DIA EDGE

TOOL NEWS B197B-H

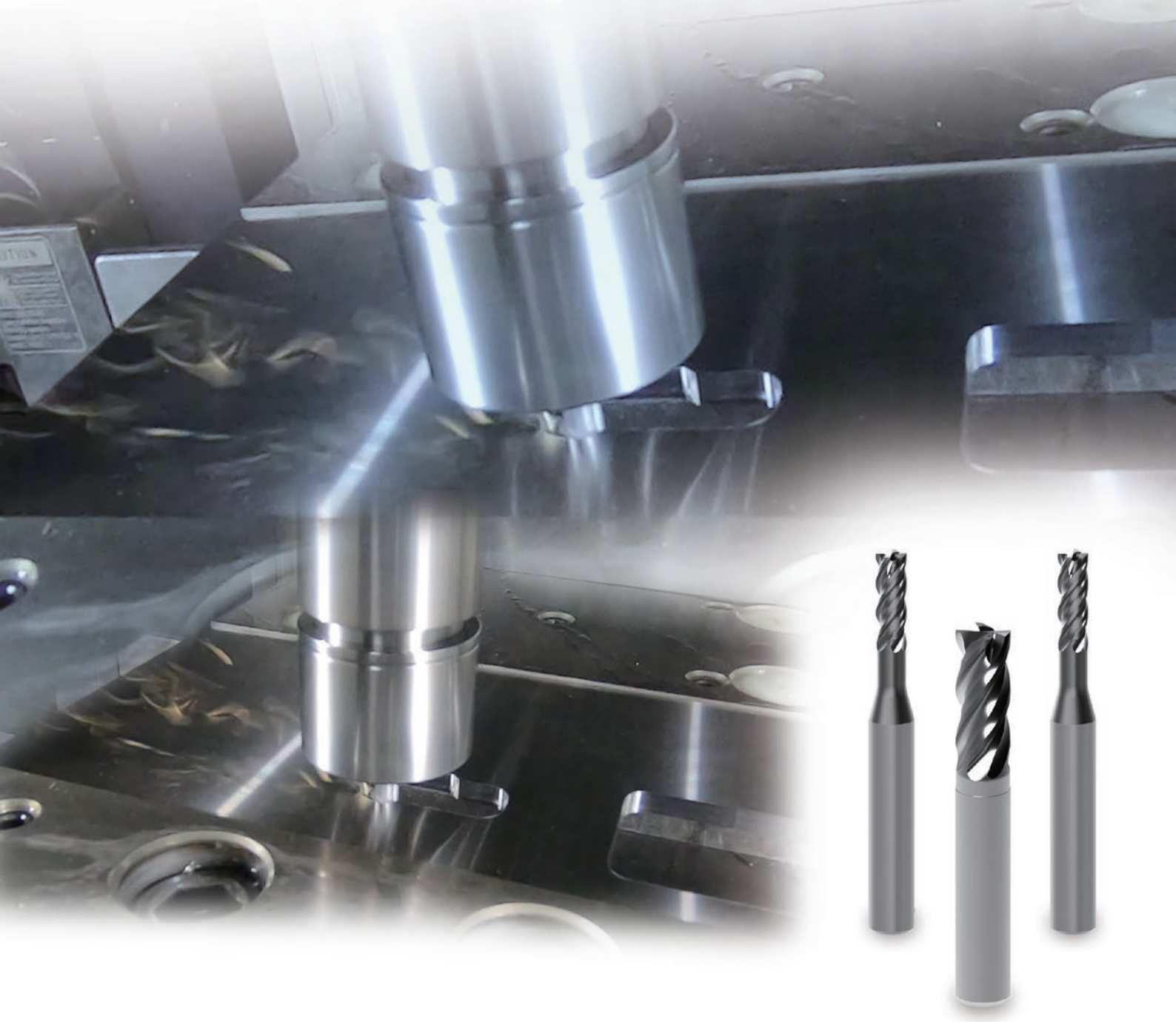
High-Performance End Mill SMART MIRACLE End Mill Series

VQ4MVM

NEW Products

Steep Ramping Capability Reduces Machining Times

Fewer tools needed, reduces costs and resource consumption.
High-efficiency cutting conditions shortens cycle times.



MITSUBISHI MATERIALS CORPORATION

High-Performance End Mill

SMART MIRACLE End Mill Series

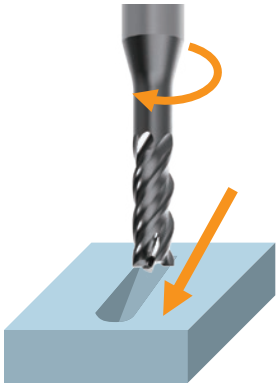
VQ4MVM

Multifunctional end mill capable of steep ramping when machining a wide range of materials.

Ramping is a method of sinking gradually as the tool traverses.

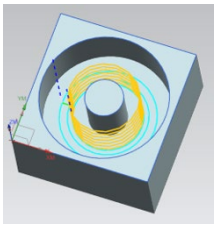
This eliminates the need for a pilot hole when machining pockets, thereby reducing costs through tool consolidation. Compared to direct plunge cutting, ramping enables simultaneous multi-axis feed at high speeds to lower machining times. This method is ideal for machining wide and shallow pockets.

VQ4MVM provides high-performance and multi-functionality. It can perform shoulder milling, grooving and helical machining as well as ramping angles of up to 30º in carbon and alloy steels.



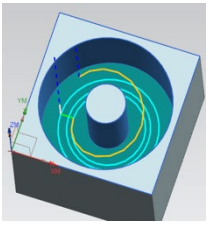
Steep Ramping Capability

27 sec

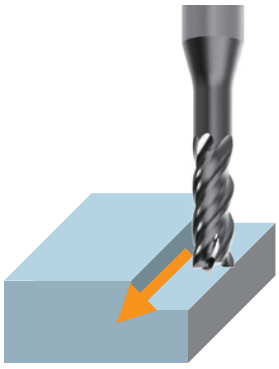


Conventional
Helical Milling
7 passes needed

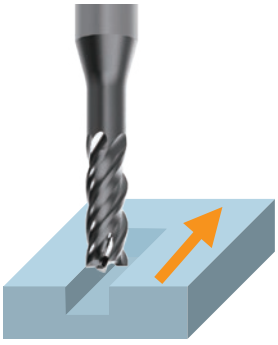
14 sec



VQ4MVM
Helical and Ramping
Only 1 pass needed



Shoulder Milling



Slot Milling

Pocket Milling

Helical Milling

SMART MIRACLE End Mill Series

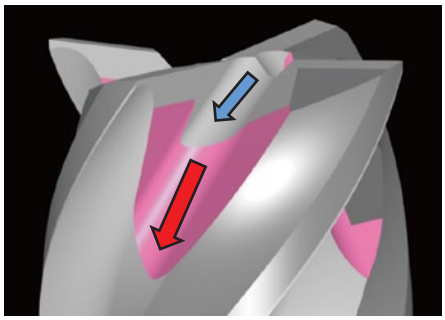
Newly-developed coating with improved wear resistance.
The smoothening treatment of the coating layer reduces cutting resistance and significantly improves chip discharge.

SMART MIRACLE Coating (Al,Cr)N coating is the most suitable coating for higher efficiency machining.

ZERO-μ Surface The original surface treatment technology provides a smooth coating layer.

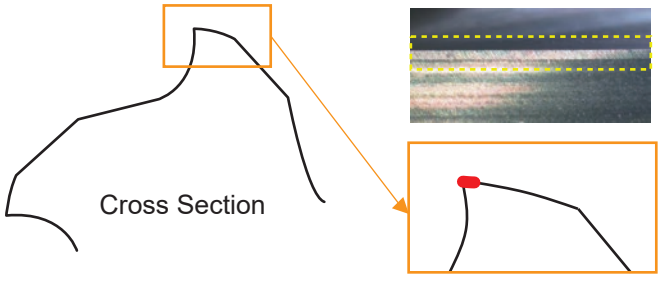
Secondary Gash

A first and secondary gash provides high capacity chip evacuation that far exceeds conventional designs when ramping.



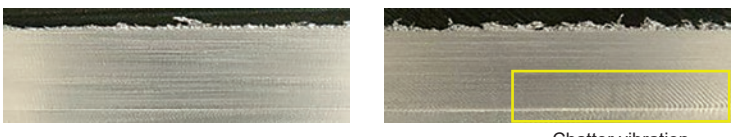
Micro Relief Angle

This exerts a margin effect that provides a guide during machining.
Combined with irregular helix flutes, vibration damping and suppression of burrs is improved.



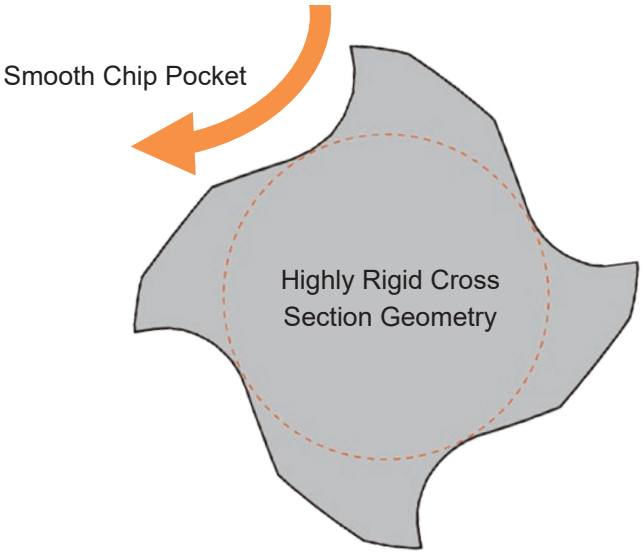
Irregular helix flutes and the micro relief angle improve vibration damping and provides excellent surface finishes.

JIS SUS304 vc=100 m/min, fz=0.05 mm/t., ap=5 mm, ae=3 mm



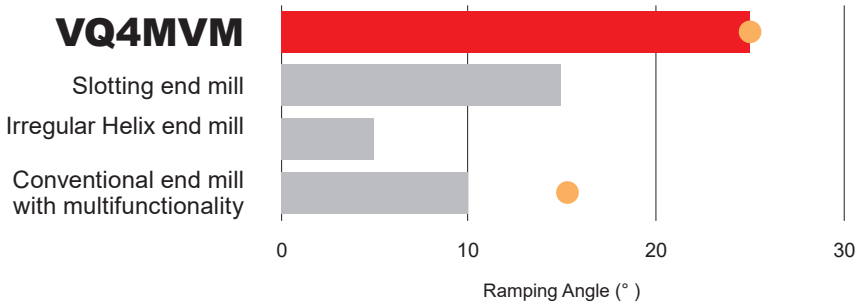
Chip Pocket and Highly Rigid Geometry

VQ4MVM is suitable for steep ramping and chip evacuation performance due to the highly rigid geometry.



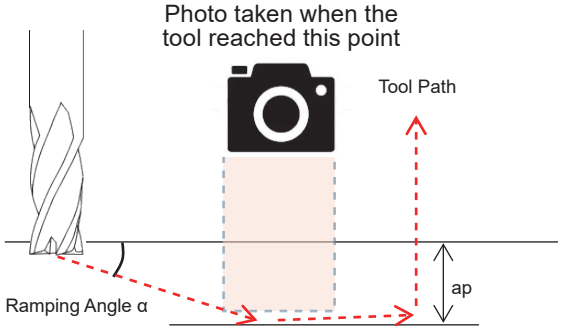
Comparison of Ramping Angles when Machining JIS SUS304

Provided a good machined surface when machining with a ramping angle of 25°. The cutting conditions used in this comparison test differ from the recommended conditions. Please check the recommended conditions before commercial use.



<Cutting Conditions>

Workpiece Material	: JIS SUS304
Tool	: Ø10
Cutting Speed	: vc=50 m/min
Feed per Tooth	: fz=0.025 mm/t.
Depth of Cut	: ap=10 mm ae=10 mm
Over Length	: 35 mm
Cutting Mode	: External Coolant (Emulsion)
Machine	: Vertical M/C (BT50)



● : Machining Surface

VQ4MVM 25°

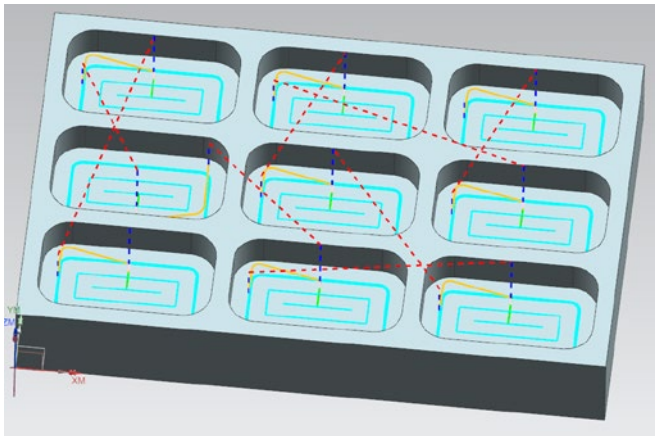
Conventional end mill

Comparison of Continuous Pocketing when Machining JIS S55C

During continuous machining of small pockets, steep ramping reliably shortens machining time.

Workpiece Material : JIS S55C Pocket Size 50 mm × 30 mm × 10 mm R=8
Tool : Ø10

Simulated by **VQ4MVM**



Total Cycle Time 4:35

Ramping Angle 17° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.04 mm/t.
Depth of Cut : ap=10 mm

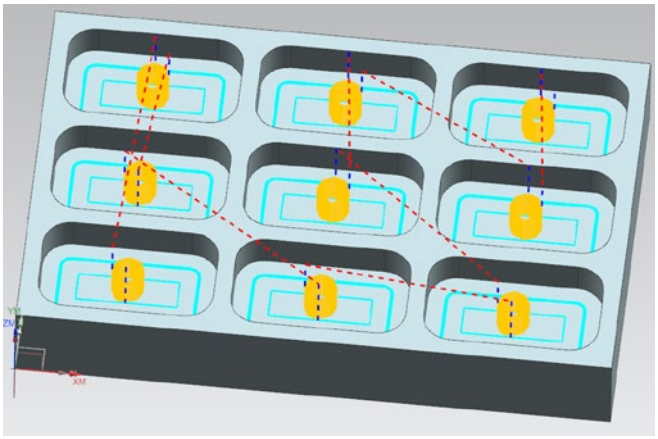
Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.065 mm/t.
Depth of Cut : ap=10 mm
ae≤5 mm

Finish Cutting

<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.065 mm/t.
Depth of Cut : ap=10 mm
ae≤5 mm

Simulated Conventional Machining



Total Cycle Time 6:42

Helical Angle 2° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.065 mm/t.
Depth of Cut : ap=10 mm

Same cutting conditions for roughing and finishing

Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.065 mm/t.
Depth of Cut : ap=10 mm
ae≤5 mm

Finish Cutting

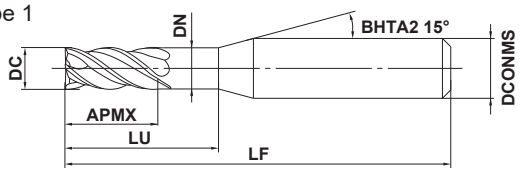
<Cutting Conditions>
Cutting Speed : vc=100 m/min
Feed per Tooth : fz=0.065 mm/t.
Depth of Cut : ap=10 mm
ae≤5 mm

VQ4MVM

End mill, Medium cut length, 4 flute, For multifunctional machining

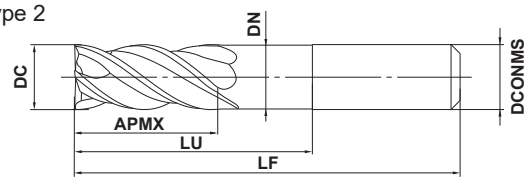
Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
◎	○			◎	○		

Type 1



DC≤12					
0 - 0.020					
DCONMS=6					
0 - 0.008					
DCONMS8, 10	DCONMS=12				
0 - 0.009	0 - 0.011				

Type 2



- Multifunctional end mill that enables steep ramping angles.
- Chip evacuation is improved by widening the radial cutting edge pocket.

Order Number	Dimensions (mm)						No. of Flutes	Stock	Type
	DC	APMX	LU	DN	LF	DCONMS			
VQ4MVMD0400N180	4	11	18	3.85	50	6	4	●	1
VQ4MVMD0500N180	5	13	18	4.85	50	6	4	●	1
VQ4MVMD0600N200	6	13	20	5.85	60	6	4	●	2
VQ4MVMD0800N240	8	19	24	7.85	60	8	4	●	2
VQ4MVMD1000N300	10	22	30	9.70	70	10	4	●	2
VQ4MVMD1200N360	12	26	36	11.70	75	12	4	●	2

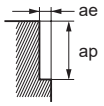
Note 1) SMART MIRACLE Coating has very low electrical conductivity. therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

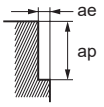
DC = Cutting dia. **DN** = Neck dia.
APMX = Depth of cut max. **LF** = Functional length
LU = Usable length **DCONMS** = Connection dia.

● : Inventory maintained in Japan.

Recommended Cutting Conditions

■ Side Milling

Workpiece Material	Mild Steel, Carbon Steel Alloy Steel (180–280HB) SS400, S45C, SCM440					Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT					Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys SUS304, SUS316, SUS410, SUS430, Ti-5Al-5V-5Mo-3Cr				
Dia. DC(mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
4	120	9500	1400	6	1.2	70	5600	490	4	0.4	80	6400	470	4	0.6
5	120	7600	1400	7.5	1.5	70	4500	500	5	0.5	80	5100	470	5	0.9
6	120	6400	1400	9	1.8	70	3700	500	6	0.6	80	4200	580	6	1.2
8	120	4800	1300	12	2.4	70	2800	520	8	0.8	80	3200	630	8	1.5
10	120	3800	1200	15	3	70	2200	460	10	1	80	2500	660	10	1.8
12	120	3200	1000	18	3.6	70	1900	450	12	1	80	2100	610	12	2.4
Depth of Cut															

Workpiece Material	Precipitation Hardening Stainless Steel Cobalt Chromium Alloys SUS630, SUS631					Heat Resistant alloys Inconel718				
Dia. DC(mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
4	70	5600	490	4	0.8	30	2400	120	4	0.4
5	70	4500	500	5	1	30	1900	120	5	0.5
6	70	3700	500	6	1.2	30	1600	130	6	0.6
8	70	2800	520	8	1.6	30	1200	130	8	0.8
10	70	2200	460	10	2	30	950	140	10	1
12	70	1900	450	12	2.4	30	800	140	12	1.2
Depth of Cut										

Note 1) SMART MIRACLE coating has very low electrical conductivity. therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

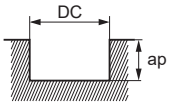
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

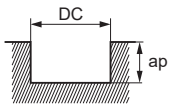
Note 3) If the depth of cut is shallow, the revolution and feed rate can be increased.

Note 4) If the rigidity of the machine or the work materials installation is very low, or chattering and noise are generated, reduce the revolution and feed rate proportionately.

Recommended Cutting Conditions

Slot Milling and Ramping

Workpiece Material	Mild Steel, Carbon Steel Alloy Steel (180–280HB) SS400, S45C, SCM440					Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT					Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys SUS304, SUS316, SUS410, SUS430, Ti-5Al-5V-5Mo-3Cr				
Dia. DC(mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
4	100	8000	840	4	4	60	4800	210	2	4	60	4800	280	4	4
5	100	6400	840	5	5	60	3800	210	2.5	5	60	3800	280	5	5
6	100	5300	840	6	6	60	3200	230	3	6	60	3200	300	6	6
8	100	4000	740	8	8	60	2400	240	4	8	60	2400	320	8	8
10	100	3200	680	10	10	60	1900	270	5	10	60	1900	350	10	10
12	100	2700	570	12	12	60	1600	260	6	12	60	1600	340	12	12
Depth of Cut															

Workpiece Material	Precipitation Hardening Stainless Steel Cobalt Chromium Alloys SUS630, SUS631					Heat Resistant Alloys Inconel718				
Dia. DC(mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
4	50	4000	250	2	4	25	2000	93	1.2	4
5	50	3200	250	2.5	5	25	1600	95	1.5	5
6	50	2700	290	3	6	25	1300	96	1.8	6
8	50	2000	260	4	8	25	990	100	2.4	8
10	50	1600	230	5	10	25	800	120	3	10
12	50	1300	210	6	12	25	660	110	3.6	12
Depth of Cut										

Note 1) SMART MIRACLE coating has very low electrical conductivity. therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

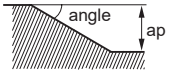
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

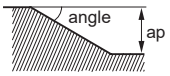
Note 3) When performing machining with a strong ramping angle, a high gripping force holder is recommended.

Note 4) When performing ramping deeper than the recommended depth of cut, please divide the process into multiple steps within the recommended depth of cut.

Note 5) If the rigidity of the machine or the work materials installation is very low, or chattering and noise are generated, reduce the revolution and feed rate proportionately.

■ Feed Rate Factor for Ramping

Workpiece Material	Mild Steel, Carbon Steel Alloy Steel (180–280HB)							Pre-Hardened Steel (≤45HRC) Alloy Tool Steel			Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel Titanium Alloys			
Dia. DC(mm)	Slot Milling Feed %							Slot Milling Feed %			Slot Milling Feed %			
	1°	5°	10°	15°	20°	25°	30°	1°	5°	10°	1°	5°	10°	15°
4	100	90	80	80	60	60	60	80	70	60	90	80	70	50
5	100	90	80	80	60	60	60	80	70	60	90	80	70	50
6	100	90	80	80	60	60	60	80	70	60	90	80	70	60
8	100	95	90	90	90	75	75	70	60	50	90	80	70	60
10	100	95	95	95	90	80	80	70	60	50	80	70	60	50
12	100	95	95	95	90	80	80	70	60	50	80	70	60	50
Depth of Cut														

Workpiece Material	Precipitation Hardening Stainless Steel Cobalt Chromium Alloys					Heat Resistant Alloys	
Dia. DC(mm)	Slot Milling Feed %					Slot Milling Feed %	
	1°	5°	10°	15°	20°	1°	5°
4	90	80	70	60	60	90	80
5	90	80	70	60	60	90	80
6	90	80	70	60	60	90	80
8	90	80	70	60	60	90	80
10	80	80	70	60	60	80	70
12	80	80	70	60	60	80	70
Depth of Cut							

Note 1) SMART MIRACLE coatinghas very low electrical conductivity. therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

Note 2) When performing ramping, please use the feed rate shown on the previous page multiplied by the coefficient.

Note 3) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

Note 4) When performing machining with large ramping angles, a high grip holder is recommended. Also, if the machine or workpiece material lacks rigidity, or if chipping occurs on the cutting edge, adjust the ramping angle and feed rate.

Note 5) When performing ramping deeper than the recommended depth of cut, please divide the process into multiple steps within the recommended depth of cut.

Memo

Memo

High-Performance End Mill　SMART MIRACLE End Mill Series

VQ4MVM

For Your Safety
●Don't handle inserts and chips without gloves. ●Please machine within the recommended application range and exchange expired tools with new ones in advance of breakage. ●Please use safety covers and wear safety glasses. ●When using compounded cutting oils, please take fire precautions. ●When attaching inserts or spare parts, please use only the correct wrench or driver. ●When using rotating tools, please make a trial run to check run-out, vibration, abnormal sounds, etc.

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https://www.mmc-carbide.com/sea
(Tool specifications are subject to change without notice.)

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