ORBIT is 1/3 compared with ball nose endmill in flat surface.

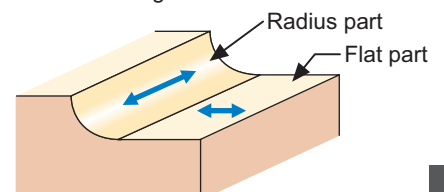
Measuring point	VC-PSRB $\phi 8 \times R3$	4 fluted ball endmill R3
Radius part	Surface roughness $Rz = 1.32 \mu m$ 	Surface roughness $Rz = 1.88 \mu m$
Flat part	Surface roughness $Rz = 1.94 \mu m$ 	Surface roughness $Rz = 5.88 \mu m$

■Cutting condition

Endmill	VC-PSRB $\phi 8 \times R3$
Work material	SKD61 (52HRC)
Revolution	13,000min ⁻¹ (327m/min)
Feed rate	2,600mm/min (0.05mm/tooth)
Cutting length	20m
Cutting method	Climb cut, Air blow



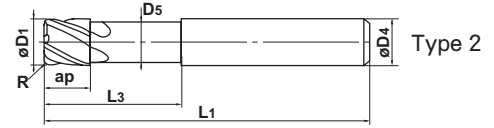
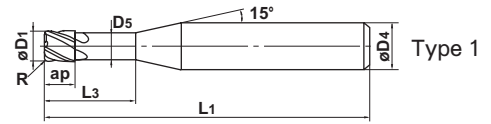
Measuring point and direction of surface roughness



MIRACLE END MILLS

VC-PSRB MIRACLE ORBIT

High Precision, Corner Radius, Short



D1=1.5

2≤D1

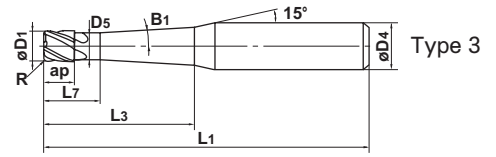
- Radius tolerance : R ±0.01mm, Diameter tolerance : 0 - -0.01mm
Suitable for high precision and high efficient machining of die & mold.

Unit : mm

Order Number	Dia.	Corner R	Length of Cut	Neck Length	Neck Dia.	Overall Length	Shank Dia.	No. of Flute	Stock	Type
	D1	R	ap	L3	D5	L1	D4	N		
VCPSRBD0150N04R05	1.5	0.5	1.5	4	1.46	50	6	2	●	1
VCPSRBD0150N06R05	1.5	0.5	1.5	6	1.46	50	6	2	●	1
VCPSRBD0150N10R05	1.5	0.5	1.5	10	1.46	50	6	2	●	1
VCPSRBD0200N06R05	2	0.5	2	6	1.96	50	6	4	●	1
VCPSRBD0200N10R05	2	0.5	2	10	1.96	50	6	4	●	1
VCPSRBD0200N15R05	2	0.5	2	15	1.96	50	6	4	●	1
VCPSRBD0250N08R10	2.5	1	2.5	8	2.46	50	6	4	●	1
VCPSRBD0250N15R10	2.5	1	2.5	15	2.46	50	6	4	●	1
VCPSRBD0300N10R05	3	0.5	3	10	2.96	60	6	4	●	1
VCPSRBD0300N15R05	3	0.5	3	15	2.96	60	6	4	●	1
VCPSRBD0300N20R05	3	0.5	3	20	2.96	60	6	4	●	1
VCPSRBD0300N10R10	3	1	3	10	2.96	60	6	4	●	1
VCPSRBD0300N15R10	3	1	3	15	2.96	60	6	4	●	1
VCPSRBD0300N20R10	3	1	3	20	2.96	60	6	4	●	1
VCPSRBD0400N12R05	4	0.5	4	12	3.96	60	6	4	●	1
VCPSRBD0400N20R05	4	0.5	4	20	3.96	60	6	4	●	1
VCPSRBD0400N30R05	4	0.5	4	30	3.96	70	6	4	●	1
VCPSRBD0400N12R10	4	1	4	12	3.96	60	6	4	●	1
VCPSRBD0400N20R10	4	1	4	20	3.96	60	6	4	●	1
VCPSRBD0400N30R10	4	1	4	30	3.96	70	6	4	●	1
VCPSRBD0600N18R05	6	0.5	6	18	5.85	70	6	4	●	2
VCPSRBD0600N18R10	6	1	6	18	5.85	70	6	4	●	2
VCPSRBD0600N18R20	6	2	6	18	5.85	70	6	4	●	2
VCPSRBD0800N24R05	8	0.5	8	24	7.85	90	8	4	●	2
VCPSRBD0800N24R10	8	1	8	24	7.85	90	8	4	●	2
VCPSRBD0800N24R20	8	2	8	24	7.85	90	8	4	●	2
VCPSRBD0800N24R30	8	3	8	24	7.85	90	8	4	●	2
VCPSRBD1000N30R05	10	0.5	10	30	9.85	100	10	4	●	2
VCPSRBD1000N30R10	10	1	10	30	9.85	100	10	4	●	2
VCPSRBD1000N30R20	10	2	10	30	9.85	100	10	4	●	2
VCPSRBD1000N30R30	10	3	10	30	9.85	100	10	4	●	2
VCPSRBD1000N30R40	10	4	10	30	9.85	100	10	4	●	2
VCPSRBD1200N36R05	12	0.5	12	36	11.85	110	12	4	●	2
VCPSRBD1200N36R10	12	1	12	36	11.85	110	12	4	●	2
VCPSRBD1200N36R20	12	2	12	36	11.85	110	12	4	●	2
VCPSRBD1200N36R30	12	3	12	36	11.85	110	12	4	●	2
VCPSRBD1200N36R40	12	4	12	36	11.85	110	12	4	●	2
VCPSRBD1200N36R50	12	5	12	36	11.85	110	12	4	●	2

VC-PSRB MIRACLE ORBIT

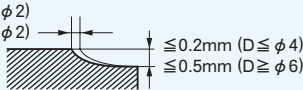
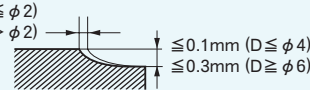
High Precision, Corner Radius, Short



- Radius tolerance : R ±0.01mm, Diameter tolerance : 0 - -0.01mm
Suitable for high precision and high efficient machining of die & mold.

Unit : mm

Order Number	Dia.	Corner R	Length of Cut	Taper Angle on Side	L7	Neck Length	Neck Dia.	Overall Length	Shank Dia.	No. of Flute	Stock	Type
	D1	R	ap	B1		L3	D5	L1	D4	N		
VCPSRBD0150N03L06R05	1.5	0.5	1.5	1.5°	3	6	1.46	50	6	2	●	3
VCPSRBD0150N03L10R05	1.5	0.5	1.5	1.5°	3	10	1.46	50	6	2	●	3
VCPSRBD0200N04L10R05	2	0.5	2	1.5°	4	10	1.96	60	6	4	●	3
VCPSRBD0200N04L15R05	2	0.5	2	1.5°	4	15	1.96	60	6	4	●	3
VCPSRBD0250N05L12R10	2.5	1	2.5	1.5°	5	12	2.46	60	6	4	●	3
VCPSRBD0250N05L20R10	2.5	1	2.5	1.5°	5	20	2.46	60	6	4	●	3
VCPSRBD0300N06L15R05	3	0.5	3	1.5°	6	15	2.96	60	6	4	●	3
VCPSRBD0300N06L20R05	3	0.5	3	1.5°	6	20	2.96	60	6	4	●	3
VCPSRBD0300N06L15R10	3	1	3	1.5°	6	15	2.96	60	6	4	●	3
VCPSRBD0300N06L20R10	3	1	3	1.5°	6	20	2.96	60	6	4	●	3
VCPSRBD0400N08L20R10	4	1	4	1.5°	8	20	3.96	60	6	4	●	3
VCPSRBD0400N08L30R10	4	1	4	1.5°	8	30	3.96	70	6	4	●	3
VCPSRBD0600N08L40R20	6	2	6	1°	8	40	5.85	70	8	4	●	3
VCPSRBD0800N10L53R20	8	2	8	1°	10	53	7.85	90	10	4	●	3
VCPSRBD1000N12L55R30	10	3	10	1°	12	55	9.85	100	12	4	●	3

Work material			Carbon steel, Alloy steel, Tool steel, Pre-hardened steel (-45HRC) AISI 1055, P20, AISI H13, AISI D2 etc.	Hardened steel (45-55HRC) AISI H13, AISI D2, Stainless steel 420 etc.	Hardened steel (55-62HRC) AISI D2, SKH, SKS etc.			
Dia. (mm)	Neck taper angle on side (°)	Neck length (mm)	Revolution (min ⁻¹)	Feed rate (mm/min)	Revolution (min ⁻¹)	Feed rate (mm/min)	Revolution (min ⁻¹)	Feed rate (mm/min)
1.5	-	4	41,000	300 - 900	27,000	200 - 600	16,000	100 - 300
1.5	-	6	32,000	240 - 720	22,000	160 - 480	13,000	80 - 240
1.5	-	10	24,000	180 - 540	16,000	120 - 360	10,000	60 - 180
1.5	1.5	6	36,000	270 - 810	24,000	180 - 540	15,000	90 - 270
1.5	1.5	10	28,000	210 - 630	19,000	140 - 420	11,000	70 - 210
2	-	6	36,000	600 - 2,000	24,000	400 - 1,300	14,000	200 - 650
2	-	10	29,000	480 - 1,600	19,000	320 - 1,000	12,000	160 - 520
2	-	15	22,000	360 - 1,200	14,000	240 - 780	9,000	120 - 390
2	1.5	10	32,000	540 - 1,800	22,000	360 - 1,200	13,000	180 - 590
2	1.5	15	25,000	420 - 1,400	17,000	280 - 910	10,000	140 - 460
2.5	-	8	33,000	750 - 2,400	22,000	500 - 1,600	13,000	250 - 800
2.5	-	15	20,000	450 - 1,400	13,000	300 - 960	8,000	150 - 480
2.5	1.5	12	26,000	600 - 1,900	18,000	400 - 1,300	11,000	200 - 640
2.5	1.5	20	20,000	450 - 140	13,000	300 - 960	8,000	150 - 480
3	-	10	30,000	900 - 3,000	20,000	600 - 2,000	12,000	300 - 1,000
3	-	15	24,000	720 - 2,400	16,000	480 - 1,600	10,000	240 - 800
3	-	20	18,000	540 - 1,800	12,000	360 - 1,200	7,000	180 - 600
3	1.5	15	27,000	810 - 2,700	18,000	540 - 1,800	11,000	270 - 900
3	1.5	20	21,000	630 - 2,100	14,000	420 - 1,400	8,000	210 - 700
4	-	12	26,000	1,200 - 4,500	17,000	800 - 3,000	10,000	400 - 1,500
4	-	20	20,000	960 - 3,600	14,000	640 - 2,400	8,000	320 - 1,200
4	-	30	15,000	720 - 2,700	10,000	480 - 1,800	6,000	240 - 900
4	1.5	20	23,000	1,080 - 4,000	15,000	720 - 2,700	9,000	360 - 1,300
4	1.5	30	18,000	840 - 3,100	12,000	560 - 2,100	7,000	280 - 1,000
6	-	18	20,000	1,650 - 7,500	13,000	1,100 - 5,000	8,000	550 - 2,500
6	1	40	20,000	1,650 - 4,500	13,000	1,100 - 3,000	8,000	550 - 1,500
8	-	24	15,000	1,950 - 7,500	10,000	1,300 - 5,000	6,000	650 - 2,500
8	1	53	15,000	1,950 - 4,500	10,000	1,300 - 3,000	6,000	650 - 1,500
10	-	30	12,000	1,650 - 7,500	8,000	1,100 - 5,000	5,000	550 - 2,500
10	1	55	12,000	1,650 - 4,500	8,000	1,100 - 3,000	5,000	550 - 1,500
12	-	36	10,000	1,500 - 7,500	7,000	1,000 - 5,000	4,000	500 - 2,500
Depth of cut			$\leq 0.2R$ ($D \leq \phi 2$) $\leq 0.4R$ ($D > \phi 2$) 		$\leq 0.1R$ ($D \leq \phi 2$) $\leq 0.2R$ ($D > \phi 2$) 			

D: Dia.

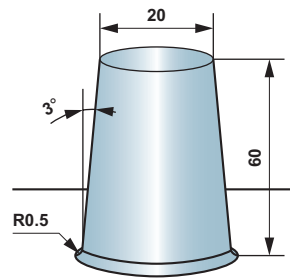
- 1) The above table shows cutting conditions in machining with corner radius cutting edge. In side milling, feed rate should be lower side.
- 2) Please use a machining center and a NC milling machine with high rigidity.
- 3) In shape milling like mold, cutting condition changes considerably due to the machined shape, milling method and depth of cut.
- 4) When the overhang of the endmill is long, reduce the revolution and feed rate proportionally to prevent chattering.
- 5) High pressure coolant and air blow are recommended to get rid of chips compulsorily.

Performance report 1

Customer recognition

Compared with conventional cutting method by ball nose endmill

1. Higher efficiency (Doubled feed rate)
2. Seamless surface between taper face and radius face.
3. Higher accuracy



Cutting condition

	Mould
Endmill	VC-PSRB $\phi 8 \times R0.5$
Work material	DAC (55HRC)
Revolution	4,000min ⁻¹ (100m/min)
Feed rate	2,300mm/min (0.14mm/tooth)
Cutting method	Climb cut, Air blow

Performance report 2

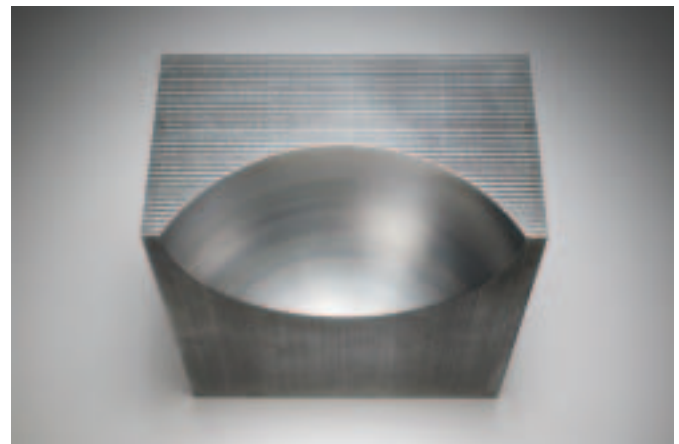
Customer recognition

Compared with conventional cutting method by ball nose endmill

1. 3times or more efficiency
(Feed rate 7,000mm/min in machining flat surface)
2. Good surface roughness and accuracy
3. Small flank wear

Cutting condition

	Mould
Endmill	VC-PSRB $\phi 8 \times R3$
Work material	PX-5
Revolution	15,000min ⁻¹ (377m/min)
Feed rate	7,000mm/min (0.12mm/tooth)
Depth of cut	0.1mm
Cutting method	Up and down cut milling, Air blow



MITSUBISHI MATERIALS KOBE TOOLSJQA-2522
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TEL 49-2159-9189-0 FAX 49-2159-50462**MITSUBISHI MATERIALS U.S.A. CORPORATION
Headquarters**17401, Eastman Street, Irvine, California, 92614, USA
TEL 1-949-862-5100 FAX 1-949-862-5180**MMC METAL SINGAPORE PTE LTD.**10, Arumugam Road, #04-00 Lion Industrial Bldg., 409957, SINGAPORE
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