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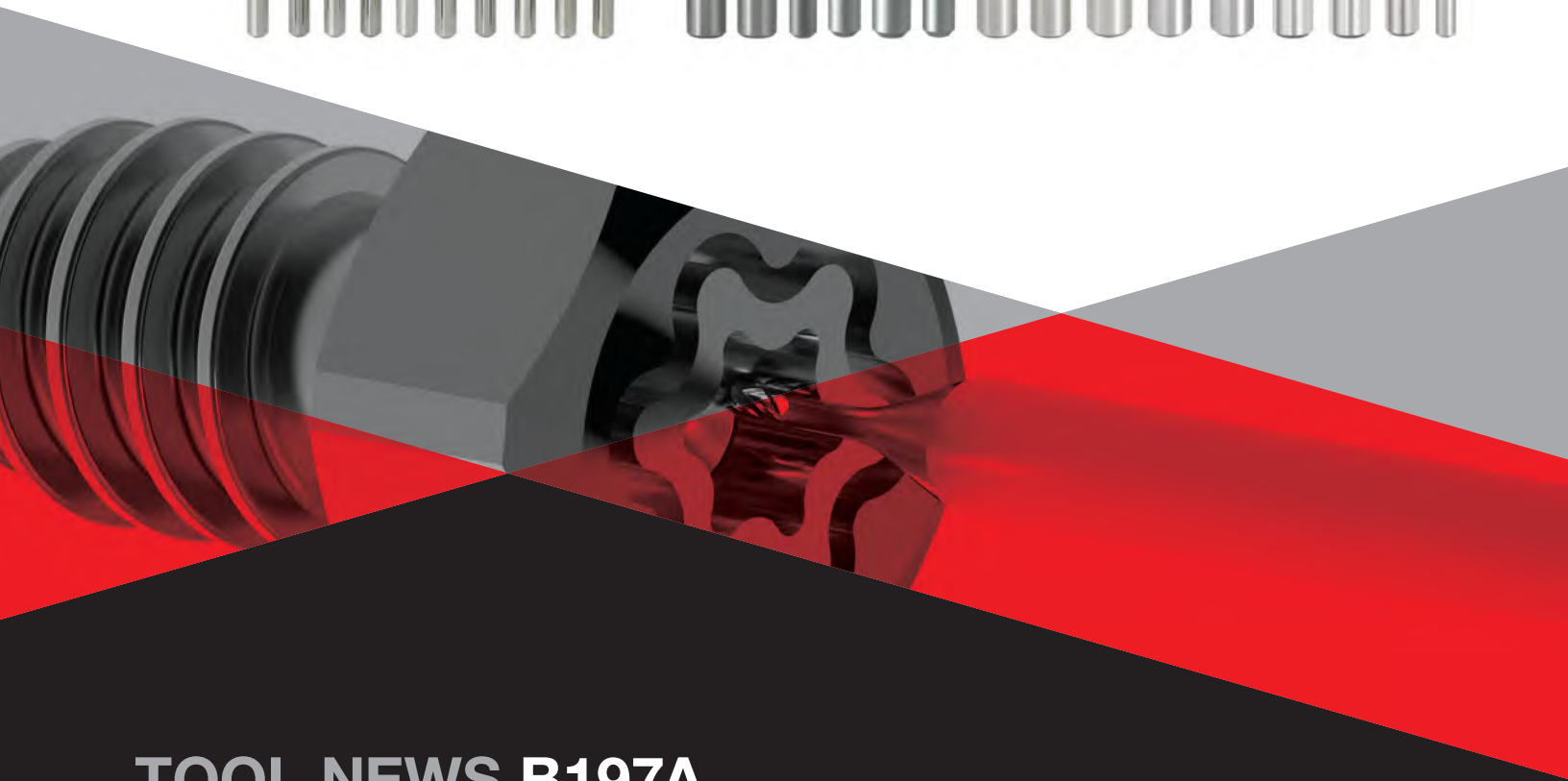
SMART MIRACLE

HIGH-PERFORMANCE END MILL SERIES

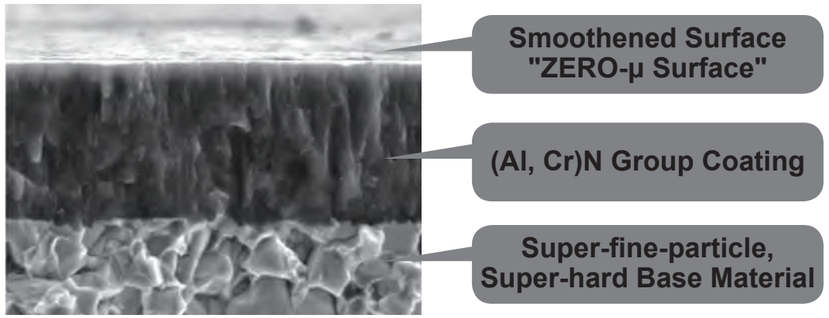


TOOL NEWS **B197A**

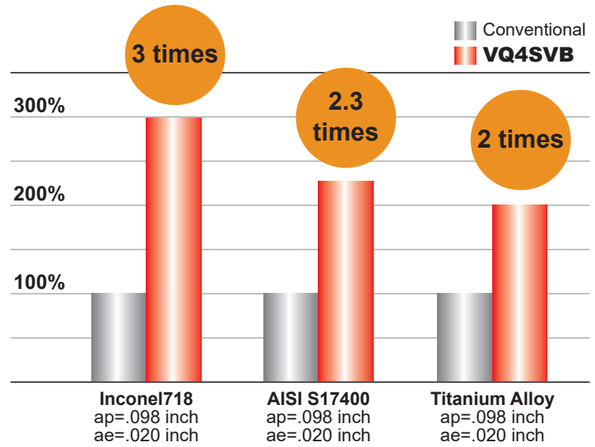
SMART MIRACLE

SMART MIRACLE Coating

SMART MIRACLE end mills have been treated with an (Al, Cr)N group coating which delivers substantially better wear resistance. The surface of the coating has been given a smoothening treatment resulting in better machined surfaces, reduced cutting resistance and improved chip discharge. These coated end mills deliver long tool life when machining stainless steels and other difficult-to-cut materials.



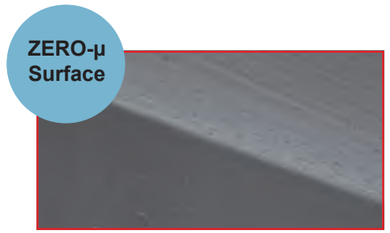
VQ4SVB achieves double tool life when machining difficult-to-cut materials.



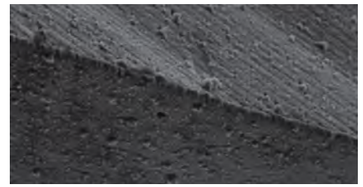
See page 71 for test data details.

ZERO-μ Surface

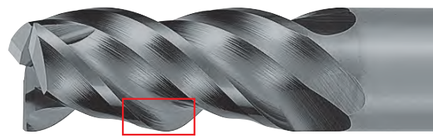
With the unique ZERO-μ Surface, the cutting edge retains its sharpness. While previous technologies often resulted in diminished sharpness, the ZERO-μ Surface achieves both smoothness and sharpness, as well as longer tool life.

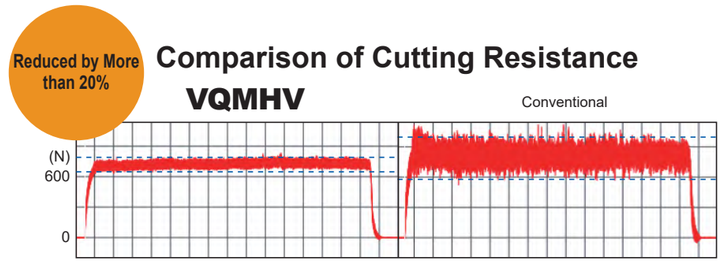


SMART MIRACLE Coating



Conventional Coating





<Cutting Conditions>

Material	: AISI 304
End Mill	: VQMHVD0600 (DC=6mm, .236")
Revolution	: 2650min^{-1}
Cutting Speed	: vc=165 SFM
Feed Rate	: vf=12.598 IPM (.001 IPT)
Depth of Cut	: ap=.236 inch
Overhang Length	: .787 inch
Cutting Mode	: Down (Climb) Cut External Coolant (Emulsion)
Machine	: Vertical M/C (BT50)

New Line-up

End mill, Multi-flute, Long neck

Multi-Flute

3 or 4-flute designs provide more efficient machining than 2-flute designs.

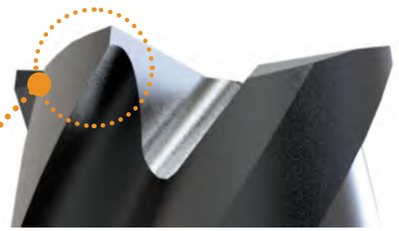
High Rigidity Long Neck

The optimized long neck shape maintains rigidity while avoiding interference with the workpiece, enabling stable machining.

VQ3XL/VQ4XL Square

Micro Gash

It suppresses chipping by increasing the strength of the tool while minimizing the remaining corners of the workpiece.



VQ4XLRB Radius

End Cutting Edge Chip Pocket

The shape of the end cutting edge chip pocket has been optimized. For items with a large RE, the chip pocket is set large, which provides excellent chip evacuation and reduces chip clogging.

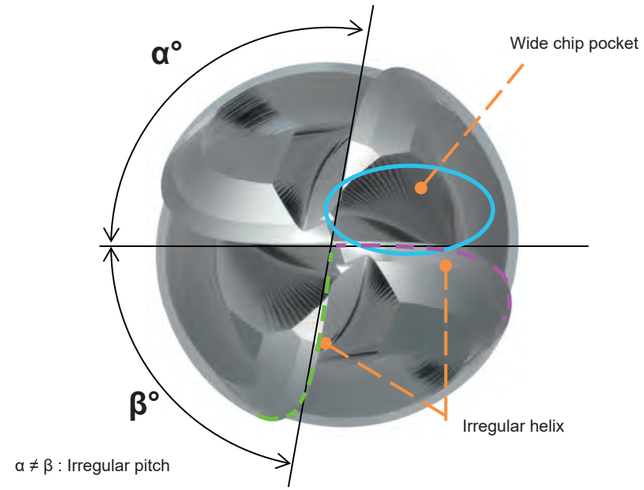
Chip Pocket with small RE

Chip Pocket with large RE
(2RE/DC>33%)

VQ4XLB Ball Nose

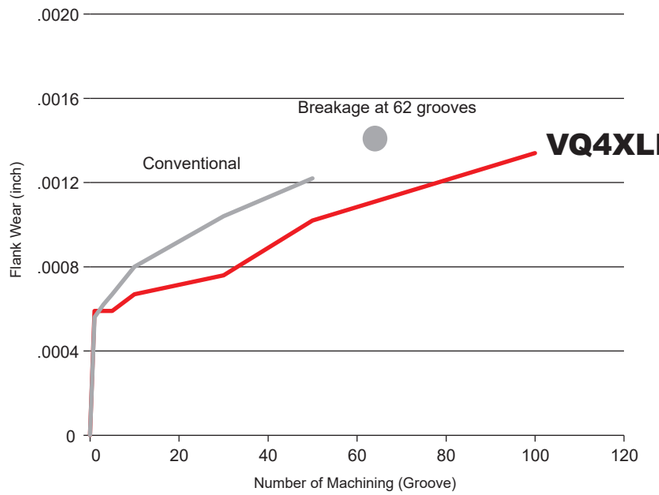
Irregular Helix and Irregular Pitch Flutes

The irregular helix and irregular pitch flutes shape improve the cutting edge's resistance to chatter vibration.
The unequal curve shape improves chip removal by providing a wide chip pocket on the long cutting edge.
This enables high efficiency and stable machining of ball end mills.



Cobalt Chromium Alloy : Grooving Number Comparison

Conventional products break after 62 grooves, but the highly rigid long neck and effective chip removal make it possible to machine more than 100 grooves.



Increased 50% Tool Life

<Cutting Conditions>

Material	: Co-Cr Alloy
Tool	: VQ4XLB DC=2.0 mm .079"
Revolution	: n=12000 min^{-1}
Cutting Speed	: vc=245 SFM
Feed Rate	: fz=.0003 IPT
Overhang Length	: .630 inch
Depth of Cut	: ap=.020 inch×3
Cutting Mode	: External Coolant (Emulsion)

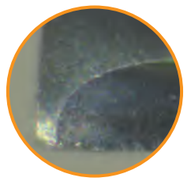
Cutting Performance

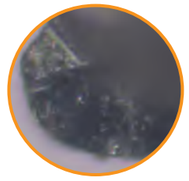
Cobalt Chromium Alloy : Wear Resistance Comparison

While conventional products wear to the point where the corner shape is lost, the VQ4XL corner shape is maintained, demonstrating excellent wear resistance.

VQ4XLB

Conventional





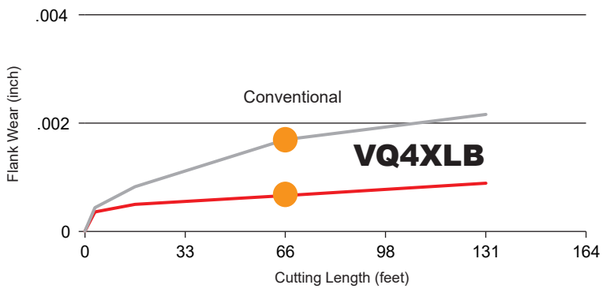
Double Tool Life

<Cutting Conditions>

Material	: Co-Cr Alloy
Tool	: VQ4XLD0050N025
Revolution	: n=32000 min^{-1}
Cutting Speed	: vc=165 SFM
Feed Rate	: fz=.0002 IPT
Depth of Cut	: ap=.0030 inch ae=.0010 inch
Cutting Mode	: Down Cutting External Coolant (Emulsion)

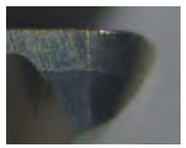
Titanium Alloy : Wear Resistance Comparison

The wear resistance of VQ4XLRB is more than twice that of conventional products. It also has excellent chip evacuation.



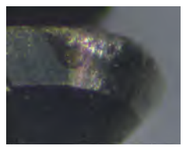
● : Photographed point

VQ4XLB



Less wear

Conventional



Severe wear on RE part

<Cutting Conditions>

Material	: Titanium Alloy
Tool	: VQ4XLRBDU031R008N5D
Revolution	: n=18000 min^{-1}
Cutting Speed	: vc=150 SFM
Feed Rate	: fz=.0003 IPT
Depth of Cut	: ap=.0016 inch
Cutting Mode	: Grooving External Coolant (Emulsion)

Double Tool Life

End mill, 5 flute, Irregular pitch flutes, Chipbreaker

VQJCS/VQLCS/VQELCS VQJCSR/VQLCSR/VQELCSR

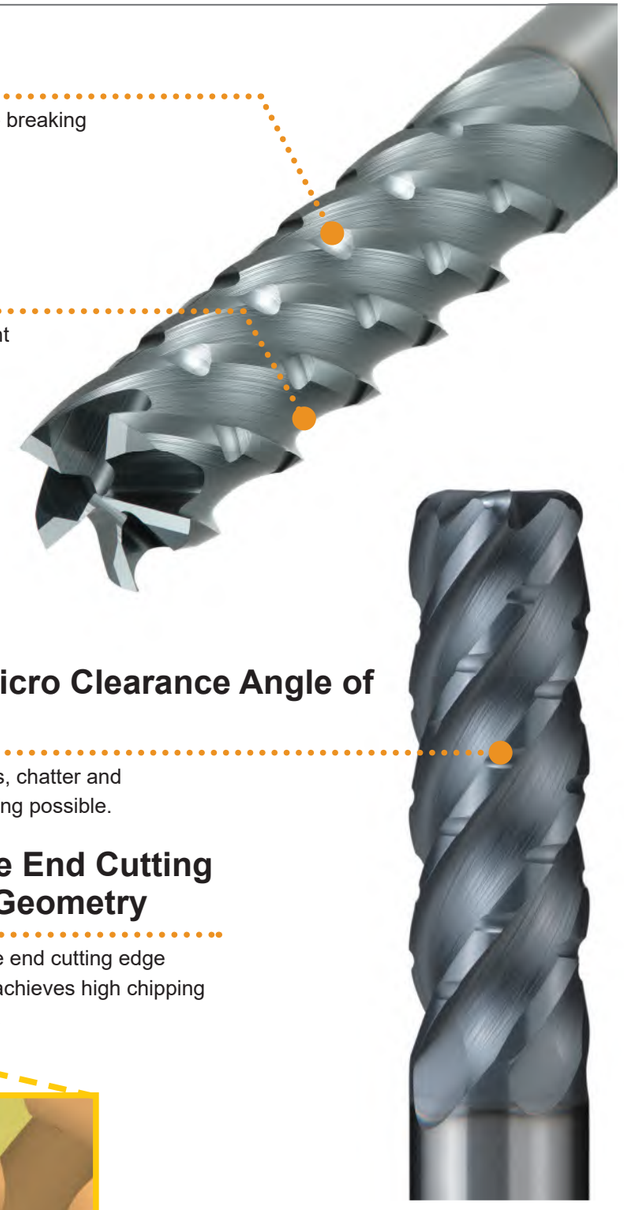
Chipbreaker Function

Prevents chip problems by combining great chip breaking capabilities and fracture resistance.

Chip Pocket Geometry for High Efficiency Machining

The rigid cross-sectional geometry with excellent chip evacuation properties is ideal for high efficiency machining such as trochoidal milling.

Ideal chip pocket geometry

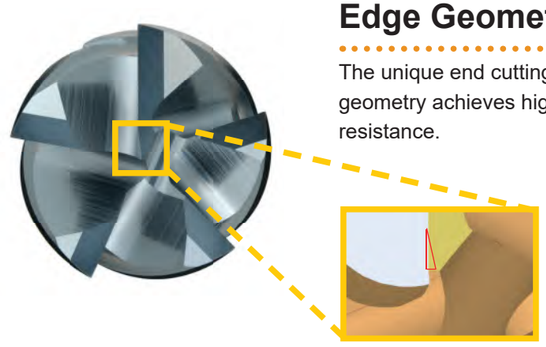


Irregular Pitch Flutes and Micro Clearance Angle of the Peripheral Cutting Edge

Due to its excellent vibration damping properties, chatter and vibration are suppressed making stable machining possible.

Unique End Cutting Edge Geometry

The unique end cutting edge geometry achieves high chipping resistance.

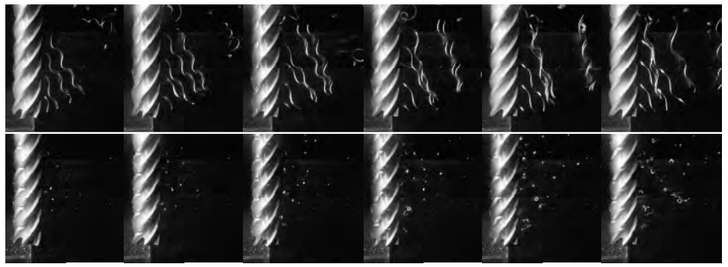


Chipbreaker Function : High-Speed Camera Comparison

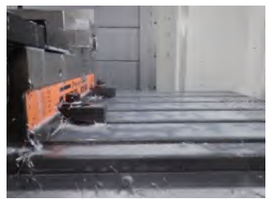
The excellent chip breaking properties reduce chip clogging and remove chips efficiently also suppressing chip pilling on the machine.

Conventional

VQLCS



After Machining with Conventional



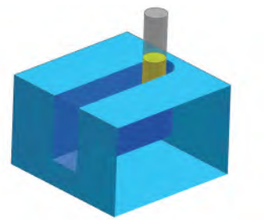
After Machining with **VQLCS**

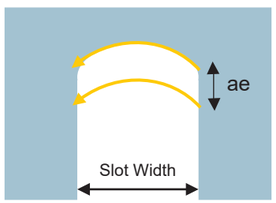
YouTube

Evaluation of Trochoidal Milling

	ae=.071"	ae=.094"	ae=.118"	ae=.142"	ae=.236"
VQLCS	YES	YES	YES	YES	YES
Conventional A	YES	YES	YES	NO	
Conventional B	YES	NO			

YES : Achieves Stable Machining
NO : Problems Caused by Chips





<Cutting Conditions>
Material : AISI 304
Tool : DC=Ø12 mm, .472 inch
Cutting Speed : vc=330 SFM
Feed Rate : ft=.002 IPT
Depth of Cut : ap=.945 inch, DCx2
ae(Pitch)=.071 - .236 inch
Slot Width=.709 inch (DCx1.5)
Overhang Length : 2.362 inch (DCx5)
Cutting Mode : Trochoidal Milling
External Coolant(Emulsion)

Memo

SERIES SELECTION CHART

Figure	No. of Flutes	Type	Shape	Coolant (Int, Ext)	Size	Dia. DC Min.	Dia. DC Max.	APMX Max. DC	Material P Carbon Steel	Material P Tool Steel	Material M Stainless Steel	Material S Cobalt Chrome Alloy, Titanium Alloy	Material S Heat Resistant Alloy	Material N Copper Alloy	Page	Features
LONG NECK SQUARE	3	NEW VQ3XL		Ext	mm	0.2	0.3	0.45	◎	○	◎	◎	○	○	P.12	P.4
LONG NECK SQUARE	4	NEW VQ4XL		Ext	mm	0.4	1	1.5	◎	○	◎	◎	○	○	P.14	P.4
LONG NECK SQUARE	3-4	VQXL		Ext	mm	0.2	1	1.5	◎	○	◎	◎	○	○	P.35	P.126
				Ext	inch	.0080	.1250	.1875	◎	○	◎	◎	○	○	P.38	P.126
LONG NECK RADIUS	4	NEW VQ4XLRB		Ext	mm	0.4	1	1.5	◎	○	◎	◎	○	○	P.24	P.4
				Ext	inch	.0156	.1250	.1875	◎	○	◎	◎	○	○	P.26	P.4
LONG NECK BALL NOSE	2	VQ2XLB		Ext	mm	0.4	3	2.3			○	◎	○		P.17	P.135
				Ext	inch	.0156	.0781	.0586			○	◎	○		P.18	P.135
LONG NECK BALL NOSE	4	NEW VQ4XLB		Ext	inch	.0800	.1250	.0938			○	◎	○		P.22	P.5
SQUARE	5	VQJCS		Ext	mm	6	20	60	◎	○	◎	◎	○	○	P.43	P.7
SQUARE	5	VQLCS		Ext	mm	6	20	80	◎	○	◎	◎	○	○	P.45	P.7
SQUARE	5	NEW VQELCS		Ext	mm	6	20	100	◎	○	◎	◎	○	○	P.47	P.7
RADIUS	5	NEW VQJCSRB		Ext	mm	6	20	60	◎	○	◎	◎	○	○	P.49	P.7
RADIUS	5	NEW VQLCSRB		Ext	mm	6	20	80	◎	○	◎	◎	○	○	P.52	P.7
RADIUS	5	NEW VQELCSRB		Ext	mm	6	20	100	◎	○	◎	◎	○	○	P.55	P.7
SQUARE	4	VQ4MVM		Ext	mm	4	12	26	◎	○	◎	○	○		P.58	P.128
SQUARE	3	VQMHZV		Ext	mm	1	20	32	◎	○	◎	◎	○	○	P.62	P.141
				Ext	inch	.0625	.5000	1.1250	◎	○	◎	◎	○	○	P.68	P.141

Figure	No. of Flutes	Type	Shape	Coolant (Int, Ext)	Size	Dia. DC Min.	Dia. DC Max.	APMX Max. DC	Material P Carbon Steel	Material P Tool Steel	Material M Stainless Steel	Material S Cobalt Chrome Alloy, Titanium Alloy	Material S Heat Resistant Alloy	Material N Copper Alloy	Page	Features
SQUARE	3	VQMHZVOH		Int	mm	6	16	30	◎	○	◎	◎	○	○	P.72	P.141
					inch	.2500	.5000	1.1252	◎	○	◎	◎	○	○	P.76	P.141
SQUARE	4	VQMHV		Ext	mm	1	25	55	◎	○	◎	◎	○	○	P.79	P.144
					inch	.1250	.5000	1.1250	◎	○	◎	◎	○	○	P.83	P.144
SQUARE	4	VQJHV		Ext	mm	1	20	70	◎	○	◎	◎	○	○	P.86	P.144
					inch	.1250	.5000	1.6500	◎	○	◎	◎	○	○	P.88	P.144
RADIUS	4	VQFDRB		Ext	mm	3	6	0.36			○	◎	○		P.90	P.132
RADIUS	4	VQHVRB		Ext	mm	1	4	4			○	◎	○		P.92	P.134
RADIUS	4	VQMHVRB		Ext	mm	2	20	45	◎	○	◎	◎	○	○	P.94	P.144
					inch	.1250	.5000	1.1250	◎	○	◎	◎	○	○	P.99	P.144
RADIUS	4	VQMHVRBF		Ext	mm	6	16	35	◎	○	◎	◎	○	○	P.102	P.144
					inch	.2500	.5000	1.1250	◎	○	◎	◎	○	○	P.104	P.144
RADIUS	4	VQ4MRB-FB		Ext	mm	4	10	15	◎	○	◎	◎	○	○	P.107	-
ROUGHING	3-4	VQSVR		Ext	mm	3	20	38	◎	○	◎	◎	○	○	P.109	P.140
BALL NOSE	4	VQ4SVB		Ext	mm	2	12	18	◎	○	◎	◎	○	○	P.112	P.140
					inch	.1250	.5000	.750	◎	○	◎	◎	○	○	P.114	P.140
LOLLIPOP	4	VQ4WB		Ext	mm	1	6	5.29	◎	○	◎	◎	○	○	P.116	P.136
SQUARE	5	VQ5MHV		Ext	inch	.2500	.5000	1.125	◎	○	◎	◎	○		P.119	P.142
RADIUS	5	VQ5MHVRB		Ext	inch	.2500	.5000	1.125	◎	○	◎	◎	○		P.120	P.142
SQUARE	6	VQ6MHVCH		Int	mm	10	20	38	○	○	◎	◎	○	○	P.123	P.139
RADIUS	6	VQ6MHVRBCH		Int	mm	10	20	38	○	○	◎	◎	○	○	P.124	P.139

VQXL Application Example

<Cutting Conditions>
Material : Ti-6Al-4V ELV
Cutting Mode : External Coolant (Emulsion)
Machining : CNC Automatic Lathe

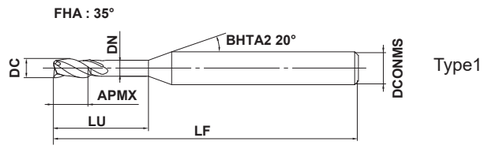
①
Tool Size : DC=.0079"
3 flutes
Revolution : 17000 min^{-1}
Feed Rate : 2.0-3.1 IPM
Depth of Cut : ap=.0010"

②
Tool Size : DC=.0157"
4 flutes
Revolution : 17000 min^{-1}
Feed Rate : 3.9 IPM
Depth of Cut : ap=.0020"
Cutting Method : Machining of TORX
There is a Pre-hole

VQ3XL NEW

End mill, Short cut length, 3 flute, Long neck

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



Type1

DC				
0 - 0.020				
DCONMS				
0 - 0.005				

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutter at a small diameter of Ø0.3 mm are realized.

(mm)

Order Number	DC	APMX	LU	LF	DCONMS	No. of Flutes	Stock	Type
VQ3XLD0020N006	0.2	0.3	0.6	40	4	3	●	1
VQ3XLD0020N010	0.2	0.3	1	40	4	3	●	1
VQ3XLD0020N016	0.2	0.3	1.6	40	4	3	●	1
VQ3XLD0030N009	0.3	0.45	0.9	40	4	3	●	1
VQ3XLD0030N015	0.3	0.45	1.5	40	4	3	●	1
VQ3XLD0030N024	0.3	0.45	2.4	40	4	3	●	1

● = NEW

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

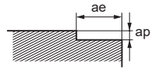
● :USA Stock

RECOMMENDED CUTTING CONDITIONS

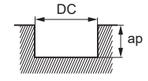
Side milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel				
RE		**LU**		Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.2	**.008**	**0.6**	**.024**	80	40000	14.2	.0012	.0004	65	32000	11.4	.0012	.0004
0.2	**.008**	**1**	**.039**	80	40000	9.4	.0012	.0004	65	32000	7.5	.0012	.0004
0.2	**.008**	**1.6**	**.063**	80	40000	4.7	.0008	.0004	65	32000	3.8	.0008	.0004
0.3	**.012**	**0.9**	**.035**	130	40000	18.9	.0018	.0006	65	21000	9.8	.0018	.0006
0.3	**.012**	**1.5**	**.059**	130	40000	14.2	.0018	.0006	65	21000	7.5	.0018	.0006
0.3	**.012**	**2.4**	**.094**	130	40000	7.1	.0012	.0006	65	21000	3.7	.0012	.0006
Depth of Cut													

Bottom face milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel				
RE		**LU**		Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.2	**.008**	**0.6**	**.024**	80	40000	14.2	.0006	≤.0049	65	32000	11.4	.0006	≤.0039
0.2	**.008**	**1**	**.039**	80	40000	9.4	.0004	≤.0049	65	32000	7.5	.0004	≤.0039
0.2	**.008**	**1.6**	**.063**	80	40000	4.7	.0002	≤.0049	65	32000	3.8	.0002	≤.0039
0.3	**.012**	**0.9**	**.035**	130	40000	18.9	.0010	≤.0118	65	21000	9.8	.0010	≤.0059
0.3	**.012**	**1.5**	**.059**	130	40000	14.2	.0008	≤.0118	65	21000	7.5	.0008	≤.0059
0.3	**.012**	**2.4**	**.094**	130	40000	7.1	.0004	≤.0118	65	21000	3.7	.0004	≤.0059
Depth of Cut													

Slotting

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel			
RE		**LU**		Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min-1)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)
(mm)	(inch)	(mm)	(inch)								
0.2	**.008**	**0.6**	**.024**	65	30000	10.6	.0006	50	24000	8.7	.0006
0.2	**.008**	**1**	**.039**	65	30000	7.1	.0004	50	24000	5.5	.0004
0.2	**.008**	**1.6**	**.063**	65	30000	3.5	.0002	50	24000	2.8	.0002
0.3	**.012**	**0.9**	**.035**	100	30000	14.2	.0010	50	16000	7.5	.0010
0.3	**.012**	**1.5**	**.059**	100	30000	10.6	.0008	50	16000	5.5	.0008
0.3	**.012**	**2.4**	**.094**	100	30000	5.5	.0004	50	16000	2.8	.0004
Depth of Cut											

DC : Dia.

VQ4XL NEW

End mill, Short cut length, 4 flute, Long neck

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

Type1

DC				
0 - 0.020				
DCONMS				
0 - 0.005				

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutter at a small diameter of Ø1.0 mm are realized.

(mm)

Order Number	DC	APMX	LU	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLD0040N012	0.4	0.6	1.2	40	4	4	●	1
VQ4XLD0040N020	0.4	0.6	2	40	4	4	●	1
VQ4XLD0040N032	0.4	0.6	3.2	40	4	4	●	1
VQ4XLD0050N015	0.5	0.75	1.5	40	4	4	●	1
VQ4XLD0050N025	0.5	0.75	2.5	40	4	4	●	1
VQ4XLD0050N040	0.5	0.75	4	45	4	4	●	1
VQ4XLD0060N018	0.6	0.9	1.8	40	4	4	●	1
VQ4XLD0060N030	0.6	0.9	3	40	4	4	●	1
VQ4XLD0060N048	0.6	0.9	4.8	45	4	4	●	1
VQ4XLD0070N021	0.7	1.05	2.1	40	4	4	●	1
VQ4XLD0070N035	0.7	1.05	3.5	40	4	4	●	1
VQ4XLD0070N056	0.7	1.05	5.6	45	4	4	●	1
VQ4XLD0080N024	0.8	1.2	2.4	40	4	4	●	1
VQ4XLD0080N040	0.8	1.2	4	40	4	4	●	1
VQ4XLD0080N064	0.8	1.2	6.4	45	4	4	●	1
VQ4XLD0100N030	1.0	1.5	3	40	4	4	●	1
VQ4XLD0100N050	1.0	1.5	5	40	4	4	●	1
VQ4XLD0100N080	1.0	1.5	8	45	4	4	●	1

● = NEW

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

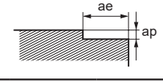
● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel				
RE		**LU**		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.4	**.016**	**1.2**	**.047**	165	40000	31.5	.0024	.0008	65	16000	12.6	.0024	.0008
0.4	**.016**	**2**	**.079**	165	40000	22	.0024	.0008	65	16000	8.7	.0024	.0008
0.4	**.016**	**3.2**	**.126**	165	40000	12.6	.0016	.0008	65	16000	5.1	.0016	.0008
0.5	**.020**	**1.5**	**.059**	195	38000	35.8	.0030	.0010	65	13000	12.2	.0030	.0010
0.5	**.020**	**2.5**	**.098**	195	38000	24	.0030	.0010	65	13000	8.3	.0030	.0010
0.5	**.020**	**4**	**.157**	195	38000	15	.0020	.0010	65	13000	5.1	.0020	.0010
0.6	**.024**	**1.8**	**.071**	195	32000	35.4	.0035	.0012	65	11000	12.2	.0035	.0012
0.6	**.024**	**3**	**.118**	195	32000	25.2	.0035	.0012	65	11000	8.7	.0035	.0012
0.6	**.024**	**4.8**	**.189**	195	32000	15	.0024	.0012	65	11000	5.1	.0024	.0012
0.7	**.028**	**2.1**	**.083**	195	27000	36.2	.0041	.0014	65	9100	12.2	.0041	.0014
0.7	**.028**	**3.5**	**.138**	195	27000	25.6	.0041	.0014	65	9100	8.7	.0041	.0014
0.7	**.028**	**5.6**	**.220**	195	27000	15	.0028	.0014	65	9100	5.1	.0028	.0014
0.8	**.031**	**2.4**	**.094**	195	24000	37.8	.0047	.0016	65	8000	12.6	.0047	.0016
0.8	**.031**	**4**	**.157**	195	24000	26.4	.0047	.0016	65	8000	8.7	.0047	.0016
0.8	**.031**	**6.4**	**.252**	195	24000	15	.0031	.0016	65	8000	5.1	.0031	.0016
1	**.039**	**3**	**.118**	195	20000	37.8	.0059	.0020	65	6500	12.2	.0059	.0020
1	**.039**	**5**	**.197**	195	20000	31.5	.0059	.0020	65	6500	10.2	.0059	.0020
1	**.039**	**8**	**.315**	195	20000	15.7	.0039	.0020	65	6500	5.1	.0039	.0020
Depth of Cut													

Bottom face milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel				
RE		**LU**		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.4	**.016**	**1.2**	**.047**	165	40000	31.5	.0012	≤.0157	65	16000	12.6	.0012	≤.0079
0.4	**.016**	**2**	**.079**	165	40000	22	.0008	≤.0157	65	16000	8.7	.0008	≤.0079
0.4	**.016**	**3.2**	**.126**	165	40000	12.6	.0004	≤.0157	65	16000	5.1	.0004	≤.0079
0.5	**.020**	**1.5**	**.059**	195	38000	35.8	.0016	≤.0197	65	13000	12.2	.0016	≤.0098
0.5	**.020**	**2.5**	**.098**	195	38000	24	.0012	≤.0197	65	13000	8.3	.0012	≤.0098
0.5	**.020**	**4**	**.157**	195	38000	15	.0006	≤.0197	65	13000	5.1	.0006	≤.0098
0.6	**.024**	**1.8**	**.071**	195	32000	35.4	.0020	≤.0236	65	11000	12.2	.0020	≤.0118
0.6	**.024**	**3**	**.118**	195	32000	25.2	.0014	≤.0236	65	11000	8.7	.0014	≤.0118
0.6	**.024**	**4.8**	**.189**	195	32000	15	.0008	≤.0236	65	11000	5.1	.0008	≤.0118
0.7	**.028**	**2.1**	**.083**	195	27000	36.2	.0022	≤.0276	65	9100	12.2	.0022	≤.0138
0.7	**.028**	**3.5**	**.138**	195	27000	25.6	.0014	≤.0276	65	9100	8.7	.0014	≤.0138
0.7	**.028**	**5.6**	**.220**	195	27000	15	.0008	≤.0276	65	9100	5.1	.0008	≤.0138
0.8	**.031**	**2.4**	**.094**	195	24000	37.8	.0024	≤.0315	65	8000	12.6	.0024	≤.0157
0.8	**.031**	**4**	**.157**	195	24000	26.4	.0016	≤.0315	65	8000	8.7	.0016	≤.0157
0.8	**.031**	**6.4**	**.252**	195	24000	15	.0010	≤.0315	65	8000	5.1	.0010	≤.0157
1	**.039**	**3**	**.118**	195	20000	37.8	.0031	≤.0394	65	6500	12.2	.0031	≤.0197
1	**.039**	**5**	**.197**	195	20000	31.5	.0020	≤.0394	65	6500	10.2	.0020	≤.0197
1	**.039**	**8**	**.315**	195	20000	15.7	.0012	≤.0394	65	6500	5.1	.0012	≤.0197
Depth of Cut													

VQ4XL

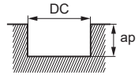
End mill, Short cut length, 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Slotting

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistanse Steel, Pre-Hardened Steel, Hardened Steel			
RE (mm)	RE (inch)	LU (mm)	LU (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)
0.4	**.016**	**1.2**	**.047**	130	30000	23.6	.0012	50	12000	9.4	.0012
0.4	**.016**	**2**	**.079**	130	30000	16.5	.0008	50	12000	6.7	.0008
0.4	**.016**	**3.2**	**.126**	130	30000	9.4	.0004	50	12000	3.8	.0004
0.5	**.020**	**1.5**	**.059**	150	28000	26.4	.0016	50	9500	9.1	.0016
0.5	**.020**	**2.5**	**.098**	150	28000	17.7	.0012	50	9500	5.9	.0012
0.5	**.020**	**4**	**.157**	150	28000	11	.0006	50	9500	3.7	.0006
0.6	**.024**	**1.8**	**.071**	150	24000	26.4	.0020	50	8000	8.7	.0020
0.6	**.024**	**3**	**.118**	150	24000	18.9	.0014	50	8000	6.3	.0014
0.6	**.024**	**4.8**	**.189**	150	24000	11.4	.0008	50	8000	3.8	.0008
0.7	**.028**	**2.1**	**.083**	150	20000	26.8	.0022	50	6800	9.1	.0022
0.7	**.028**	**3.5**	**.138**	150	20000	18.9	.0014	50	6800	6.3	.0014
0.7	**.028**	**5.6**	**.220**	150	20000	11	.0008	50	6800	3.7	.0008
0.8	**.031**	**2.4**	**.094**	150	18000	28.3	.0024	50	6000	9.4	.0024
0.8	**.031**	**4**	**.157**	150	18000	19.7	.0016	50	6000	6.7	.0016
0.8	**.031**	**6.4**	**.252**	150	18000	11.4	.0010	50	6000	3.8	.0010
1	**.039**	**3**	**.118**	150	15000	28.3	.0031	50	4800	9.1	.0031
1	**.039**	**5**	**.197**	150	15000	23.6	.0020	50	4800	7.5	.0020
1	**.039**	**8**	**.315**	150	15000	11.8	.0012	50	4800	3.8	.0012

Depth of Cut

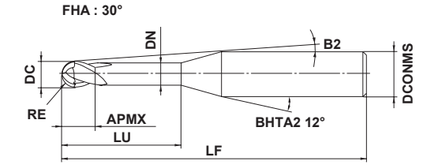


DC : Dia.

VQ2XLB

Ball nose, Short cut length, 2 flute, Long neck

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



Type1

RE			
±0.005			
DCONMS			
0 - 0.005			

- Fracture resistance is improved by adopting a new S-shape, reinforced cutting edge geometry.
- SMART MIRACLE coating provides better wear resistance when machining difficult-to-cut materials.

(mm)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCONMS	No. of Flutes	Stock	Type
VQ2XLBR0020N012	0.2	0.4	0.3	1.2	0.36	13.1°	40	4	2	●	1
VQ2XLBR0020N020	0.2	0.4	0.3	2	0.36	11.9°	40	4	2	●	1
VQ2XLBR0020N032	0.2	0.4	0.3	3.2	0.36	10.5°	45	4	2	●	1
VQ2XLBR0025N015	0.25	0.5	0.375	1.5	0.46	12.6°	40	4	2	●	1
VQ2XLBR0025N025	0.25	0.5	0.375	2.5	0.46	11.2°	40	4	2	●	1
VQ2XLBR0025N040	0.25	0.5	0.375	4	0.46	9.6°	45	4	2	●	1
VQ2XLBR0030N018	0.3	0.6	0.45	1.8	0.56	12.0°	40	4	2	●	1
VQ2XLBR0030N030	0.3	0.6	0.45	3	0.56	10.5°	40	4	2	●	1
VQ2XLBR0030N048	0.3	0.6	0.45	4.8	0.56	8.8°	45	4	2	●	1
VQ2XLBR0035N021	0.35	0.7	0.525	2.1	0.66	11.6°	40	4	2	●	1
VQ2XLBR0035N035	0.35	0.7	0.525	3.5	0.66	9.9°	40	4	2	●	1
VQ2XLBR0035N056	0.35	0.7	0.525	5.6	0.66	8.2°	45	4	2	●	1
VQ2XLBR0040N024	0.4	0.8	0.6	2.4	0.76	11.2°	40	4	2	●	1
VQ2XLBR0040N040	0.4	0.8	0.6	4	0.76	9.4°	40	4	2	●	1
VQ2XLBR0040N064	0.4	0.8	0.6	6.4	0.76	7.6°	50	4	2	●	1
VQ2XLBR0050N030	0.5	1	0.75	3	0.94	10.1°	40	4	2	●	1
VQ2XLBR0050N050	0.5	1	0.75	5	0.94	8.2°	40	4	2	●	1
VQ2XLBR0050N080	0.5	1	0.75	8	0.94	6.4°	50	4	2	●	1
VQ2XLBR0050N080S06	0.5	1	0.75	8	0.94	8.3°	50	6	2	●	1
VQ2XLBR0050N100	0.5	1	0.75	10	0.94	5.6°	50	4	2	●	1
VQ2XLBR0050N100S06	0.5	1	0.75	10	0.94	7.5°	55	6	2	●	1
VQ2XLBR0050N120S06	0.5	1	0.75	12	0.94	6.8°	55	6	2	●	1
VQ2XLBR0075N100S06	0.75	1.5	1.1	10	1.44	7.2°	55	6	2	●	1
VQ2XLBR0075N120S06	0.75	1.5	1.1	12	1.44	6.5°	55	6	2	●	1
VQ2XLBR0100N100	1.0	2	1.5	10	1.9	4.5°	50	4	2	●	1
VQ2XLBR0100N100S06	1.0	2	1.5	10	1.9	6.9°	55	6	2	●	1
VQ2XLBR0100N120	1.0	2	1.5	12	1.9	3.9°	50	4	2	●	1
VQ2XLBR0100N120S06	1.0	2	1.5	12	1.9	6.1°	55	6	2	●	1
VQ2XLBR0150N120	1.5	3	2.3	12	2.9	5.3°	55	4	2	●	1
VQ2XLBR0150N140	1.5	3	2.3	14	2.9	4.7°	60	4	2	●	1
VQ2XLBR0150N160	1.5	3	2.3	16	2.9	4.3°	60	4	2	●	1

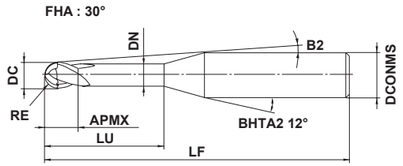
● = NEW

● :USA Stock

VQ2XLB – Inch sizes NEW

Ball nose, Short cut length, 2 flute, Long neck

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



Type1

RE			
±.0002"			
DCONMS			
0 - .00020"			

- Fracture resistance is improved by adopting a new S-shape, reinforced cutting edge geometry.
- SMART MIRACLE coating provides better wear resistance when machining difficult-to-cut materials.

(inch)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCONMS	No. of Flutes	Stock	Type
VQ2XLBDU016N3D	.0080	.0156	.0117	.0468	.0144	13.0°	1.58	.1575	2	●	1
VQ2XLBDU016N5D	.0080	.0156	.0117	.0780	.0144	11.9°	1.58	.1575	2	●	1
VQ2XLBDU016N8D	.0080	.0156	.0117	.1248	.0144	10.5°	1.77	.1575	2	●	1
VQ2XLBDU020N3D	.0100	.0200	.0150	.0600	.0184	12.6°	1.58	.1575	2	●	1
VQ2XLBDU020N5D	.0100	.0200	.0150	.1000	.0184	11.2°	1.58	.1575	2	●	1
VQ2XLBDU020N8D	.0100	.0200	.0150	.1600	.0184	9.6°	1.77	.1575	2	●	1
VQ2XLBDU025N3D	.0125	.0250	.0188	.0750	.0234	11.9°	1.58	.1575	2	●	1
VQ2XLBDU025N5D	.0125	.0250	.0188	.1250	.0234	10.3°	1.58	.1575	2	●	1
VQ2XLBDU025N8D	.0125	.0250	.0188	.2000	.0234	8.6°	1.77	.1575	2	●	1
VQ2XLBDU030N3D	.0150	.0300	.0225	.0900	.0284	11.3°	1.58	.1575	2	●	1
VQ2XLBDU030N5D	.0150	.0300	.0225	.1500	.0284	9.6°	1.58	.1575	2	●	1
VQ2XLBDU030N8D	.0150	.0300	.0225	.2400	.0284	7.8°	1.77	.1575	2	●	1
VQ2XLBDU031N3D	.0155	.0313	.0235	.0939	.0297	11.2°	1.58	.1575	2	●	1
VQ2XLBDU031N5D	.0155	.0313	.0235	.1565	.0297	9.4°	1.58	.1575	2	●	1
VQ2XLBDU031N8D	.0155	.0313	.0235	.2504	.0297	7.6°	1.97	.1575	2	●	1
VQ2XLBDU035N3D	.0175	.0350	.0263	.1050	.0334	10.8°	1.58	.1575	2	●	1
VQ2XLBDU035N5D	.0175	.0350	.0263	.1750	.0334	8.9°	1.58	.1575	2	●	1
VQ2XLBDU035N8D	.0175	.0350	.0263	.2800	.0334	7.1°	1.97	.1575	2	●	1
VQ2XLBDU040N3D	.0200	.0400	.0300	.1200	.0376	10.1°	1.58	.1575	2	●	1
VQ2XLBDU040N5D	.0200	.0400	.0300	.2000	.0376	8.2°	1.58	.1575	2	●	1
VQ2XLBDU040N8D	.0200	.0400	.0300	.3200	.0376	6.3°	1.97	.1575	2	●	1
VQ2XLBDU045N3D	.0225	.0450	.0338	.1350	.0426	9.5°	1.58	.1575	2	●	1
VQ2XLBDU045N5D	.0225	.0450	.0338	.2250	.0426	7.6°	1.58	.1575	2	●	1
VQ2XLBDU045N8D	.0225	.0450	.0338	.3600	.0426	5.8°	1.97	.1575	2	●	1
VQ2XLBDU047N3D	.0235	.0469	.0352	.1407	.0445	9.4°	1.58	.1575	2	●	1
VQ2XLBDU047N5D	.0235	.0469	.0352	.2345	.0445	7.4°	1.58	.1575	2	●	1
VQ2XLBDU047N8D	.0235	.0469	.0352	.3752	.0445	5.6°	1.97	.1575	2	●	1
VQ2XLBDU050N3D	.0250	.0500	.0375	.1500	.0476	9.0°	1.58	.1575	2	●	1
VQ2XLBDU050N5D	.0250	.0500	.0375	.2500	.0476	7.0°	1.58	.1575	2	●	1
VQ2XLBDU050N8D	.0250	.0500	.0375	.4000	.0476	5.3°	1.97	.1575	2	●	1

● = NEW

● :USA Stock

(inch)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCONMS	No. of Flutes	Stock	Type
VQ2XLBDU055N3D	.0275	.0550	.0413	.1650	.0526	8.6°	1.58	.1575	2	●	1
VQ2XLBDU055N5D	.0275	.0550	.0413	.2750	.0526	6.5°	1.58	.1575	2	●	1
VQ2XLBDU055N8D	.0275	.0550	.0413	.4400	.0526	4.8°	1.97	.1575	2	●	1
VQ2XLBDU060N3D	.0300	.0600	.0450	.1800	.0576	8.1°	1.58	.1575	2	●	1
VQ2XLBDU060N5D	.0300	.0600	.0450	.3000	.0576	6.0°	1.58	.1575	2	●	1
VQ2XLBDU060N8D	.0300	.0600	.0450	.4800	.0576	4.4°	1.97	.1575	2	●	1
VQ2XLBDU063N3D	.0315	.0625	.0469	.1875	.0602	7.8°	1.58	.1575	2	●	1
VQ2XLBDU063N5D	.0315	.0625	.0469	.3125	.0602	5.8°	1.58	.1575	2	●	1
VQ2XLBDU063N8D	.0315	.0625	.0469	.5000	.0602	4.2°	1.97	.1575	2	●	1
VQ2XLBDU070N3D	.0350	.0700	.0525	.2100	.0676	7.1°	1.58	.1575	2	●	1
VQ2XLBDU070N5D	.0350	.0700	.0525	.3500	.0676	5.1°	1.58	.1575	2	●	1
VQ2XLBDU070N8D	.0350	.0700	.0525	.5600	.0676	3.6°	1.97	.1575	2	●	1
VQ2XLBDU078N3D	.0390	.0781	.0586	.2343	.0757	6.4°	1.58	.1575	2	●	1
VQ2XLBDU078N5D	.0390	.0781	.0586	.3905	.0757	4.5°	1.77	.1575	2	●	1
VQ2XLBDU078N8D	.0390	.0781	.0586	.6248	.0757	3.1°	1.97	.1575	2	●	1

● = NEW

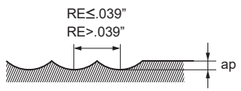
VQ2XLB

Ball nose, Short cut length, 2 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Material				Titanium Alloys					Cobalt Chromium Alloys, Precipitation Hardening Stainless Steel					Pure Titanium				
RE		LU		Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut	Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut	Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut
(mm)	(inch)	(mm)	(inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)
0.198	**.0078**	**1.189**	**.0468**	165	40000	47.2	.0008	.0016	165	40000	47.2	.0008	.0016	165	40000	37.8	.0012	.0016
0.198	**.0078**	**1.981**	**.0780**	165	40000	37.8	.0008	.0016	165	40000	37.8	.0008	.0016	165	40000	29.9	.0012	.0016
0.198	**.0078**	**3.170**	**.1248**	165	40000	26	.0008	.0016	165	40000	26	.0008	.0016	165	40000	20.9	.0012	.0016
0.200	**.0079**	**1.200**	**.0472**	165	40000	47.2	.0008	.0016	165	40000	47.2	.0008	.0016	165	40000	37.8	.0012	.0016
0.200	**.0079**	**2.000**	**.0787**	165	40000	37.8	.0008	.0016	165	40000	37.8	.0008	.0016	165	40000	29.9	.0012	.0016
0.200	**.0079**	**3.200**	**.1260**	165	40000	26	.0008	.0016	165	40000	26	.0008	.0016	165	40000	20.9	.0012	.0016
0.250	**.0098**	**1.500**	**.0591**	205	40000	78.7	.0012	.0020	205	40000	78.7	.0012	.0020	205	40000	63	.0020	.0020
0.250	**.0098**	**2.500**	**.0984**	205	40000	59.1	.0012	.0020	205	40000	59.1	.0012	.0020	205	40000	47.2	.0020	.0020
0.250	**.0098**	**4.000**	**.1575**	205	40000	39.4	.0012	.0020	205	40000	39.4	.0012	.0020	205	40000	31.5	.0020	.0020
0.254	**.0100**	**1.524**	**.0600**	210	40000	78.7	.0012	.0020	210	40000	78.7	.0012	.0020	210	40000	63	.0020	.0020
0.254	**.0100**	**2.540**	**.1000**	210	40000	59.1	.0012	.0020	210	40000	59.1	.0012	.0020	210	40000	47.2	.0020	.0020
0.254	**.0100**	**4.064**	**.1600**	210	40000	39.4	.0012	.0020	210	40000	39.4	.0012	.0020	210	40000	31.5	.0020	.0020
0.300	**.0118**	**1.800**	**.0709**	245	40000	102.4	.0012	.0024	245	40000	102.4	.0012	.0024	245	40000	78.7	.0020	.0024
0.300	**.0118**	**3.000**	**.1181**	245	40000	78.7	.0012	.0024	245	40000	78.7	.0012	.0024	245	40000	63	.0020	.0024
0.300	**.0118**	**4.800**	**.1890**	245	40000	55.1	.0012	.0024	245	40000	55.1	.0012	.0024	245	40000	43.3	.0020	.0024
0.318	**.0125**	**1.905**	**.0750**	260	40000	102.4	.0012	.0024	260	40000	102.4	.0012	.0024	260	40000	78.7	.0020	.0024
0.318	**.0125**	**3.175**	**.1250**	260	40000	78.7	.0012	.0024	260	40000	78.7	.0012	.0024	260	40000	63	.0020	.0024
0.318	**.0125**	**5.080**	**.2000**	260	40000	55.1	.0012	.0024	260	40000	55.1	.0012	.0024	260	40000	43.3	.0020	.0024
0.350	**.0138**	**2.100**	**.0827**	285	40000	126	.0016	.0028	260	36000	110.2	.0016	.0028	260	36000	86.6	.0024	.0028
0.350	**.0138**	**3.500**	**.1378**	285	40000	98.4	.0016	.0028	260	36000	86.6	.0016	.0028	260	36000	70.9	.0024	.0028
0.350	**.0138**	**5.600**	**.2205**	285	40000	66.9	.0016	.0028	260	36000	59.1	.0016	.0028	260	36000	47.2	.0024	.0028
0.381	**.0150**	**2.286**	**.0900**	310	40000	137.8	.0016	.0028	260	33000	110.2	.0016	.0028	260	33000	94.5	.0024	.0028
0.381	**.0150**	**3.810**	**.1500**	310	40000	106.3	.0016	.0028	260	33000	90.6	.0016	.0028	260	33000	70.9	.0024	.0028
0.381	**.0150**	**6.096**	**.2400**	310	40000	74.8	.0016	.0028	260	33000	63	.0016	.0028	260	33000	47.2	.0024	.0028
0.398	**.0157**	**2.385**	**.0939**	330	40000	137.8	.0016	.0031	260	32000	110.2	.0016	.0031	260	32000	102.4	.0024	.0031
0.398	**.0157**	**3.975**	**.1565**	330	40000	118.1	.0016	.0031	260	32000	98.4	.0016	.0031	260	32000	78.7	.0024	.0031
0.398	**.0157**	**6.360**	**.2504**	330	40000	82.7	.0016	.0031	260	32000	66.9	.0016	.0031	260	32000	55.1	.0024	.0031
0.400	**.0157**	**2.400**	**.0945**	330	40000	137.8	.0016	.0031	260	32000	110.2	.0016	.0031	260	32000	102.4	.0024	.0031
0.400	**.0157**	**4.000**	**.1575**	330	40000	118.1	.0016	.0031	260	32000	98.4	.0016	.0031	260	32000	78.7	.0024	.0031
0.400	**.0157**	**6.400**	**.2520**	330	40000	82.7	.0016	.0031	260	32000	66.9	.0016	.0031	260	32000	55.1	.0024	.0031
0.445	**.0175**	**2.667**	**.1050**	330	36000	137.8	.0016	.0031	260	29000	110.2	.0016	.0031	260	29000	102.4	.0024	.0031
0.445	**.0175**	**4.445**	**.1750**	330	36000	118.1	.0016	.0031	260	29000	98.4	.0016	.0031	260	29000	78.7	.0024	.0031
0.445	**.0175**	**7.112**	**.2800**	330	36000	82.7	.0016	.0031	260	29000	66.9	.0016	.0031	260	29000	55.1	.0024	.0031
0.500	**.0197**	**3.000**	**.1181**	330	32000	137.8	.0020	.0039	260	25000	110.2	.0020	.0039	260	27000	98.4	.0031	.0039
0.500	**.0197**	**5.000**	**.1969**	330	32000	118.1	.0020	.0039	260	25000	94.5	.0020	.0039	260	27000	78.7	.0031	.0039
0.500	**.0197**	**8.000**	**.3150**	330	32000	98.4	.0020	.0039	260	25000	78.7	.0020	.0039	260	27000	63	.0031	.0039
0.500	**.0197**	**10.000**	**.3937**	245	24000	59.1	.0020	.0039	195	19000	59.1	.0020	.0039	195	19000	47.2	.0031	.0039
0.500	**.0197**	**12.000**	**.4724**	245	24000	59.1	.0012	.0039	195	19000	59.1	.0012	.0039	195	19000	47.2	.0016	.0039
0.508	**.0200**	**3.048**	**.1200**	330	31000	137.8	.0020	.0039	260	25000	110.2	.0020	.0039	260	25000	98.4	.0031	.0039
0.508	**.0200**	**5.080**	**.2000**	330	31000	118.1	.0020	.0039	260	25000	94.5	.0020	.0039	260	25000	78.7	.0031	.0039
0.508	**.0200**	**8.128**	**.3200**	330	31000	82.7	.0020	.0039	260	25000	78.7	.0020	.0039	260	25000	63	.0031	.0039
0.572	**.0225**	**3.429**	**.1350**	330	28000	141.7	.0024	.0051	260	22000	110.2	.0024	.0039	260	22000	86.6	.0039	.0047
0.572	**.0225**	**5.715**	**.2250**	330	28000	110.2	.0024	.0051	260	22000	86.6	.0024	.0039	260	22000	70.9	.0039	.0047
0.572	**.0225**	**9.144**	**.3600**	330	28000	78.7	.0024	.0051	260	22000	59.1	.0024	.0039	260	22000	47.2	.0039	.0047
0.596	**.0235**	**3.574**	**.1407**	330	27000	141.7	.0028	.0059	260	21000	106.3	.0028	.0039	295	24000	94.5	.0043	.0055
0.596	**.0235**	**5.956**	**.2345**	330	27000	110.2	.0028	.0051	260	21000	82.7	.0028	.0039	295	24000	74.8	.0043	.0055
0.596	**.0235**	**9.530**	**.3752**	330	27000	78.7	.0028	.0051	260	21000	59.1	.0028	.0039	260	21000	47.2	.0043	.0055

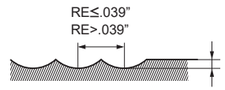
Depth of Cut



RE : Radius

Material				Titanium Alloys					Cobalt Chromium Alloys, Precipitation Hardening Stainless Steel					Pure Titanium				
RE		LU		Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut	Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut	Cutting Speed	Revolution	Table Feed	Depth of cut	Width of cut
(mm)	(inch)	(mm)	(inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)	vc (SFM)	n (min-1)	vf (IPM)	ap (inch)	ae (inch)
0.635	**.0250**	**3.810**	**.1500**	330	25000	133.9	.0031	.0079	260	20000	102.4	.0031	.0039	330	25000	102.4	.0051	.0063
0.635	**.0250**	**6.350**	**.2500**	330	25000	102.4	.0031	.0079	260	20000	78.7	.0031	.0039	330	25000	78.7	.0051	.0063
0.635	**.0250**	**10.160**	**.4000**	330	25000	70.9	.0031	.0079	260	20000	55.1	.0031	.0039	295	23000	51.2	.0051	.0063
0.699	**.0275**	**4.191**	**.1650**	330	23000	122	.0039	.0098	260	18000	98.4	.0031	.0039	360	25000	106.3	.0051	.0071
0.699	**.0275**	**6.985**	**.2750**	330	23000	94.5	.0039	.0098	260	18000	74.8	.0031	.0039	360	25000	82.7	.0051	.0071
0.699	**.0275**	**11.176**	**.4400**	330	23000	66.9	.0039	.0098	260	18000	51.2	.0031	.0039	295	20000	47.2	.0051	.0071
0.750	**.0295**	**10.000**	**.3937**	330	21000	82.7	.0051	.0118	260	17000	66.9	.0031	.0039	395	25000	78.7	.0051	.0079
0.750	**.0295**	**12.000**	**.4724**	245	16000	59.1	.0051	.0118	195	13000	47.2	.0031	.0039	330	21000	63	.0051	.0079
0.762	**.0300**	**4.572**	**.1800**	330	21000	118.1	.0051	.0118	260	17000	94.5	.0031	.0039	395	25000	102.4	.0051	.0079
0.762	**.0300**	**7.620**	**.3000**	330	21000	90.6	.0051	.0118	260	17000	70.9	.0031	.0039	395	25000	78.7	.0051	.0079
0.762	**.0300**	**12.192**	**.4800**	330	21000	63	.0051	.0118	260	17000	51.2	.0031	.0039	330	21000	63	.0051	.0079
0.794	**.0313**	**4.763**	**.1875**	330	20000	106.3	.0055	.0157	260	16000	86.6	.0039	.0059	460	28000	118.1	.0063	.0118
0.794	**.0313**	**7.938**	**.3125**	330	20000	82.7	.0055	.0157	260	16000	66.9	.0039	.0059	460	28000	90.6	.0063	.0118
0.794	**.0313**	**12.700**	**.5000**	330	20000	59.1	.0055	.0157	260	16000	47.2	.0039	.0059	395	24000	63	.0063	.0118
0.889	**.0350**	**5.334**	**.2100**	330	18000	102.4	.0063	.0177	260	14000	82.7	.0059	.0118	560	30000	118.1	.0094	.0197
0.889	**.0350**	**8.890**	**.3500**	330	18000	78.7	.0063	.0177	260	14000	63	.0059	.0118	560	30000	90.6	.0094	.0197
0.889	**.0350**	**14.224**	**.5600**	330	18000	55.1	.0063	.0177	260	14000	43.3	.0059	.0118	490	27000	63	.0094	.0197
0.992	**.0391**	**5.951**	**.2343**	330	16000	90.6	.0079	.0197	260	13000	78.7	.0079	.0197	655	32000	126	.0126	.0315
0.992	**.0391**	**9.919**	**.3905**	330	16000	70.9	.0079	.0197	260	13000	59.1	.0079	.0197	655	32000	98.4	.0126	.0315
0.992	**.0391**	**15.870**	**.6248**	330	16000	51.2	.0079	.0197	260	13000	43.3	.0079	.0197	590	29000	66.9	.0126	.0315
1.000	**.0394**	**10.000**	**.3937**	330	16000	70.9	.0079	.0197	260	13000	59.1	.0079	.0197	655	32000	98.4	.0126	.0315
1.000	**.0394**	**12.000**	**.4724**	330	16000	70.9	.0079	.0197	260	13000	59.1	.0079	.0197	590	29000	66.9	.0126	.0315
1.500	**.0591**	**12.000**	**.4724**	330	10000	63	.0118	.0315	260	8500	51.2	.0118	.0315	655	21000	63	.0189	.0472
1.500	**.0591**	**14.000**	**.5512**	330	10000	63	.0118	.0315	260	8500	51.2	.0118	.0315	655	21000	63	.0189	.0472
1.500	**.0591**	**16.000**	**.6299**	330	10000	63	.0118	.0315	260	8500	51.2	.0118	.0315	655	21000	63	.0189	.0472

Depth of Cut



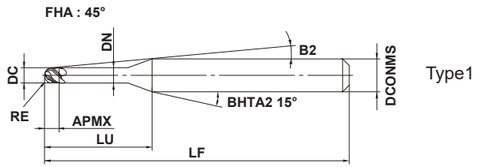
RE : Radius

Note 1) The SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electrically 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 titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) If the depth of cut is shallow, the revolution and the feed rate can be increased.

VQ4XLB – Inch sizes NEW

Ball nose, Short cut length, 4 flute, Long neck

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



Type1

RE			
±.0003"			
DCONMS			
0 - .00020"			

- Fracture resistance is improved by adopting a new S-shape, reinforced cutting edge geometry.
- SMART MIRACLE coating provides better wear resistance when machining difficult-to-cut materials.

(inch)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLBDU080N3D	.0400	.0800	.0600	.2400	.0761	6.3°	1.58	.1575	4	●	1
VQ4XLBDU080N5D	.0400	.0800	.0600	.4000	.0761	4.4°	1.97	.1575	4	●	1
VQ4XLBDU080N8D	.0400	.0800	.0600	.6400	.0761	3.0°	1.97	.1575	4	●	1
VQ4XLBDU090N3D	.0450	.0900	.0675	.2700	.0861	5.4°	1.58	.1575	4	●	1
VQ4XLBDU090N5D	.0450	.0900	.0675	.4500	.0861	3.6°	1.97	.1575	4	●	1
VQ4XLBDU090N8D	.0450	.0900	.0675	.7200	.0861	2.4°	1.97	.1575	4	●	1
VQ4XLBDU094N3D	.0470	.0938	.0704	.2814	.0899	5.1°	1.58	.1575	4	●	1
VQ4XLBDU094N5D	.0470	.0938	.0704	.4690	.0899	3.4°	1.97	.1575	4	●	1
VQ4XLBDU094N8D	.0470	.0938	.0704	.7504	.0899	2.2°	1.97	.1575	4	●	1
VQ4XLBDU100N3D	.0500	.1000	.0750	.3000	.0961	4.5°	1.58	.1575	4	●	1
VQ4XLBDU100N5D	.0500	.1000	.0750	.5000	.0961	3.0°	1.97	.1575	4	●	1
VQ4XLBDU100N8D	.0500	.1000	.0750	.8000	.0961	2.0°	1.97	.1575	4	●	1
VQ4XLBDU109N3D	.0545	.1094	.0821	.3282	.1055	3.7°	1.58	.1575	4	●	1
VQ4XLBDU109N5D	.0545	.1094	.0821	.5470	.1055	2.4°	1.97	.1575	4	●	1
VQ4XLBDU109N8D	.0545	.1094	.0821	.8752	.1055	1.5°	2.17	.1575	4	●	1
VQ4XLBDU125N3D	.0625	.1250	.0938	.3750	.1211	2.5°	1.58	.1575	4	●	1
VQ4XLBDU125N5D	.0625	.1250	.0938	.6250	.1211	1.5°	2.36	.1575	4	●	1
VQ4XLBDU125N8D	.0625	.1250	.0938	1.0000	.1211	1.0°	2.36	.1575	4	●	1

● = NEW

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Material		Titanium Alloys					Cobalt Chromium Alloys, Precipitation Hardening Stainless Steel					Pure Titanium				
RE (inch)	**LU** (inch)	Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
.0400	**.2400**	330	16000	114.2	.0087	.0197	260	13000	94.5	.0087	.0197	655	31000	173.2	.0126	.0315
.0400	**.4000**	330	16000	86.6	.0087	.0197	260	13000	70.9	.0087	.0197	655	31000	133.9	.0126	.0315
.0400	**.6400**	330	16000	63	.0087	.0197	260	13000	51.2	.0087	.0197	655	31000	94.5	.0126	.0315
.0450	**.2700**	330	14000	102.4	.0098	.0217	260	11000	82.7	.0098	.0217	655	28000	161.4	.0138	.0354
.0450	**.4500**	330	14000	78.7	.0098	.0217	260	11000	63	.0098	.0217	655	28000	122	.0138	.0354
.0450	**.7200**	330	14000	55.1	.0098	.0217	260	11000	43.3	.0098	.0217	655	28000	86.6	.0138	.0354
.0470	**.2814**	330	13000	98.4	.0102	.0236	260	11000	82.7	.0102	.0236	655	27000	157.5	.0146	.0354
.0470	**.4690**	330	13000	74.8	.0102	.0236	260	11000	63	.0102	.0236	655	27000	122	.0146	.0354
.0470	**.7504**	330	13000	51.2	.0102	.0236	260	11000	43.3	.0102	.0236	655	27000	86.6	.0146	.0354
.0500	**.3000**	330	13000	98.4	.0110	.0256	260	10000	74.8	.0110	.0256	655	25000	149.6	.0157	.0394
.0500	**.5000**	330	13000	74.8	.0110	.0256	260	10000	59.1	.0110	.0256	655	25000	114.2	.0157	.0394
.0500	**.8000**	330	13000	51.2	.0110	.0256	260	10000	39.4	.0110	.0256	655	25000	78.7	.0157	.0394
.0545	**.3282**	330	11000	86.6	.0118	.0276	260	9200	70.9	.0118	.0276	655	23000	141.7	.0169	.0433
.0545	**.5470**	330	11000	66.9	.0118	.0276	260	9200	55.1	.0118	.0276	655	23000	110.2	.0169	.0433
.0545	**.8752**	330	11000	47.2	.0118	.0276	260	9200	39.4	.0118	.0276	655	23000	74.8	.0169	.0433
.0625	**.3750**	330	10000	78.7	.0138	.0315	260	8000	63	.0138	.0315	655	20000	126	.0189	.0472
.0625	**.6250**	330	10000	59.1	.0138	.0315	260	8000	47.2	.0138	.0315	655	20000	98.4	.0189	.0472
.0625	**1.0000**	330	10000	39.4	.0138	.0315	260	8000	35.4	.0138	.0315	655	20000	66.9	.0189	.0472

Depth of Cut

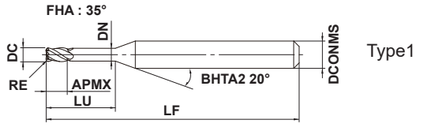
RE : Radius

Note 1) The SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electrically 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 titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) If the depth of cut is shallow, the revolution and the feed rate can be increased.

VQ4XLRB NEW

Corner radius, Short cut length, 4 flute, Long neck

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



Type1

RE			
±0.01			
DC			
0 - 0.02			
DCONMS			
0 - 0.005			

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutter at a small diameter of Ø1.0 mm are realized.

(mm)

Order Number	DC	RE	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLRBD0040R005N012	0.4	0.05	0.6	1.2	0.36	40	4	4	●	1
VQ4XLRBD0040R005N020	0.4	0.05	0.6	2.0	0.36	40	4	4	●	1
VQ4XLRBD0040R005N032	0.4	0.05	0.6	3.2	0.36	40	4	4	●	1
VQ4XLRBD0050R005N015	0.5	0.05	0.75	1.5	0.46	40	4	4	●	1
VQ4XLRBD0050R010N015	0.5	0.1	0.75	1.5	0.46	40	4	4	●	1
VQ4XLRBD0050R005N025	0.5	0.05	0.75	2.5	0.46	40	4	4	●	1
VQ4XLRBD0050R010N025	0.5	0.1	0.75	2.5	0.46	40	4	4	●	1
VQ4XLRBD0050R005N040	0.5	0.05	0.75	4.0	0.46	45	4	4	●	1
VQ4XLRBD0050R010N040	0.5	0.1	0.75	4.0	0.46	45	4	4	●	1
VQ4XLRBD0060R005N018	0.6	0.05	0.9	1.8	0.56	40	4	4	●	1
VQ4XLRBD0060R010N018	0.6	0.1	0.9	1.8	0.56	40	4	4	●	1
VQ4XLRBD0060R005N030	0.6	0.05	0.9	3.0	0.56	40	4	4	●	1
VQ4XLRBD0060R010N030	0.6	0.1	0.9	3.0	0.56	40	4	4	●	1
VQ4XLRBD0060R005N048	0.6	0.05	0.9	4.8	0.56	45	4	4	●	1
VQ4XLRBD0060R010N048	0.6	0.1	0.9	4.8	0.56	45	4	4	●	1
VQ4XLRBD0070R005N021	0.7	0.05	1.05	2.1	0.66	40	4	4	●	1
VQ4XLRBD0070R010N021	0.7	0.1	1.05	2.1	0.66	40	4	4	●	1
VQ4XLRBD0070R005N035	0.7	0.05	1.05	3.5	0.66	40	4	4	●	1
VQ4XLRBD0070R010N035	0.7	0.1	1.05	3.5	0.66	40	4	4	●	1
VQ4XLRBD0070R005N056	0.7	0.05	1.05	5.6	0.66	45	4	4	●	1
VQ4XLRBD0070R010N056	0.7	0.1	1.05	5.6	0.66	45	4	4	●	1
VQ4XLRBD0080R005N024	0.8	0.05	1.2	2.4	0.76	40	4	4	●	1
VQ4XLRBD0080R010N024	0.8	0.1	1.2	2.4	0.76	40	4	4	●	1
VQ4XLRBD0080R005N040	0.8	0.05	1.2	4.0	0.76	40	4	4	●	1
VQ4XLRBD0080R010N040	0.8	0.1	1.2	4.0	0.76	40	4	4	●	1
VQ4XLRBD0080R005N064	0.8	0.05	1.2	6.4	0.76	45	4	4	●	1
VQ4XLRBD0080R010N064	0.8	0.1	1.2	6.4	0.76	45	4	4	●	1
VQ4XLRBD0100R010N030	1.0	0.1	1.5	3.0	0.95	40	4	4	●	1
VQ4XLRBD0100R020N030	1.0	0.2	1.5	3.0	0.95	40	4	4	●	1
VQ4XLRBD0100R010N050	1.0	0.1	1.5	5.0	0.95	40	4	4	●	1

● = NEW

● :USA Stock

(mm)

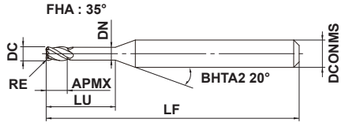
Order Number	DC	RE	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLRBD0100R020N050	1.0	0.2	1.5	5.0	0.95	40	4	4	●	1
VQ4XLRBD0100R010N080	1.0	0.1	1.5	8.0	0.95	45	4	4	●	1
VQ4XLRBD0100R020N080	1.0	0.2	1.5	8.0	0.95	45	4	4	●	1

● = NEW

VQ4XLRB – Inch sizes NEW

Corner radius, Short cut length, 4 flute, Long neck

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



Type1

RE			
±.0004"			
DC			
0 - .0008"			
DCONMS			
0 - .00020"			

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutter at a small diameter of Ø.1250 inch are realized.

(inch)

Order Number	DC	RE	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLRBDU016R003N3D	.0156	.0030	.0234	.0468	.0145	1.58	.1575	4	●	1
VQ4XLRBDU016R005N3D	.0156	.0050	.0234	.0468	.0145	1.58	.1575	4	●	1
VQ4XLRBDU016R003N5D	.0156	.0030	.0234	.0780	.0145	1.58	.1575	4	●	1
VQ4XLRBDU016R005N5D	.0156	.0050	.0234	.0780	.0145	1.58	.1575	4	●	1
VQ4XLRBDU016R003N8D	.0156	.0030	.0234	.1248	.0145	1.58	.1575	4	●	1
VQ4XLRBDU016R005N8D	.0156	.0050	.0234	.1248	.0145	1.58	.1575	4	●	1
VQ4XLRBDU020R003N3D	.0200	.0030	.0300	.0600	.0185	1.58	.1575	4	●	1
VQ4XLRBDU020R005N3D	.0200	.0050	.0300	.0600	.0185	1.58	.1575	4	●	1
VQ4XLRBDU020R003N5D	.0200	.0030	.0300	.1000	.0185	1.58	.1575	4	●	1
VQ4XLRBDU020R005N5D	.0200	.0050	.0300	.1000	.0185	1.58	.1575	4	●	1
VQ4XLRBDU020R003N8D	.0200	.0030	.0300	.1600	.0185	1.77	.1575	4	●	1
VQ4XLRBDU020R005N8D	.0200	.0050	.0300	.1600	.0185	1.77	.1575	4	●	1
VQ4XLRBDU025R005N3D	.0250	.0050	.0375	.0750	.0235	1.58	.1575	4	●	1
VQ4XLRBDU025R005N5D	.0250	.0050	.0375	.1250	.0235	1.58	.1575	4	●	1
VQ4XLRBDU025R005N8D	.0250	.0050	.0375	.2000	.0235	1.77	.1575	4	●	1
VQ4XLRBDU030R005N3D	.0300	.0050	.0450	.0900	.0285	1.58	.1575	4	●	1
VQ4XLRBDU030R005N5D	.0300	.0050	.0450	.1500	.0285	1.58	.1575	4	●	1
VQ4XLRBDU030R005N8D	.0300	.0050	.0450	.2400	.0285	1.77	.1575	4	●	1
VQ4XLRBDU031R003N3D	.0313	.0030	.0469	.0939	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R005N3D	.0313	.0050	.0469	.0939	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R008N3D	.0313	.0080	.0469	.0939	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R003N5D	.0313	.0030	.0469	.1565	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R005N5D	.0313	.0050	.0469	.1565	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R008N5D	.0313	.0080	.0469	.1565	.0298	1.58	.1575	4	●	1
VQ4XLRBDU031R003N8D	.0313	.0030	.0469	.2504	.0298	1.77	.1575	4	●	1
VQ4XLRBDU031R005N8D	.0313	.0050	.0469	.2504	.0298	1.77	.1575	4	●	1
VQ4XLRBDU031R008N8D	.0313	.0080	.0469	.2504	.0298	1.77	.1575	4	●	1
VQ4XLRBDU035R005N3D	.0350	.0050	.0525	.1050	.0335	1.58	.1575	4	●	1
VQ4XLRBDU035R005N5D	.0350	.0050	.0525	.1750	.0335	1.58	.1575	4	●	1
VQ4XLRBDU035R005N8D	.0350	.0050	.0525	.2800	.0335	1.77	.1575	4	●	1

● = NEW

● :USA Stock

(inch)

Order Number	DC	RE	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLRBDU040R005N3D	.0400	.0050	.0600	.1200	.0381	1.58	.1575	4	●	1
VQ4XLRBDU040R005N5D	.0400	.0050	.0600	.2000	.0381	1.58	.1575	4	●	1
VQ4XLRBDU040R005N8D	.0400	.0050	.0600	.3200	.0381	1.77	.1575	4	●	1
VQ4XLRBDU045R005N3D	.0450	.0050	.0675	.1350	.0431	1.58	.1575	4	●	1
VQ4XLRBDU045R005N5D	.0450	.0050	.0675	.2250	.0431	1.58	.1575	4	●	1
VQ4XLRBDU045R005N8D	.0450	.0050	.0675	.3600	.0431	1.77	.1575	4	●	1
VQ4XLRBDU047R003N3D	.0469	.0030	.0703	.1407	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R005N3D	.0469	.0050	.0703	.1407	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R008N3D	.0469	.0080	.0703	.1407	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R003N5D	.0469	.0030	.0703	.2345	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R005N5D	.0469	.0050	.0703	.2345	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R008N5D	.0469	.0080	.0703	.2345	.0450	1.58	.1575	4	●	1
VQ4XLRBDU047R003N8D	.0469	.0030	.0703	.3752	.0450	1.77	.1575	4	●	1
VQ4XLRBDU047R005N8D	.0469	.0050	.0703	.3752	.0450	1.77	.1575	4	●	1
VQ4XLRBDU047R008N8D	.0469	.0080	.0703	.3752	.0450	1.77	.1575	4	●	1
VQ4XLRBDU050R005N3D	.0500	.0050	.0750	.1500	.0481	1.58	.1575	4	●	1
VQ4XLRBDU050R005N5D	.0500	.0050	.0750	.2500	.0481	1.58	.1575	4	●	1
VQ4XLRBDU050R005N8D	.0500	.0050	.0750	.4000	.0481	1.77	.1575	4	●	1
VQ4XLRBDU055R005N3D	.0550	.0050	.0825	.1650	.0531	1.58	.1575	4	●	1
VQ4XLRBDU055R005N5D	.0550	.0050	.0825	.2750	.0531	1.58	.1575	4	●	1
VQ4XLRBDU055R005N8D	.0550	.0050	.0825	.4400	.0531	1.97	.1575	4	●	1
VQ4XLRBDU060R005N3D	.0600	.0050	.0900	.1800	.0581	1.58	.1575	4	●	1
VQ4XLRBDU060R005N5D	.0600	.0050	.0900	.3000	.0581	1.58	.1575	4	●	1
VQ4XLRBDU060R005N8D	.0600	.0050	.0900	.4800	.0581	1.77	.1575	4	●	1
VQ4XLRBDU063R003N3D	.0625	.0030	.0938	.1875	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R005N3D	.0625	.0050	.0938	.1875	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R008N3D	.0625	.0080	.0938	.1875	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R003N5D	.0625	.0030	.0938	.3125	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R005N5D	.0625	.0050	.0938	.3125	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R008N5D	.0625	.0080	.0938	.3125	.0606	1.58	.1575	4	●	1
VQ4XLRBDU063R003N8D	.0625	.0030	.0938	.5000	.0606	1.77	.1575	4	●	1
VQ4XLRBDU063R005N8D	.0625	.0050	.0938	.5000	.0606	1.77	.1575	4	●	1
VQ4XLRBDU063R008N8D	.0625	.0080	.0938	.5000	.0606	1.77	.1575	4	●	1
VQ4XLRBDU070R005N3D	.0700	.0050	.1050	.2100	.0681	1.58	.1575	4	●	1
VQ4XLRBDU070R005N5D	.0700	.0050	.1050	.3500	.0681	1.58	.1575	4	●	1
VQ4XLRBDU070R005N8D	.0700	.0050	.1050	.5600	.0681	1.77	.1575	4	●	1
VQ4XLRBDU078R003N3D	.0781	.0030	.1172	.2343	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R005N3D	.0781	.0050	.1172	.2343	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R008N3D	.0781	.0080	.1172	.2343	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R003N5D	.0781	.0030	.1172	.3905	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R005N5D	.0781	.0050	.1172	.3905	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R008N5D	.0781	.0080	.1172	.3905	.0762	1.58	.1575	4	●	1
VQ4XLRBDU078R003N8D	.0781	.0030	.1172	.6248	.0762	1.97	.1575	4	●	1
VQ4XLRBDU078R005N8D	.0781	.0050	.1172	.6248	.0762	1.97	.1575	4	●	1
VQ4XLRBDU078R008N8D	.0781	.0080	.1172	.6248	.0762	1.97	.1575	4	●	1
VQ4XLRBDU080R005N3D	.0800	.0050	.1200	.2400	.0773	1.58	.1575	4	●	1
VQ4XLRBDU080R005N5D	.0800	.0050	.1200	.4000	.0773	1.77	.1575	4	●	1
VQ4XLRBDU080R005N8D	.0800	.0050	.1200	.6400	.0773	1.97	.1575	4	●	1

● = NEW

VQ4XLRB

Corner radius, Short cut length, 4 flute, Long neck

(inch)

Order Number	DC	RE	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4XLRBDU090R005N3D	.0900	.0050	.1350	.2700	.0873	1.58	.1575	4	●	1
VQ4XLRBDU090R005N5D	.0900	.0050	.1350	.4500	.0873	1.77	.1575	4	●	1
VQ4XLRBDU090R005N8D	.0900	.0050	.1350	.7200	.0873	1.97	.1575	4	●	1
VQ4XLRBDU094R003N3D	.0938	.0030	.1406	.2814	.0911	1.58	.1575	4	●	1
VQ4XLRBDU094R005N3D	.0938	.0050	.1406	.2814	.0911	1.58	.1575	4	●	1
VQ4XLRBDU094R008N3D	.0938	.0080	.1406	.2814	.0911	1.58	.1575	4	●	1
VQ4XLRBDU094R003N5D	.0938	.0030	.1406	.4690	.0911	1.77	.1575	4	●	1
VQ4XLRBDU094R005N5D	.0938	.0050	.1406	.4690	.0911	1.77	.1575	4	●	1
VQ4XLRBDU094R008N5D	.0938	.0080	.1406	.4690	.0911	1.77	.1575	4	●	1
VQ4XLRBDU094R003N8D	.0938	.0030	.1406	.7504	.0911	1.97	.1575	4	●	1
VQ4XLRBDU094R005N8D	.0938	.0050	.1406	.7504	.0911	1.97	.1575	4	●	1
VQ4XLRBDU094R008N8D	.0938	.0080	.1406	.7504	.0911	1.97	.1575	4	●	1
VQ4XLRBDU100R005N3D	.1000	.0050	.1500	.3000	.0973	1.58	.1575	4	●	1
VQ4XLRBDU100R005N5D	.1000	.0050	.1500	.5000	.0973	1.77	.1575	4	●	1
VQ4XLRBDU100R005N8D	.1000	.0050	.1500	.8000	.0973	1.97	.1575	4	●	1
VQ4XLRBDU109R003N3D	.1094	.0030	.1641	.3282	.1067	1.58	.1575	4	●	1
VQ4XLRBDU109R005N3D	.1094	.0050	.1641	.3282	.1067	1.58	.1575	4	●	1
VQ4XLRBDU109R008N3D	.1094	.0080	.1641	.3282	.1067	1.58	.1575	4	●	1
VQ4XLRBDU109R003N5D	.1094	.0030	.1641	.5470	.1067	1.77	.1575	4	●	1
VQ4XLRBDU109R005N5D	.1094	.0050	.1641	.5470	.1067	1.77	.1575	4	●	1
VQ4XLRBDU109R008N5D	.1094	.0080	.1641	.5470	.1067	1.77	.1575	4	●	1
VQ4XLRBDU109R003N8D	.1094	.0030	.1641	.8752	.1067	2.17	.1575	4	●	1
VQ4XLRBDU109R005N8D	.1094	.0050	.1641	.8752	.1067	2.17	.1575	4	●	1
VQ4XLRBDU109R008N8D	.1094	.0080	.1641	.8752	.1067	2.17	.1575	4	●	1
VQ4XLRBDU125R003N3D	.1250	.0030	.1875	.3750	.1223	1.58	.1575	4	●	1
VQ4XLRBDU125R005N3D	.1250	.0050	.1875	.3750	.1223	1.58	.1575	4	●	1
VQ4XLRBDU125R003N5D	.1250	.0030	.1875	.6250	.1223	1.77	.1575	4	●	1
VQ4XLRBDU125R005N5D	.1250	.0050	.1875	.6250	.1223	1.77	.1575	4	●	1
VQ4XLRBDU125R003N8D	.1250	.0030	.1875	1.0000	.1223	2.17	.1575	4	●	1
VQ4XLRBDU125R005N8D	.1250	.0050	.1875	1.0000	.1223	2.17	.1575	4	●	1

● = NEW

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel				
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.396	.0156	1.188	.0468	165	40000	31.5	.0023	.0008	65	16000	12.6	.0023	.0008
0.396	.0156	1.980	.0780	165	40000	22	.0023	.0008	65	16000	8.8	.0023	.0008
0.396	.0156	3.168	.1247	165	40000	12.6	.0016	.0008	65	16000	5	.0016	.0008
0.400	.0157	1.200	.0472	165	40000	31.5	.0024	.0008	65	16000	12.6	.0024	.0008
0.400	.0157	2.000	.0787	165	40000	22	.0024	.0008	65	16000	8.7	.0024	.0008
0.400	.0157	3.200	.1260	165	40000	12.6	.0016	.0008	65	16000	5.1	.0016	.0008
0.500	.0197	1.500	.0591	195	38000	35.8	.0030	.0010	65	13000	12.2	.0030	.0010
0.500	.0197	2.500	.0984	195	38000	24	.0030	.0010	65	13000	8.3	.0030	.0010
0.500	.0197	4.000	.1575	195	38000	15	.0020	.0010	65	13000	5.1	.0020	.0010
0.508	.0200	1.524	.0600	195	38000	35.9	.0030	.0010	65	13000	12.3	.0030	.0010
0.508	.0200	2.540	.1000	195	38000	23.9	.0030	.0010	65	13000	8.2	.0030	.0010
0.508	.0200	4.064	.1600	195	38000	15	.0020	.0010	65	13000	5.1	.0020	.0010
0.600	.0236	1.800	.0709	195	32000	35.4	.0035	.0012	65	11000	12.2	.0035	.0012
0.600	.0236	3.000	.1181	195	32000	25.2	.0035	.0012	65	11000	8.7	.0035	.0012
0.600	.0236	4.800	.1890	195	32000	15	.0024	.0012	65	11000	5.1	.0024	.0012
0.635	.0250	1.905	.0750	195	30000	33.1	.0037	.0013	65	10000	11	.0037	.0013
0.635	.0250	3.175	.1250	195	30000	23.6	.0037	.0013	65	10000	7.9	.0037	.0013
0.635	.0250	5.080	.2000	195	30000	14.2	.0025	.0013	65	10000	4.7	.0025	.0013
0.700	.0276	2.100	.0827	195	27000	36.2	.0041	.0014	65	9100	12.2	.0041	.0014
0.700	.0276	3.500	.1378	195	27000	25.6	.0041	.0014	65	9100	8.7	.0041	.0014
0.700	.0276	5.600	.2205	195	27000	15	.0028	.0014	65	9100	5.1	.0028	.0014
0.762	.0300	2.286	.0900	195	25000	35.4	.0045	.0015	65	8400	11.9	.0045	.0015
0.762	.0300	3.810	.1500	195	25000	25.6	.0045	.0015	65	8400	8.6	.0045	.0015
0.762	.0300	6.096	.2400	195	25000	14.6	.0030	.0015	65	8400	4.9	.0030	.0015
0.795	.0313	2.385	.0939	195	24000	34	.0047	.0016	65	8000	11.3	.0047	.0016
0.795	.0313	3.975	.1565	195	24000	24.6	.0047	.0016	65	8000	8.2	.0047	.0016
0.795	.0313	6.360	.2504	195	24000	14	.0031	.0016	65	8000	4.7	.0031	.0016
0.800	.0315	2.400	.0945	195	24000	37.8	.0047	.0016	65	8000	12.6	.0047	.0016
0.800	.0315	4.000	.1575	195	24000	26.4	.0047	.0016	65	8000	8.7	.0047	.0016
0.800	.0315	6.400	.2520	195	24000	15	.0031	.0016	65	8000	5.1	.0031	.0016
0.889	.0350	2.667	.1050	195	21000	36.4	.0052	.0018	65	7200	12.5	.0052	.0018
0.889	.0350	4.445	.1750	195	21000	26.5	.0052	.0018	65	7200	9.1	.0052	.0018
0.889	.0350	7.112	.2800	195	21000	14.9	.0035	.0018	65	7200	5.1	.0035	.0018
1.000	.0394	3.000	.1181	195	20000	37.8	.0059	.0020	65	6500	12.2	.0059	.0020
1.000	.0394	5.000	.1969	195	20000	31.5	.0059	.0020	65	6500	10.2	.0059	.0020
1.000	.0394	8.000	.3150	195	20000	15.7	.0039	.0020	65	6500	5.1	.0039	.0020
1.016	.0400	3.048	.1200	195	19000	35.9	.0060	.0020	65	6300	11.9	.0060	.0020
1.016	.0400	5.080	.2000	195	19000	29.9	.0060	.0020	65	6300	9.9	.0060	.0020
1.016	.0400	8.128	.3200	195	19000	15	.0040	.0020	65	6300	5	.0040	.0020
1.143	.0450	3.429	.1350	195	17000	37.5	.0067	.0023	65	5600	12.3	.0067	.0023
1.143	.0450	5.715	.2250	195	17000	29.4	.0067	.0023	65	5600	9.7	.0067	.0023
1.143	.0450	9.144	.3600	195	17000	16.1	.0045	.0023	65	5600	5.3	.0045	.0023

Depth of Cut

VQ4XLRB

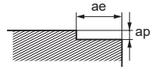
Corner radius, Short cut length, 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Side milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel				
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
1.191	**.0469**	**3.573**	**.1407**	195	16000	35.3	.0070	.0023	65	5300	11.7	.0070	.0023
1.191	**.0469**	**5.955**	**.2344**	195	16000	27.7	.0070	.0023	65	5300	9.2	.0070	.0023
1.191	**.0469**	**9.528**	**.3751**	195	16000	15.1	.0047	.0023	65	5300	5	.0047	.0023
1.270	**.0500**	**3.810**	**.1500**	195	15000	35.4	.0075	.0025	65	5000	11.8	.0075	.0025
1.270	**.0500**	**6.350**	**.2500**	195	15000	28.3	.0075	.0025	65	5000	9.4	.0075	.0025
1.270	**.0500**	**10.160**	**.4000**	195	15000	14.2	.0050	.0025	65	5000	4.7	.0050	.0025
1.397	**.0550**	**4.191**	**.1650**	195	14000	35.3	.0083	.0028	65	4600	11.6	.0083	.0028
1.397	**.0550**	**6.985**	**.2750**	195	14000	28.7	.0083	.0028	65	4600	9.4	.0083	.0028
1.397	**.0550**	**11.176**	**.4400**	195	14000	15.4	.0055	.0028	65	4600	5.1	.0055	.0028
1.524	**.0600**	**4.572**	**.1800**	195	13000	36.9	.0090	.0030	65	4200	11.9	.0090	.0030
1.524	**.0600**	**7.620**	**.3000**	195	13000	30.7	.0090	.0030	65	4200	9.9	.0090	.0030
1.524	**.0600**	**12.192**	**.4800**	195	13000	15.4	.0060	.0030	65	4200	5	.0060	.0030
1.588	**.0625**	**4.764**	**.1876**	195	12000	34	.0094	.0031	65	4000	11.3	.0094	.0031
1.588	**.0625**	**7.940**	**.3126**	195	12000	28.3	.0094	.0031	65	4000	9.4	.0094	.0031
1.588	**.0625**	**12.704**	**.5002**	195	12000	14.2	.0063	.0031	65	4000	4.7	.0063	.0031
1.778	**.0700**	**5.334**	**.2100**	195	11000	36.4	.0105	.0035	65	3600	11.9	.0105	.0035
1.778	**.0700**	**8.890**	**.3500**	195	11000	29.4	.0105	.0035	65	3600	9.6	.0105	.0035
1.778	**.0700**	**14.224**	**.5600**	195	11000	15.6	.0070	.0035	65	3600	5.1	.0070	.0035
1.984	**.0781**	**5.952**	**.2343**	195	9600	36.3	.0117	.0039	65	3200	12.1	.0117	.0039
1.984	**.0781**	**9.920**	**.3906**	195	9600	30.2	.0117	.0039	65	3200	10.1	.0117	.0039
1.984	**.0781**	**15.872**	**.6249**	195	9600	15.1	.0078	.0039	65	3200	5	.0078	.0039
2.032	**.0800**	**6.096**	**.2400**	195	9400	35.5	.0120	.0040	65	3100	11.7	.0120	.0040
2.032	**.0800**	**10.160**	**.4000**	195	9400	29.6	.0120	.0040	65	3100	9.8	.0120	.0040
2.032	**.0800**	**16.256**	**.6400**	195	9400	14.8	.0080	.0040	65	3100	4.9	.0080	.0040
2.286	**.0900**	**6.858**	**.2700**	195	8400	35.7	.0135	.0045	65	2800	11.9	.0135	.0045
2.286	**.0900**	**11.430**	**.4500**	195	8400	30.4	.0135	.0045	65	2800	10.1	.0135	.0045
2.286	**.0900**	**18.288**	**.7200**	195	8400	17.2	.0090	.0045	65	2800	5.7	.0090	.0045
2.383	**.0938**	**7.149**	**.2815**	195	8000	34	.0141	.0047	65	2700	11.5	.0141	.0047
2.383	**.0938**	**11.915**	**.4691**	195	8000	29	.0141	.0047	65	2700	9.8	.0141	.0047
2.383	**.0938**	**19.064**	**.7506**	195	8000	16.4	.0094	.0047	65	2700	5.5	.0094	.0047
2.540	**.1000**	**7.62**	**.3000**	195	7500	35.4	.0150	.0050	65	2500	11.8	.0150	.0050
2.540	**.1000**	**12.7**	**.5000**	195	7500	29.5	.0150	.0050	65	2500	9.8	.0150	.0050
2.540	**.1000**	**20.32**	**.8000**	195	7500	17.7	.0100	.0050	65	2500	5.9	.0100	.0050
2.779	**.1094**	**8.337**	**.3282**	195	6900	35.9	.0164	.0055	65	2300	12	.0164	.0055
2.779	**.1094**	**13.895**	**.5470**	195	6900	29.3	.0164	.0055	65	2300	9.8	.0164	.0055
2.779	**.1094**	**22.232**	**.8753**	195	6900	19.6	.0109	.0055	65	2300	6.5	.0109	.0055
3.175	**.1250**	**9.525**	**.3750**	195	6000	34	.0187	.0063	65	2000	11.3	.0187	.0063
3.175	**.1250**	**15.875**	**.6250**	195	6000	28.3	.0187	.0063	65	2000	9.4	.0187	.0063
3.175	**.1250**	**25.4**	**1.0000**	195	6000	18.9	.0125	.0063	65	2000	6.3	.0125	.0063
Depth of Cut													

Bottm face milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel				
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
0.396	**.0156**	**1.188**	**.0468**	165	40000	31.5	.0012	≤.0156	65	16000	12.6	.0012	≤.0078
0.396	**.0156**	**1.980**	**.0780**	165	40000	22	.0008	≤.0156	65	16000	8.8	.0008	≤.0078
0.396	**.0156**	**3.168**	**.1247**	165	40000	12.6	.0004	≤.0156	65	16000	5	.0004	≤.0078
0.400	**.0157**	**1.200**	**.0472**	165	40000	31.5	.0012	≤.0157	65	16000	12.6	.0012	≤.0079
0.400	**.0157**	**2.000**	**.0787**	165	40000	22	.0008	≤.0157	65	16000	8.7	.0008	≤.0079
0.400	**.0157**	**3.200**	**.1260**	165	40000	12.6	.0004	≤.0157	65	16000	5.1	.0004	≤.0079
0.500	**.0197**	**1.500**	**.0591**	195	38000	35.8	.0016	≤.0197	65	13000	12.2	.0016	≤.0098
0.500	**.0197**	**2.500**	**.0984**	195	38000	24	.0012	≤.0197	65	13000	8.3	.0012	≤.0098
0.500	**.0197**	**4.000**	**.1575**	195	38000	15	.0006	≤.0197	65	13000	5.1	.0006	≤.0098
0.508	**.0200**	**1.524**	**.0600**	195	38000	35.9	.0016	≤.0200	65	13000	12.3	.0016	≤.0100
0.508	**.0200**	**2.540**	**.1000**	195	38000	23.9	.0012	≤.0200	65	13000	8.2	.0012	≤.0100
0.508	**.0200**	**4.064**	**.1600**	195	38000	15	.0006	≤.0200	65	13000	5.1	.0006	≤.0100
0.600	**.0236**	**1.800**	**.0709**	195	32000	35.4	.0020	≤.0236	65	11000	12.2	.0020	≤.0118
0.600	**.0236**	**3.000**	**.1181**	195	32000	25.2	.0014	≤.0236	65	11000	8.7	.0014	≤.0118
0.600	**.0236**	**4.800**	**.1890**	195	32000	15	.0008	≤.0236	65	11000	5.1	.0008	≤.0118
0.635	**.0250**	**1.905**	**.0750**	195	30000	33.1	.0020	≤.0250	65	10000	11	.0020	≤.0125
0.635	**.0250**	**3.175**	**.1250**	195	30000	23.6	.0014	≤.0250	65	10000	7.9	.0014	≤.0125
0.635	**.0250**	**5.080**	**.2000**	195	30000	14.2	.0008	≤.0250	65	10000	4.7	.0008	≤.0125
0.700	**.0276**	**2.100**	**.0827**	195	27000	36.2	.0022	≤.0276	65	9100	12.2	.0022	≤.0138
0.700	**.0276**	**3.500**	**.1378**	195	27000	25.6	.0014	≤.0276	65	9100	8.7	.0014	≤.0138
0.700	**.0276**	**5.600**	**.2205**	195	27000	15	.0008	≤.0276	65	9100	5.1	.0008	≤.0138
0.762	**.0300**	**2.286**	**.0900**	195	25000	35.4	.0023	≤.0300	65	8400	11.9	.0023	≤.0150
0.762	**.0300**	**3.810**	**.1500**	195	25000	25.6	.0015	≤.0300	65	8400	8.6	.0015	≤.0150
0.762	**.0300**	**6.096**	**.2400**	195	25000	14.6	.0009	≤.0300	65	8400	4.9	.0009	≤.0150
0.795	**.0313**	**2.385**	**.0939**	195	24000	34	.0023	≤.0313	65	8000	11.3	.0023	≤.0157
0.795	**.0313**	**3.975**	**.1565**	195	24000	24.6	.0015	≤.0313	65	8000	8.2	.0015	≤.0157
0.795	**.0313**	**6.360**	**.2504**	195	24000	14	.0009	≤.0313	65	8000	4.7	.0009	≤.0157
0.800	**.0315**	**2.400**	**.0945**	195	24000	37.8	.0024	≤.0315	65	8000	12.6	.0024	≤.0157
0.800	**.0315**	**4.000**	**.1575**	195	24000	26.4	.0016	≤.0315	65	8000	8.7	.0016	≤.0157
0.800	**.0315**	**6.400**	**.2520**	195	24000	15	.0010	≤.0315	65	8000	5.1	.0010	≤.0157
0.889	**.0350**	**2.667**	**.1050**	195	21000	36.4	.0028	≤.0350	65	7200	12.5	.0028	≤.0175
0.889	**.0350**	**4.445**	**.1750**	195	21000	26.5	.0018	≤.0350	65	7200	9.1	.0018	≤.0175
0.889	**.0350**	**7.112**	**.2800**	195	21000	14.9	.0011	≤.0350	65	7200	5.1	.0011	≤.0175
1.000	**.0394**	**3.000**	**.1181**	195	20000	37.8	.0031	≤.0394	65	6500	12.2	.0031	≤.0197
1.000	**.0394**	**5.000**	**.1969**	195	20000	31.5	.0020	≤.0394	65	6500	10.2	.0020	≤.0197
1.000	**.0394**	**8.000**	**.3150**	195	20000	15.7	.0012	≤.0394	65	6500	5.1	.0012	≤.0197
1.016	**.0400**	**3.048**	**.1200**	195	19000	35.9	.0031	≤.0400	65	6300	11.9	.0031	≤.0200
1.016	**.0400**	**5.080**	**.2000**	195	19000	29.9	.0020	≤.0400	65	6300	9.9	.0020	≤.0200
1.016	**.0400**	**8.128**	**.3200**	195	19000	15	.0012	≤.0400	65	6300	5	.0012	≤.0200
1.143	**.0450**	**3.429**	**.1350**	195	17000	37.5	.0035	≤.0450	65	5600	12.3	.0035	≤.0225
1.143	**.0450**	**5.715**	**.2250**	195	17000	29.4	.0024	≤.0450	65	5600	9.7	.0024	≤.0225
1.143	**.0450**	**9.144**	**.3600**	195	17000	16.1	.0013	≤.0450	65	5600	5.3	.0013	≤.0225
Depth of Cut													

VQ4XLRB

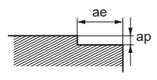
Corner radius, Short cut length, 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Bottm face milling

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel				
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
1.191	**.0469**	**3.573**	**.1407**	195	16000	35.3	.0035	≤.0469	65	5300	11.7	.0035	≤.0235
1.191	**.0469**	**5.955**	**.2344**	195	16000	27.7	.0024	≤.0469	65	5300	9.2	.0024	≤.0235
1.191	**.0469**	**9.528**	**.3751**	195	16000	15.1	.0013	≤.0469	65	5300	5	.0013	≤.0235
1.270	**.0500**	**3.810**	**.1500**	195	15000	35.4	.0039	≤.0500	65	5000	11.8	.0039	≤.0250
1.270	**.0500**	**6.350**	**.2500**	195	15000	28.3	.0026	≤.0500	65	5000	9.4	.0026	≤.0250
1.270	**.0500**	**10.160**	**.4000**	195	15000	14.2	.0014	≤.0500	65	5000	4.7	.0014	≤.0250
1.397	**.0550**	**4.191**	**.1650**	195	14000	35.3	.0043	≤.0550	65	4600	11.6	.0043	≤.0275
1.397	**.0550**	**6.985**	**.2750**	195	14000	28.7	.0028	≤.0550	65	4600	9.4	.0028	≤.0275
1.397	**.0550**	**11.176**	**.4400**	195	14000	15.4	.0015	≤.0550	65	4600	5.1	.0015	≤.0275
1.524	**.0600**	**4.572**	**.1800**	195	13000	36.9	.0047	≤.0600	65	4200	11.9	.0047	≤.0300
1.524	**.0600**	**7.620**	**.3000**	195	13000	30.7	.0031	≤.0600	65	4200	9.9	.0031	≤.0300
1.524	**.0600**	**12.192**	**.4800**	195	13000	15.4	.0016	≤.0600	65	4200	5	.0016	≤.0300
1.588	**.0625**	**4.764**	**.1876**	195	12000	34	.0047	≤.0625	65	4000	11.3	.0047	≤.0313
1.588	**.0625**	**7.940**	**.3126**	195	12000	28.3	.0031	≤.0625	65	4000	9.4	.0031	≤.0313
1.588	**.0625**	**12.704**	**.5002**	195	12000	14.2	.0016	≤.0625	65	4000	4.7	.0016	≤.0313
1.778	**.0700**	**5.334**	**.2100**	195	11000	36.4	.0055	≤.0700	65	3600	11.9	.0055	≤.0350
1.778	**.0700**	**8.890**	**.3500**	195	11000	29.4	.0035	≤.0700	65	3600	9.6	.0035	≤.0350
1.778	**.0700**	**14.224**	**.5600**	195	11000	15.6	.0018	≤.0700	65	3600	5.1	.0018	≤.0350
1.984	**.0781**	**5.952**	**.2343**	195	9600	36.3	.0063	≤.0781	65	3200	12.1	.0063	≤.0391
1.984	**.0781**	**9.920**	**.3906**	195	9600	30.2	.0039	≤.0781	65	3200	10.1	.0039	≤.0391
1.984	**.0781**	**15.872**	**.6249**	195	9600	15.1	.0020	≤.0781	65	3200	5	.0020	≤.0391
2.032	**.0800**	**6.096**	**.2400**	195	9400	35.5	.0063	≤.0800	65	3100	11.7	.0063	≤.0400
2.032	**.0800**	**10.160**	**.4000**	195	9400	29.6	.0039	≤.0800	65	3100	9.8	.0039	≤.0400
2.032	**.0800**	**16.256**	**.6400**	195	9400	14.8	.0020	≤.0800	65	3100	4.9	.0020	≤.0400
2.286	**.0900**	**6.858**	**.2700**	195	8400	35.7	.0071	≤.0900	65	2800	11.9	.0071	≤.0450
2.286	**.0900**	**11.430**	**.4500**	195	8400	30.4	.0047	≤.0900	65	2800	10.1	.0047	≤.0450
2.286	**.0900**	**18.288**	**.7200**	195	8400	17.2	.0024	≤.0900	65	2800	5.7	.0024	≤.0450
2.383	**.0938**	**7.149**	**.2815**	195	8000	34	.0071	≤.0938	65	2700	11.5	.0071	≤.0469
2.383	**.0938**	**11.915**	**.4691**	195	8000	29	.0047	≤.0938	65	2700	9.8	.0047	≤.0469
2.383	**.0938**	**19.064**	**.7506**	195	8000	16.4	.0024	≤.0938	65	2700	5.5	.0024	≤.0469
2.540	**.1000**	**7.62**	**.3000**	195	7500	35.4	.0079	≤.1000	65	2500	11.8	.0079	≤.0500
2.540	**.1000**	**12.7**	**.5000**	195	7500	29.5	.0051	≤.1000	65	2500	9.8	.0051	≤.0500
2.540	**.1000**	**20.32**	**.8000**	195	7500	17.7	.0028	≤.1000	65	2500	5.9	.0028	≤.0500
2.779	**.1094**	**8.337**	**.3282**	195	6900	35.9	.0087	≤.1094	65	2300	12	.0087	≤.0547
2.779	**.1094**	**13.895**	**.5470**	195	6900	29.3	.0059	≤.1094	65	2300	9.8	.0059	≤.0547
2.779	**.1094**	**22.232**	**.8753**	195	6900	19.6	.0035	≤.1094	65	2300	6.5	.0035	≤.0547
3.175	**.1250**	**9.525**	**.3750**	195	6000	34	.0094	≤.1250	65	2000	11.3	.0094	≤.0625
3.175	**.1250**	**15.875**	**.6250**	195	6000	28.3	.0063	≤.1250	65	2000	9.4	.0063	≤.0625
3.175	**.1250**	**25.4**	**1.0000**	195	6000	18.9	.0039	≤.1250	65	2000	6.3	.0039	≤.0625

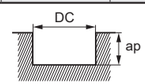
Depth of Cut



Slotting

Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)
(mm)	(inch)	(mm)	(inch)								
0.396	**.0156**	**1.188**	**.0468**	120	30000	23.6	.0012	50	12000	9.4	.0012
0.396	**.0156**	**1.980**	**.0780**	120	30000	16.5	.0008	50	12000	6.6	.0008
0.396	**.0156**	**3.168**	**.1247**	120	30000	9.4	.0004	50	12000	3.8	.0004
0.400	**.0157**	**1.200**	**.0472**	130	30000	23.6	.0012	50	12000	9.4	.0012
0.400	**.0157**	**2.000**	**.0787**	130	30000	16.5	.0008	50	12000	6.7	.0008
0.400	**.0157**	**3.200**	**.1260**	130	30000	9.4	.0004	50	12000	3.8	.0004
0.500	**.0197**	**1.500**	**.0591**	150	28000	26.4	.0016	50	9500	9.1	.0016
0.500	**.0197**	**2.500**	**.0984**	150	28000	17.7	.0012	50	9500	5.9	.0012
0.500	**.0197**	**4.000**	**.1575**	150	28000	11	.0006	50	9500	3.7	.0006
0.508	**.0200**	**1.524**	**.0600**	150	28000	26.5	.0016	50	9400	8.9	.0016
0.508	**.0200**	**2.540**	**.1000**	150	28000	17.6	.0012	50	9400	5.9	.0012
0.508	**.0200**	**4.064**	**.1600**	150	28000	11	.0006	50	9400	3.7	.0006
0.600	**.0236**	**1.800**	**.0709**	150	24000	26.4	.0020	50	8000	8.7	.0020
0.600	**.0236**	**3.000**	**.1181**	150	24000	18.9	.0014	50	8000	6.3	.0014
0.600	**.0236**	**4.800**	**.1890**	150	24000	11.4	.0008	50	8000	3.8	.0008
0.635	**.0250**	**1.905**	**.0750**	150	23000	25.4	.0020	50	7500	8.3	.0020
0.635	**.0250**	**3.175**	**.1250**	150	23000	18.1	.0014	50	7500	5.9	.0014
0.635	**.0250**	**5.080**	**.2000**	150	23000	10.9	.0008	50	7500	3.5	.0008
0.700	**.0276**	**2.100**	**.0827**	150	20000	26.8	.0022	50	6800	9.1	.0022
0.700	**.0276**	**3.500**	**.1378**	150	20000	18.9	.0014	50	6800	6.3	.0014
0.700	**.0276**	**5.600**	**.2205**	150	20000	11	.0008	50	6800	3.7	.0008
0.762	**.0300**	**2.286**	**.0900**	150	19000	26.9	.0023	50	6300	8.9	.0023
0.762	**.0300**	**3.810**	**.1500**	150	19000	19.4	.0015	50	6300	6.4	.0015
0.762	**.0300**	**6.096**	**.2400**	150	19000	11.1	.0009	50	6300	3.7	.0009
0.795	**.0313**	**2.385**	**.0939**	150	18000	25.5	.0023	50	6000	8.5	.0023
0.795	**.0313**	**3.975**	**.1565**	150	18000	18.4	.0015	50	6000	6.1	.0015
0.795	**.0313**	**6.360**	**.2504**	150	18000	10.5	.0009	50	6000	3.5	.0009
0.800	**.0315**	**2.400**	**.0945**	150	18000	28.3	.0024	50	6000	9.4	.0024
0.800	**.0315**	**4.000**	**.1575**	150	18000	19.7	.0016	50	6000	6.7	.0016
0.800	**.0315**	**6.400**	**.2520**	150	18000	11.4	.0010	50	6000	3.8	.0010
0.889	**.0350**	**2.667**	**.1050**	150	16000	27.7	.0028	50	5400	9.4	.0028
0.889	**.0350**	**4.445**	**.1750**	150	16000	20.2	.0018	50	5400	6.8	.0018
0.889	**.0350**	**7.112**	**.2800**	150	16000	11.3	.0011	50	5400	3.8	.0011
1.000	**.0394**	**3.000**	**.1181**	150	15000	28.3	.0031	50	4800	9.1	.0031
1.000	**.0394**	**5.000**	**.1969**	150	15000	23.6	.0020	50	4800	7.5	.0020
1.000	**.0394**	**8.000**	**.3150**	150	15000	11.8	.0012	50	4800	3.8	.0012
1.016	**.0400**	**3.048**	**.1200**	150	14000	26.5	.0031	50	4700	8.9	.0031
1.016	**.0400**	**5.080**	**.2000**	150	14000	22	.0020	50	4700	7.4	.0020
1.016	**.0400**	**8.128**	**.3200**	150	14000	11	.0012	50	4700	3.7	.0012
1.143	**.0450**	**3.429**	**.1350**	150	13000	28.7	.0035	50	4200	9.3	.0035
1.143	**.0450**	**5.715**	**.2250**	150	13000	22.5	.0024	50	4200	7.3	.0024
1.143	**.0450**	**9.144**	**.3600**	150	13000	12.3	.0013	50	4200	4	.0013

Depth of Cut



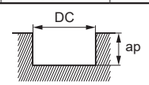
DC : Dia.

VQ4XLRB

Corner radius, Short cut length, 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Slotting

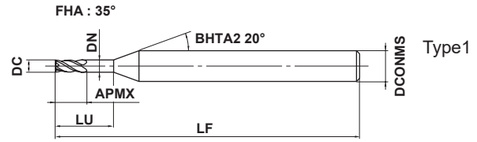
Material				Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC		LU		Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Cutting Speed **vc** (SFM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)
(mm)	(inch)	(mm)	(inch)								
1.191	**.0469**	**3.573**	**.1407**	150	12000	26.5	.0035	50	4000	8.8	.0035
1.191	**.0469**	**5.955**	**.2344**	150	12000	20.8	.0024	50	4000	6.9	.0024
1.191	**.0469**	**9.528**	**.3751**	150	12000	11.3	.0013	50	4000	3.8	.0013
1.270	**.0500**	**3.810**	**.1500**	150	11000	26	.0039	50	3800	9	.0039
1.270	**.0500**	**6.350**	**.2500**	150	11000	20.8	.0026	50	3800	7.2	.0026
1.270	**.0500**	**10.160**	**.4000**	150	11000	10.4	.0014	50	3800	3.6	.0014
1.397	**.0550**	**4.191**	**.1650**	150	10000	25.2	.0043	50	3400	8.6	.0043
1.397	**.0550**	**6.985**	**.2750**	150	10000	20.5	.0028	50	3400	7	.0028
1.397	**.0550**	**11.176**	**.4400**	150	10000	11	.0015	50	3400	3.7	.0015
1.524	**.0600**	**4.572**	**.1800**	150	9400	26.6	.0047	50	3100	8.8	.0047
1.524	**.0600**	**7.620**	**.3000**	150	9400	22.2	.0031	50	3100	7.3	.0031
1.524	**.0600**	**12.192**	**.4800**	150	9400	11.1	.0016	50	3100	3.7	.0016
1.588	**.0625**	**4.764**	**.1876**	150	9000	25.5	.0047	50	3000	8.5	.0047
1.588	**.0625**	**7.940**	**.3126**	150	9000	21.3	.0031	50	3000	7.1	.0031
1.588	**.0625**	**12.704**	**.5002**	150	9000	10.6	.0016	50	3000	3.5	.0016
1.778	**.0700**	**5.334**	**.2100**	150	8100	26.8	.0055	50	2700	8.9	.0055
1.778	**.0700**	**8.890**	**.3500**	150	8100	21.7	.0035	50	2700	7.2	.0035
1.778	**.0700**	**14.224**	**.5600**	150	8100	11.5	.0018	50	2700	3.8	.0018
1.984	**.0781**	**5.952**	**.2343**	150	7200	27.2	.0063	50	2400	9.1	.0063
1.984	**.0781**	**9.920**	**.3906**	150	7200	22.7	.0039	50	2400	7.6	.0039
1.984	**.0781**	**15.872**	**.6249**	150	7200	11.3	.0020	50	2400	3.8	.0020
2.032	**.0800**	**6.096**	**.2400**	150	7000	26.5	.0063	50	2300	8.7	.0063
2.032	**.0800**	**10.160**	**.4000**	150	7000	22	.0039	50	2300	7.2	.0039
2.032	**.0800**	**16.256**	**.6400**	150	7000	11	.0020	50	2300	3.6	.0020
2.286	**.0900**	**6.858**	**.2700**	150	6300	26.8	.0071	50	2100	8.9	.0071
2.286	**.0900**	**11.430**	**.4500**	150	6300	22.8	.0047	50	2100	7.6	.0047
2.286	**.0900**	**18.288**	**.7200**	150	6300	12.9	.0024	50	2100	4.3	.0024
2.383	**.0938**	**7.149**	**.2815**	150	6000	25.5	.0071	50	2000	8.5	.0071
2.383	**.0938**	**11.915**	**.4691**	150	6000	21.7	.0047	50	2000	7.2	.0047
2.383	**.0938**	**19.064**	**.7506**	150	6000	12.3	.0024	50	2000	4.1	.0024
2.540	**.1000**	**7.62**	**.3000**	150	5600	26.5	.0079	50	1900	9	.0079
2.540	**.1000**	**12.7**	**.5000**	150	5600	22	.0051	50	1900	7.5	.0051
2.540	**.1000**	**20.32**	**.8000**	150	5600	13.2	.0028	50	1900	4.5	.0028
2.779	**.1094**	**8.337**	**.3282**	150	5200	27	.0087	50	1700	8.8	.0087
2.779	**.1094**	**13.895**	**.5470**	150	5200	22.1	.0059	50	1700	7.2	.0059
2.779	**.1094**	**22.232**	**.8753**	150	5200	14.7	.0035	50	1700	4.8	.0035
3.175	**.1250**	**9.525**	**.3750**	150	4500	25.5	.0094	50	1500	8.5	.0094
3.175	**.1250**	**15.875**	**.6250**	150	4500	21.3	.0063	50	1500	7.1	.0063
3.175	**.1250**	**25.4**	**1.0000**	150	4500	14.2	.0039	50	1500	4.7	.0039
Depth of Cut				 DC : Dia.							

VQXL

End mill, Short cut length, 3 or 4 flute, Long neck

UWC | VQ | 35° | DC≤0.3 | DC≥0.4

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



Type1

	DC				
	0 - 0.010				
h6	DCONMS				
	0 - 0.005				

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutters at a small diameter of ϕ1 are realized.

(mm)

Order Number	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQXLD0020N006	0.2	0.3	0.6	0.18	40	4	3	●	1
VQXLD0030N009	0.3	0.5	0.9	0.28	40	4	3	●	1
VQXLD0030N015	0.3	0.5	1.5	0.28	40	4	3	●	1
VQXLD0040N010	0.4	0.6	1	0.37	40	4	4	●	1
VQXLD0040N018	0.4	0.6	1.8	0.37	40	4	4	●	1
VQXLD0050N015	0.5	0.7	1.5	0.46	40	4	4	●	1
VQXLD0050N025	0.5	0.7	2.5	0.46	40	4	4	●	1
VQXLD0050N030	0.5	0.7	3	0.46	40	4	4	●	1
VQXLD0060N030	0.6	0.9	3	0.57	40	4	4	●	1
VQXLD0070N035	0.7	1	3.5	0.67	40	4	4	●	1
VQXLD0080N024	0.8	1.2	2.4	0.77	40	4	4	●	1
VQXLD0080N030	0.8	1.2	3	0.77	40	4	4	●	1
VQXLD0080N040	0.8	1.2	4	0.77	40	4	4	●	1
VQXLD0100N050	1	1.5	5	0.96	40	4	4	●	1

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

TORX Chart

Order Number	ISO 10664 TORX Type
VQXLD0020N006	T4
VQXLD0030N009	T6
VQXLD0030N015	
VQXLD0040N010	T8
VQXLD0040N018	
VQXLD0050N015	T15
VQXLD0050N025	
VQXLD0050N030	
VQXLD0080N024	T25
VQXLD0080N040	
VQXLD0100N050	T40

● : USA Stock

VQXL

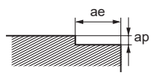
End mill, Short cut length, 3 or 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Shoulder milling

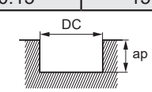
Material		Carbon Steel, Alloy Steel, Mild Steel, Alloy Tool Steel, Austenitic Stainless Steel, Titanium Alloys Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloy, Pre-Hardened Steel, Hardened Steel				
DC (mm)	**LU** (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	**0.6**	25	40000	360	0.03	0.01	20	32000	290	0.03	0.01
0.3	**0.9**	40	40000	480	0.045	0.015	20	21000	250	0.045	0.015
0.3	**1.5**	40	40000	360	0.045	0.015	20	21000	190	0.045	0.015
0.4	**1**	50	40000	800	0.06	0.02	20	16000	320	0.06	0.02
0.4	**1.8**	50	40000	560	0.06	0.02	20	16000	220	0.06	0.025
0.5	**1.5**	60	38000	910	0.075	0.025	20	13000	310	0.075	0.025
0.5	**2.5**	60	38000	610	0.075	0.025	20	13000	210	0.075	0.025
0.5	**3**	60	38000	550	0.075	0.025	20	13000	180	0.075	0.025
0.6	**3**	60	32000	640	0.09	0.03	20	10500	210	0.09	0.03
0.7	**3.5**	60	27000	650	0.11	0.035	20	9100	200	0.11	0.035
0.8	**2.4**	60	24000	960	0.12	0.04	20	8000	260	0.12	0.04
0.8	**3**	60	24000	860	0.12	0.04	20	8000	230	0.12	0.04
0.8	**4**	60	24000	670	0.12	0.04	20	8000	190	0.12	0.04
1	**5**	60	20000	800	0.15	0.05	20	6500	210	0.15	0.05
Depth of cut											

Bottom face milling

Material		Carbon Steel, Alloy Steel, Mild Steel, Alloy Tool Steel, Austenitic Stainless Steel, Titanium Alloys Cobalt Chromium Alloys, Copper, Copper Alloys					Heat Resistant Alloy, Pre-Hardened Steel, Hardened Steel				
DC (mm)	**LU** (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	**0.6**	25	40000	360	0.015	≤0.2	20	32000	290	0.015	≤0.1
0.3	**0.9**	40	40000	480	0.025	≤0.3	20	21000	250	0.025	≤0.15
0.3	**1.5**	40	40000	360	0.02	≤0.3	20	21000	190	0.02	≤0.15
0.4	**1**	50	40000	800	0.03	≤0.4	20	16000	320	0.03	≤0.2
0.4	**1.8**	50	40000	560	0.02	≤0.4	20	16000	220	0.02	≤0.2
0.5	**1.5**	60	38000	910	0.04	≤0.5	20	13000	310	0.04	≤0.25
0.5	**2.5**	60	38000	610	0.03	≤0.5	20	13000	210	0.03	≤0.25
0.5	**3**	60	38000	550	0.03	≤0.5	20	13000	180	0.03	≤0.25
0.6	**3**	60	32000	640	0.035	≤0.6	20	10500	210	0.035	≤0.3
0.7	**3.5**	60	27000	640	0.035	≤0.7	20	9100	190	0.035	≤0.35
0.8	**2.4**	60	24000	960	0.06	≤0.8	20	8000	260	0.06	≤0.4
0.8	**3**	60	24000	840	0.05	≤0.8	20	8000	230	0.05	≤0.4
0.8	**4**	60	24000	670	0.04	≤0.8	20	8000	190	0.04	≤0.4
1	**5**	60	20000	800	0.05	≤1	20	6500	210	0.05	≤0.5
Depth of cut											

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

Slotting

Material		Carbon Steel, Alloy Steel, Mild Steel, Alloy Tool Steel, Austenitic Stainless Steel, Titanium Alloys Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC (mm)	**LU** (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
0.2	**0.6**	20	30000	270	0.03	15	24000	220	0.03
0.3	**0.9**	30	30000	360	0.045	14	15000	180	0.045
0.3	**1.5**	30	30000	270	0.045	14	15000	140	0.045
0.4	**1**	40	30000	600	0.06	15	12000	240	0.06
0.4	**1.8**	40	30000	420	0.06	15	12000	170	0.06
0.5	**1.5**	45	28000	670	0.075	15	9500	230	0.075
0.5	**2.5**	45	28000	450	0.075	15	9500	150	0.075
0.5	**3**	45	28000	390	0.075	15	9500	130	0.075
0.6	**3**	45	24000	480	0.09	15	7800	160	0.09
0.7	**3.5**	45	20000	480	0.11	15	6800	140	0.11
0.8	**2.4**	45	18000	720	0.12	15	6000	190	0.12
0.8	**3**	45	18000	650	0.12	15	6000	170	0.12
0.8	**4**	45	18000	500	0.12	15	6000	140	0.12
1	**5**	45	15000	600	0.15	15	4800	150	0.15
Depth of cut									

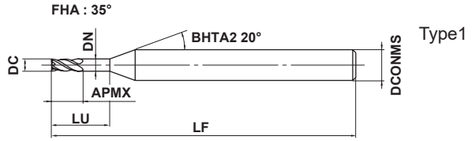
DC : Dia.

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) When the depth of cut is smaller than shown the feed rate can be increased.

VQXL – Inch sizes

End mill, Short cut length, 3 or 4 flute, Long neck

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



Type1

	DC				
	0 -.0008"				
h5	DCONMS				
	0 -.0002"				

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutters at a small diameter of .125 inch or less are realized.

(inch)

Order Number	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQXLDU008N3D	.0080	.0120	.0240	.0069	1.575	.1575	3	●	1
VQXLDU008N5D	.0080	.0120	.0400	.0069	1.575	.1575	3	●	1
VQXLDU008N8D	.0080	.0120	.0640	.0069	1.575	.1575	3	●	1
VQXLDU010N3D	.0100	.0150	.0300	.0089	1.575	.1575	3	●	1
VQXLDU010N5D	.0100	.0150	.0500	.0089	1.575	.1575	3	●	1
VQXLDU010N8D	.0100	.0150	.0800	.0089	1.575	.1575	3	●	1
VQXLDU016N3D	.0156	.0234	.0469	.0145	1.575	.1575	4	●	1
VQXLDU016N5D	.0156	.0234	.0781	.0145	1.575	.1575	4	●	1
VQXLDU016N8D	.0156	.0234	.1250	.0145	1.575	.1575	4	●	1
VQXLDU020N3D	.0200	.0300	.0600	.0185	1.575	.1575	4	●	1
VQXLDU020N5D	.0200	.0300	.1000	.0185	1.575	.1575	4	●	1
VQXLDU020N8D	.0200	.0300	.1600	.0185	1.575	.1575	4	●	1
VQXLDU025N3D	.0250	.0375	.0750	.0235	1.575	.1575	4	●	1
VQXLDU025N5D	.0250	.0375	.1250	.0235	1.575	.1575	4	●	1
VQXLDU025N8D	.0250	.0375	.2000	.0235	1.575	.1575	4	●	1
VQXLDU030N3D	.0300	.0450	.0900	.0285	1.575	.1575	4	●	1
VQXLDU030N5D	.0300	.0450	.1500	.0285	1.575	.1575	4	●	1
VQXLDU030N8D	.0300	.0450	.2400	.0285	1.575	.1575	4	●	1
VQXLDU031N3D	.0313	.0469	.0938	.0298	1.575	.1575	4	●	1
VQXLDU031N5D	.0313	.0469	.1563	.0298	1.575	.1575	4	●	1
VQXLDU031N8D	.0313	.0469	.2500	.0298	1.575	.1575	4	●	1
VQXLDU035N3D	.0350	.0525	.1050	.0335	1.575	.1575	4	●	1
VQXLDU035N5D	.0350	.0525	.1750	.0335	1.575	.1575	4	●	1
VQXLDU035N8D	.0350	.0525	.2800	.0335	1.575	.1575	4	●	1
VQXLDU040N3D	.0400	.0600	.1200	.0381	1.575	.1575	4	●	1
VQXLDU040N5D	.0400	.0600	.2000	.0381	1.575	.1575	4	●	1
VQXLDU040N8D	.0400	.0600	.3200	.0381	1.575	.1575	4	●	1
VQXLDU045N3D	.0450	.0675	.1350	.0431	1.575	.1575	4	●	1
VQXLDU045N5D	.0450	.0675	.2250	.0431	1.575	.1575	4	●	1
VQXLDU045N8D	.0450	.0675	.3600	.0431	1.772	.1575	4	●	1

● :USA Stock

(inch)

Order Number	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQXLDU047N3D	.0469	.0703	.1406	.0450	1.575	.1575	4	●	1
VQXLDU047N5D	.0469	.0703	.2344	.0450	1.575	.1575	4	●	1
VQXLDU047N8D	.0469	.0703	.3750	.0450	1.772	.1575	4	●	1
VQXLDU050N3D	.0500	.0750	.1500	.0481	1.575	.1575	4	●	1
VQXLDU050N5D	.0500	.0750	.2500	.0481	1.575	.1575	4	●	1
VQXLDU050N8D	.0500	.0750	.4000	.0481	1.772	.1575	4	●	1
VQXLDU055N3D	.0550	.0825	.1650	.0531	1.575	.1575	4	●	1
VQXLDU055N5D	.0550	.0825	.2750	.0531	1.575	.1575	4	●	1
VQXLDU055N8D	.0550	.0825	.4400	.0531	1.772	.1575	4	●	1
VQXLDU060N3D	.0600	.0900	.1800	.0581	1.575	.1575	4	●	1
VQXLDU060N5D	.0600	.0900	.3000	.0581	1.575	.1575	4	●	1
VQXLDU060N8D	.0600	.0900	.4800	.0581	1.772	.1575	4	●	1
VQXLDU063N3D	.0625	.0938	.1875	.0606	1.575	.1575	4	●	1
VQXLDU063N5D	.0625	.0938	.3125	.0606	1.575	.1575	4	●	1
VQXLDU063N8D	.0625	.0938	.5000	.0606	1.772	.1575	4	●	1
VQXLDU070N3D	.0700	.1050	.2100	.0681	1.575	.1575	4	●	1
VQXLDU070N5D	.0700	.1050	.3500	.0681	1.575	.1575	4	●	1
VQXLDU070N8D	.0700	.1050	.5600	.0681	1.772	.1575	4	●	1
VQXLDU078N3D	.0781	.1172	.2344	.0762	1.575	.1575	4	●	1
VQXLDU078N5D	.0781	.1172	.3906	.0762	1.575	.1575	4	●	1
VQXLDU078N8D	.0781	.1172	.6250	.0762	1.969	.1575	4	●	1
VQXLDU080N3D	.0800	.1200	.2400	.0773	1.575	.1575	4	●	1
VQXLDU080N5D	.0800	.1200	.4000	.0773	1.772	.1575	4	●	1
VQXLDU080N8D	.0800	.1200	.6400	.0773	1.969	.1575	4	●	1
VQXLDU090N3D	.0900	.1350	.2700	.0873	1.575	.1575	4	●	1
VQXLDU090N5D	.0900	.1350	.4500	.0873	1.772	.1575	4	●	1
VQXLDU090N8D	.0900	.1350	.7200	.0873	1.969	.1575	4	●	1
VQXLDU094N3D	.0938	.1406	.2813	.0911	1.575	.1575	4	●	1
VQXLDU094N5D	.0938	.1406	.4688	.0911	1.772	.1575	4	●	1
VQXLDU094N8D	.0938	.1406	.7500	.0911	1.969	.1575	4	●	1
VQXLDU100N3D	.1000	.1500	.3000	.0973	1.508	.1575	4	●	1
VQXLDU100N5D	.1000	.1500	.5000	.0973	1.772	.1575	4	●	1
VQXLDU100N8D	.1000	.1500	.8000	.0973	1.969	.1575	4	●	1
VQXLDU109N3D	.1094	.1641	.3281	.1067	1.575	.1575	4	●	1
VQXLDU109N5D	.1094	.1641	.5469	.1067	1.772	.1575	4	●	1
VQXLDU109N8D	.1094	.1641	.8750	.1067	2.165	.1575	4	●	1
VQXLDU125N3D	.1250	.1875	.3750	.1223	1.575	.1575	4	●	1
VQXLDU125N5D	.1250	.1875	.6250	.1223	1.772	.1575	4	●	1
VQXLDU125N8D	.1250	.1875	1.0000	.1223	2.165	.1575	4	●	1

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

VQXL – Inch sizes

End mill, Short cut length, 3 or 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Side milling

Material		Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC (inch)	LU (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)
.008	**.024**	40000	14.2	.0012	.0004	31000	11.0	.0012	.0004
.008	**.040**	40000	9.4	.0012	.0004	31000	7.3	.0012	.0004
.008	**.064**	40000	4.7	.0008	.0004	31000	3.7	.0008	.0004
.010	**.030**	40000	16.5	.0015	.0005	25000	10.3	.0015	.0005
.010	**.050**	40000	11.8	.0015	.0005	25000	7.4	.0015	.0005
.010	**.080**	40000	6.1	.0010	.0005	25000	3.8	.0010	.0005
.016	**.047**	40000	31.5	.0023	.0008	16000	12.6	.0023	.0008
.016	**.078**	40000	22.0	.0023	.0008	16000	8.8	.0023	.0008
.016	**.125**	40000	12.6	.0016	.0008	16000	5.0	.0016	.0008
.020	**.060**	38000	35.9	.0030	.0010	13000	12.3	.0030	.0010
.020	**.010**	38000	23.9	.0030	.0010	13000	8.2	.0030	.0010
.020	**.016**	38000	15.0	.0020	.0010	13000	5.1	.0020	.0010
.025	**.075**	30000	33.1	.0038	.0013	10000	11.0	.0038	.0013
.025	**.125**	30000	23.6	.0038	.0013	10000	7.9	.0038	.0013
.025	**.200**	30000	14.2	.0025	.0013	10000	4.7	.0025	.0013
.030	**.090**	25000	35.4	.0045	.0015	8400	11.9	.0045	.0015
.030	**.150**	25000	25.6	.0045	.0015	8400	8.6	.0045	.0015
.030	**.240**	25000	14.6	.0030	.0015	8400	4.9	.0030	.0015
.031	**.094**	24000	34.0	.0047	.0016	8000	11.3	.0047	.0016
.031	**.156**	24000	24.6	.0047	.0016	8000	8.2	.0047	.0016
.031	**.250**	24000	14.0	.0031	.0016	8000	4.7	.0031	.0016
.035	**.105**	21000	36.4	.0053	.0018	7200	12.5	.0053	.0018
.035	**.175**	21000	26.5	.0053	.0018	7200	9.1	.0053	.0018
.035	**.280**	21000	14.9	.0035	.0018	7200	5.1	.0035	.0018
.040	**.120**	19000	35.9	.0060	.0020	6300	11.9	.0060	.0020
.040	**.200**	19000	29.9	.0060	.0020	6300	9.9	.0060	.0020
.040	**.320**	19000	15.0	.0040	.0020	6300	5.0	.0040	.0020
.045	**.135**	17000	37.5	.0068	.0023	5600	12.3	.0068	.0023
.045	**.225**	17000	29.4	.0068	.0023	5600	9.7	.0068	.0023
.045	**.360**	17000	16.1	.0045	.0023	5600	5.3	.0045	.0023
.047	**.141**	16000	35.3	.0070	.0023	5300	11.7	.0070	.0023
.047	**.234**	16000	27.7	.0070	.0023	5300	9.2	.0070	.0023
.047	**.375**	16000	15.1	.0047	.0023	5300	5.0	.0047	.0023
.050	**.150**	15000	35.4	.0075	.0025	5000	11.8	.0075	.0025
.050	**.250**	15000	28.3	.0075	.0025	5000	9.4	.0075	.0025
.050	**.400**	15000	14.2	.0050	.0025	5000	4.7	.0050	.0025
.055	**.165**	14000	35.3	.0083	.0028	4600	11.6	.0083	.0028
.055	**.275**	**14000**	**28.7**	**.0083**	**.0028**	**4600**	**9.4**	**.0083**	**.0028**
.055	**.440**	**14000**	**15.4**	**.0055**	**.0028**	**4600**	**5.1**	**.0055**	**.0028**

Material		Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC (inch)	LU (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)
.060	**.180**	13000	36.9	.0090	.0030	4200	11.9	.0090	.0030
.060	**.300**	13000	30.7	.0090	.0030	4200	9.9	.0090	.0030
.060	**.480**	13000	15.4	.0060	.0030	4200	5.0	.0060	.0030
.063	**.188**	12000	34.0	.0094	.0031	4000	11.3	.0094	.0031
.063	**.313**	12000	28.3	.0094	.0031	4000	9.4	.0094	.0031
.063	**.500**	12000	14.2	.0063	.0031	4000	4.7	.0063	.0031
.070	**.210**	11000	36.4	.0105	.0035	3600	11.9	.0105	.0035
.070	**.350**	11000	29.4	.0105	.0035	3600	9.6	.0105	.0035
.070	**.560**	11000	15.6	.0070	.0035	3600	5.1	.0070	.0035
.078	**.234**	9600	36.3	.0117	.0039	3200	12.1	.0117	.0039
.078	**.391**	9600	30.2	.0117	.0039	3200	10.1	.0117	.0039
.078	**.625**	9600	15.1	.0078	.0039	3200	5.0	.0078	.0039
.080	**.240**	9400	35.5	.0120	.0040	3100	11.7	.0120	.0040
.080	**.400**	9400	29.6	.0120	.0040	3100	9.8	.0120	.0040
.080	**.640**	9400	14.8	.0080	.0040	3100	4.9	.0080	.0040
.090	**.270**	8400	35.7	.0135	.0045	2800	11.9	.0135	.0045
.090	**.450**	8400	30.4	.0135	.0045	2800	10.1	.0135	.0045
.090	**.720**	8400	17.2	.0090	.0045	2800	5.7	.0090	.0045
.094	**.281**	8000	34.0	.0141	.0047	2700	11.5	.0141	.0047
.094	**.469**	8000	29.0	.0141	.0047	2700	9.8	.0141	.0047
.094	**.750**	8000	16.4	.0094	.0047	2700	5.5	.0094	.0047
.100	**.300**	7500	35.4	.0150	.0050	2500	11.8	.0150	.0050
.100	**.500**	7500	29.5	.0150	.0050	2500	9.8	.0150	.0050
.100	**.800**	7500	17.7	.0100	.0050	2500	5.9	.0100	.0050
.109	**.328**	6900	35.9	.0164	.0055	2300	12.0	.0164	.0055
.109	**.547**	6900	29.3	.0164	.0055	2300	9.8	.0164	.0055
.109	**.875**	6900	19.6	.0109	.0055	2300	6.5	.0109	.0055
.125	**.375**	6000	34.0	.0188	.0063	2000	11.3	.0188	.0063
.125	**.625**	6000	28.3	.0188	.0063	2000	9.4	.0188	.0063
.125	**1.000**	6000	18.9	.0125	.0063	2000	6.3	.0125	.0063

Depth of Cut

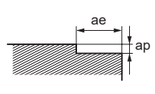
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

Bottom face milling

Material		Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC (inch)	LU (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)
.008	**.024**	40000	14.2	.0006	.0080	31000	11.0	.0006	.0040
.008	**.040**	40000	9.4	.0004	.0080	31000	7.3	.0004	.0040
.008	**.064**	40000	4.7	.0002	.0080	31000	3.7	.0002	.0040
.010	**.030**	40000	16.5	.0008	.0100	25000	10.3	.0008	.0050
.010	**.050**	40000	11.8	.0006	.0100	25000	7.4	.0006	.0050
.010	**.080**	40000	6.1	.0003	.0100	25000	3.8	.0003	.0050
.016	**.047**	40000	31.5	.0012	.0156	16000	12.6	.0012	.0078
.016	**.078**	40000	22.0	.0008	.0156	16000	8.8	.0008	.0078
.016	**.125**	40000	12.6	.0004	.0156	16000	5.0	.0004	.0078
.020	**.060**	38000	35.9	.0016	.0200	13000	12.3	.0016	.0100
.020	**.010**	38000	23.9	.0012	.0200	13000	8.2	.0012	.0100
.020	**.016**	38000	15.0	.0006	.0200	13000	5.1	.0006	.0100
.025	**.075**	30000	33.1	.0020	.0250	10000	11.0	.0020	.0125
.025	**.125**	30000	23.6	.0014	.0250	10000	7.9	.0014	.0125
.025	**.200**	30000	14.2	.0008	.0250	10000	4.7	.0008	.0125
.030	**.090**	25000	35.4	.0023	.0300	8400	11.9	.0023	.0150
.030	**.150**	25000	25.6	.0015	.0300	8400	8.6	.0015	.0150
.030	**.240**	25000	14.6	.0009	.0300	8400	4.9	.0009	.0150
.031	**.094**	24000	34.0	.0023	.0313	8000	11.3	.0023	.0157
.031	**.156**	24000	24.6	.0015	.0313	8000	8.2	.0015	.0157
.031	**.250**	24000	14.0	.0009	.0313	8000	4.7	.0009	.0157
.035	**.105**	21000	36.4	.0028	.0350	7200	12.5	.0028	.0175
.035	**.175**	21000	26.5	.0018	.0350	7200	9.1	.0018	.0175
.035	**.280**	21000	14.9	.0011	.0350	7200	5.1	.0011	.0175
.040	**.120**	19000	35.9	.0031	.0400	6300	11.9	.0031	.0200
.040	**.200**	19000	29.9	.0020	.0400	6300	9.9	.0020	.0200
.040	**.320**	19000	15.0	.0012	.0400	6300	5.0	.0012	.0200
.045	**.135**	17000	37.5	.0035	.0450	5600	12.3	.0035	.0225
.045	**.225**	17000	29.4	.0024	.0450	5600	9.7	.0024	.0225
.045	**.360**	17000	16.1	.0013	.0450	5600	5.3	.0013	.0225
.047	**.141**	16000	35.3	.0035	.0469	5300	11.7	.0035	.0235
.047	**.234**	16000	27.7	.0024	.0469	5300	9.2	.0024	.0235
.047	**.375**	16000	15.1	.0013	.0469	5300	5.0	.0013	.0235
.050	**.150**	15000	35.4	.0039	.0500	5000	11.8	.0039	.0250
.050	**.250**	15000	28.3	.0026	.0500	5000	9.4	.0026	.0250
.050	**.400**	15000	14.2	.0014	.0500	5000	4.7	.0014	.0250
.055	**.165**	14000	35.3	.0043	.0550	4600	11.6	.0043	.0275
.055	**.275**	**14000**	**28.7**	**.0028**	**.0550**	**4600**	**9.4**	**.0028**	**.0275**
.055	**.440**	**14000**	**15.4**	**.0015**	**.0550**	**4600**	**5.1**	**.0015**	**.0275**

Material		Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys				Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel			
DC (inch)	LU (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Depth of cut **ae** (inch)
.060	**.180**	13000	36.9	.0047	.0600	4200	11.9	.0047	.0300
.060	**.300**	13000	30.7	.0031	.0600	4200	9.9	.0031	.0300
.060	**.480**	13000	15.4	.0016	.0600	4200	5.0	.0016	.0300
.063	**.188**	12000	34.0	.0047	.0625	4000	11.3	.0047	.0313
.063	**.313**	12000	28.3	.0031	.0625	4000	9.4	.0031	.0313
.063	**.500**	12000	14.2	.0016	.0625	4000	4.7	.0016	.0313
.070	**.210**	11000	36.4	.0055	.0700	3600	11.9	.0055	.0350
.070	**.350**	11000	29.4	.0035	.0700	3600	9.6	.0035	.0350
.070	**.560**	11000	15.6	.0018	.0700	3600	5.1	.0018	.0350
.078	**.234**	9600	36.3	.0063	.0781	3200	12.1	.0063	.0391
.078	**.391**	9600	30.2	.0039	.0781	3200	10.1	.0039	.0391
.078	**.625**	9600	15.1	.0020	.0781	3200	5.0	.0020	.0391
.080	**.240**	9400	35.5	.0063	.0800	3100	11.7	.0063	.0400
.080	**.400**	9400	29.6	.0039	.0800	3100	9.8	.0039	.0400
.080	**.640**	9400	14.8	.0020	.0800	3100	4.9	.0020	.0400
.090	**.270**	8400	35.7	.0071	.0900	2800	11.9	.0071	.0450
.090	**.450**	8400	30.4	.0047	.0900	2800	10.1	.0047	.0450
.090	**.720**	8400	17.2	.0024	.0900	2800	5.7	.0024	.0450
.094	**.281**	8000	34.0	.0071	.0930	2700	11.5	.0071	.0469
.094	**.469**	8000	29.0	.0047	.0930	2700	9.8	.0047	.0469
.094	**.750**	8000	16.4	.0024	.0930	2700	5.5	.0024	.0469
.100	**.300**	7500	35.4	.0079	.1000	2500	11.8	.0079	.0500
.100	**.500**	7500	29.5	.0051	.1000	2500	9.8	.0051	.0500
.100	**.800**	7500	17.7	.0028	.1000	2500	5.9	.0028	.0500
.109	**.328**	6900	35.9	.0087	.1094	2300	12.0	.0087	.0547
.109	**.547**	6900	29.3	.0059	.1094	2300	9.8	.0059	.0547
.109	**.875**	6900	19.6	.0035	.1094	2300	6.5	.0035	.0547
.125	**.375**	6000	34.0	.0094	.1250	2000	11.3	.0094	.0625
.125	**.625**	6000	28.3	.0063	.1250	2000	9.4	.0063	.0625
.125	**1.000**	6000	18.9	.0039	.1250	2000	6.3	.0039	.0625

Depth of Cut



Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQXL – Inch sizes

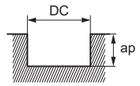
End mill, Short cut length, 3 or 4 flute, Long neck

RECOMMENDED CUTTING CONDITIONS

Slotting

Material		Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys			Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel		
DC (inch)	LU (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)	Revolution (min^{-1})	Table feed **vf** (IPM)	Depth of cut **ap** (inch)
.008	**.024**	30000	10.6	.0006	24000	8.5	.0006
.008	**.040**	30000	7.1	.0004	24000	5.7	.0004
.008	**.064**	30000	3.5	.0002	24000	2.8	.0002
.010	**.030**	30000	12.4	.0008	19000	7.9	.0008
.010	**.050**	30000	8.9	.0006	19000	5.6	.0006
.010	**.080**	30000	4.6	.0003	19000	2.9	.0003
.016	**.047**	30000	23.6	.0012	12000	9.4	.0012
.016	**.078**	30000	16.5	.0008	12000	6.6	.0008
.016	**.125**	30000	9.4	.0004	12000	3.8	.0004
.020	**.060**	28000	26.5	.0016	9400	8.9	.0016
.020	**.010**	28000	17.6	.0012	9400	5.9	.0012
.020	**.016**	28000	11.0	.0006	9400	3.7	.0006
.025	**.075**	23000	25.4	.0020	7500	8.3	.0020
.025	**.125**	23000	18.1	.0014	7500	5.9	.0014
.025	**.200**	23000	10.9	.0008	7500	3.5	.0008
.030	**.090**	19000	26.9	.0023	6300	8.9	.0023
.030	**.150**	19000	19.4	.0015	6300	6.4	.0015
.030	**.240**	19000	11.1	.0009	6300	3.7	.0009
.031	**.094**	18000	25.5	.0023	6000	8.5	.0023
.031	**.156**	18000	18.4	.0015	6000	6.1	.0015
.031	**.250**	18000	10.5	.0009	6000	3.5	.0009
.035	**.105**	16000	27.7	.0028	5400	9.4	.0028
.035	**.175**	16000	20.2	.0018	5400	6.8	.0018
.035	**.280**	16000	11.3	.0011	5400	3.8	.0011
.040	**.120**	14000	26.5	.0031	4700	8.9	.0031
.040	**.200**	14000	22.0	.0020	4700	7.4	.0020
.040	**.320**	14000	11.0	.0012	4700	3.7	.0012
.045	**.135**	13000	28.7	.0035	4200	9.3	.0035
.045	**.225**	13000	22.5	.0024	4200	7.3	.0024
.045	**.360**	13000	12.3	.0013	4200	4.0	.0013
.047	**.141**	12000	26.5	.0035	4000	8.8	.0035
.047	**.234**	12000	20.8	.0024	4000	6.9	.0024
.047	**.375**	12000	11.3	.0013	4000	3.8	.0013
.050	**.150**	11000	26.0	.0039	3800	9.0	.0039
.050	**.250**	11000	20.8	.0026	3800	7.2	.0026
.050	**.400**	11000	10.4	.0014	3800	3.6	.0014
.055	**.165**	10000	25.2	.0043	3400	8.6	.0043
.055	**.275**	10000	20.5	.0028	3400	7.0	.0028
.055	**.440**	10000	11.0	.0015	3400	3.7	.0015
.060	**.180**	9400	26.6	.0047	3100	8.8	.0047
.060	**.300**	9400	22.2	.0031	3100	7.3	.0031
.060	**.480**	9400	11.1	.0016	3100	3.7	.0016
.063	**.188**	9000	25.5	.0047	3000	8.5	.0047
.063	**.313**	9000	21.3	.0031	3000	7.1	.0031
.063	**.500**	9000	10.6	.0016	3000	3.5	.0016
.070	**.210**	8100	26.8	.0055	2700	8.9	.0055
.070	**.350**	8100	21.7	.0035	2700	7.2	.0035
.070	**.560**	8100	11.5	.0018	2700	3.8	.0018
.078	**.234**	7200	27.2	.0063	2400	9.1	.0063
.078	**.391**	7200	22.7	.0039	2400	7.6	.0039
.078	**.625**	7200	11.3	.0020	2400	3.8	.0020
.080	**.240**	7000	26.5	.0063	2300	8.7	.0063
.080	**.400**	7000	22.0	.0039	2300	7.2	.0039
.080	**.640**	7000	11.0	.0020	2300	3.6	.0020
.090	**.270**	6300	26.8	.0071	2100	8.9	.0071
.090	**.450**	6300	22.8	.0047	2100	7.6	.0047
.090	**.720**	6300	12.9	.0024	2100	4.3	.0024
.094	**.281**	6000	25.5	.0071	2000	8.5	.0071
.094	**.469**	6000	21.7	.0047	2000	7.2	.0047
.094	**.750**	6000	12.3	.0024	2000	4.1	.0024
.100	**.300**	5600	26.5	.0079	1900	9.0	.0079
.100	**.500**	5600	22.0	.0051	1900	7.5	.0051
.100	**.800**	5600	13.2	.0028	1900	4.5	.0028
.109	**.328**	5200	27.0	.0087	1700	8.8	.0087
.109	**.547**	5200	22.1	.0059	1700	7.2	.0059
.109	**.875**	5200	14.7	.0035	1700	4.8	.0035
.125	**.375**	4500	25.5	.0094	1500	8.5	.0094
.125	**.625**	4500	21.3	.0063	1500	7.1	.0063
.125	**1.000**	4500	14.2	.0039	1500	4.7	.0039

Depth of Cut

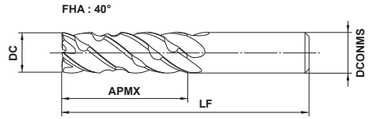


Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQJCS

End mill, Semi long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

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



Type1

DC≤12	DC>12			
0 - 0.030	0 - 0.040			
DCONMS=6	DCONMS=8,10	DCONMS=12	DCONMS=16	DCONMS=20
0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	APMX	LF	DCONMS	*1 No.F	Stock	Type
VQJCSD0600	6	18	70	6	5	●	1
VQJCSD0800	8	24	80	8	5	●	1
VQJCSD1000	10	30	90	10	5	●	1
VQJCSD1200	12	36	100	12	5	●	1
VQJCSD1600	16	48	110	16	5	●	1
VQJCSD2000	20	60	125	20	5	●	1

*1 Number of Flutes

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

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

● :USA Stock

VQJCS

End mill, Semi long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

Material		Carbon Steel, Alloy Steel, Mild Steel				Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobaly Chromium Alloys			
Dia. **DC**		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)																
6	**.236**	10600	70.9	.709	.035	9500	59.1	.709	.035	6400	39.4	.709	.018	5300	31.5	.709	.018
8	**.315**	8000	70.9	.945	.047	7200	59.1	.945	.047	4800	39.4	.945	.024	4000	31.5	.945	.024
10	**.394**	6400	66.9	1.181	.059	5700	55.1	1.181	.059	3800	35.4	1.181	.030	3200	31.5	1.181	.030
12	**.472**	5300	66.9	1.417	.071	4800	55.1	1.417	.071	3200	31.5	1.417	.035	2700	27.6	1.417	.035
16	**.630**	4000	55.1	1.890	.094	3600	47.2	1.890	.094	2400	27.6	1.890	.047	2000	23.6	1.890	.047
20	**.787**	3200	47.2	2.362	.118	2900	39.4	2.362	.118	1900	23.6	2.362	.059	1600	19.7	2.362	.059
Depth of Cut																	

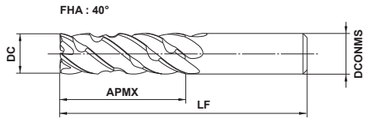
Material		Copper, Copper Alloys				Heat Resistant Alloys			
Dia. **DC**		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)								
6	**.236**	11700	82.7	.709	.035	2100	7.9	.709	.007
8	**.315**	8800	82.7	.945	.047	1600	7.9	.945	.009
10	**.394**	7000	70.9	1.181	.059	1300	7.9	1.181	.012
12	**.472**	5800	70.9	1.417	.071	1100	3.9	1.417	.014
16	**.630**	4400	59.1	1.890	.094	800	3.9	1.890	.019
20	**.787**	3500	55.1	2.362	.118	600	3.9	2.362	.024
Depth of Cut									

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with a smaller depth of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQLCS

End mill, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

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



Type1

h6	DC≤12	DC>12			
	0 - 0.030	0 - 0.040			
	DCONMS=6	DCONMS=8,10	DCONMS=12	DCONMS=16	DCONMS=20
	0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	APMX	LF	DCONMS	∗1 No.F	Stock	Type
VQLCSD0600	6	24	70	6	5	●	1
VQLCSD0800	8	32	90	8	5	●	1
VQLCSD1000	10	40	100	10	5	●	1
VQLCSD1200	12	48	110	12	5	●	1
VQLCSD1600	16	64	130	16	5	●	1
VQLCSD2000	20	80	150	20	5	●	1

∗1 Number of Flutes ● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

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

● :USA Stock

VQLCS

End mill, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

Material		Carbon Steel, Alloy Steel, Mild Steel					Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobaly Chromium Alloys				
Dia. **DC**		Cutting Speed	Revolution	Feed rate	Depth of	Depth of	Cutting Speed	Revolution	Feed rate	Depth of	Depth of	Cutting Speed	Revolution	Feed rate	Depth of	Depth of	Cutting Speed	Revolution	Feed rate	Depth of	Depth of
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae
6	**.236**	590	9500	63.0	.945	.024	525	8500	47.2	.945	.024	330	5300	31.5	.945	.012	295	4800	27.6	.945	.012
8	**.315**	590	7200	63.0	1.260	.031	525	6400	51.2	1.260	.031	330	4000	31.5	1.260	.016	295	3600	27.6	1.260	.016
10	**.394**	590	5700	59.1	1.575	.039	525	5100	47.2	1.575	.039	330	3200	27.6	1.575	.020	295	2900	27.6	1.575	.020
12	**.472**	590	4800	59.1	1.890	.047	525	4200	47.2	1.890	.047	330	2700	27.6	1.890	.024	295	2400	23.6	1.890	.024
16	**.630**	590	3600	51.2	2.520	.063	525	3200	39.4	2.520	.063	330	2100	23.6	2.520	.031	295	1800	19.7	2.520	.031
20	**.787**	590	2900	43.3	3.150	.079	525	2500	31.5	3.150	.079	330	1600	19.7	3.150	.039	295	1400	15.7	3.150	.039
Depth of Cut																					

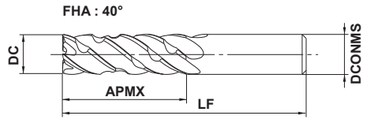
Material		Copper, Copper Alloys					Heat Resistant Alloys				
Dia. **DC**		Cutting Speed	Revolution	Feed rate	Depth of	Depth of	Cutting Speed	Revolution	Feed rate	Depth of	Depth of
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae	(SFM)	(min^{-1})	(IPM)	cut ap	cut ae
6	**.236**	655	10600	70.9	.945	.024	100	1600	3.9	.945	.005
8	**.315**	655	8000	70.9	1.260	.031	100	1200	3.9	1.260	.006
10	**.394**	655	6400	63.0	1.575	.039	100	1000	3.9	1.575	.008
12	**.472**	655	5300	63.0	1.890	.047	100	800	3.9	1.890	.009
16	**.630**	655	4000	55.1	2.520	.063	100	600	3.1	2.520	.013
20	**.787**	655	3200	51.2	3.150	.079	100	500	3.1	3.150	.016
Depth of Cut											

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with a smaller depth of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQELCS NEW

End mill, Extra Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

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



Type1

DC≤12	DC>12			
0 - 0.030	0 - 0.040			
DCONMS=6	DCONMS=8,10	DCONMS=12	DCONMS=16	DCONMS=20
0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	APMX	LF	DCONMS	∗1 No.F	Stock	Type
VQELCSD0600	6	30	80	6	5	●	1
VQELCSD0800	8	40	100	8	5	●	1
VQELCSD1000	10	50	110	10	5	●	1
VQELCSD1200	12	60	125	12	5	●	1
VQELCSD1600	16	80	150	16	5	●	1
VQELCSD2000	20	100	170	20	5	●	1

∗1 Number of Flutes ● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

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

● :USA Stock

VQELCS

End mill, Extra Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

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					Precipitation Hardening Stainless Steel Cobalt Chromium Alloys				
Dia. DC		Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)		
6	**.236**	525	8500	55.1	1.181	.020	490	8000	43.3	1.181	.020	295	4800	27.6	1.181	.008	260	4200	23.6	1.181	.008
8	**.315**	525	6400	55.1	1.575	.024	490	6000	47.2	1.575	.024	295	3600	27.6	1.575	.012	260	3200	23.6	1.575	.012
10	**.394**	525	5100	51.2	1.969	.031	490	4800	43.3	1.969	.031	295	2900	23.6	1.969	.016	260	2500	23.6	1.969	.016
12	**.472**	525	4200	51.2	2.362	.035	490	4000	43.3	2.362	.035	295	2400	23.6	2.362	.020	260	2100	19.7	2.362	.020
16	**.630**	525	3200	43.3	3.150	.047	490	3000	37.4	3.150	.047	295	1800	19.7	3.150	.024	260	1600	15.7	3.150	.024
20	**.787**	525	2500	37.4	3.937	.059	490	2400	27.6	3.937	.059	295	1400	15.7	3.937	.031	260	1300	13.8	3.937	.031
Depth of Cut																					

Material		Copper, Copper Alloys					Heat Resistant Alloys				
Dia. DC		Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)		
6	**.236**	590	9500	63.0	1.181	.020	80	1300	3.5	1.181	.004
8	**.315**	590	7200	63.0	1.575	.024	80	1000	3.5	1.575	.005
10	**.394**	590	5700	59.1	1.969	.031	80	800	3.5	1.969	.006
12	**.472**	590	4800	59.1	2.362	.035	80	700	3.1	2.362	.007
16	**.630**	590	3600	51.2	3.150	.047	80	500	2.8	3.150	.009
20	**.787**	590	2900	47.2	3.937	.059	80	400	2.8	3.937	.012
Depth of Cut											

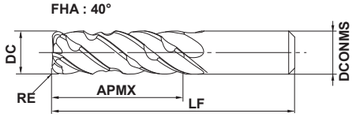
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with at smaller depths of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQJCSRB NEW

Corner radius, Semi long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

UWC VQ γ 40° RE<0.5 RE≥0.5

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



Type1

RE≤0.3	RE≥0.5			
±0.015	±0.020			
DC≤12	DC>12			
0 - 0.030	0 - 0.040			
DCONMS=6	DCONMS=8, 10	DCONMS=12	DCONMS=16	DCONMS=20
0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type radius end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping radius end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	*1 No.F	Stock	Type
VQJCSRBD0600R010	6	0.1	18	70	6	5	●	1
VQJCSRBD0600R020	6	0.2	18	70	6	5	●	1
VQJCSRBD0600R030	6	0.3	18	70	6	5	●	1
VQJCSRBD0600R050	6	0.5	18	70	6	5	●	1
VQJCSRBD0600R100	6	1.0	18	70	6	5	●	1
VQJCSRBD0800R020	8	0.2	24	80	8	5	●	1
VQJCSRBD0800R030	8	0.3	24	80	8	5	●	1
VQJCSRBD0800R050	8	0.5	24	80	8	5	●	1
VQJCSRBD0800R100	8	1.0	24	80	8	5	●	1
VQJCSRBD0800R150	8	1.5	24	80	8	5	●	1
VQJCSRBD0800R200	8	2.0	24	80	8	5	●	1
VQJCSRBD1000R020	10	0.2	30	90	10	5	●	1
VQJCSRBD1000R030	10	0.3	30	90	10	5	●	1
VQJCSRBD1000R050	10	0.5	30	90	10	5	●	1
VQJCSRBD1000R100	10	1.0	30	90	10	5	●	1
VQJCSRBD1000R150	10	1.5	30	90	10	5	●	1
VQJCSRBD1000R200	10	2.0	30	90	10	5	●	1
VQJCSRBD1000R250	10	2.5	30	90	10	5	●	1
VQJCSRBD1200R050	12	0.5	36	100	12	5	●	1
VQJCSRBD1200R100	12	1.0	36	100	12	5	●	1
VQJCSRBD1200R150	12	1.5	36	100	12	5	●	1
VQJCSRBD1200R200	12	2.0	36	100	12	5	●	1

*1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

DC = Cutting dia. **LF** = Functional length
RE = Corner radius **DCONMS** = Connection dia.
APMX = Depth of cut max.

● :USA Stock

VQJCSRB NEW

Corner radius, Semi long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	*1 No.F	Stock	Type
VQJCSRBD1200R250	12	2.5	36	100	12	5	●	1
VQJCSRBD1200R300	12	3.0	36	100	12	5	●	1
VQJCSRBD1600R050	16	0.5	48	110	16	5	●	1
VQJCSRBD1600R100	16	1.0	48	110	16	5	●	1
VQJCSRBD1600R200	16	2.0	48	110	16	5	●	1
VQJCSRBD1600R250	16	2.5	48	110	16	5	●	1
VQJCSRBD1600R300	16	3.0	48	110	16	5	●	1
VQJCSRBD1600R400	16	4.0	48	110	16	5	●	1
VQJCSRBD1600R500	16	5.0	48	110	16	5	●	1
VQJCSRBD1600R600	16	6.0	48	110	16	5	●	1
VQJCSRBD2000R050	20	0.5	60	125	20	5	●	1
VQJCSRBD2000R100	20	1.0	60	125	20	5	●	1
VQJCSRBD2000R200	20	2.0	60	125	20	5	●	1
VQJCSRBD2000R250	20	2.5	60	125	20	5	●	1
VQJCSRBD2000R300	20	3.0	60	125	20	5	●	1
VQJCSRBD2000R400	20	4.0	60	125	20	5	●	1
VQJCSRBD2000R500	20	5.0	60	125	20	5	●	1
VQJCSRBD2000R600	20	6.0	60	125	20	5	●	1

*1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

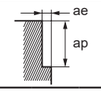
DC = Cutting dia.
RE = Corner radius
APMX = Depth of cut max.
LF = Functional length
DCONMS = Connection dia.

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

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					Precipitation Hardening Stainless Steel Cobalt Chromium Alloys				
Dia. DC		Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)																				
6	**.236**	655	10600	70.9	.709	.035	590	9500	59.1	.709	.035	395	6400	39.4	.709	.020	330	5300	31.5	.709	.020
8	**.315**	655	8000	70.9	.945	.047	590	7200	59.1	.945	.047	395	4800	39.4	.945	.024	330	4000	31.5	.945	.024
10	**.394**	655	6400	66.9	1.181	.059	590	5700	55.1	1.181	.059	395	3800	35.4	1.181	.031	330	3200	31.5	1.181	.031
12	**.472**	655	5300	66.9	1.417	.071	590	4800	55.1	1.417	.071	395	3200	31.5	1.417	.035	330	2700	27.6	1.417	.035
16	**.630**	655	4000	55.1	1.890	.094	590	3600	47.2	1.890	.094	395	2400	27.6	1.890	.047	330	2000	23.6	1.890	.047
20	**.787**	655	3200	47.2	2.362	.118	590	2900	39.4	2.362	.118	395	1900	23.6	2.362	.059	330	1600	19.7	2.362	.059
Depth of Cut																					

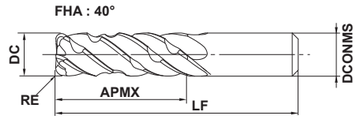
Material		Copper, Copper Alloys					Heat Resistant Alloys				
Dia. DC		Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)										
6	**.236**	720	11700	82.7	.709	.035	130	2100	7.9	.709	.007
8	**.315**	720	8800	82.7	.945	.047	130	1600	7.9	.945	.009
10	**.394**	720	7000	70.9	1.181	.059	130	1300	7.9	1.181	.012
12	**.472**	720	5800	70.9	1.417	.071	130	1100	3.9	1.417	.014
16	**.630**	720	4400	59.1	1.890	.094	130	800	3.9	1.890	.019
20	**.787**	720	3500	55.1	2.362	.118	130	600	3.9	2.362	.024
Depth of Cut											

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with at smaller depths of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQLCSRB NEW

Corner radius, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

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



Type1

RE≤0.3	RE≥0.5			
±0.015	±0.020			

DC≤12	DC>12			
0 - 0.030	0 - 0.040			

DCONMS=6	DCONMS=8, 10	DCONMS=12	DCONMS=16	DCONMS=20
0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type radius end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping radius end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	∗1 No.F	Stock	Type
VQLCSRBD0600R010	6	0.1	24	70	6	5	●	1
VQLCSRBD0600R020	6	0.2	24	70	6	5	●	1
VQLCSRBD0600R030	6	0.3	24	70	6	5	●	1
VQLCSRBD0600R050	6	0.5	24	70	6	5	●	1
VQLCSRBD0600R100	6	1.0	24	70	6	5	●	1
VQLCSRBD0800R020	8	0.2	32	90	8	5	●	1
VQLCSRBD0800R030	8	0.3	32	90	8	5	●	1
VQLCSRBD0800R050	8	0.5	32	90	8	5	●	1
VQLCSRBD0800R100	8	1.0	32	90	8	5	●	1
VQLCSRBD0800R150	8	1.5	32	90	8	5	●	1
VQLCSRBD0800R200	8	2.0	32	90	8	5	●	1
VQLCSRBD1000R020	10	0.2	40	100	10	5	●	1
VQLCSRBD1000R030	10	0.3	40	100	10	5	●	1
VQLCSRBD1000R050	10	0.5	40	100	10	5	●	1
VQLCSRBD1000R100	10	1.0	40	100	10	5	●	1
VQLCSRBD1000R150	10	1.5	40	100	10	5	●	1
VQLCSRBD1000R200	10	2.0	40	100	10	5	●	1
VQLCSRBD1000R250	10	2.5	40	100	10	5	●	1
VQLCSRBD1200R050	12	0.5	48	110	12	5	●	1
VQLCSRBD1200R100	12	1.0	48	110	12	5	●	1
VQLCSRBD1200R150	12	1.5	48	110	12	5	●	1
VQLCSRBD1200R200	12	2.0	48	110	12	5	●	1
VQLCSRBD1200R250	12	2.5	48	110	12	5	●	1
VQLCSRBD1200R300	12	3.0	48	110	12	5	●	1

∗1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

● :USA Stock

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	∗1 No.F	Stock	Type
VQLCSRBD1600R050	16	0.5	64	130	16	5	●	1
VQLCSRBD1600R100	16	1.0	64	130	16	5	●	1
VQLCSRBD1600R200	16	2.0	64	130	16	5	●	1
VQLCSRBD1600R250	16	2.5	64	130	16	5	●	1
VQLCSRBD1600R300	16	3.0	64	130	16	5	●	1
VQLCSRBD1600R400	16	4.0	64	130	16	5	●	1
VQLCSRBD1600R500	16	5.0	64	130	16	5	●	1
VQLCSRBD1600R600	16	6.0	64	130	16	5	●	1
VQLCSRBD2000R050	20	0.5	80	150	20	5	●	1
VQLCSRBD2000R100	20	1.0	80	150	20	5	●	1
VQLCSRBD2000R200	20	2.0	80	150	20	5	●	1
VQLCSRBD2000R250	20	2.5	80	150	20	5	●	1
VQLCSRBD2000R300	20	3.0	80	150	20	5	●	1
VQLCSRBD2000R400	20	4.0	80	150	20	5	●	1
VQLCSRBD2000R500	20	5.0	80	150	20	5	●	1
VQLCSRBD2000R600	20	6.0	80	150	20	5	●	1

∗1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

DC = Cutting dia.
RE = Corner radius
APMX = Depth of cut max.
LF = Functional length
DCONMS = Connection dia.

VQLCSRB

Corner radius, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

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					Precipitation Hardening Stainless Steel Cobalt Chromium Alloys				
Dia. DC		Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)		
6	**.236**	590	9500	63.0	.945	.024	525	8500	47.2	.945	.024	330	5300	31.5	.945	.012	295	4800	27.6	.945	.012
8	**.315**	590	7200	63.0	1.260	.031	525	6400	51.2	1.260	.031	330	4000	31.5	1.260	.016	295	3600	27.6	1.260	.016
10	**.394**	590	5700	59.1	1.575	.039	525	5100	47.2	1.575	.039	330	3200	27.6	1.575	.020	295	2900	27.6	1.575	.020
12	**.472**	590	4800	59.1	1.890	.047	525	4200	47.2	1.890	.047	330	2700	27.6	1.890	.024	295	2400	23.6	1.890	.024
16	**.630**	590	3600	51.2	2.520	.063	525	3200	39.4	2.520	.063	330	2100	23.6	2.520	.031	295	1800	19.7	2.520	.031
20	**.787**	590	2900	43.3	3.150	.079	525	2500	31.5	3.150	.079	330	1600	19.7	3.150	.039	295	1400	15.7	3.150	.039
Depth of Cut																					

Material		Copper, Copper Alloys					Heat Resistant Alloys				
Dia. DC		Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae	Cutting Speed	Revolution	Feed rate	Depth of cut ap	Depth of cut ae
(mm)	(inch)	(SFM)	(min^{-1})	(IPM)			(SFM)	(min^{-1})	(IPM)		
6	**.236**	655	10600	70.9	.945	.024	100	1600	3.9	.945	.005
8	**.315**	655	8000	70.9	1.260	.031	100	1200	3.9	1.260	.006
10	**.394**	655	6400	63.0	1.575	.039	100	1000	3.9	1.575	.008
12	**.472**	655	5300	63.0	1.890	.047	100	800	3.9	1.890	.009
16	**.630**	655	4000	55.1	2.520	.063	100	600	3.1	2.520	.013
20	**.787**	655	3200	51.2	3.150	.079	100	500	3.1	3.150	.016
Depth of Cut											

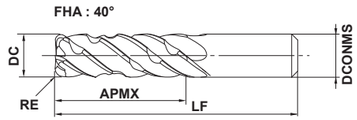
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with at smaller depths of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQELCSRB NEW

Corner radius, Extra Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

UWC VQ γ 40° RE<0.5 RE≥0.5

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



Type1

RE≤0.3	RE≥0.5			
±0.015	±0.020			
DC≤12	DC>12			
0 - 0.030	0 - 0.040			
DCONMS=6	DCONMS=8, 10	DCONMS=12	DCONMS=16	DCONMS=20
0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.011	0 - 0.013

- Chipbreaker type radius end mill for efficient chip breaking capabilities that also provides good surface finishes.
- A high rigidity Smart Miracle vibration damping radius end mill for high efficiency trochoidal milling.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	*1 No.F	Stock	Type
VQELCSRBD0600R010	6	0.1	30	80	6	5	●	1
VQELCSRBD0600R020	6	0.2	30	80	6	5	●	1
VQELCSRBD0600R030	6	0.3	30	80	6	5	●	1
VQELCSRBD0600R050	6	0.5	30	80	6	5	●	1
VQELCSRBD0600R100	6	1.0	30	80	6	5	●	1
VQELCSRBD0800R020	8	0.2	40	100	8	5	●	1
VQELCSRBD0800R030	8	0.3	40	100	8	5	●	1
VQELCSRBD0800R050	8	0.5	40	100	8	5	●	1
VQELCSRBD0800R100	8	1.0	40	100	8	5	●	1
VQELCSRBD0800R150	8	1.5	40	100	8	5	●	1
VQELCSRBD0800R200	8	2.0	40	100	8	5	●	1
VQELCSRBD1000R020	10	0.2	50	110	10	5	●	1
VQELCSRBD1000R030	10	0.3	50	110	10	5	●	1
VQELCSRBD1000R050	10	0.5	50	110	10	5	●	1
VQELCSRBD1000R100	10	1.0	50	110	10	5	●	1
VQELCSRBD1000R150	10	1.5	50	110	10	5	●	1
VQELCSRBD1000R200	10	2.0	50	110	10	5	●	1
VQELCSRBD1000R250	10	2.5	50	110	10	5	●	1
VQELCSRBD1200R050	12	0.5	60	125	12	5	●	1
VQELCSRBD1200R100	12	1.0	60	125	12	5	●	1
VQELCSRBD1200R150	12	1.5	60	125	12	5	●	1
VQELCSRBD1200R200	12	2.0	60	125	12	5	●	1
VQELCSRBD1200R250	12	2.5	60	125	12	5	●	1
VQELCSRBD1200R300	12	3.0	60	125	12	5	●	1

*1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

DC = Cutting dia. **LF** = Functional length
RE = Corner radius **DCONMS** = Connection dia.
APMX = Depth of cut max.

● :USA Stock

VQELCSRB NEW

Corner radius, Extra Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	*1 No.F	Stock	Type
VQELCSRBD1600R050	16	0.5	80	150	16	5	●	1
VQELCSRBD1600R100	16	1.0	80	150	16	5	●	1
VQELCSRBD1600R200	16	2.0	80	150	16	5	●	1
VQELCSRBD1600R250	16	2.5	80	150	16	5	●	1
VQELCSRBD1600R300	16	3.0	80	150	16	5	●	1
VQELCSRBD1600R400	16	4.0	80	150	16	5	●	1
VQELCSRBD1600R500	16	5.0	80	150	16	5	●	1
VQELCSRBD1600R600	16	6.0	80	150	16	5	●	1
VQELCSRBD2000R050	20	0.5	100	170	20	5	●	1
VQELCSRBD2000R100	20	1.0	100	170	20	5	●	1
VQELCSRBD2000R200	20	2.0	100	170	20	5	●	1
VQELCSRBD2000R250	20	2.5	100	170	20	5	●	1
VQELCSRBD2000R300	20	3.0	100	170	20	5	●	1
VQELCSRBD2000R400	20	4.0	100	170	20	5	●	1
VQELCSRBD2000R500	20	5.0	100	170	20	5	●	1
VQELCSRBD2000R600	20	6.0	100	170	20	5	●	1

*1 Number of Flutes

● = NEW

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.

DC = Cutting dia.
RE = Corner radius
APMX = Depth of cut max.
LF = Functional length
DCONMS = Connection dia.

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

■Side milling

(inch)

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					Precipitation Hardening Stainless Steel Cobalt Chromium Alloys				
Dia. DC		Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)																				
6	**.236**	525	8500	55.1	1.181	.020	490	8000	43.3	1.181	.020	295	4800	27.6	1.181	.008	260	4200	23.6	1.181	.008
8	**.315**	525	6400	55.1	1.575	.024	490	6000	47.2	1.575	.024	295	3600	27.6	1.575	.012	260	3200	23.6	1.575	.012
10	**.394**	525	5100	51.2	1.969	.031	490	4800	43.3	1.969	.031	295	2900	23.6	1.969	.016	260	2500	23.6	1.969	.016
12	**.472**	525	4200	51.2	2.362	.035	490	4000	43.3	2.362	.035	295	2400	23.6	2.362	.020	260	2100	19.7	2.362	.020
16	**.630**	525	3200	43.3	3.150	.047	490	3000	37.4	3.150	.047	295	1800	19.7	3.150	.024	260	1600	15.7	3.150	.024
20	**.787**	525	2500	37.4	3.937	.059	490	2400	27.6	3.937	.059	295	1400	15.7	3.937	.031	260	1300	13.8	3.937	.031
Depth of Cut																					

Material		Copper, Copper Alloys					Heat Resistant Alloys				
Dia. DC		Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae	Cutting Speed (SFM)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap	Depth of cut ae
(mm)	(inch)										
6	**.236**	590	9500	63.0	1.181	.020	80	1300	3.5	1.181	.004
8	**.315**	590	7200	63.0	1.575	.024	80	1000	3.5	1.575	.005
10	**.394**	590	5700	59.1	1.969	.031	80	800	3.5	1.969	.006
12	**.472**	590	4800	59.1	2.362	.035	80	700	3.1	2.362	.007
16	**.630**	590	3600	51.2	3.150	.047	80	500	2.8	3.150	.009
20	**.787**	590	2900	47.2	3.937	.059	80	400	2.8	3.937	.012
Depth of Cut											

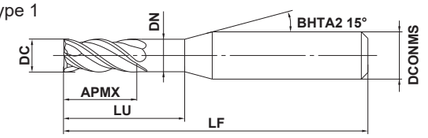
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sounds can occur. In that case, please adjust the revolution, feed rate and depth of cut.
Note 3) The revolution and feed rate can be increased with at smaller depths of cut.
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

VQ4MVM

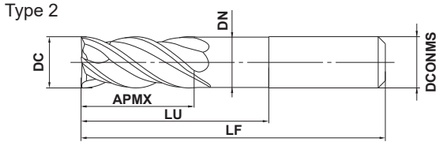
End mill, Medium cut length, 4 flute, For multi-functional machining

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

Type 1



Type 2



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

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

(mm)

Order Number	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
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.

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side Milling

Material		Mild Steel, Carbon Steel Alloy Steel (180–280HB) AISI 1045, AISI 4140				Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT				Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys AISI 304, AISI 316, AISI 410, AISI 430, Ti-5Al-5V-Mo-3Cr			
Dia. DC		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)												
4	**.157**	9500	55.1	.236	.047	5600	19.3	.157	.016	6400	18.5	.157	.024
5	**.197**	7600	55.1	.295	.059	4500	19.7	.197	.020	5100	18.5	.197	.035
6	**.236**	6400	55.1	.354	.071	3700	19.7	.236	.024	4200	22.8	.236	.047
8	**.315**	4800	51.2	.472	.094	2800	20.5	.315	.031	3200	24.8	.315	.059
10	**.394**	3800	47.2	.591	.118	2200	18.1	.394	.039	2500	26.0	.394	.071
12	**.472**	3200	39.4	.709	.142	1900	17.7	.472	.039	2100	24.0	.472	.094
Depth of Cut													

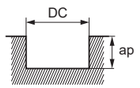
Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys AISI 630, AISI 631				Heat Resistant Alloys Inconel718			
Dia. DC		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)								
4	**.157**	5600	19.3	.157	.031	2400	4.7	.157	.016
5	**.197**	4500	19.7	.197	.039	1900	4.7	.197	.020
6	**.236**	3700	19.7	.236	.047	1600	5.1	.236	.024
8	**.315**	2800	20.5	.315	.063	1200	5.1	.315	.031
10	**.394**	2200	18.1	.394	.079	950	5.5	.394	.039
12	**.472**	1900	17.7	.472	.094	800	5.5	.472	.047
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

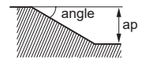
Slot Milling and Ramping

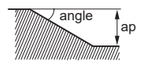
Material		Mild Steel, Carbon Steel Alloy Steel (180–280HB) AISI 1045, AISI 4140				Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT				Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys AISI 304, AISI 316, AISI 410, AISI 430, Ti-5Al-5V-Mo-3Cr			
Dia. DC		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)												
4	**.157**	8000	33.1	.157	.157	4800	8.3	.079	.157	4800	11.0	.157	.157
5	**.197**	6400	33.1	.197	.197	3800	8.3	.098	.197	3800	11.0	.197	.197
6	**.236**	5300	33.1	.236	.236	3200	9.1	.118	.236	3200	11.8	.236	.236
8	**.315**	4000	29.1	.315	.315	2400	9.4	.157	.315	2400	12.6	.315	.315
10	**.394**	3200	26.8	.394	.394	1900	10.6	.197	.394	1900	13.8	.394	.394
12	**.472**	2700	22.4	.472	.472	1600	10.2	.236	.472	1600	13.4	.472	.472
Depth of Cut													

Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys AISI 630, AISI 631				Heat Resistant Alloys Inconel718			
Dia. DC		Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)								
4	**.157**	4000	9.8	.079	.157	2000	3.7	.047	.157
5	**.197**	3200	9.8	.098	.197	1600	3.7	.059	.197
6	**.236**	2700	11.4	.118	.236	1300	3.8	.071	.236
8	**.315**	2000	10.2	.157	.315	990	3.9	.094	.315
10	**.394**	1600	9.1	.197	.394	800	4.7	.118	.394
12	**.472**	1300	8.3	.236	.472	660	4.3	.142	.472
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

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		Slot Milling Feed %							Slot Milling Feed %			Slot Milling Feed %			
(mm)	(inch)	1°	5°	10°	15°	20°	25°	30°	1°	5°	10°	1°	5°	10°	15°
4	**.157**	100	90	80	80	60	60	60	80	70	60	90	80	70	50
5	**.197**	100	90	80	80	60	60	60	80	70	60	90	80	70	50
6	**.236**	100	90	80	80	60	60	60	80	70	60	90	80	70	60
8	**.315**	100	95	90	90	90	75	75	70	60	50	90	80	70	60
10	**.394**	100	95	95	95	90	80	80	70	60	50	80	70	60	50
12	**.472**	100	95	95	95	90	80	80	70	60	50	80	70	60	50
Depth of Cut															

Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys					Heat Resistant Alloys	
Dia. DC		Slot Milling Feed %					Slot Milling Feed %	
(mm)	(inch)	1°	5°	10°	15°	20°	1°	5°
4	**.157**	90	80	70	60	60	90	80
5	**.197**	90	80	70	60	60	90	80
6	**.236**	90	80	70	60	60	90	80
8	**.315**	90	80	70	60	60	90	80
10	**.394**	80	80	70	60	60	80	70
12	**.472**	80	80	70	60	60	80	70
Depth of Cut								

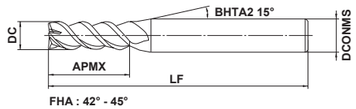
Note 1) SMART MIRACLE coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.
Note 2) When performing ramping, 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.

VQMHZV

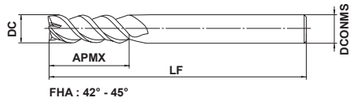
End mill, Medium cut length, 3 flute for drilling and slotting

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

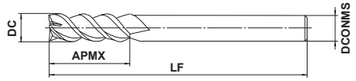
FHA : 42° - 45°



Type1



Type2



Type3

DC<12	DC>12			
0 - 0.02	0 - 0.03			

DCONMS=4, 6	DCONMS=8, 10	DCONMS=12, 16	DCONMS=20	
0 - 0.008	0 - 0.009	0 - 0.011	0 - 0.013	

- A single end mill for both plunging and slotting.
- Irregular helical geometry controls the vibration.

(mm)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHZVD0100	1	2	45	4	3	●	1
VQMHZVD0110	1.1	2.2	45	4	3	●	1
VQMHZVD0120	1.2	2.4	45	4	3	●	1
VQMHZVD0130	1.3	2.6	45	4	3	●	1
VQMHZVD0140	1.4	2.8	45	4	3	●	1
VQMHZVD0150	1.5	3	45	4	3	●	1
VQMHZVD0160	1.6	3.2	45	4	3	●	1
VQMHZVD0170	1.7	3.4	45	4	3	●	1
VQMHZVD0180	1.8	3.6	45	4	3	●	1
VQMHZVD0190	1.9	3.8	45	4	3	●	1
VQMHZVD0200	2	4	50	6	3	●	1
VQMHZVD0210	2.1	4.2	50	6	3	●	1
VQMHZVD0220	2.2	4.4	50	6	3	●	1
VQMHZVD0230	2.3	4.6	50	6	3	●	1
VQMHZVD0240	2.4	4.8	50	6	3	●	1
VQMHZVD0250	2.5	5	50	6	3	●	1
VQMHZVD0260	2.6	5.2	50	6	3	●	1
VQMHZVD0270	2.7	5.4	50	6	3	●	1
VQMHZVD0280	2.8	5.6	50	6	3	●	1
VQMHZVD0290	2.9	5.8	50	6	3	●	1
VQMHZVD0300	3	6	50	6	3	●	1
VQMHZVD0310	3.1	7	50	6	3	●	1
VQMHZVD0320	3.2	7	50	6	3	●	1
VQMHZVD0330	3.3	7	50	6	3	●	1
VQMHZVD0340	3.4	7	50	6	3	●	1
VQMHZVD0350	3.5	8	50	6	3	●	1
VQMHZVD0360	3.6	8	50	6	3	●	1
VQMHZVD0370	3.7	8	50	6	3	●	1
VQMHZVD0380	3.8	8	50	6	3	●	1
VQMHZVD0390	3.9	8	50	6	3	●	1

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

● : USA Stock ★ : Stocked in Japan

(mm)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHZVD0400	4	8	50	6	3	●	1
VQMHZVD0450	4.5	10	50	6	3	●	1
VQMHZVD0500	5	10	50	6	3	●	1
VQMHZVD0550	5.5	13	50	6	3	●	1
VQMHZVD0600	6	13	60	6	3	●	2
VQMHZVD0650	6.5	16	60	8	3	●	1
VQMHZVD0700	7	16	60	8	3	●	1
VQMHZVD0750	7.5	16	60	8	3	●	1
VQMHZVD0800	8	19	70	8	3	●	2
VQMHZVD0850	8.5	19	70	10	3	●	1
VQMHZVD0900	9	19	70	10	3	●	1
VQMHZVD0950	9.5	19	70	10	3	●	1
VQMHZVD1000	10	22	80	10	3	●	2
VQMHZVD1100	11	22	80	12	3	●	1
VQMHZVD1200	12	26	90	12	3	●	2
VQMHZVD1300	13	26	90	12	3	★	3
VQMHZVD1400	14	26	90	12	3	★	3
VQMHZVD1500	15	26	110	16	3	★	1
VQMHZVD1600	16	30	110	16	3	★	2
VQMHZVD2000	20	32	140	20	3	★	2

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

VQMHZV

End mill, Medium cut length, 3 flute for drilling and slotting

RECOMMENDED CUTTING CONDITIONS

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	100	32000	720	1.5	0.2	80	25000	530	1.5	0.2	60	19000	430	1.5	0.2	50	16000	340	1.5	0.1
1.5	130	28000	1300	2.25	0.3	100	21000	630	2.25	0.3	85	18000	540	2.25	0.3	65	14000	420	2.25	0.15
2	150	24000	1800	3	0.6	120	19000	860	3	0.6	100	16000	620	3	0.6	75	12000	540	3	0.4
3	150	16000	1900	4.5	0.9	120	13000	940	4.5	0.9	100	11000	660	4.5	0.9	75	8000	580	4.5	0.6
4	150	12000	2000	6	1.2	120	9500	940	6	1.2	100	8000	670	6	1.2	75	6000	590	6	0.8
5	150	9500	1900	7.5	1.5	120	7600	960	7.5	1.5	100	6400	670	7.5	1.5	75	4800	600	7.5	1
6	150	8000	1900	9	1.8	120	6400	960	9	1.8	100	5300	830	9	1.8	75	4000	600	9	1.2
8	150	6000	1900	12	2.4	120	4800	1000	12	2.4	100	4000	900	12	2.4	75	3000	630	12	1.6
10	150	4800	1700	15	3	120	3800	910	15	3	100	3200	960	15	3	75	2400	580	15	2
12	150	4000	1400	18	3.6	120	3200	860	18	3.6	100	2700	890	18	3.6	75	2000	540	18	2.4
16	150	3000	1200	24	4.8	120	2400	720	24	4.8	100	2000	720	24	4.8	75	1500	450	24	3.2
20	150	2400	970	30	6	120	1900	570	30	6	100	1600	580	30	6	75	1200	360	30	4
Depth of cut																				

General purpose cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	100	32000	480	1.5	0.2	80	25000	350	1.5	0.2	60	19000	280	1.5	0.2	50	16000	220	1.5	0.1
1.5	120	25000	740	2.25	0.3	100	21000	420	2.25	0.3	80	17000	340	2.25	0.3	65	14000	280	2.25	0.15
2	120	19000	940	3	0.6	100	16000	480	3	0.6	80	13000	340	3	0.6	70	11000	330	3	0.4
3	120	13000	1000	4.5	0.9	100	11000	520	4.5	0.9	80	8500	340	4.5	0.9	70	7400	350	4.5	0.6
4	120	9500	1000	6	1.2	100	8000	520	6	1.2	80	6400	350	6	1.2	70	5600	370	6	0.8
5	120	7600	980	7.5	1.5	100	6400	530	7.5	1.5	80	5100	350	7.5	1.5	70	4500	370	7.5	1
6	120	6400	1000	9	1.8	100	5300	540	9	1.8	80	4200	400	9	1.8	70	3700	370	9	1.2
8	120	4800	1000	12	2.4	100	4000	550	12	2.4	80	3200	430	12	2.4	70	2800	390	12	1.6
10	120	3800	900	15	3	100	3200	510	15	3	80	2500	450	15	3	70	2200	350	15	2
12	120	3200	760	18	3.6	100	2700	480	18	3.6	80	2100	420	18	3.6	70	1900	340	18	2.4
16	120	2400	640	24	4.8	100	2000	400	24	4.8	80	1600	340	24	4.8	70	1400	280	24	3.2
20	120	1900	510	30	6	100	1600	320	30	6	80	1300	270	30	6	70	1100	220	30	4
Depth of cut																				

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency cutting conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	120	38000	860	1.5	0.2	40	13000	160	1.5	0.05
1.5	150	32000	1400	2.25	0.3	40	8500	170	2.25	0.08
2	180	29000	2200	3	0.6	40	6400	170	3	0.2
3	180	19000	2300	4.5	0.9	40	4200	180	4.5	0.3
4	180	14000	2300	6	1.2	40	3200	180	6	0.4
5	180	11000	2300	7.5	1.5	40	2500	180	7.5	0.5
6	180	9500	2300	9	1.8	40	2100	190	9	0.6
8	180	7200	2300	12	2.4	40	1600	190	12	0.8
10	180	5700	2100	15	3	40	1300	220	15	1
12	180	4800	1700	18	3.6	40	1100	210	18	1.2
16	180	3600	1500	24	4.8	40	800	150	24	1.6
20	180	2900	1200	30	6	40	640	120	30	2
Depth of cut										

General purpose cutting conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	120	38000	560	1.5	0.2	30	9500	75	1.5	0.05
1.5	140	30000	890	2.25	0.3	30	6400	82	2.25	0.07
2	140	22000	1100	3	0.6	30	4800	86	3	0.2
3	140	15000	1200	4.5	0.9	30	3200	89	4.5	0.3
4	140	11000	1200	6	1.2	30	2400	90	6	0.4
5	140	8900	1200	7.5	1.5	30	1900	90	7.5	0.5
6	140	7400	1200	9	1.8	30	1600	95	9	0.6
8	140	5600	1200	12	2.4	30	1200	95	12	0.8
10	140	4500	1100	15	3	30	950	110	15	1
12	140	3700	880	18	3.6	30	800	100	18	1.2
16	140	2800	750	24	4.8	30	600	76	24	1.6
20	140	2200	590	30	6	30	480	61	30	2
Depth of cut										

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQMHZV

End mill, Medium cut length, 3 flute for drilling and slotting

RECOMMENDED CUTTING CONDITIONS

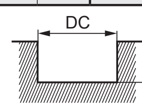
Slotting

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
1	100	32000	380	0.5	80	25000	150	0.5	60	19000	100	0.5	45	14000	80	0.3	120	38000	460	0.5	30	9500	60	0.2
1.5	130	28000	590	0.75	100	21000	250	0.75	85	18000	220	0.75	60	12000	140	0.4	150	32000	670	0.75	30	6400	80	0.3
2	150	24000	940	2	120	19000	460	2	100	16000	480	2	60	9500	230	1	180	29000	1100	2	30	4800	100	0.6
3	150	16000	1100	3	120	13000	550	3	100	11000	500	3	60	6400	270	1.5	180	19000	1300	3	30	3200	120	0.9
4	150	12000	1400	4	120	9500	680	4	100	8000	530	4	60	4800	350	2	180	14000	1700	4	30	2400	130	1.2
5	150	9500	1400	5	120	7600	680	5	100	6400	540	5	60	3800	350	2.5	180	11000	1700	5	30	1900	130	1.5
6	150	8000	1400	6	120	6400	770	6	100	5300	560	6	60	3200	380	3	180	9500	1700	6	30	1600	130	1.8
8	150	6000	1300	8	120	4800	720	8	100	4000	600	8	60	2400	360	4	180	7200	1500	8	30	1200	140	2.4
10	150	4800	1200	10	120	3800	630	10	100	3200	670	10	60	1900	310	5	180	5700	1400	10	30	950	160	3
12	150	4000	960	12	120	3200	580	12	100	2700	650	12	60	1600	290	6	180	4800	1200	12	30	800	150	3.6
16	150	3000	810	12	120	2400	500	12	100	2000	480	12	60	1200	250	8	180	3600	970	12	30	600	120	4.8
20	150	2400	650	12	120	1900	400	12	100	1600	380	12	60	950	200	10	180	2900	780	12	30	480	90	6

Depth of cut

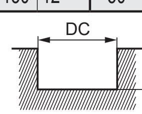


DC:Dia.

General purpose cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
1	100	32000	250	0.5	80	25000	99	0.5	60	19000	80	0.5	45	14000	60	0.3	120	38000	300	0.5	25	8000	30	0.2
1.5	100	21000	290	0.75	80	17000	130	0.75	60	13000	100	0.75	50	11000	87	0.4	120	25000	350	0.75	25	5300	40	0.3
2	100	16000	410	2	80	13000	210	2	60	9500	190	2	50	8000	130	1	120	19000	490	2	25	4000	55	0.6
3	100	11000	500	3	80	8500	240	3	60	6400	190	3	50	5300	150	1.5	120	13000	590	3	25	2700	64	0.9
4	100	8000	630	4	80	6400	300	4	60	4800	210	4	50	4000	190	2	120	9500	750	4	25	2000	70	1.2
5	100	6400	630	5	80	5100	300	5	60	3800	210	5	50	3200	190	2.5	120	7600	750	5	25	1600	71	1.5
6	100	5300	630	6	80	4200	330	6	60	3200	220	6	50	2700	210	3	120	6400	760	6	25	1300	72	1.8
8	100	4000	550	8	80	3200	320	8	60	2400	240	8	50	2000	200	4	120	4800	670	8	25	990	78	2.4
10	100	3200	510	10	80	2500	270	10	60	1900	260	10	50	1600	170	5	120	3800	600	10	25	800	89	3
12	100	2700	430	12	80	2100	250	12	60	1600	250	12	50	1300	150	6	120	3200	510	12	25	660	84	3.6
16	100	2000	360	12	80	1600	220	12	60	1200	190	12	50	990	140	8	120	2400	430	12	25	500	63	4.8
20	100	1600	290	12	80	1300	180	12	60	950	150	12	50	800	110	10	120	1900	340	12	25	400	50	6

Depth of cut



DC:Dia.

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

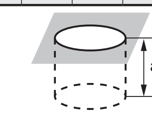
Plunging

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys					Copper, Copper Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)
1	65	20000	160	0.5	0.1	50	16000	100	0.5	0.1	50	16000	50	0.5	0.05	30	9500	30	0.5	0.05	75	24000	190	0.5	0.1
1.5	85	18000	270	0.75	0.3	60	13000	120	0.75	0.3	60	13000	80	0.75	0.1	35	7400	40	0.75	0.1	100	21000	320	0.75	0.3
2	100	16000	480	2	0.5	70	11000	200	2	0.4	60	9500	90	1	0.15	40	6400	60	1	0.1	120	19000	570	2	0.5
3	100	11000	660	3	1	70	7400	270	3	0.6	60	6400	100	1.5	0.2	40	4200	60	1.5	0.2	120	13000	780	3	1.0
4	100	8000	800	4	2	70	5600	340	4	0.8	60	4800	100	2	0.4	40	3200	60	2	0.4	120	9500	950	4	2
5	100	6400	960	5	2.5	70	4500	410	5	1	60	3800	100	2.5	0.5	40	2500	60	2.5	0.5	120	7600	1100	5	2.5
6	100	5300	950	6	3	70	3700	440	6	1.2	60	3200	100	3	0.6	40	2100	60	3	0.6	120	6400	1200	6	3
8	100	4000	720	8	4	70	2800	340	8	1.6	60	2400	70	4	0.6	40	1600	50	4	0.6	120	4800	860	8	4
10	100	3200	580	10	5	70	2200	260	10	2.5	60	1900	60	5	0.6	40	1300	40	5	0.6	120	3800	680	10	5
12	100	2700	490	12	5	70	1900	230	12	3	60	1600	50	6	0.6	40	1100	30	6	0.6	120	3200	580	12	5
16	100	2000	360	16	5	70	1400	170	16	4	60	1200	40	8	0.6	40	800	20	8	0.6	120	2400	430	16	5
20	100	1600	290	20	5	70	1100	130	20	5	60	950	30	10	0.6	40	640	20	10	0.6	120	1900	340	20	5

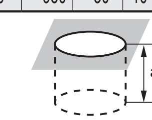
Depth of cut



General purpose cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys					Copper, Copper Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Step (mm)
1	65	20000	160	0.5	0.05	50	16000	100	0.5	0.05	50	16000	50	0.5	0.05	30	9500	30	0.5	0.05	75	24000	190	0.5	0.05
1.5	85	18000	270	0.75	0.15	60	13000	120	0.75	0.1	60	13000	80	0.75	0.05	35	7400	40	0.75	0.05	100	21000	320	0.75	0.15
2	100	16000	480	2	0.25	70	11000	200	2	0.2	60	9500	90	1	0.05	40	6400	60	1	0.05	120	19000	570	2	0.25
3	100	11000	660	3	0.3	70	7400	270	3	0.3	60	6400	100	1.5	0.1	40	4200	60	1.5	0.1	120	13000	780	3	0.3
4	100	8000	800	4	0.4	70	5600	340	4	0.4	60	4800	100	2	0.2	40	3200	60	2	0.2	120	9500	950	4	0.4
5	100	6400	960	5	0.5	70	4500	410	5	0.5	60	3800	100	2.5	0.25	40	2500	60	2.5	0.25	120	7600	1100	5	0.5
6	100	5300	950	6	0.6	70	3700	440	6	0.6	60	3200	100	3	0.3	40	2100	60	3	0.3	120	6400	1200	6	0.6
8	100	4000	720	8	0.7	70	2800	340	8	0.7	60	2400	70	4	0.3	40	1600	50	4	0.3	120	4800	860	8	0.7
10	100	3200	580	10	0.75	70	2200	260	10	0.75	60	1900	60	5	0.3	40	1300	40	5	0.3	120	3800	680	10	0.75
12	100	2700	490	12	0.75	70	1900	230	12	0.75	60	1600	50	6	0.3	40	1100	30	6	0.3	120	3200	580	12	0.75
16	100	2000	360	16	0.75	70	1400	170	16	0.75	60	1200	40	8	0.3	40	800	20	8	0.3	120	2400	430	16	0.75
20	100	1600	290	20	0.75	70	1100	130	20	0.75	60	950	30	10	0.3	40	640	20	10	0.3	120	1900	340	20	0.75

Depth of cut

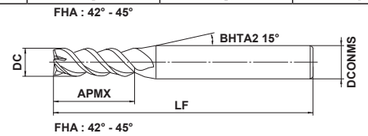


Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

VQMHZV – Inch sizes

End mill, Medium cut length, 3 flute for drilling and slotting

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



DC<.5000"	DC=.5000"			
0 - .0008"	0 - .0012"			
DCONMS≤.3750"	DCONMS=.5000"			
0 - .00035"	0 - .00043"			

- A single end mill for both plunging and slotting.
- Irregular helical geometry controls the vibration.

(inch)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHZVD1/16	.0625	.1250	2.0	.2500	3	●	1
VQMHZVD5/64	.0781	.1560	2.0	.2500	3	●	1
VQMHZVD3/32	.0938	.1880	2.0	.2500	3	●	1
VQMHZVD7/64	.1094	.2500	2.0	.2500	3	●	1
VQMHZVD1/8	.1250	.3130	2.0	.2500	3	●	1
VQMHZVD5/32	.1563	.3750	2.0	.2500	3	●	1
VQMHZVD3/16	.1875	.4375	2.0	.2500	3	●	1
VQMHZVD1/4	.2500	.6250	2.5	.2500	3	●	2
VQMHZVD5/16	.3125	.7500	2.75	.3125	3	●	2
VQMHZVD11/32	.3438	.7500	3.0	.3750	3	●	1
VQMHZVD3/8	.3750	.8750	3.0	.3750	3	●	2
VQMHZVD1/2	.5000	1.1250	3.5	.5000	3	●	2

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

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side milling

Material	Carbon Steel (<30HRC)						Alloy Steel, Pre-Hardened Steel						Austenitic Stainless Steel, Titanium Alloys					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/16	26000	55.3	24000	33.9	.094	.013	20000	26.0	20000	17.3	.094	.013	18000	23.4	16000	13.8	.094	.013
5/64	24000	70.9	19000	37.0	.12	.023	19000	33.7	16000	18.9	.12	.023	16000	24.6	13000	13.0	.12	.023
3/32	20000	70.9	16000	37.4	.14	.028	16000	34.0	13000	18.1	.14	.028	13000	24.6	11000	13.8	.14	.028
7/64	17000	72.3	14000	39.4	.16	.033	14000	34.7	11000	18.1	.16	.033	11000	24.7	9200	13.8	.16	.033
1/8	15000	76.2	12000	39.4	.19	.038	12000	36.9	10000	20.1	.19	.038	10000	26.0	8000	13.8	.19	.038
5/32	12000	78.0	9600	39.4	.23	.047	9600	37.4	8000	20.5	.23	.047	8000	26.5	6400	13.8	.23	.047
3/16	10000	74.4	8000	39.4	.28	.056	8000	37.8	6700	20.9	.28	.056	6700	26.5	5300	13.8	.28	.056
1/4	7500	74.4	6000	39.4	.38	.075	6000	39.0	5000	21.3	.38	.075	5000	35.4	4000	18.9	.38	.075
5/16	6000	74.4	4800	39.4	.47	.094	4800	39.7	4000	21.7	.47	.094	4000	35.4	3200	18.9	.47	.094
11/32	5500	71.5	4400	37.8	.52	.10	4400	37.9	3600	20.5	.52	.10	3600	36.1	2900	19.3	.52	.10
3/8	5000	67.9	4000	35.8	.56	.11	4000	36.9	3300	20.1	.56	.11	3300	37.0	2700	20.1	.56	.11
1/2	3800	56.1	3000	29.1	.75	.15	3000	32.6	2500	18.1	.75	.15	2500	32.5	2000	17.3	.75	.15
Depth of cut																		

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys						Copper, Copper alloy						Heat Resistant Alloy					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/16	13000	16.9	13000	11.0	.094	.0063	30000	63.8	28000	39.4	.094	.013	8000	3.3	6000	13.8	.094	.0031
5/64	12000	21.3	11000	13.0	.12	.016	29000	85.6	22000	43.3	.12	.023	6400	3.4	4800	13.0	.12	.0078
3/32	10000	21.3	9400	13.4	.14	.019	24000	85.0	19000	43.3	.14	.028	5300	3.4	4000	13.8	.14	.0094
7/64	8600	21.3	8000	13.0	.16	.022	21000	89.3	16000	43.3	.16	.033	4600	3.5	3400	13.8	.16	.011
1/8	7500	23.0	7000	14.2	.19	.025	18000	91.4	14000	47.2	.19	.038	4000	3.5	3000	13.8	.19	.013
5/32	6000	23.4	5600	14.6	.23	.031	14000	90.9	11000	47.2	.23	.047	3200	3.5	2400	13.8	.23	.016
3/16	5000	23.6	4700	14.6	.28	.038	12000	89.3	9400	47.2	.28	.056	2700	3.6	2000	13.8	.28	.019
1/4	3800	24.7	3500	15.0	.38	.050	9000	89.3	7000	47.2	.38	.075	2000	3.7	1500	18.9	.38	.025
5/16	3000	24.8	2800	15.4	.47	.063	7200	89.3	5600	47.2	.47	.094	1600	3.7	1200	18.9	.47	.031
11/32	2700	23.3	2600	15.0	.52	.069	6600	85.7	5100	43.3	.52	.10	1500	3.9	1100	19.3	.52	.034
3/8	2500	23.0	2300	14.2	.56	.075	6000	81.5	4700	43.3	.56	.11	1300	3.9	1000	20.1	.56	.038
1/2	1900	20.6	1800	13.0	.75	.10	4500	66.4	3500	34.3	.75	.15	1000	3.7	750	17.3	.75	.050
Depth of cut																		

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Note 2) Effective cutting of stainless steel, and titanium alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

VQMHZV – Inch sizes

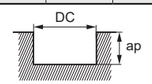
End mill, Medium cut length, 3 flute for drilling and slotting

RECOMMENDED CUTTING CONDITIONS

Slotting

Material	Carbon Steel (<30HRC)					Alloy Steel, Pre-Hardened Steel					Austenitic Stainless Steel, Titanium Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/16	26000	27.6	20000	14.2	.031	20000	11.8	16000	6.3	.031	18000	10.6	12000	4.7	.031
5/64	24000	36.9	16000	16.1	.078	19000	18.0	13000	8.3	.078	16000	18.9	9600	7.5	.078
3/32	20000	37.8	13000	16.1	.094	16000	18.9	11000	8.7	.094	13000	19.2	8000	7.9	.094
7/64	17000	40.2	11000	17.3	.11	14000	19.8	9200	8.7	.11	11000	19.5	6900	7.9	.11
1/8	15000	44.3	10000	19.7	.13	12000	22.7	8000	9.8	.13	10000	20.1	6000	7.9	.13
5/32	12000	56.7	8000	24.8	.16	9600	26.1	6400	11.4	.16	8000	20.8	4800	8.3	.16
3/16	10000	56.7	6700	25.2	.19	8000	26.9	5300	11.8	.19	6700	21.4	4000	8.3	.19
1/4	7500	55.8	5000	24.4	.25	6000	29.8	4000	13.0	.25	5000	21.9	3000	8.7	.25
5/16	6000	49.6	4000	21.7	.31	4800	28.3	3200	12.6	.31	4000	23.6	2400	9.4	.31
11/32	5500	48.7	3600	20.9	.34	4400	27.0	2900	11.8	.34	3600	24.2	2200	9.8	.34
3/8	5000	46.1	3300	20.1	.38	4000	25.5	2700	11.4	.38	3300	25.3	2000	10.2	.38
1/2	3800	35.9	2500	15.7	.50	3000	22.3	2000	9.8	.50	2500	23.6	1500	9.4	.50

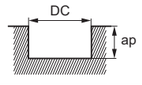
Depth of cut



DC : Dia.

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys					Copper, Copper Alloys					Heat Resistant Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/16	11000	6.5	10000	3.9	.019	30000	31.9	24000	16.9	.031	6000	3.5	5000	2.0	.013
5/64	9600	9.1	8000	5.1	.039	29000	44.5	19000	19.3	.078	4800	4.0	4000	2.2	.023
3/32	8000	9.5	6700	5.1	.047	24000	45.4	16000	20.1	.094	4000	4.3	3300	2.3	.028
7/64	6900	9.8	5700	5.5	.055	21000	49.6	14000	21.7	.11	3400	4.4	2900	2.5	.033
1/8	6000	11.3	5000	6.3	.063	18000	53.1	12000	23.2	.13	3000	4.6	2500	2.5	.038
5/32	4800	13.0	4000	7.1	.078	14000	66.1	9600	29.9	.16	2400	5.0	2000	2.8	.047
3/16	4000	13.7	3300	7.5	.094	12000	68.0	8000	29.9	.19	2000	5.1	1700	2.9	.056
1/4	3000	14.9	2500	8.3	.13	9000	67.0	6000	29.5	.25	1500	5.3	1300	3.0	.075
5/16	2400	14.2	2000	7.9	.16	7200	59.5	4800	26.4	.31	1200	5.7	1000	3.1	.094
11/32	2200	13.5	1800	7.5	.17	6600	58.5	4400	25.6	.34	1100	5.9	910	3.2	.10
3/8	2000	12.8	1700	7.1	.19	6000	55.3	4000	24.4	.38	1000	6.1	840	3.4	.11
1/2	1500	11.2	1300	6.3	.25	4500	42.5	3000	18.9	.50	750	5.7	630	3.1	.15

Depth of cut



DC : Dia.

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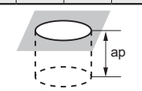
Note 2) Effective cutting of stainless steel, titanium alloy, and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

Drilling

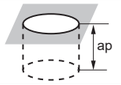
Material	Carbon Steel (<30HRC)							Alloy Steel, Pre-Hardened Steel							Austenitic Stainless Steel, Titanium Alloys						
DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	
1/16	18000	12.8	.013	18000	12.6	.006	.031	12000	5.2	.013	12000	5.2	.006	.031	12000	3.3	.004	12000	3.3	.002	.031
5/64	16000	18.9	.020	16000	18.9	.006	.078	11000	7.8	.016	11000	7.8	.006	.078	9600	3.5	.004	9600	3.5	.002	.039
3/32	13000	20.5	.023	13000	20.5	.010	.094	9400	8.8	.019	9400	8.8	.010	.094	8000	3.5	.006	8000	3.5	.002	.047
7/64	11000	21.7	.033	11000	21.7	.010	.11	8000	9.4	.022	8000	9.4	.010	.11	6900	3.5	.008	6900	3.5	.002	.055
1/8	10000	27.6	.044	10000	27.6	.012	.13	7000	11.0	.025	7000	11.0	.012	.13	6000	4.0	.008	6000	4.0	.004	.063
5/32	8000	31.5	.078	8000	31.5	.012	.16	5600	13.2	.031	5600	13.2	.012	.16	4800	3.8	.016	4800	3.8	.004	.078
3/16	6700	34.3	.094	6700	34.3	.016	.19	4700	15.0	.038	4700	15.0	.016	.19	4000	3.8	.020	4000	3.8	.008	.094
1/4	5000	35.4	.13	5000	35.4	.024	.25	3500	16.5	.050	3500	16.5	.024	.25	3000	3.5	.024	3000	3.5	.012	.13
5/16	4000	28.3	.16	4000	28.3	.028	.31	2800	13.2	.063	2800	13.2	.028	.31	2400	2.8	.024	2400	2.8	.012	.16
11/32	3600	25.5	.17	3600	25.5	.028	.34	2600	12.3	.069	2600	12.3	.028	.34	2200	2.6	.024	2200	2.6	.012	.17
3/8	3300	23.4	.19	3300	23.4	.030	.38	2300	11.0	.094	2300	11.0	.030	.38	2000	2.3	.024	2000	2.3	.012	.19
1/2	2500	17.7	.20	2500	17.7	.030	.50	1800	8.5	.13	1800	8.5	.030	.50	1500	2.0	.024	1500	2.0	.012	.25

Hole depth



Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys							Copper, Copper Alloys						
DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	
1/16	7000	2.0	.004	7000	2.0	.002	.031	22000	15.6	.013	22000	15.6	.006	.031
5/64	6400	2.4	.004	6400	2.4	.002	.039	19000	22.4	.020	19000	22.4	.006	.039
3/32	5300	2.4	.006	5300	2.4	.002	.047	16000	25.2	.023	16000	25.2	.010	.047
7/64	4600	2.4	.008	4600	2.4	.002	.055	14000	27.6	.033	14000	27.6	.010	.055
1/8	4000	2.8	.008	4000	2.8	.004	.063	12000	33.1	.044	12000	33.1	.012	.063
5/32	3200	2.4	.016	3200	2.4	.004	.078	9600	37.8	.078	9600	37.8	.012	.078
3/16	2700	2.4	.020	2700	2.4	.008	.094	8000	39.4	.094	8000	39.4	.016	.094
1/4	2000	2.4	.024	2000	2.4	.012	.13	6000	43.3	.130	6000	43.3	.024	.13
5/16	1600	2.0	.024	1600	2.0	.012	.16	4800	33.9	.160	4800	33.9	.028	.16
11/32	1500	1.8	.024	1500	1.8	.012	.17	4400	31.1	.17	4400	31.1	.028	.17
3/8	1300	1.5	.024	1300	1.5	.012	.19	4000	28.3	.19	4000	28.3	.030	.19
1/2	1000	1.2	.024	1000	1.2	.012	.25	3000	21.3	.20	3000	21.3	.030	.25

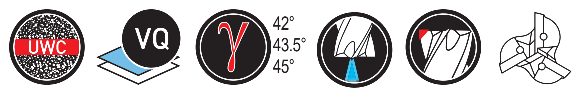
Hole depth



Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, and titanium alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

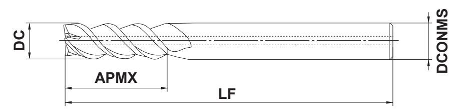
VQMHZVOH

End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant



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

FHA : 42° - 45°



Type1

	DC≤12	DC=16			
	0 / - 0.02	0 / - 0.03			
h6	DCONMS=6	DCONMS=8, 10	DCONMS=12, 16		
	0 / - 0.008	0 / - 0.009	0 / - 0.011		

- A single end mill for both plunging and slotting.
- Excellent peformance in slotting and pocketing with oil supply from the end cutting edge.

(mm)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHZVOHD0600	6	13	60	6	3	●	1
VQMHZVOHD0800	8	19	70	8	3	●	1
VQMHZVOHD1000	10	22	80	10	3	●	1
VQMHZVOHD1200	12	26	90	12	3	●	1
VQMHZVOHD1600	16	30	110	16	3	★	1

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

● : USA Stock ★ : Stocked in Japan

RECOMMENDED CUTTING CONDITIONS

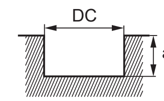
Slotting

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
6	150	8000	1400	6	120	6400	770	6	100	5300	560	6	60	3200	380	3	180	9500	1700	6	30	1600	130	1.8
8	150	6000	1300	8	120	4800	720	8	100	4000	600	8	60	2400	360	4	180	7200	1500	8	30	1200	140	2.4
10	150	4800	1200	10	120	3800	630	10	100	3200	670	10	60	1900	310	5	180	5700	1400	10	30	950	160	3
12	150	4000	960	12	120	3200	580	12	100	2700	650	12	60	1600	290	6	180	4800	1200	12	30	800	150	3.6
16	150	3000	810	12	120	2400	500	12	100	2000	480	12	60	1200	250	8	180	3600	970	12	30	600	120	4.8

Depth of cut

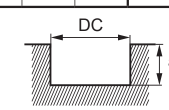


DC : Dia.

General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
6	100	5300	630	6	80	4200	330	6	60	3200	220	6	50	2700	210	3	120	6400	760	6	25	1300	72	1.8
8	100	4000	550	8	80	3200	320	8	60	2400	240	8	50	2000	200	4	120	4800	670	8	25	990	78	2.4
10	100	3200	510	10	80	2500	270	10	60	1900	260	10	50	1600	170	5	120	3800	600	10	25	800	89	3
12	100	2700	430	12	80	2100	250	12	60	1600	250	12	50	1300	150	6	120	3200	510	12	25	660	84	3.6
16	100	2000	360	12	80	1600	220	12	60	1200	190	12	50	990	140	8	120	2400	430	12	25	500	63	4.8

Depth of cut



DC : Dia.

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

VQMHZVOH

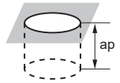
End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant

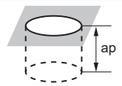
RECOMMENDED CUTTING CONDITIONS

Plunging

The rigidity of the machine or workpiece material and chip discharge are sufficient at high efficiency conditions.
The rigidity of the machine or workpiece material or chip discharge is insufficient at general-purpose conditions.

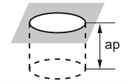
High efficiency conditions

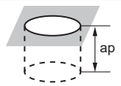
Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
Dia. DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)
6	100	5300	950	9	3	70	3700	440	9	1.2	60	3200	100	6	0.6	40	2100	60	6	0.6
8	100	4000	720	12	4	70	2800	340	12	1.6	60	2400	70	8	0.6	40	1600	50	8	0.6
10	100	3200	580	15	5	70	2200	260	15	2.5	60	1900	60	10	0.6	40	1300	40	10	0.6
12	100	2700	490	18	5	70	1900	230	18	3	60	1600	50	12	0.6	40	1100	30	12	0.6
16	100	2000	360	24	5	70	1400	170	24	4	60	1200	40	16	0.6	40	800	20	16	0.6
Depth of cut																				

Material	Copper, Copper Alloys				
Dia. DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)
6	120	6400	1200	9	3
8	120	4800	860	12	4
10	120	3800	680	15	5
12	120	3200	580	18	5
16	120	2400	430	24	5
Depth of cut					

Note 1) SMART MIRACLE coating is not energized because of its nature. Therefore, an external contact (voltaic type) tool setter cannot be used. An internal contact (non-voltaic) type or laser type tool setter is recommended to measure the length of the tool.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.

General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
Dia. DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)
6	100	5300	950	9	0.6	70	3700	440	9	0.6	60	3200	100	6	0.3	40	2100	60	6	0.3
8	100	4000	720	12	0.7	70	2800	340	12	0.7	60	2400	70	8	0.3	40	1600	50	8	0.3
10	100	3200	580	15	0.75	70	2200	260	15	0.75	60	1900	60	10	0.3	40	1300	40	10	0.3
12	100	2700	490	18	0.75	70	1900	230	18	0.75	60	1600	50	12	0.3	40	1100	30	12	0.3
16	100	2000	360	24	0.75	70	1400	170	24	0.75	60	1200	40	16	0.3	40	800	20	16	0.3
Depth of cut																				

Material	Copper, Copper Alloys				
Dia. DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table Feed (mm/min)	Hole Depth ap (mm)	Step (mm)
6	120	6400	1200	9	0.6
8	120	4800	860	12	0.7
10	120	3800	680	15	0.75
12	120	3200	580	18	0.75
16	120	2400	430	24	0.75
Depth of cut					

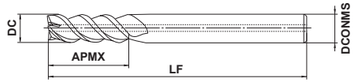
Note 1) SMART MIRACLE coating is not energized because of its nature. Therefore, an external contact (voltaic type) tool setter cannot be used. An internal contact (non-voltaic) type or laser type tool setter is recommended to measure the length of the tool.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.

VQMHZVOH – Inch sizes

End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant

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

FHA : 42° - 45°



Type1

DC<.5000"	DC=.5000"			
0 - .0008"	0 - .0012"			
DCONMS≤.3750"	DCONMS=.5000"			
0 - .00035"	0 - .00043"			

●A single end mill for both plunging and slotting.
●Excellent peformance in slotting and pocketing with oil supply from the end cutting edge.

(inch)

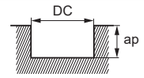
Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHZVOHD1/4	.2500	.6252	2.5	.2500	3	●	1
VQMHZVOHD5/16	.3125	.7500	2.75	.3125	3	●	1
VQMHZVOHD3/8	.3750	.8752	3.0	.3750	3	●	1
VQMHZVOHD1/2	.5000	1.1252	3.5	.5000	3	●	1

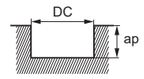
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Slotting

Material	Carbon Steel (<30HRC)					Alloy Steel, Pre-Hardened Steel					Austenitic Stainless Steel, Titanium Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/4	7500	55.8	5000	24.4	.25	6000	29.8	5000	16.5	.25	5000	21.9	3000	8.7	.25
5/16	6000	49.6	4000	21.7	.31	4800	28.3	4000	15.7	.31	4000	23.6	2400	9.4	.31
3/8	5000	46.1	3300	20.1	.38	4000	25.5	3300	13.8	.38	3300	25.3	2000	10.2	.38
1/2	3800	35.9	2500	15.7	.50	3000	22.3	2500	12.2	.50	2500	23.6	1500	9.4	.50
Depth of cut	 DC : Dia.														

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys					Copper, Copper Alloys					Heat Resistant Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/4	3000	14.9	2500	8.3	.25	9000	67.0	6000	29.5	.25	1500	5.3	1300	3.0	.075
5/16	2400	14.2	2000	7.9	.31	7200	59.5	4800	26.4	.31	1200	5.7	1000	3.1	.094
3/8	2000	12.8	1700	7.1	.38	6000	55.3	4000	24.4	.38	1000	6.1	840	3.4	.11
1/2	1500	11.2	1300	6.3	.50	4500	42.5	3000	18.9	.50	750	5.7	630	3.1	.15
Depth of cut	 DC : Dia.														

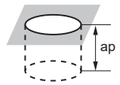
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy, and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

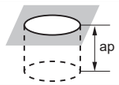
VQMHZVOH – Inch sizes

End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant

RECOMMENDED CUTTING CONDITIONS

Plunging

Material	Carbon Steel (<30HRC)							Alloy Steel, Pre-Hardened Steel							Austenitic Stainless Steel, Titanium Alloys						
DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	
1/4	5000	35.4	.13	5000	35.4	.024	.38	3500	16.5	.050	3500	16.5	.024	.38	3000	3.5	.024	3000	3.5	.012	.38
5/16	4000	28.3	.16	4000	28.3	.028	.47	2800	13.2	.063	2800	13.2	.028	.47	2400	2.8	.024	2400	2.8	.012	.47
3/8	3300	23.4	.19	3300	23.4	.030	.56	2300	11.0	.094	2300	11.0	.030	.56	2000	2.3	.024	2000	2.3	.012	.56
1/2	2500	17.7	.20	2500	17.7	.030	.75	1800	8.5	.13	1800	8.5	.030	.75	1500	2.0	.024	1500	2.0	.012	.75
Hole depth																					

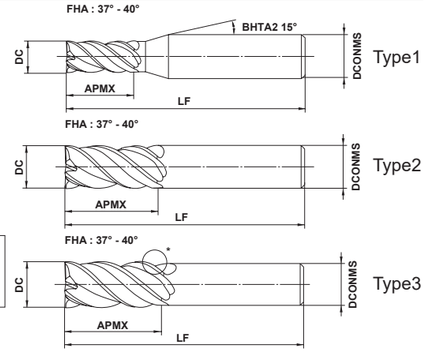
Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys							Copper, Copper Alloys						
DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)		Revolution (min^{-1})	Table feed (IPM)	Step (inch)	Revolution (min^{-1})	Table feed (IPM)	Step (inch)	
1/4	2000	2.3	.024	2000	2.3	.012	.38	6000	42.5	.13	6000	42.5	.0024	.38
5/16	1600	2.0	.024	1600	2.0	.012	.47	4800	34.0	.16	4800	34.0	.0028	.47
3/8	1300	1.5	.024	1300	1.5	.012	.56	4000	28.3	.19	4000	28.3	.003	.56
1/2	1000	1.2	.024	1000	1.2	.012	.75	3000	21.3	.20	3000	21.3	.003	.75
Hole depth														

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy, and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

VQMHV

End mill, Medium cut length, 4 flute, Irregular helix flutes

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



DC≦12	DC>12		
0 - 0.020	0 - 0.030		
DCONMS=4, 6	DCONMS=8, 10	DCONMS=12, 16	DCONMS=20, 25
0 - 0.008	0 - 0.009	0 - 0.011	0 - 0.013

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(mm)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVD0100	1	2	45	4	4	●	1
VQMHVD0150	1.5	3	45	4	4	●	1
VQMHVD0200	2	4	45	4	4	●	1
VQMHVD0250	2.5	5	45	4	4	●	1
VQMHVD0300	3	8	45	6	4	●	1
VQMHVD0350	3.5	8	45	6	4	●	1
VQMHVD0400	4	11	45	6	4	●	1
VQMHVD0500	5	13	50	6	4	●	1
VQMHVD0600	6	13	50	6	4	●	2
VQMHVD0700	7	19	60	8	4	●	1
VQMHVD0800	8	19	60	8	4	●	2
VQMHVD0900	9	22	70	10	4	●	1
VQMHVD0900S08	9	22	75	8	4	●	3
VQMHVD1000	10	22	70	10	4	●	2
VQMHVD1000S08	10	22	100	8	4	●	3
VQMHVD1100	11	26	75	12	4	●	1
VQMHVD1100S10	11	26	100	10	4	●	3
VQMHVD1200	12	26	75	12	4	●	2
VQMHVD1200S10	12	26	110	10	4	●	3
VQMHVD1300	13	26	75	12	4	★	3
VQMHVD1300S12	13	26	110	12	4	★	3
VQMHVD1400	14	30	90	16	4	★	1
VQMHVD1400S12	14	32	130	12	4	★	3
VQMHVD1600	16	35	90	16	4	★	2
VQMHVD1800	18	40	100	16	4	★	3
VQMHVD1800S16	18	42	150	16	4	★	3
VQMHVD2000	20	45	110	20	4	★	2
VQMHVD2500	25	55	125	25	4	★	2

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

● : USA Stock ★ : Stocked in Japan

VQMHV

End mill, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	130	40000	1800	1.5	0.3	120	38000	910	1.5	0.3	80	25000	500	1.5	0.2	75	24000	580	1.5	0.2
2	150	24000	2400	3	0.6	120	19000	1100	3	0.6	100	16000	830	3	0.6	75	12000	720	3	0.4
3	150	16000	2600	4.5	0.9	120	13000	1200	4.5	0.9	100	11000	880	4.5	0.9	75	8000	770	4.5	0.6
4	150	12000	2600	6	1.2	120	9500	1300	6	1.2	100	8000	900	6	1.2	75	6000	790	6	0.8
5	150	9500	2600	7.5	1.5	120	7600	1300	7.5	1.5	100	6400	900	7.5	1.5	75	4800	810	7.5	1
6	150	8000	2600	9	1.8	120	6400	1300	9	1.8	100	5300	1100	9	1.8	75	4000	810	9	1.2
8	150	6000	2500	12	2.4	120	4800	1300	12	2.4	100	4000	1200	12	2.4	75	3000	840	12	1.6
10	150	4800	2300	15	3	120	3800	1200	15	3	100	3200	1300	15	3	75	2400	770	15	2
12	150	4000	1900	18	3.6	120	3200	1200	18	3.6	100	2700	1200	18	3.6	75	2000	720	18	2.4
16	150	3000	1600	24	4.8	120	2400	960	24	4.8	100	2000	960	24	4.8	75	1500	600	24	3.2
20	150	2400	1300	30	6	120	1900	760	30	6	100	1600	770	30	6	75	1200	480	30	4
25	150	1900	1100	37.5	7.5	120	1500	600	37.5	7.5	100	1300	620	37.5	7.5	75	950	380	37.5	5
Depth of cut																				

General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	120	38000	1000	1.5	0.3	100	32000	560	1.5	0.3	80	25000	400	0.75	0.1	70	22000	390	1.5	0.2
2	120	19000	1300	3	0.6	100	16000	630	3	0.6	80	13000	450	1.5	0.2	70	11000	440	3	0.4
3	120	13000	1400	4.5	0.9	100	11000	700	4.5	0.9	80	8500	450	2.2	0.3	70	7400	470	4.5	0.6
4	120	9500	1400	6	1.2	100	8000	700	6	1.2	80	6400	470	3	0.6	70	5600	490	6	0.8
5	120	7600	1400	7.5	1.5	100	6400	710	7.5	1.5	80	5100	470	4.5	0.9	70	4500	500	7.5	1
6	120	6400	1400	9	1.8	100	5300	710	9	1.8	80	4200	580	6	1.2	70	3700	500	9	1.2
8	120	4800	1300	12	2.4	100	4000	740	12	2.4	80	3200	630	7.5	1.5	70	2800	520	12	1.6
10	120	3800	1200	15	3	100	3200	680	15	3	80	2500	660	9	1.8	70	2200	460	15	2
12	120	3200	1000	18	3.6	100	2700	640	18	3.6	80	2100	610	12	2.4	70	1900	450	18	2.4
16	120	2400	860	24	4.8	100	2000	530	24	4.8	80	1600	510	15	3	70	1400	370	24	3.2
20	120	1900	680	30	6	100	1600	420	30	6	80	1300	410	18	3.6	70	1100	290	30	4
25	120	1500	390	37.5	7.5	100	1300	340	37.5	7.5	80	1000	210	24	4.8	70	890	230	37.5	5
Depth of cut																				

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	130	40000	1800	1.5	0.3	40	13000	210	1.5	0.1
2	180	29000	2900	3	0.6	40	6400	230	3	0.2
3	180	19000	3000	4.5	0.9	40	4200	240	4.5	0.3
4	180	14000	3000	6	1.2	40	3200	240	6	0.4
5	180	11000	3000	7.5	1.5	40	2500	240	7.5	0.5
6	180	9500	3000	9	1.8	40	2100	250	9	0.6
8	180	7200	3000	12	2.4	40	1600	260	12	0.8
10	180	5700	2700	15	3	40	1300	290	15	1
12	180	4800	2300	18	3.6	40	1100	280	18	1.2
16	180	3600	1900	24	4.8	40	800	200	24	1.6
20	180	2900	1600	30	6	40	640	160	30	2
25	180	2300	1300	37.5	7.5	40	510	130	37.5	2.5
Depth of cut										

General-purpose conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	130	40000	1300	1.5	0.3	30	9600	92	1.5	0.1
2	140	22000	1500	3	0.6	30	4800	110	3	0.2
3	140	15000	1600	4.5	0.9	30	3200	120	4.5	0.3
4	140	11000	1600	6	1.2	30	2400	120	6	0.4
5	140	8900	1600	7.5	1.5	30	1900	120	7.5	0.5
6	140	7400	1600	9	1.8	30	1600	130	9	0.6
8	140	5600	1600	12	2.4	30	1200	130	12	0.8
10	140	4500	1400	15	3	30	950	140	15	1
12	140	3700	1200	18	3.6	30	800	140	18	1.2
16	140	2800	1000	24	4.8	30	600	100	24	1.6
20	140	2200	780	30	6	30	480	81	30	2
25	140	1800	670	37.5	7.5	30	380	64	37.5	2.5
Depth of cut										

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQMHV

End mill, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

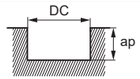
Slotting

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)
2	150	24000	1200	2	120	19000	610	2	100	16000	640	2	60	9500	300	1	180	29000	1500	2	30	4800	130	0.6
3	150	16000	1500	3	120	13000	730	3	100	11000	660	3	60	6400	360	1.5	180	19000	1700	3	30	3200	150	0.9
4	150	12000	1900	4	120	9500	910	4	100	8000	700	4	60	4800	460	2	180	14000	2200	4	30	2400	170	1.2
5	150	9500	1900	5	120	7600	910	5	100	6400	720	5	60	3800	460	2.5	180	11000	2200	5	30	1900	170	1.5
6	150	8000	1900	6	120	6400	1000	6	100	5300	740	6	60	3200	510	3	180	9500	2300	6	30	1600	180	1.8
8	150	6000	1700	8	120	4800	960	8	100	4000	800	8	60	2400	480	4	180	7200	2000	8	30	1200	190	2.4
10	150	4800	1500	10	120	3800	840	10	100	3200	900	10	60	1900	420	5	180	5700	1800	10	30	950	210	3
12	150	4000	1300	12	120	3200	770	12	100	2700	860	12	60	1600	380	6	180	4800	1500	12	30	800	200	3.6
16	150	3000	1100	12	120	2400	670	12	100	2000	640	12	60	1200	340	8	180	3600	1300	12	30	600	150	4.8
20	150	2400	860	12	120	1900	530	12	100	1600	510	12	60	950	270	10	180	2900	1000	12	30	480	120	6
25	150	1900	760	12	120	1500	420	12	100	1300	420	12	60	760	210	12	180	2300	920	12	30	380	100	7.5

Depth of cut

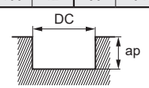


DC : Dia.

General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat Resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)
1	100	32000	500	1	80	25000	250	1	80	25000	300	1	50	16000	150	0.5	120	38000	590	1	25	8000	67	0.3
2	100	16000	550	2	80	13000	270	2	60	9500	250	2	50	8000	170	1	120	19000	650	2	25	4000	74	0.6
3	100	11000	670	3	80	8500	310	3	60	6400	250	3	50	5300	200	1.5	120	13000	790	3	25	2700	86	0.9
4	100	8000	840	4	80	6400	410	4	60	4800	280	4	50	4000	250	2	120	9500	1000	4	25	2000	93	1.2
5	100	6400	840	5	80	5100	410	5	60	3800	280	5	50	3200	250	2.5	120	7600	1000	5	25	1600	95	1.5
6	100	5300	840	6	80	4200	440	6	60	3200	300	6	50	2700	290	3	120	6400	1000	6	25	1300	96	1.8
8	100	4000	740	8	80	3200	420	8	60	2400	320	8	50	2000	260	4	120	4800	890	8	25	990	100	2.4
10	100	3200	680	10	80	2500	360	10	60	1900	350	10	50	1600	230	5	120	3800	800	10	25	800	120	3
12	100	2700	570	12	80	2100	330	12	60	1600	340	12	50	1300	210	6	120	3200	680	12	25	660	110	3.6
16	100	2000	480	12	80	1600	300	12	60	1200	250	12	50	990	180	8	120	2400	570	12	25	500	84	4.8
20	100	1600	380	12	80	1300	240	12	60	950	200	12	50	800	150	10	120	1900	450	12	25	400	68	6
25	100	1300	340	12	80	1000	180	12	60	760	160	12	50	640	120	12	120	1500	400	12	25	320	50	7.5

Depth of cut



DC : Dia.

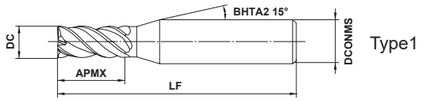
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

VQMHV – Inch sizes

End mill, Medium cut length, 4 flute, Irregular helix flutes

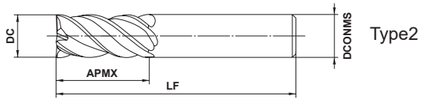
Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-hardened Steel, Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Cobalt Chrome Alloy Titanium Alloy	Heat Resistanse Alloy	Copper Alloy
◎	○			◎	◎	○	○

FHA : 37° - 40°



Type1

FHA : 37° - 40°



Type2

DC<.5000"	DC=.5000"			
0 - .0008"	0 - .0012"			
DCONMS≤.3750"	DCONMS=.5000"			
0 - .00035"	0 - .00043"			

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(inch)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVD1/8	.1250	.3130	2.0	.2500	4	●	1
VQMHVD3/16	.1875	.4375	2.0	.2500	4	●	1
VQMHVD1/4	.2500	.6250	2.5	.2500	4	●	2
VQMHVD5/16	.3125	.7500	2.75	.3125	4	●	2
VQMHVD3/8	.3750	.8750	3.0	.3750	4	●	2
VQMHVD1/2	.5000	1.1250	3.5	.5000	4	●	2

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

● : USA Stock

VQMHV – Inch sizes

End mill, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

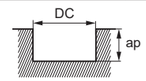
Side milling

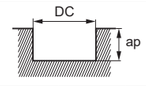
Material	Carbon Steel (<30HRC)						Alloy Steel, Pre-Hardened Steel						Austenitic Stainless Steel, Titanium Alloys					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/8	15000	102.0	12000	55.1	.19	.038	12000	49.1	10000	27.2	.19	.038	10000	34.6	8000	18.1	.19	.038
3/16	10000	99.2	8000	51.2	.28	.056	8000	50.4	6700	28.0	.28	.056	6700	35.3	5300	18.5	.28	.056
1/4	7500	99.2	6000	51.2	.38	.075	6000	52.0	5000	28.7	.38	.075	5000	47.2	4000	24.8	.38	.075
5/16	6000	99.2	4800	51.2	.47	.094	4800	52.9	4000	29.1	.47	.094	4000	47.2	3200	24.8	.47	.094
3/8	5000	90.6	4000	47.2	.56	.11	4000	49.1	3300	26.8	.56	.11	3300	49.4	2700	26.8	.56	.11
1/2	3800	74.8	3000	39.0	.75	.15	3000	43.5	2500	24.0	.75	.15	2500	43.3	2000	22.8	.75	.15
Depth of cut																		

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys						Copper, Copper Alloys						Heat Resistant Alloy					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/8	7500	30.7	7000	18.9	.19	.025	18000	122.0	14000	63.0	.19	.038	4000	9.5	3000	4.7	.19	.013
3/16	5000	31.5	4700	19.7	.28	.038	12000	119.0	9400	63.0	.28	.056	2700	9.8	2000	4.7	.28	.019
1/4	3800	32.9	3500	20.1	.38	.050	9000	119.0	7000	63.0	.38	.075	2000	10.1	1500	5.1	.38	.025
5/16	3000	33.1	2800	20.5	.47	.063	7200	119.0	5600	63.0	.47	.094	1600	10.1	1200	5.1	.47	.031
3/8	2500	30.7	2300	18.5	.56	.075	6000	109.0	4700	55.1	.56	.11	1300	10.6	1000	5.5	.56	.038
1/2	1900	27.5	1800	17.3	.75	.10	4500	88.6	3500	47.2	.75	.15	1000	10.1	750	5.1	.75	.050
Depth of cut																		

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

Slotting

Material	Carbon Steel (<30HRC)					Alloy Steel, Pre-Hardened Steel					Austenitic Stainless Steel, Titanium Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/8	15000	59.1	10000	26.0	.13	12000	30.2	8000	13.4	.13	10000	26.8	6000	10.6	.13
3/16	10000	75.6	6700	33.5	.19	8000	35.9	5300	15.7	.19	6700	28.5	4000	11.4	.19
1/4	7500	74.4	5000	32.7	.25	6000	39.7	4000	17.3	.25	5000	29.1	3000	11.4	.25
5/16	6000	66.1	4000	29.1	.31	4800	37.8	3200	16.5	.31	4000	31.5	2400	12.6	.31
3/8	5000	61.4	3300	26.8	.38	4000	34.0	2700	15.0	.38	3300	33.8	2000	13.4	.38
1/2	3800	47.9	2500	20.9	.50	3000	29.8	2000	13.0	.50	2500	31.5	1500	12.6	.50
Depth of cut	 DC : Dia.														

Material	Precipitation Hardening Martensitic Stainless steel, Co-Cr-Mo Alloys					Copper, Copper Alloys					Heat Resistant Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/8	6000	15.1	5000	8.3	.063	18000	70.9	12000	31.1	.13	3000	6.14	2500	3.4	.038
3/16	4000	18.3	3300	9.8	.094	12000	90.7	8000	39.4	.19	2000	6.80	1700	3.8	.056
1/4	3000	19.8	2500	11.0	.13	9000	89.3	6000	39.4	.25	1500	7.09	1300	3.9	.075
5/16	2400	18.9	2000	10.2	.16	7200	79.4	4800	35.0	.31	1200	7.56	1000	4.3	.094
3/8	2000	17.0	1700	9.4	.19	6000	73.7	4000	32.3	.38	1000	8.19	840	4.7	.11
1/2	1500	14.9	1300	8.7	.25	4500	56.7	3000	24.8	.50	750	7.56	630	4.3	.15
Depth of cut	 DC : Dia.														

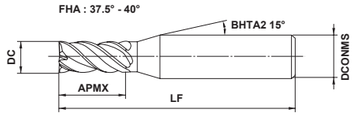
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

VQJHV

End mill, Semi long cut length, 4 flute, Irregular helix flutes

UWC | VQ | γ 38° 40° DC≤6 | γ 37.5° 40° DC>6

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



DC≤12	DC>12			
0 - 0.020	0 - 0.030			
DCONMS=6	**DCONMS=8, 10**	**DCONMS=12, 16**	**DCONMS=20**	
0 - 0.008	0 - 0.009	0 - 0.011	0 - 0.013	

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(mm)

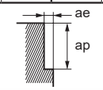
Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQJHVD0100	1	4	45	4	4	●	1
VQJHVD0150	1.5	6	45	4	4	●	1
VQJHVD0200	2	8	60	6	4	●	1
VQJHVD0250	2.5	10	60	6	4	●	1
VQJHVD0300	3	12	60	6	4	●	1
VQJHVD0350	3.5	14	60	6	4	●	1
VQJHVD0400	4	16	60	6	4	●	1
VQJHVD0450	4.5	18	60	6	4	●	1
VQJHVD0500	5	20	60	6	4	●	1
VQJHVD0600	6	24	60	6	4	●	2
VQJHVD0700	7	25	80	8	4	●	1
VQJHVD0800	8	28	80	8	4	●	2
VQJHVD0900	9	32	90	10	4	●	1
VQJHVD1000	10	35	90	10	4	●	2
VQJHVD1200	12	40	100	12	4	●	2
VQJHVD1600	16	55	125	16	4	★	2
VQJHVD2000	20	70	140	20	4	★	2

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

● : USA Stock ★ : Stocked in Japan

RECOMMENDED CUTTING CONDITIONS

Side milling

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	130	40000	530	2.5	0.1	100	32000	410	2.5	0.1	80	25000	300	2.5	0.05	75	24000	290	2.5	0.05
2	130	21000	700	5	0.2	100	16000	510	5	0.2	80	13000	390	5	0.1	75	12000	360	5	0.1
3	130	14000	960	7.5	0.3	100	11000	680	7.5	0.3	80	8500	490	7.5	0.15	75	8000	460	7.5	0.15
4	130	10000	1000	10	0.4	100	8000	690	10	0.4	80	6400	540	10	0.2	75	6000	510	10	0.2
5	130	8300	1100	12.5	0.5	100	6400	730	12.5	0.5	80	5100	570	12.5	0.25	75	4800	540	12.5	0.25
6	130	6900	1200	15	0.6	100	5300	810	15	0.6	80	4200	630	15	0.3	75	4000	600	15	0.3
8	130	5200	1200	20	0.8	100	4000	840	20	0.8	80	3200	640	20	0.4	75	3000	600	20	0.4
10	130	4100	1100	25	1	100	3200	810	25	1	80	2500	590	25	0.5	75	2400	570	25	0.5
12	130	3400	1100	30	1.2	100	2700	780	30	1.2	80	2100	550	30	0.6	75	2000	520	30	0.6
16	130	2600	920	40	1.6	100	2000	640	40	1.6	80	1600	450	40	0.8	75	1500	420	40	0.8
20	130	2100	820	50	2	100	1600	570	50	2	80	1300	420	50	1	75	1200	390	50	1
Depth of cut																				

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
1	130	40000	530	2.5	0.1	40	13000	73	2.5	0.02
2	160	25000	830	5	0.2	40	6400	90	5	0.04
3	160	17000	1200	7.5	0.3	40	4200	130	7.5	0.06
4	160	13000	1300	10	0.4	40	3200	190	10	0.08
5	160	10000	1300	12.5	0.5	40	2500	180	12.5	0.1
6	160	8500	1500	15	0.6	40	2100	180	15	0.12
8	160	6400	1500	20	0.8	40	1600	170	20	0.16
10	160	5100	1300	25	1	40	1300	170	25	0.2
12	160	4200	1300	30	1.2	40	1100	140	30	0.24
16	160	3200	1100	40	1.6	40	800	110	40	0.32
20	160	2500	970	50	2	40	640	80	50	0.4
Depth of cut										

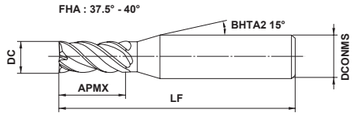
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQJHV – Inch sizes

End mill, Semi long cut length, 4 flute, Irregular helix flutes

UWC | VQ | γ 38° 40° DC≤1/4 | γ 37.5° 40° DC>1/4

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



DC<.5000"	DC=.5000"			
0 - .0008"	0 - .0012"			
DCONMS≤.3750"	DCONMS=.5000"			
0 - .00035"	0 - .00043"			

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(inch)

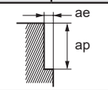
Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQJHVD1/8	.1250	.5000	2.5	.2500	4	●	1
VQJHVD3/16	.1875	.7500	2.5	.2500	4	●	1
VQJHVD1/4	.2500	1.0000	2.5	.2500	4	●	2
VQJHVD5/16	.3125	1.0900	3.25	.3125	4	●	2
VQJHVD3/8	.3750	1.3100	3.5	.3750	4	●	2
VQJHVD1/2	.5000	1.6500	4.0	.5000	4	●	2

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

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side milling

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-Hardened Steel, Carbon Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
1/8	13000	39	.313	.013	10000	26.8	.313	.013	8000	20.1	.313	.006	7500	18.9	.313	.006
3/16	8700	39.4	.469	.019	6700	27.6	.469	.019	5300	21.7	.469	.009	5000	20.5	.469	.009
1/4	6500	47.2	.625	.025	5000	32.3	.625	.025	4000	25.2	.625	.013	3800	24	.625	.013
5/16	5200	47.2	.781	.031	4000	33.5	.781	.031	3200	25.2	.781	.016	3000	23.6	.781	.016
3/8	4300	43.3	.938	.038	3300	31.9	.938	.038	2700	23.2	.938	.019	2500	22.4	.938	.019
1/2	3300	43.3	1.25	.05	2500	29.1	1.25	.05	2000	20.9	1.25	.025	1900	20.1	1.25	.025
Depth of cut																

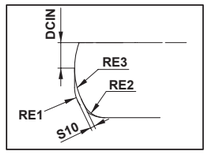
Material	Copper, Copper Alloys				Heat Resistant Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
1/8	16000	48	.013	.013	4000	5.1	.313	.003
3/16	11000	51.9	.019	.019	2700	7.1	.469	.004
1/4	8000	57.9	.025	.025	2000	6.7	.625	.005
5/16	6400	59.4	.031	.031	1600	6.7	.781	.006
3/8	5300	51.7	.038	.038	1300	6.7	.938	.008
1/2	4000	50.4	.05	.05	1000	5.1	1.25	.01
Depth of cut								

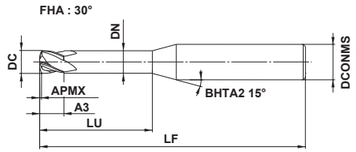
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQFDRB

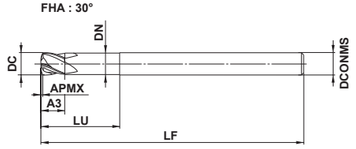
Duplex corner radius end mill for high speed cutting

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





Type 1



Type 2

DC				
0 - 0.020				
DCONMS				
0 - 0.005				

- Duplex corner radius type allows more efficient high feed.
- High feed cutting realized through use of multiple cuts.

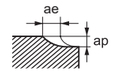
(mm)

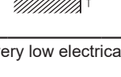
Order Number	DC	RE1 *1	APMX	A3 *3	LU	DN	LF	DCONMS	No. of Flutes	Multi-task radius part				RMPX *2	Stock	Type
										S10	DCIN	RE2	RE3			
VQFDRBD0300N080	3	0.64	0.18	3	8	2.8	50	6	4	0.08	0.75	0.5	2	2.1°	●	1
VQFDRBD0300N120	3	0.64	0.18	3	12	2.8	55	6	4	0.08	0.75	0.5	2	2.1°	●	1
VQFDRBD0400N120	4	0.71	0.25	4	12	3.8	55	6	4	0.13	1.0	0.5	3	1.9°	●	1
VQFDRBD0400N160	4	0.71	0.25	4	16	3.8	60	6	4	0.13	1.0	0.5	3	1.9°	●	1
VQFDRBD0600N180	6	0.92	0.36	6	18	5.6	60	6	4	0.21	1.5	0.6	5	1.7°	●	2

*1 RE1 : Approx. R
*2 RMPX : Max. Ramping Angle
*3 A3 : Cutting Edge Effective Length

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Material		Titanium Alloys					Cobalt Chromium Alloys Precipitation Hardening Stainless Steel				
DC		Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)										
3	**.118**	8500	260	82.7	.008	.051	6400	195	118.1	.008	.051
4	**.157**	6400	260	86.6	.008	.067	4800	195	106.3	.008	.067
6	**.236**	4200	260	55.1	.012	.079	3200	195	82.7	.012	.102
Depth of Cut											

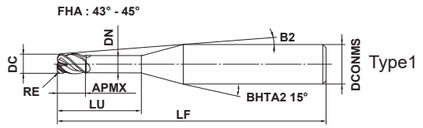
Material		Heat Resistant Alloys				
DC		Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Feed Rate **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)					
3	**.118**	3200	100	30.3	.008	.024
4	**.157**	2400	100	30.3	.008	.031
6	**.236**	1600	100	20.5	.012	.051
Depth of 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-electricity type) or a laser tool setter.
Note 2) When cutting titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) If the depth of cut is smaller, the revolution and the feed rate can be increased.

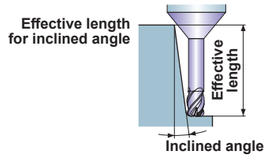
VQHVRB

Corner radius, Short cut length, 4 flute, Irregular helix flutes

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



RE			
±0.01			
DC			
0 - 0.02			
DCONMS			
0 - 0.005			



● SMART MIRACLE corner radius end mill for high feed rates and efficient machining.

(mm)

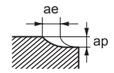
Order Number	DC	RE	APMX	LU	DN	B2	LF	DCON MS	No. of Flutes	Stock	Type
VQHVRBD0100R01N080	1	0.1	1	8	0.94	8.2°	50	6	4	●	1
VQHVRBD0100R01N120	1	0.1	1	12	0.94	6.7°	55	6	4	●	1
VQHVRBD0200R02N120	2	0.2	2	12	1.9	5.9°	55	6	4	●	1
VQHVRBD0200R02N160	2	0.2	2	16	1.9	4.9°	60	6	4	●	1
VQHVRBD0300R05N100	3	0.5	3	10	2.9	5.6°	55	6	4	●	1
VQHVRBD0300R05N180	3	0.5	3	18	2.9	3.7°	60	6	4	●	1
VQHVRBD0400R10N120	4	1.0	4	12	3.9	3.9°	55	6	4	●	1
VQHVRBD0400R10N200	4	1.0	4	20	3.9	2.5°	60	6	4	●	1

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Material				Titanium Alloys					Cobalt Chromium Alloys Precipitation Hardening Stainless Steel				
DC		LU		Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)	Revolution **n** (min^{-1})	Cutting Speed **vc** (SFM)	Table Feed **vf** (IPM)	Depth of cut **ap** (inch)	Width of cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)										
1	**.039**	**8**	**.315**	2500	25	19.7	.001	.004	2500	25	19.7	.001	.004
1	**.039**	**12**	**.472**	2500	25	13.8	.001	.004	2500	25	13.8	.001	.004
2	**.079**	**12**	**.472**	4800	100	23.6	.003	.012	4800	100	23.6	.003	.012
2	**.079**	**16**	**.630**	4800	100	13.4	.003	.012	4800	100	13.8	.003	.012
3	**.118**	**10**	**.394**	8500	260	94.5	.007	.051	6400	195	86.6	.007	.051
3	**.118**	**18**	**.709**	8500	260	78.7	.007	.051	6400	195	63.0	.007	.051
4	**.157**	**12**	**.472**	6400	260	78.7	.010	.067	4800	195	70.9	.009	.067
4	**.157**	**20**	**.787**	6400	260	78.7	.010	.067	4800	195	70.9	.009	.067

Depth of Cut



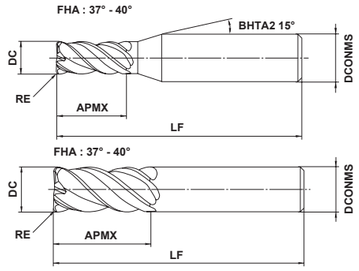
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) or a laser tool setter.
Note 2) When cutting titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) If the depth of cut is smaller, the revolution and the feed rate can be increased.
Note 4) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnormal sound can occur.
In this case, please reduce the revolution and the feed rate proportionately, or set a lower depth of cut.

VQMHVRB

Corner radius, Medium cut length, 4 flute, Irregular helix flutes

37°
40°

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



RE				
±0.015				
DC≤12	DC>12			
0 - 0.02	0 - 0.03			
DCONMS=4, 6	DCONMS=8, 10	DCONMS=12, 16	DCONMS=20	
0 - 0.008	0 - 0.009	0 - 0.011	0 - 0.013	

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVRBD0200R020	2	0.2	4	45	4	4	●	1
VQMHVRBD0200R030	2	0.3	4	45	4	4	●	1
VQMHVRBD0300R020	3	0.2	8	45	6	4	●	1
VQMHVRBD0300R030	3	0.3	8	45	6	4	●	1
VQMHVRBD0300R050	3	0.5	8	45	6	4	●	1
VQMHVRBD0400R020	4	0.2	11	45	6	4	●	1
VQMHVRBD0400R030	4	0.3	11	45	6	4	●	1
VQMHVRBD0400R050	4	0.5	11	45	6	4	●	1
VQMHVRBD0500R020	5	0.2	13	50	6	4	●	1
VQMHVRBD0500R030	5	0.3	13	50	6	4	●	1
VQMHVRBD0500R050	5	0.5	13	50	6	4	●	1
VQMHVRBD0500R100	5	1	13	50	6	4	●	1
VQMHVRBD0600R030	6	0.3	13	50	6	4	●	2
VQMHVRBD0600R050	6	0.5	13	50	6	4	●	2
VQMHVRBD0600R100	6	1	13	50	6	4	●	2
VQMHVRBD0800R030	8	0.3	19	60	8	4	●	2
VQMHVRBD0800R050	8	0.5	19	60	8	4	●	2
VQMHVRBD0800R100	8	1	19	60	8	4	●	2
VQMHVRBD0800R150	8	1.5	19	60	8	4	●	2
VQMHVRBD1000R030	10	0.3	22	70	10	4	●	2
VQMHVRBD1000R050	10	0.5	22	70	10	4	●	2
VQMHVRBD1000R100	10	1	22	70	10	4	●	2
VQMHVRBD1000R150	10	1.5	22	70	10	4	●	2
VQMHVRBD1000R200	10	2	22	70	10	4	●	2
VQMHVRBD1200R050	12	0.5	26	75	12	4	●	2
VQMHVRBD1200R100	12	1	26	75	12	4	●	2
VQMHVRBD1200R150	12	1.5	26	75	12	4	●	2
VQMHVRBD1200R200	12	2	26	75	12	4	●	2
VQMHVRBD1200R250	12	2.5	26	75	12	4	●	2
VQMHVRBD1200R300	12	3	26	75	12	4	●	2

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

● : USA Stock ★ : Stocked in Japan

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVRBD1600R100	16	1	35	90	16	4	★	2
VQMHVRBD1600R150	16	1.5	35	90	16	4	★	2
VQMHVRBD1600R200	16	2	35	90	16	4	★	2
VQMHVRBD1600R250	16	2.5	35	90	16	4	★	2
VQMHVRBD1600R300	16	3	35	90	16	4	★	2
VQMHVRBD1600R400	16	4	35	90	16	4	★	2
VQMHVRBD1600R500	16	5	35	90	16	4	★	2
VQMHVRBD2000R100	20	1	45	110	20	4	★	2
VQMHVRBD2000R150	20	1.5	45	110	20	4	★	2
VQMHVRBD2000R200	20	2	45	110	20	4	★	2
VQMHVRBD2000R250	20	2.5	45	110	20	4	★	2
VQMHVRBD2000R300	20	3	45	110	20	4	★	2
VQMHVRBD2000R400	20	4	45	110	20	4	★	2
VQMHVRBD2000R500	20	5	45	110	20	4	★	2
VQMHVRBD2000R635	20	6.35	45	110	20	4	★	2

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

VQMHVRB

Corner radius, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
2	150	24000	2400	3	0.6	120	19000	1100	3	0.6	100	16000	830	3	0.6	75	12000	720	3	0.4
3	150	16000	2600	4.5	0.9	120	13000	1200	4.5	0.9	100	11000	880	4.5	0.9	75	8000	770	4.5	0.6
4	150	12000	2600	6	1.2	120	9500	1300	6	1.2	100	8000	900	6	1.2	75	6000	790	6	0.8
5	150	9500	2600	7.5	1.5	120	7600	1300	7.5	1.5	100	6400	900	7.5	1.5	75	4800	810	7.5	1
6	150	8000	2600	9	1.8	120	6400	1300	9	1.8	100	5300	1100	9	1.8	75	4000	810	9	1.2
8	150	6000	2500	12	2.4	120	4800	1300	12	2.4	100	4000	1200	12	2.4	75	3000	840	12	1.6
10	150	4800	2300	15	3	120	3800	1200	15	3	100	3200	1300	15	3	75	2400	770	15	2
12	150	4000	1900	18	3.6	120	3200	1200	18	3.6	100	2700	1200	18	3.6	75	2000	720	18	2.4
16	150	3000	1600	24	4.8	120	2400	960	24	4.8	100	2000	960	24	4.8	75	1500	600	24	3.2
20	150	2400	1300	30	6	120	1900	760	30	6	100	1600	770	30	6	75	1200	480	30	4
Depth of cut																				

General purpose cutting conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless Steel, Cobalt Chromium Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
2	120	19000	1300	3	0.6	100	16000	630	3	0.6	80	13000	450	1.5	0.2	70	11000	440	3	0.4
3	120	13000	1400	4.5	0.9	100	11000	700	4.5	0.9	80	8500	450	2.2	0.3	70	7400	470	4.5	0.6
4	120	9500	1400	6	1.2	100	8000	700	6	1.2	80	6400	470	3	0.6	70	5600	490	6	0.8
5	120	7600	1400	7.5	1.5	100	6400	710	7.5	1.5	80	5100	470	4.5	0.9	70	4500	500	7.5	1
6	120	6400	1400	9	1.8	100	5300	710	9	1.8	80	4200	580	6	1.2	70	3700	500	9	1.2
8	120	4800	1300	12	2.4	100	4000	740	12	2.4	80	3200	630	7.5	1.5	70	2800	520	12	1.6
10	120	3800	1200	15	3	100	3200	680	15	3	80	2500	660	9	1.8	70	2200	460	15	2
12	120	3200	1000	18	3.6	100	2700	640	18	3.6	80	2100	610	12	2.4	70	1900	450	18	2.4
16	120	2400	860	24	4.8	100	2000	530	24	4.8	80	1600	510	15	3	70	1400	370	24	3.2
20	120	1900	680	30	6	100	1600	420	30	6	80	1300	410	18	3.6	70	1100	290	30	4
Depth of cut																				

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
2	180	29000	2900	3	0.6	40	6400	230	3	0.2
3	180	19000	3000	4.5	0.9	40	4200	240	4.5	0.3
4	180	14000	3000	6	1.2	40	3200	240	6	0.4
5	180	11000	3000	7.5	1.5	40	2500	240	7.5	0.5
6	180	9500	3000	9	1.8	40	2100	250	9	0.6
8	180	7200	3000	12	2.4	40	1600	260	12	0.8
10	180	5700	2700	15	3	40	1300	290	15	1
12	180	4800	2300	18	3.6	40	1100	280	18	1.2
16	180	3600	1900	24	4.8	40	800	200	24	1.6
20	180	2900	1600	30	6	40	640	160	30	2
Depth of cut										

General-purpose conditions

Material	Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
2	140	22000	1500	3	0.6	30	4800	110	3	0.2
3	140	15000	1600	4.5	0.9	30	3200	120	4.5	0.3
4	140	11000	1600	6	1.2	30	2400	120	6	0.4
5	140	8900	1600	7.5	1.5	30	1900	120	7.5	0.5
6	140	7400	1600	9	1.8	30	1600	130	9	0.6
8	140	5600	1600	12	2.4	30	1200	130	12	0.8
10	140	4500	1400	15	3	30	950	140	15	1
12	140	3700	1200	18	3.6	30	800	140	18	1.2
16	140	2800	1000	24	4.8	30	600	100	24	1.6
20	140	2200	780	30	6	30	480	81	30	2
Depth of cut										

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQMHVRB

Corner radius, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

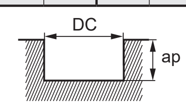
Slotting

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloys Steel, Mild Steel				Pre-hardened Steel, Carbon Steel, Alloys Steel, Alloys tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)
2	150	24000	1200	2	120	19000	610	2	100	16000	640	2	60	9500	300	1	180	29000	1500	2	30	4800	130	0.6
3	150	16000	1500	3	120	13000	730	3	100	11000	660	3	60	6400	360	1.5	180	19000	1700	3	30	3200	150	0.9
4	150	12000	1900	4	120	9500	910	4	100	8000	700	4	60	4800	460	2	180	14000	2200	4	30	2400	170	1.2
5	150	9500	1900	5	120	7600	910	5	100	6400	720	5	60	3800	460	2.5	180	11000	2200	5	30	1900	170	1.5
6	150	8000	1900	6	120	6400	1000	6	100	5300	740	6	60	3200	510	3	180	9500	2300	6	30	1600	180	1.8
8	150	6000	1700	8	120	4800	960	8	100	4000	800	8	60	2400	480	4	180	7200	2000	8	30	1200	190	2.4
10	150	4800	1500	10	120	3800	840	10	100	3200	900	10	60	1900	420	5	180	5700	1800	10	30	950	210	3
12	150	4000	1300	12	120	3200	770	12	100	2700	860	12	60	1600	380	6	180	4800	1500	12	30	800	200	3.6
16	150	3000	1100	12	120	2400	670	12	100	2000	640	12	60	1200	340	8	180	3600	1300	12	30	600	150	4.8
20	150	2400	860	12	120	1900	530	12	100	1600	510	12	60	950	270	10	180	2900	1000	12	30	480	120	6

Depth of cut

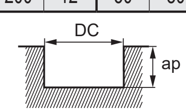


DC : Dia.

General-purpose conditions

Material	Carbon Steel, Alloys Steel, Mild Steel				Pre-hardened Steel, Carbon Steel, Alloys Steel, Alloys tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless Steel, Cobalt Chromium Alloys				Copper, Copper Alloys				Heat resistant Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Depth of cut ap (mm)
2	100	16000	550	2	80	13000	270	2	60	9500	250	2	50	8000	170	1	120	19000	650	2	25	4000	74	0.6
3	100	11000	670	3	80	8500	310	3	60	6400	250	3	50	5300	200	1.5	120	13000	790	3	25	2700	86	0.9
4	100	8000	840	4	80	6400	410	4	60	4800	280	4	50	4000	250	2	120	9500	1000	4	25	2000	93	1.2
5	100	6400	840	5	80	5100	410	5	60	3800	280	5	50	3200	250	2.5	120	7600	1000	5	25	1600	95	1.5
6	100	5300	840	6	80	4200	440	6	60	3200	300	6	50	2700	290	3	120	6400	1000	6	25	1300	96	1.8
8	100	4000	740	8	80	3200	420	8	60	2400	320	8	50	2000	260	4	120	4800	890	8	25	990	100	2.4
10	100	3200	680	10	80	2500	360	10	60	1900	350	10	50	1600	230	5	120	3800	800	10	25	800	120	3
12	100	2700	570	12	80	2100	330	12	60	1600	340	12	50	1300	210	6	120	3200	680	12	25	660	110	3.6
16	100	2000	480	12	80	1600	300	12	60	1200	250	12	50	990	180	8	120	2400	570	12	25	500	84	4.8
20	100	1600	380	12	80	1300	240	12	60	950	200	12	50	800	150	10	120	1900	450	12	25	400	68	6

Depth of cut



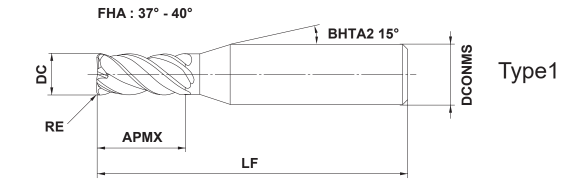
DC : Dia.

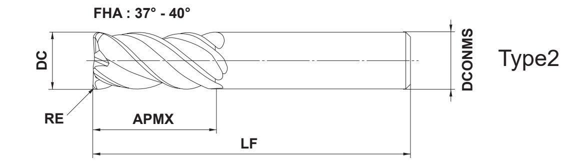
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

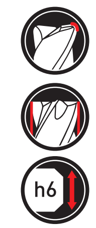
VQMHVRB – Inch sizes

Corner radius, Medium cut length, 4 flute, Irregular helix flutes

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







RE	
±.0006"	
DC<.5000"	DC=.5000"
0 / -.0008"	0 / -.0012"
DCONMS≤.3750"	DCONMS=.5000"
0 / -.00035"	0 / -.00043"

● Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials and for long overhang applications.

(inch)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVRBD1/8R008	.1250	.0080	.3130	2.0	.2500	4	●	1
VQMHVRBD1/8R010	.1250	.0100	.3130	2.0	.2500	4	●	1
VQMHVRBD3/16R010	.1875	.0100	.4375	2.0	.2500	4	●	1
VQMHVRBD3/16R015	.1875	.0150	.4375	2.0	.2500	4	●	1
VQMHVRBD3/16R020	.1875	.0200	.4375	2.0	.2500	4	●	1
VQMHVRBD3/16R030	.1875	.0300	.4375	2.0	.2500	4	●	1
VQMHVRBD1/4R008	.2500	.0080	.6250	2.5	.2500	4	●	2
VQMHVRBD1/4R010	.2500	.0100	.6250	2.5	.2500	4	●	2
VQMHVRBD1/4R015	.2500	.0150	.6250	2.5	.2500	4	●	2
VQMHVRBD1/4R020	.2500	.0200	.6250	2.5	.2500	4	●	2
VQMHVRBD1/4R030	.2500	.0300	.6250	2.5	.2500	4	●	2
VQMHVRBD5/16R010	.3125	.0100	.7500	2.75	.3125	4	●	2
VQMHVRBD5/16R015	.3125	.0150	.7500	2.75	.3125	4	●	2
VQMHVRBD5/16R020	.3125	.0200	.7500	2.75	.3125	4	●	2
VQMHVRBD5/16R030	.3125	.0300	.7500	2.75	.3125	4	●	2
VQMHVRBD5/16R060	.3125	.0600	.7500	2.75	.3125	4	●	2
VQMHVRBD3/8R010	.3750	.0100	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R015	.3750	.0150	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R020	.3750	.0200	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R030	.3750	.0300	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R040	.3750	.0400	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R060	.3750	.0600	.8750	3.0	.3750	4	●	2
VQMHVRBD3/8R090	.3750	.0900	.8750	3.0	.3750	4	●	2
VQMHVRBD1/2R010	.5000	.0100	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R015	.5000	.0150	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R020	.5000	.0200	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R030	.5000	.0300	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R060	.5000	.0600	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R090	.5000	.0900	1.1250	3.5	.5000	4	●	2
VQMHVRBD1/2R120	.5000	.1200	1.1250	3.5	.5000	4	●	2

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

● : USA Stock

VQMHVRB – Inch sizes

Corner radius, Medium cut length, 4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

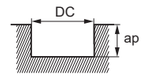
Side milling

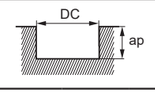
Material	Carbon Steel (<30HRC)						Alloy Steel, Pre-Hardened Steel						Austenitic Stainless Steel, Titanium Alloys					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/8	15000	102.0	12000	55.1	.19	.038	12000	49.1	10000	27.2	.19	.038	10000	34.6	8000	18.1	.19	.038
3/16	10000	99.2	8000	51.2	.28	.056	8000	50.4	6700	28.0	.28	.056	6700	35.3	5300	18.5	.28	.056
1/4	7500	99.2	6000	51.2	.38	.075	6000	52.0	5000	28.7	.38	.075	5000	47.2	4000	24.8	.38	.075
5/16	6000	99.2	4800	51.2	.47	.094	4800	52.9	4000	29.1	.47	.094	4000	47.2	3200	24.8	.47	.094
3/8	5000	90.6	4000	47.2	.56	.11	4000	49.1	3300	26.8	.56	.11	3300	49.4	2700	26.8	.56	.11
1/2	3800	74.8	3000	39.0	.75	.15	3000	43.5	2500	24.0	.75	.15	2500	43.3	2000	22.8	.75	.15
Depth of cut																		

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys						Copper, Copper Alloys						Heat Resistant Alloy					
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
1/8	7500	30.7	7000	18.9	.19	.025	18000	122.0	14000	63.0	.19	.038	4000	9.5	3000	4.7	.19	.013
3/16	5000	31.5	4700	19.7	.28	.038	12000	119.0	9400	63.0	.28	.056	2700	9.8	2000	4.7	.28	.019
1/4	3800	32.9	3500	20.1	.38	.050	9000	119.0	7000	63.0	.38	.075	2000	10.1	1500	5.1	.38	.025
5/16	3000	33.1	2800	20.5	.47	.063	7200	119.0	5600	63.0	.47	.094	1600	10.1	1200	5.1	.47	.031
3/8	2500	30.7	2300	18.5	.56	.075	6000	109.0	4700	55.1	.56	.11	1300	10.6	1000	5.5	.56	.038
1/2	1900	27.5	1800	17.3	.75	.10	4500	88.6	3500	47.2	.75	.15	1000	10.1	750	5.1	.75	.050
Depth of cut																		

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

Slotting

Material	Carbon Steel (<30HRC)					Alloy Steel, Pre-Hardened Steel					Austenitic Stainless Steel, Titanium Alloys				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/8	15000	59.1	10000	26.0	.13	12000	30.2	8000	13.4	.13	10000	26.8	6000	10.6	.13
3/16	10000	75.6	6700	33.5	.19	8000	35.9	5300	15.7	.19	6700	28.5	4000	11.4	.19
1/4	7500	74.4	5000	32.7	.25	6000	39.7	4000	17.3	.25	5000	29.1	3000	11.4	.25
5/16	6000	66.1	4000	29.1	.31	4800	37.8	3200	16.5	.31	4000	31.5	2400	12.6	.31
3/8	5000	61.4	3300	26.8	.38	4000	34.0	2700	15.0	.38	3300	33.8	2000	13.4	.38
1/2	3800	47.9	2500	20.9	.50	3000	29.8	2000	13.0	.50	2500	31.5	1500	12.6	.50
Depth of cut	 DC : Dia.														

Material	Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys					Copper, Copper Alloys					Heat Resistant Alloy				
DC (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	
1/8	6000	15.1	5000	8.3	.063	18000	70.9	12000	31.1	.13	3000	6.14	2500	3.4	.038
3/16	4000	18.3	3300	9.8	.094	12000	90.7	8000	39.4	.19	2000	6.80	1700	3.8	.056
1/4	3000	19.8	2500	11.0	.13	9000	89.3	6000	39.4	.25	1500	7.09	1300	3.9	.075
5/16	2400	18.9	2000	10.2	.16	7200	79.4	4800	35.0	.31	1200	7.56	1000	4.3	.094
3/8	2000	17.0	1700	9.4	.19	6000	73.7	4000	32.3	.38	1000	8.19	840	4.7	.11
1/2	1500	14.9	1300	8.7	.25	4500	56.7	3000	24.8	.50	750	7.56	630	4.3	.15
Depth of cut	 DC : Dia.														

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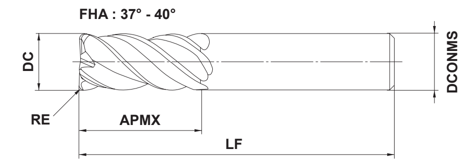
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

VQMHVRBF

Corner radius, Medium cut length, 4 flute, Irregular helix flutes (for finishing)

37°
40°

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



Type1

RE				
±0.015				
DC≤12	DC>12			
0 - 0.02	0 - 0.03			
DCONMS=6	DCONMS=8, 10	DCONMS=12, 16		
0 - 0.008	0 - 0.009	0 - 0.011		

- Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials.
- With the special substrate, suitable for finishing of heat resistance alloy, etc.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVRBFD0600R030	6	0.3	13	50	6	4	●	1
VQMHVRBFD0600R050	6	0.5	13	50	6	4	●	1
VQMHVRBFD0600R100	6	1	13	50	6	4	●	1
VQMHVRBFD0800R050	8	0.5	19	60	8	4	●	1
VQMHVRBFD0800R100	8	1	19	60	8	4	●	1
VQMHVRBFD1000R030	10	0.3	22	70	10	4	●	1
VQMHVRBFD1000R050	10	0.5	22	70	10	4	●	1
VQMHVRBFD1000R100	10	1	22	70	10	4	●	1
VQMHVRBFD1000R200	10	2	22	70	10	4	●	1
VQMHVRBFD1200R100	12	1	26	75	12	4	●	1
VQMHVRBFD1200R200	12	2	26	75	12	4	●	1
VQMHVRBFD1200R300	12	3	26	75	12	4	●	1
VQMHVRBFD1600R100	16	1	35	90	16	4	★	1
VQMHVRBFD1600R200	16	2	35	90	16	4	★	1

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

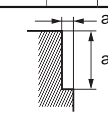
● : USA Stock ★ : Stocked in Japan

RECOMMENDED CUTTING CONDITIONS

Side milling

Material	Carbon Steel, Alloys Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloys Steel, Alloys Tool Steel					Hardened Stainless Steel, Cobalt Chromium Alloys					Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
6	150	8000	2600	9	0.3	120	6400	1300	9	0.3	75	4000	800	9	0.3	180	9500	3000	9	0.3	40	2100	250	9	0.18
8	150	6000	2500	12	0.4	120	4800	1300	12	0.4	75	3000	840	12	0.4	180	7200	3000	12	0.4	40	1600	260	12	0.24
10	150	4800	2300	15	0.5	120	3800	1200	15	0.5	75	2400	770	15	0.5	180	5700	2700	15	0.5	41	1300	290	15	0.3
12	150	4000	1900	18	0.6	120	3200	1200	18	0.6	75	2000	720	18	0.6	180	4800	2300	18	0.6	41	1100	280	18	0.36
16	150	3000	1600	24	0.8	120	2400	960	24	0.8	75	1500	600	24	0.8	180	3600	1900	24	0.8	40	800	200	24	0.48

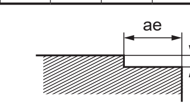
Depth of cut



Bottom face milling

Material	Carbon Steel, Alloys Steel, Mild Steel					Pre-Hardened Steel, Carbon Steel, Alloys Steel, Alloys Tool Steel					Hardened Stainless Steel, Cobalt Chromium Alloys					Copper, Copper Alloys					Heat Resistant Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Width of cut ae (mm)
6	110	5800	1400	0.3	4.8	90	4800	770	0.3	4.8	55	2900	460	0.3	4.8	130	6900	1700	0.3	4.8	30	1600	180	0.18	4.8
8	110	4400	1200	0.4	6.4	90	3600	720	0.4	6.4	55	2200	440	0.4	6.4	130	5200	1500	0.4	6.4	30	1200	190	0.24	6.4
10	110	3500	1100	0.5	8	90	2900	640	0.5	8	55	1800	400	0.5	8	130	4100	1300	0.5	8	30	950	210	0.3	8
12	110	2900	930	0.6	9.6	90	2400	580	0.6	9.6	55	1500	360	0.6	9.6	130	3400	1100	0.6	9.6	30	800	200	0.36	9.6
16	110	2200	790	0.8	12.8	90	1800	500	0.8	12.8	55	1100	310	0.8	12.8	130	2600	940	0.8	12.8	30	600	150	0.48	12.8

Depth of cut

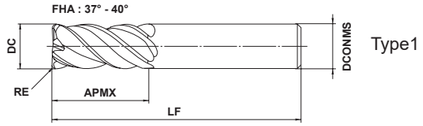


Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

VQMHVRBF – Inch sizes

Corner radius, Medium cut length, 4 flute, Irregular helix flutes (for finishing)

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



Type1

RE				
±.0006"				
DC<.5000"	DC=.5000"			
0 - .0008"	0 - .0012"			
DCONMS≤.3750"	DCONMS=.5000"			
0 - .00035"	0 - .00043"			

- Smart Miracle vibration control end mill achieving stable machining of difficult-to-cut materials.
- With the special substrate, suitable for finishing of heat resistance alloy, etc.

(inch)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQMHVRBFD1/4R015	.2500	.0150	.6250	2.5	.2500	4	●	1
VQMHVRBFD1/4R030	.2500	.0300	.6250	2.5	.2500	4	●	1
VQMHVRBFD5/16R015	.3125	.0150	.7500	2.75	.3125	4	●	1
VQMHVRBFD5/16R030	.3125	.0300	.7500	2.75	.3125	4	●	1
VQMHVRBFD5/16R060	.3125	.0600	.7500	2.75	.3125	4	●	1
VQMHVRBFD3/8R015	.3750	.0150	.8750	3.0	.3750	4	●	1
VQMHVRBFD3/8R030	.3750	.0300	.8750	3.0	.3750	4	●	1
VQMHVRBFD3/8R060	.3750	.0600	.8750	3.0	.3750	4	●	1
VQMHVRBFD3/8R090	.3750	.0900	.8750	3.0	.3750	4	●	1
VQMHVRBFD1/2R030	.5000	.0300	1.1250	3.5	.5000	4	●	1
VQMHVRBFD1/2R060	.5000	.0600	1.1250	3.5	.5000	4	●	1
VQMHVRBFD1/2R090	.5000	.0900	1.1250	3.5	.5000	4	●	1
VQMHVRBFD1/2R120	.5000	.1200	1.1250	3.5	.5000	4	●	1

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

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Side milling

Material	Carbon Steel (<30HRC)				Alloy Steel, Pre-Hardened Steel				Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)
1/4	7500	94.5	.38	.013	6000	47.2	.38	.013	3800	29.9	.38	.013
5/16	6000	99.2	.47	.016	4800	52.9	.47	.016	3000	33.1	.47	.016
3/8	5000	94.5	.56	.019	4000	50.4	.56	.019	2500	31.5	.56	.019
1/2	3800	71.8	.75	.025	3000	42.5	.75	.025	1900	26.9	.75	.025
Depth of cut												

Material	Copper, Copper Alloys				Heat Resistant Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)
1/4	9000	113	.38	.013	2000	9.5	.38	.008
5/16	7200	119	.47	.016	1600	10.1	.47	.009
3/8	6000	113	.56	.019	1300	11.5	.56	.011
1/2	4500	85.0	.75	.025	1000	10.1	.75	.015
Depth of cut								

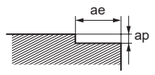
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy, and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) If the depth of cut is smaller than this table, feed rate can be increased.
Note 4) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is very low, then vibration can occur. In this case, please reduce the revolution and feed rate proportionately, or set a lower depth of cut.

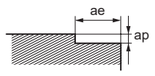
VQMHVRBF – Inch sizes

Corner radius, Medium cut length, 4 flute, Irregular helix flutes (for finishing)

RECOMMENDED CUTTING CONDITIONS

Bottom face milling

Material	Carbon Steel (<30HRC)				Alloy Steel, Pre-Hardened Steel				Precipitation Hardening Martensitic Stainless Steel, Co-Cr-Mo Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)
1/4	5500	52.0	.013	.2	4500	28.3	.013	.2	2800	17.6	.013	.2
5/16	4400	48.5	.016	.25	3600	28.3	.016	.25	2200	17.3	.016	.25
3/8	3700	46.6	.019	.3	3000	26.0	.019	.3	1800	15.6	.019	.3
1/2	2800	35.3	.025	.4	2300	21.7	.025	.4	1400	13.2	.025	.4
Depth of cut												

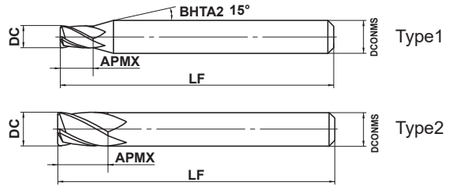
Material	Copper, Copper Alloys				Heat Resistant Alloys			
DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)	Revolution (min^{-1})	Table feed (IPM)	Depth of cut ap (inch)	Width of cut ae (inch)
1/4	6500	61.4	.013	.2	1500	6.6	.008	.2
5/16	5200	57.3	.016	.25	1200	7.6	.009	.25
3/8	4300	54.2	.019	.3	1000	8.8	.011	.3
1/2	3300	41.6	.025	.4	750	7.6	.015	.4
Depth of cut								

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy, and heat resistant alloy can be achieved with the use of water-soluble cutting fluid.
Note 3) Higher feeds and speeds can be used for smaller depth of cut.
Note 4) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is very low, then vibration can occur. In this case, please reduce the revolution and feed rate proportionately, or set a lower depth of cut.

VQ4MRB-FB

Corner radius end mill, Medium cut length, 4 flute, For Swiss-Type lathe

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



DC				
0 - 0.020				
DCONMS=6	DCONMS=8, 10			
0 - 0.008	0 - 0.009			

- A corner radius end mill with high fracture resistance.
- A turn milling machine tool for Swiss-type automatic lathes for machining lobe surfaces.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQ4MRBD0400R030-FB	4	0.3	6	50	6	4	●	1
VQ4MRBD0600R030-FB	6	0.3	9	50	6	4	●	2
VQ4MRBD0800R030-FB	8	0.3	12	60	8	4	●	2
VQ4MRBD1000R050-FB	10	0.5	15	70	10	4	●	2

Note 1) SMART MIRACLE Coating is not conductive because of its nature. Therefore, an external contact (voltaic type) tool setter cannot be used. An internal contact (non-voltaic) type or laser type tool setter is recommended to measure the length of the tool.

● : USA Stock

VQ4MRB-FB

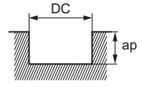
Corner radius end mill, Medium cut length, 4 flute, For Swiss-Type lathe

RECOMMENDED CUTTING CONDITIONS

Side Milling

Material		Carbon Steel, Cast Iron, Alloy Steel (<30HRC)				Alloy Steel, Tool Steel, Pre-Hardened Steel				Austenitic Stainless Steel, Titanium Alloys				Copper, Copper Alloys			
DC (mm)	DC (inch)	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap** (inch)	Width of Cut **ae** (inch)	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap** (inch)	Width of Cut **ae** (inch)	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap** (inch)	Width of Cut **ae** (inch)	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap** (inch)	Width of Cut **ae** (inch)
4	**.157**	7500	35.4	.157	.024	5200	23.6	.157	.024	4500	17.7	.157	.024	9500	43.3	.157	.024
6	**.236**	5000	35.4	.236	.024	3500	23.6	.236	.024	3000	17.7	.236	.024	6400	43.3	.236	.024
8	**.315**	4000	30.7	.315	.024	2800	20.5	.315	.024	2400	15.4	.315	.024	4800	37.0	.315	.024
10	**.394**	3200	26.8	.394	.024	2200	17.7	.394	.024	1900	13.4	.394	.024	3800	31.9	.394	.024
Depth of Cut																	

Slotting

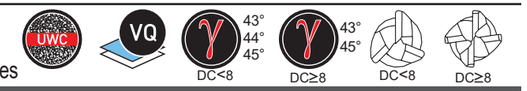
Material		Carbon Steel, Cast Iron, Alloy Steel (−30HRC)			Alloy Steel, Tool Steel, Pre-Hardened Steel			Austenitic Stainless Steel, Titanium Alloys			Copper, Copper Alloys		
DC (mm)	DC (inch)	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap**	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap**	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap**	Revolution (min^{-1})	Table Feed (IPM)	Depth of Cut **ap**
4	**.157**	7500	35.4	.024	5200	23.6	.024	4500	17.7	.024	9500	43.3	.024
6	**.236**	5000	35.4	.024	3500	23.6	.024	3000	17.7	.024	6400	43.3	.024
8	**.315**	4000	30.7	.024	2800	20.5	.024	2400	15.4	.024	4800	37.0	.024
10	**.394**	3200	26.8	.024	2200	17.7	.024	1900	13.4	.024	3800	31.9	.024
Depth of Cut													

DC:Dia.

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work.
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) When drilling, please set the feed rate at 1/3 or below the values above.
Note 5) If the rigidity of the machine or the workpiece material installation is very low, or chattering and noise are generated, reduce the revolution and feed rate proportionately.

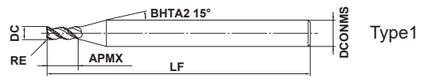
VQSVR

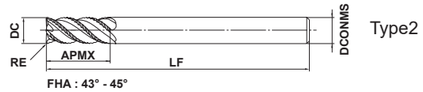
Roughing end mill, Short cut length, 3—4 flute, Irregular helix flutes

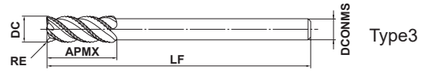


Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-hardened Steel Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Cobalt Chrome Alloy Titanium Alloy	Heat Resistanse Alloy	Copper Alloy
◎	○			◎	◎	○	○

FHA : 43° - 45°







h6

DCONMS=6	DCONMS=8, 10	DCONMS=12, 16	DCONMS=20
0 - 0.008	0 - 0.009	0 - 0.011	0 - 0.013

- Achieving an excellent vibration resistance due to the adoption of irregular helix.
- Use of an asymmetric chip breaker improves fracture resistance substantially. (Compared to a conventional roughing end mill)

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQSVRD0300	3	0.2	6	60	6	3	●	1
VQSVRD0400	4	0.2	8	60	6	3	●	1
VQSVRD0500	5	0.3	10	60	6	3	●	1
VQSVRD0600	6	0.3	12	70	6	3	●	2
VQSVRD0700	7	0.3	17	80	8	3	●	1
VQSVRD0800	8	0.5	17	80	8	4	●	2
VQSVRD0900	9	0.5	22	90	10	4	●	1
VQSVRD1000S08	10	0.5	22	90	8	4	●	3
VQSVRD1000	10	0.5	22	90	10	4	●	2
VQSVRD1200S10	12	0.5	27	100	10	4	●	3
VQSVRD1200	12	0.5	27	100	12	4	●	2
VQSVRD1400	14	0.5	27	130	12	4	★	3
VQSVRD1600	16	0.5	33	125	16	4	★	2
VQSVRD1800	18	0.5	33	150	16	4	★	3
VQSVRD2000	20	0.5	38	140	20	4	★	2

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

● : USA Stock ★ : Stocked in Japan

VQSVR

Roughing end mill, Short cut length, 3—4 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

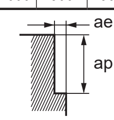
Side milling

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless steel, Cobalt Chromium Alloys					Copper, Copper Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)
3	150	16000	960	4.5	1.5	120	13000	640	4.5	1.5	100	11000	450	4.5	1.5	75	8000	330	4.5	0.9	180	19000	1100	4.5	1.5
4	150	12000	960	6	2	120	9500	640	6	2	100	8000	430	6	2	75	6000	330	6	1.2	180	14000	1100	6	2
5	150	9500	960	7.5	2.5	120	7600	640	7.5	2.5	100	6400	440	7.5	2.5	75	4800	330	7.5	1.5	180	11000	1100	7.5	2.5
6	150	8000	960	9	3	120	6400	680	9	3	100	5300	480	9	3	75	4000	360	9	1.8	180	9500	1100	9	3
7	150	6800	950	10.5	3.5	120	5500	700	10.5	3.5	100	4500	500	10.5	3.5	75	3400	380	10.5	2.1	180	8200	1100	10.5	3.5
8	150	6000	1100	12	4	120	4800	800	12	4	100	4000	570	12	4	75	3000	430	12	2.4	180	7200	1300	12	4
9	150	5300	1100	13.5	4.5	120	4200	760	13.5	4.5	100	3500	570	13.5	4.5	75	2700	430	13.5	2.7	180	6400	1300	13.5	4.5
10	150	4800	1100	15	5	120	3800	760	15	5	100	3200	570	15	5	75	2400	430	15	3	180	5700	1200	15	5
12	150	4000	960	18	6	120	3200	700	18	6	100	2700	540	18	6	75	2000	400	18	3.6	180	4800	1200	18	6
14	150	3400	880	21	7	120	2700	650	21	7	100	2300	510	21	7	75	1700	380	21	4.2	180	4100	1100	21	7
16	150	3000	840	24	8	120	2400	620	24	8	100	2000	500	24	8	75	1500	380	24	4.8	180	3600	1000	24	8
18	150	2700	810	27	9	120	2100	590	27	9	100	1800	500	27	9	75	1300	360	27	5.4	180	3200	960	27	9
20	150	2400	760	30	10	120	1900	560	30	10	100	1600	500	30	10	75	1200	360	30	6	180	2900	920	30	10

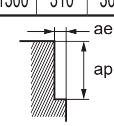
Depth of cut



General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel					Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel					Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys					Hardened Stainless steel, Cobalt Chromium Alloys					Copper, Copper Alloys				
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Hole Depth ap (mm)	Hole Depth ae (mm)
3	120	13000	610	4.5	1.5	100	11000	430	4.5	1.5	80	8500	280	4.5	1.5	70	7400	240	4.5	0.9	140	15000	700	4.5	1.5
4	120	9500	610	6	2	100	8000	430	6	2	80	6400	280	6	2	70	5600	240	6	1.2	140	11000	700	6	2
5	120	7600	610	7.5	2.5	100	6400	430	7.5	2.5	80	5100	280	7.5	2.5	70	4500	250	7.5	1.5	140	8900	720	7.5	2.5
6	120	6400	610	9	3	100	5300	450	9	3	80	4200	300	9	3	70	3700	270	9	1.8	140	7400	720	9	3
7	120	5500	620	10.5	3.5	100	4500	480	10.5	3.5	80	3600	320	10.5	3.5	70	3200	290	10.5	2.1	140	6400	720	10.5	3.5
8	120	4800	720	12	4	100	4000	570	12	4	80	3200	380	12	4	70	2800	340	12	2.4	140	5600	840	12	4
9	120	4200	670	13.5	4.5	100	3500	510	13.5	4.5	80	2800	360	13.5	4.5	70	2500	320	13.5	2.7	140	5000	800	13.5	4.5
10	120	3800	670	15	5	100	3200	510	15	5	80	2500	360	15	5	70	2200	310	15	3	140	4500	790	15	5
12	120	3200	610	18	6	100	2700	470	18	6	80	2100	340	18	6	70	1900	300	18	3.6	140	3700	710	18	6
14	120	2700	560	21	7	100	2300	440	21	7	80	1800	320	21	7	70	1600	280	21	4.2	140	3200	670	21	7
16	120	2400	540	24	8	100	2000	410	24	8	80	1600	320	24	8	70	1400	280	24	4.8	140	2800	630	24	8
18	120	2100	500	27	9	100	1800	400	27	9	80	1400	310	27	9	70	1200	270	27	5.4	140	2500	600	27	9
20	120	1900	480	30	10	100	1600	380	30	10	80	1300	310	30	10	70	1100	270	30	6	140	2200	560	30	10

Depth of cut



Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

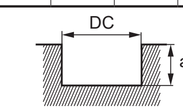
Slotting

When machine rigidity, workpiece material rigidity and chip discharge are enough, please select the high efficiency cutting conditions.
When either machine rigidity, workpiece material rigidity or chip discharge are not enough, please select the general-purpose cutting conditions.

High efficiency conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless steel, Cobalt Chromium Alloys				Copper, Copper Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
3	120	13000	720	3	100	11000	440	3	80	8500	340	3	60	6400	250	1.5	150	16000	890	3
4	120	9500	720	4	100	8000	450	4	80	6400	340	4	60	4800	250	2	150	12000	900	4
5	120	7600	720	5	100	6400	460	5	80	5100	300	5	60	3800	230	2.5	150	9500	900	5
6	120	6400	720	6	100	5300	460	6	80	4200	310	6	60	3200	240	3	150	8000	900	6
7	120	5500	730	7	100	4500	470	7	80	3600	330	7	60	2700	250	3.5	150	6800	950	7
8	120	4800	840	8	100	4000	560	8	80	3200	400	8	60	2400	300	4	150	6000	1100	8
9	120	4200	810	9	100	3500	540	9	80	2800	350	9	60	2100	260	4.5	150	5300	1000	9
10	120	3800	800	10	100	3200	520	10	80	2500	340	10	60	1900	260	5	150	4800	1000	10
12	120	3200	750	12	100	2700	480	12	80	2100	340	12	60	1600	260	6	150	4000	940	12
14	120	2700	670	14	100	2300	420	14	80	1800	300	14	60	1400	240	7	150	3400	840	14
16	120	2400	620	16	100	2000	380	16	80	1600	290	16	60	1200	220	8	150	3000	780	16
18	120	2100	570	18	100	1800	380	18	80	1400	260	18	60	1100	210	9	150	2700	730	18
20	120	1900	540	20	100	1600	350	20	80	1300	260	20	60	950	190	10	150	2400	680	20

Depth of cut

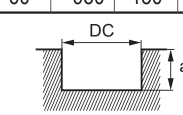


DC : Dia.

General-purpose conditions

Material	Carbon Steel, Alloy Steel, Mild Steel				Pre-hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel				Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys				Hardened Stainless steel, Cobalt Chromium Alloys				Copper, Copper Alloys			
DC (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)	Cutting speed (m/min)	Revolution (min^{-1})	Table feed (mm/min)	Depth of cut ap (mm)
3	100	11000	490	3	80	8500	300	3	60	6400	200	3	50	5300	170	1.5	120	13000	580	3
4	100	8000	490	4	80	6400	310	4	60	4800	200	4	50	4000	170	2	120	9500	580	4
5	100	6400	490	5	80	5100	310	5	60	3800	200	5	50	3200	170	2.5	120	7600	580	5
6	100	5300	490	6	80	4200	310	6	60	3200	200	6	50	2700	170	3	120	6400	580	6
7	100	4500	500	7	80	3600	320	7	60	2700	200	7	50	2300	170	3.5	120	5500	620	7
8	100	4000	600	8	80	3200	380	8	60	2400	240	8	50	2000	200	4	120	4800	720	8
9	100	3500	540	9	80	2800	330	9	60	2100	210	9	50	1800	180	4.5	120	4200	650	9
10	100	3200	540	10	80	2500	330	10	60	1900	210	10	50	1600	180	5	120	3800	640	10
12	100	2700	510	12	80	2100	320	12	60	1600	210	12	50	1300	170	6	120	3200	600	12
14	100	2300	460	14	80	1800	300	14	60	1400	190	14	50	1100	150	7	120	2700	540	14
16	100	2000	410	16	80	1600	290	16	60	1200	170	16	50	990	140	8	120	2400	500	16
18	100	1800	390	18	80	1400	260	18	60	1100	170	18	50	880	130	9	120	2100	460	18
20	100	1600	360	20	80	1300	260	20	60	950	150	20	50	800	130	10	120	1900	430	20

Depth of cut



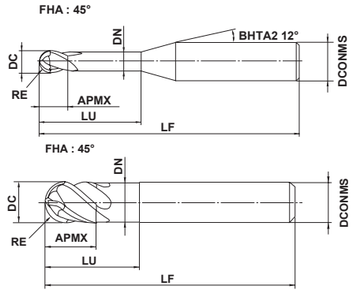
DC : Dia.

Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the feed rate can be increased.

VQ4SVB

Ball nose, Medium cut length, 4 flute

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



RE				
±0.01				
DCONMS=6	DCONMS=8 10	DCONMS=12		
0 - 0.008	0 - 0.009	0 - 0.011		

- 4 flute ball nose end mill
- With the special substrate, suitable for finishing of heat resistance alloy, etc.

(mm)

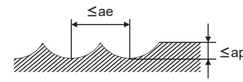
Order Number	RE	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4SVBR0100	1	2	3	5	1.9	50	6	4	●	1
VQ4SVBR0150	1.5	3	4.5	7.5	2.9	50	6	4	●	1
VQ4SVBR0200	2	4	6	10	3.9	50	6	4	●	1
VQ4SVBR0250	2.5	5	7.5	12.5	4.9	50	6	4	●	1
VQ4SVBR0300	3	6	9	15	5.85	50	6	4	●	2
VQ4SVBR0400	4	8	12	20	7.85	60	8	4	●	2
VQ4SVBR0500	5	10	15	25	9.7	70	10	4	●	2
VQ4SVBR0600	6	12	18	30	11.7	75	12	4	●	2

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

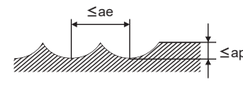
● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Shoulder milling (slotting)

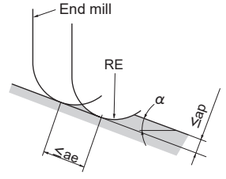
Material	Carbon Steel, Alloy Steel, Mild Steel, Pre-Hardened Steel								Austenitic Stainless Steel, Titanium Alloys, Precipitation Hardening Stainless Steel, Cobalt Chromium Alloys, Ferritic and Martensitic Stainless Steel							
RE (mm)	α≤15°			α>15°			Depth of cut ap (mm)	Depth of cut ae (mm)	α≤15°			α>15°			Depth of cut ap (mm)	Depth of cut ae (mm)
	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)			Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)		
R 1	250	40000	8000	200	32000	3800	0.17	0.5	230	36000	6500	150	24000	2900	0.17	0.5
R 1.5	300	32000	7700	200	21000	3200	0.25	0.75	230	24000	4800	150	16000	1900	0.25	0.75
R 2	300	24000	5800	200	16000	2800	0.33	1	230	18000	4000	150	12000	1700	0.33	1
R 2.5	300	19000	5300	200	12700	2600	0.42	1.25	230	14400	3500	150	9600	1500	0.42	1.25
R 3	300	16000	4800	200	10600	2100	0.5	1.5	230	12000	3200	150	8000	1400	0.5	1.5
R 4	300	12000	4300	200	8000	1900	0.8	2	230	9000	3200	150	6000	1400	0.8	2
R 5	300	9600	4100	200	6400	1800	1	2.5	230	7200	3000	150	4800	1300	1	2.5
R 6	300	8000	4000	200	5300	1800	1.2	3	230	6000	3000	150	4000	1300	1.2	3
Depth of cut																

RE : Radius

Material	Copper, Copper Alloys								Heat Resistant Alloy							
RE (mm)	α≤15°			α>15°			Depth of cut ap (mm)	Depth of cut ae (mm)	α≤15°			α>15°			Depth of cut ap (mm)	Depth of cut ae (mm)
	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)			Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)	Cutting speed (m/min)	Revolution (min-1)	Table feed (mm/min)		
R 1	250	40000	8000	240	38000	4500	0.17	0.5	60	9600	960	40	6400	510	0.08	0.2
R 1.5	360	38000	9100	240	25000	3800	0.25	0.7	60	6400	640	40	4200	340	0.13	0.3
R 2	360	29000	7000	240	19000	3300	0.33	1	60	4800	580	40	3200	260	0.17	0.4
R 2.5	360	23000	6400	240	15000	3100	0.42	1.2	60	3800	530	39	2500	250	0.21	0.5
R 3	360	19000	5700	240	13000	2600	0.5	1.5	60	3200	500	40	2100	210	0.25	0.6
R 4	360	14000	5000	240	9600	2300	0.8	2	60	2400	430	40	1600	190	0.4	0.8
R 5	360	12000	5100	240	7700	2200	1	2.5	63	2000	420	41	1300	180	0.5	1
R 6	360	9600	4800	240	6400	2200	1.2	3	64	1700	350	41	1100	150	0.6	1.2
Depth of cut																

RE : Radius

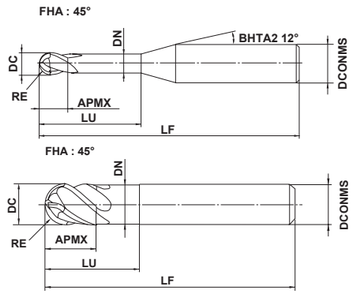
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.
Note 4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.
Note 5) α is the inclination angle of the machined surface.



VQ4SVB – Inch sizes

Ball nose, Medium cut length, 4 flute

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



RE				
±.0004"				
DCONMS≤.3750"	DCONMS=.5000"			
h6 0 - .00035"	h6 0 - .00043"			

- 4 flute ball nose end mill
- With the special substrate, suitable for finishing of heat resistance alloy, etc.

(inch)

Order Number	RE	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock	Type
VQ4SVBD1/8	.0625	.1250	.188	.3126	.1213	2.0	.2500	4	●	1
VQ4SVBD3/16	.0938	.1875	.281	.4689	.1835	2.0	.2500	4	●	1
VQ4SVBD1/4	.1250	.2500	.375	.6252	.2441	2.0	.2500	4	●	2
VQ4SVBD5/16	.1563	.3125	.469	.7811	.3067	2.5	.3125	4	●	2
VQ4SVBD3/8	.1875	.3750	.563	.9374	.3693	2.75	.3750	4	●	2
VQ4SVBD1/2	.2500	.5000	.750	1.2500	.4882	3.0	.5000	4	●	2

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

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Shoulder milling (Slotting)

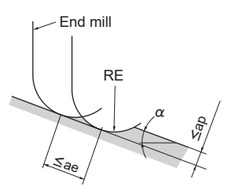
Material	Carbon Steel, Alloy Steel, Mild Steel, Pre-Hardened Steel						Austenitic Steinless Steel, Precipitation Hardening Stainless Steel, Ferritic and Martensitic Stainless Steel, Cobalt Chomium Alloys, Titanium alloys					
RE (inch)	α≤15°		α>15°		Depth of cut ap (inch)	Depth of cut ae (inch)	α≤15°		α>15°		Depth of cut ap (inch)	Depth of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
.0625	30000	283.5	20000	118.1	.0098	.0313	22500	189.0	15000	74.8	.0098	.0313
.0938	20000	220.5	13400	102.4	.0165	.0469	15000	137.8	10000	59.1	.0165	.0469
.1250	15000	177.2	10000	82.7	.0197	.0626	11200	126.0	7500	55.1	.0197	.0626
.1563	12000	169.3	8000	74.8	.0315	.0781	9000	126.0	6000	55.1	.0315	.0781
.1875	10000	161.4	6700	70.9	.0394	.0937	7500	118.1	5000	51.2	.0394	.0937
.2500	7600	149.6	5000	70.9	.0472	.125	5600	118.1	3800	51.2	.0472	.125
Depth of cut	≤ae ≤ap											

RE : Radius

Material	Copper, Copper Alloys						Heat Resistant Alloys					
RE (inch)	α≤15°		α>15°		Depth of cut ap (inch)	Depth of cut ae (inch)	α≤15°		α>15°		Depth of cut ap (inch)	Depth of cut ae (inch)
	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)			Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)		
.0625	36000	338.6	24000	141.7	.0098	.0313	6000	25.2	4000	13.4	.0051	.0313
.0938	24000	263.8	16000	122.0	.0165	.0469	4000	20.9	2700	9.8	.0083	.0469
.1250	18000	212.6	12000	98.4	.0197	.0626	3000	19.7	2000	8.3	.0098	.0626
.1563	14000	196.9	9600	90.6	.0315	.0781	2400	16.9	1600	7.5	.0157	.0781
.1875	12000	192.9	8000	82.7	.0394	.0937	2000	16.5	1300	7.1	.0197	.0937
.2500	9100	181.1	6000	86.6	.0472	.125	1500	13.8	1000	5.9	.0236	.0125
Depth of cut	≤ae ≤ap											

RE : Radius

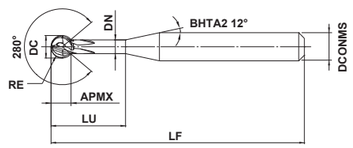
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) When cutting austenitic stainless steel, the use of water-soluble cutting fluid is especially effective.
Note 3) If the depth of cut is smaller than this table, feed rate can be increased.
Note 4) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is very low, then vibration can occur. In this case, please reduce the revolution and feed rate proportionately, or set a lower depth of cut.
Note 5) α is the inclination of the machined surface.



VQ4WB

Lollipop, Short cut length, 4 flute

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



RE				
±0.01				
DCONMS				
0 - 0.008				

- Multi-function ball end mill with a lollipop shape for 5-axis machining.
- Optimal for back deburring, undercutting, and inner curved surface machining.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCONMS	No. of Flutes	Stock
VQ4WBR0050N06E280	0.5	1.0	0.88	6	0.61	50	4	4	●
VQ4WBR0065N08E280	0.65	1.3	1.14	8	0.80	50	4	4	●
VQ4WBR0090N06E280	0.9	1.8	1.58	6	1.11	50	4	4	●
VQ4WBR0100N06E280	1.0	2.0	1.76	6	1.24	60	6	4	●
VQ4WBR0140N16E280	1.4	2.8	2.47	16	1.74	60	6	4	●
VQ4WBR0150N08E280	1.5	3.0	2.64	8	1.87	60	6	4	●
VQ4WBR0190N12E280	1.9	3.8	3.35	12	2.37	60	6	4	●
VQ4WBR0200N12E280	2.0	4.0	3.53	12	2.50	60	6	4	●
VQ4WBR0240N16E280	2.4	4.8	4.23	16	3.00	70	6	4	●
VQ4WBR0250N12E280	2.5	5.0	4.41	12	3.13	80	6	4	●
VQ4WBR0300N12E280	3.0	6.0	5.29	12	3.76	80	6	4	●

Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work.

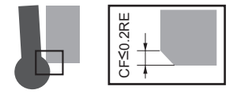
<Order for Special Product>

For special products other than the above tool specifications, please contact our sales department.

● :USA Stock

RECOMMENDED CUTTING CONDITIONS

Chamfering (Debarring)

Material				Milld Steel, Carbon Steel, Copper Alloys, Pre-Hardened Steel			Austentic, Ferritic and Martensitic Stainless Steel, Precipitation Hardening Stainless Steel, Cobalt Chrome Alloys, Titanium Alloys		
DC		**RE**		Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of Cut **Max.CF** (inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of Cut **Max.CF** (inch)
(mm)	(inch)	(mm)	(inch)						
1.0	**.039**	**0.5**	**.020**	19000	11.8	.004	14000	8.7	.004
1.3	**.051**	**0.65**	**.026**	15000	16.5	.005	11000	12.2	.005
1.8	**.071**	**0.9**	**.035**	11000	22.4	.007	8000	16.5	.007
2.0	**.079**	**1.0**	**.039**	9500	24.0	.008	7200	18.1	.008
2.8	**.110**	**1.4**	**.055**	6800	29.9	.011	5100	22.4	.011
3.0	**.118**	**1.5**	**.059**	6400	30.3	.012	4800	22.8	.012
3.8	**.150**	**1.9**	**.075**	5000	33.1	.015	3800	25.2	.015
4.0	**.157**	**2.0**	**.079**	4800	34.6	.016	3600	26.0	.016
4.8	**.189**	**2.4**	**.094**	4000	37.8	.019	3000	28.3	.019
5.0	**.197**	**2.5**	**.098**	3800	38.2	.020	2900	29.1	.020
6.0	**.236**	**3.0**	**.118**	3200	39.4	.024	2400	30.3	.024
Depth of Cut				 RE : Radius					

Internal Profile / Undercut

Material				Milld Steel, Carbon Steel, Copper Alloys, Pre-Hardened Steel			Austentic, Ferritic and Martensitic Stainless Steel, Precipitation Hardening Stainless Steel, Cobalt Chrome Alloys, Titanium Alloys		
DC		**RE**		Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of Cut **ae** (inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of Cut **ae** (inch)
(mm)	(inch)	(mm)	(inch)						
2.0	**.079**	**1.0**	**.039**	9500	18.1	.001	7200	11.4	.001
3.0	**.118**	**1.5**	**.059**	6400	22.0	.004	4800	13.8	.004
4.0	**.157**	**2.0**	**.079**	4800	25.6	.006	3600	15.4	.006
5.0	**.197**	**2.5**	**.098**	3800	28.7	.007	2900	17.3	.007
6.0	**.236**	**3.0**	**.118**	3200	30.3	.009	2400	18.1	.009
Depth of Cut				 RE : Radius					

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-electricity type) or a laser tool setter.
Note 2) If the depth of cut is smaller than this table, feed rate can be increased.
Note 3) If the rigidity of the machine or the workpiece material installation is very low, or chattering is generated, please reduce the revolution and the feed rate proportionately.
Note 4) For sizes RE 0.5, 0.65, 0.9, 1.4, 1.9 and RE 2.4 which have long neck lengths, internal profile milling and round shape slotting are not recommended.

VQ4WB

Lollipop, Short cut length, 4 flute

Radiused Shape Slotting

Material				Milld Steel, Carbon Steel, Copper Alloys, Pre-Hardened Steel				Austentic, Ferritic and Martensitic Stainless Steel, Precipitation Hardening Stainless Steel, Cobalt Chrome Alloys, Titanium Alloys			
DC		RE		Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Depth of Cut		Revolution **n** (min^{-1})	Feed Rate **vf** (IPM)	Depth of Cut	
(mm)	(inch)	(mm)	(inch)			**ae** (inch)	**Max. ae** (inch)			**ae** (inch)	**Max. ae** (inch)
2.0	**.079**	**1.0**	**.039**	9500	11.8	.001	.002	7200	5.5	.001	.002
3.0	**.118**	**1.5**	**.059**	6400	15.0	.004	.008	4800	7.5	.004	.008
4.0	**.157**	**2.0**	**.079**	4800	17.3	.006	.011	3600	9.1	.006	.011
5.0	**.197**	**2.5**	**.098**	3800	19.3	.007	.021	2900	10.2	.007	.021
6.0	**.236**	**3.0**	**.118**	3200	20.1	.009	.035	2400	10.6	.009	.035
Depth of Cut				Max Cut of Depth ae				Max Cut of Depth ae			

RE : Radius

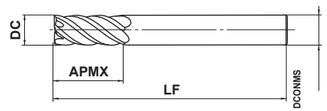
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electricity type) or a laser tool setter.
Note 2) If the depth of cut is smaller than this table, feed rate can be increased.
Note 3) If the rigidity of the machine or the workpiece material installation is very low, or chattering is generated, please reduce the revolution and the feed rate proportionately.
Note 4) For sizes RE 0.5, 0.65, 0.9, 1.4, 1.9 and RE 2.4 which have long neck lengths, internal profile milling and round shape slotting are not recommended.
Note 5) Though max ae means stably machinable cutting condition, maximum depth of calculated by effective cutting edge angle is 0.3 times RE. (In that case please reduce the revolution and feed rate than this table.)

VQ5MHV – Inch sizes

End mill, Medium cut length, 5 flute, Irregular helix flutes

UWC VQ γ 39° 40° 41°

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



DC				
0 - .0012"				
DCONMS≤.3750"	DCONMS=.5000"			
0 - .0002"	0 - .0003"			

● SMART MIRACLE irregular helix end mills for reducing vibration and for delivering stable performance on difficult-to-cut materials and long overhang applications.

(inch)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock
VQ5MHVD1/4	.2500	.625	2.500	.2500	5	●
VQ5MHVD5/16	.3125	.750	2.750	.3125	5	●
VQ5MHVD3/8	.3750	.875	3.250	.3750	5	●
VQ5MHVD1/2	.5000	1.125	4.000	.5000	5	●

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

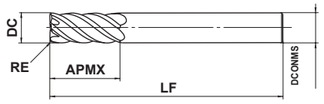
● : USA Stock

VQ5MHVRB – Inch sizes

Corner radius, Medium cut length, 5 flute, Irregular helix flutes

39°
40°
41°

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



RE				
±.0006"				
DC				
0 - .0012"				
DCONMS≤.3750"	DCONMS=.5000"			
0 - .0002"	0 - .0003"			

● SMART MIRACLE corner radius, irregular helix end mills for reducing vibration and for delivering stable performance on difficult-to-cut materials and long overhang applications.

(inch)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock
VQ5MHVRBD1/4R010	.2500	.010	.625	2.500	.2500	5	●
VQ5MHVRBD5/16R015	.3125	.015	.750	2.750	.3125	5	●
VQ5MHVRBD3/8R030	.3750	.030	.875	3.250	.3750	5	●
VQ5MHVRBD1/2R030	.5000	.030	1.125	4.000	.5000	5	●

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

● :USA Stock

VQ5MHV – Inch sizes

End mill, Medium cut length, 5 flute, Irregular helix flutes

VQ5MHVRB – Inch sizes

Corner radius, Medium cut length, 5 flute, Irregular helix flutes

RECOMMENDED CUTTING CONDITIONS

Side milling

(inch)

Material		Carbon Steel(<30HRC)						Alloy Steel, Pre-Hardened Steel					
DC		High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	Depth of Cut **ae** (inch)	High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	Depth of Cut **ae** (inch)
(mm)	(inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)			Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)		
6.350	**.2500**	7500	90.6	6000	63.0	.375	.075	6000	47.2	5000	31.5	.375	.075
7.938	**.3125**	6000	90.6	4800	63.0	.469	.094	4800	51.2	4000	35.4	.469	.094
9.525	**.3750**	5000	90.6	4000	59.1	.563	.113	4000	51.2	3300	33.5	.563	.113
12.700	**.5000**	3800	66.9	3000	43.3	.750	.150	3000	43.3	2500	29.5	.750	.150
Depth of Cut													

Material		Austenitic Stainless Steel, Titanium Alloys						Precipitation Hardening Steinless Steel, Cobalt Chrome Alloys					
DC		High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	Depth of Cut **ae** (inch)	High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	Depth of Cut **ae** (inch)
(mm)	(inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)			Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)		
6.350	**.2500**	5000	39.4	4000	25.6	.375	.050	3800	37.4	3500	21.7	.375	.050
7.938	**.3125**	4000	43.3	3200	29.5	.469	.063	3000	43.3	2800	25.6	.469	.063
9.525	**.3750**	3300	51.2	2700	33.5	.563	.075	2500	39.4	2300	23.6	.563	.075
12.700	**.5000**	2500	39.4	2000	27.6	.750	.100	1900	30.3	1800	19.7	.750	.100
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-electricity type) or a laser tool setter.
Note 2) When cutting titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills.
However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnomal sound can occur.
In this case, please reduce the revolution and the feed rate proportionately, or set a lower depth of cut.
Note 4) If the depth of cut is smaller, the revolution and the feed rate can be increased.

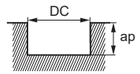
VQ5MHV – Inch sizes

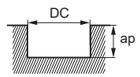
End mill, Medium cut length, 5 flute, Irregular helix flutes

VQ5MHVRB – Inch sizes

Corner radius, Medium cut length, 5 flute, Irregular helix flutes

Slot Milling

Material		Carbon Steel(<30HRC)					Alloy Steel, Pre-Hardened Steel				
DC		High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)
(mm)	(inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)		Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	
6.350	**.2500**	7500	55.1	5000	37.4	.250	6000	31.5	4000	19.7	.250
7.938	**.3125**	6000	55.1	4000	35.4	.312	4800	31.5	3200	19.7	.312
9.525	**.3750**	5000	51.2	3300	33.5	.375	4000	28.3	2700	17.7	.375
12.700	**.5000**	3800	39.4	2500	25.6	.500	3000	23.2	2000	13.8	.500
Depth of Cut											

Material		Austenitic Stainless Steel, Titanium Alloys					Precipitation Hardening Steinless Steel				
DC		High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)	High Speed Cutting		General Purpose Cutting		Depth of Cut **ap** (inch)
(mm)	(inch)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)		Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	Revolution **n** (min^{-1})	Table Feed **vf** (IPM)	
6.350	**.2500**	5000	34.3	3000	13.8	.250	3000	23.6	2500	11.8	.250
7.938	**.3125**	4000	39.4	2400	15.7	.312	2400	23.6	2000	11.8	.312
9.525	**.3750**	3300	37.8	2000	17.7	.375	2000	21.7	1700	9.8	.375
12.700	**.5000**	2500	31.5	1500	13.8	.500	1500	17.7	1300	7.9	.500
Depth of Cut											

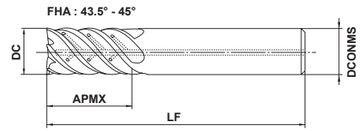
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) or a laser tool setter.
Note 2) When cutting titanium alloys, the use of water-soluble cutting fluid is effective.
Note 3) The irregular helix flute end mill has a larger effect on controlling vibration when compred to standard end mills.
However, if the rigidity of the machine or the workpiece material installation is poor, vibration or abnomal sound can occur.
In this case, please reduce the revolution and the feed rate proportionately, or set a lower depth of cut.
Note 4) If the depth of cut is smaller, the revolution and the feed rate can be increased.

VQ6MHVCH

End mill, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant

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

CoolStar



Type1

DC≤12	DC>12			
0 - 0.020	0 - 0.030			
DCONMS=10	DCONMS=12, 16	DCONMS=20		
0 - 0.009	0 - 0.011	0 - 0.013		

●Vibration control end mill with multiple thru-coolant holes ensures stable machining on difficult-to-cut materials and applications requiring long overhangs.

(mm)

Order Number	DC	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQ6MHVCHD1000	10	22	70	10	6	●	1
VQ6MHVCHD1200	12	26	75	12	6	●	1
VQ6MHVCHD1600	16	32	90	16	6	●	1
VQ6MHVCHD2000	20	38	100	20	6	●	1

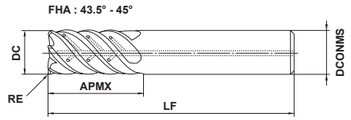
● : USA Stock

VQ6MHVRBCH

Corner radius, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant

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

CoolStar



Type1

RE				
±0.015				
DC≤12	DC>12			
0 - 0.020	0 - 0.030			
DCONMS=10	DCONMS=12, 16	DCONMS=20		
0 - 0.009	0 - 0.011	0 - 0.013		

● Vibration control corner radius end mill with multiple thru-coolant holes ensures stable machining on difficult-to-cut materials and applications requiring long overhangs.

(mm)

Order Number	DC	RE	APMX	LF	DCONMS	No. of Flutes	Stock	Type
VQ6MHVRBCHD1000R050	10	0.5	22	70	10	6	●	1
VQ6MHVRBCHD1000R100	10	1	22	70	10	6	●	1
VQ6MHVRBCHD1200R050	12	0.5	26	75	12	6	●	1
VQ6MHVRBCHD1200R100	12	1	26	75	12	6	●	1
VQ6MHVRBCHD1200R050	12	0.5	26	75	12	6	●	1
VQ6MHVRBCHD1200R100	12	1	26	75	12	6	●	1
VQ6MHVRBCHD1600R100	16	1	32	90	16	6	●	1
VQ6MHVRBCHD1600R300	16	3	32	90	16	6	●	1
VQ6MHVRBCHD1600R400	16	4	32	90	16	6	●	1
VQ6MHVRBCHD2000R100	20	1	38	100	20	6	●	1
VQ6MHVRBCHD2000R300	20	3	38	100	20	6	●	1
VQ6MHVRBCHD2000R400	20	4	38	100	20	6	●	1

● :USA Stock

VQ6MHVCH

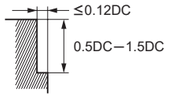
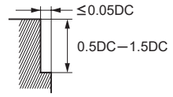
End mill, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant

VQ6MHVRBCH

Corner radius, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant

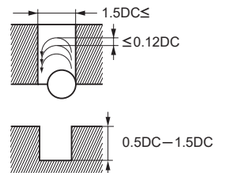
RECOMMENDED CUTTING CONDITIONS

Shoulder milling

Material		Alloy Steel, Tool Steel, Pre-Hardened Steel		Austenitic Stainless Steel(≤200HB) Titanium Alloys		Copper, Copper Alloys		Heat Resistant Alloys	
DC (mm)	DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)
10	**.394**	–	–	4800	78.7	–	–	1300	10.2
12	**.472**	–	–	4000	78.7	–	–	1100	9.1
16	**.630**	4000	86.6	3000	63.0	2400	55.1	800	7.1
20	**.787**	3200	74.8	2400	55.1	1900	43.3	640	5.9
Depth of Cut									

DC : Dia.

Trochoid milling

Material		Alloy Steel, Tool Steel, Pre-Hardened Steel		Austenitic Stainless Steel(≤200HB) Titanium Alloys	
DC (mm)	DC (inch)	Revolution (min^{-1})	Table feed (IPM)	Revolution (min^{-1})	Table feed (IPM)
10	**.394**	–	–	4800	55.1
12	**.472**	–	–	4000	47.2
16	**.630**	4000	63.0	3000	43.3
20	**.787**	3200	55.1	2400	35.4
Depth of Cut					

DC : Dia.

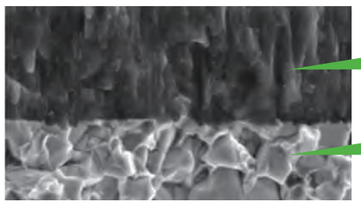
Note 1) If the depth of cut is smaller, the revolution and the feed rate can be increased.
Note 2) The irregular helix flute end mill has a larger effect on controlling vibration when compared to standard end mills. However, if the rigidity of the machine or the workpiece material installation is very low, then vibration can occur. In this case, please reduce the revolution and the feed rate proportionately, or set a lower depth of cut.

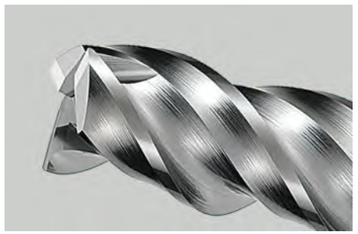
High-Performance End Mill
SMART MIRACLE End Mill Series

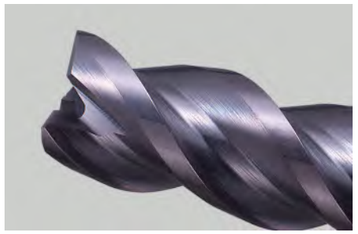
VQXL

SMART MIRACLE Coating

Smart Miracle end mills have been treated with a newly developed (Al, Cr)N group coating which delivers substantially better wear resistance. This is the next generation of coated end mills that delivers long tool life when machining stainless steels and other difficult-to-cut materials.




SMART MIRACLE Coating


Conventional Coating

3 or 4 Flutes

The 3/4-flute design allows for more efficient machining compared to conventional 2-flute long neck end mills.

High Rigidity Neck Design

Optimized neck design (diameter, angle, connection radius) ensures maximum rigidity while avoiding interference with the workpiece, achieving stable machining.

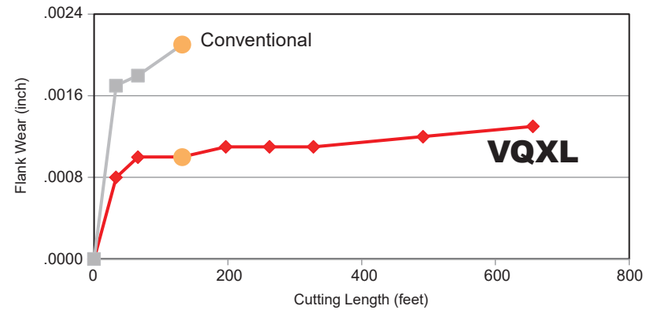
Optimized Gash Land

Micro gash land design minimizes corner residue while maintaining corner strength.

Cutting Performance

Comparison of Tool Life when Machining Titanium Alloy

Compared to conventional products, VQXL achieves stable machining without chipping at the corners. We were also able to reduce the amount of wear to 1/2 that of conventional products.



<Cutting Conditions>
Material : Ti-6AL-4V
Tool : DC=.118 inch
LN=.591 inch
Cutting Speed : vc=195 SFM
Revolution : n=6400 min^{-1}
Feed per Tooth : fz=.0004 IPT
Depth of Cut : ap=.059 inch
ae=.012 inch
Cutting Mode : Wet Cutting
Emulsion

Cutting Length 131.2 feet

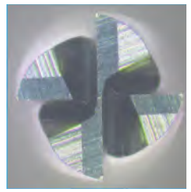

VQXL


Conventional

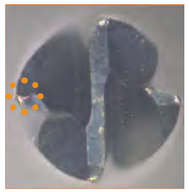
Comparison of TPRX Machining Cobalt Chromium Alloy

VQXL achieved longer tool life and good machined surface.

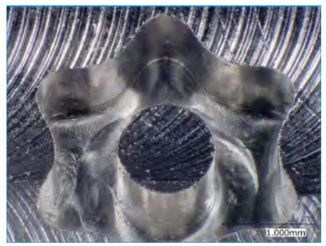
VQXL



Conventional



Severe damage to corners



Burrs due to wear

<Cutting Conditions>
Material : Ti-6AL-4V
Tool : DC=.020 inch
LN=.100 inch
Cutting Speed : vc=195 SFM
Revolution : n=38000 min^{-1}
Feed per Tooth : fz=.0002 IPT
Depth of Cut : ap=.0012 inch
Cutting Mode : Wet Cutting
Emulsion

<Machining Method>
No pilot hole
Repetition of ramping 2°
Shallow groove
Side milling

High-Performance End Mill

SMART MIRACLE End Mill Series

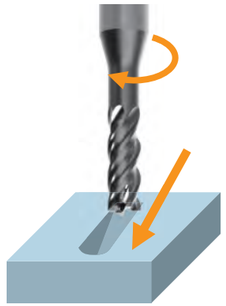
VQ4MVM

Multi-functional end mill capable of steep ramping when machining a wide range of materials.

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

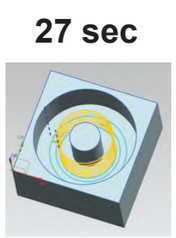
This eliminates the need for a pilot hole when machining pockets, thereby reducing costs through tool consolidation. Compared to direct plunge cutting, ramping enables simultaneous multi-axis feed at high speeds to lower machining times. This method is ideal for machining wide and shallow pockets.

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.



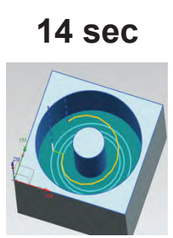
Steep Ramping Capability

27 sec

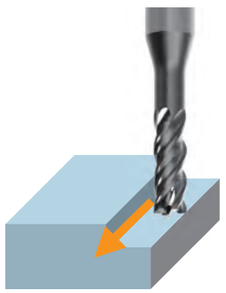


Conventional
Helical Milling
7 passes needed

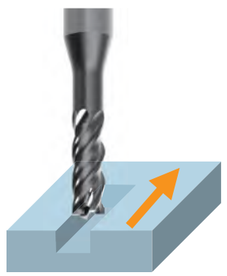
14 sec



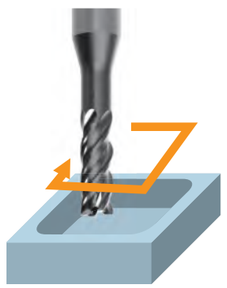
VQ4MVM
Helical and Ramping
Only 1 pass needed



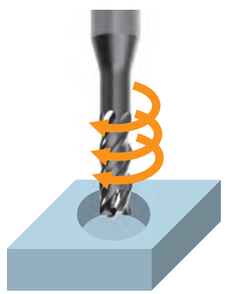
Shoulder Milling



Slot Milling



Pocket Milling



Helical Milling

SMART MIRACLE End Mill Series

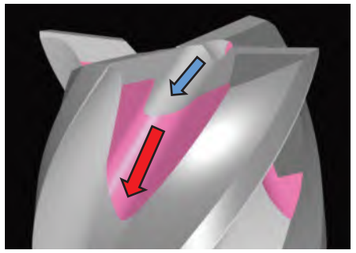
Newly-developed coating with improved wear resistance.
The smoothening treatment of the coating layer reduces cutting resistance and significantly improves chip discharge.

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.

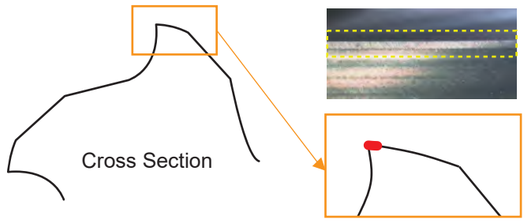
Secondary Gash

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 are improved.



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

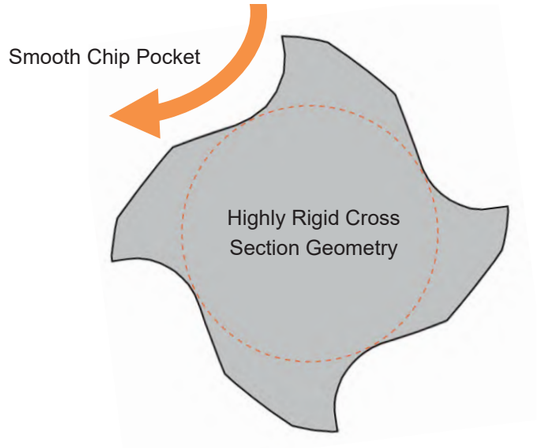
ANSI 304 vc=330 SFM, fz=.002 IPT, ap=.197 inch, ae=.118 inch

VQ4MVM

Conventional

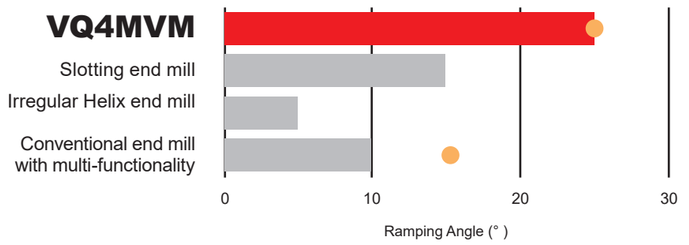
Chip Pocket and Highly Rigid Geometry

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

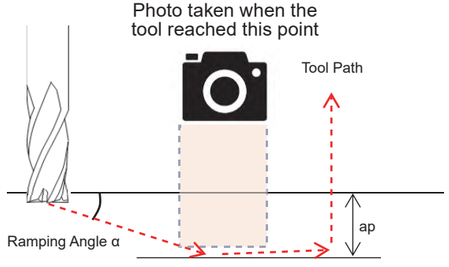


Comparison of Ramping Angles when Machining 304

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>
Material : AISI 304
Tool : Ø.394 inch
Cutting Speed : vc=165 SFM
Feed per Tooth : fz=.001 IPT
Depth of Cut : ap=.394 inch
ae=.394 inch
Over Length : 1.378 inch
Cutting Mode : External Coolant (Emulsion)
Machine : Vertical M/C (BT50)



● : Machining Surface

VQ4MVM 25°

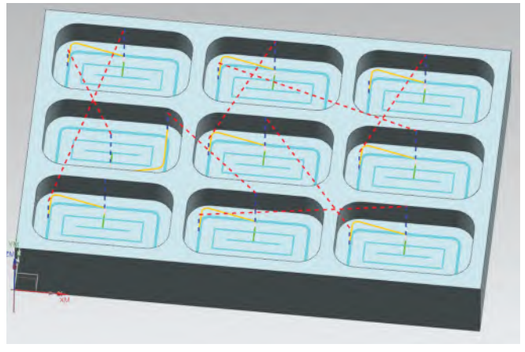
Conventional end mill 15°

Comparison of Continuous Pocketing when Machining 1055

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

Material : AISI 1055 Pocket Size 1.969" x 1.181" x .394" R=8
Tool : Ø.394 inch

Simulated by **VQ4MVM**



Total Cycle Time 4:35

Ramping Angle 17° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.002 IPT
Depth of Cut : ap=.394 inch

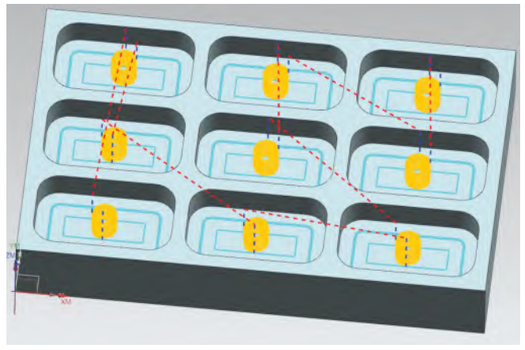
Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Finish Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Simulated Conventional Machining



Total Cycle Time 6:42

Helical Angle 2° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch

Same cutting conditions for roughing and finishing

Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Finish Cutting

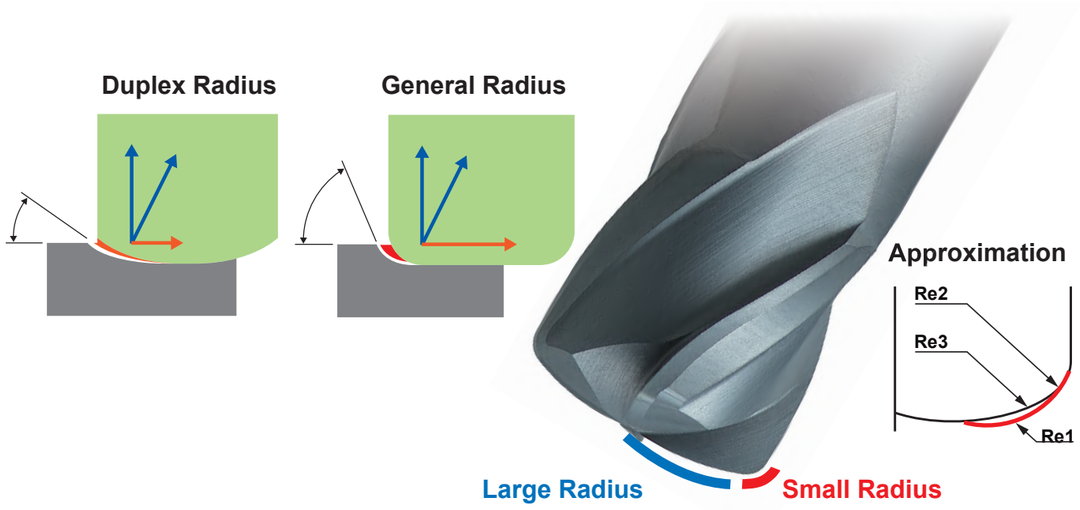
<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

SMART MIRACLE End Mill Series for Dental Milling

Duplex Radius End Mills VQFDRB

VQFDRB provides amazingly long tool life when machining Cobalt Chrome Alloy.

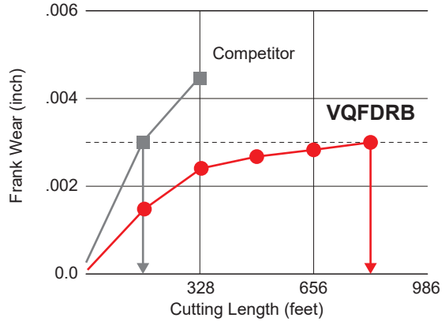
- Improved notch wear via the small side cutting edge angle.
- Reduced flank wear through use of SMART MIRACLE coating and ultra micro-grain cemented carbide.
- Provides stable machining with low radial cutting force.



Cutting Performance : Competitive Comparison

VQFDRB achieved 5 times longer tool life than competitors duplex radius when machining cobalt chrome alloy.

<Cutting Conditions>
Material : Co-Cr-Mo Alloy (ASTM F1537)
Tool : VQFDRBD0300N080 ø0.1181″
Revolution : n=8600min^{-1}(vc=260 SFM)
Feed Rate : vf=51.2 IPM (.0016 IPT)
Depth of Cut : ap=.0079 inch ae=.0512 inch
Coolant : Emulsion



Cutting Example

Competitive Comparison

<Cutting Conditions>
Part Name : Dental Crown
Material : Co-Cr-Mo Alloy (ASTM F1537)
Cutting Process : Rough
Tool : VQFDRBD0400N120 (ø.1575" Re: .0279")
Machine : 5 axis M/C (HSK63)
Coolant : Emulsion
CAM : Hyper Dent

hyperDENT®

< Cutting conditions & Result >

VQFDRB can machine at twice the feed rate without chipping.

Tool	Revolution (min^{-1})	Feed rate (IPM)	Depth of Cut (inch)
VQFDRB	6000 (245 SFM)	118 (.0049 IPT)	ap=.0157 ae=.0787
Genral Radius	6000 (245 SFM)	59 (.0025 IPT)	ap=.0157 ae=.0787

Dental Cobalt Chrome Dentures

<Cutting Conditions>
Part Name : Dental Denture
Material : Co-Cr-Mo Alloy (CAD/CAM Milling Disc)
Cutting Process : Rough
Tool : VQFDRBD0400N120 (ø.1575" Re: .0279")
Machine : 5 axis M/C (HSK63)
Coolant : Emulsion
Revolution : n=8600min^{-1}(vc=355 SFM)
Feed Rate : vf=51.2 IPM (.0016 IPT)
Depth of Cut : ap=.0098 inch (Z Level Operation)

Wada Precision Dental Laboratories Co., Ltd.

Vb=.0018″

< Result >

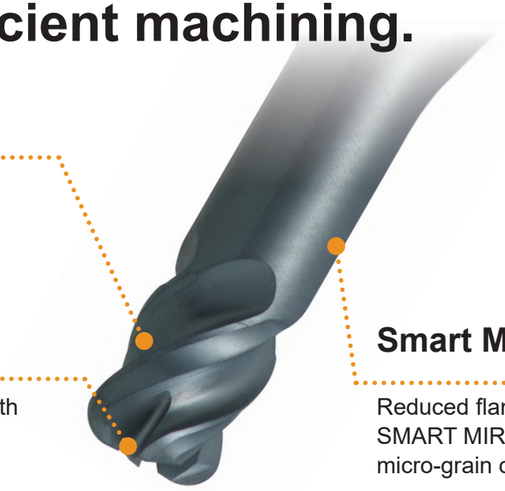
VQFDRB maintained stable machining and achieved good wear resistance throughout machining of disc.

Vibration Control Radius End Mills **VQHVRB**

Increased feed rates and large depths of cut are achievable with VQHVRB resulting in highly efficient machining.

Variable Helix

Vibration control geometry
for stable and smooth cutting.



Special Gash

Good chip disposal enables both increased feed rates and large depths of cut.

Smart Miracle Coating

Reduced flank wear through use of SMART MIRACLE coating and ultra micro-grain cemented carbide.

Cutting Performance : Competitive Comparison

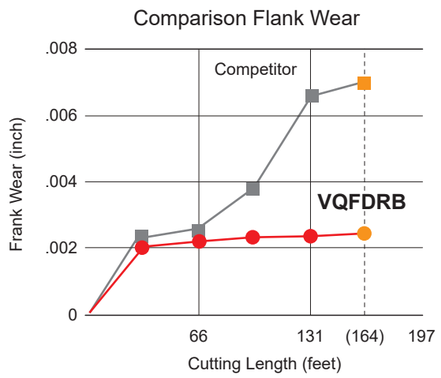
VQHVRB wears less than competitor and enables stable cutting.

<Cutting Conditions>

Material	: Titanium Alloy
Tool	: VQHVRBD0300R05N180 (ø.118")
Revolution	: n=8600min^{-1}(vc=260 SFM)
Feed Rate	: vf=51.2 IPM (.002 IPT)
Depth of Cut	: ap=.008" ae=.051"
Coolant	: Emulsion
Cutting Length	: 164 feet

VQHVRB

Competitor



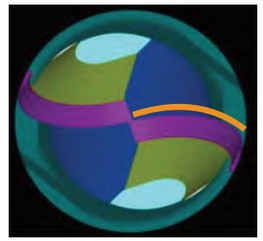
Long Neck Ball Nose End Mills **VQ2XLB**

VQ2XLB provides long tool life and stable cutting when machining Cobalt Chrome Alloy and Titanium Alloy.

- **Improved resistance to chipping via new cutting edge geometry.**
- **SMART MIRACLE coating providing better wear resistance when machining difficult-to-cut materials.**

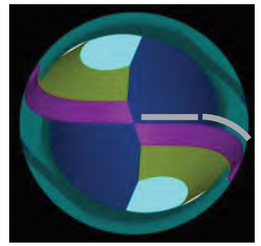
VQ2XLB (For Dental)

Strong S



General (For Mold)

Normal Curve



Tooling Example : Dental Crown (CAD-CAM Disc)

Material : Co-Cr-Mo Alloys

● Customer Comment

"Machined surface roughness is better than conventional tools under normal conditions"

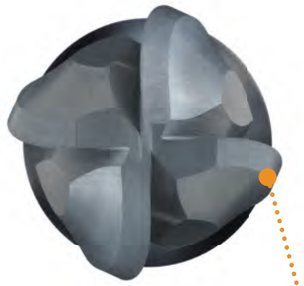
Process		Rough 1	Rough 2	Finish 1	Finish 2
Tool		VQ2XLBR0150N140 Ø.118"(RE.059")	VQ2XLBR0150N140 Ø.118"(RE.059")	VQ2XLBR0100N100S06 Ø.079"(RE.039")	VQ2XLBR0050N080N06 Ø.039"(RE.020")
Cutting Speed **vc** (SFM)		195	260	245	205
Revolution **n** (min^{-1})		6400	8500	12000	20000
Feed Rate **vf** (IPM)		31.5	37.8	31.5	26.0
fz (IPT)		.0025	.0022	.0013	.0007
Depth of Cut	**ap** (inch)	.0059	.0047	.0039	.0020
	ae (inch)	.0394	.0118	.0079	.0031
Cutting Time (min)		400	60	90	150
Wear Condition		Good	Good	Good	Good

Lollipop End Mill for Multi-Functional Difficult-to-Cut Machining

SMART MIRACLE End Mill Series

VQ4WB

**280º extended cutting edge and special geometry of the cutting edge & rake face realizes multi-functional machining and wide range of applications.
Optimal choice for machining undercut and complex shapes when using a 5-axis machine.**



High Efficiency

4 flutes, extended cutting edge, specialized geometry and long tool life make for a highly efficient tool.

Low Cutting Resistance

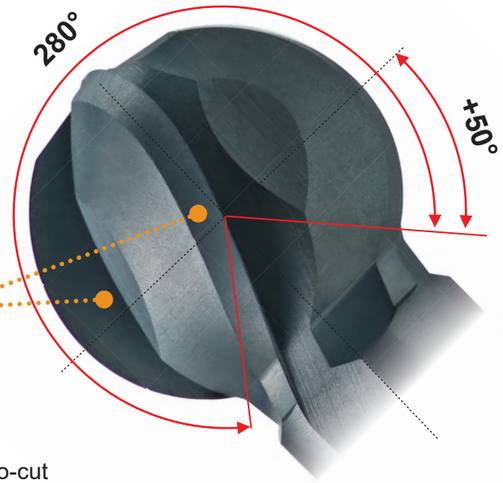
Constant edge and rake geometry helps to prevent burrs and chattering.

Long Tool Life

Long life when machining carbon steel to difficult-to-cut materials by (Al,Cr)N based SMART MIRACLE coating.

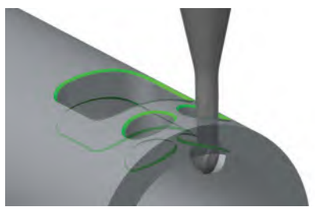
Multiple-Applications

True round ball cutting edge over the full 280º achieves stable cutting even during undercut machining.

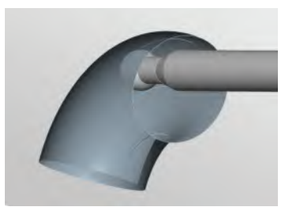


Multiple Applications

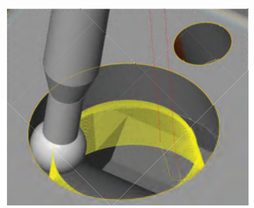
Deburring (Chamfering)



Internal Profile Milling



Undercut Machining



Application Example

①Rounded Shape Slotting

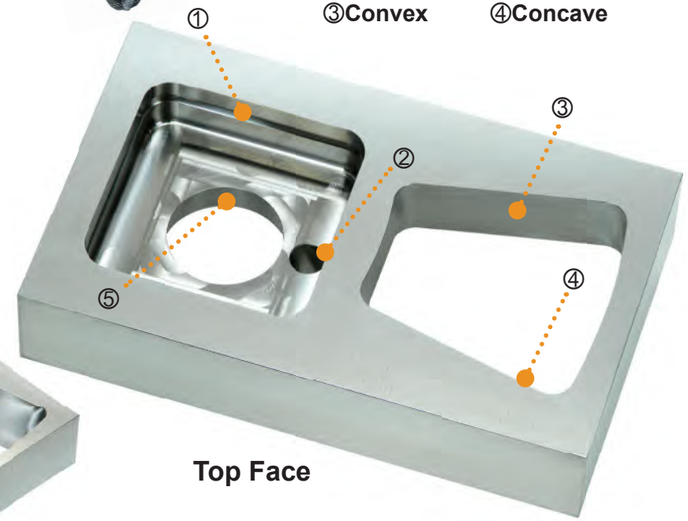
②Deburring (Top & Back Face)

Internal Profile

③Convex ④Concave

⑤Undercut (Taper Hole)

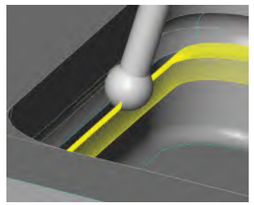
Back Face



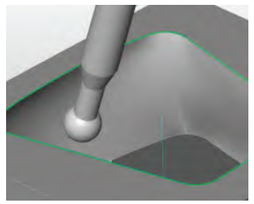
Top Face

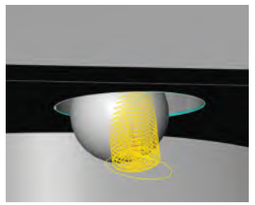
Multiple Applications

Rounded Shape Slotting

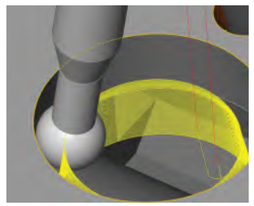


Deburring and Chamfering

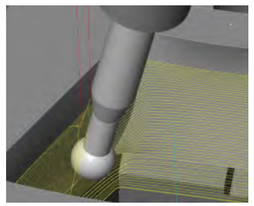


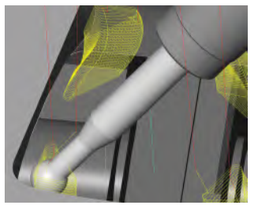


Under Cut (Taper Hole)



Internal Profile Milling





Cutting Performance

Comparison of Back Deburring in AISI S17400

Significantly less burrs than Competing Lollipop End Mills

VQ4WB

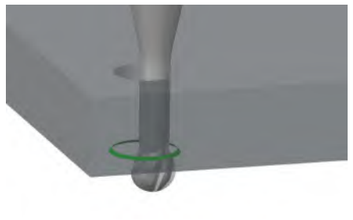
Excellent Finish with No Burrs

Competitor A

Heavy Burring Remains

Competitor B

Visible Burrs Persist

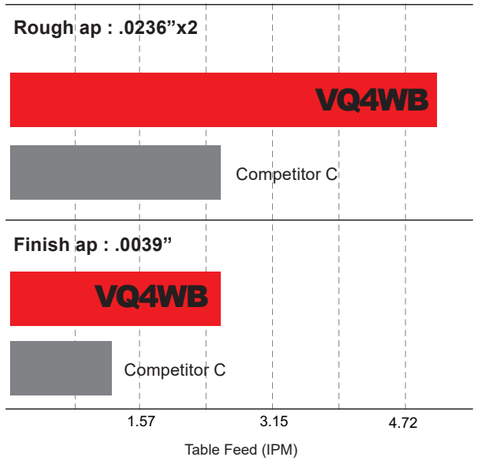


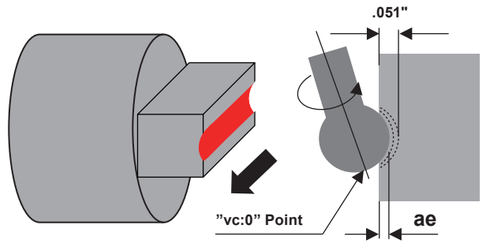
<Cutting Conditions>

Material	: AISI S17400
Tool	: VQ4WBR0150N08E280 DC = .1181”
Revolution	: n = 3200 min^{-1}
Cutting Speed	: vc = 98.5 SFM
Feed Rate	: vf = 2.16 IPM, fz = .0002 IPT
Chamfer Width	: .0394”
Cutting Mode	: Hole Size .1575” External Coolant (Emulsion)
Machine	: Vertical M/C (HSK-E25)

Rounded Shape Slotting in Ti-6Al-4V ELI

VQ4WB (4 flute) achieves double machining efficiency compared to conventional lollipop end mill (2 flute).
Even after the same number of machining (rough + finish) as competitor tool, wear is minimal and VQ4WB can continue machining.





<Cutting Conditions>

Material	: Ti-6Al-4V ELI
Tool	: VQ4WBR0300N12E280 DC = .2362”
Revolution	: n = 800 min^{-1}
Cutting Speed	: vc = 49.0 SFM
Cutting Mode	: External Coolant (Oil)
Machine	: Multi-task Lathe

VQ6MHVCH

4 Sizes (DC=10mm, 12mm, 16mm, 20mm)

End mill, Medium cut length,
6 flute, Irregular helix flutes,
with multiple thru-coolant holes

VQ6MHVRBCH

10 Sizes (DC=10mm, 12mm, 16mm, 20mm)

Corner radius, Medium cut length,
6 flute, Irregular helix flutes,
with multiple thru-coolant holes

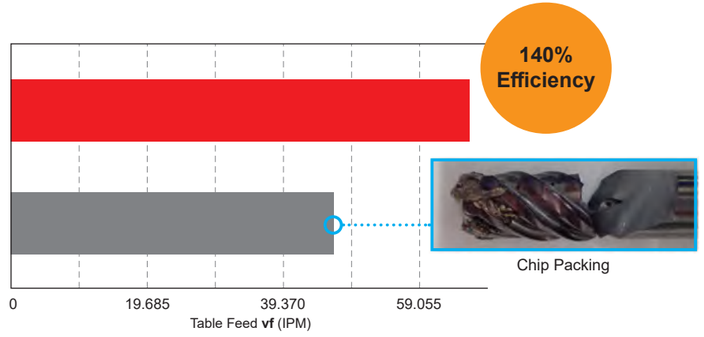
Cutting Performance

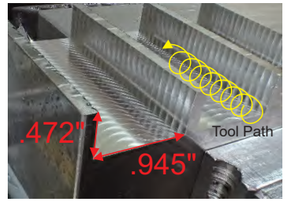
AISI 304 Efficiency Comparison in Trochoid Milling

VQ6MHVCH achieves machine 140% more efficiently compared to conventional.

VQ6MHVCH

Conventional





<Cutting Conditions>

Material	: AISI 304
Tool	: VQ6MHVCHD1600 (DC=.630")
Revolution	: n=2000 min^{-1} (330 SFM)
Depth of Cut	: ap=.472 inch, ae (Trochoid Pitch)=.094 inch
Cutting Mode	: Trochoid Milling, Down(Climb) Cut Internal Coolant (Emulsion)
Machine	: Vertical MC (BT50)

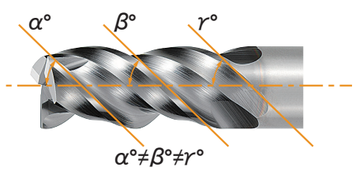
Features

Compared to conventional end mills, irregular helix flutes help prevent vibration.
Superior vibration resistance on difficult-to-cut materials and long overhang applications.
Newly developed coating gives long tool life and high efficiency machining.

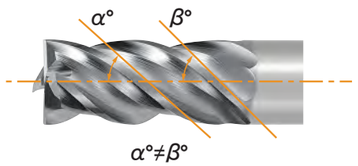
Geometry

Irregular Helical Flutes

No Vibration!



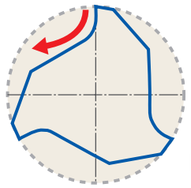
3 flute



4 flute

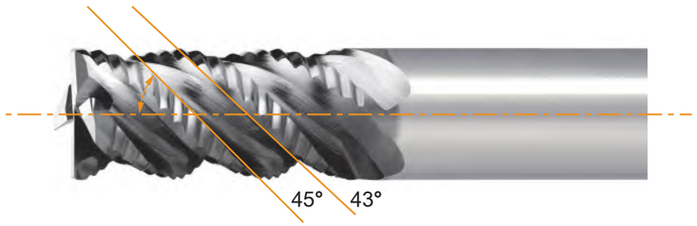
Special Flute Geometry

Improved Chip Disposal



New flute geometry with low resistance for smooth chip evacuation.

VQSVR



Provides a long tool life without vibration, because of the efficiency of irregular helix asymmetrical nick geometry.

VQ4SVB

Irregular pitch flutes

4 flutes, Helix angle 45°
Dedicated carbide substrate gives excellent wear resistance.

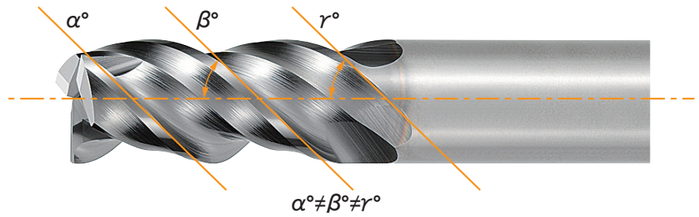
End Mill, 3 Flute for Drilling and Slot Milling

VQMHZV

Multi-functional machining with one end mill.
Drilling, slot milling and shoulder milling.

VQMHZVOH

Stability and high efficiency achieved due to the through coolant holes.

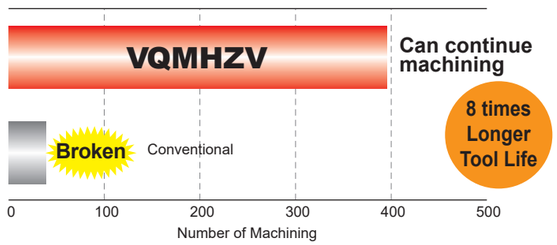


Unique geometry - 3 flute end mill with irregular helix flutes suppresses chatter for increased machining stability.
Optimized tool geometry and SMART MIRACLE coating give excellent chip evacuation for higher efficiency.
The performance of VQMHZVOH when drilling is significantly improved on difficult-to-cut materials because of the through coolant holes.

Cutting Performance

AISI 304 Keyway Machining

SMART MIRACLE coating with irregular helix angle achieves more than 8 times longer tool life compared to conventional.

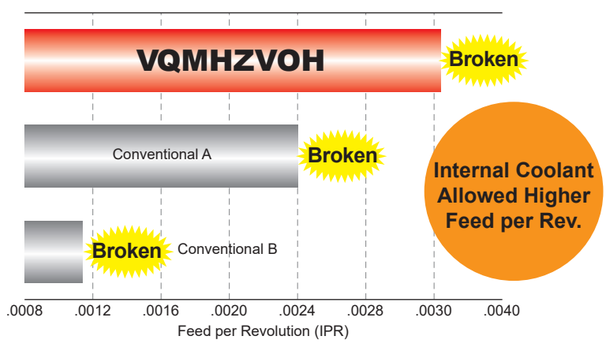


<Cutting Conditions>

Material	: AISI 304
End Mill	: VQMHZVD0800 (DC=.315")
Revolution	: 2400min^{-1}
Cutting Speed	: 195 SFM
Table Feed	: Drilling 2.756, Slot Milling 14.173 IPM (Drilling .001 IPR, Slot Milling .002 IPT)
Depth of Cut	: ap .118 inch
Flute Length	: .630 inch
Overhang Length	: 1.181 inch
Cutting Mode	: External Coolant (Emulsion)
Machine	: Vertical M/C (BT50)

AISI 304 vertical feed milling

With through coolant holes, vertical feed rates can be up to 5 times higher than conventionals.



<Cutting Conditions>

Material	: AISI 304
End Mill	: VQMHZVOHD0600 (DC=.234")
Revolution	: 3200min^{-1}
Cutting Speed	: 195 SFM
Table Feed	: 3.780−10.079 IPM(.001−.003 IPR)
Depth of Cut	: .118 inch
Overhang Length	: .787 inch
Cutting Mode	: Internal Coolant (Emulsion)
Machine	: Vertical M/C (BT50)

Vibration Control End Mills for High Efficiency Machining of Difficult-to-Cut Materials

SMART MIRACLE End Mill Series

VQ5MHV/MHVRB

The combination of 5 flutes and irregular helix for reducing vibration enables highly efficient machining of difficult-to-cut materials.

5 Flutes

Optimal flute shape improves chip evacuation and is ideal for slot milling with deep depths of cut.

Variable helix: 39°/40°/41°

Excellent chatter resistance with variable helix angle for stability and smooth cutting.

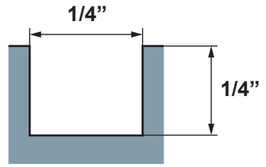
Corner Radius

Strong chipping resistance and increased tool life in heavy cutting as a result of a new and improved geometric design.

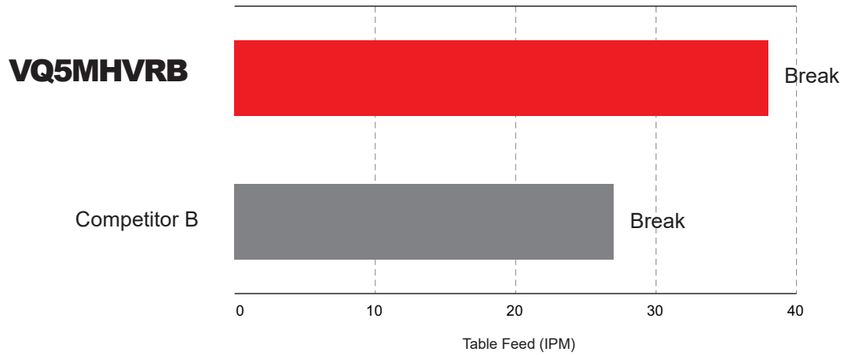
SMART MIRACLE Coating

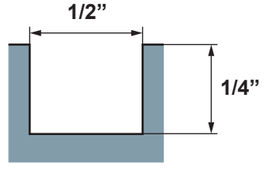
Improved flank wear through use of SMART MIRACLE coating and Micro-grain Cemented Carbide.

Application Example

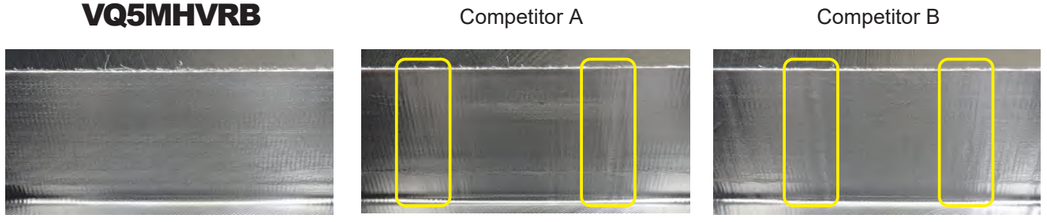


<Cutting Conditions>
Material : 17-4PH (AISI S17400)
Tool : VQ5MHVRBD1/4R020
ø1/4 RE = .020
Revolution : n = 3509 min^{-1}
Cutting Speed : vc = 230 SFM
Cutting Modev : External Coolant (Emulsion)
Machine : Vertical M/C (HSK100A)





<Cutting Conditions>
Material : 17-4PH (AISI S17400)
Tool : VQ5MHVRBD1/2R030
ø1/2 RE = .030
Revolution : n = 1754 min^{-1}
Cutting Speed : vc = 230 SFM
Table Feed : vf = 24.17 IPM
Feed per Tooth : .0038 inch
Cutting Mode : External Coolant (Emulsion)
Machine : Vertical M/C (HSK100A)



End Mill, 4 Flute, Irregular Helix Flutes

VQMHV, VQJHV

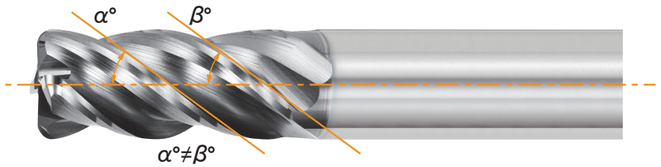
A carbide substrate with excellent wear and fracture resistance allows a wide range of different machining applications.

VQMHVRB

Available in a wide range of corner radius, including large sizes suitable for aerospace components.

VQMHVRBF

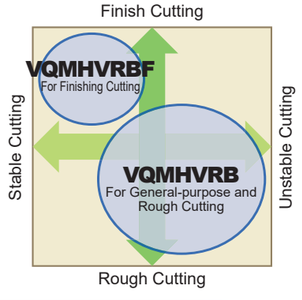
Ideal for finish machining of heat resistant alloys and precipitation hardening stainless steel due to the special carbide substrate with excellent wear resistance.



Optimised irregular helix angle improves cutting performance.
The combination of an excellent carbide substrate and SMART MIRACLE coating allows a wide range of machining applications.

How to Select VQMHVRB and VQMHVRBF

Comparing Different Forms of Machining



Comparing Different Material

Finish Cutting

◎=1st Recommendation
○=2nd Recommendation

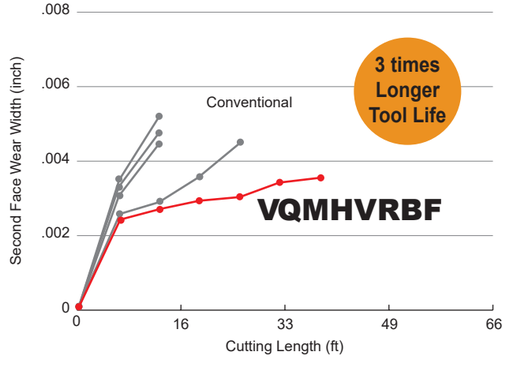
	Inconel	AISI S17400	Titanium Alloy	AISI 304
VQMHVRB	○	○	◎	◎
VQMHVRBF	◎	◎	○	○

Cutting Performance

Wear Resistance Against Super Alloys

VQMHVRBF achieves 3 times longer tool life than conventional when finish machining Inconel 718.

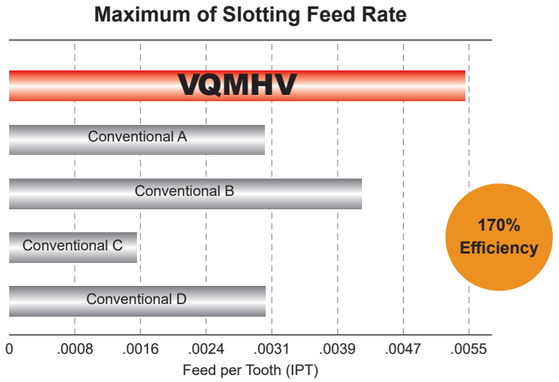
<Cutting Conditions>
Material : Inconel718
End Mill : VQMHVRBFD1000R050 (DC=.394" / RE=.020")
Revolution : 950 min^{-1}
Cutting Speed : 100 SFM
Feed Rate : 4.3 IPM(.001 IPT)
Depth of Cut : ap=.197"
Width of Cut : ae=.012"
Overhang Length : 1.378"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT50)



Cutting Performance

Efficiency Comparison in AISI 304

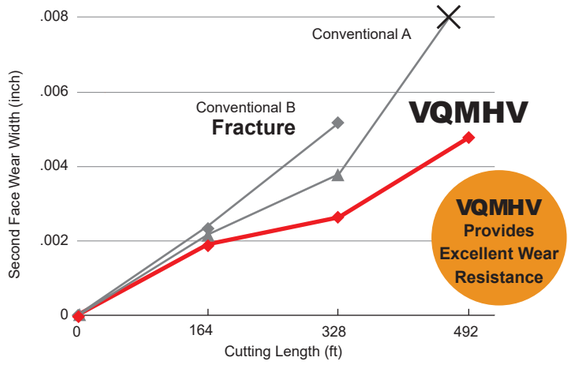
Compared to conventional machining time can be shortened by using high efficiency machining methods.



<Cutting Conditions>
Material : AISI 304
End Mill : VQMHVD1000(DC=.394")
Revolution : 4800 min^{-1}
Cutting Speed : 490 SFM
Feed Rate : 15.12−105.83 IPM
Feed per Tooth : .001−.006 IPT
Depth of Cut : ap=.394"
Overhang Length : 1.299"
Cutting Length : 9.843 inch/pass
Cutting Mode : External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

Comparison of Tool Life when Machining Titanium Alloy

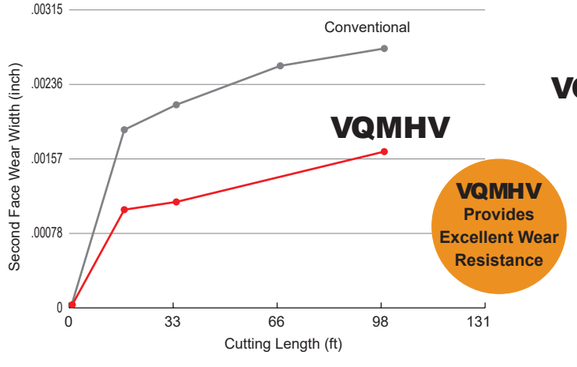
The wear resistance of SMART MIRACLE End Mills exceeds that of conventional end mills when machining Ti-6Al-4V.



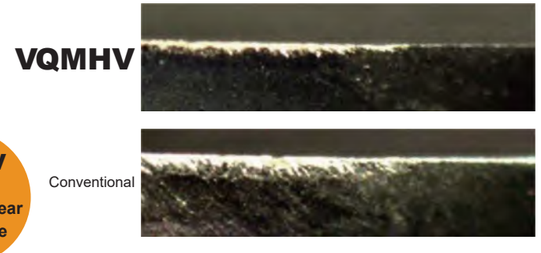
<Cutting Conditions>
Material : Ti-6Al-4V
End Mill : VQMHVD0600(DC=.236")
Revolution : 8000 min^{-1}
Cutting Speed : 490 SFM
Feed Rate : 63 IPM(.002 IPT)
Depth of Cut : ap=.236"
Width of Cut : ae=.012"
Overhang Length : .787"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

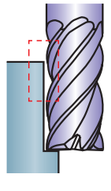
Comparison of Wear in Co-Cr-Mo Alloy

Long tool life even when machining Co-Cr-Mo alloys used in the medical industry.



Wear at the depth of cut point after 30 m machining

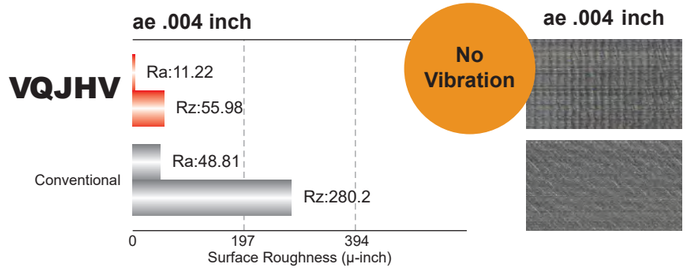




<Cutting Conditions>
Material : Co-Cr-Mo Alloy
End Mill : VQMHVD0600(DC=.236")
Revolution : 3700 min^{-1}
Cutting Speed : 227 SFM
Feed Rate : 29 IPM(.002 IPT)
Depth of Cut : ap=.079"
Width of Cut : ae=.012"
Overhang Length : .787"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

Cutting Performance

Irregular helix provides an excellent finishing performance without vibration.



<Cutting Conditions>
Material : AISI 304
Tool Size : DC=10mm, .394"
Revolution : 2500min^{-1} (260 SFM)
Feed Rate : 19.7 IPM (.002 IPT)
Depth of Cut : ap=1.18"
Width of Cut ae=.004" or .039"
Overhang Length : 1.77"
Cutting Mode : Shoulder Milling
External Coolant (Emulsion)
Machine : Vertical M/C (BT50)

Test of Changing the Feed per Tooth

Surface roughness is improved by decreasing a feed rate.

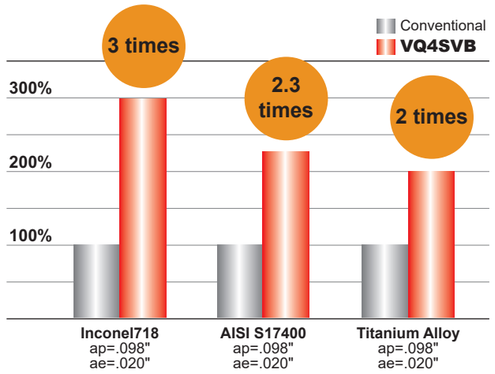
<Cutting Conditions>
Material : AISI 304
Tool Size : DC=10mm, .394"
Revolution : 2500min^{-1} (260 SFM)
Feed Rate : 3.93−39.37 IPM (.0004−.0039 IPT)
Depth of Cut : ap=1.18"
Width of Cut ae=.012"
Overhang Length : 1.77"
Cutting Mode : Shoulder Milling
External Coolant (Emulsion)
Machine : Vertical M/C (BT50)

Test of Changing the Width of Cut

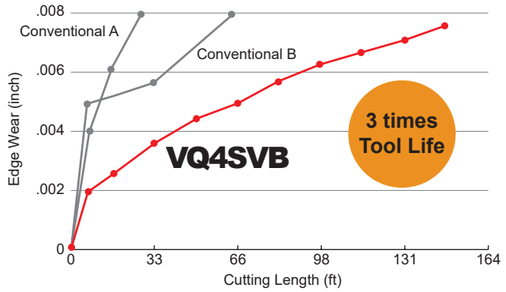
Available condition for finishing is ae .020 inch or less when considering only the roughness of machining surface.

<Cutting Conditions>
Material : AISI 304
Tool Size : DC=10mm, .394"
Revolution : 2500min^{-1} (260 SFM)
Feed Rate : 19.7 IPM (.002 IPT)
Depth of Cut : ap=1.18"
Width of Cut ae=.004"−.020"
Overhang Length : 1.77"
Cutting Mode : Shoulder Milling
External Coolant (Emulsion)
Machine : Vertical M/C (BT50)

VQ4SVB achieves double tool life when machining difficult-to-cut materials.

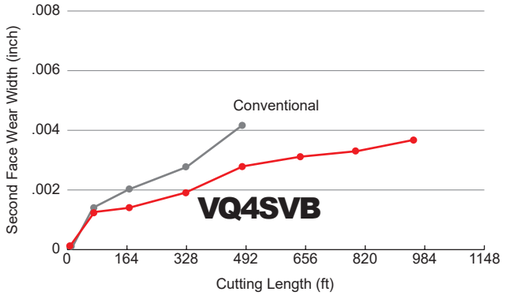


Comparison of Edge Wear when Shoulder Milling Inconel 718



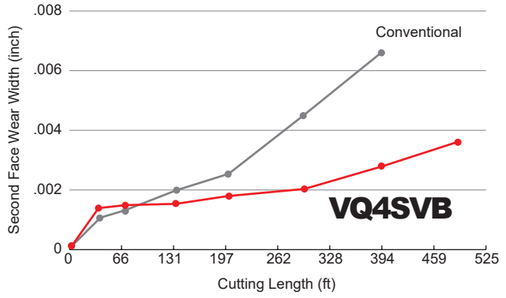
<Cutting Conditions>
Material : Inconel718
End Mill : VQ4SVBR0500(RE=.197")
Revolution : 1100min^{-1}
Cutting Speed : 100 SFM
Feed Rate : 8.66 IPM(.002 IPT)
Depth of Cut : ap=.098"
Width of Cut ae=.020"
Overhang Length : .984"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

Comparison of Edge Wear when Shoulder Milling AISI S17400



<Cutting Conditions>
Material : AISI S17400
End Mill : VQ4SVBR0500(RE=.197")
Revolution : 2600min^{-1}
Cutting Speed : 230 SFM
Feed Rate : 20.47 IPM(.002 IPT)
Depth of Cut : ap=.098"
Width of Cut ae=.020"
Overhang Length : .787"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

Comparison of Edge Wear when Shoulder Milling Ti-6Al-4V

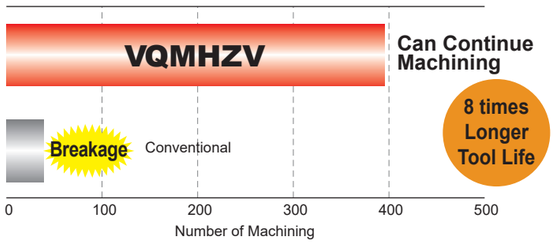


<Cutting Conditions>
Material : Ti-6Al-4V
End Mill : VQ4SVBR0500(RE=.197")
Revolution : 4800min^{-1}
Cutting Speed : 490 SFM
Feed Rate : 37.8 IPM(.002 IPT)
Depth of Cut : ap=.098"
Width of Cut ae=.020"
Overhang Length : .984"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical M/C (BT40)

Cutting Performance

AISI 304 Keyway Machining

SMART MIRACLE coating with irregular helix angle achieves more than 8 times longer tool life compared to conventional.

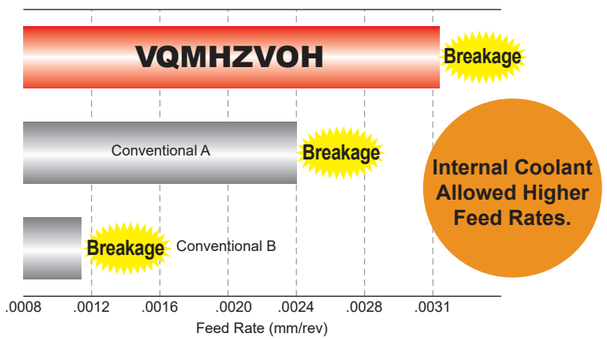


<Cutting Conditions>

Material	: AISI 304
End Mill	: VQMHZVD0800(DC=.315")
Revolution	: 2400 min^{-1}
Cutting Speed	: vc=195 SFM
Feed Rate	: Drilling 2.8 IPM, Slotting 14.1 IPM (Drilling .0012 IPR, Slotting .0020 IPR)
Depth of Cut	: ap=.118"
Flute Length	: .630"
Overhang Length	: 1.181"
Cutting Mode	: External Coolant (Emulsion)
Machine	: Vertical M/C (BT50)

AISI 304 Vertical Feed Milling

With through coolant holes, vertical feed rates can be up to 5 times higher than conventional.



<Cutting Conditions>

Material	: AISI 304
End Mill	: VQMHZVOHD0600(DC=.236")
Revolution	: 3200 min^{-1}
Cutting Speed	: vc=195 SFM
Feed Rate	: 3.8−10.1 IPM (.0012−.0031 IPR)
Depth of Cut	: ap=.1181"
Overhang Length	: .787"
Cutting Mode	: Internal Coolant (Emulsion)
Machine	: Vertical M/C (BT50)

Memo

MTEC

MACHINING TECHNOLOGY AND EDUCATION CENTER

Welcome to our new world-class Machining Technology and Education Center (MTEC) in Mooresville, NC providing year round support and services to North America.

ABOUT MTEC

TOOLING PROPOSALS & EVALUATION

We will review your current processes or outline a new process. From this review, we will improve productivity, analyze programming methods and output a solution with programming, tooling and time savings.

MACHINING SIMULATION

Using the latest CAD/CAM software and our cutting tool experience, we will outline a new process using proper machining techniques to maximize tool life and productivity.

TECHNICAL SUPPORT

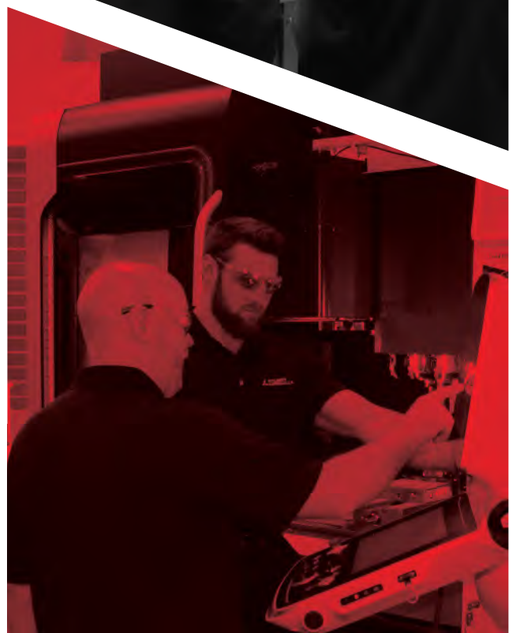
Dedicated local professionals to answer any of your order, product or technical questions.

TRAINING

We are excited to offer several levels of training with goals to reach our highest level--Craftsman Machining Technology. At MTEC NC, we will train using a combination of classroom and hands-on machine time to develop skills and real-world understanding of materials, tools and applications. In addition to multi-day courses, we will have Machining Technology skills seminars, as well as seminars from our partners to complement our apprentice level courses, our journeyman courses, and up to our craftsman level courses.

PROCESS IMPROVEMENTS

Review of the complete part processing and recommend changes of speed, feed, new tooling, reduction of passes, modifying programming and other solutions to reduce cycle time, save money and be proactive.



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Our FREE online webinar series is available anytime on-demand. Narrated by the MTEC training staff, you will receive in-depth knowledge of the topic. Simply register online at the link below for access. You will receive a certificate upon completion of each course.

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Programs are designed for several levels of skill development – from basic understanding to advance manufacturing with digital solutions, complementing to your valued experience in CNC machining environment. Participate in machining demonstrations with Mitsubishi Materials' skilled engineers. Discover methods to reduce setup and cycle time, optimize programs and enhance your knowledge base.

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Fax: 248.308.2627

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 and abnormal sounds etc.

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